

BCSIR Central Laboratory Complex

By

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A thesis submitted to the Department of Department of Architecture
in partial fulfillment of the requirements for the degree of
Bachelor of Architecture

Department of Architecture

BRAC University
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Declaration

It is hereby declared that

1. The thesis submitted is my/our own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I/We have acknowledged all main sources of help.

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Approval

The project titled

“BCSIR Central Laboratory Complex”

submitted by

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of Fall, 2019 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Architecture on 22-12-2019.

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Abstract

This project is initially issued by BCSIR which is the industrial researching body of Bangladesh. Though it has separate research departments for separate products, there is a growing need of a central lab where training can be carried out besides research. The training will also require training facilities with all the supporting functions. There will also be a conference hall and an auditorium to accommodate large gatherings and seminars.

The facility will also contain residential facilities for the workers and the guests coming for training and other purposes. Since a residential quarter will be built, there will be great emphasis on livability and a good neighborhood.

The training facilities and laboratories will have a modern working environment with adjacent open spaces for workers to have a place to relax and interact.

Acknowledgement

First and foremost I would like to thank Almighty Allah for giving me the opportunity and strength to finish my final undergraduate project. I would also like to express my gratitude to my parents, A.K Azad and Lubna Zerin Ishaque for the support, love, encouragement and affection they have given me without which I could never have come to this point in my life. Also I would thank my brother, my grandparents and my family for all the help and support they have given me.

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Chapter 1: Introduction

1.1 Background of the Project:

Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories, formerly known as East Regional Laboratories, was established by the renowned scientist Dr. Muhammad Qudrat-i-Khuda in 1955. Since then the laboratory has different research sectors but has no central lab where experiments and training can be done. A training facility is also to be made with multiple public functions and residential facilities. The main benefit will be of the trainees who will come here to learn and gather skill. The project will be financed by BCSIR's funding.

The vision of BCSIR laboratories are:

- To conduct researches on indigenous natural products in an eco-friendly way.
- Help develop new means/technologies to increase industrial production.
- To give assurance on good health, create environment for entrepreneurship to reach national self-sufficient by providing analytical services.
- Provide ISO standard analytical services for business and research works.

BCSIR is not only a research institute but it is also a training institute where various scientific trainings are provided followed by conferences and seminars. These training services are linked to research divisions of which there are seven:

1. Chemical Research Division
2. Industrial Research Division
3. Fiber and Polymer Research Division
4. Physical Instrumentation Division
5. Biological Research Division

6. Pharmaceutical Research Division
7. Pulp and Paper Research Division

1.2 Project Brief:

- **Name of the Project :** BCSIR Multipurpose & Residential Complex
- **Client :** Bangladesh Council of Scientific and Industrial Research (BCSIR)
- **Site Location:** BCSIR Complex, Green Road, Dhanmondi, Dhaka 1205.
- **Site Area:** 2.8 acre

1.3 Project Introduction:

As BCSIR is one of the research institutes in Bangladesh, it has multiple departments in which it has to operate. This results in the involvement of different government ministries to be involved in the research as the work that goes on is in the national level. Thus the complex has separate administrative buildings and laboratories and also residential quarters for workers to stay. Since the research is carried out on a national level, there are a lot of foreign delegates who come to either participate or for training purposes. The amount of research that goes on here also requires a lot of ancillary facilities to support. These facilities are lacking in the current situation for which the natural procedure of works are being hindered.

BCSIR wants a multi-purpose building to be built for these functions to be accommodated in. This building will be both environmentally and technologically sustainable as it is a research institute and thus it aspires to be a landmark for innovation. The building must also maintain international standards so that it can support all the needs for the functions that is to be served. Along with the ancillary functions, it must also have accommodation facilities for

different government officials. As there will be an additional laboratory, it is required for more residential quarters for workers with adequate housing conditions and proper facilities.

1.4 Project Objective:

The primary objective of this project is to make two structures, one for multi-purpose and the other for housing purposes. The multi-purpose building will have an auditorium which will be used for large seminars and other occasions where a huge crowd will be present. It also will contain a conference hall for international and national conference meetings to be held in. This is very significant as the research institute complex does not have such facilities and is to be held elsewhere. Seminar rooms are also to be built for training purposes, this will enhance the productivity of the workers working there and sharing of knowledge. These facilities must be of international standards as they play a direct role in the decision making of the ministry. Along with these multiple class rooms and supporting functions is to be included. Dormitories are also to be made for higher officials to stay. A separate structure is also needed for residential purpose with proper housing facilities.

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1.6 Project Rationale:

The main reason for this project is to be built is that BCSIR is one of the head research industrial institutes currently present in Bangladesh especially in Dhaka. It must have all the required facilities a research institute should have. As it is just not a laboratory but it also have training facilities and a decision making place which will affect the way industries are running and manufacturing products. As this directly influences our economy and guides the manufacturing process in almost all major manufacturing entities.

Chapter 2: Literature Review

2.1 Research and training Institute

A research institute or research center is an establishment found for research purpose. Research institutes can be both specialized in basic research or be oriented to applied research. Research institutes came to emerge as a concept at the beginning of the twentieth century. In 1900, both in Europe and the United States, the scientific profession had already evolved far enough to include the theoretical implications of science and not just its application. Research institutes becoming increasingly recognized as a vital element for the innovation and national economic growth, it has become a matter of primary concern for both government and public. The most common type of research institutes are often based on natural science research, but these institutes can also be based on subjects like food, sociology, agro-physical, paper and fibre etc. Training institution on the other hand means an accredited public or private institution which implements a training program for its users with a goal to improve and develop skills, knowledge, attitude and behavior for performing a particular kind of a job. When the idea of a research institute is combined with that of a training institute, it establishes a whole new institute where besides researches and innovations a structured training method is also provided to achieve required goals. (E. S. Kennedy (1962))

2.2 BCSIR: what it is, when it was established and why, how many buildings it is generally comprised of and what its purposes are:

Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories, formerly known as East Regional Laboratories, was established by the renowned scientist Dr.

Muhammad Qudrat-i-Khuda in 1955. BCSIR, the country's lone multidisciplinary research institute located in Dhaka, Chittagong, Rajshahi & Savar; which comprises different institutes and divisions. Among them BCSIR Laboratories, Dhaka is the largest and pioneer multidisciplinary research unit established in 1955 with an aim to help the industrial sector as well as scientific development through its continuous research & development activities. Scientists of this laboratory are engaged in research with the aim of developing the technological advancement and self-reliant industrial development. As Bangladesh is heading towards increasing industrialization, research became a vital part of the whole process. Dhaka laboratories single handedly operates in testing and giving technical solutions in chemical, biological, pharmaceutical and environmental aspects.

BOROWKA, A., JJJJ, G., & OOOO, D. (2013). *No Title*. 2(SGEM2016 Conference Proceedings, ISBN 978-619-7105-16-2 / ISSN 1314-2704), 1–39.

2.3 Laboratories

A laboratory is a facility that provides controlled conditions in which scientific or technological research, experiments, and measurement can be performed. It is basically one of the most important parts of a research institute that bears apparatus to conduct scientific experiments, tests, investigations, etc. Early instances of laboratories involved only alchemy and medicines. The earliest laboratory is assumed to be a home laboratory made by Pythagoras of Samos, the well-known Greek philosopher and scientist. However, laboratory services today are provide a variety of settings such as physicians' offices, clinics, and regional and national referral centers. Laboratories used for

scientific researches can take many forms because of the specialized requirements of specialists in the various fields of science and engineering. A physics laboratory might contain a particle accelerator or vacuum chamber, while a metallurgy laboratory could have apparatus for casting or refining metals or for testing their strength. A chemist or biologist might use a wet laboratory, while a psychologist's laboratory might be a room with one-way mirrors and hidden cameras in which to observe behavior. Laboratories used by computer scientists are used for either simulations or the analysis of data. Engineers also use laboratories to design, build, and test technological devices.

Laboratories have strict set of techniques and rules, depending on what field it is based on. These techniques are the set of procedures used on natural sciences such as chemistry, biology and physics to conduct an experiment. All of the techniques follow scientific methods, while some of them involve the use of complex laboratory equipment; others require more specific or expensive supplies. It can be concluded to the fact that the way a laboratory functions will completely depend on its typology, required supplies, topic of research and factors as such.

2.4 BCSIR TRAINING METHODS: What courses and how are they conducted:

The courses that are offered in BCSIR are mainly conducted by Pilot Plant and Process Development Centre (PP & PDC). These courses are conducted in different intervals in time and require both theoretical and practical implementations. The courses that are offered are:

- PLC &HMI Training for Industrial Automation- As our country lacks the amount of expert personnel in order to automate a factory and need foreign aid in doing so, this

program helps in solving that problem as it gives an in depth training of industrial automation to participants who are normally from engineering background. The training contents are as follows:

1. Industrial application and interfacing of various switch and sensor.
 2. Description and designing of Control Circuits using followings
 3. Electrical wiring
 4. Switchgear and control.
 5. Programmable Logic Controllers
 6. Various Motor and their Control
 7. Human Machine Interface
 8. Practical training on various machinery existing within the premises.
- CNC Milling M/C Operation & Manufacturing Technology- For advanced and faster production in industrial goods and in the market of spare parts, CNC and manufacturing techniques are very important. Skilled personnel are required in this area of work as it is related to mass production and precision as it can be crucial to the entire supply chain. This program requires a minimum of secondary standard education. The course contents are:
 1. Introduction
 2. Operating mode
 3. Tool & Work Set-up
 4. Programming structure & execution
 5. Editing
 6. Graphic simulation
 7. VQC & Canned cycles explanation

8. Help and calculator

9. Mold Cutting

- Solid Works & AutoCAD- This field is crucial as it is related to the engineering and design work that goes in a product development. From a product development to the final drawings of it, this sector is responsible for it. All the errors and quirks must be analyzed here and fixed. This program requires a minimum of an engineering degree as this requires a basic understanding of computers and physics and in many cases design. The training program for this sector requires computer labs and access to 3D printers and CNC cutters, etc.
- Mechanical & Chemical Testing & Heat Treatment- this training is required for quality control and testing various products. The program will also help in understanding the standard materials for a particular production process. The course contents are:
 1. Mechanical training
 2. Chemical training
 3. Learn to choose the right metal for the right kind of work
- Metallography & Crystallography- This training is useful for various purposes like food testing and different product quality controls. The program deals with the R&D sector and other research works for any new product that BCSIR produces. The course contents are:
 1. Metallography training
 2. Crystallography training
 3. Thermal testing trainings
- Heat treatment & Foundry Engineering- in this training program the trainees will be taught about the different effects of heat on metals and alloys. This will enable them

in building furnaces and different metal treatment expertise. As the amount of industries in Bangladesh are growing, there is a huge need for such kind of expertise.

(BOROWKA, A., JJJJ, G., & OOOO, D. (2013). *No Title*. 2(SGEM2016 Conference Proceedings, ISBN 978-619-7105-16-2 / ISSN 1314-2704), 1–39.)

2.5 Public and open Spaces:

In the last few decades we have seen a massive decline in public physical activity around different countries. This is crucial as people spend most of their active hours in their workspaces. However recently studies have shown that open spaces along the workspace helps in productivity and the psychological state of workers heavily (Dalton et al., 2013; Karusisi et al., 2014; Panter et al., 2013).

There are different ways an open space can be organized in order to enhance a workspace. It usually depends on the type of function, amount of space, terrain, people who will use the space and the surroundings it has.

In the image bellow we can see the different types of urban plazas that is a result of a research done by “The Field Guide to Urban Plazas” which shows the different types of public behavior that people show in different public places.

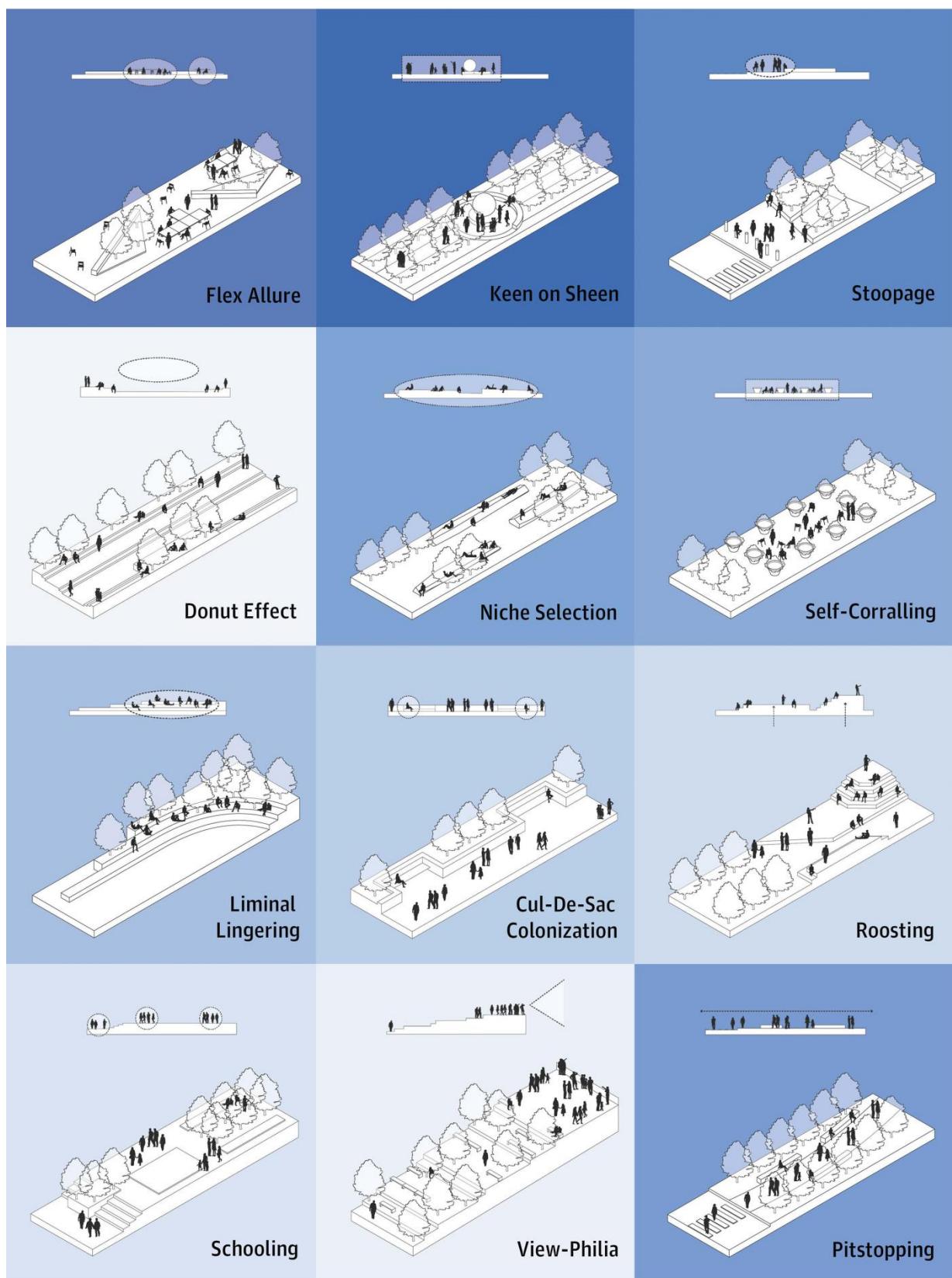


Figure 1

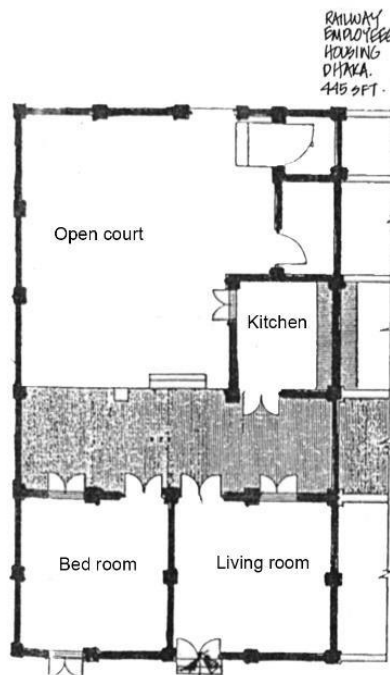
Different types of public plazas and the clustering of people in respect to that. (The Field Guide to Urban Plazas, SWA Group, Aug 2019)

2.6 Housing for Government employees current situation:

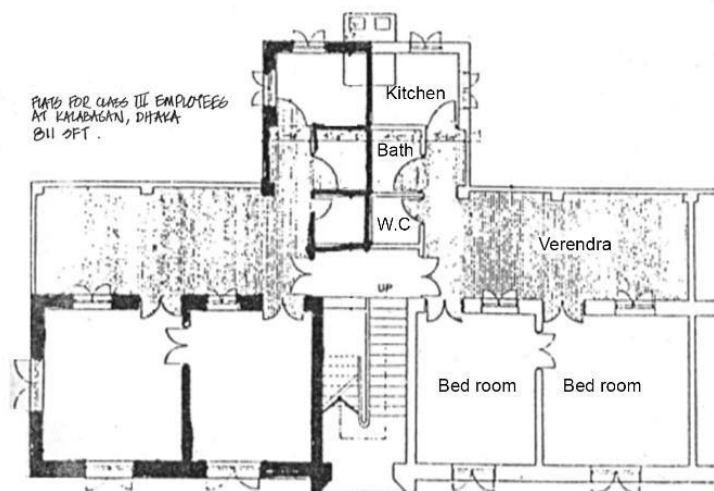
The first government housing that was built before Bangladesh gained independence was Motijhil colony in Dhaka. Afterwards the Eskaton Garden Government housing and Azimpur colony was established (Afroza, 2000).

There are generally three types of housing currently available for government officials. They are:

01. Single story row houses.



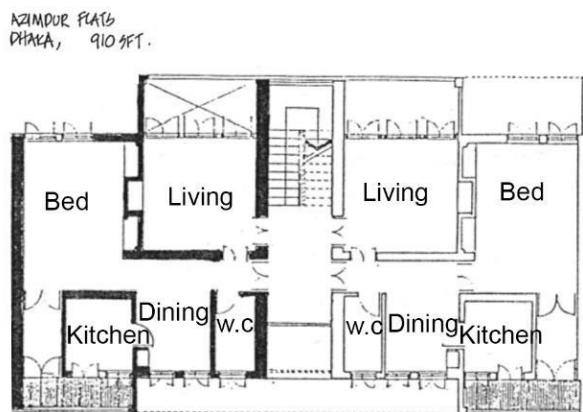
Example 01: Railway Housing



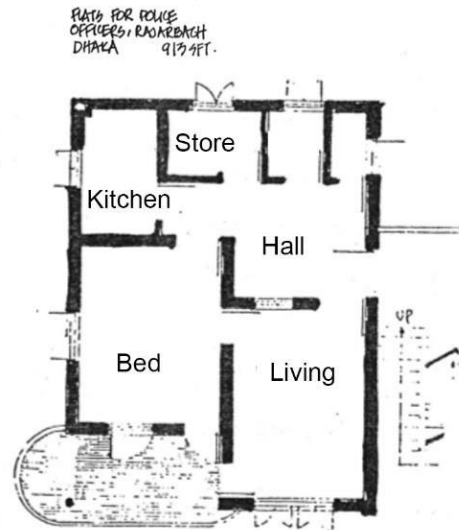
Example 02: Kalabagan Housing (class III),

Figure 2 Government single story row house (Source: Mallick, 1987. *A Local Approach to Urban Housing in Bangladesh*)

02. Multi-story blocks with each staircase accommodating two units.



Example 03, Azimpur Housing



Example 04, Rajarbagh Housing

Figure 3 Government Multi-story house (Source: Mallick, 1987. A Local Approach to Urban Housing in Bangladesh)

03. Multi-story blocks with each staircase accommodating a number of units.

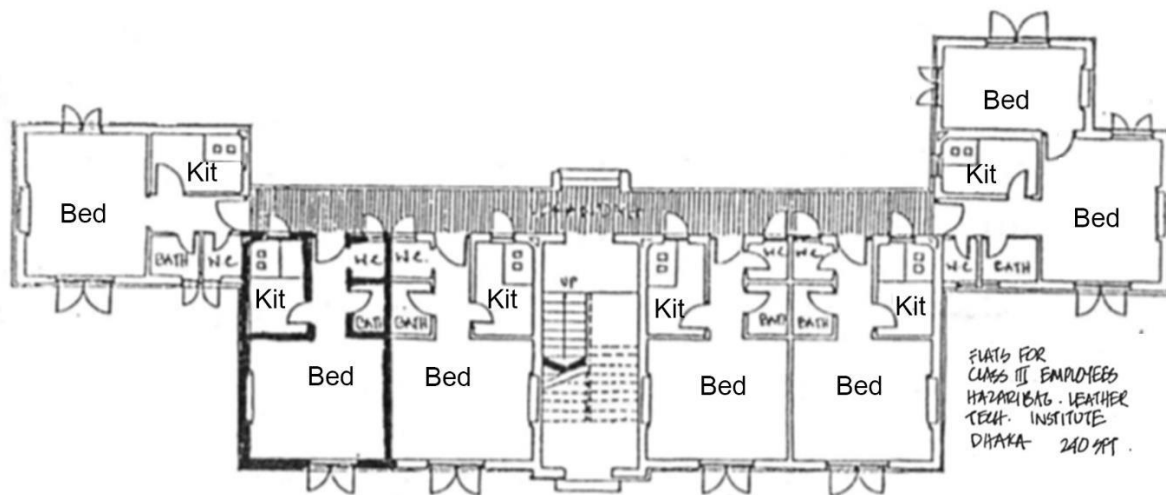


Figure 4 Government Multi-story house (Source: Mallick, 1987. A Local Approach to Urban Housing in Bangladesh)

2.7 Current Housing Trend:

As the number of demand of housing is ever increasing with the increasing amount of population, there is a need of more sustainable and livable environment in housing. Due to the high density of population most housing projects are inclining towards multi-storied housing and more sustainable resources. Materials for building are also chosen to be sustainable and have as minimal effect on the environment as possible. Accessibility is also a big concern as we have aged and differently abled people among us who should be able to carry out their everyday lives in ease. There also must be sensitivity towards the surroundings and the weather where the building is built (Jackie Craven, 2017).

2.8 Sustainable Building:

Sustainable building can comprises of the materials that it is made out of and the way the building functions to be sustainable. Sustainable building has a lot of upsides like causing less harm to the environment, more energy efficient, and better at waste treatment.

- **Structure:** The building can be made of locally available materials causing less carbon footprints and thus less effect on the environment. The structure itself can be modular so that further addition or subtraction to it can be easy.
- **Method of construction:** prefabricated materials are more commonly used to build modern structures as mass producing it is more cost effective and easy to build.
- **Energy Efficiency:** The structures energy requirements can be met by more renewable energy like solar energy and wind energy reducing the load on the grid.



Figure 5 Solar panel (Source: GEOSOL Das Bild ist urheberrechtlich)



Figure 6 Wind turbine (Source: Mike Munsell, 2019)

- Waste management: This is a very big issue for commercial buildings and industrial buildings as they produce huge amounts of waste directly to the water bodies. So there must be a proper water treatment plant for a sustainable building in order to lessen its effects on the environment.

(Wang, N., & Adeli, H. (2014). SUSTAINABLE BUILDING DESIGN. *JOURNAL OF CIVIL ENGINEERING AND MANAGEMENT*, 20(1), 1–10. <https://doi.org/10.3846/13923730.2013.871330>)

(Kumar, A. (2016). Minor 1 copies. *Waste Water Treatment Process*.)

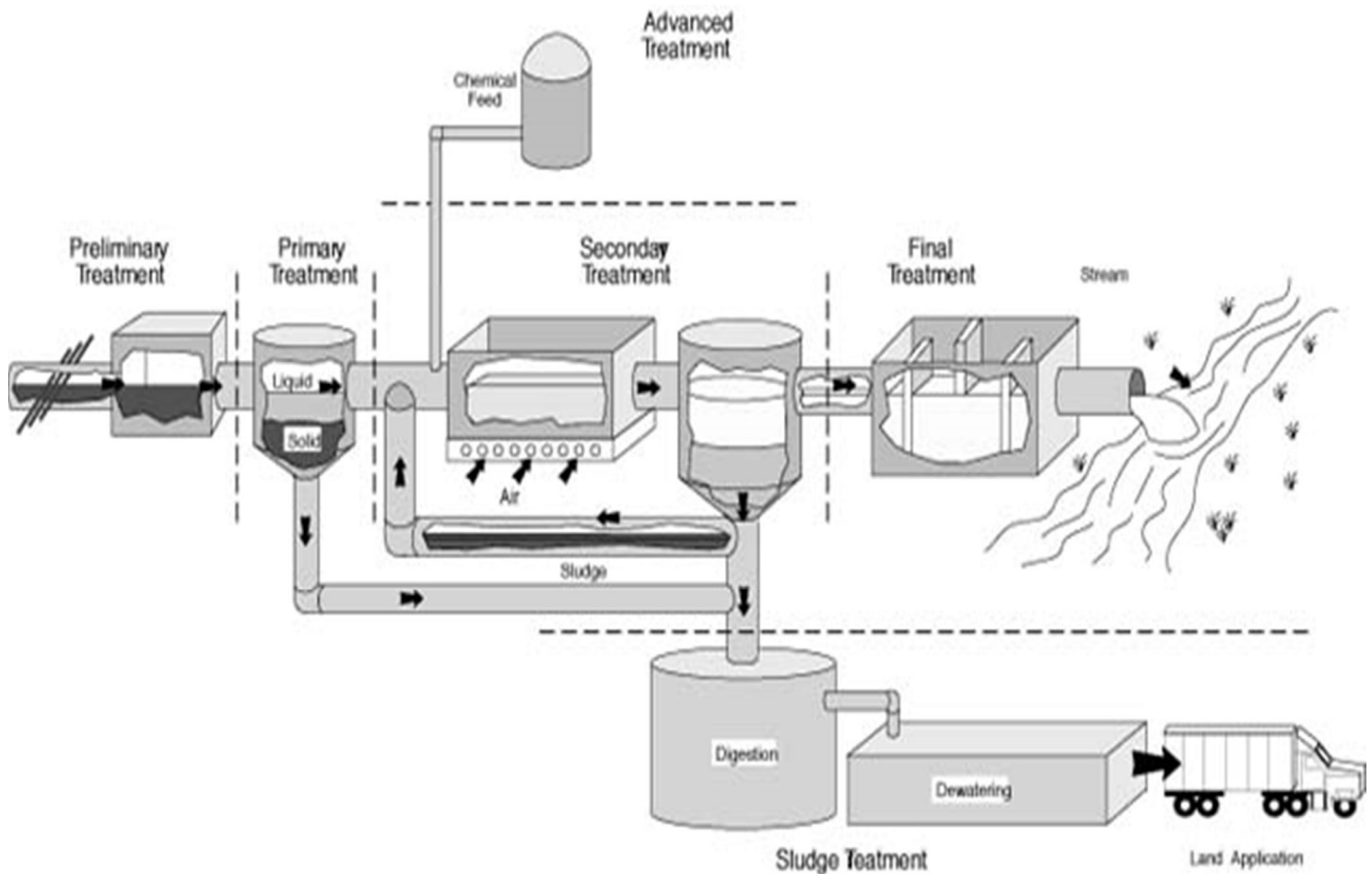


Figure 7 Water treatment plant (Source: Kumar, Arun, Waste water treatment process, 2016)

Chapter 3: Site Context Analysis

3.1. Site Appraisal

The site is situated in Dhanmondi inside the BCSIR premises.

3.2. Site Location:

BCSIR Complex is situated on the south-western part of Dhaka city (from 23° 44'20" to 23° 44'29" North latitude and 90° 22' to 90° 23' East longitude) surrounded by major areas and important road networks of the city. The complex is adjacent to elephant road and

Mirpur road. It is surrounded by Dhanmondi area in the west, Kathal bagan and Kalabagan in its north, Hatirpul to the east and Katabon to the south. It has a total area of 27.4 acres surrounded by Sher-e-Bangla Nagar and Tejgaon thanas on the north, Ramna thana on the east, New Market thana on the south, and Dhanmondi thana on the west.

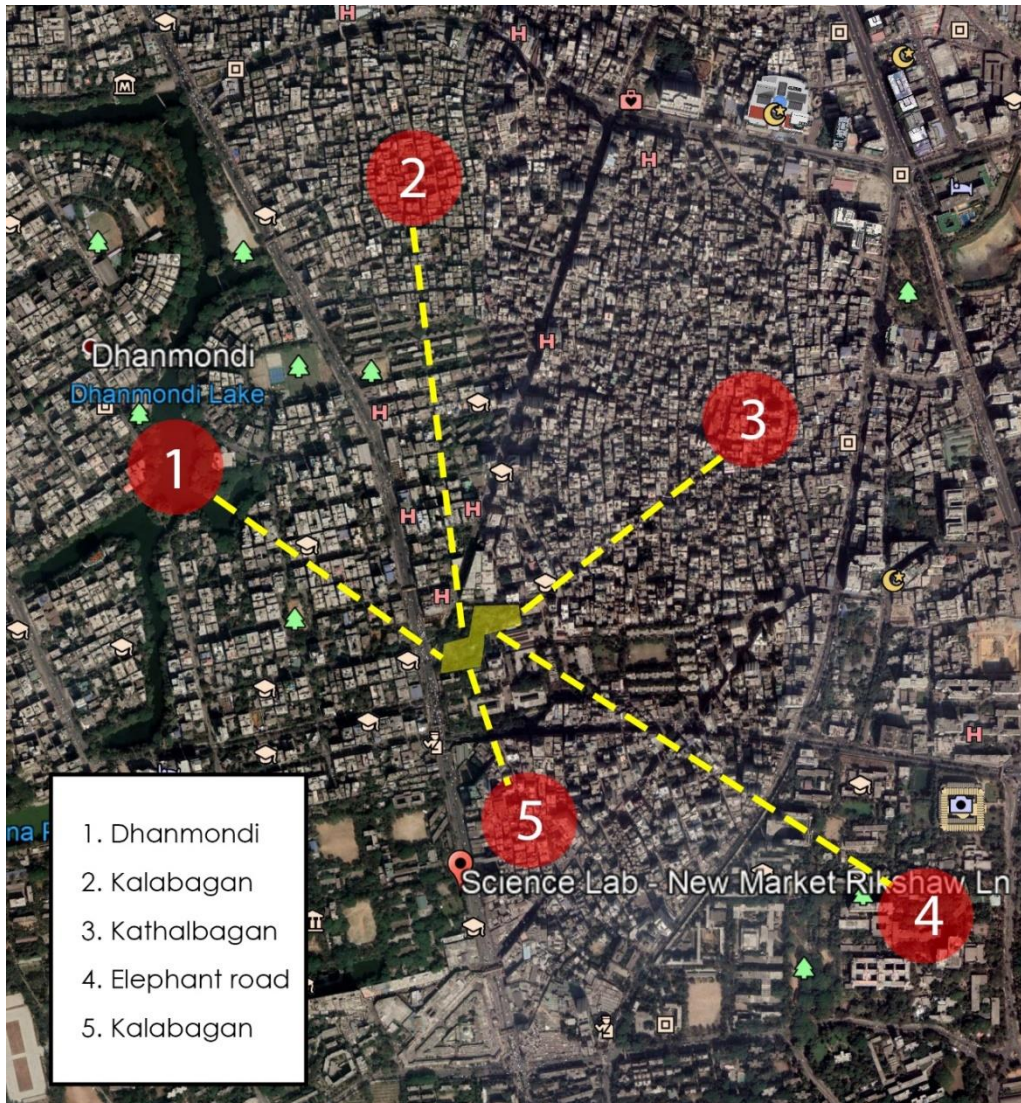


Figure 8 Site location shown in yellow along with the peripheral area (Source: Google Maps)

3.3. Historical development of the Site:

The growth of Dhaka city was initially started from the south more specifically known as the old Dhaka. The establishment of Dhaka University area and New market has made this area more economically active and a place where people was drawn to. After the master plan of dhanmondi area has been made, large population growth took place there and thus caused peripheral areas like Kalabagan, Kathalbag, Jigatala, Mohammadpur and Hatirpul to develop and get inhabited. Since Dhanmondi areas land use plans was not entirely followed the area started to have other commercial and social facilities. Among these lands, the research institute called East Regional Laboratories started building its own labs in order to expand its research parameters and later given the name BCSIR after independence.

3.4. Morphology:

Figure 3.2- Satellite map of Dhanmondi in 2001 (Source: Google Earth)



Density of structures in the are relatively less and less commercial structures and more open space.

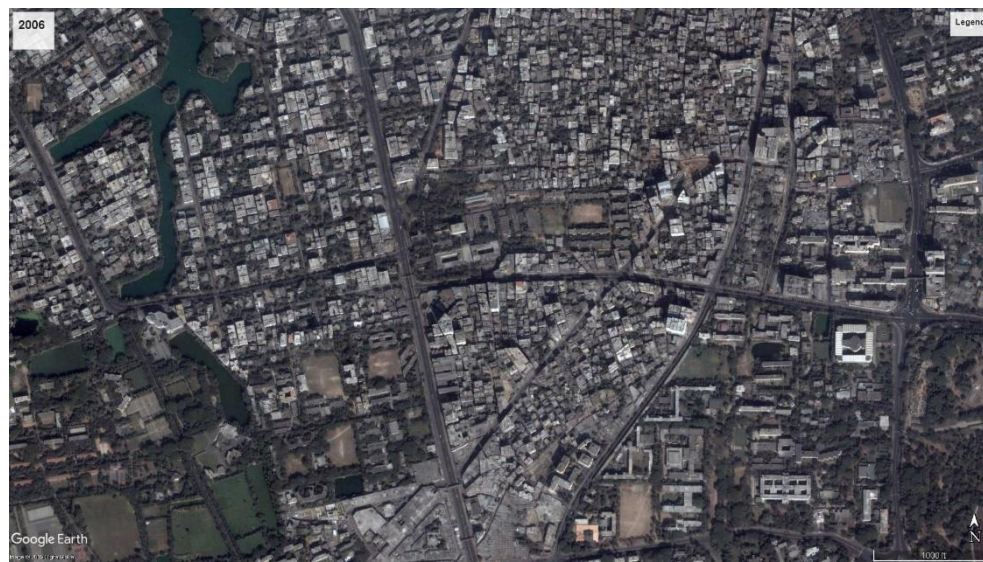


Figure 3.3- Satellite map of Dhanmondi in 2001 (Source: Google Earth)

Density increased, new commercial structures being built, open spaces lessen throughout the area.

Figure 3.4- Satellite map of Dhanmondi in 2012 (Source: Google Earth)



Highly dense urban environment with commercial and residential buildings clustered together.

Satellite map of Dhanmondi in 2019 (Source: Google Earth)



Highly dense area with very little open space.

3.5. Geographical Characteristics of the Site:

The condition of terrain in this site is flat which has a moderately compact soil composition.

3.6. Figure ground Map:

The site is very dense in type with over 80% of the area built with permanent structures. Having very less green space and almost no water body around. Since it is a very busy area, the amount of green space is being reduced which is alarming for the area.

Figure 9 Height Map of Site (Within 1km of the site)
(Source: <https://www.openstreetmap.org/export#map=16/23.7443/90.3775>)

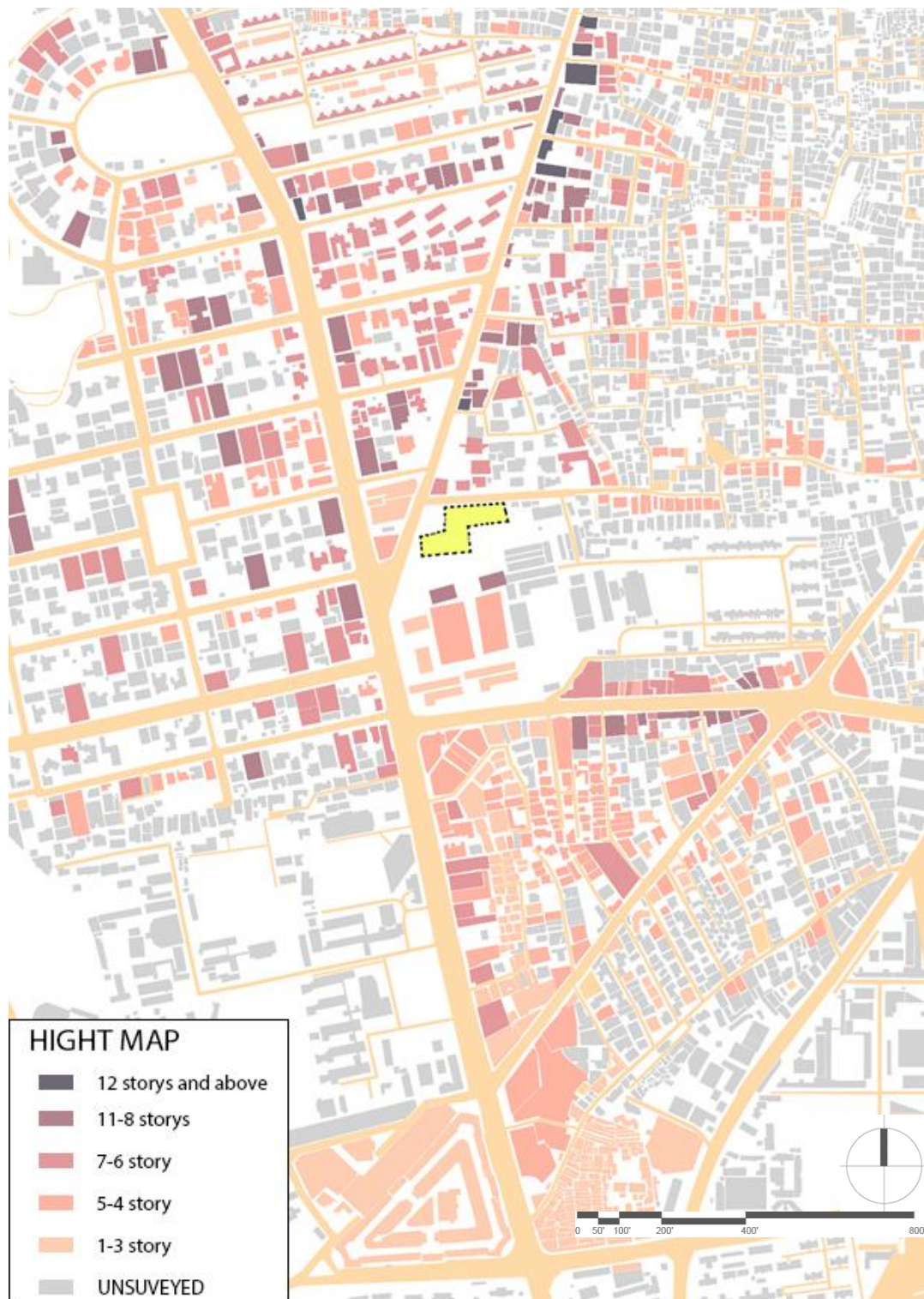




Figure 10 Figure Ground Map of Site (Within 1km of the site)
 (Source: <https://www.openstreetmap.org/export#map=16/23.7443/90.3775>)

3.7. Land-use Pattern of the Surroundings:

The site is surrounded by areas with different land-use patterns. In the north of the site Kalabagan area contains residential zones along with multiple hospitals and educational institutes and to the north-western and western sides in Dhanmondi area is mostly residential with several convention centers and malls near the site. The site has a high-school in its own

compound and on its north-eastern region. Southward we can find shopping malls along the elephant road which continues to the southern part on Mirpur road. On the south-western part another high-school campus and a college campus are situated.

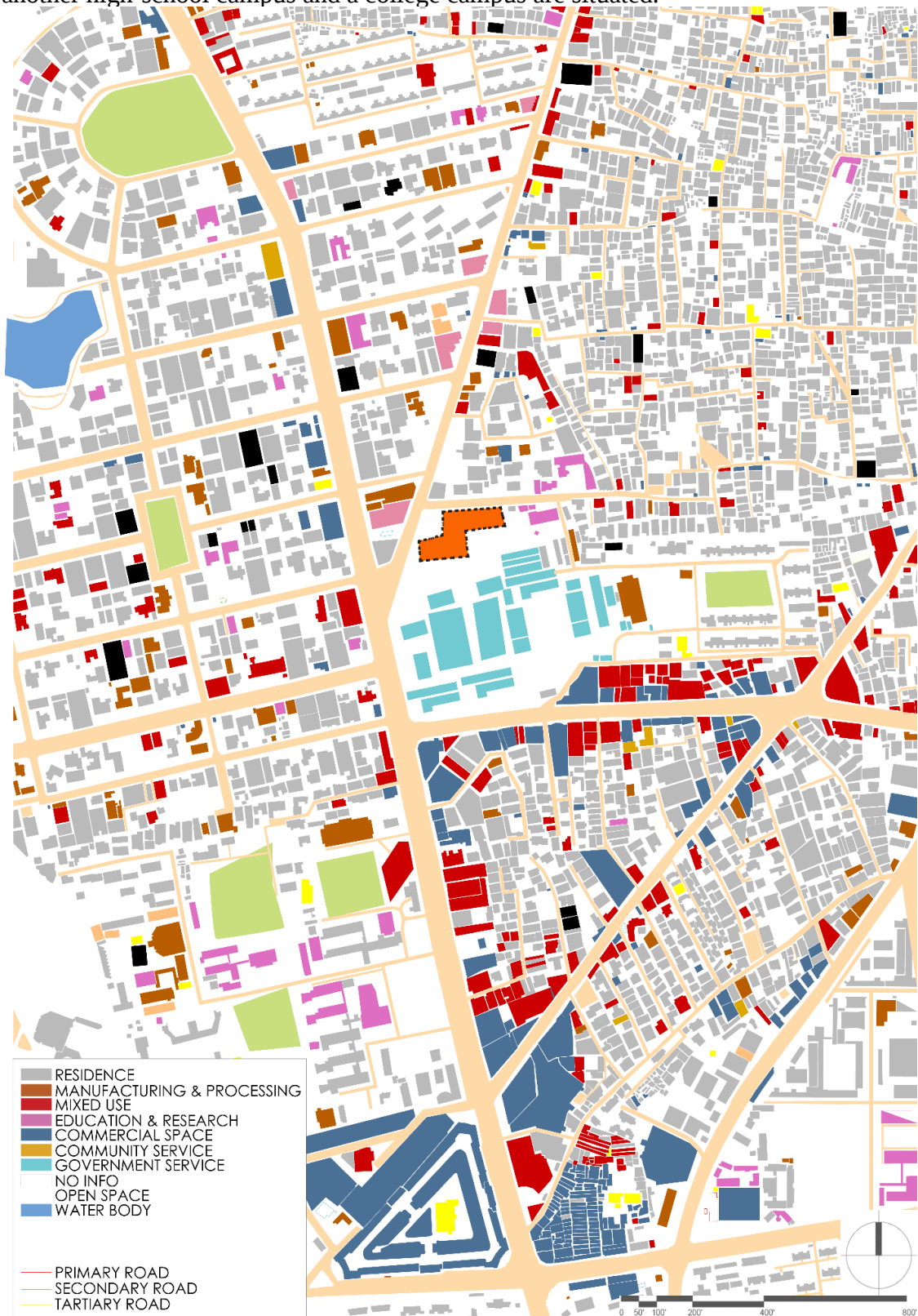
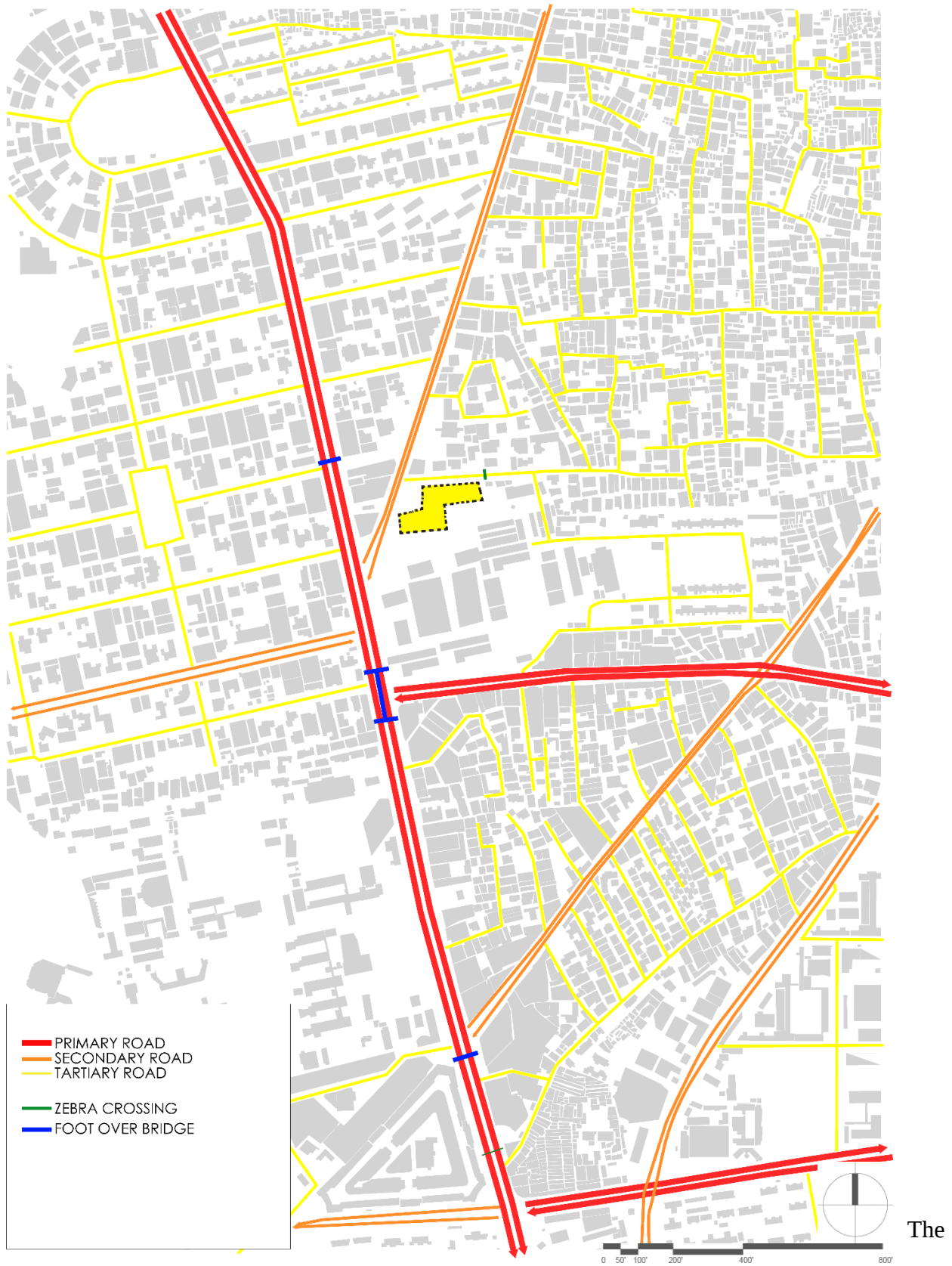


Figure 11 Land Use Map of Site (Within 1km of the site)
 (Source: <https://www.openstreetmap.org/export#map=16/23.7443/90.3775>)

3.8. Accessibility and Connectivity:



site is adjacent to Mirpur Road which is a major arterial road in Dhaka connecting the north-

Figure 12 Accessibility Map of Site (Within 1km of the site)

(Source: <https://www.openstreetmap.org/export#map=16/23.7443/90.3775>)

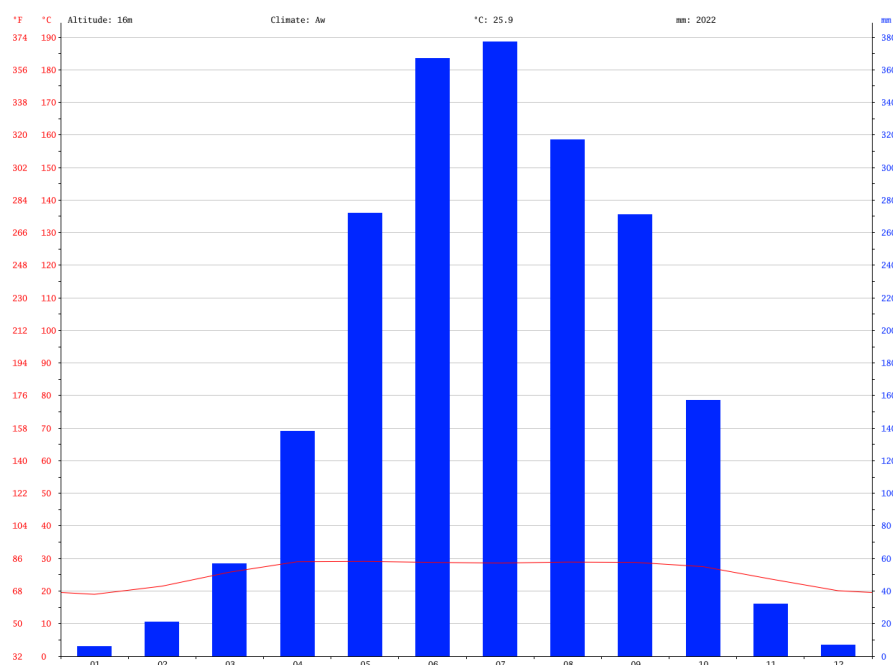
western part of the city with the southern part of the city. To the south side of the site there is Elephant road which meets with Mirpur road and is also a primary road. On the northern part of the site green road terminates in a junction with Mirpur road and also has a secondary connection called the central road. These two major junctions on the two sides of the site makes it a very prone location for heavy traffic congestion. There are a few foot over bridges near the nodes and very less or no zebra crossing in the primary or tertiary roads.

The major congestion points are the junctions where two major roads meet, usually due to large amounts of traffic and especially lack of bus stands or miss management of public transport. Pedestrian access is there in the major roads but does not have sufficient width for the amount of traffic that these roads have due to the increasing numbers of educational institutes, commercial facilities and social facilities that this area has.

3.9. Climatic Conditions:

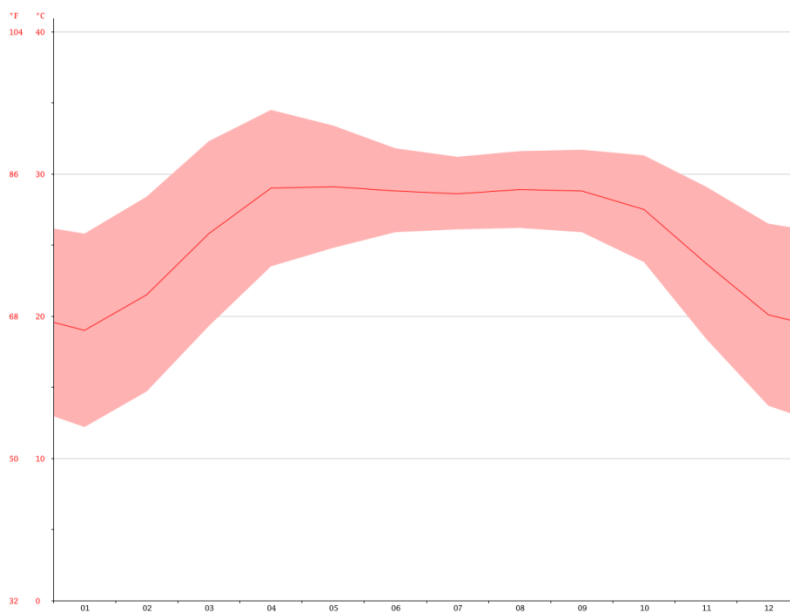
Dhaka has a hot, wet and tropical climate with heavy rains in monsoon and moderate amount of cold in winter. The summers here have a good deal of rainfall, while the winters have very little. The average temperature in Dhaka is 25.9 °C. In a year, the average rainfall is 2022 mm.

Table 1 Climate graph of Dhaka (Source: <https://en.climate-data.org/asia/bangladesh/dhaka-division/dhaka-1062098/>)



The driest month is January. There is 6 mm of precipitation in January. Most of the precipitation here falls in July, averaging 377 mm.

Table 2 figure 3.10- Average temperature Dhaka (Source: <https://en.climate-data.org/asia/bangladesh/dhaka-division/dhaka-1062098/>)



With an average of 29.1 °C, May is the warmest month. January is the coldest month, with temperatures averaging 19.0 °C.

Table 3 Dhaka weather by month (Source: <https://en.climate-data.org/asia/bangladesh/dhaka-division/dhaka-1062098/>)

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	19	21.5	25.8	29	29.1	28.8	28.6	28.9	28.8	27.5	23.7	20.1
Min.	12.2	14.7	19.3	23.5	24.8	25.9	26.1	26.2	25.9	23.8	18.4	13.7

	January	February	March	April	May	June	July	August	September	October	November	December
Temperature (°C)												
Max. Temperature (°C)	25.8	28.4	32.3	34.5	33.4	31.8	31.2	31.6	31.7	31.3	29.1	26.5
Avg. Temperature (°F)	66.2	70.7	78.4	84.2	84.4	83.8	83.5	84.0	83.8	81.5	74.7	68.2
Min. Temperature (°F)	54.0	58.5	66.7	74.3	76.6	78.6	79.0	79.2	78.6	74.8	65.1	56.7
Max. Temperature (°F)	78.4	83.1	90.1	94.1	92.1	89.2	88.2	88.9	89.1	88.3	84.4	79.7
Precipitation / Rainfall (mm)	6	21	57	138	272	367	377	317	271	157	32	7

The precipitation varies 371 mm between the driest month and the wettest month.

Throughout the year, temperatures vary by 10.1 °C.

3.10. Socio-Cultural and Economic Context:

The north-eastern part of the site where kalabagan and kathalbagan area is situated has residential areas with middle-middle to lower-middle income people. On the north-western side dhanmondi has people ranging from middle-middle income to upper class citizen. The total population of dhanmondi, kalabagan and kathalbagan area is 413,946 pax with literacy rate on average of 83%. The majority of people are Muslim with Hindu being the second major religion. The main language is the national language.

Science lab area is surrounded by more than 40 hospitals, diagnostic centers and medical college on its northern side. It also consists of residential facilities, departmental stores and shopping malls. On the southern part there are convention centers and malls.

(Bangladesh Bureau of Statistics, 2019) <http://www.bbs.gov.bd/>

3.11. Site Pictures:



Figure 13 figure 3.12- Pictures of activities happening around the site.

Chapter 4: Case Study

4.1. Salk Institute of Biological Studies

Project Introduction

Architect: Louis I. Kahn

Location: 10010 N Torrey Pines Rd, San Diego, CA 92037, United States

Client: Jonas Salk

Area: 27 acre

Project Completion Year: 1962

Program: Laboratories, Office spaces, Study area.

Project Background: In 1959, Jonas Salk the man who invented the vaccine for polio approached

Louis I. Kahn for a project which was intended to be a biological research center.

Salk gave him a picturesque site in San Diego, California beside a cliff overlooking the Pacific Ocean so that he could create his masterpiece.



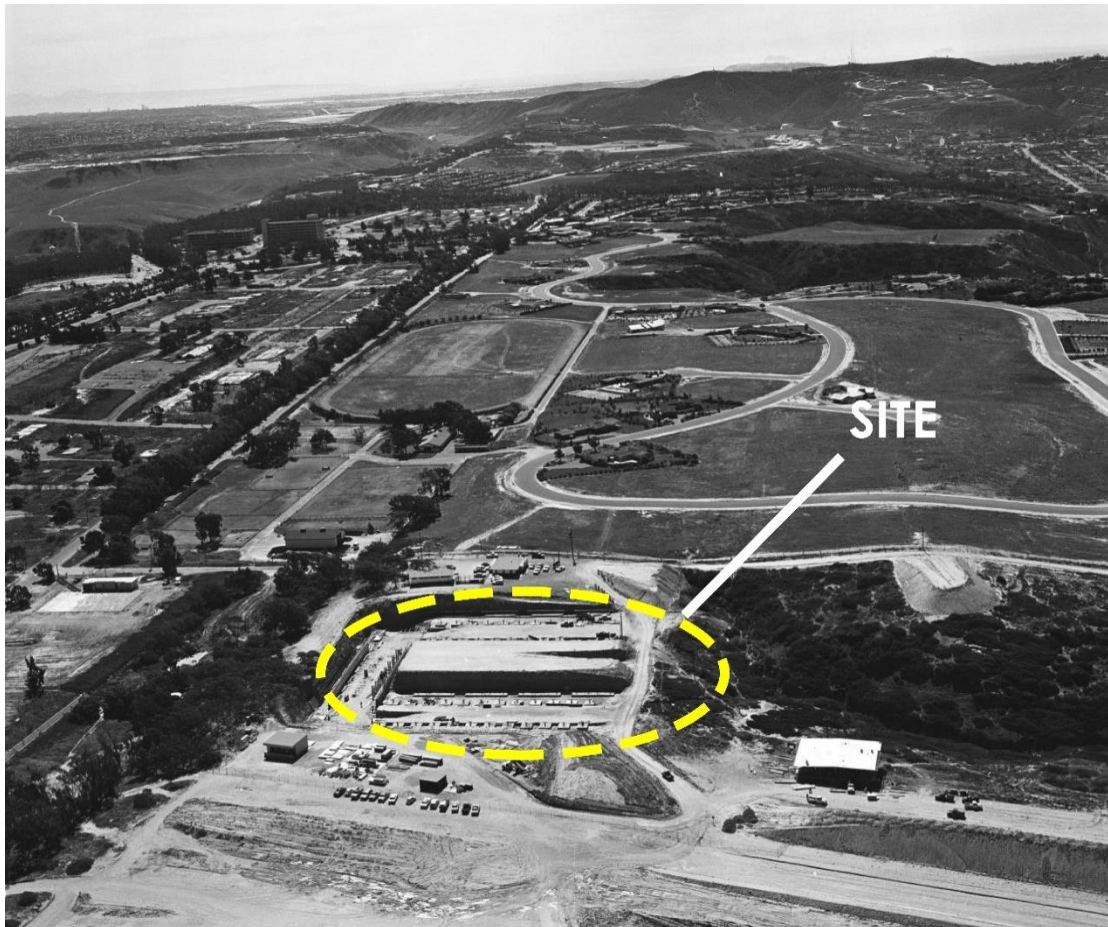


Figure 14 Salk Institute Site in San Diego, California (Source Jolla, L. (2017). Conservation Management Plan Salk Institute for Biological Studies. (October 2016).)

The laboratories is to be designed as open as possible so that it can house and facilitate future discoveries. The master plan had three main zones called the Meeting House, the Village, and the laboratories all facing to the west towards the Pacific. Ultimately the village and the Meeting House was cut off from the project and only the laboratory where made.

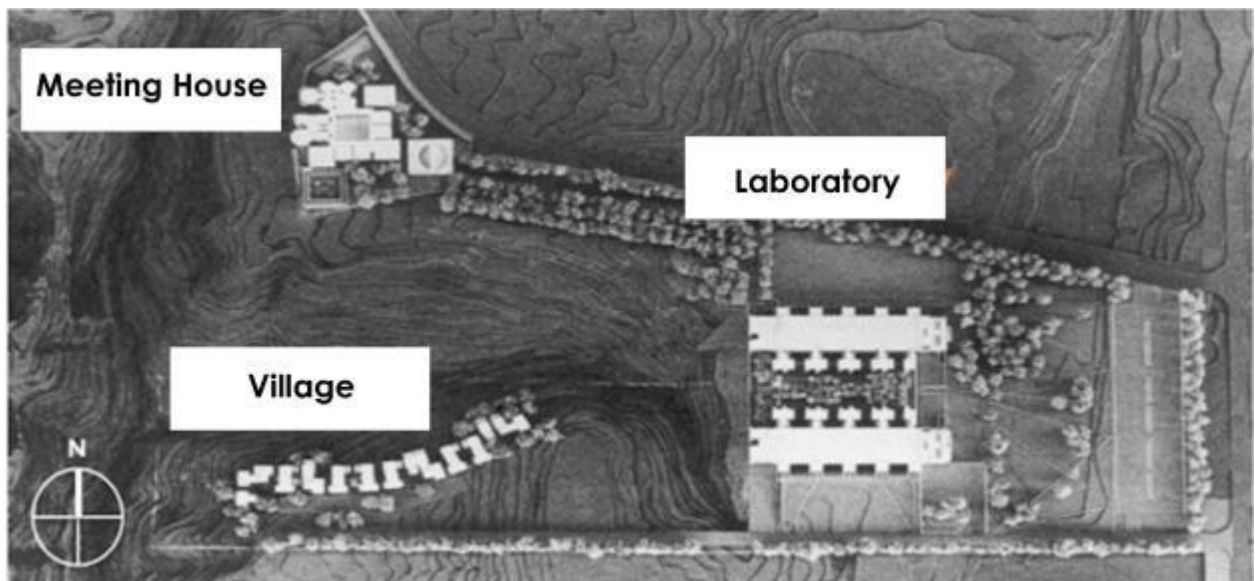


Figure 15 Salk Institute Initial Site Model (Source Jolla, L. (2017). Conservation Management Plan Salk Institute for Biological Studies. (October 2016).)

Thoughts and planning: Salk institute has a pair of towers mirroring each other separated by a plaza originally designed to be a garden with a sharp water passage cutting through it and terminating at the west towards the ocean. The towers are study areas and vertical circulation connected with small passages to the main lab. The office spaces are faced to the west all the mechanical services placed in the east. Later a second pair of labs were built as an extension to the institute.

Zoning and Plan Layout: There are basically two towers six stories high with the laboratories in the center and flanked by study rooms facing the center court and vertical circulation and services facing outwards. The ends contain office spaces for the scientists in the west and mechanical facilities facing east. Every alternate floor contains service pipes and other mechanical equipment for the laboratory.

Circulation: There are stair cases and lifts situated in the five towers facing the court and in the service towers with horizontal circulation going around the laboratory in a corridor fashion.

Structure: The structure is mainly made of RCC with the central laboratory made of vierendeel truss so that there is an uninterrupted space there. The entire building is of fair face concrete with the window modules made of teak wood.

Central Court: The central court is linear and draws the datum which terminates to a recreational space looking at the Pacific ocean. There is a shallow water channel running through and the entire plaza is paved.



Figure 16 Salk Institute Plaza View (Source: Lardinois, S. (2017). *Salk Institute for Biological Studies Conservation Project : Teak Window Wall Assemblies.*)



Figure 17 Salk Institute Site Zoning Map (Source: Google Earth)

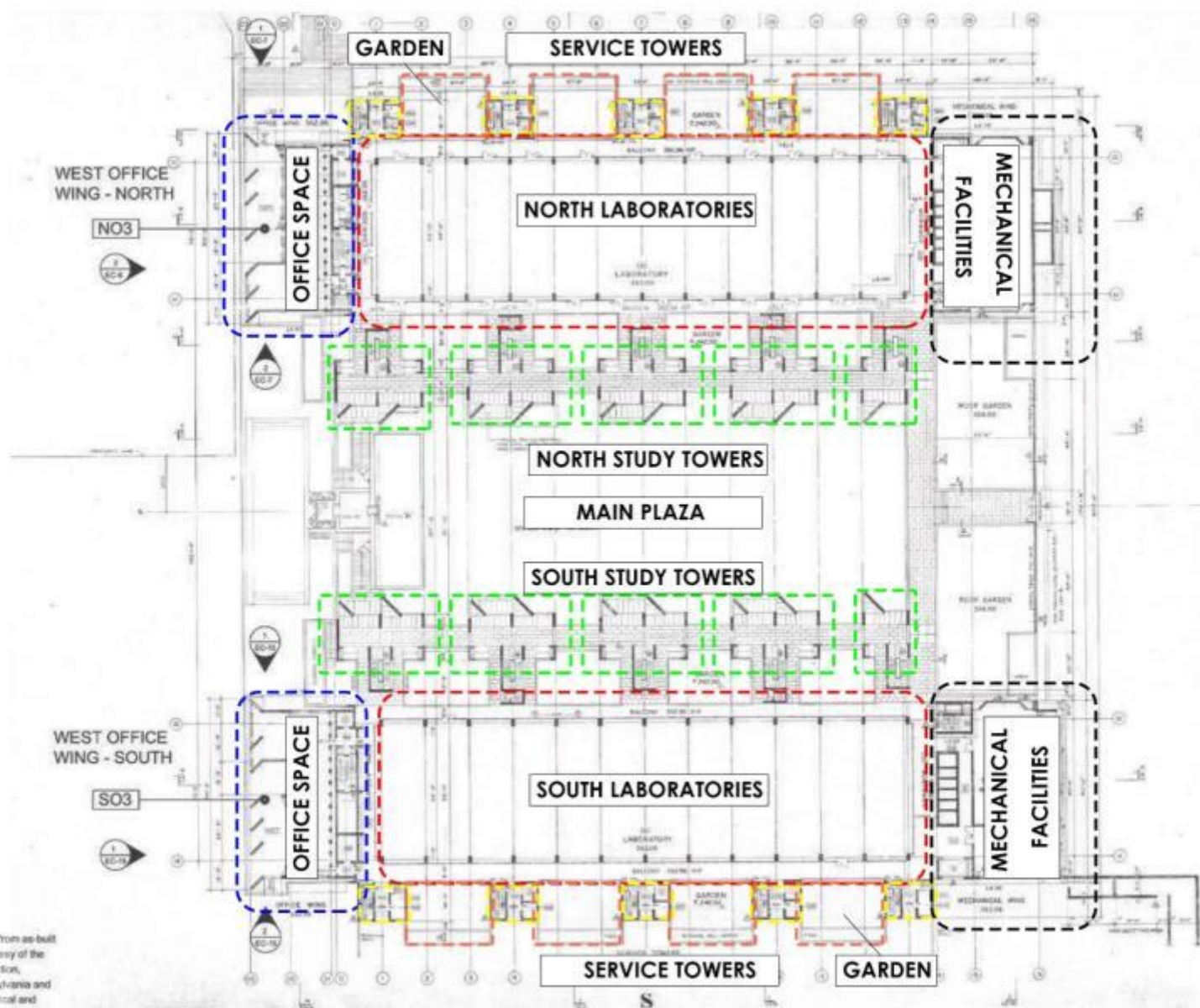


Figure 18 Salk Institute Zoning Plan (Source: Jolla, L. (2017). Conservation Management Plan Salk Institute for Biological Studies. (October 2016).)

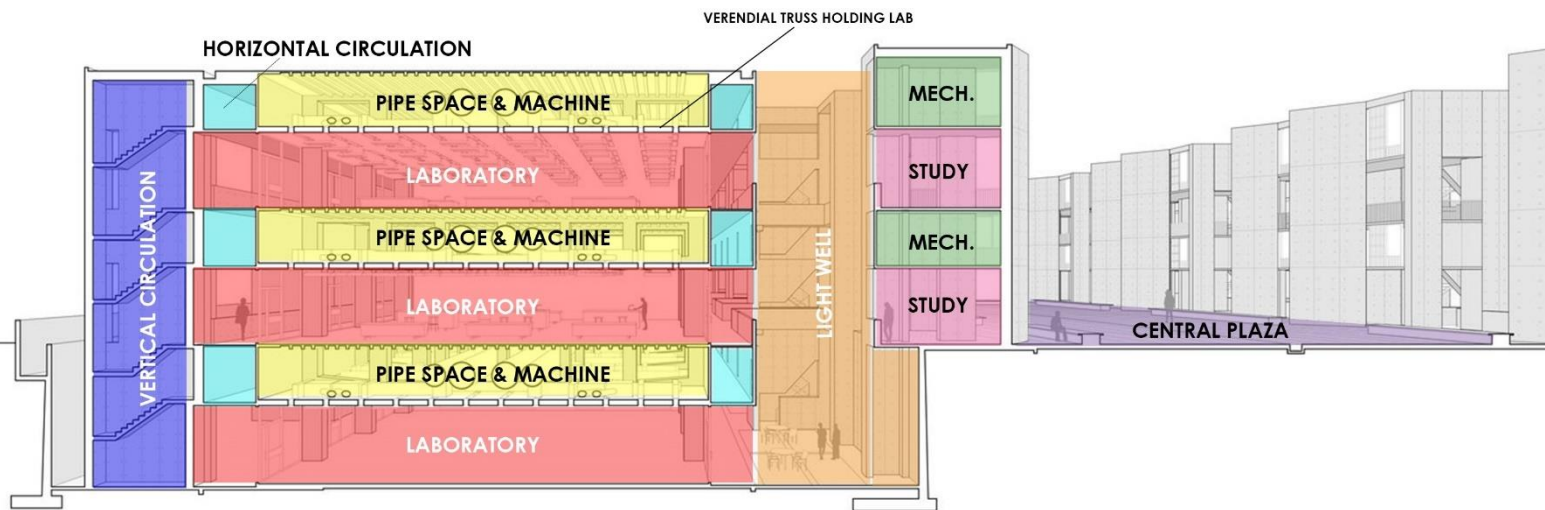


Figure 19 Salk Institute Zoneing Plan (Source: Jolla, L. (2017). Conservation Management Plan Salk Institute for Biological Studies. (October 2016).)

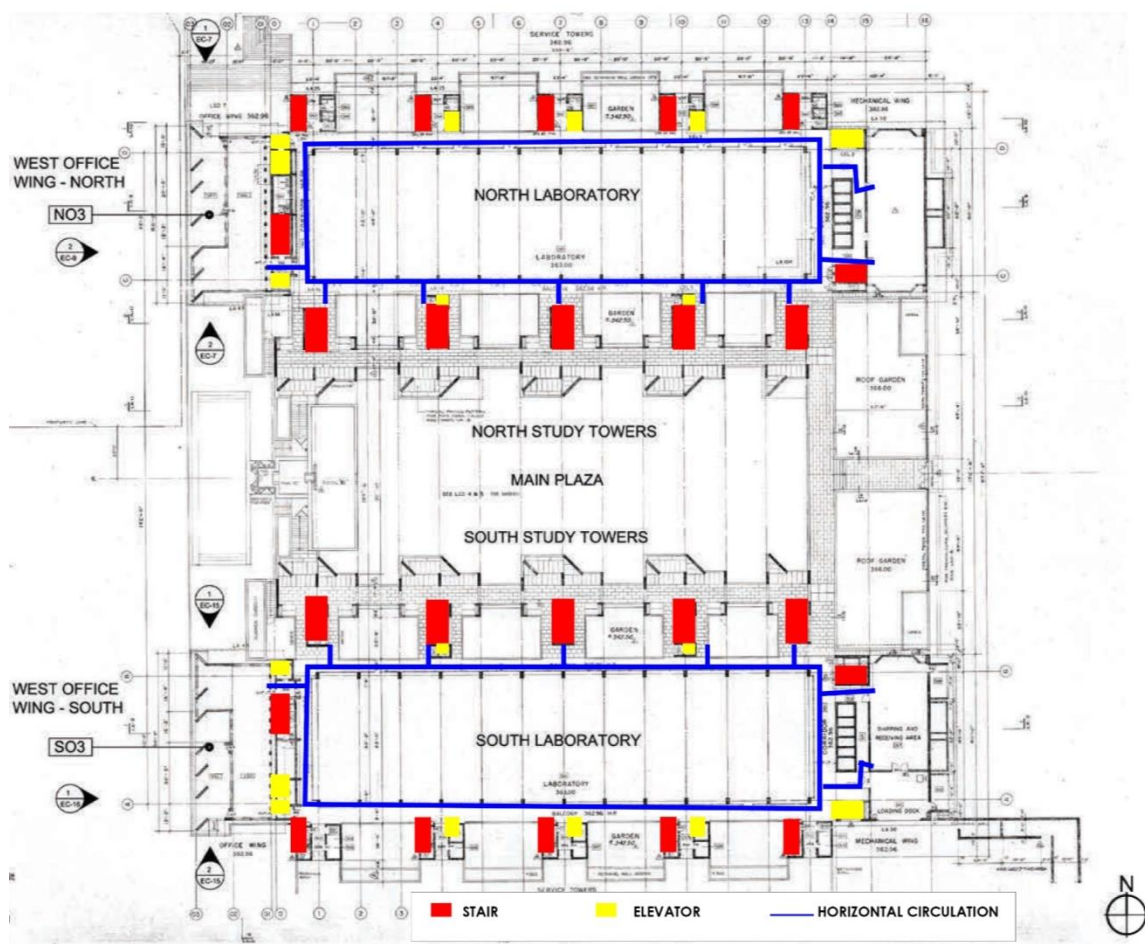


Figure 20 Salk Institute Zoneing Plan (Source: Jolla, L. (2017). Conservation Management Plan Salk Institute for Biological Studies. (October 2016).)

4.2. Biomedicum Laboratory Building

Project Introduction

Architects: C.F. Moller Architects

Location: Stockholm, Sweden

Client: Karolinska Institute

Area: 65000 msq.

Project Completion Year: 2019

Program: Training Centre, Laboratory, Conference hall, Office space.

Project Background: It is an extension of the university campus of Karolinska Medical Institute where researches will be carried out. They are one of the leading figures in medical research so the designers had to provide all the facilities along with the sensitivity of keeping the open spaces as it is inside the university campus. The architects created good balance between public and private space.

The continuity of the open space from the outside leads to the atrium inside the building. This has the café and sitting spaces which receives natural light through the glass roof and also keeping green spaces along the walkways.



Figure 21 Biomedicum Laboratory Building (Source: María Francisca González, 2019)

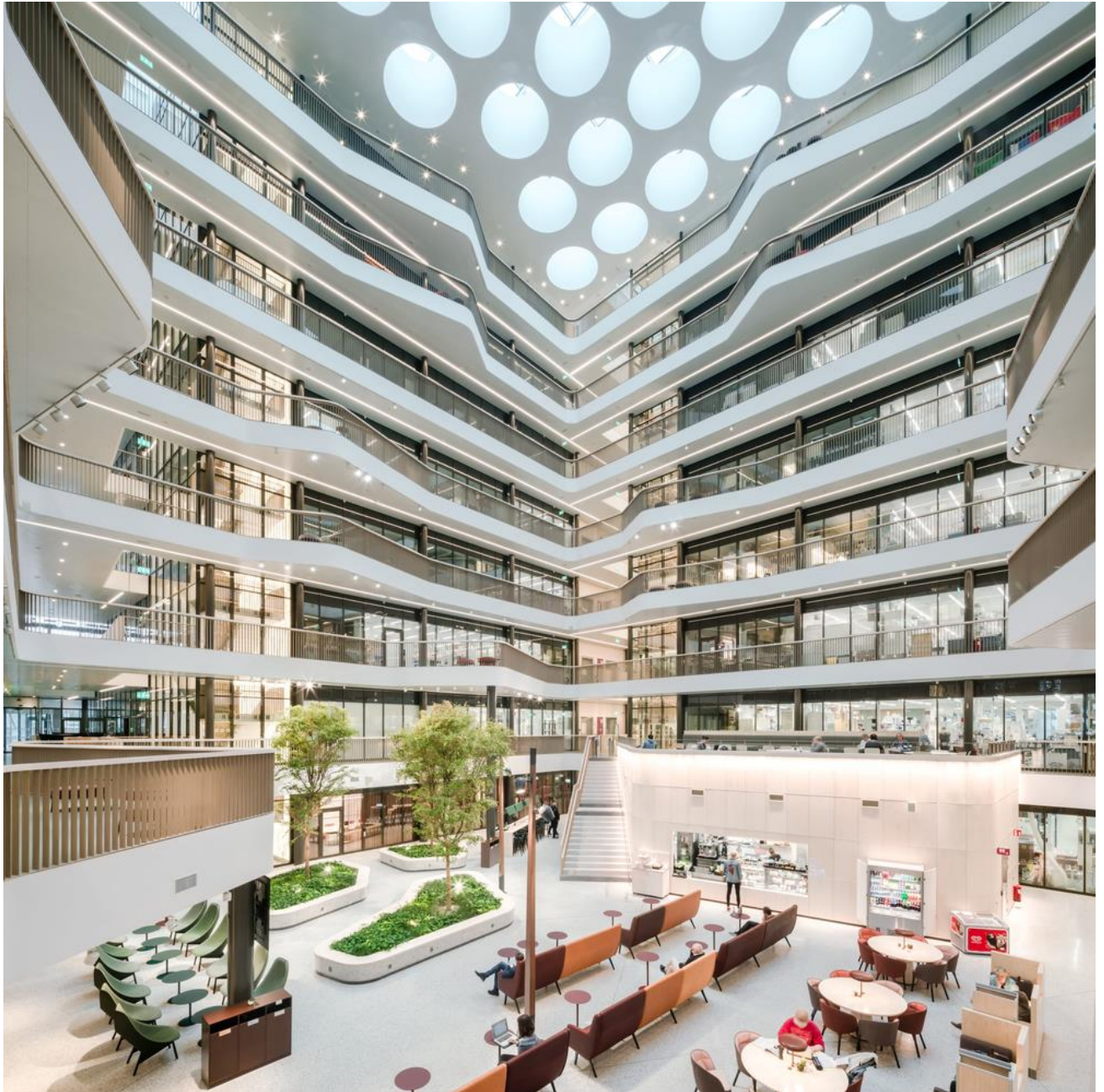


Figure 22 Inside the Atrium of Biomedicum Laboratory Building (Source: María Francisca González, 2019)

For seminars and other conferences they have a conference hall which is an open style conference hall. It also has labs that are situated along the corridor which is looking down to the atrium, this results in bringing natural light to the lab where it is necessary.

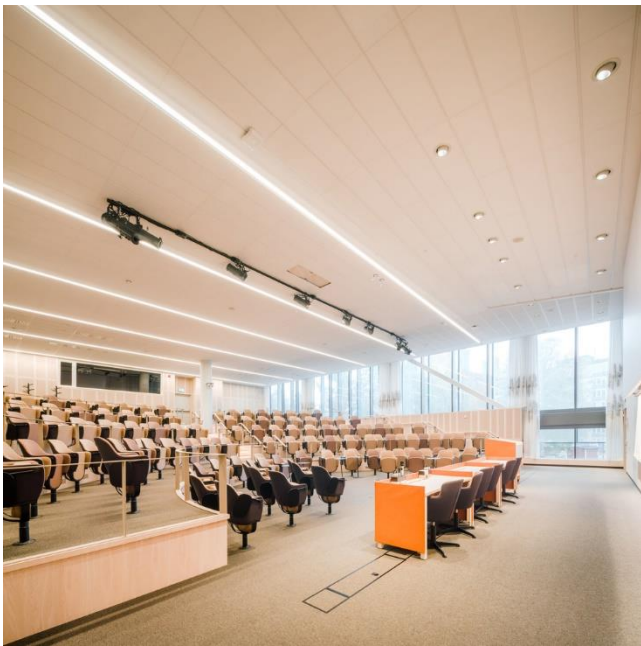


Figure 4.10- Conference Hall of Biomedicum Laboratory Building (Source: María Francisca González, 2019)

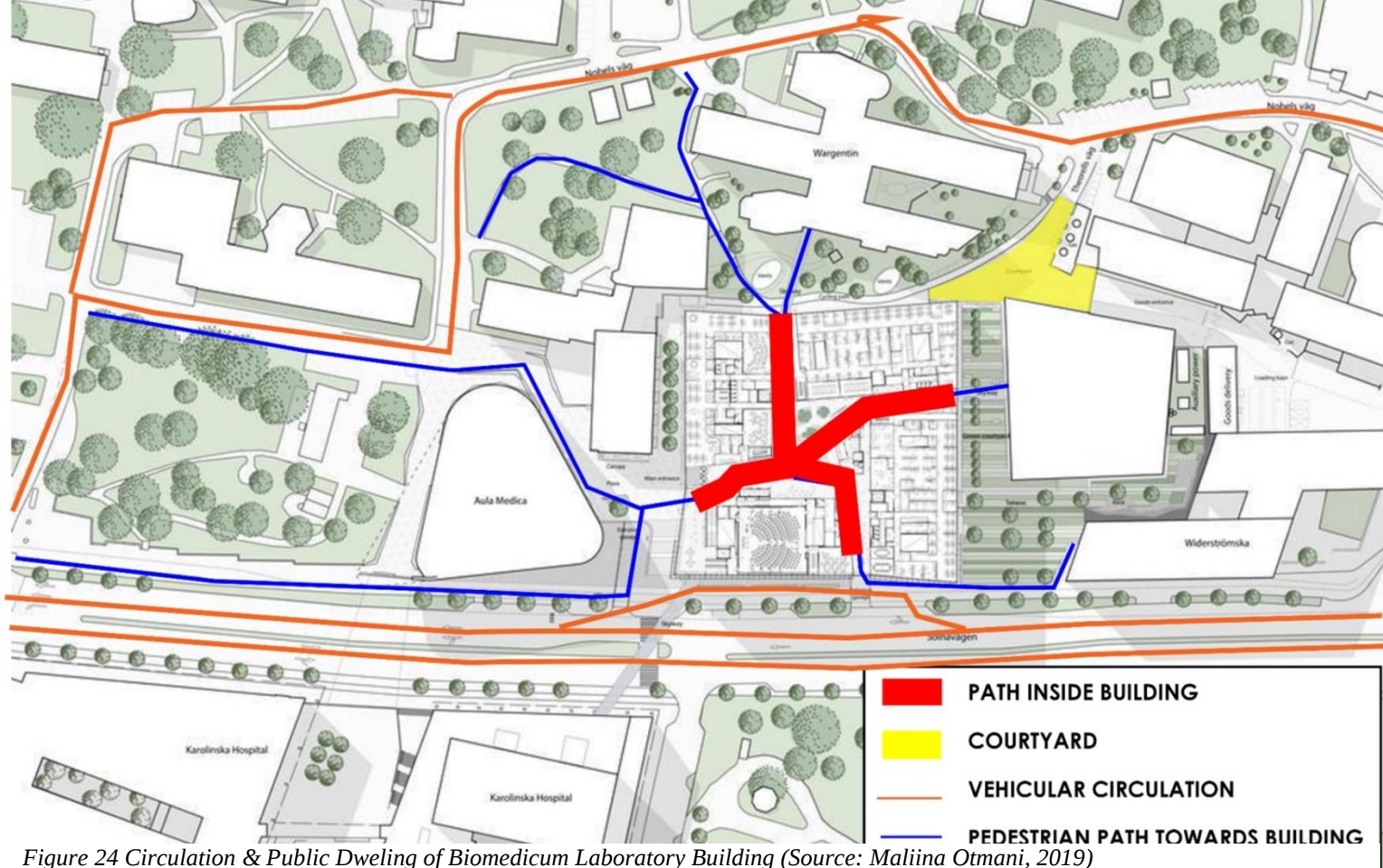


Figure 24 Circulation & Public Dweling of Biomedicum Laboratory Building (Source: Maliina Otmani, 2019)

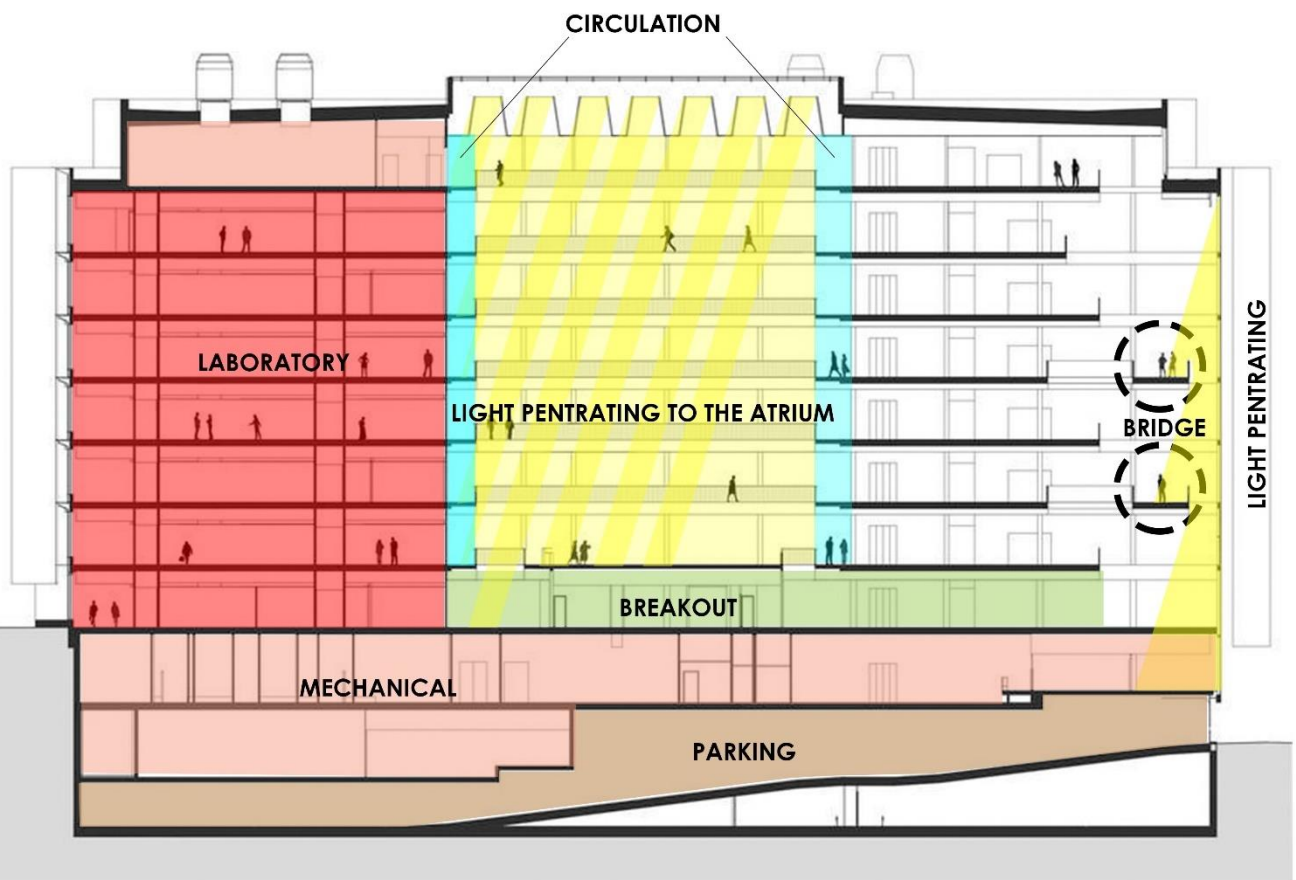
Circulation: The circulation of this project allows pedestrians to cross the building in a pinwheel fashion. The upper floors are arranged around the atrium in a corridor fashion opening to laboratories. It has the vertical circulations positioned around the atrium for ease of access.

Zoning and planning: the entire planning of the building is made encircling the central atrium. Laboratories and study areas are arranged in a pinwheel arrangement divided into four chunks with one of it in the ground floor being a conference hall. There are multiple sitting throughout the facility for people to take rest. The upper floors contain most of the laboratories and training class rooms.



Figure 25 Functional Zoning of Biomedicum Laboratory Building (Source: Maliina Otmani, 2019)

Figure 26 Sectional Analysis of Biomedicum Laboratory Building (Source: Maliina Otmani, 2019)



4.3. BCSIR Industrial Research Institute

Project Introduction

Architect: Muzharul Islam

Location: BCSIR Science Lab, Dhanmondi, Dhaka 1205, Bangladesh

Client: BCSIR

Area: 74350 sft.

Project Completion Year: 1955

Program: Laboratories, Office spaces.

Project Background: The BCSIR research institute was established to accommodate all the industrial research works to be carried out in one compound. The architect had designed two towers mirroring each other separated by a paved walkway.

Structure: The building typically has a standard beam and column structure with brick walls as partition. It also has jalis on the facades to let in natural ventilation and sunlight inside the building.



Figure 27 BCSIR Laboratory Building (Source: <http://www.bcsir.gov.bd/>, 2019)

Zoning and planning: The buildings have a central court in each one which brings natural light to the internal functions. The laboratories are arranged around the court where it is connected with a corridor and has vertical circulations on the north and south directions. On

the facades we can see jail work to keep the sunlight out and at the same time to allow natural ventilation to take place.

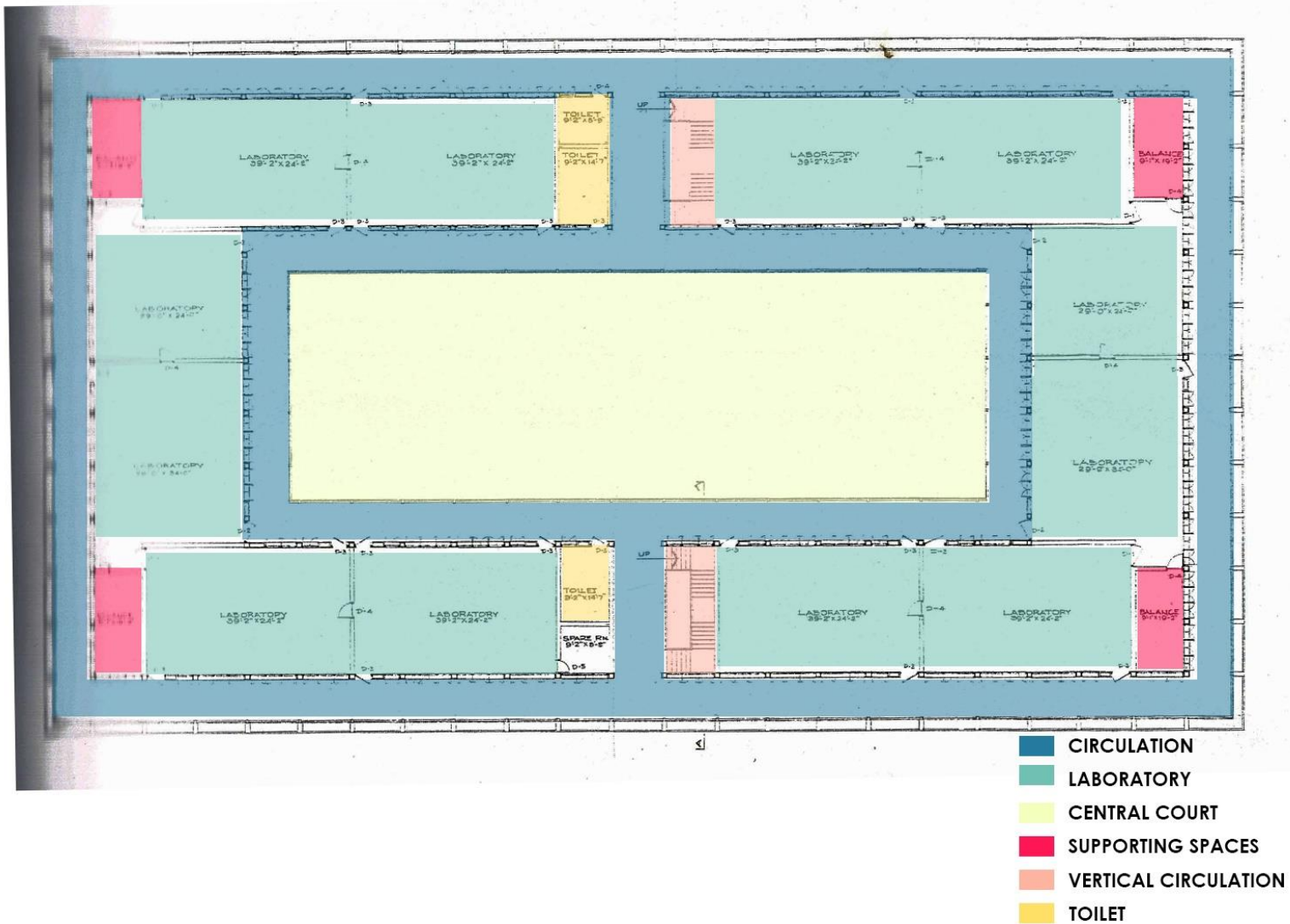


Figure 28 BCSIR Laboratory Building Plan Zoning (Source: Fuad, B., Editor, H. M., Faruqui, Z., & Editor, A. (2012). Muzharul Islam Architect. 2012.)

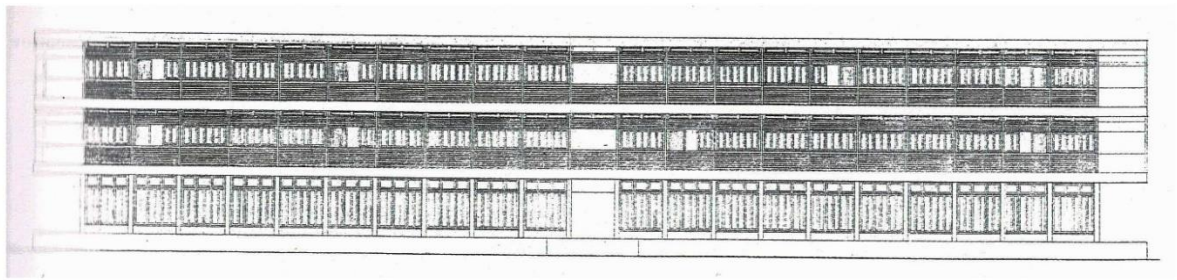
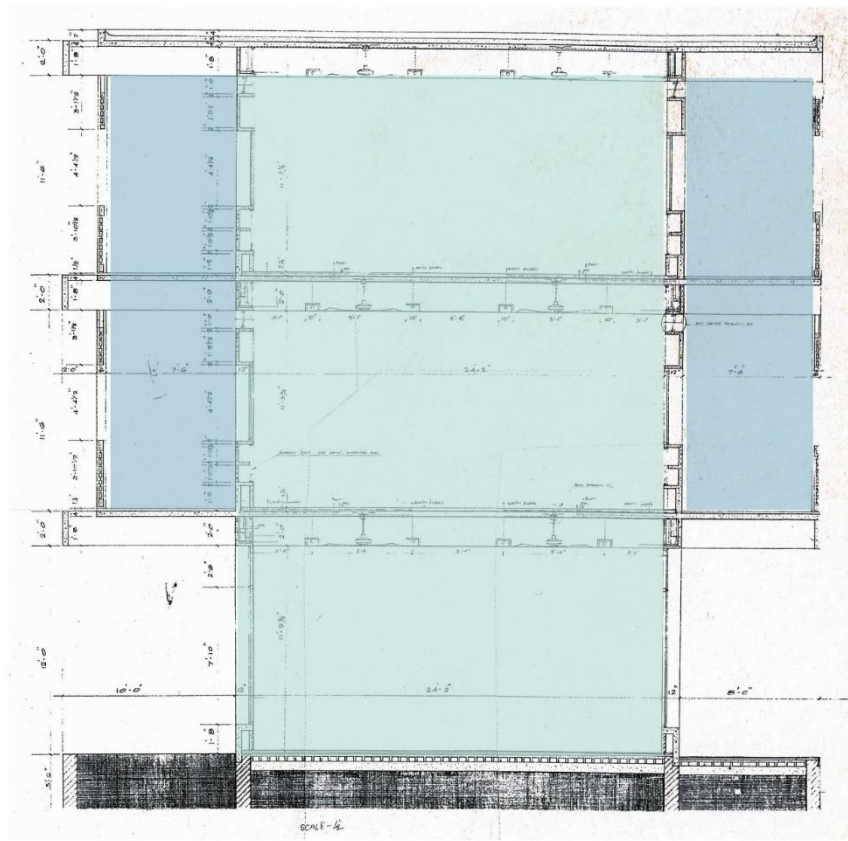


Figure 30 BCSIR Laboratory Building Plan Elevation (Source: Fuad, B., Editor, H. M., Faruqi, Z., & Editor, A. (2012). Muzharul Islam Architect. 2012.)

Chapter 5: Program Analysis

5.1. Proposed Program from Client:

A. Training Facilities:

Seminar Rooms: for 300 people (2) =7200sft

Seminar Rooms: for 100 people (4) =4800sft

Lecture Rooms: for 30 people (5) =2500sft

Lecture Rooms (IT): for 20 people (1) =500sft

TOTAL =15000

B. Administrative Facilities:

Admin Space (two rooms): for 5 people =2000sft

TOTAL =2000

C. Recreation Facilities:

Swimming pool: for 20 people (2) =1000sft

TOTAL =1000

D. Public Gathering Facilities:

Conference Hall: for 500 people =21550sft

Auditorium: for 500 people =22000sft

Archive and Exhibition centre: for 300 people= 10000sft

Library: for 100 people =6650sft

TOTAL =60,200

E. Laboratory Facilities:

Central Lab: for 200 people =8000sft

TOTAL =8000

F. Residential Facilities:

Dormitory: for 24 people =1200sft

VIP Suit: for 15 people =12000

Residential Quarters (Grade 4 officers): 104 people =46800sft

Residential Quarters (Grade 9 officers): 104 people =39000sft

TOTAL =99000

G. Dining Facilities:

Food Court: for 200 people =8000sft

TOTAL =8000

GRAND TOTAL= 1,93,200sft

5.2. Rationale of the Program:

A. Training facilities: Since this is a training institute among other functions that this facility contains, there will be about six or more training programs that will be held here in a single day with the capacity of students ranging from 20 to 30 pax in each classrooms. And as there will be research going on in a daily basis, this has to be conveyed to the students and other government officials who are to be notified of the matter thus 6 conference rooms ranging from 150-25 pax capacity is suggested so that 400 people can attend different seminars at the same time. The seminar halls will have flexible partitions in order to adjust the space of the place to their requirement.

	Functional space	Number of units	Number of users	Area per unit (in sft)	Total area (in sft)
A. Training facilities					
1	Seminar Room (large)	2	300	3600	7200
2	Seminar Room (small)	4	100	1200	4800
3	Break Lounge	1	500	4000	4000
4	Lecture Room	5	150	500	2500
5	Lecture Room IT	1	20	500	500
6	Store Room	1	-	50	50
7	Toilet	13	1200	40	520
8	Circulation and Maintenance	1	—	—	5871
Subtotal					25441

Table 4 Training facilities

B. Public Facilities: The main public places in this facility are the Conference hall and the Auditorium which will hold 500 people each. This will help in solving the problem space that is currently occurring in the facility as there is not a place where a new product or progress can be showcased or be discussed about. These facilities will also come with all the ancillary facilities that are required to run it. For a better understanding of the people about what happens in the facility, there will be an archive and exhibition hall which will be open to public to better understand about the various research and experiments that are going on here. A library will also be built so that the trainees that are staying and studying there can have their books and other learning aids at their disposal. The facility will also include a prayer room for the users of the facility to use.

	Functional space	Number of units	Number of users	Area per unit (in sft)	Total area (in sft)
B. Public facilities					
1	Main Entrance	1	300	3000	3000
2	Reception	1	—	60	60
3	Waiting area	1	300	2400	2500
4	Toilet	4	300	40	240
5	Conference Hall				
6	Lobby	1	500	2000	2000
7	Conference Reception	1	—	100	100
8	Seating	1	500	6000	6000
9	Stage	1	8	1050	1050
10	Projection Room	1	—	150	150
11	Equipment Storage	1	—	400	400
12	Toilet	6	500	40	240
13	Circulation	—	—	500	320
14	Auditorium				
15	Lobby	1	500	2000	2000
16	Entrance Vestibule	1	500	2000	2000
17	Seating	1	500	6000	6000
18	Stage	1	20	2000	2000
19	Projection Room	1	—	150	150
20	Equipment Storage	1	—	400	400
21	Toilet	6	500	40	240
22	Circulation	—	—	500	320
23	Archive and Exhibition Hall				
24	Archive Section	1	300	4000	4000
25	Exhibition Section	1	300	3000	3000
26	Reception\Ticketing Section	1	50	800	800
27	Toilet	4	300	40	160
28	Library				
29	Checkout and Librarian seating area	2	20	500	1000
30	Book Shelf area	1	—	1200	1200
31	Reading area	1	100	1500	1500
32	Computer Area	1	50	500	500
33	Storage	1	—	200	200
34	Toilet	4	200	40	160
35	Prayer Room				
36	Main hall	1	50	400	400
37	Ablution Area	1	10	200	200
Subtotal					42290

Table 5 Public facilities

C. Laboratory Facilities: Laboratory is the central function of the entire facility which is encircled by other facilities. This will have two parts to hold 50 people each and ancillary supporting functions for it to run properly. The rationale of placing a laboratory of this size is to accommodate regular research work as well as the training sessions that will go on throughout the year. This will help in giving the trainees the opportunity to do experiments and be practical about their training.

Functional space	Number of units	Number of users	Area per unit (in sft)	Total area (in sft)
C. Laboratory facilities				
1	Laboratory			
2	Research Hall (wet)	1	50	5000
3	Research Hall (dry)	1	50	6000
4	Office Space for Scientists	20	20	150
5	Decontamination Chamber	2	20	200
6	Locker Room	2	30	800
7	Mechanical Room	1	5	100
8	Shower Room	10	10	15
9	Toilet	4	100	40
10	Storage	1	—	200
11	Circulation and Maintenance	—	—	5000
Subtotal				21610

Table 6 Laboratory facilities

D. Residential Facilities: There will be two kinds of accommodation for this facility which will be a permanent and a temporary one. The permanent residence will be the residential quarter where the 4th and 9th class officers that work there will be given accommodation until their retirement. For grade 9 officers there will be a 1500sft flat for 26 families and for grade 4 officers there will be a 1800sft flat for 26 families. This number of flat are given as there will be a total of about 50 government officials working in this training institute. There will be both male and female dorms for

trainees or the trainers that will stay here for a relatively short time. Along with all these facilities, there will also be 15 VIP accommodations.

Functional space		Number of units	Number of users	Area per unit (in sft)	Total area (in sft)
D. Residential facilities					
1	Dormitory (Male)	12	12	100	1200
2	Toilet	4	4	40	160
3	Shower room	2	2	40	80
4	Dormitory (Female)	12	12	100	1200
5	Toilet	4	4	40	160
6	Shower room	2	2	40	80
7	Residential Quarter (Grade 4 officers)	26	104	1800	46800
8	Residential Quarter (Grade 9 officers)	26	104	1500	39000
9	VIP Suit	15	15	800	12000
10	Laundry	2	—	300	600
11	Prayer Hall	1	50	400	400
12	Circulation and maintainance	1		5000	5000
Subtotal					106680

Table 7 Residential facilities

E. Administrative Facilities: The administrative facilities of the building will need a number of things in order to make all the other functions here to work and be monitored properly. Since this facility has a number of public and semipublic areas, this needs a waiting and an information desk. There will be office rooms for the officers who will be in the responsibility of the whole facility. Since there will be hazardous objects in the laboratories, a medical room must be provided. There will also be security surveillance areas for monitoring the entire facility all the time.

	Functional space	Number of units	Number of users	Area per unit (in sft)	Total area (in sft)
E. Administrative facilities					
1	Offices Rooms	2	2	132	264
2	Waiting AND Information area	1	5	1200	1200
3	Security Servailence room	2	30	500	1000
4	Toilet	3	5	40	120
5	Medical Room	2	5	100	200
6	Service Lobby	1	—	400	400
7	Storage	2	—	200	400
Subtotal					3584

Table 8 Administrative functions

F. Dining Facilities: Dining facilities are divided into two places that will facilitate two different groups of functions. The first one being the food court for the entire facility including the labs and the training facilities seating 200 people at a time as at a given time there will not be more than 200 people going for meal due to scheduling of activities, the other is the food court for dorm which will seat 30 people and facilitate only the people staying in the dormitory.

	Functional space	Number of units	Number of users	Area per unit (in sft)	Total area (in sft)
F. Dining facilities					
1	Food Court				
2	Dining Area	1	200	3000	3000
3	Food serving counter	1	50	1000	1000
4	Toilet	4	200	40	160
5	Kitchen				
6	Meat preparation	1	—	400	400
7	Bakeshop	1	—	300	300
8	Cold Foods	1	—	50	50
9	Vegitable preperation	1	—	80	80
10	Range/Grill	1	—	50	50
11	Storage area				0

12	Pantry	1	—	100	100
13	Refrigerated	1	—	150	150
14	Cleaning areas	1	—	100	100
15	Food Court for Dorm				
16	Dining Area	1	30	1200	1200
17	Food serving counter	1	30	50	50
18	Toilet	2	30	40	80
19	Kitchen				
20	Meat preparation	1	—	200	200
21	Bakeshop	1	—	150	150
22	Cold Foods	1	—	50	50
23	Vegitable preparation	1	—	80	80
24	Range\Grill	1	—	50	50
25	Storage area				
26	Pantry	1	—	40	40
27	Refrigerated	1	—	50	50
28	Cleaning areas	1	—	50	50
Subtotal					7390

Table 9 Dining facilities

G. Recreational Facilities: For recreational purpose a swimming pool is to be provided for the residents facilitating 20 people at a time.

Functional space	Number of units	Number of users	Area per unit (in sft)	Total area (in sft)
G. Recreational facilities				
Swimming pool				
2	Pool area	1	20	1000
	Shower room	10	10	40
4	Locker room	2	20	300
Subtotal				2000

Table 10 Recreational facility

The total area to be built is 208995sft.

5.3. Maximum Ground Coverage

Site Area, A = 3acres = 130680sft

Minimum Width of road inside the site = 9m= 29.527feet

FAR for Commercial area = 8.5

MGC = 50% of Area = 65,340sft

Setback for the site: Front: 1.50m = 5.0ft Back: 3m = 10ft Side: 3m = 10ft

Chapter 6: Design Considerations & Development

6.1.1 Proper Laboratory Layout:

In this project the location of the laboratory is a key component around which the other functions will be laid out. As seen in the case studies, we can see that the laboratories are placed in the location that is most secured and accessible by the users. It should be placed in a place where external environment cannot disturb it, this is to keep the laboratory sterile. The ventilation of the laboratories must be passive with proper HVAC systems and not naturally ventilated. Natural light maybe allowed to some extent but not in all places depending on the type of experiments that are being carried out inside. Noise must also be cut off from the internal conditions of the lab.

Other supporting function that is needed for the laboratory must be given as they are equally important to run the facility. The laboratory environment must not feel claustrophobic and design in a more humane way. Connectivity to open spaces with the lab is required so that the workers can access spaces of peace and calmness whenever they want.

6.1.2 Creating an Ambience of learning:

Since the project contains a training program with different lecture and seminar rooms, there is a need of an open or recreational space. The seminar and lecture halls must have access to proper ventilation and natural light for a better environment in order to create a better learning environment.

6.1.3 Public Access for Public Awareness:

As the entire facility is mostly containing private functions, there is a very little chance for the public to come in and see what is happening. But since this is a national procedure that works for the people of this country people must be aware about the different works that goes

on in these labs. Thus an integration of public in the facility is crucial and will undoubtedly contribute to the research that goes on here. On-the-other-hand a public plaza may also contribute to the society making the project not only being contained within its users but also the general public. From the site study we can see that the area has very few open spaces, this might be a breathing space for the people there to relax.

6.2 Conceptual Development:

Bangladesh has an agriculture based economy before it was independent as a country. Thus the local government when it was in Pakistan rule had attempted in thriving in the industrial sector by setting up an industrial research center in this region called Pakistan Council of Scientific and Industrial Research (PCSIR) or more known as the Eastern Labs in the Polytechnic Institute in Tejgaon. Later a renowned scientist known as Qudrat-E-Khuda took the initiative in establishing the centers own research facility and have been granted a site beside Mirpur road in the Dhanmondi area.

After the war in 1971 and Bangladesh gaining independence, the institution was officially given the name Bangladesh Council of Industrial Research (BCSIR). But the primary goal of setting up the institute of enhancing the industrial research and encouraging people in investing or working in this sector was lost as the facility is heavily fortified and guarded with no public access.

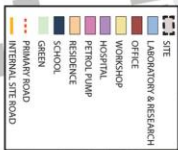


Figure 31 Design considerations

The site has all its lab and offices haphazardly arranged with no proper public access or spaces where they can get familiar to the institution.

With schools and colleges around the site and major hospitals surrounding it, this would be a great place to welcome the public to have an open space and learn about the research going on inside. Thus there will be three major kinds of spaces that is going to flow throughout the project which will be a **public space**, a **semi-private space** and a **private space**.

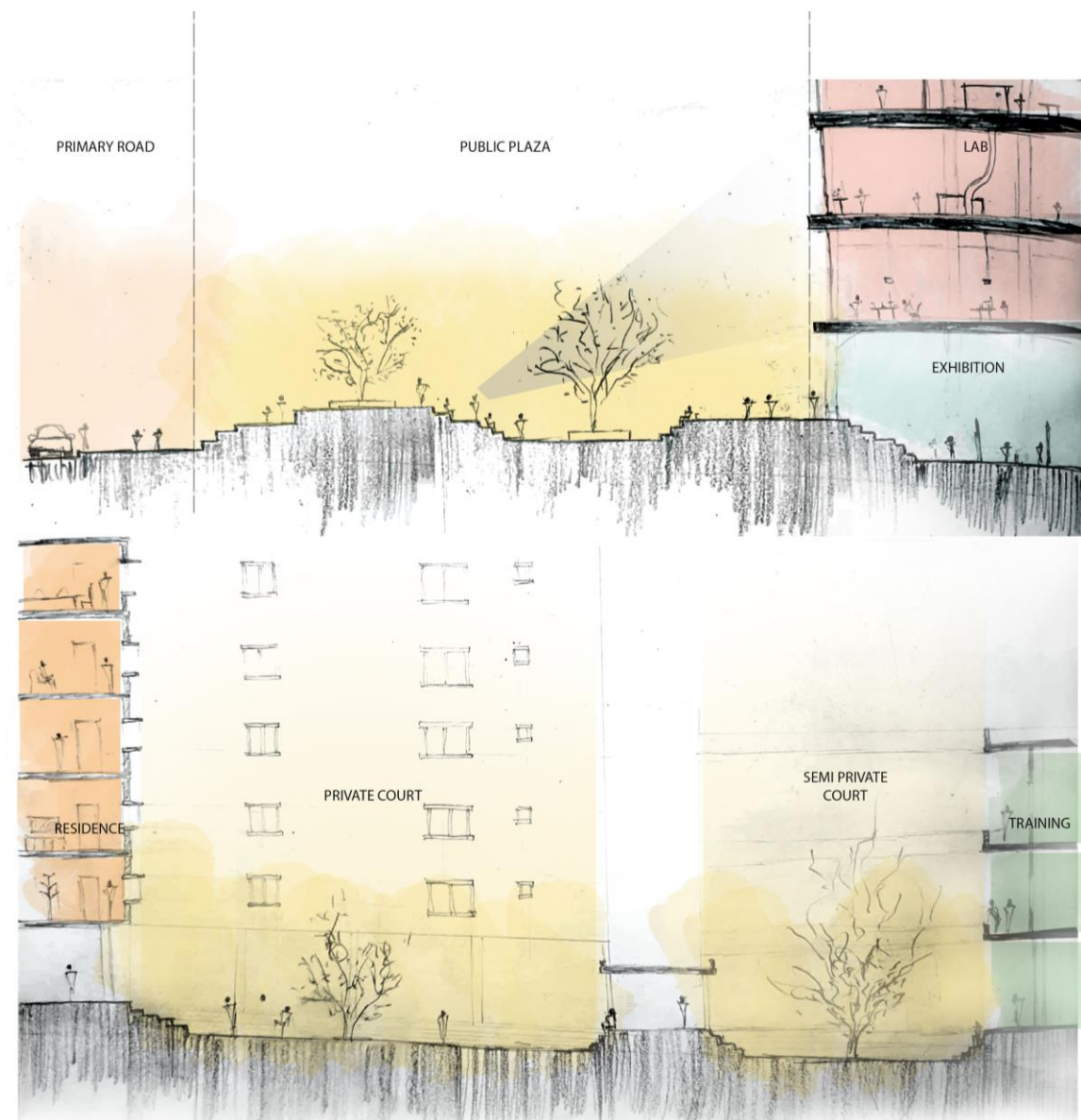


Figure 32 Conceptual sketch

6.3 Design Decisions:

There are four major functions and they are arranged in the site considering the site forces and the accessibility of people around the site.

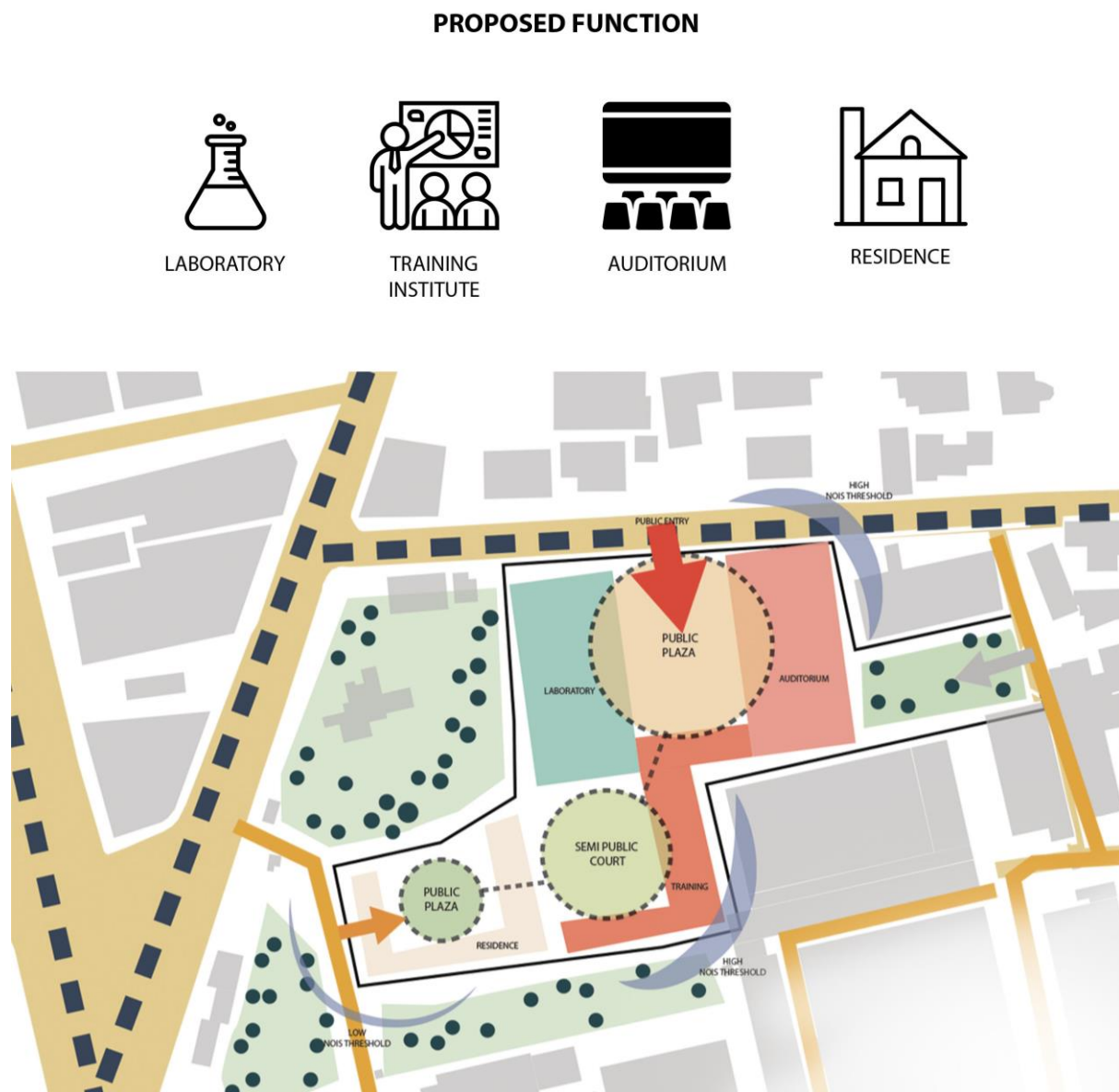


Figure 33 Design implementation

The more public and major functions are placed in the more accessible side of the site and the more private functions are placed in places with less noise threshold. This will ensure in better interaction of spaces as there are a lot of different functions that are situated in this site.

The four major functions are classified into three different blocks where the auditorium and conference block and the lab and training institution blocks are placed in either side of the public plaza and the residential block is separated and placed in a more segregated side of the site. As the laboratory and the training institute have a functional connection, they are connected into some level by sharing a semi private court. The residential block which comprises of the dormitory and the residential quarters for the scientists, share a private court buffering it from the rest of the functions. The public plaza is flanked by the auditorium block and the laboratory blocks where there is a controlled central lobby to enter the complex.

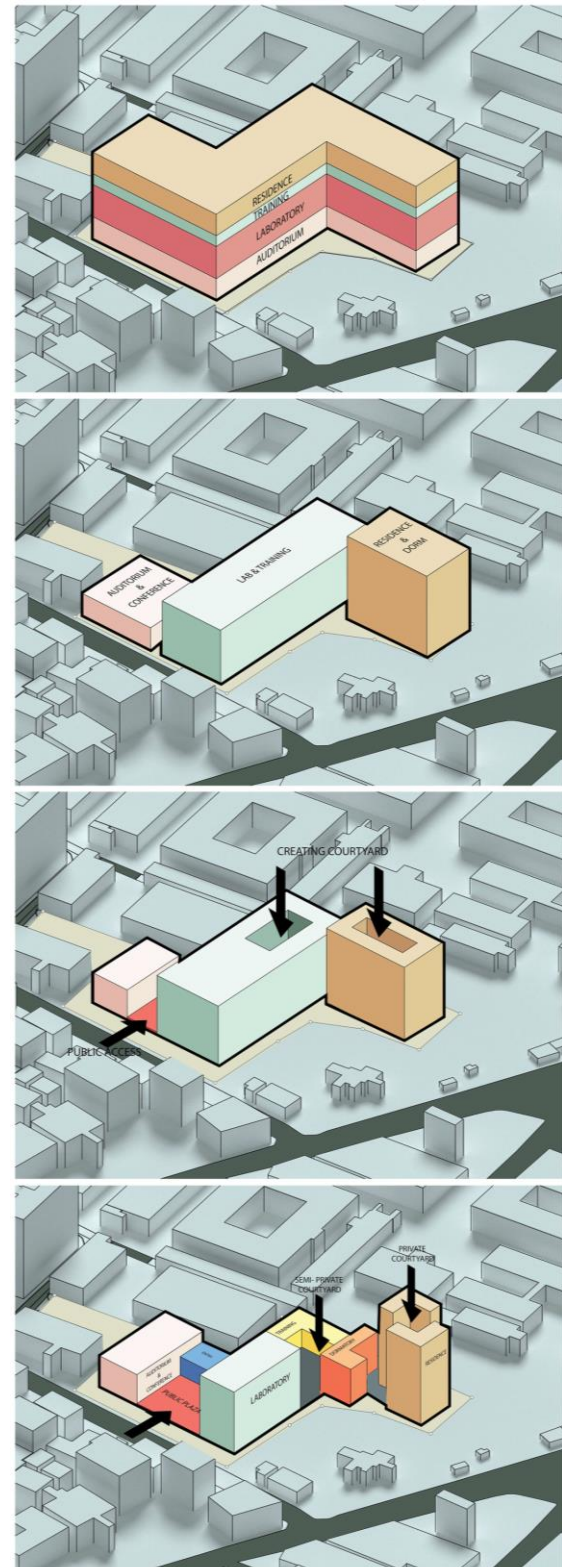


Figure 34 Form development

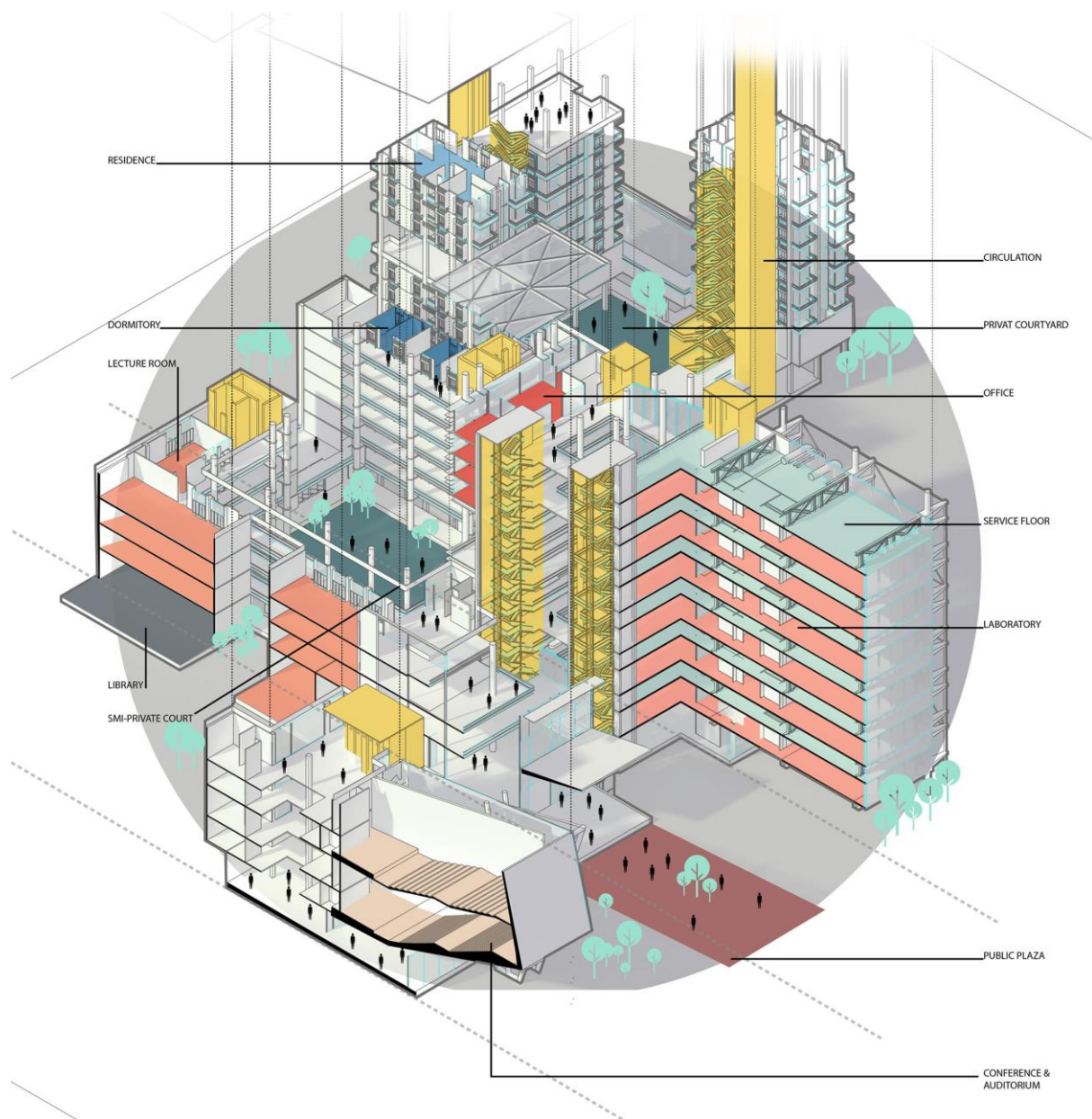


Figure 35 Functional layout

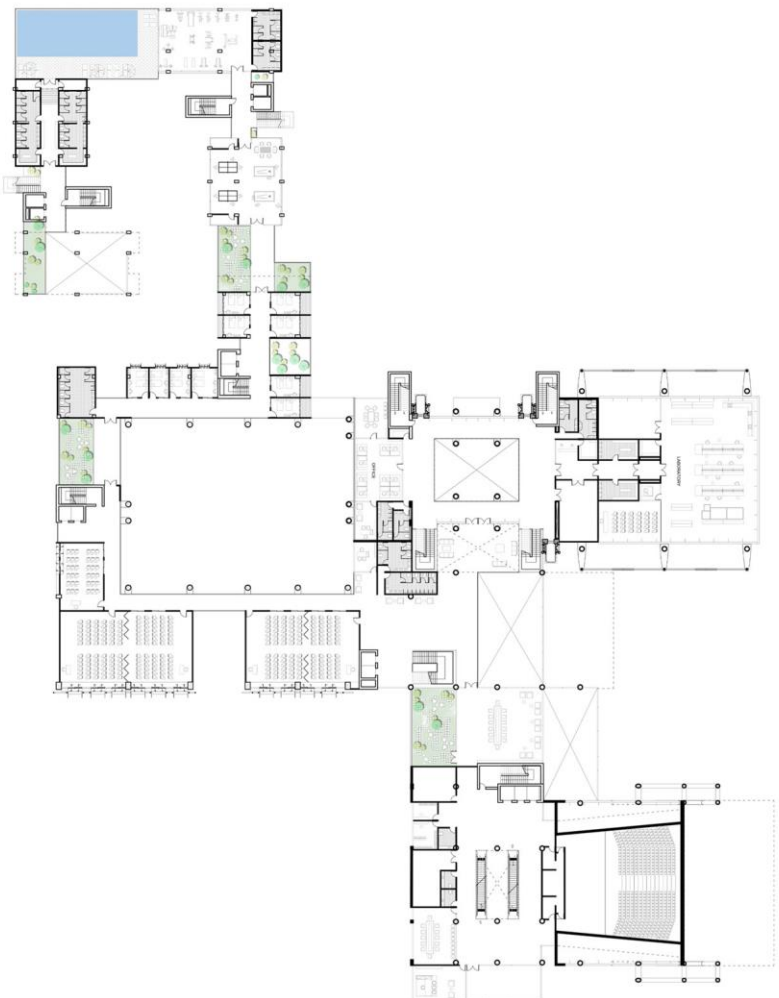
On one side of the public plaza there is the laboratory which is laid out on every alternate floors and the service floors which are laid out on top of each lab floor so that the sterile environment of the lab does not get disrupted in case of servicing and the whole building is kept column free for maximum flexibility. It also has a central atrium which has an office

space for the scientists on the other side. On the other side there are the auditorium and the conference halls laid on top of each other with an expo which can be accessed from the plaza. After entering the central lobby, we can access the training institute which comprises of seminar halls and lecture rooms surrounding a courtyard and on the opposite of it is the dormitory for the visiting government officials. A library is also situated with an archive and a study area for students along the courtyard. The dormitory acts as a buffer for the private court that is shared by it and the residence. There is a café and a dinning for the dormitory along the private court. On the first floor of the residence there are amenities like swimming pool, gym and indoor games room.

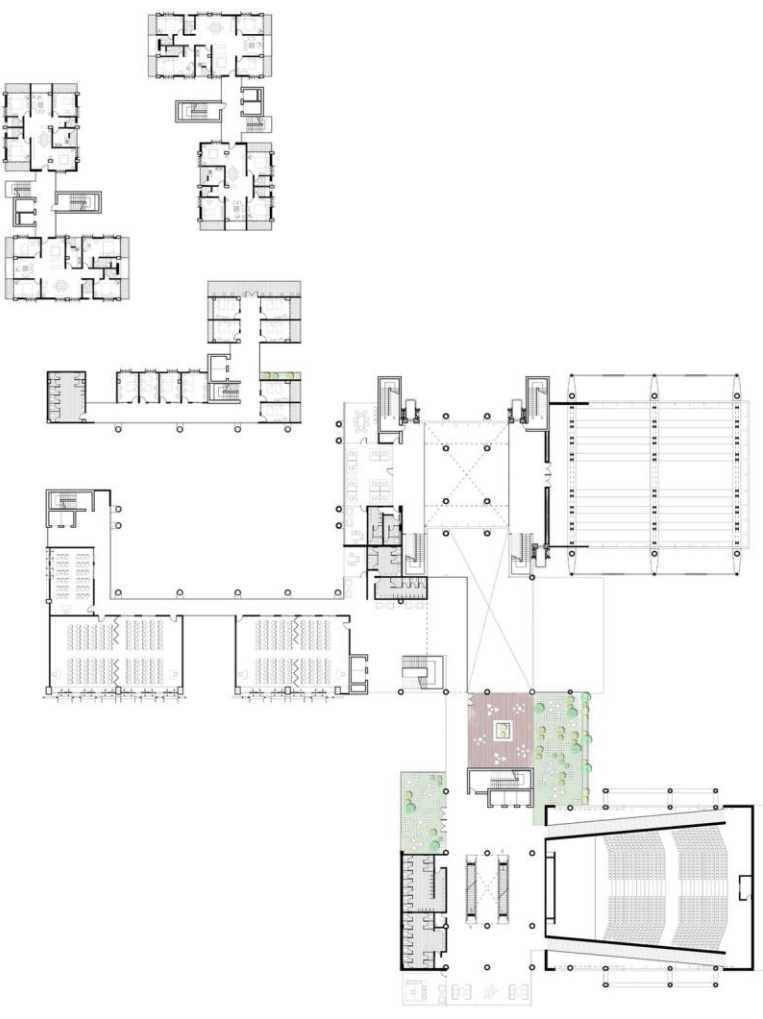
6.4 Architectural Drawings:



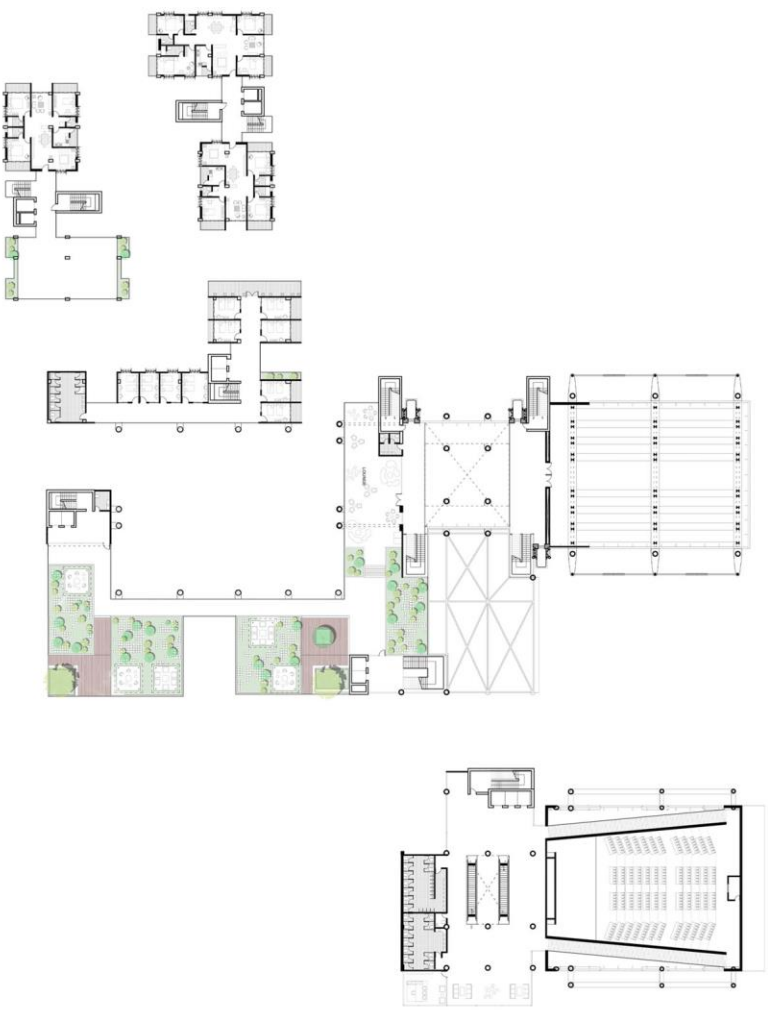
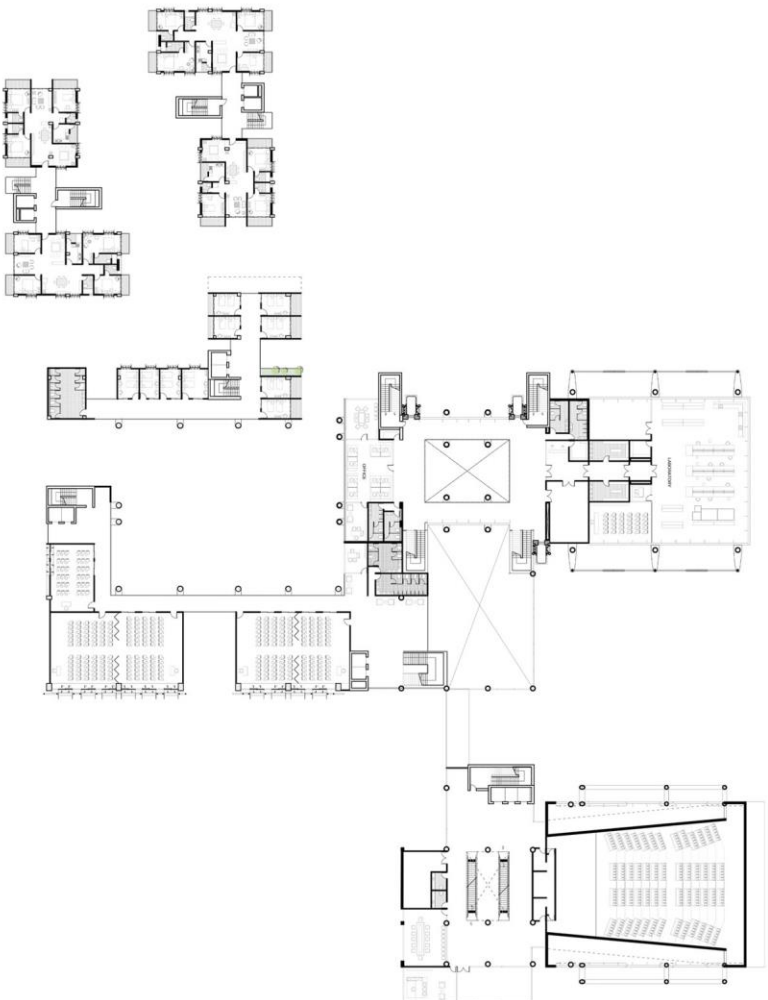
 GROUND FLOOR PLAN
0' 10' 50' 100'




FIRST FLOOR PLAN
 0' 10' 50' 100'

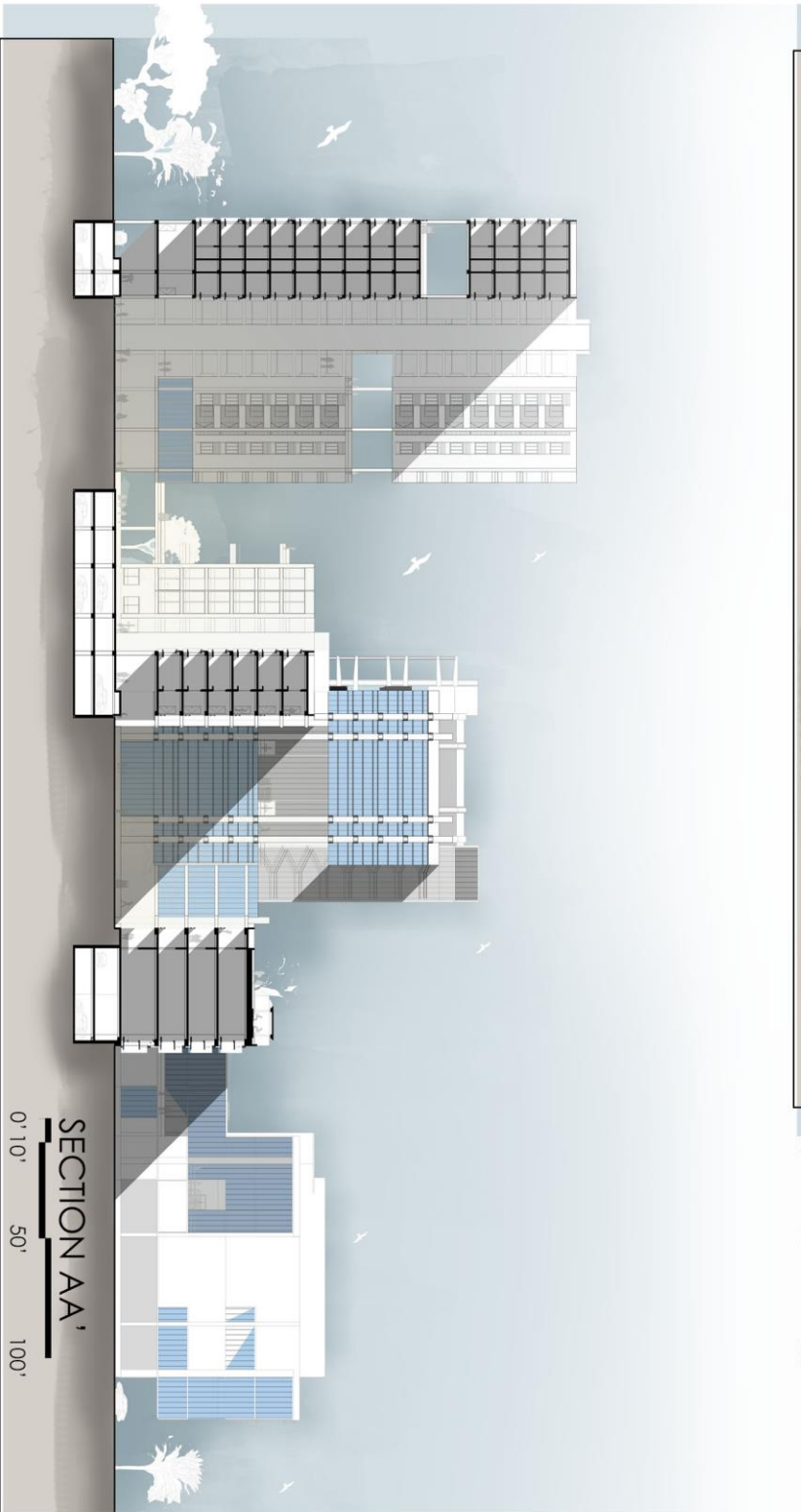
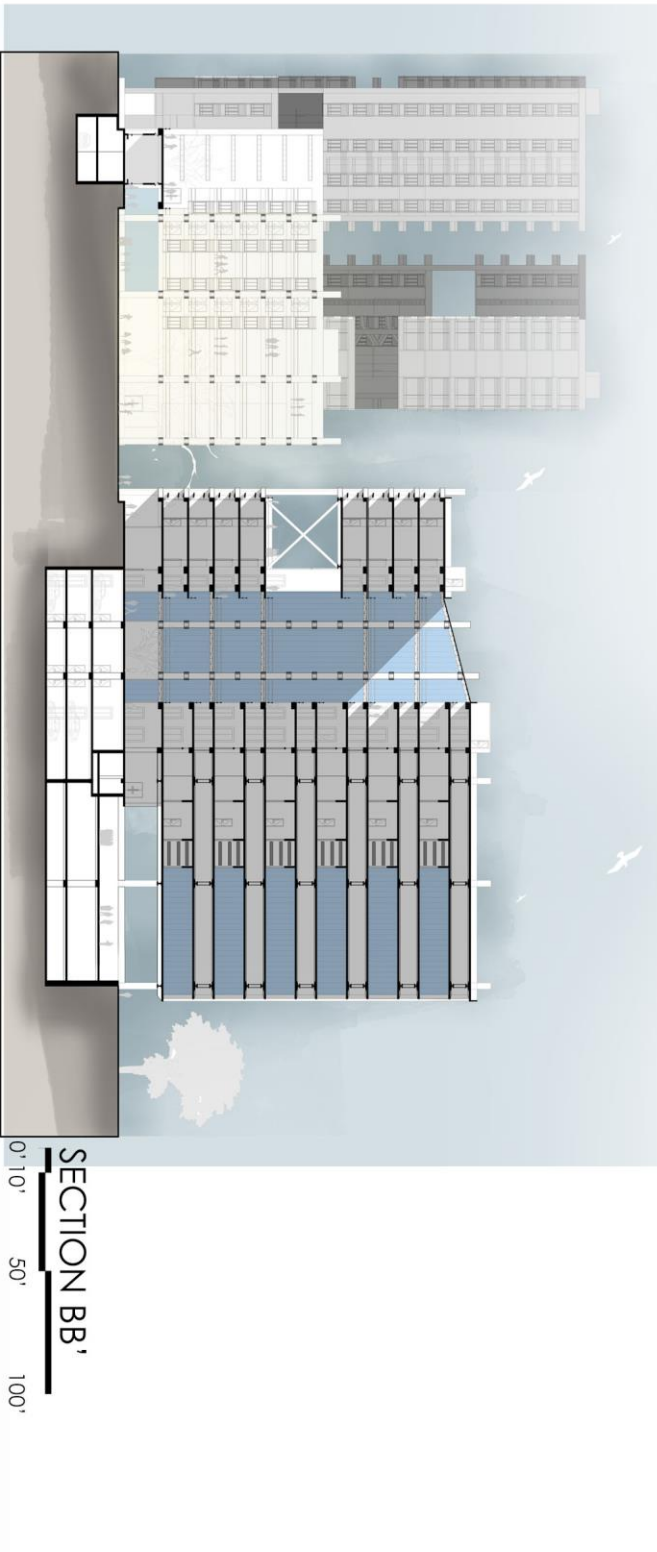


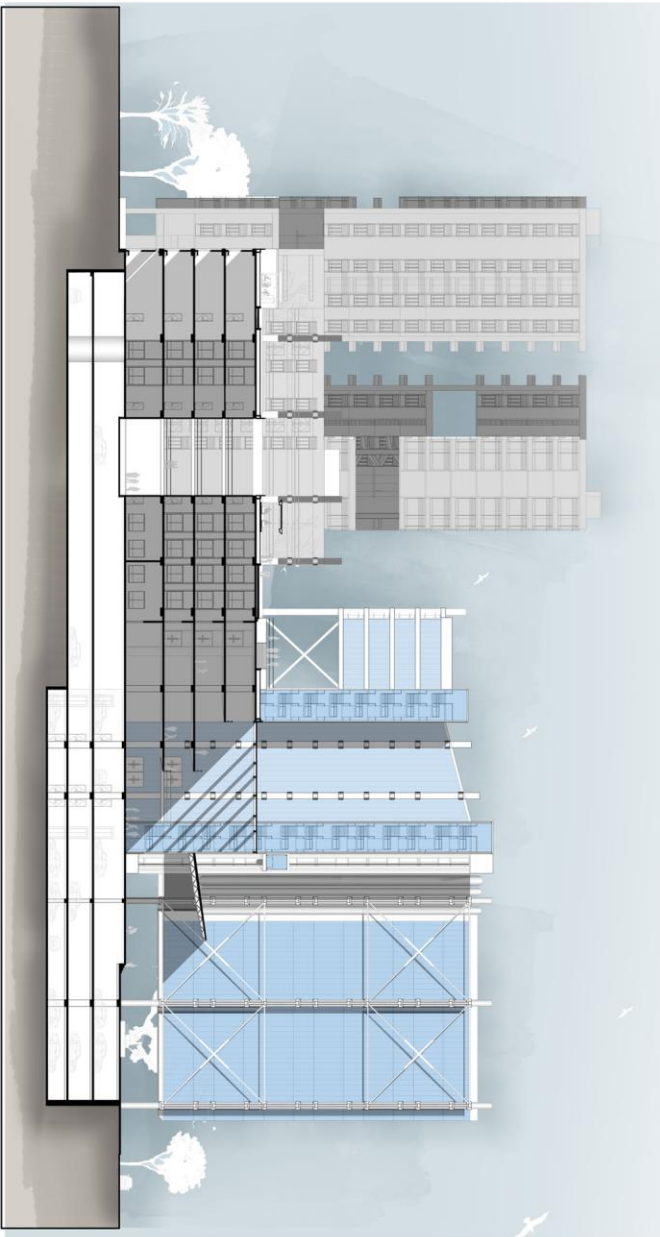

SECOND FLOOR PLAN
 0' 10' 50' 100'



 **THIRD FLOOR PLAN**
 0' 10' 50' 100'

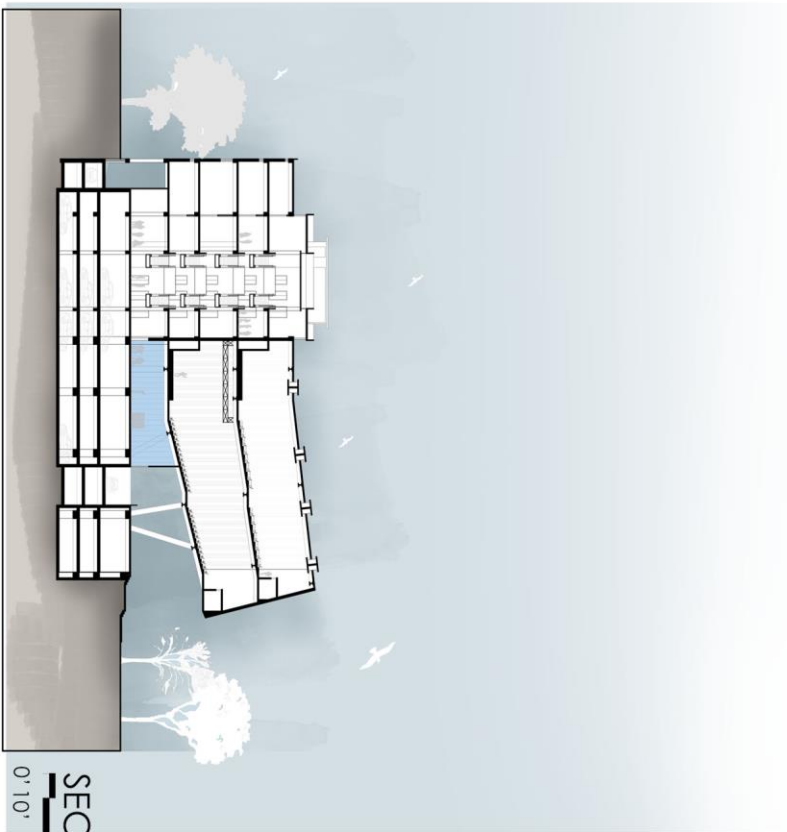
 **FOURTH FLOOR PLAN**
 0' 10' 50' 100'





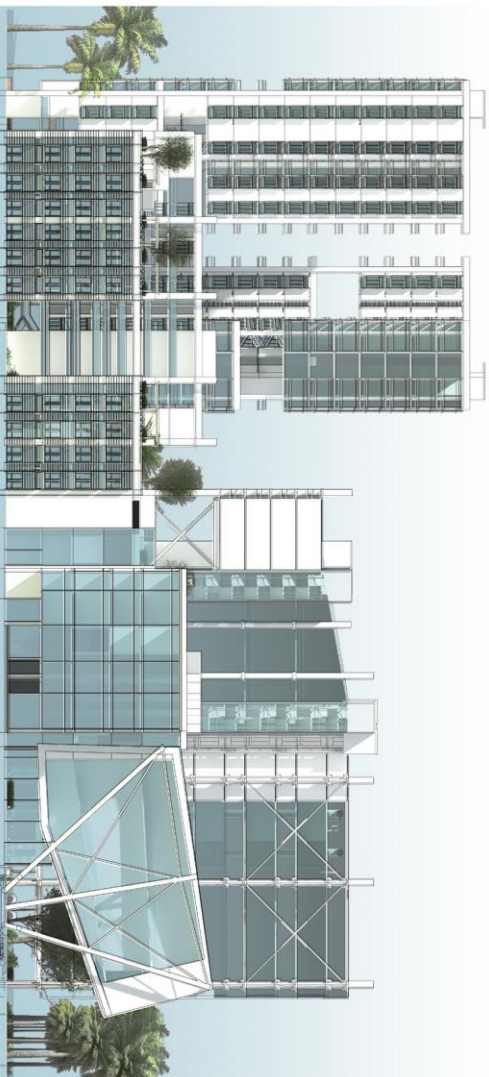
SECTION CC'

0' 10' 50' 100'



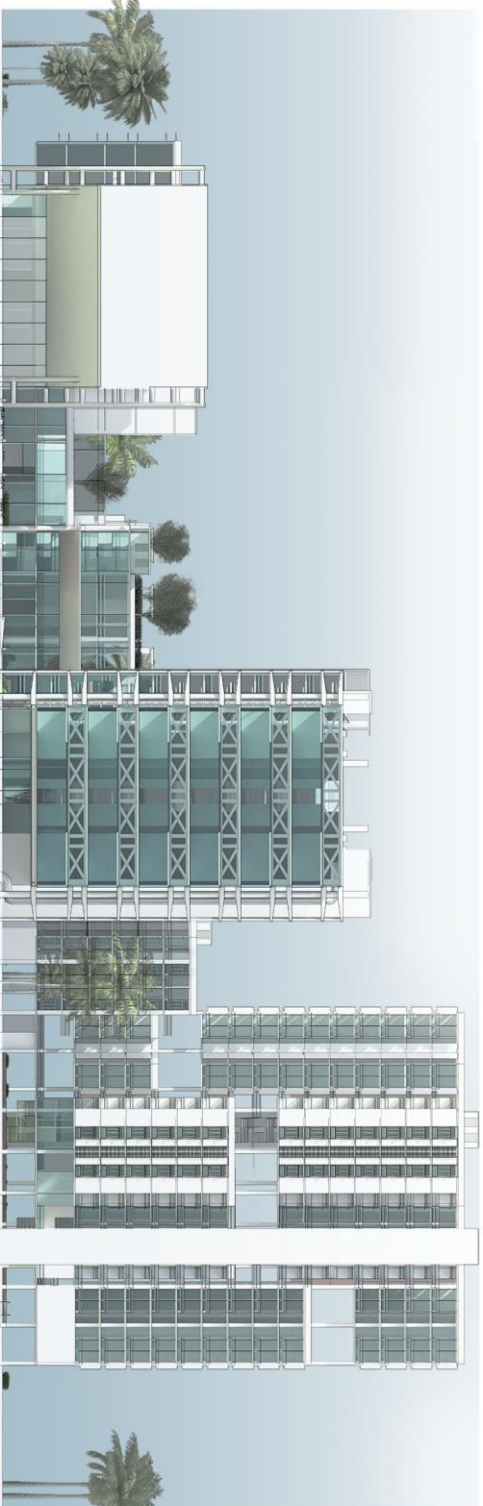
SECTION DD'

0' 10' 50' 100'



EAST ELEVATION

0' 10' 50' 100'



NORTH ELEVATION

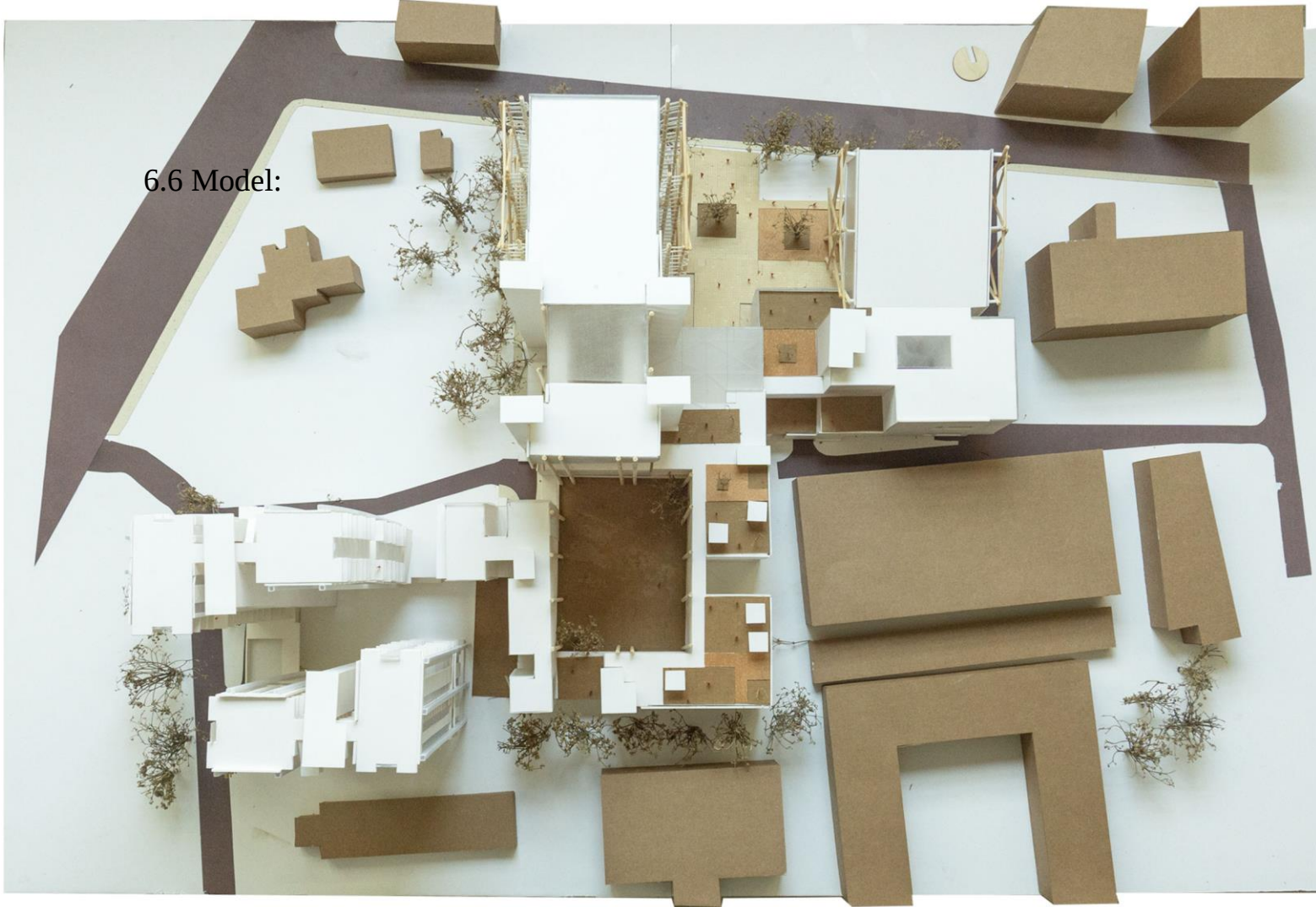
0' 10' 50' 100'

6.5 Perspectives:





6.6 Model:





Chapter 7: Conclusion

It is essential that the industrial sector of this country excels as it may drive the country further as we have a large number of young working force. Thus it is important for industrial research facilities such as BCSIR to have a compound where people can come and get to know the latest inventions that are going on in this sector. The initiative of this project will inspire and encourage people to get involved with this facility and the users to carry out their jobs better in a healthy and interactive environment.

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