OPTIMIZATION OF DAY LIGHTING AND ARTIFICIAL LIGHTING IN OFFICE BUILDINGS AN APPROACH TOWARDS SUSTAINABLE ARCHITECTURE

A DISSERTATION

Submitted in Fulfilment

of the Requirement for the degree

of

MASTER OF ARCHITECTURE

by

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(Roll No:1200109001)

Under the supervision of

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SCHOOL OF ARCHITECTURE AND PLANNING
BABU BANARASI DAS UNIVERSITY LUCKNOW

June, 2023

ANNEXURE II

CERTIFICATE

It is certified that the work contained in this thesis entitled **“OPTIMIZATION OF DAY LIGHTING AND ARTIFICIAL LIGHTING IN OFFICE BUILDINGS AN APPROACH TOWARDS SUSTAINABLE ARCHITECTURE”,** by **Ar. Anurag Tripathi** (Roll No. 1200109001), for the award of **Master of Architecture** from Babu Banarasi Das University has been carried out under my/our supervision and that this work has not been submitted elsewhere for a degree.

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Annexure IV

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3. Thesis title: **OPTIMIZATION OF DAY LIGHTING AND ARTIFICIAL LIGHTING IN OFFICE BUILDINGS AN APPROACH TOWARDS SUSTAINABLE ARCHITECTURE**

4. Degree for which the thesis is submitted: **M. Arch**

5. Faculty of the University to which the thesis is submitted:
Prof. Mohit Kumar Agarwal & Prof. Sangeeta Sharma

6. Thesis Preparation Guide was referred to for preparing the thesis. ☐ YES ☐ NO

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8. The contents of the thesis have been organized based on the guidelines. ☐ YES ☐ NO

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ABSTRACT

Daylight provides high luminance and permits excellent colour discrimination and colour rendering. These two properties mean that daylight provides the condition for good vision. However, daylight can also produce uncomfortable solar glare and very high luminance reflections on display screens, both of which interfere with good vision. Daylight strategies and systems have not always lived up to their promise as energy efficiency strategies that enhance occupant comfort and performance. One reason is the lack of appropriate, low-cost, high-performance day lighting systems, simple tools to predict the performance of these advanced daylight strategies, and techniques to integrate daylight planning into the building design process. The paper discusses some of the results on the subjective rating of the indoor lighting environment. Space and light perception often does neither correspond with the regulations lighting levels nor the control strategies for shading devices.

AKNOWLEDGEMENT

First of all I wish to express my deep sense of gratitude to BABU BANARASI DAS UNIVERSITY, LUCKNOW for providing me this opportunity to undertake research studies in the field of Day Lightning for the partial fulfilment for the degree of M.Arch(Architecture). I sincerely thank respected Prof. Mohit Kumar Agarwal Sir & respected Prof. Sangeeta Sharma Ma'am for guiding me in every stage.

I would also like to thank the Dean of the School Prof. Mohit Kumar Agarwal and the entire thesis team for kind support.

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1.0 INTRODUCTION

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Opening serve as appliances which makes connection between interior and exterior spaces and psychologically have direct effect on human beings. Therefore, the existence of sufficient natural light in indoor spaces is more important and prefered to the existence of irritation natural light. Beside this function, opening have three roles which are-

- To function as an entrance for sun rays
- To allow visual access to outdoor spaces
- To provide ventilation

1.1 AIM OF THE RESEARCH

The purpose of this thesis is to investigate and evaluate the degree of common and satisfaction in the indoor office space in terms of daylighting Besides, it aims to suggest a more appropriate way of maximizing natural light to create a more suitable working environment of employing different suitable means

1.2 OBJECTIVES

In this dissertation. therefore the role of openings in interior spaces of office buildings as gateways of sun rays will be explored and important cntena such as size, matenal, location, and installation angle of openings which leads to create apocopate openings for the office building are investigated. The examination of various kinds of daylighting measurements such as roof and top lighting (horizontal), angled lighting, indirect lighting atria, lignt courts rent rant lighting. Light shelves, louver and blind systems,, prismatic panels and amalgamation will depict preferences of each for different requirements.

- Optimum possible use of natural light is a factor that must be considered in new constriction projects.
- Lowering environmental Impact and improving energy efficiency in buildings should be given importance by making contribution of natural lighting to the rational use of energy in buildings, and also using techniques that enable the designer to ensure that efficiency energy plans are based on interior natural lighting.
- Controlling solar heat gains in summer, preventing loss of interior heat in winter, and allowing occupants to reduce electric lighting use by making maximum use of day light, spectrally selective glazing significantly reduces the buildings energy consumption and peak demand.

1.3 METHODOLOGY OF THE STUDY

This study is initiated by getting familiar with the significance of day lighting in interior spaces, its importance in human performance it’s influence on people and how the consumption of electricity can be reduced by preferring daylight which achieve less costs. By surveying the traits and characteristics of openings, daylight measurements and shading devices, importance of appropriate opening for various climates with different latitude is depicted.

1.4 SCOPE AND LIMITATIONS

Scopes

A proper day lighting plan can reduce energy costs with little or no additional investment in systems

- As People have a natural attraction and need for daylight
- It can have a direct impact on well-being, productivity, and overall sense of satisfaction.
- A proper day lighting plan can reduce HVAC (heating, ventilation, and air conditioning) costs

Limitations

- As no innovative day lighting systems are likely to overcome all the challenges that's why as per the need different factor have to be implemented as per need of the building.
- The main challenges are the high initial cost and application limitations.

2.0 LITRATURE STUDY BACKGROUND

In a world newly concerned about carbon emissions, global warming, and sustainable design, the planned use of natural light in non-residential buildings has become an important strategy to improve energy efficiency by minimizing lighting, heating, and cooling loads. The introduction of innovative, advanced day lighting strategies and systems can considerably reduce a building's electricity consumption and also significantly improve the quality of light in an indoor environment.

Daylight factor is the ratio of the light level inside a structure to the light level outside the structure.

2.1 COMPONENTS OF DAY LIGHTING

SKY COMPONENT (SC) depends on

1) Width of the Window
2) Distance between the point and window

SC varies from 0.01 to 15%

2.2 EXTERNALLY REFLECTED COMPONENT

Reflected off the around trees or other buildings.
ERC is small the luminance of obstruction is taken as 10-20% that of the sky.

2.3 INTERNALLY REFLECTED COMPONENT

The internal reflection of one or two off the surface within the room

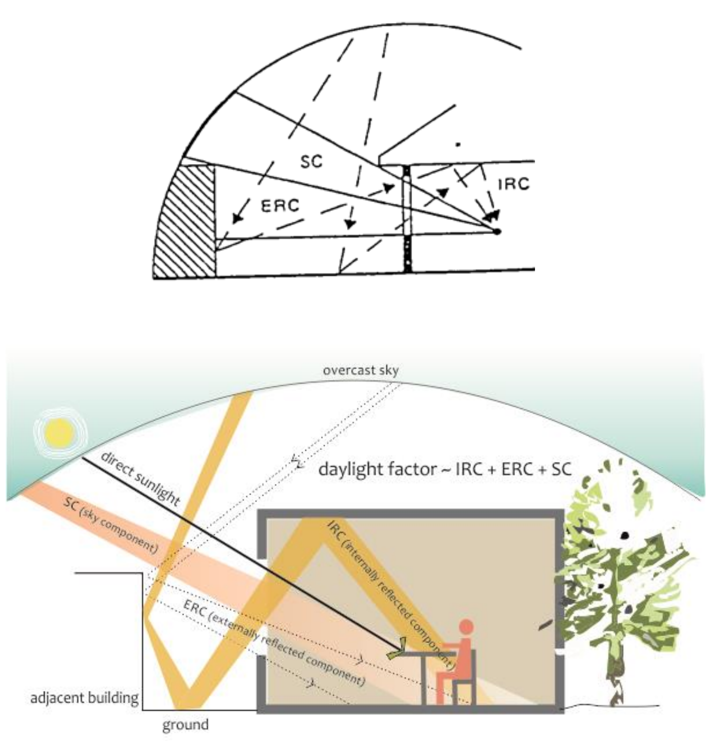


Fig. 1 diagram shows day lighting components

2.4 LUMINOUS EFFICACY

The luminous efficacy is defined as the ratio of the emitted luminous flux to the expended electric power of a lamp.

The luminous efficacy describes the efficacy of a lamp. It is expressed as the ratio of the emitted luminous flux in lumen and the power used in watts. The theoretically attainable maximum value assuming complete conversion of energy at 555 nm would be 683 lm/W. The luminous efficacies that can actually be attained vary depending on the lamp, but always remain far below this ideal value.

2.5 COLOR RENDERING INDEX

A colour rendering index (CRI) is a quantitative measure of the ability of a light source to reveal the colours of various objects faithfully comparison with an ideal or natural light source. Light sources with a high CR1 are desirable in colour-critical applications such as neonatal care and art restoration.

The CRI of a light source does not indicate the apparent colour of the light source; that information is under the rubric of the correlated colour temperature (CT). The CRI is determined by the light source's spectrum. The pictures on the right show the continuous spectrum ofal Incandescent lamp and the discrete line spectrum of a fluorescent lamp; the former lamp has the higher CRI.

BUILDING /FUNCTION	AVERAGE DF (%)	MINIMUM DF (%)
HOUSING		
KITCHEN, GENERAL		1.0
KITCHN MAIN WORK TOP		1.5
LIVING ROOM GEN.		0.5
LIVING ROOM - DESK		1.5
BEDROOM GENERAL		0.25
BEDROOM DRESSING TABLE		1.0
CIRCULATION		0.2
ENTRANCE HALLS AND RECEPTION AREAS	1.0	0.3
GENERAL OFFICES	2.5	1.0
SCHOOL ASSEMBLY HALLS	0.6	0.2
SCHOOL CLASSROOMS	2.5	1.0

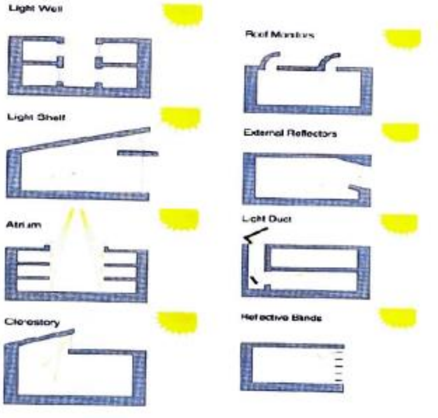


Table 1 (Day light Factor)

2.6 SOLID ANGLE

An object's solid angle in steadies is equal to the area of the segment of a unit sphere, centred at the apex, that the object covers. Giving the area of a segment of a unit sphere in steadies is analogous to giving the length of an arc of a unit circle in radians. Just like a planar angle in radians is the ratio of the length of an arc to its radius, a solid angle in steadies is the ratio of the area covered on a sphere by an object to the area given by the square of the radius of said sphere.

2.7 CANDELA

The SI unit of luminous intensity, one candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency and that has a radiation intensity in that direction of 1/683 watt per steradian.

2.8 IMPORTANCE OF DAYLIGHT

Natural light plays a very important role in our day to day life, as it provides great comfort, health, and a mood for a human being. In architecture providing a good amount of light is an integral part of our design which gives an added value. Sometimes, the main focus would be on the most effective means to reduce the overall capital expenditure and the best way to do so is by making future buildings as sustainable as possible. which helps in saving the energy used in a particular place or so. All come in different ways which are architecturally classified.

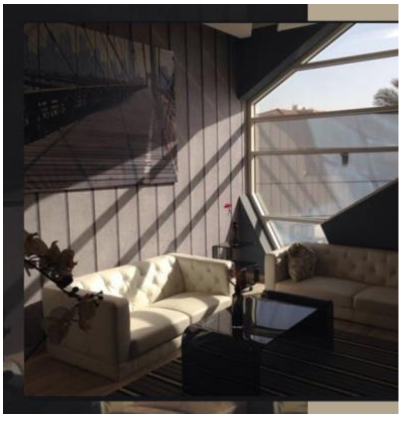


Fig. 2 (Natural light in a room)

Based on the **diffused and uniform light** which comes from large openings for example a large window at a certain place which allows a good amount of light into space.

Fig. 3 (Diffused and Uniform light)

Direct light entering into a certain place is all about how a certain space is designed in such a way that allows a good amount of light.

Fig. 4 (Direct light in room)

An overhead light is such a trend where the windows provided on the sides don't allow a good amount of light but when it comes to providing a skylight or an opening on top would let in a good amount of light as there is direct sunlight hitting on to the roof.
People these days also follow **the reflecting process** where the light gets reflected into certain spaces which are slightly darker compared to the other rooms.

Fig. 5 (Overhead light)

Another thing which plays a very important role is the **orientation of the building** about the sun. Which is one of the most influential factors is the orientation of the building concerning the sun. It helps with the visual comfort of the rooms but improves the energy efficiency of the rooms. To take the most of the sunlight and the main focus must be on the common spaces which are used and accessed by everyone. For example, being a living room service, stairs the others could be placed accordingly.

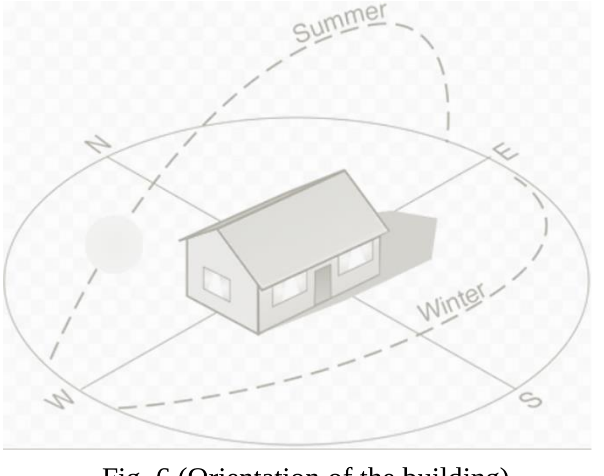


Fig. 6 (Orientation of the building)

2.9 THE LOCATION AND SIZE OF THE WINDOWS

usually play a very important role as the windows are huge then the ventilation and the lighting of the window will automatically tend to play a role with a good amount of light inside. These mostly affect the area like the staircase providing windows on the sides instead of providing them as a skylight would act as a reflecting surface at the same time.

Seasons which are another most important thing which plays a very important role in day lighting. As we know that in winter the sun is around 22 degrees and in summer around 68 degrees which makes the sun lower during the winters compared to the summers.
For example, a window which is placed in the centre of the wall in summers the direct light coming into a certain room is less so, they tend to leave a shade. But, during the winters they create a space that keeps the surrounding warm. This depends on how we use the space and where exactly the opening is given.

Clearance around the building seems very to enjoy the beauty where there is some sort of obstruction around that wouldn't allow the light to enter directly so keeping the surrounding clear will help in allowing a good amount of natural light coming inside. In urban areas or forests, the availability of light will be difficult, therefore we need to imagine before we do something or plan something architecturally. If it's the countryside or a clearing, it will be easier to work with the building based on the environment.

2.10 PASSIVE DAYLIGHTING SYSTEMS COULD TRANSFORM THE ARCHITECTURE OF NATURAL LIGHT

Natural light is a powerful architectural tool. As the importance of sustainable design grows, passive strategies like daylighting have become critical in reducing the impact of the built environment. Additionally, research in the last decade has shown daylighting to have significant health and wellness benefits for users.
Today, we have more tools than ever to harness daylight. From innovative reflective materials to advanced computer modelling, architects are using modern technology to light buildings more efficiently. When you embrace these systems, you'll create a brighter future.

Passive daylighting strategies promote the quantity and even distribution of daylight throughout a building by collecting natural light and reflecting itt into darker areas of the building. What makes this a "passive" strategy is that the design elements do not require any special mechanical equipment or energy sources. As soon as the sun rises, the passive daylighting strategies collect and reflect light throughout the building.
Architects use windows, skylights, clear doors, light tubes, mirrors, light shelves and other reflective surfaces to collect and direct light to key areas in the room. For example, if a waiting area is located in a dark corner with no nearby windows, architects can redirect light from other well-lit parts of the room using passive reflecting elements.
This type of system is incredibly beneficial both for building owners and for visitors. You'll use less energy to keep the building lit during the day. This, in turn, could save you money and help you reach sustainability and renewability goals.
There are also a number of health and wellness benefits when you allow more natural light into your building. Exposure to natural light improves:

2.11 PASSIVE DAYLIGHTING STRATEGIES

Every building is different, which is why architects customize passive daylighting strategies based on the building's location and its intended use. The goal of daylighting is to collect enough daylight in the summer to turn off electric lights and collect as much as possible in the winter to help heat the building. Here are a few design elements that architects use to bring in as much natural daylight as possible:

- **Skylights.** Skylights allow daylight to enter from above, which is useful in spaces at the centre of the building where light from windows can't reach. As with windows, uniform skylight spacing results in uniform lighting. Architects can also place skylights high above the floor, allowing the light to diffuse before it reaches the ground.

- **External Shading Systems.** At certain times of the day at each orientation, the light will be too bright and may produce a strong glare inside the building. To prevent this, architects design custom external shading systems to protect windows and other transparent openings. These systems usually include a combination of horizontal and vertical elements, but vary depending on the geographical location, climate, and building orientation.

- **Light shelves.** A reflective horizontal shelf placed above windows reduces glare and directs light deeper into the space.

- **Solar tubes.** These channel sunlight from the roof through a narrow opening. During the day, they look like ordinary ceiling lamps, but they are powered by the sun rather than electricity. These work well when placed directly above desks, where people need plenty of light.

- **Light wall colours.** Light, reflective paint helps light to bounce around the room and makes the space feel brighter.

- **Parametric modeling, daylight simulation, and artificial intelligence (AI).** Modern architecture firms use parametric software to generate optimized daylighting strategies for buildings. Daylight simulation software analyzes the building geometry and calculates the anticipated daylighting levels throughout the building at any given time of year. AI is the latest development, and its potential yet to be seen, but it is capable of synthesizing massive data sets in seconds to automatically generate a solution, then learn from the solution to create a more efficient solution.

3.0 GUIDELINES FOR DAYLIGHTING SYSTEMS IN BUILDINGS

3.0 GUIDELINES FOR DAYLIGHTING SYSTEMS IN BUILDINGS

3.1 INTEGRATE DAY LIGHTING DESIGN AT THE CONCEPT DESIGN STAGE

Poor integration of daylighting technologies can lead to discomfort and unreliable performance. Building floor plate depth window orientation, size and angles as well as shading and transmission
Characteristics all must be considered.

3.2 BUILDING FORM AND DAYLIGHT PENETRATION

To max. daylighting potential, a shallow flood plate is preferred. Alternatively, inner coutyard, roof monitors and atrium can bring light into central cores, especially in low building.

3.3 OBSTRUCTIONS

Outside obstructions can reduce daylighting potential. The sky exposure angle is the amount of Sky that can be seen from a window. It is defined as the vertical angle of sky between the top of an obstruction and the vertical and is typically measured from a point two meters above the floor.
The sky exposure angles that are required inadequate daylight

3.4 BUILDING ORIENTATION

To maximize daylighting advantages, building can be located and oriented to take advantage of the sun's movement throughout the day, as well as seasonal variations. As a general rule, building that have their long axes running east and west have a better daylighting potential.

3.5 WINDOW ORIENTATION

We receive the greatest amount of energy from the sun at noon on any given day in the year. The greatest amount of energy recived through a window is when the sun is perpendicular to the window, and 30 to 35 degrees above the horizon. A south, east, or west-facing window will receive about the same annual maximum of solar radiation. The time and date that the maximum energy is received depends on the buildings latitude and the wall orientation. The Earth rotates 15 degrees every hour, therefore, when a window is oriented 30 degrees east of south, the maximum heat gain will be about two hours before solar noon. East and west facades experience their maximum solar gain during the summer, whereas a south facing surface receives its annual maximum in the late fall or winter.

North- facing windows providing consistent indirect light with minimal heat gains, but can also create heat

Loss and comfort issues during the heating season. South-facing windows provide strong direct and indirect sunlighting. The light intensity varies during the day and controlling heat grain can be an issue in the cooling session.

Shading is easily done with horizontal shading devices. East and west facing windows can create more problems with glare and heat gain and are more difficult to shade because the sun is closer to the horizon. In our northern locations the sun is a low angle in the sky during winter, when sunlight is most needed to contribute to heating.

3.6 WINDOW PERFORMANCE AND TUNING

General rules for turning window orientation include

Determine the window size, height and glazing treatments for each façade separetely
Max.
Southern exposure
Optimize northern exposure
Min. western exposure, when the sun is lower and most likely to cause glare and overheating.
Windows themselves can be oriented differently from the plane of the wall.

Window sizing
The calculations section of this article provides a simple formula for calculation window size based on the deserved level of natural lighting

3.7 EXTERIOR SHADING

A good shading system will permit lower levels of artificial illumination to be specified, become the eye can accommodate itself without strain to function within a wide illumination range.

4.0 CASE STUDY -1

CII SOHRABJI GODREJ GREEN BUSINESS CENTRE HYDRABAD

4.1 INTRODUCTION

Hyderabad is the capital of the state Andhra Pradesh and is one of the fastest growing economic state in India. The city is situated at an elevation of 544 M the average temperature during the months of summer is anywhere around 40 degree celsius, in the month of winters the average temperature is about 16 degree celsius. Best time to visit Hyderabad is during the months of
September to March.

Summers: (Chart 1)
Average maximum temperature – 40 Degree Celsius
Average minimum temperature – 25 Degree Celsius

Winters: (Chart 1)
Average maximum temperature – 28 Degree Celsius
Average minimum temperature – 13 Degree Celsius

Average Rainfall – 79 cm (approximately)

CII Sohrabji Godrej Green Business Centre (CII-Godrej GBC) was established in the year 2004, as CII's Developmental Institute on Green Practices and Businesses, aimed at offering world class advisory services on conservation of natural resources. The climate of Hyderabad an arid climate. The days are hot and dry, usually going up to extreme highs 40 degree celsius, while nights are cool and breezy.

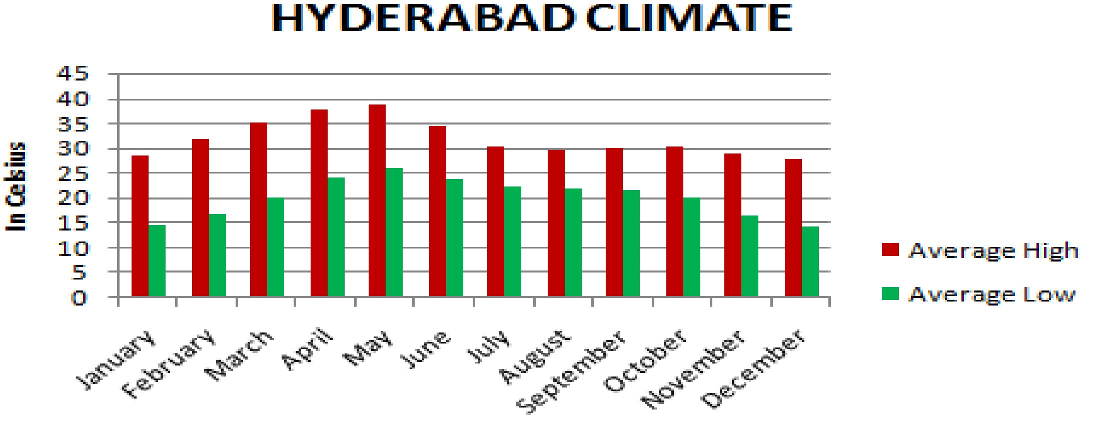


Chart :1 (Hyderabad Climate)

<u>Godrej The First LEED Platinum Rated Building in India –</u>

It offers advisory services to the Industry in the areas of:

- Green buildings Energy Efficiency
- Water Management
- Environmental management
- Renewable energy
- Green business incubation
- Climate change activities CII Godrej GBC

An attempt to make a positive change in design by Reducing the negative impact on the environment in terms of:

- Use of materials
- Energy Efficiency
- Natural Ventilation Ecological footprint
- Socio Cultural Response etc.
- Water Management
- Sustainability
- Reuse and Recycle
- Renewable Energy Effective Land Use
- Carbon Footprint

Green Architecture is about Expanding and complementing the classical Expanding and complementing the classical building design in building design in matters of economy, utility, durability, and comfort. Designing to reduce the overall impact of the built-up environment on human health and the natural environment by:

1. Efficiently using energy, water, and other resources
2. Protecting occupants' health and improving productivity
3. Reducing waste, pollution and environmental degradation
4. Ensuring sustainability
5. Natural building - use of natural materials available locally.

Fig. 1 (Green Business Centre)

The First LEED Platinum Rated Building in India – CII Godrej GBC

It offers advisory services to the Industry in the areas of :

- Green buildings
- Energy Efficiency
- Water Management
- Environmental management
- Renewable energy
- Green business incubation
- Climate change activities

LOCATION

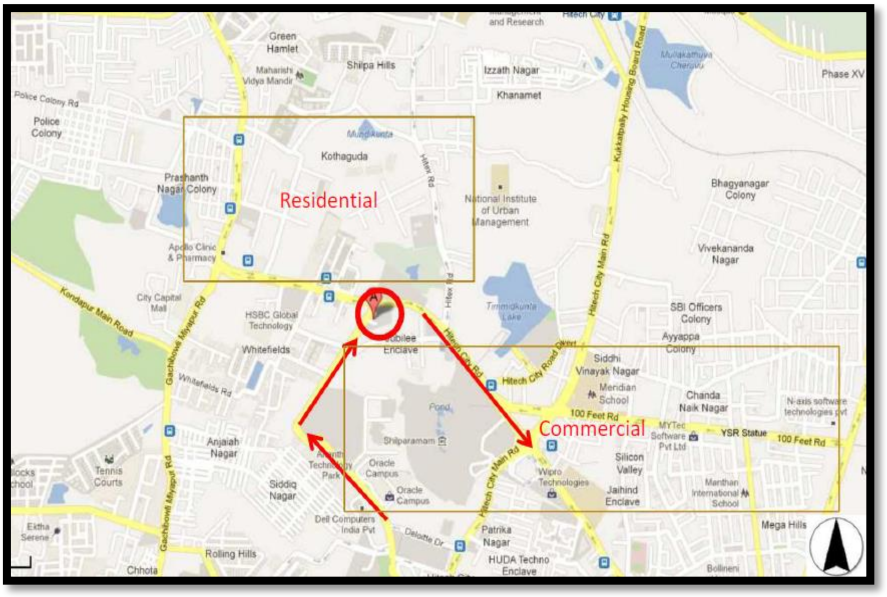


Fig. 2 (Macro level)

Fig. 3 (Micro level)

4.2 DESIGN EVOLUTION

- Site Area : 5 acre
- Built up area : 20000 sq ft
- Building footprint : Only 9.2% of the site
- Minimum disturbance to the existing site feature
- Large area for landscape to enhance micro climate and for visual delight

The Main gate opens to a long driveway with a lush greenery on both side creating emphasis to the entrance.

The Main building has direct access from the main road, but the entrance to it is form the inside to insure privacy and security.

ZONING *(*Fig. 3)

Zoning done by HIERARCHY in terms of PRIVACY

- PUBLIC - Reception, Library
- SEMI PUBLIC - Administration, Office for employees
- SEMI PRIVATE - Seminar hall
- PRIVATE - Conference rooms, Cabins for Senior Executives
- COMMON AREAS - for circulation and gathering

Fig. 3 (Zoning)

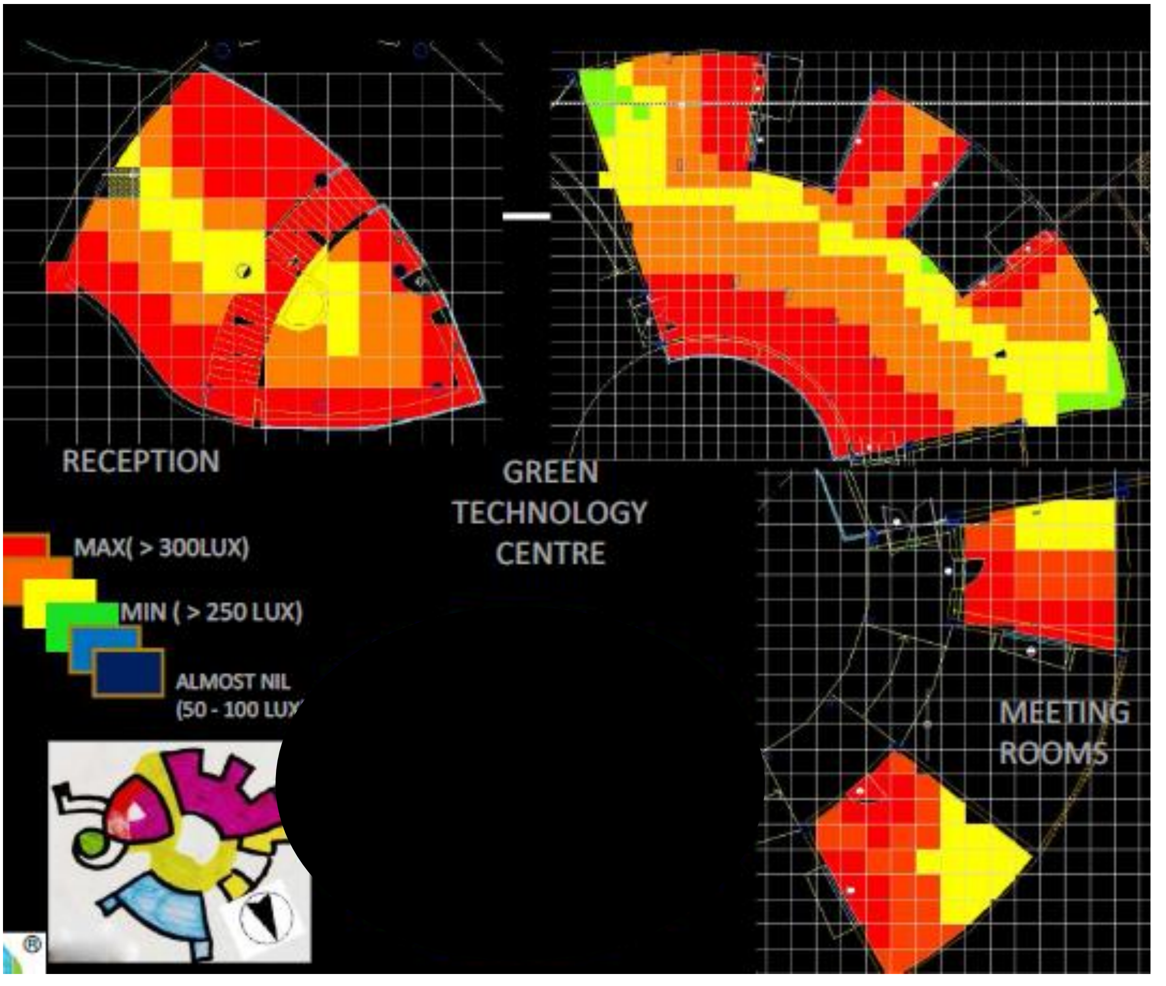


Fig. 4 (Natural Light quantity in Blocks)

The office block on the first floor receives sufficient natural light (Fig. 4) within even on dull days by the presence of internal courtyard and glass windows along all exterior walls

Since the seminar hall is generally air conditioned and lit mechanically, only optimum level of natural light has been ensured.

Where natural light un available- washrooms sensor lights have been used to save power

Main campus –

- Located on the flattest zone on site- least
- interference to site features during construction
- Easy access from Main Road
- Centrally located on site
- Scope to create buffers surrounding the building for effective design according to site climate
- Less prone to pollution

Water Body –

- Located at the lowest region of the site for maximum accumulation using existing site drainage pattern

4.3 Views / Plans

- Bicycle riders are treated preferentially - convenient parking, lockers, shower cleaning
- 30 % of employee transportation: carpools, bicycles, and LPG cars
- Use of battery operated vehicles encouraged – Charging stations available
- The documented reduction of harmful emissions achieved is 62 %
- Encourage building occupants to minimize their reliance on fossil fuel-based transportation.

Fig. 5 (Parking Area)

Fig. 6 (Approach from road)

PEDESTRIAN CIRCULATION

- Emphasis of the entrance by a large projected overhang/portico
- Separation of pedestrian and vehicular movement for easy circulation

Fig. 7 (Pedestrian circulation)

THE TRADITIONAL CENTRAL COURTYARD

- The spatial and formal elements around a courtyard create introverted blueprint.
- Courtyard space was not rigidly fixed but could be adaptable depending on the time of day, season
- Its mood changed with varying degrees of light and shade, and with them the ambience
- Centrally located, serves as visual anchor.. It was the spatial, social, and environment control center of the home.
- Brought in an additional usable space within the living space.
- Court yard acts as the energy centre, also the communication centre
- Courtyard functions as a convective thermostat and gives protection from extremes of weather. The total number of courtyards in one residence could sometimes be five to six.

RECEPTION AND LIBRARY


Fig. 8 (Reception and Library area)

Like most olden system of construction , structures are kept ground hugging ensuring natural modulation of microclimate and creating more interaction with nature. Give a sense of being close to nature.


Fig. 9 (Office desks)

Grid like arrangement of desk spaces. Sufficient diffused daylight for all areas through recessed courtyards and North light glazing.

First Floor Office

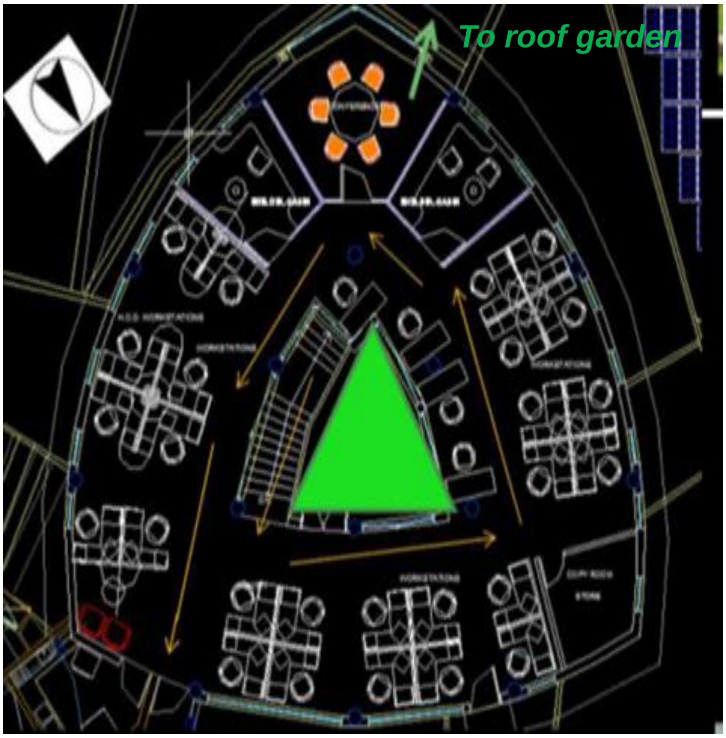


Fig. 10 (Floor Plan)

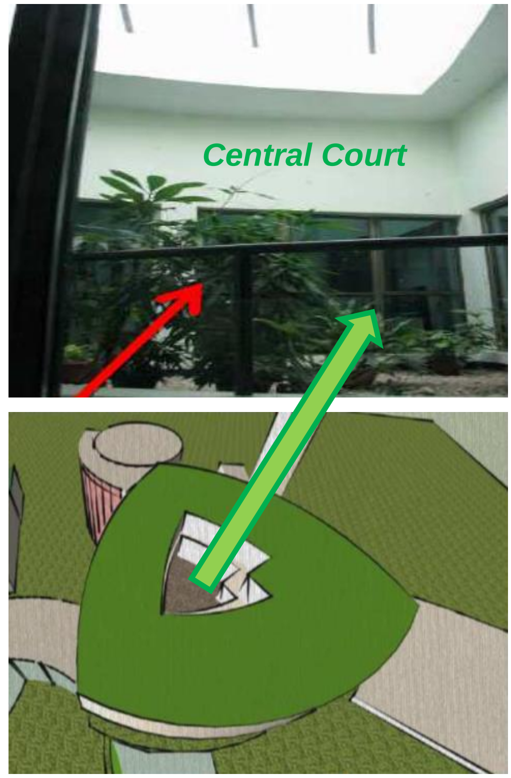


Fig. 11 (Courtyard shown thus)

Fig. 12 (Work space)

All workstations organized around a central court. Naturally lit throughout the day

SEMINAR HALL

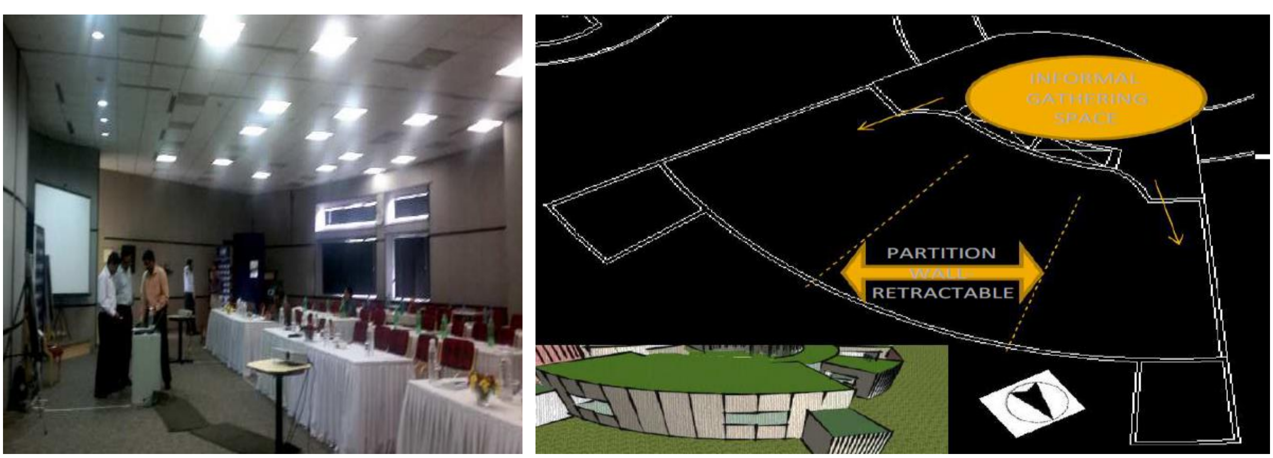


Fig. 13 (Seminar Hall)

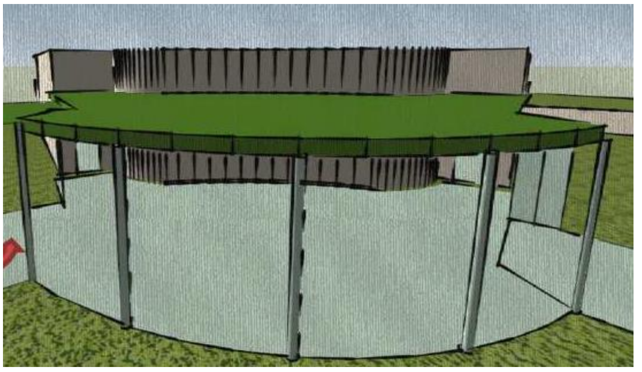
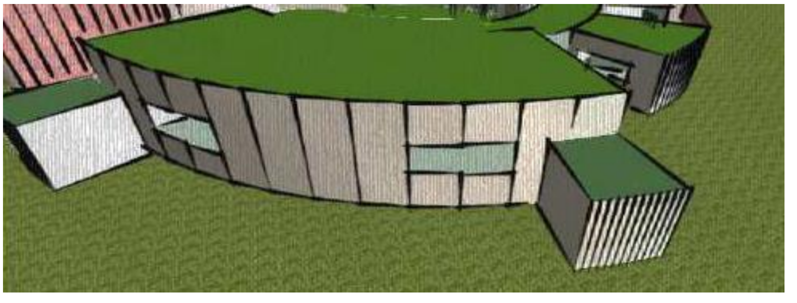


Fig.14 Gathering space outside for interactive discussions before and after seminars may also be used as dining space

Fig.15 Can be divided using partition walls to create smaller meeting rooms, flexibility of spaces



Fenestration : Light and Ventilation

- Building layout ensures that 90% of spaces have daylight access and views to the outside.
- North facades are glazed for efficient diffused light
- Low heat transmitting glass used
- Double glass to further reduce heat gain
- Natural lighting - no lights are used until late in the evening
- Minimum lux levels for all work stations have been ensured
- Light captured from as many sides possible - the use of courtyards

Fig. 16 (Placement of glasses and windows)

Fig. 17 Natural light ensured in dark corners by the use of full length slits for maximum light

Fig. 18 Fully glazed windows help to light the entire technology centre

Fig. 20 North light roof used to naturally light the entire green technology center

Fig. 19 All work stations have ample natural light

Fig. 21 Light may been filtered in meeting rooms and offices by the use of shutter curtain panels

5.0 CASE STUDY -2

VISITORS CENTRE AUROVILLE

5.1 INTRODUCTION

The Auroville Visitors and Reception Centre is a popular and pleasant placefor the visitors and Aurovilians alike.

Type of building use : Institutional building for visitors of Auroville
Architect: Suhasini Iyer
Construction Started: 1988
Built-up Area: 5000 sqm
Plot area: 3 acres
Location: Auroville International Zone, Auroville
Climate : Hot humid coastal

Fig. 1 (Site)

The Visitors Centre, which welcomes large numbers of visitors every day, has been conceived as a demonstration site for **alternative sustainable technology, renewable energy, alternative building techniques and integrated waste water management**. The aim is to demonstrate the possibility to successfully run such acentre in a pleasant set up with low or no environmental impact and pollution

4.2 DESIGN EVOLUTION

The concept of the visitor centre had been initially designed by Suhasini Iyer, but she had absolutely no knowledge about Earth Architecture and site management. Satprem Maini joined Auroville to design fully and build this centre, and at the same time createthe former Auroville Building Centre/Earth Unit. He trained Suhasini, gave a technical design to the concept and mostly managed the construction site.

Fig. 2 (Zoning)

LEGEND :

1. Parking
2. Entry
3. Washrooms
4. Food & Shop kiosks
5. Seating area
6. Exhibition Hall
7. A/V Room
8. Boutique stores
9. Cafe
10. OAT Seating
11. Waste water treatment
12. Watchman store
13. RCC Shed parking

Auroville attempts to link the ancestral tradition of raw earth building with the modern technologies of stabilised earth.
Earth as a building material, can be used for creating a modern, progressive and eco-friendly habitat.

SALIENT FEATURES

- Integrated site planning for effective management of surface and roof run-off to recharge the aquifer.
- Landscaping with indigenous “tropical deciduous evergreen forest” – reduced water needs Decentralised recycling of all waste water including black
- Urban agriculture to grow fruits
- Solid waste management with segregation / recycling / composting
- Wind mill for Water pumping
- Use of appropriate building materials and technology like CSEB / Ferro cement / rammed earth / light roofing / natural stone floors / minimum wood use
- Solar passive design; natural ventilation / lighting / solar chimneys
- Energy efficient fixtures for lighting and appliances
- Reclamation and afforestation

- It is a popular and pleasant complex specifically designed for visitors from all over the world, with the local climate, materials and building skills influencing the design.
- Special emphasis has been placed on natural lighting and ventilation in the building, as renewable energy sources were to be used.
- From the outset, the plan for the building was to limit the use of concrete and steel.
- Prefabricated Ferro cement elements were used for all doors and overhangs, thereby doing away with the use of wood.
- A 4m grid using load-bearing pillars and arched or corbelled openings was made with stabilised compressed earth blocks to reduce costs.
- Stabilised earth blocks for domes and prefabricated Ferro cement channels were considered as the best solution for roofing.

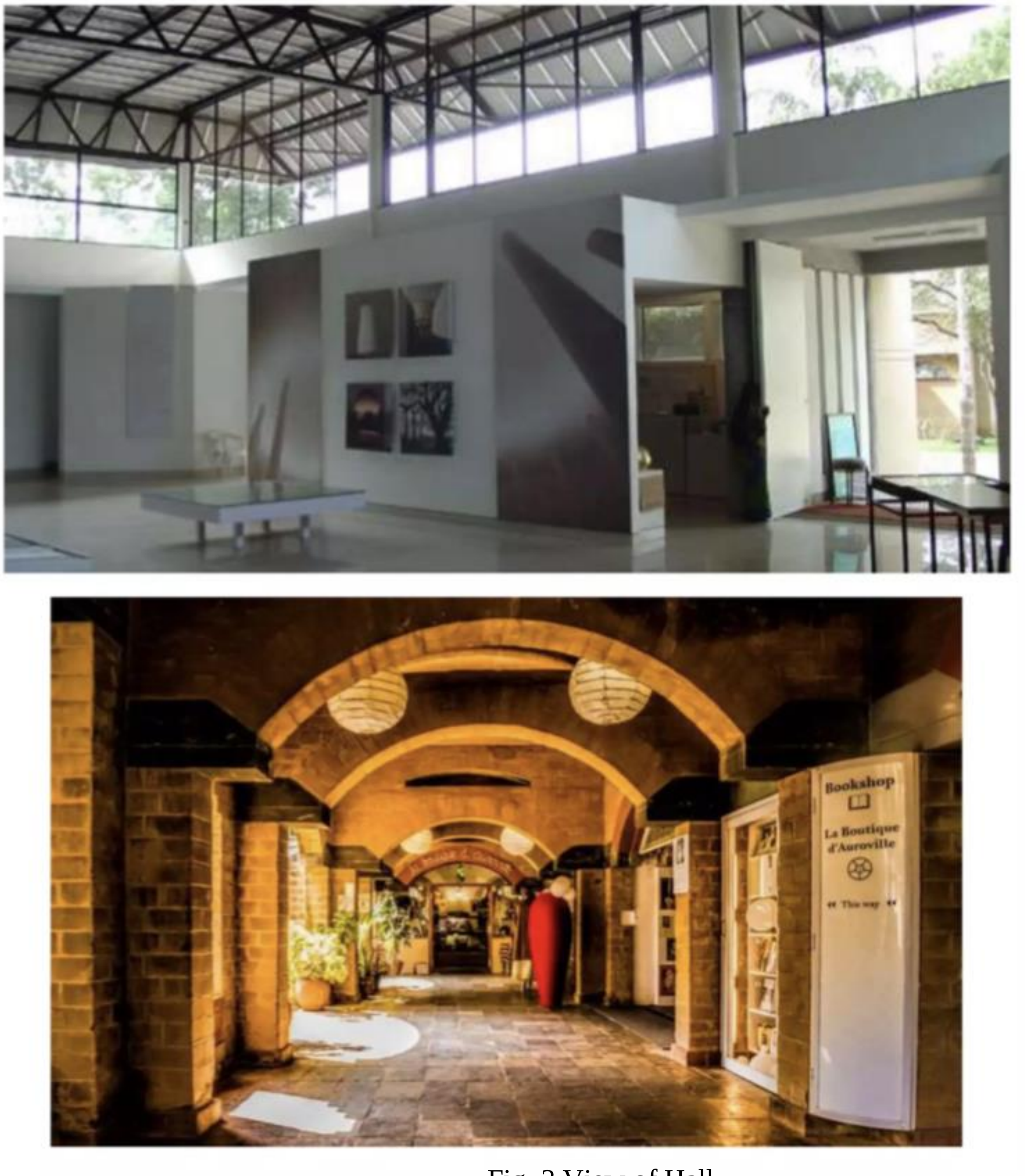


Fig. 3 View of Hall

5.3 PLANS

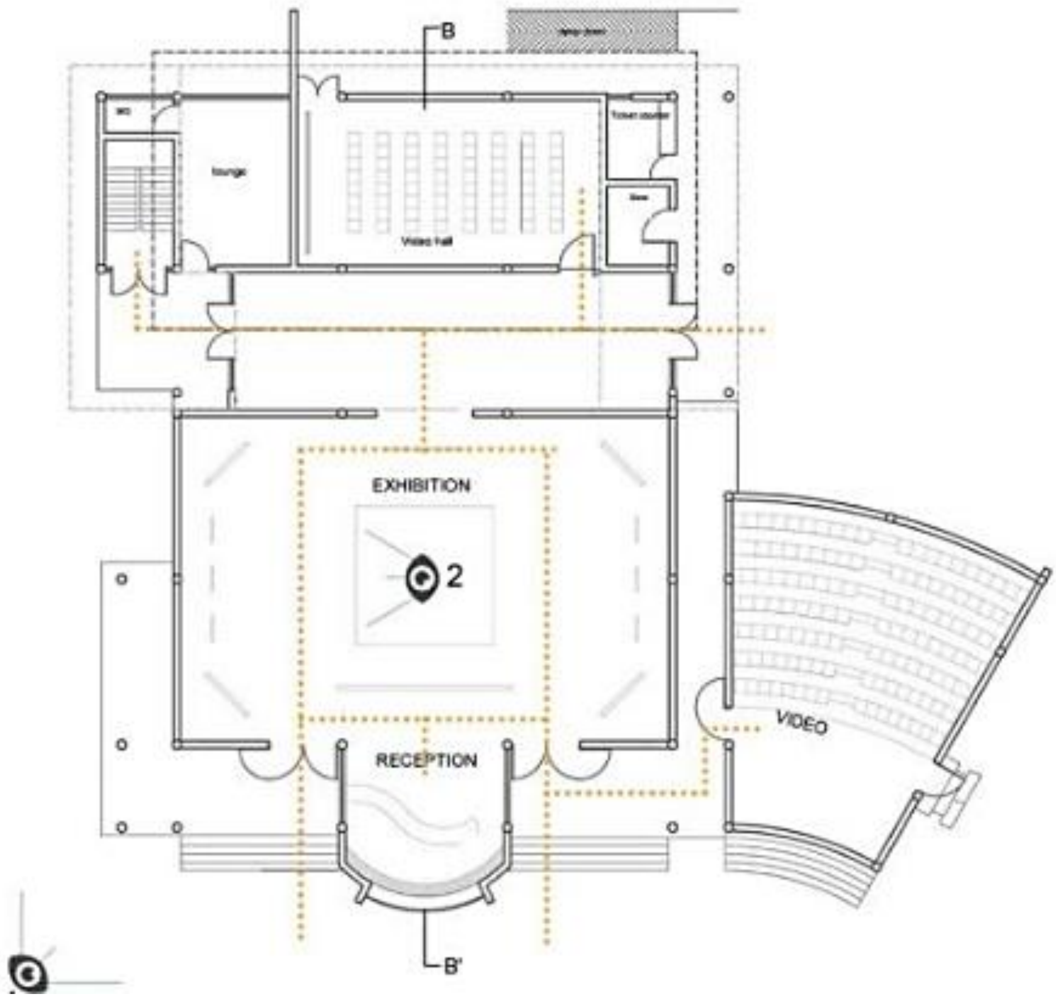


Fig. 4 (Ground floor plan of Exhibition)

SECTION DETAIL OF EXHIBITION

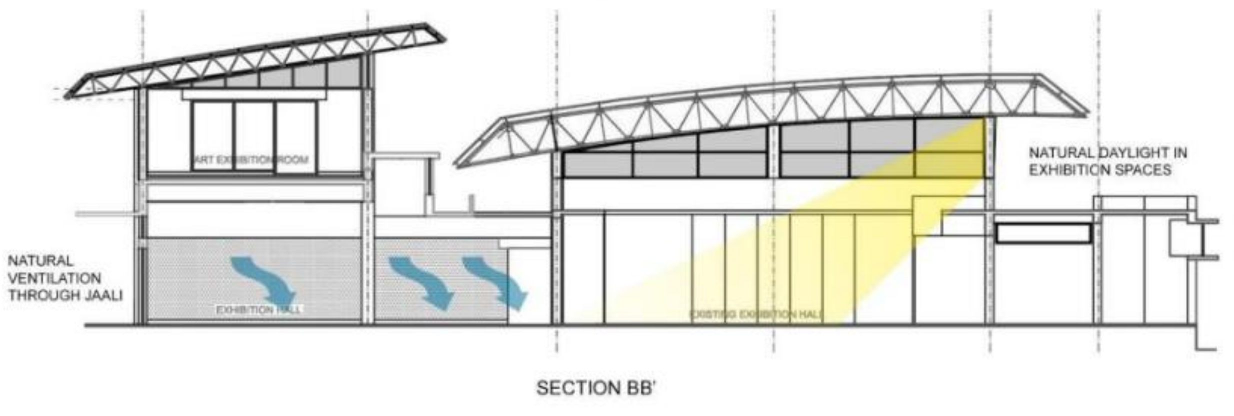


Fig. 5 (Sectional detail of exhibition)

4.6 GROUND FLOOR PLAN OF BANQUET HALL

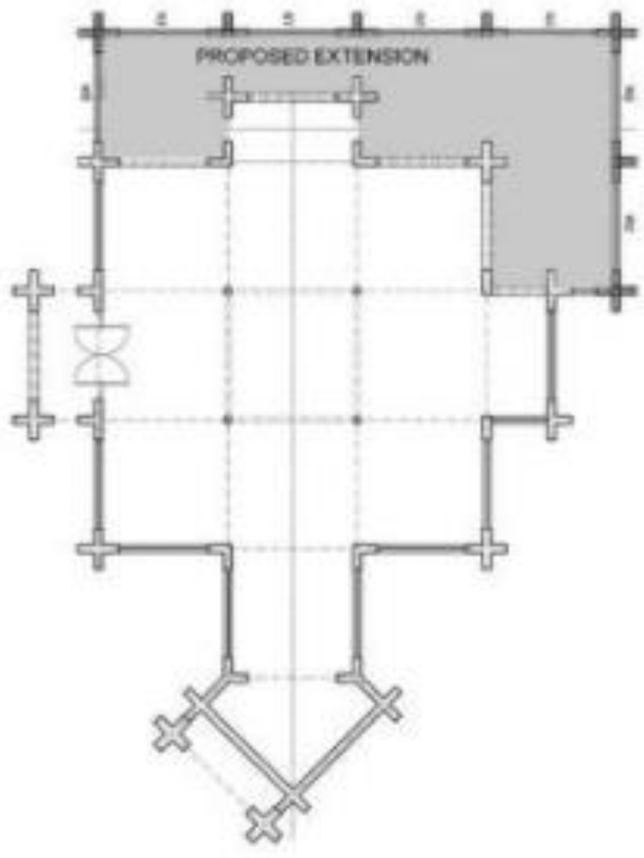


Fig. 6 (Ground floor plan of Banquet Hall)

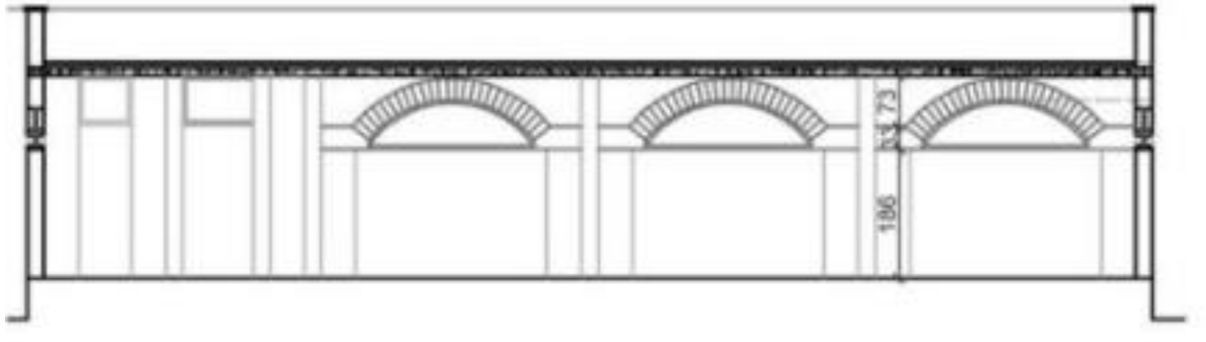


Fig. 7 (Sectional detail of Banquet hall)

6.0 LITRATURE STUDY-1

DIAMOND BUILDING, MALAYSIA

6.1 INTRODUCTION

Diamond building, Malaysia is located in Putrajaya, Malaysia. Malaysia is a country located in South east-Asia with a tropical climate zone.

Fig. 1 Map

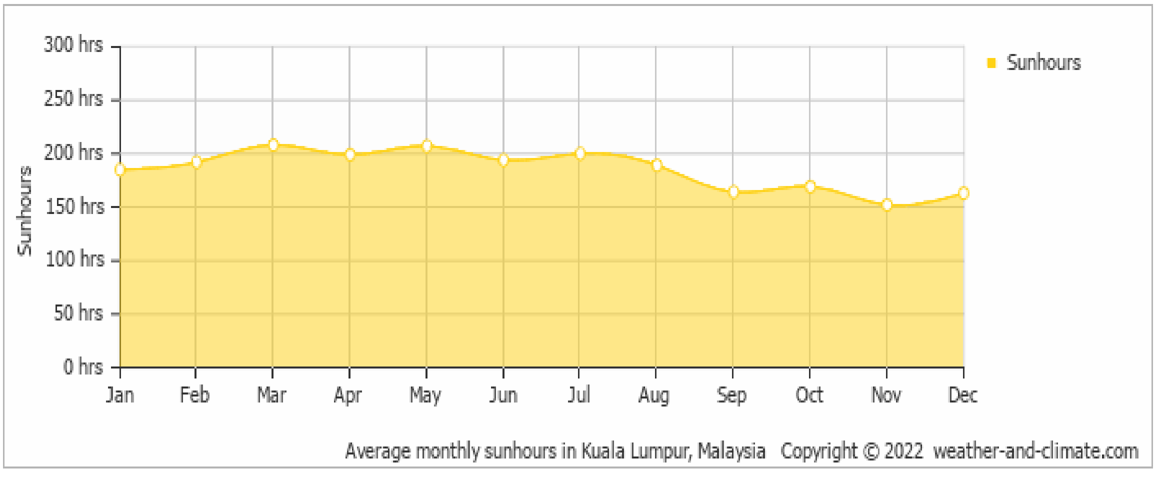


Fig.2 Average Sun hours

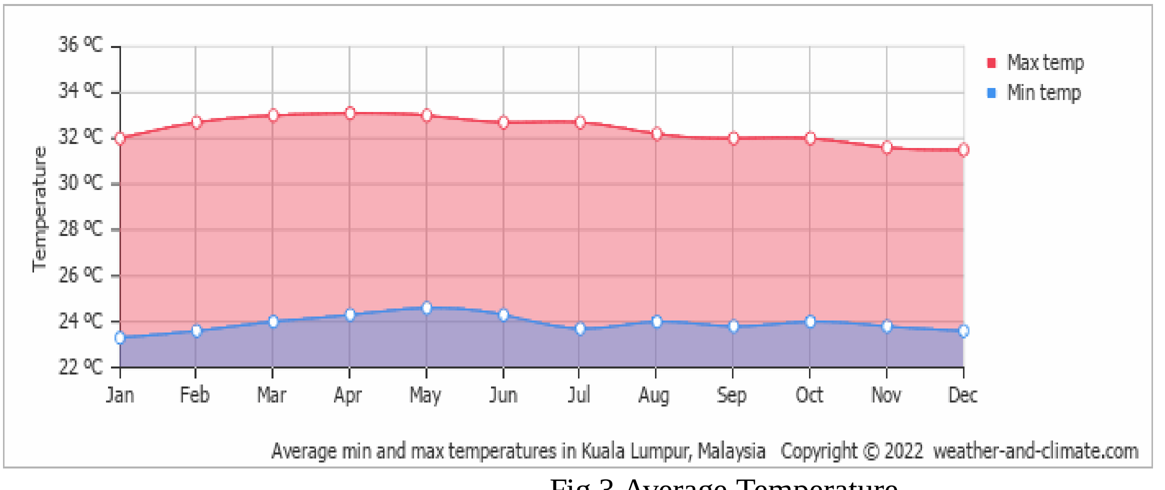


Fig.3 Average Temperature

- The site is on Lot 2C15 Precinct 2, Putrajaya.
- Precinct 2, is the Commercial and Business District of Core Island, Putrajaya
- The plot area is 4,928.11sq.m

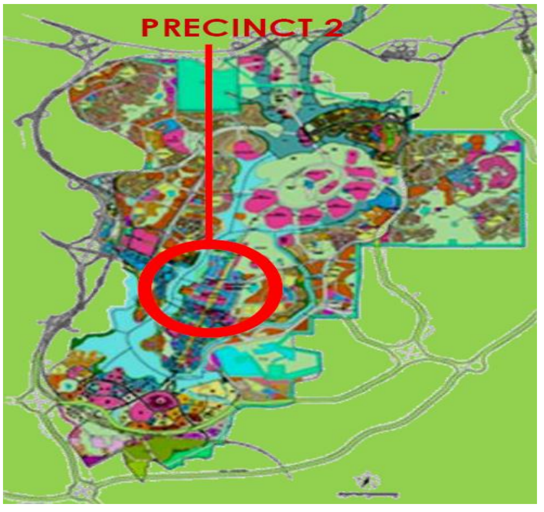


Fig. 4 Putrajaya : Master Plan

Fig. 5 Location Plan

Fig.6 View of Site from the East, Pancarona Park

6.2 DESIGN EVOLUTION

A distinctive diamond form:

- Is prominent and unique
- Symbolizes value, quality, transparency & durability,
- Characterize EC’s role as a regulatory body
- Is an optimum passive design approach to achieve energy efficiency
- The diamond form with the Tilting Façade avoid direct sun rays into building
- Tilting Facade results in smaller building footprint which allows for more area for landscape.
- Surrounding landscape reduce heat gain into the building

6.3 PLANS/ VIEWS:

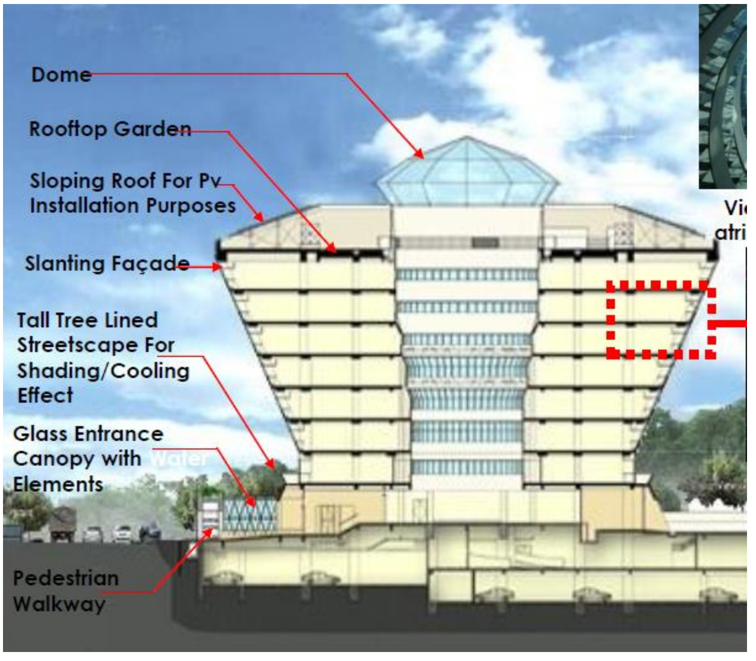


Fig.7 Overall Cross Section

Fig.9 View of dome from atrium space below

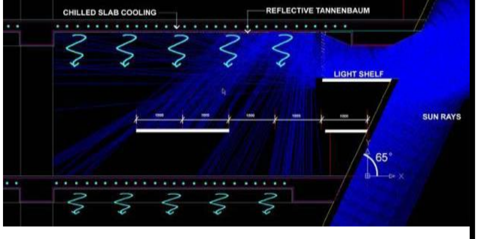


Fig.10 Cross Section at Light Shelf

Building Design Plan : Basement 1 / 1A

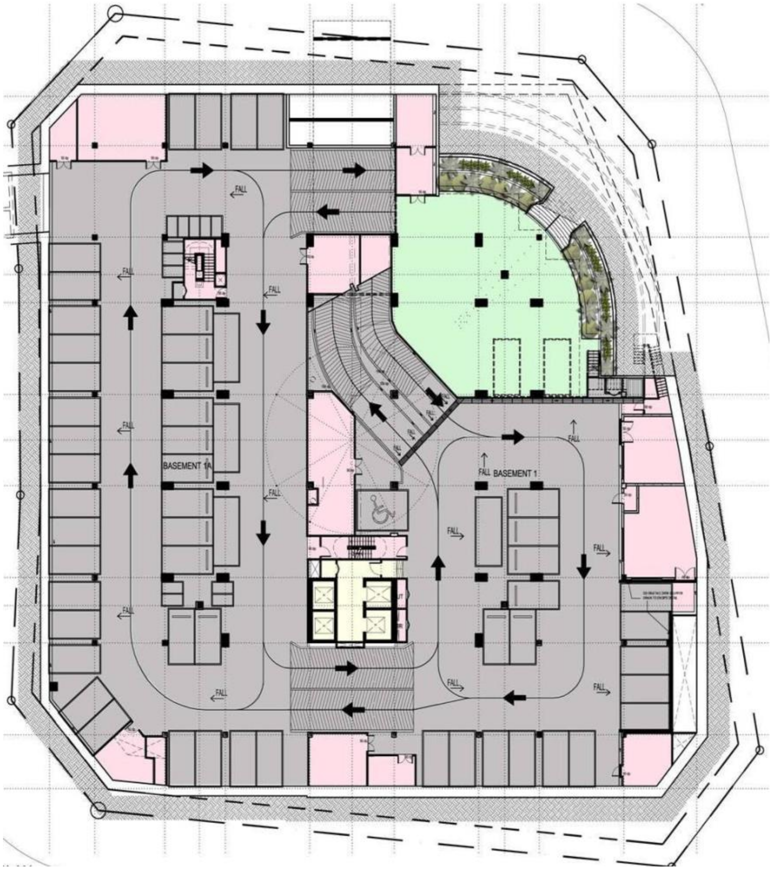


Fig.8 (Basement 1 / 1A Plan)

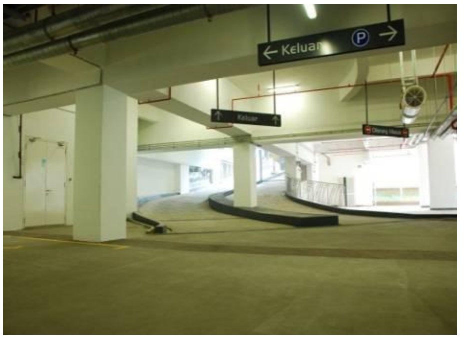


Fig. 11 Main ramp at basement 1

Fig.12 View from sunken garden from basement 1

Building Design Plan : Ground Floor

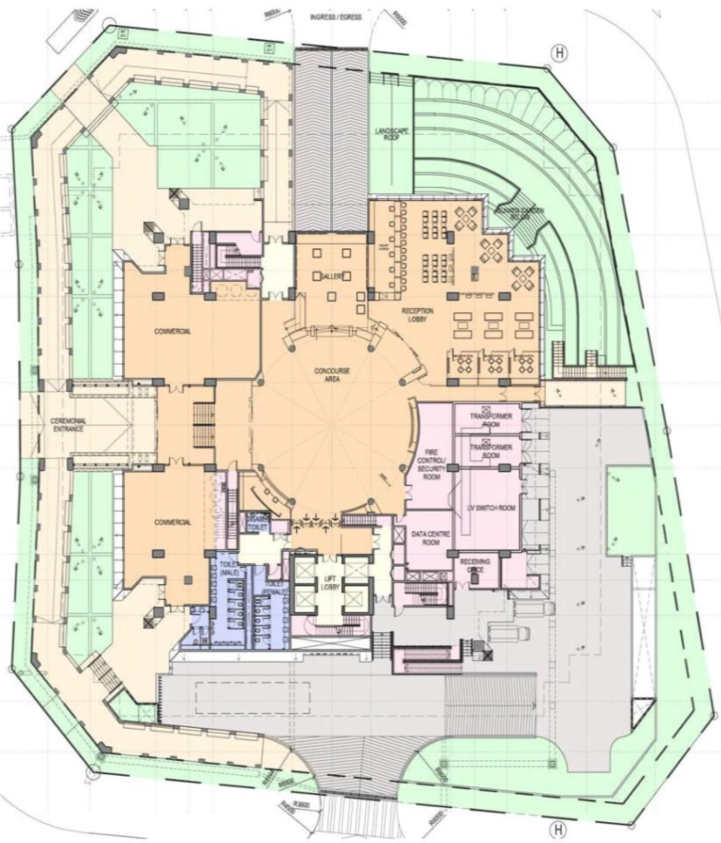


Fig. 13 (Ground Floor Plan)

Fig.15 Light Shelf

Fig.16 Landscape signage of the building

Building Design Plan : Typical Floor Plan Level - 4

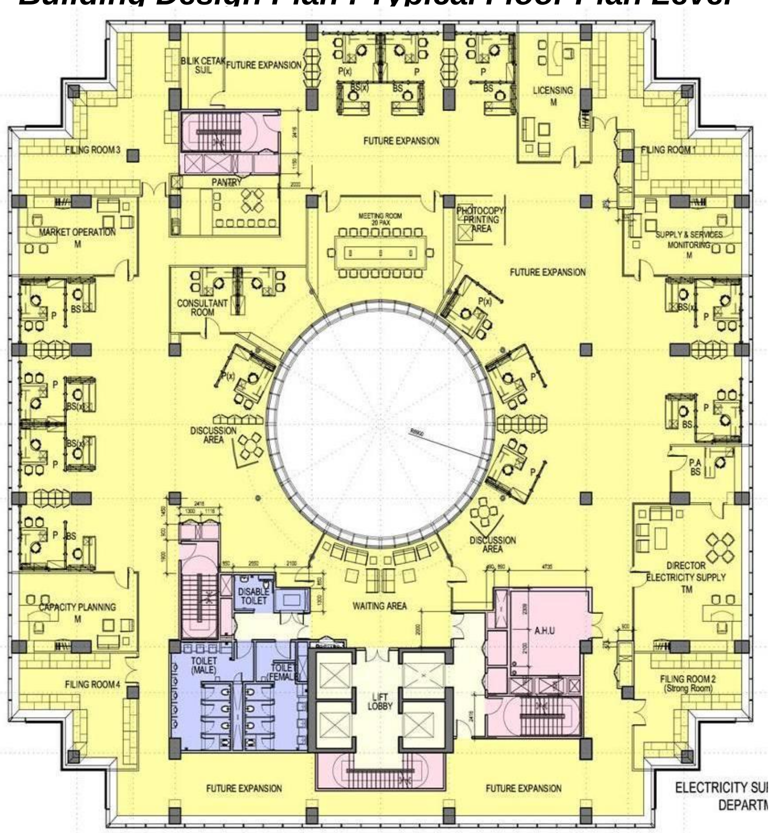


Fig.14 (Typical Floor Plan)

Fig.17 View of typical waiting area at the atrium

Fig.18 View of typical office room with glass partition

Building Design Plan : Main Meeting Rooms

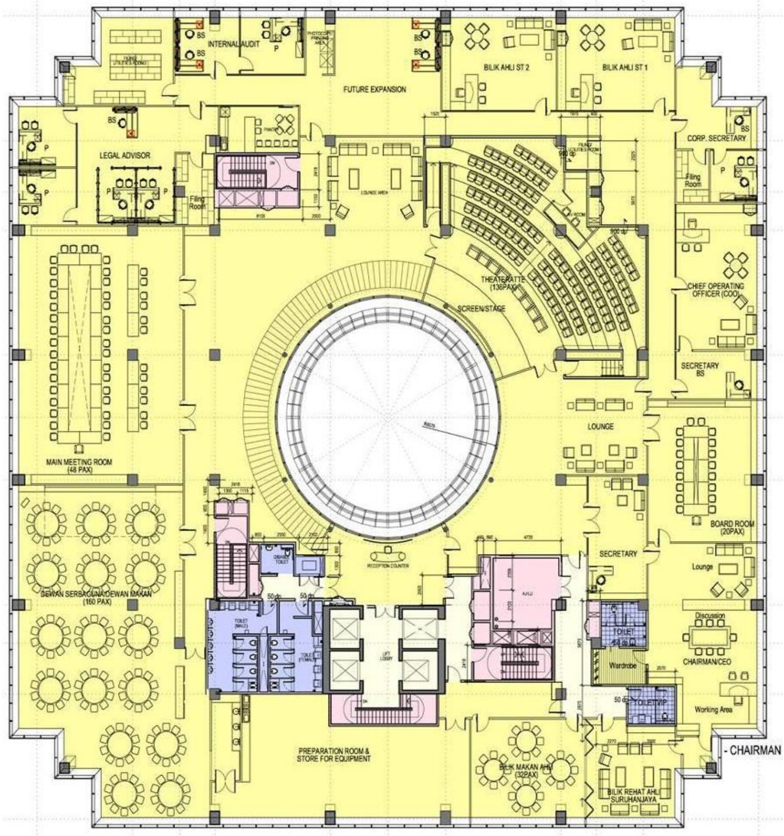
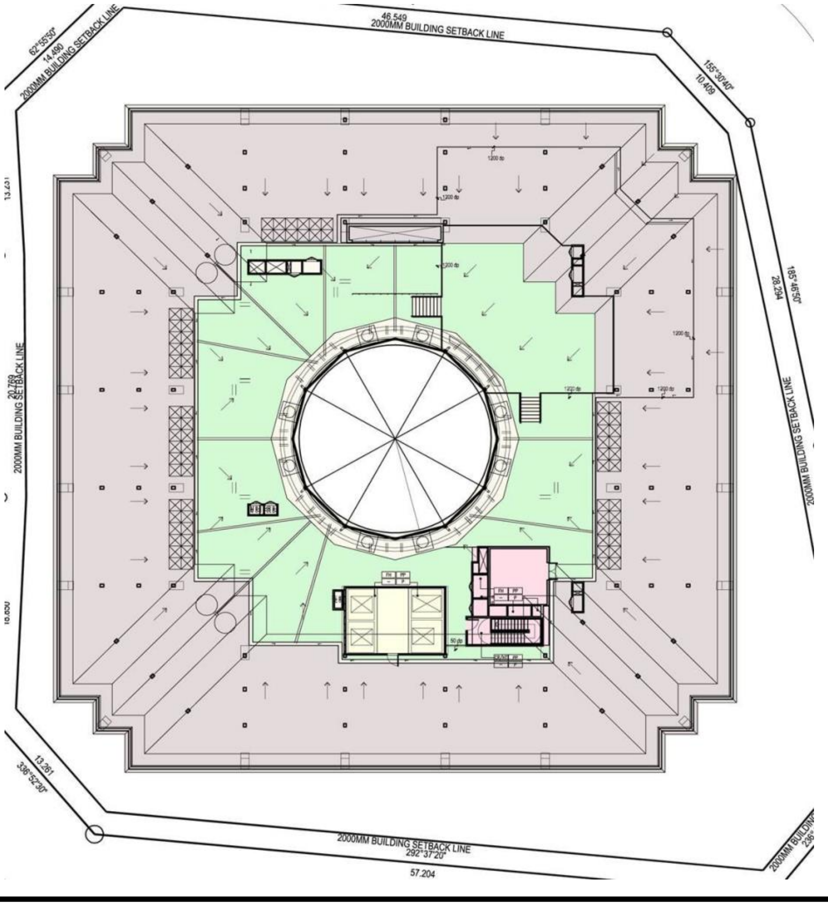


Fig.19 (Main Meeting Rooms)

Fig.21 Theaters

Fig.22 Meeting room with light trough along the window

Building Design Plan : Green Roof



7 Green Roof Elements are incorporated on Level

- Building Integrated Photovoltaic(PV) Panel
- Glass Dome
- Rainwater Harvesting
- Roof Light Trough
- Greeneries on the Roof
- Insulated Concrete Roof
- Roof/ Floor Slab Cooling

Fig.20 (Roof Plan)

To sculpt the geometry of the office building, the solar path is used. The facades of the building were tilted by 25 degrees which aimed to ensure that the north and south facades could shade themselves during hottest mid-day hours. On the other hand, this tilted surface helps the east and west facades to reduce solar impact by up to 41%.

Due to the fact that the facades were tilted, the glazing allows in more of the diffused desirable light that is reflected from the landscape to give glare free illuminated natural light for use in the office space.

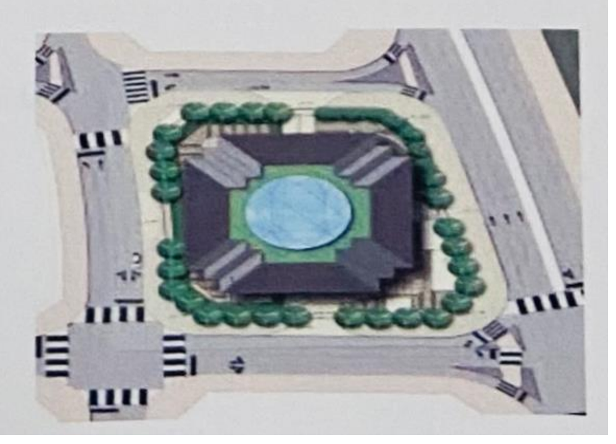


Fig.23 (Site Plan)

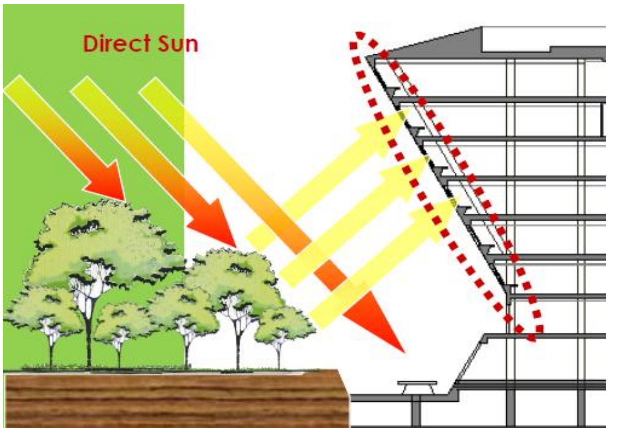


Fig. 24 (Direct & Indirect Light)

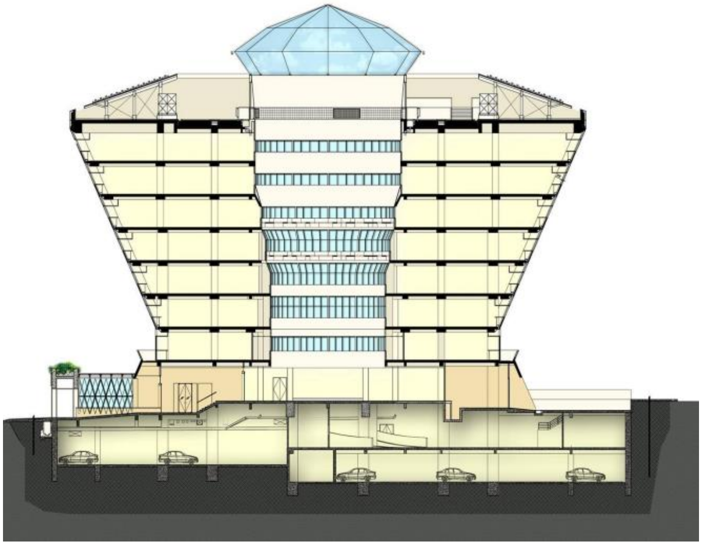
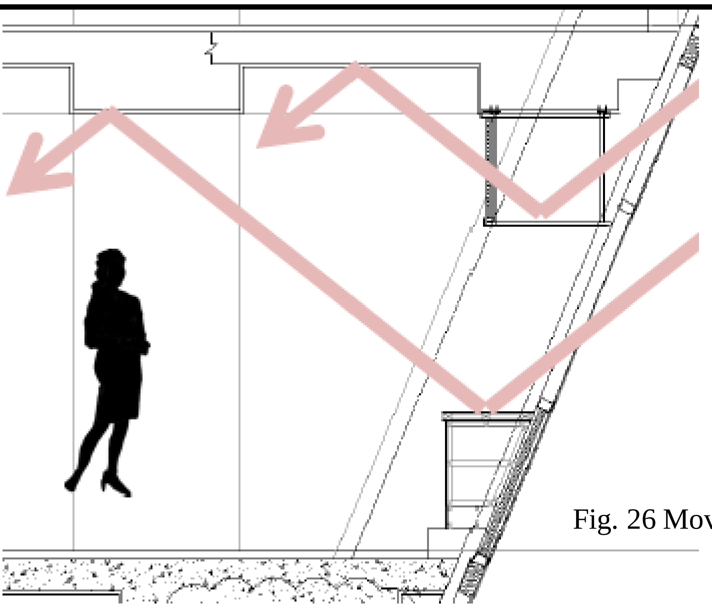


Fig.25 (Sectional Elevation)

5.5 DAYLIGHT STRATEGY

Facade Daylight Design

The office building has 50% daylight. The façade day lighting system was designed in such a way that it consists of a mirror light shelf and a white painted window sill. Both of them reflect the incoming daylight onto the white ceiling for efficient natural light distribution which goes as far as 5 meters from the façade in addition to two meters into the corridor space. White fixed louvers with mirror finish on the top surfaces are mounted on the top side with a 30 degree tilt angle higher than the light shelf, in order to protect from glare and at the same time allowing daylight to be deflected right onto the ceiling. To further enhance the depth of the daylight into the office spaces, the suspended ceiling was removed to increase the head room height to about 3.7m.



Diffuse light deflected into room by light shelf and window sill

50% daylight
Mirror Light Shelf
Fixed white louvers
White painted window cill

Fig. 26 Movement of Diffuse light

LIGHT REFLECTIONS FROM:
Light shelf + Window sill

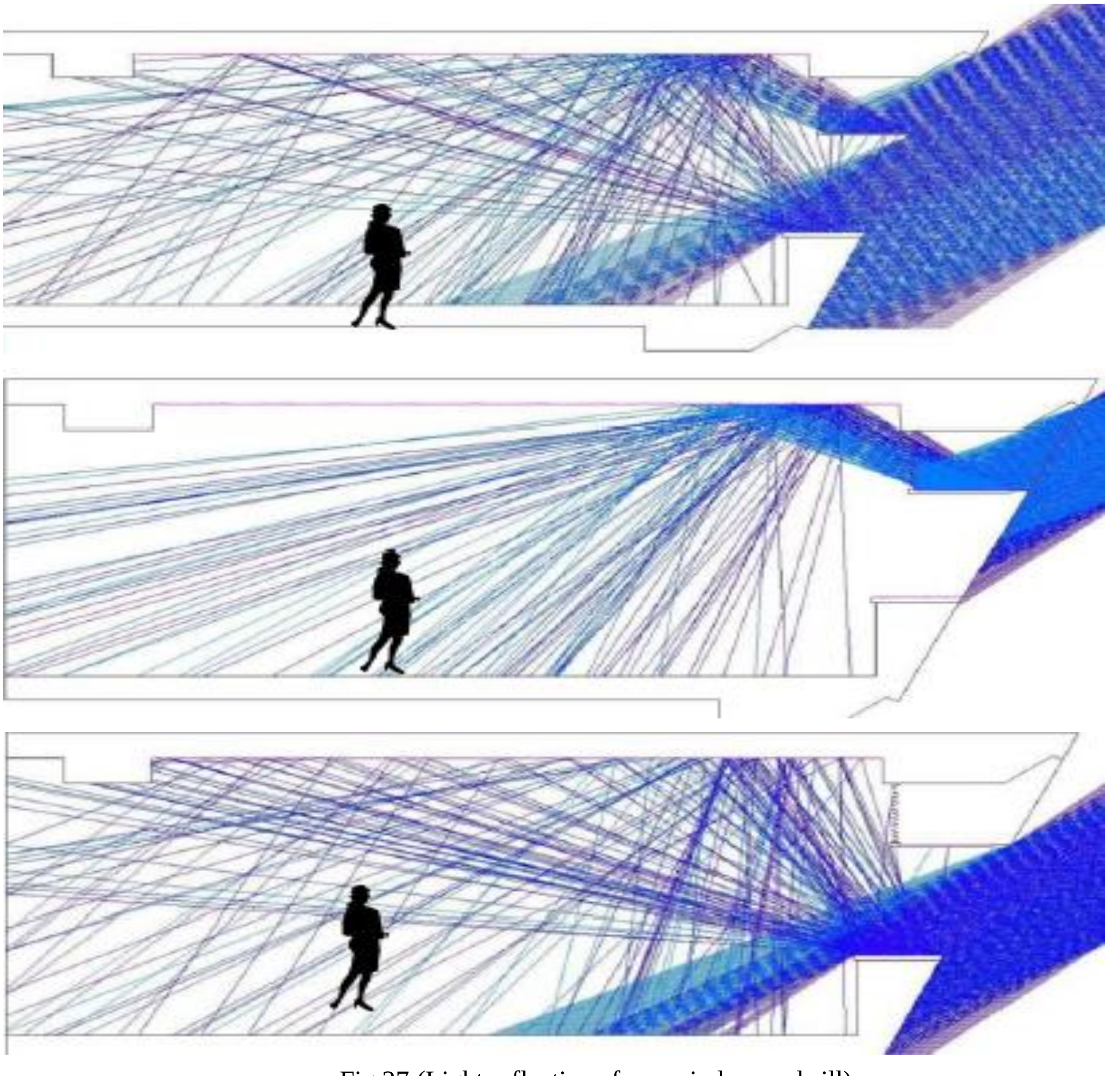


Fig.27 (Light reflections from window and sill)

ATRIUM DAYLIGHT DESIGN :

The atrium was systematically designed to maximize natural daylight for use in each of the floors. The three basic strategies used to achieve this goal are:

The blinds, which are automated, have up to six different configurations to sustain the natural light availability for as long as possible

Some of the blinds that possess 30% light passing through are controlled every 15 minutes and go through three different adjustments during morning, noon and later in the evening.

The size of the window is shaped larger and broader towards the atrium which results in the collection of lower daylight.

In order to deflect the daylight across the atrium to reach the first and second floor level where the daylight hardly reaches, a band of Tannenbaum reflector panels are applied strategically to the fourth and fifth floor. Furthermore, the Christmas tree profile reflectors which have a 10 degree inclination which provides reflection up to 80% of the light in semi-diffuse manner, thus preventing visual glare issues for the office users.

In order to deflect the daylight across the atrium to reach the first and second floor level where the daylight hardly reaches, a band of Tannenbaum reflector panels are applied strategically to the fourth and fifth floor. Furthermore, the Christmas tree' profile reflectors which have a 10 degree inclination which provides reflection up to 80% of the light in semi-diffuse manner, thus preventing visual glare issues for the office users.

Fig. 28 Glass Dome

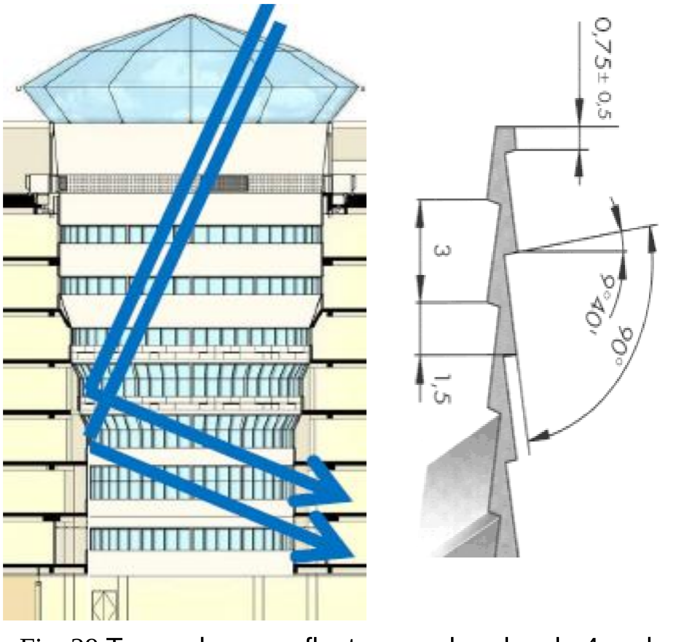


Fig. 29 Tannenbaum reflector panel on levels 4 and 5

7.0 LITRATURE STUDY-2

THE SAN FRANCISCO FEDERAL BUILDING

THE SAN FRANCISCO FEDERAL BUILDING

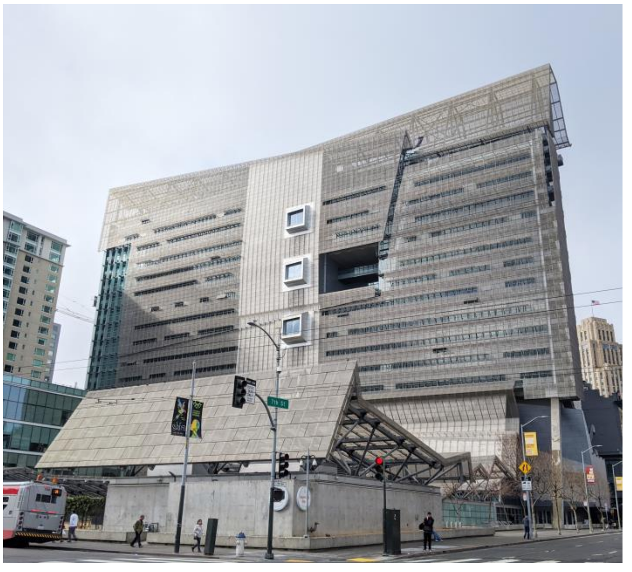


Fig.1 (The San Francisco Federal Building)

7.1 INTRODUCTION

The San Francisco Federal Building is a 605,000 GSF office building located in the Market District of San Francisco, with offices for the Department of Health and Human Services, Social Security Administration, Department of Sate, Department of Labor, and the Department of Agriculture.6 The total building population is approximately 2000 people. The design team consisted of Morphosis (design consultant), Smith Group (Executive Architect), Hunt Construction Group (construction manager), and Brian Kangas Foulk (civil engineer). Ove Arup's Los Angeles office led the structural, mechanical, and electrical engineering from the schematic design stage onwards and lighting design was provided by Horton Lees Brogden Lighting Design, Inc. Smith Group led the space planning effort and acted as the main liaison with the tenant agencies

6.2 DAYLIGHT AND NATURAL VENTILATION

Publications by McConahey et al. (2002) and Haves (2004) reveal the interest of the design team in applying natural ventilation and daylight achieve energy and IEQ objectives. Based on San Francisco's temperate outdoor air temperatures (the monthly mean maximum temperature for September, which is the hottest month, is 75 deg. F), the possibility of a naturally ventilated building became an early consideration of the design team as an energy efficiency strategy. In addition to the potential to reduce or eliminate the need for mechanical air handling systems, the design team claimed that naturally ventilated buildings present additional benefits in terms of enhanced productivity and health, "the expected advantages of naturally ventilated buildings include increased worker productivity, lower turnover in the workforce, and fewer health issues, in contrast to the documented ventilation problems with sealed building envelopes" (McConahey et al., 2002).

In response to the goal stated in the Program and Feasibility Study to "maximize daylight, access to views, as well as privacy for the tenants from the outside view" the creation of "day lit interiors" was an additional consideration early in the design process with the objectives of enhanced productivity and health. To develop concept for a naturally ventilated building with "day lit" interiors, the design team worked in a self-described "environment of close collaboration where emphasis was placed on the need for "multi-disciplinary" interaction. The design of a building that offers dramatically reduced energy consumption through the integration of architecture and sustainable engineering principles. The creation of office environments that influence the productivity and health of the working population through natural ventilation, operable windows, and daylit interiors.1. The redefinition of the circulation and vertical movement paths in the building, using innovative elevators, three-story sky lobbies, and compelling stairways to promote walking throughout the building.

SITE DESCRIPTION

The SFFB is located in San Francisco among predominantly low-rise buildings to the west of the SFFB are several taller buildings that overshadow lower portions of the of the SFFB for a period of the day.

Fig. 2 (Site on Map)

7.2 DESIGN EVOLUTION

The building massing consists of a slender, 18 story tower along the northwest edge of the site, with a 4-story annex building located perpendicular to the tower, along the western edge.

Fig. 3(Building Massing & Orientation)

7.3 PLANS & VIEWS

Fig. 4 (Site Plan)

LOBBY FLOOR PLAN

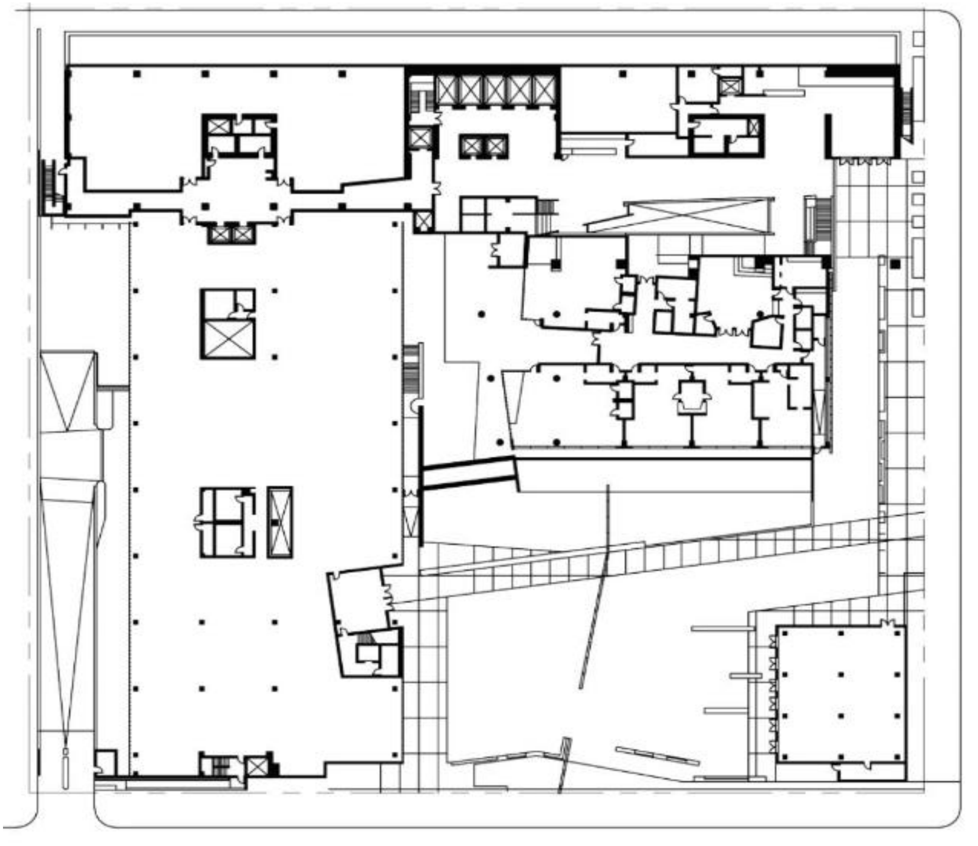


Fig.5 (Lobby Floor Plan)

TYPICAL OFFICE FLOOR PLAN

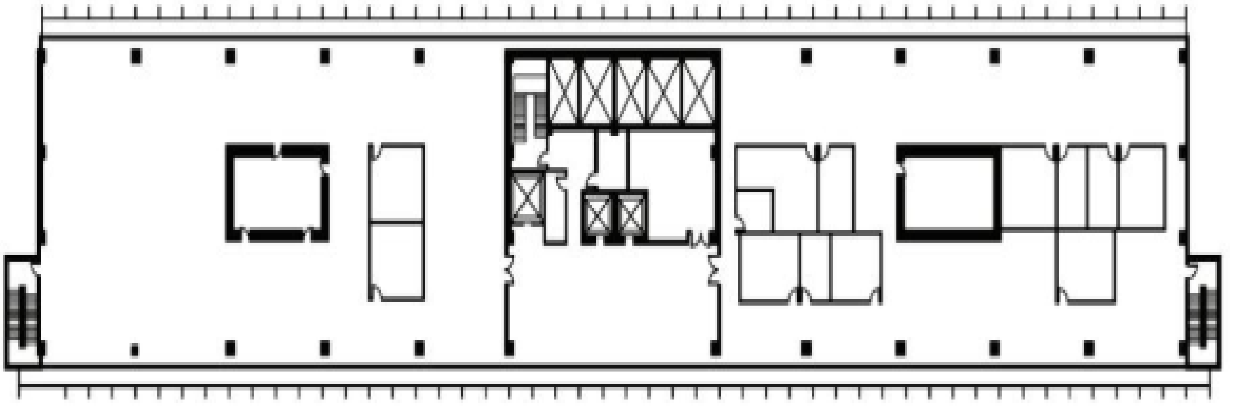


Fig.6 (Typical Floor plan)

GREEN MATERIAL

- The building minimizes pollution by replacing high proportions of portland cement in its concrete foundations and frame. During the manufacturing process, portland cement is associated with very high levels of greenhouse gas emissions
- In the federal building's concrete mixture, 50% of the pollution-intensive portland cement is replaced with blast furnace slag, a recycled waste product from the steel industry, significantly reducing greenhouse gas emissions resulting from conventional concrete.
- This environmentally sound choice also results in higher- strength concrete and has a warm, light-colored tone that contributes to the favorable daylight penetration within the office space.
- Throughout the day the thermal mass of the exposed concrete columns, shear walls and wave-form ceilings help cool the occupants of the building
- The outer perimeter of the tower is configured with open offices and 52-inch-high workstation partitions, maximizing access to natural light
- Fritted glass panels that enclose meeting rooms and offices located in the middle "spine" of the tower, provide both privacy and access to natural light.

Fritted glass panel

Exterior column

Dry-polish concrete

Decomposed Granite

Fig.7 (Green Materials))

PLAN AND SECTIONAL ORGANIZATION

As a result of the tower's narrow profile and strategic integration of structural mechanical and electrical systems, the building provides natural ventilation to 70% of the work area in lieu of air conditioning, and affords natural light and operable windows to 90% of the workstations. The objective of cross-ventilation in the tower section led to the decision to limit the floor plate depth to 20.8m is addition, the conventional commercial office layout of cellular offices along the perimeter and open plan workspaces in the core was inverted to reduce the level of obstructions between the windows on both facades. This decision resulted in a floor plan layout with a single row

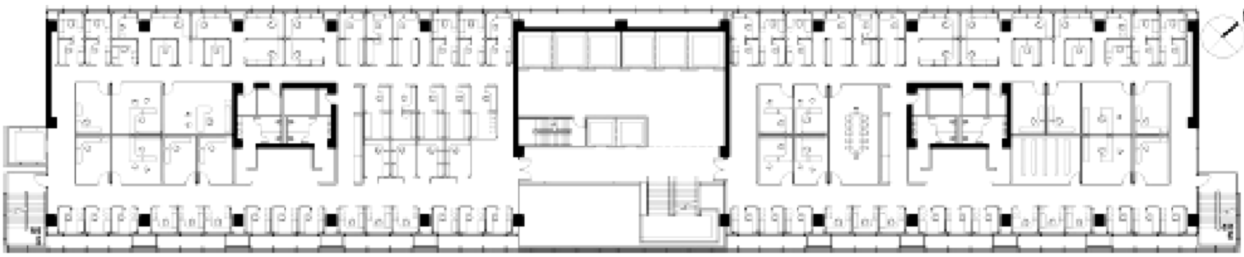


Fig.8 (Plan and Sectional Organization)

An open plan workspace arrayed along the SE perimeter zone and two rows of open plan workspaces along the NW. Enclosed offices, open plan offices and miscellaneous program spaces are located in central core area.

The average floor-to-ceiling height of the SFFB of 13 feet (at the perimeter) is significantly greater than that of conventional commercial office construction. The decision to extend the floor-to-ceiling height was based on the objective of achieving sufficient height above the interior cabin offices for cross-flow ventilation as well as to increase the level of daylight transmission to interior workspaces

With an average overall celling height in tower of 13 feet, natural daylight will penetrate deep into
Analysis of wind climate showed a strong prevailing wind condition from the west northwest, leading to a decision to align the long axis of the tower section parallel to market street which is oriented 45 degree from true north. works paces – Morphosis Architects

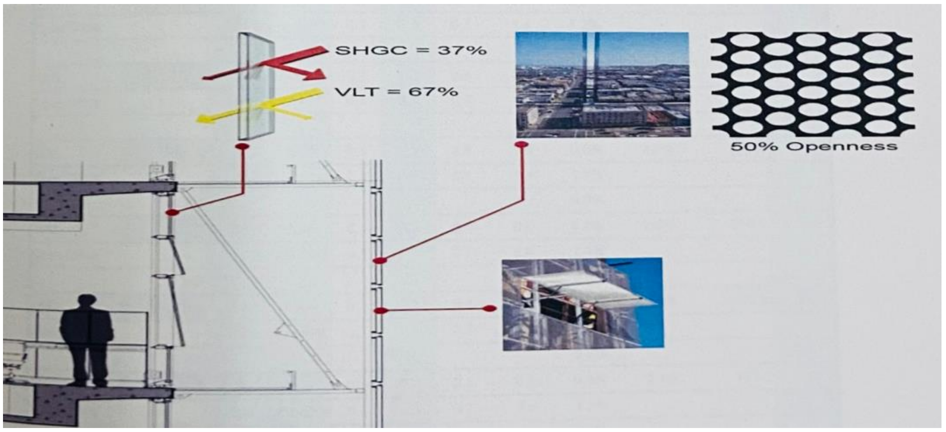


Fig.9

MATERIAL PALETTE - NORTH FACADE

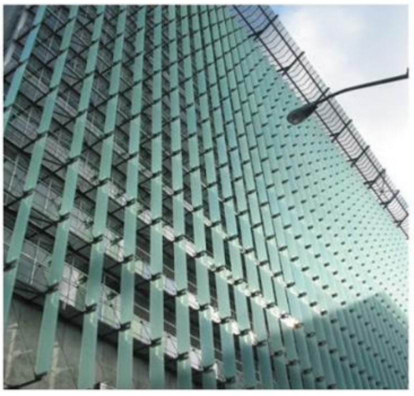


Fig. 10 Vertical sunshade fins

Fig.11 Steel cables and metal clips with fins

Fig. 12 User operator window

Fig. 13 Double glazed windows lining entire facade

Fig. 14 Staggered windows with steel structure

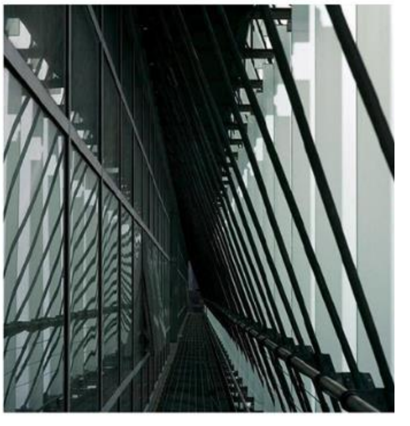


Fig. 15 Catwalk with steel grate

Material Palette - Structure

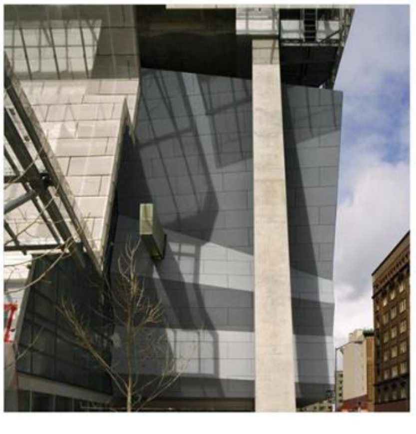


Fig. 16 Concrete buttress

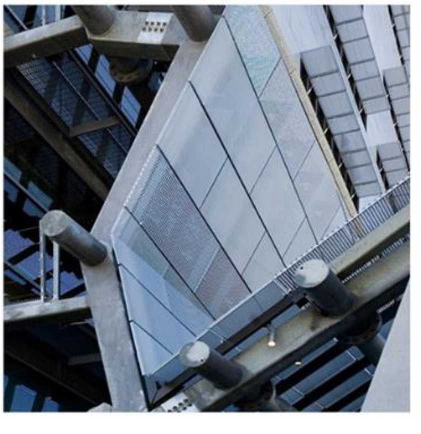


Fig. 17 Circular beam

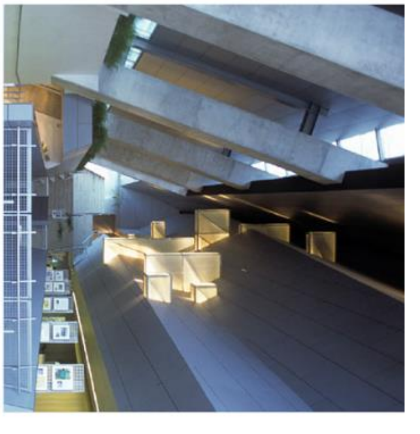


Fig. 18 Concrete cantilevered beams

8.0 COMPARATIVE ANALYSIS

8.0 COMPARATIVE ANALYSIS

Case Study 1	Case Study 2	Literature Study 1	Literature Study 1
Building layout ensure that 90% of space have day light access and views to the outsides	Optimum orientation of build form for cooling by ventilation	The facade day lighting system was designed in such a way that it consists of a mirror light shelf and a white painted windows sill.	The building massing and orientation were determined to achieve the objective of a naturally ventilation tower section. The building massing consists of a slender, 18-story tower along the northwest edge of the site, with 4-story building located perpendicular to the tower
Fully glazed windows help to light the entire technology centre	Shading of windows to reduce heat gain	Light shelf and window sill was used. The size of the window is shaped larger and broader	The building provides natural ventilation to 70% of the work area is in air condition and affords natural light and operable windows to 90% of the workstations
Courtyard space was not rigidly fixed but could be adaptable depending on the time of day, season Light captured from as many sides possible the use of courtyards	A courtyard to enhance cross ventilation and providing daylighing	The daylight across the atrium to reach the first and second floor level where the daylight hardly reaches, a band of Tannenbaum reflector panels are applied strategically to the fourth and fifth floor	The creation of office environment that influence the productivity and health of the working population through natural ventilation operable windows and daylit interior

9.0 GENERAL CONCLUSION

9.0 GENERAL CONCLUSION

- Many strategies including the integration of daylight with artificial lighting through lighting controls can be used to contribute to energy conservation in office buildings

- Daylight integration with artificial lighing can significantly contribute to eneray reduction in office buildings which can be enhanced by employing proper window design.

- Optimum possible use of natural light is a factor that must be considered in new construction projects.

- Lowering environmental impact and improving energy efficiency in buildings should be given importance by making contribution natural lighting to the rational use of energy in buildings, and also using techniques that enable the designer to ensure that efficiency energy plans are based on interior natural lighting.

- The use of appropriate architectural standards, specification of materials and energy-efficient products and the adequacy of criteria for rational designs can enable upto 60% reduction in the energy consumption of buildings, giving architects, engineers, and designers the opportunity to explore and realize this potential.

- The most effective method to achieve thermal comfort in offices is to reduce cooling loads in order to avail additional energy-consuming device for cooling.

- Controlling solar heat gains in summer, preventing loss of interior heat in winters and allowing occupants to reduce electric lighting use by making max. use of daylight spectrally selective glazing significantly reduces the buildings energy consumption and peak demand.

10.0 COMMON AND RECOMMENDED LIGHT LEVELS INDOORS

GUIDELINES FOR DAYLIGHTING SYSTEMS IN BUILDINGS

10.0 COMMON AND RECOMMENDED LIGHT LEVELS INDOORS

The outdoor light level is approximately 10,000 lux on a clear day. In the building, in the area closest to windows, the light level may be reduced to approximately 1,000 lux. In the middle area its may be as low as 25 - 50 lux. Additional lighting equipment is often necessary to compensate the low levels. Earlier it was common with light levels in the range 100 - 300 lux for normal activities. Today the light level is more common in the range 500 - 1000 lux - depending on activity. For precision and detailed works, the light level may even approach 1500 - 2000 lux.

Activity	**Illumination** *(lux, lumen/m^2)*
Public areas with dark surroundings	20 - 50
Simple orientation for short visits	50 - 100
Working areas where visual tasks are only occasionally performed	100 - 150
Warehouses, Homes, Theaters, Archives	150
Easy Office Work, Classes	250
Normal Office Work, PC Work, Study Library, Groceries, Show Rooms, Laboratories	500
Supermarkets, Mechanical Workshops, Office Landscapes	750
Normal Drawing Work, Detailed Mechanical Workshops, Operation Theatres	1,000
Detailed Drawing Work, Very Detailed Mechanical Works	1500 - 2000
Performance of visual tasks of low contrast and very small size for prolonged periods of time	2000 - 5000
Performance of very prolonged and exacting visual tasks	5000 - 10000
Performance of very special visual tasks of extremely low contrast and small size	10000 - 20000

Table 1 (Recommended Light levels for activity area)

10.1 ADDITIONAL RECOMMENDED LIGHT LEVELS INDOORS

Office Space	
Normal work station space, open or closed offices[1]	500
ADP Areas	500
Conference Rooms	300
Training Rooms	500
Internal Corridors	200
Auditoria	150-200

Public Areas	
Entrance Lobbies, Atria	200
Elevator Lobbies, Public Corridors	200
Ped. Tunnels and Bridges	200
Stairwells	200
Support Spaces	
Toilets	200
Staff Locker Rooms	200
Storage Rooms, Janitors' Closets	200
Electrical Rooms, Generator Rooms	200
Mechanical Rooms	200
Communications Rooms	200
Maintenance Shops	200
Loading Docks	200
Trash Rooms	200

Specialty Areas	
Dining Areas	150-200
Kitchens	500
Outleased Space	500
Physical Fitness Space	500
Child Care Centers	500
Structured Parking, General Space	50
Structured Parking, Intersections	100
Structured Parking, Entrances	500

Table 2 (Recommended Light levels for office space)

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- Alison Williams, Bartara Atkinson , PE, Karina Garbesi, PhD, Erik Page, PE & Francis Rubinstein , IFIES

- The Influence of Daylight Design in Office Buildings
- on the Users Comfort Department of Environmental Architecture, Faculty of Building, University of Dortmund Baroper Str. 301, 44227 Dortmund, Germany,
- E-mail: heide,schuster@uni-dortmund,de

- Energy savings due to daylight and artificial lighting integration in office buildings in hot climate, Nagib T. Al-Ashwall,Ismail M. Budaiwi2

1 Sana'a University, Yemen.
2 King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia.

- Optimization of daylight and artificial light in cultural heritage Hauptschule Hotting in Innsbruck. Austria (3ENCULT Case Study 5) Rainer Pfluger, Matthias

Werer, Wolfgang Feist, Faculty of Civil Engineering, Unit Energy Efficient Buildings, University of Innsbruck

- A Study on Daylight Integration with Thermal Comfort for Energy Conservation in a General Office, SandhyalaxmiG. Navada, Chandrashekara S. Adiga, and Savitha G. Kini Department of Electrical & Electronics Engineering, Manipal Institute of Technology, Manipal University, Manipal, India

- Research Papers and journals:
  a. Smart Structures and Material Technologies in Architecture Applications
     By- Sherif Mohamed Sabry Elattar (Architecture Department, Faculty of Engineering,
     Fayoum University, Egypt).
  b. Smart Materials - Toward A new Architecture
     By- Dr. Mona Mohammed Hosni Aggour (Department of Architecture, Faculty of Engineering, Mataria ,Helwan University, Egypt).
     Dr. Olfat AbdElghany Soliman (Department of Architecture, Faculty Engineering,
     Mataria, Helwan University, Egypt).
  c. Double Skin Facades for Office Buildings
     By- Harris Poirazis (Division of Energy and Building Design, Department of Construction and Architecture, Lund Institute of Technology,Lund University, 2004).

11.0 SITE STUDY

Profile :

The North East facing site has Parallelogram profile. Site is almost flat with irregular shape. Site is almost 6 acre in area.

Connection :

The connectivity to the site is from the ring road which ROW is 300'.

Service Lines :

Service line of water supply,sewer,Electrical,telephone run Parallel to the site and also High tension line run through south west corner of the site

Trees and Plantation :

There is no more vegetation and plantation on the site.

Adjoining area :

Adjacent features of site.......

1. A non operating railway track at their north direction.
2. Ring road at East direction.
3. Railway track running towards south to west direction.
4. GPT. Infrapjojects limited kolkata based factory.

Context :

IP depo is situated from 500 mt. away at north direction. Indraprastha Metro station is also in the same direction from 600 mt. away. Pragati thermal Power plant is 400 mt. away from the site at its east direction. Pragati Maidan is 150 mt. away from the site at its south direction.

Views :

The site will be visible from ring road.

Soil :

The soil in Delhi is basically alluvial in nature and hence the site has alluvial soil. Since the site is situated near the awater body and the Yamuna river hence, moisture is there in the soil.

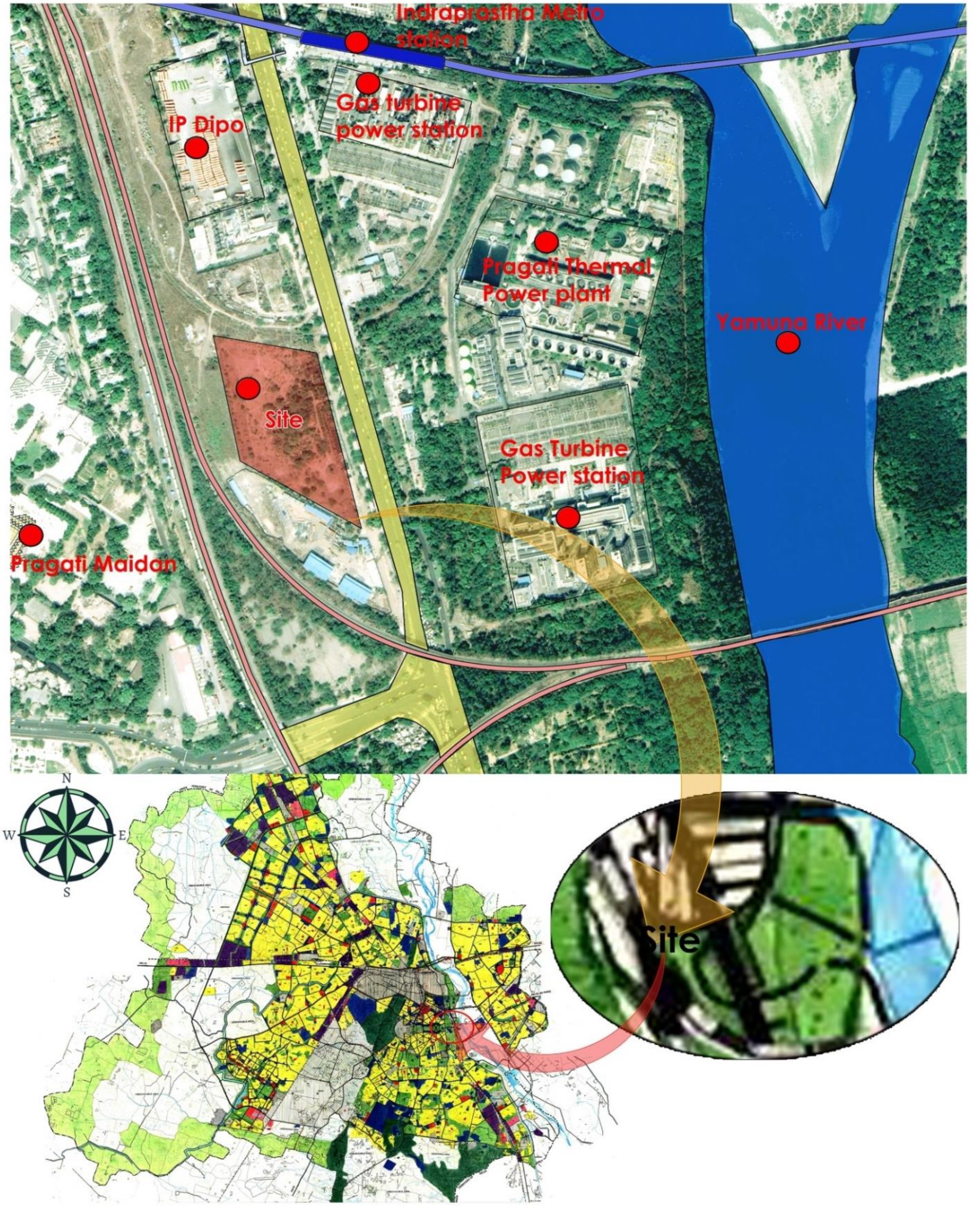
Drainage,water and Power supply :

The drainage is through pipelinesf exposed)near the site and the water needs is also catered through the lines near the site.

Power supply is through poles near the roads and across the Noida toll bridge we have the high tension wires running.

Site location :

Site located in Delhi near indraprastha metro station adjajcent to ring road.Yamuna river is 500 mt.away at east direction and Pragati maidan is 150 mt.away at west direction.



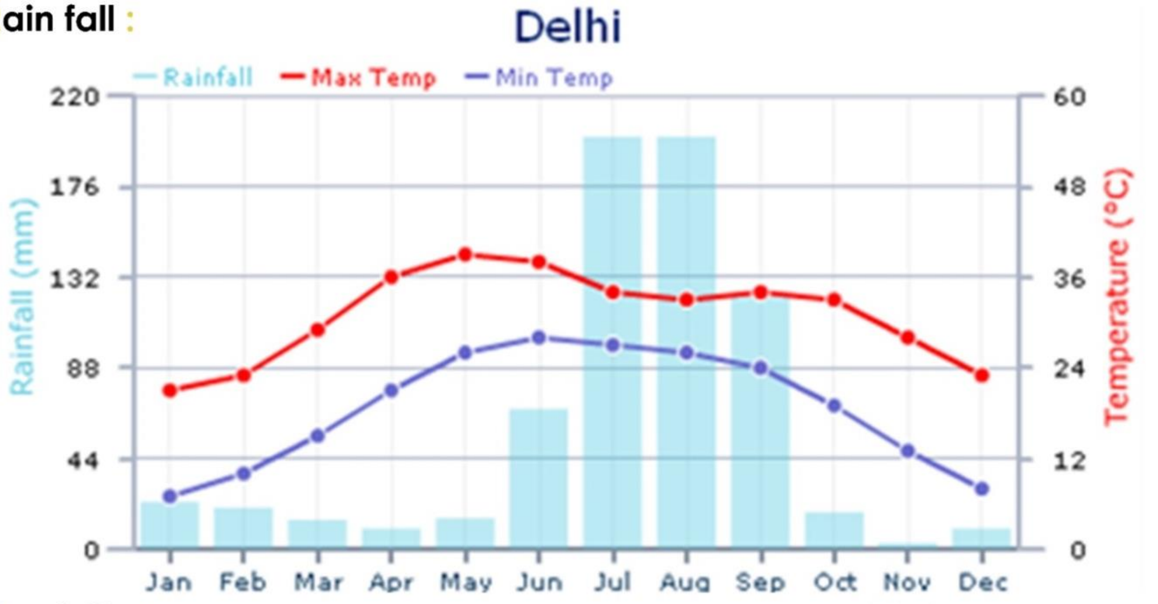
Site Surroundings :

Important Features of Site :

1. A non operating railway track at their north direction.
2. Ring road at East direction.
3. Railway track running towards south to west direction.
4. GPT. Infrapjojects limited kolkata based factory.
5. National science museum at west.
6. Indraprastha metro station is also situated at north direction of the site.

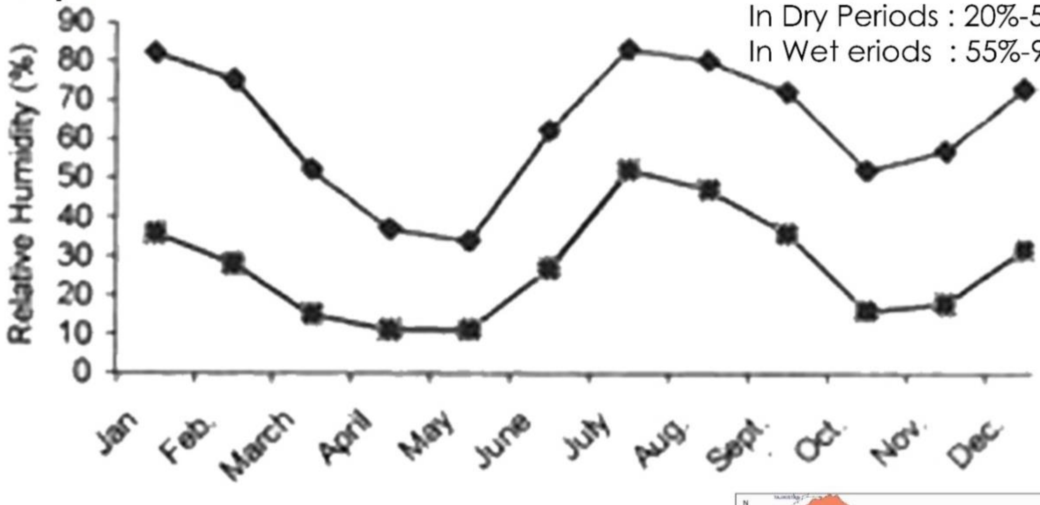
1. Golf Club - 2.0 km
2. National Zoological Park - 1.2 km
3. Humayun's Tomb- 2.5 km
4. Akshardhaam Temple - 2.6 km
5. River - 0.5 km
6. Rajghat Stadium - 1.6 km km
7. National Stadium - 1.8 km km
8. Supreme Court - 1.0 km
9. Cannaught Place - 3.2 km
10. India Gate - 1.8 km
11. Purana Quila - 0.7 km
12. Metro (indaprasth)- 0.5 km
13. Railway Station - 3.95 km
14. Airport - 15.7 km

Rain fall :



Humidity :

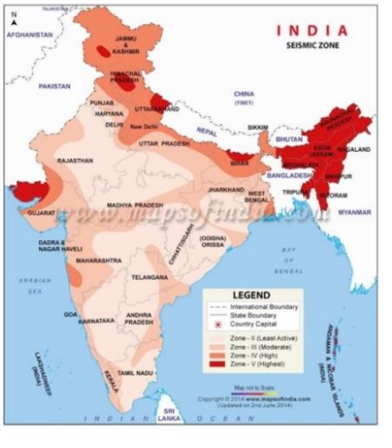
Humidity is low.
In Dry Periods : 20%-55%
In Wet eriods : 55%-95%



Seismicity :

Delhi lies in - zone IV
General occurance - 5-6 magnitude
Ocasionally - 7-8 magnitude

Delhi thus lies among the high risk areas.



Aim :

To create a space which can form the node for experiencing office culture and social activities.

The project will hybrid between socio culture and administrative centre.

Methodology :

Design for functionality.

Building orientation should facilitate the intended function of the civic centre .

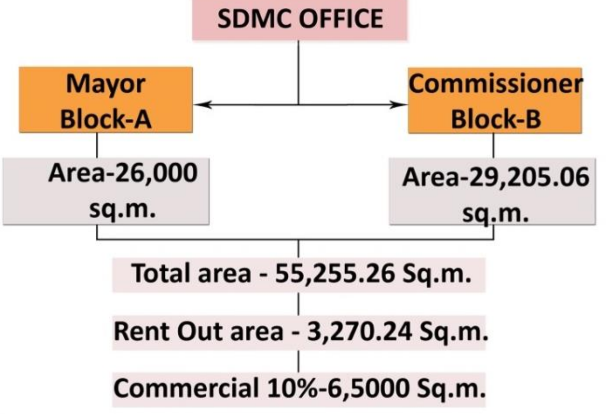
Need of the Project :

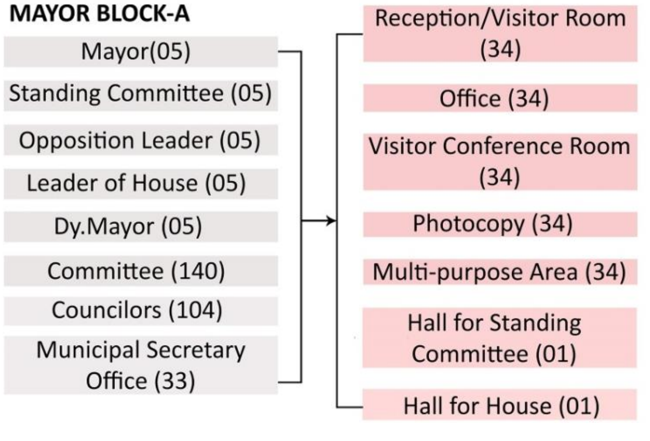
South Delhi municipal Corporation (SDMC) is one of the municipal corporation in Delhi, India created when the former Municipal corporation of Delhi was divided Into three Trifurcation . It is a Government Proposal which requirements are given below.

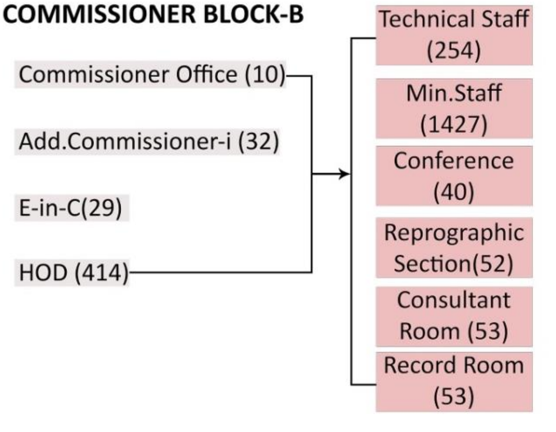
North Delhi Municipal Corporation
East Delhi Municipal Corporation
New Delhi Municipal Council

Project Area Requirement :

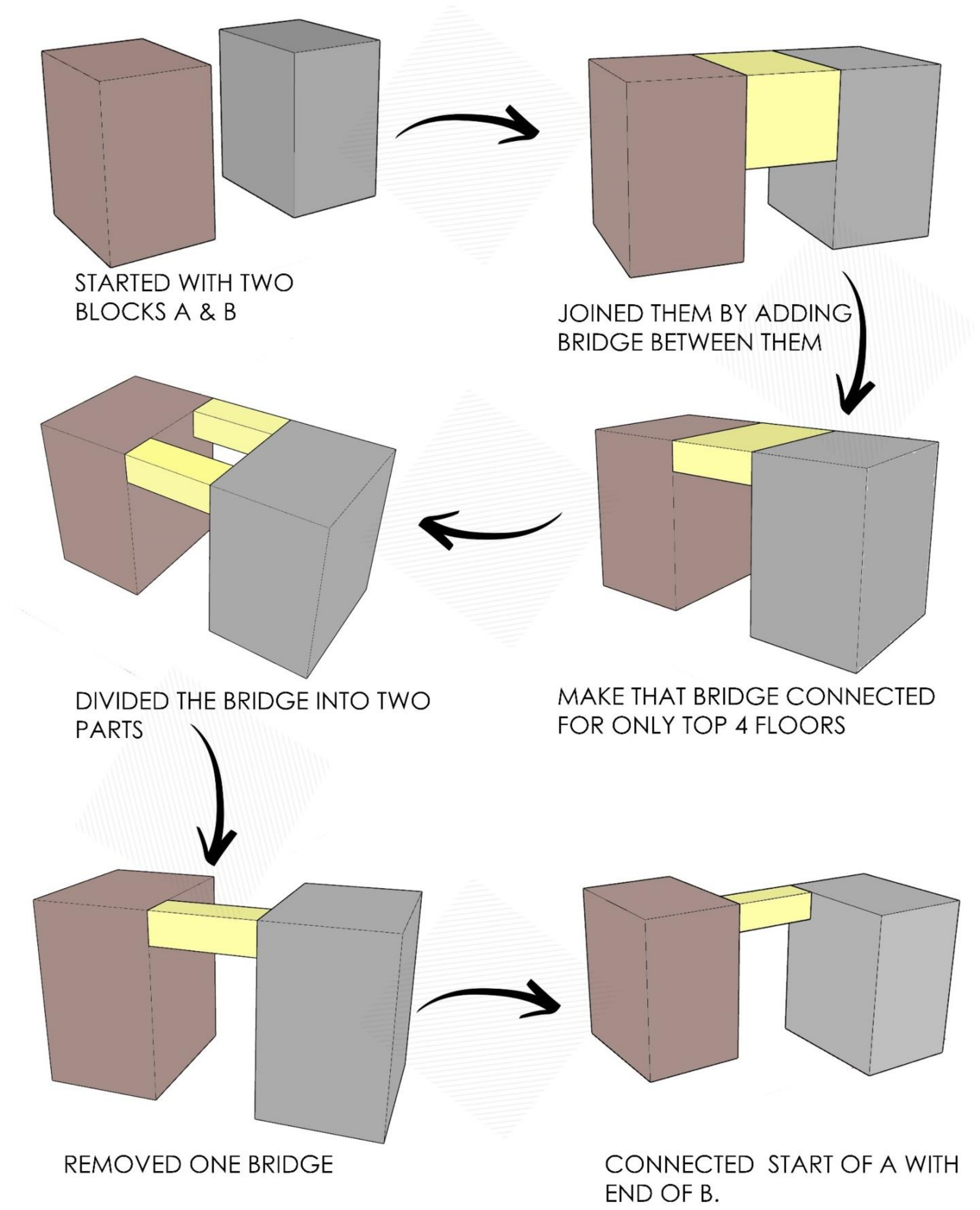
* Site Area : 24376.94 sq.mt. (6.0 acre)
* Change of Land use : 20258.50 sq.mt. (5.0 acre)
* FAR : 20258.50x3 = 60775.50 sq.mt.
* Free of FAR Areas 7% of 60775.50 = 4250 sq.mt.
* Total FAR : 65025.50 sq.mt.
* Occupancy : 4000



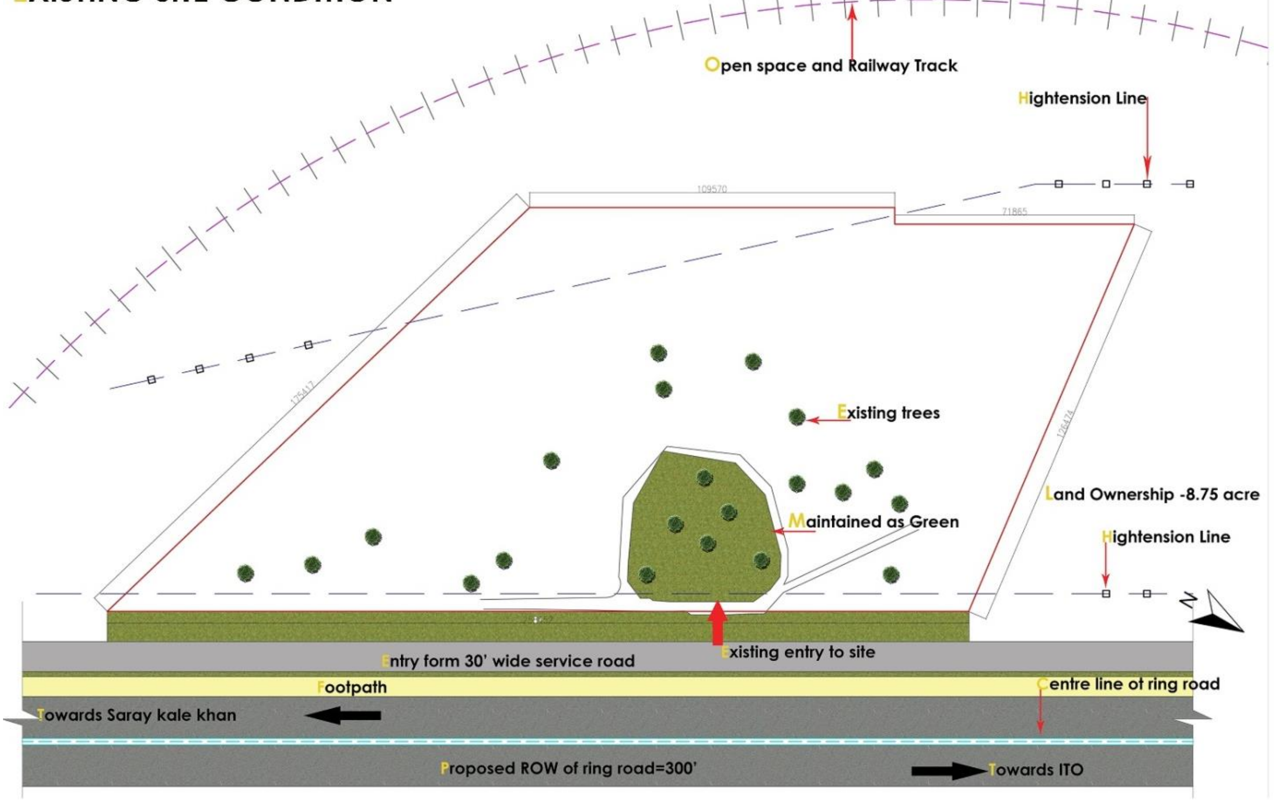




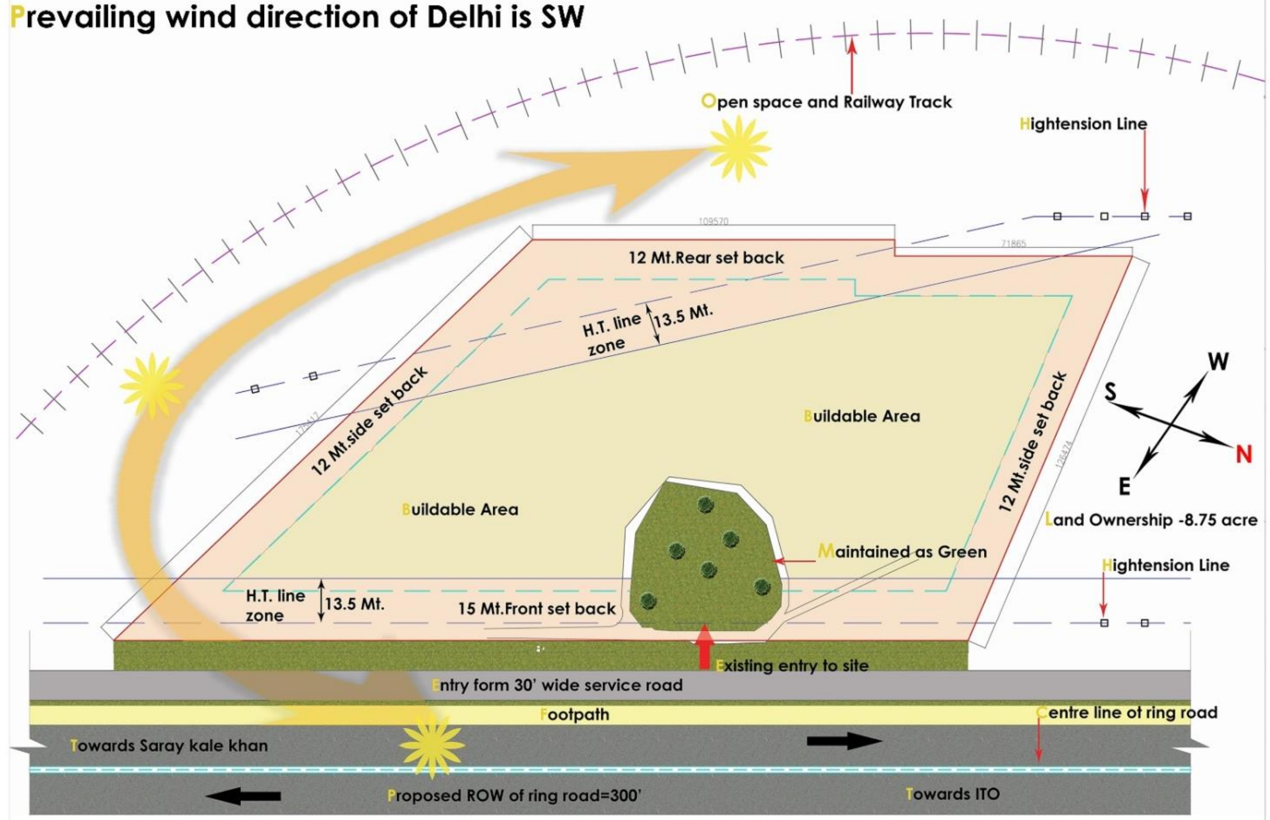
Form Evolution



EXISTING SITE CONDITION

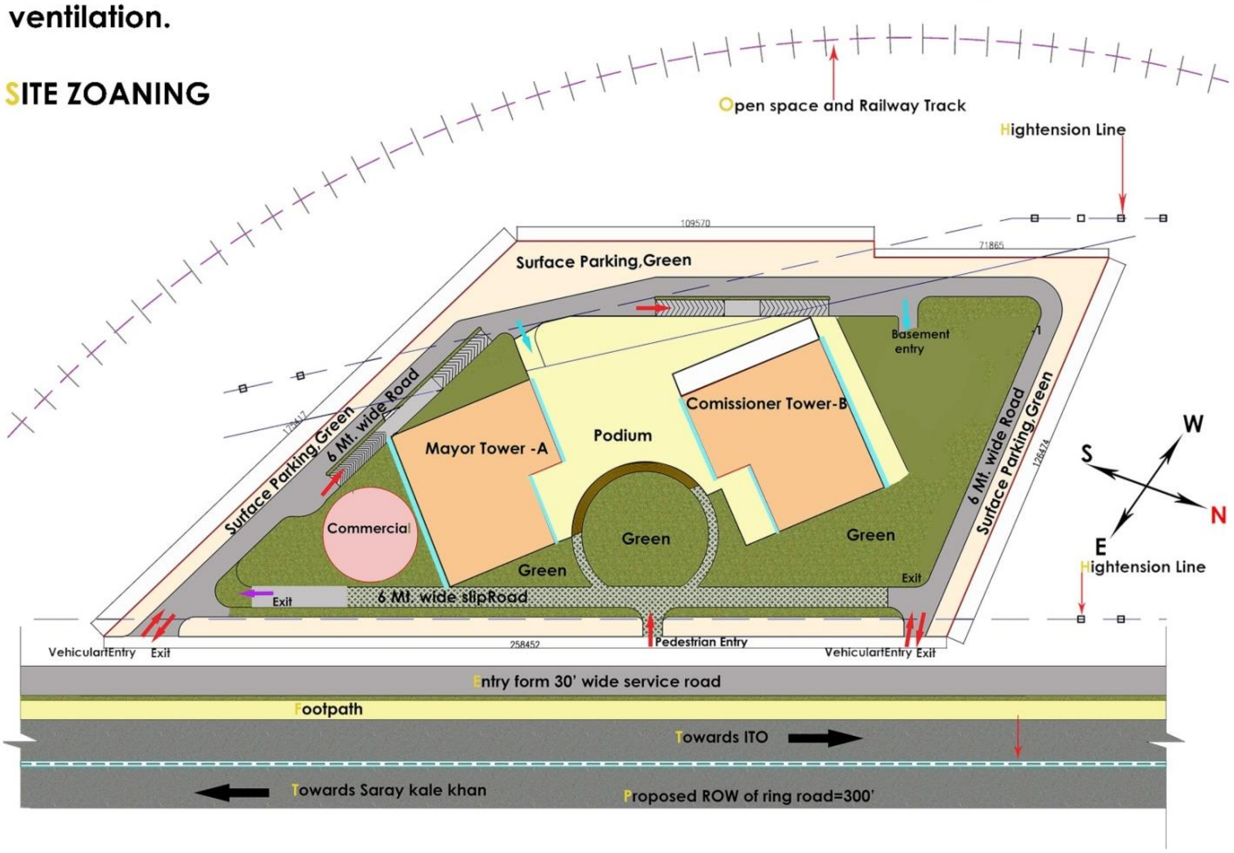


Prevailing wind direction of Delhi is SW

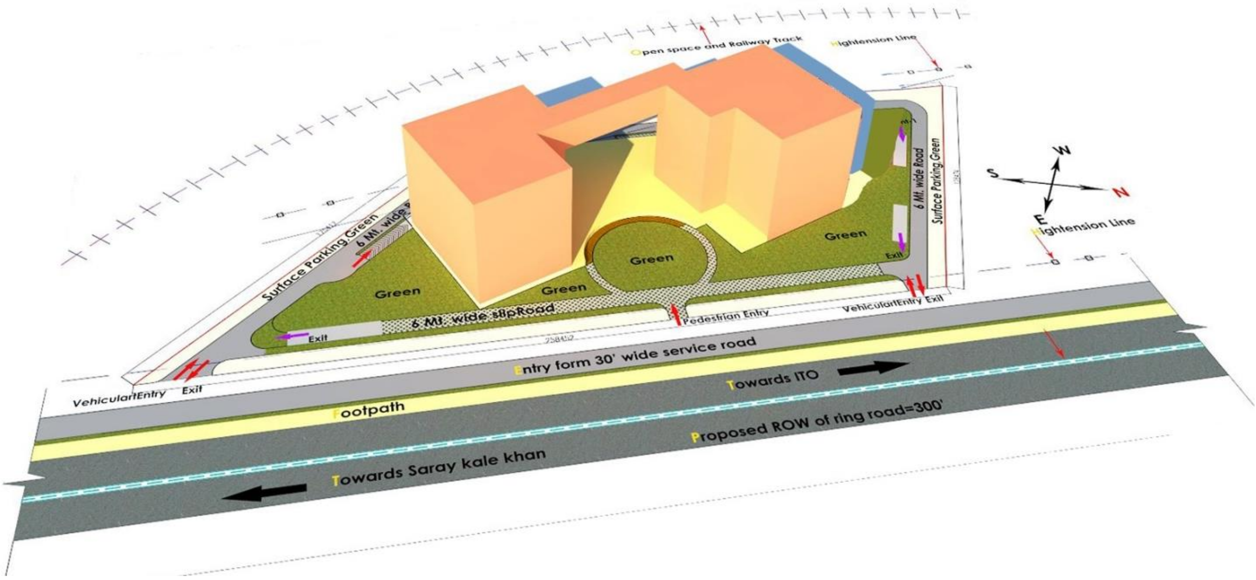


Building orientation plays a vital role in preventing heat gain.
East and west face corner of the building,minimize heat gain
Minimum window/openings should be east and west facade to minimize direct heat gain.
Glass should be on north west and south east facade for natural light and ventilation.

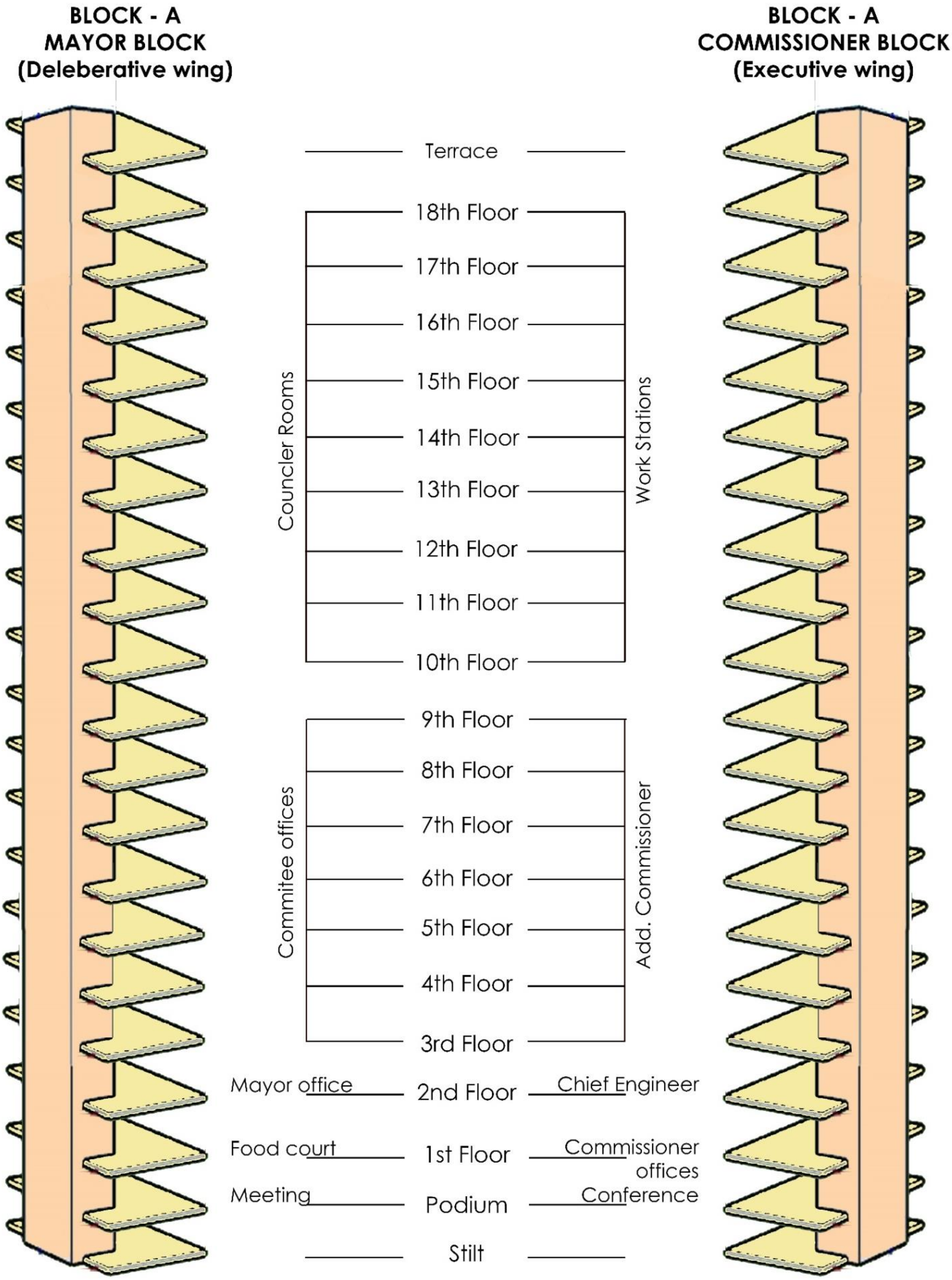
SITE ZOANING



Conceptual Block Model:



VERTICAL ZONING



12.0 AREA STATEMENT

Project Area Requirement :

MAYOR TOWER - B

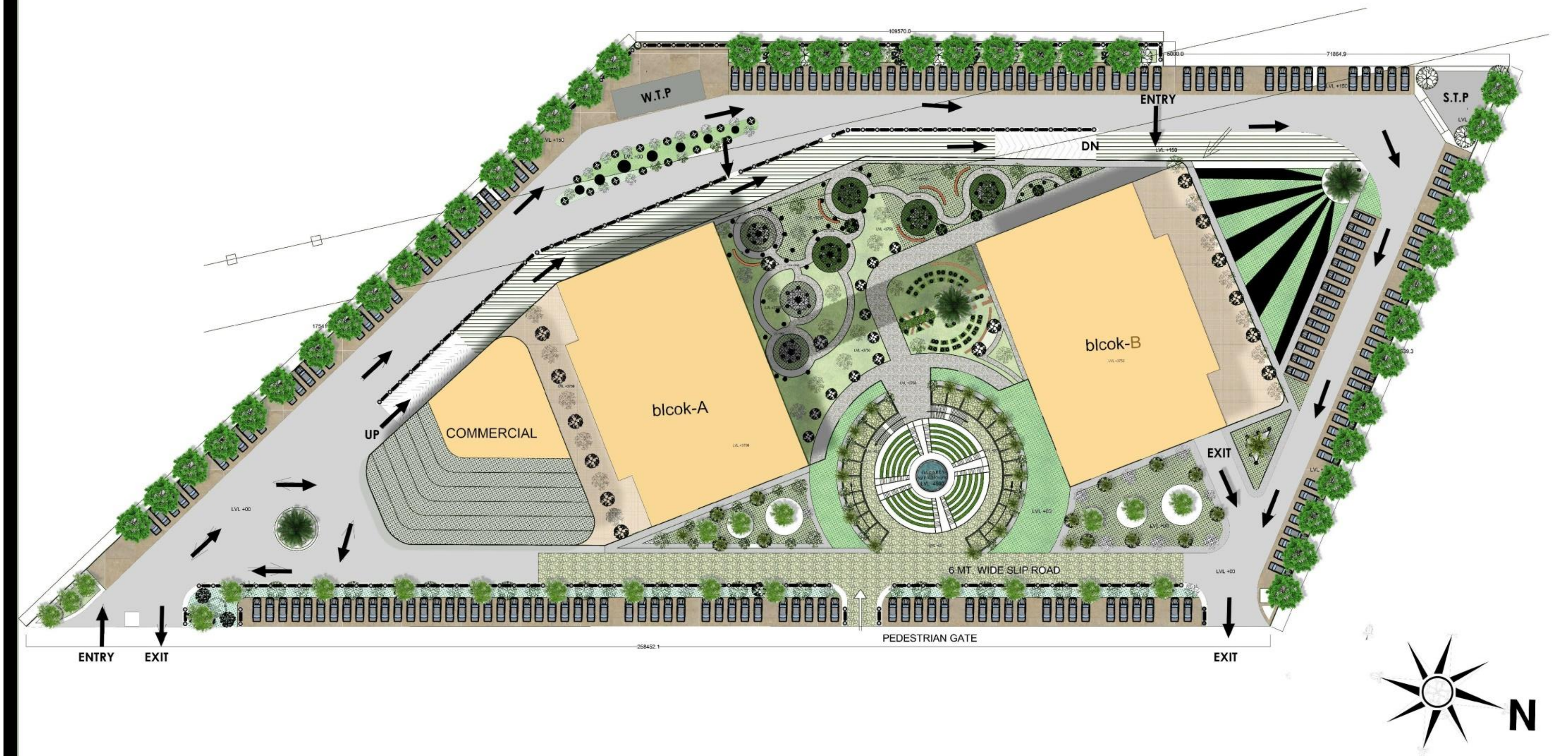
Activity	PB-4	PB-3 (a)	PB-3 (b)	PB-2	Total	Tech. Staff	Min. Staff	Reception / visitor Room	Office	Visitor/ Conference Room	Photocopy	Multipurpose Area	Remarks
Area each	33.40	22.30	11.15	5.60	-	5.60	3.71	22.30	42.70	B: 92.9 S: 46.45	31.60	9.30	
Mayor	-	-	01	04	05	-	20	01	01	01	01	01	
	-	-	11.15	22.4	33.55	-	74.20	22.30	42.70	92.9	31.60	9.30	
Standing Committee	-	-	01	04	05	-	20	01	01	01	01	01	
	-	-	11.15	22.4	33.55	-	74.20	22.30	42.70	92.9	31.60	9.30	
Opposition Leader	-	-	01	04	05	-	20	01	01	01	01	01	
	-	-	11.15	22.4	33.55	-	74.20	22.30	42.70	92.9	31.60	9.30	
Leader of House	-	-	01	04	05	-	20	01	01	01	01	01	
	-	-	11.15	22.4	33.55	-	74.20	22.30	42.70	92.9	31.60	9.30	Independent Toilets, Reception & Public Waiting required for all HoDs
Dy. Mayor	-	-	01	04	05	-	20	01	01	01	01	01	
	-	-	11.15	22.4	33.55	-	74.20	22.30	42.70	92.9	31.60	9.30	
Committee	-	-	28	112	140	-	560	28	28	28	28	28	
	-	-	312.20	627.2	939.4	-	2077.60	624.40	1195.6	1300.60	884.80	260.40	
Councilors Room (104)	-	-	-	-	104	-	04	-	01	-	-	-	
	-	-	-	-		-	-	-	-	-	-	-	
Municipal secretary Office	01	02	18	12	33	61	-	-	-	01	-	-	
	-	-	-	-								-	
Meeting hall for Standing Committee	-	-	-	-	01	-	-	-	-	-	-	-	
	-	-	-	-		-	-	-	-	-	-	-	
Meeting hall for House	-	-	-	-	01	-	-	-	-	-	-	-	
	-	-	-	-									
AREA	• Built up Area :20,000 sq.m. • Service Core 30% : 6000 sq.m.							• Total Area : 26,000 sq.m.					
OCCUPANCY	• Population : 1027 • Visitor 25% : 266							• Total Population : 1293					

COMMISSIONER TOWER - B

Activity	PB-4	PB-3 (a)	PB- 3 (b)	PB-2	Total	Tech. Staff	Min. Staff	Conference	Reprographic Section	Consultant Room	Record Room	Remarks
Area each	33.45 sq.m.	22.30 sq.m.	11.15 sq.m.	5.60 sq.m.	-	5.60 sq.m.	3.71 sq.m.	B: 464.50 M : 185.80 S: 44.00	3.70 each	22.30 each	B: 37.20 S: 18.60	
Commissioner Office	1	2	2	5	10	-	20	01	01	01	01	
	66.90	44.60	22.30	27.90	161.70	-	74.20	464.50	3.70	33.45	37.20	
Add. Commissioner-I	04	04	04	20	32	-	60	04	04	04	04	
	178.40	89.20	44.60	112	424.20	-	222.60	185.80 each	14.80	33.45 each	37.20 each	Independent Toilet, Reception, Public Waiting
E-in-C	01	04	08	16	29	-	30	01	01	01	01	
	44.60	89.20	89.20	89.60	312.60	-	111.3	464.50 each	3.70	33.45	37.20	
HoD	36	79	121	178	414	254	1317	34	46	47	47	
	1204.20	1761.70	1349.15	996.80	5311.85	1422.40	4886.07	44.0 each	3.70 each	22.30 each	18.60 each	

12.0 DRAWINGS

SITE PLAN



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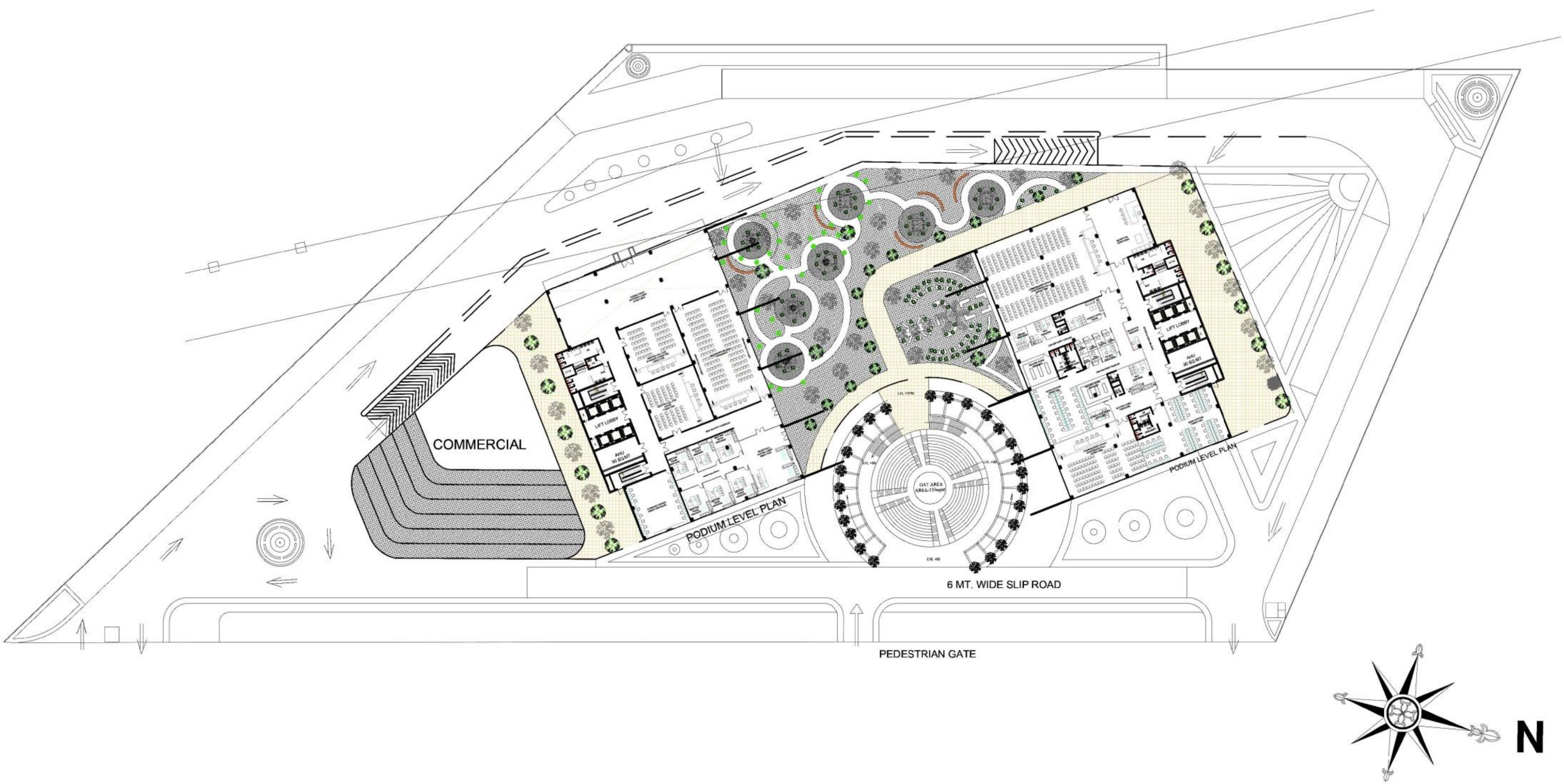
ENTRY LEVEL PLAN



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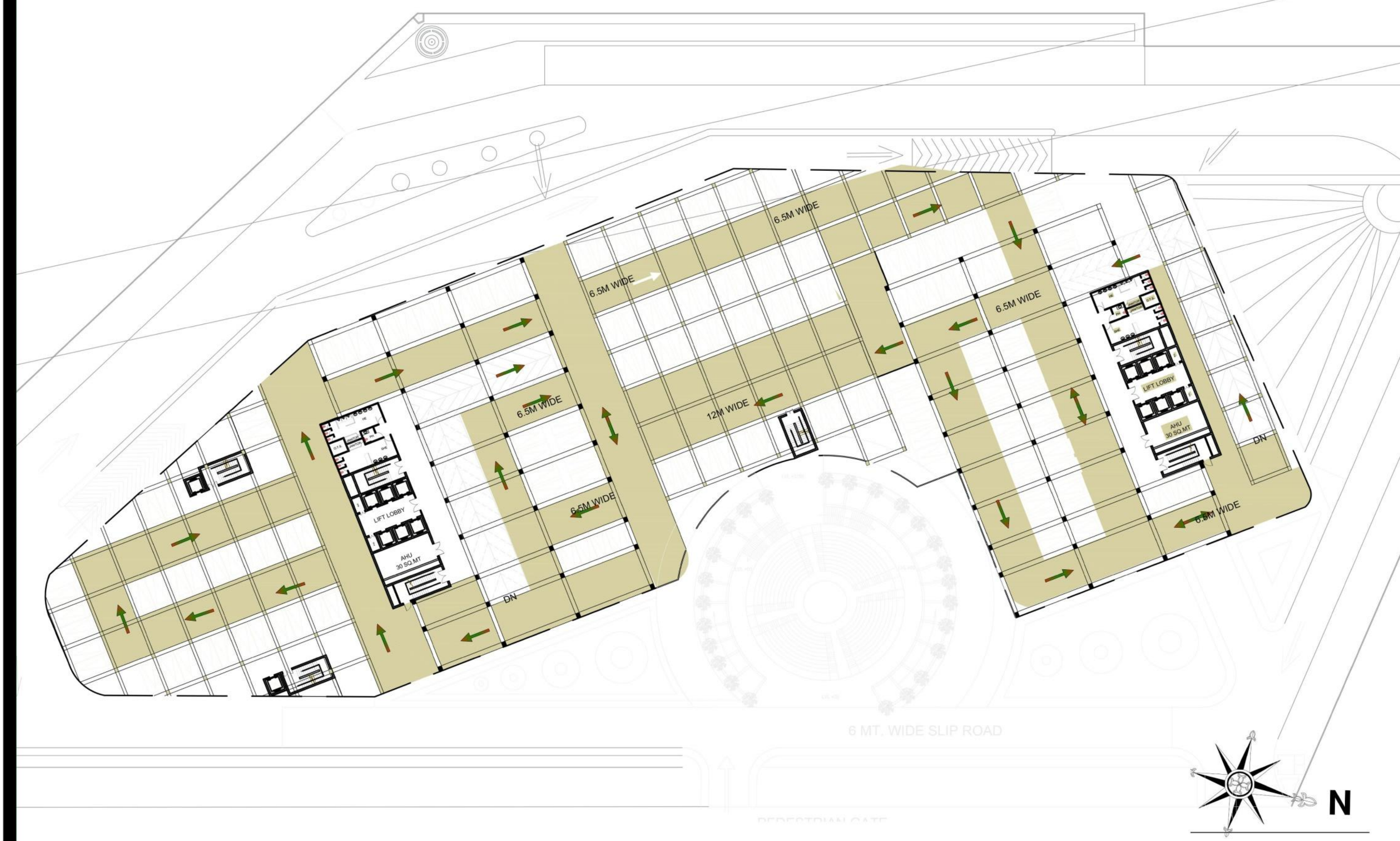
BASEMENT PLAN



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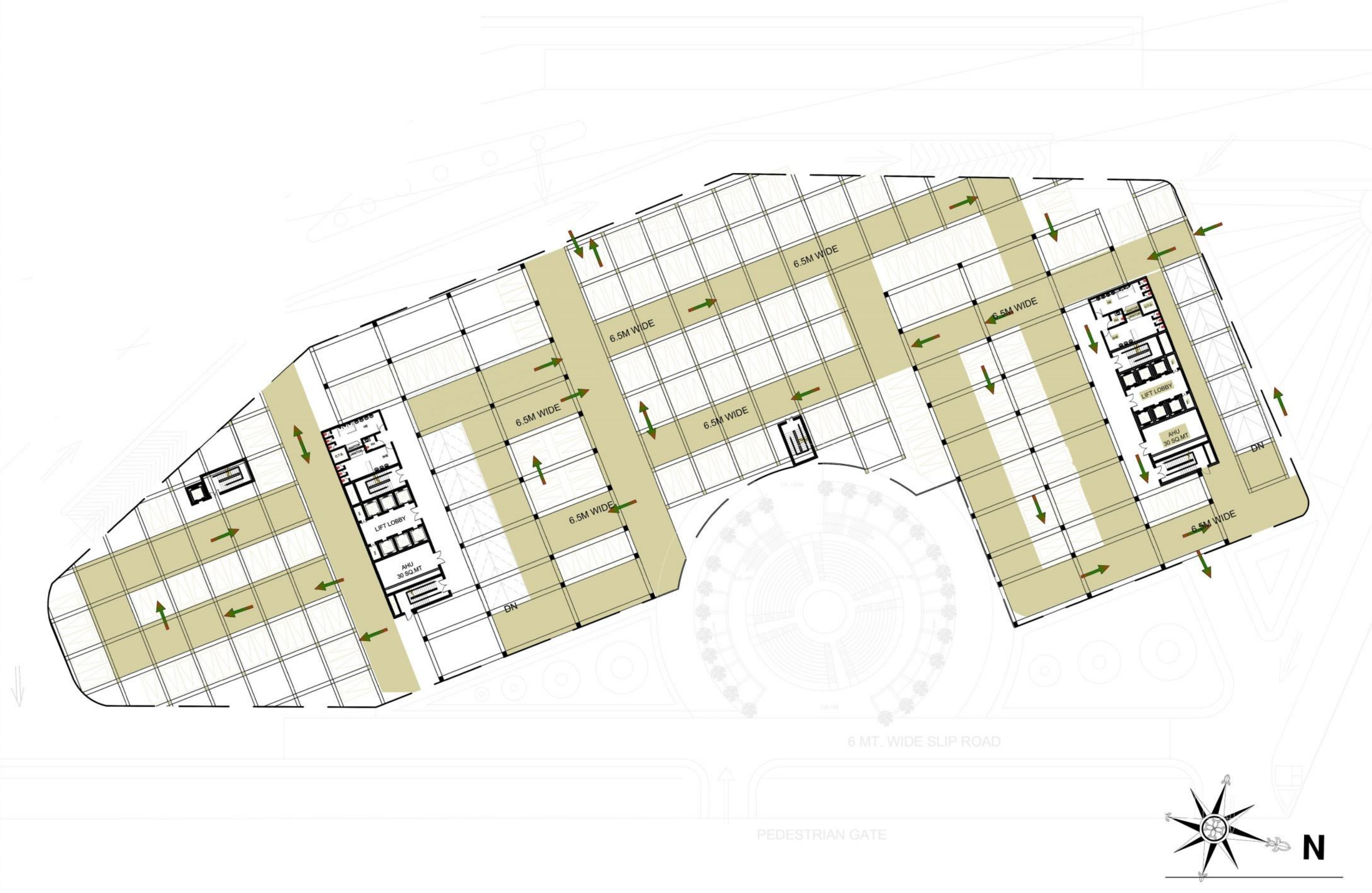
STILT PARKING



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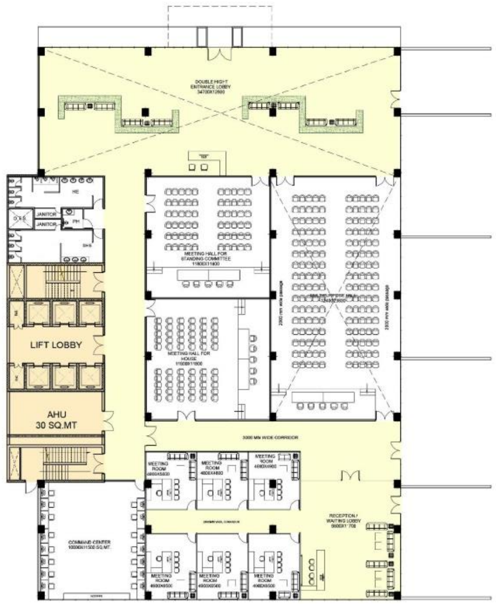
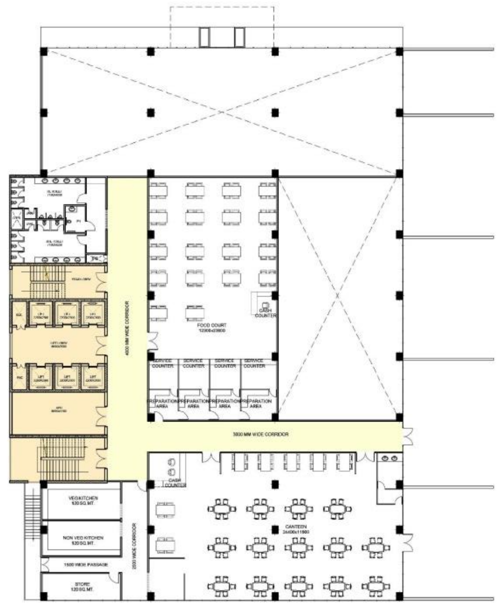
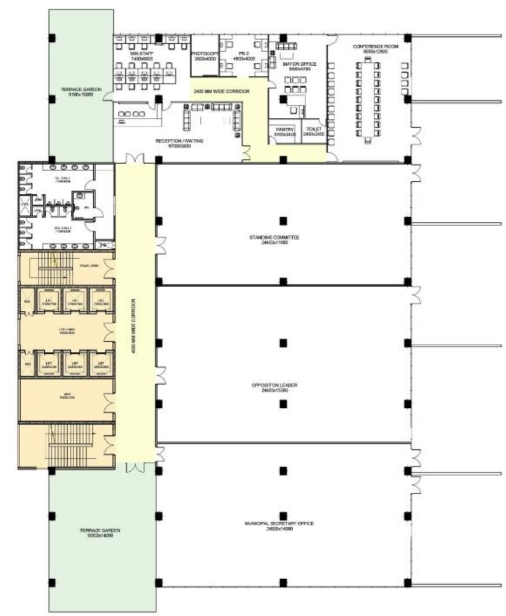
FLOOR PLANS OF BLOCK A



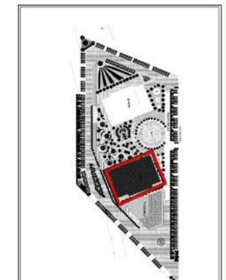
PODIUM LEVEL PLAN



FIRST FLOOR PLAN



SECOND FLOOR PLAN

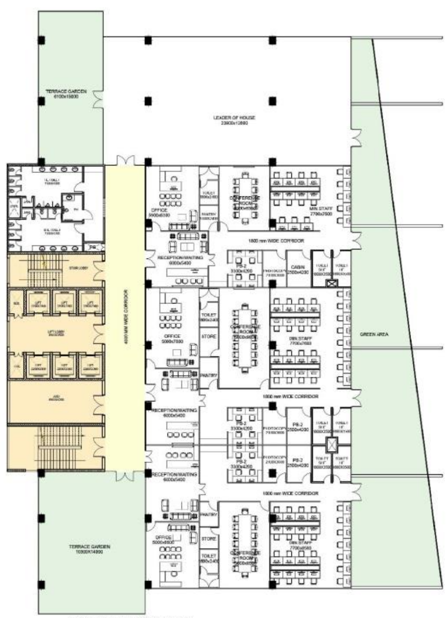


KEY PLAN

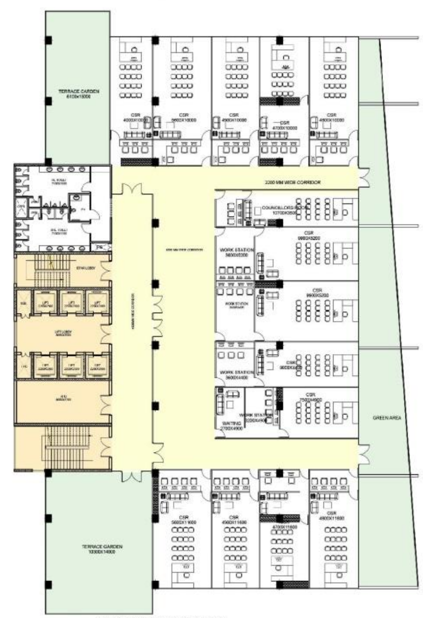
TERRACE GARDEN

CIRCULATION

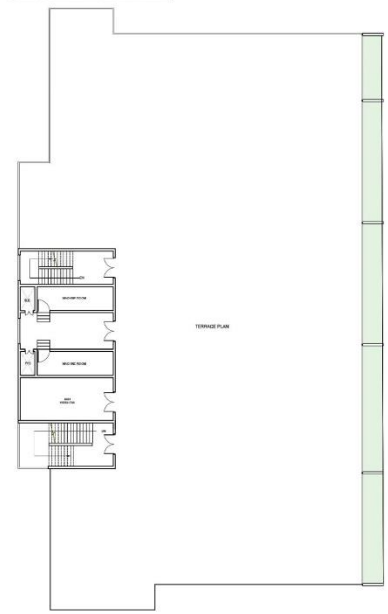
CORE



THIRD FLOOR TO
NINTH FLOOR TYPICAL PLAN



TENTH FLOOR TO
EIGHTEENTH FLOOR TYPICAL PLAN



N

TERRACE PLAN

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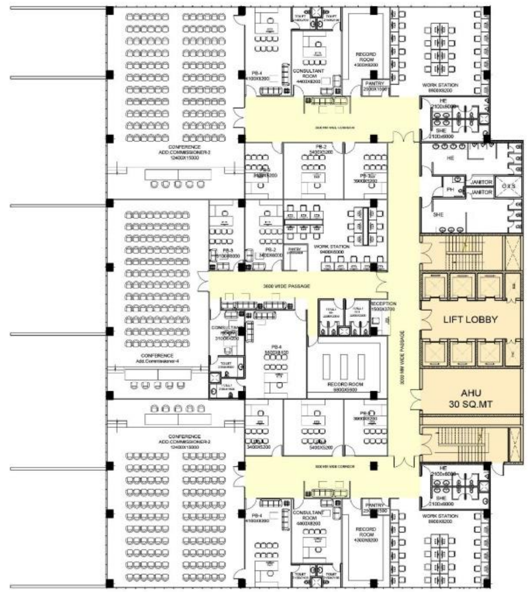
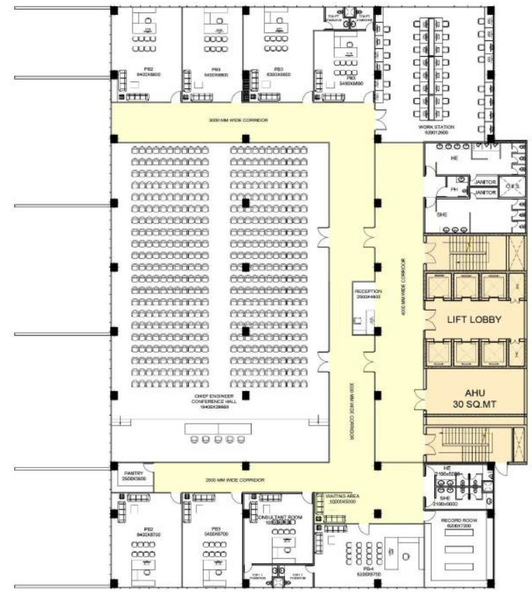
FLOOR PLANS OF BLOCK B

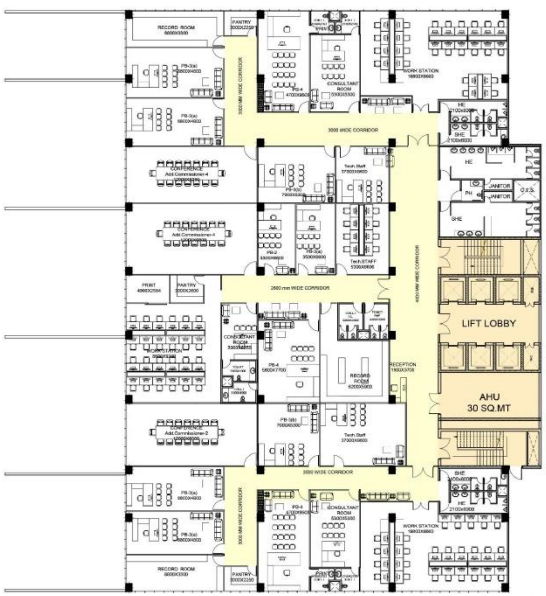
PODIUM LEVEL PLAN



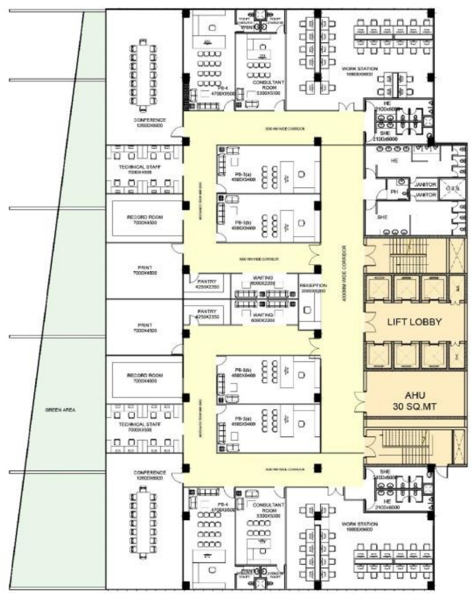
FIRST FLOOR PLAN



SECOND FLOOR PLAN

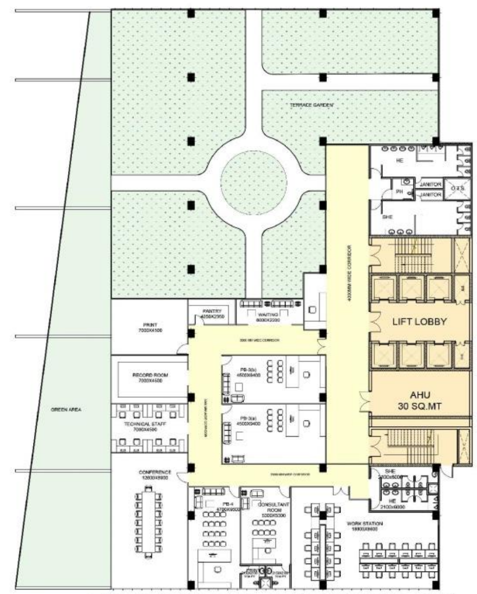


THIRD FLOOR to NINTH FLOOR PLAN

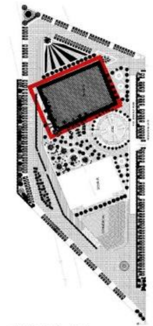


NINTH FLOOR to TWELTH FLOOR PLAN

SIXTEENTH FLOOR to EIGHTEENTH FLOOR PLAN



THIRTEENTH FLOOR to FIFTEENTH FLOOR PLAN



KEY PLAN

- TERRACE GARDEN
- CIRCULATION
- CORE

N

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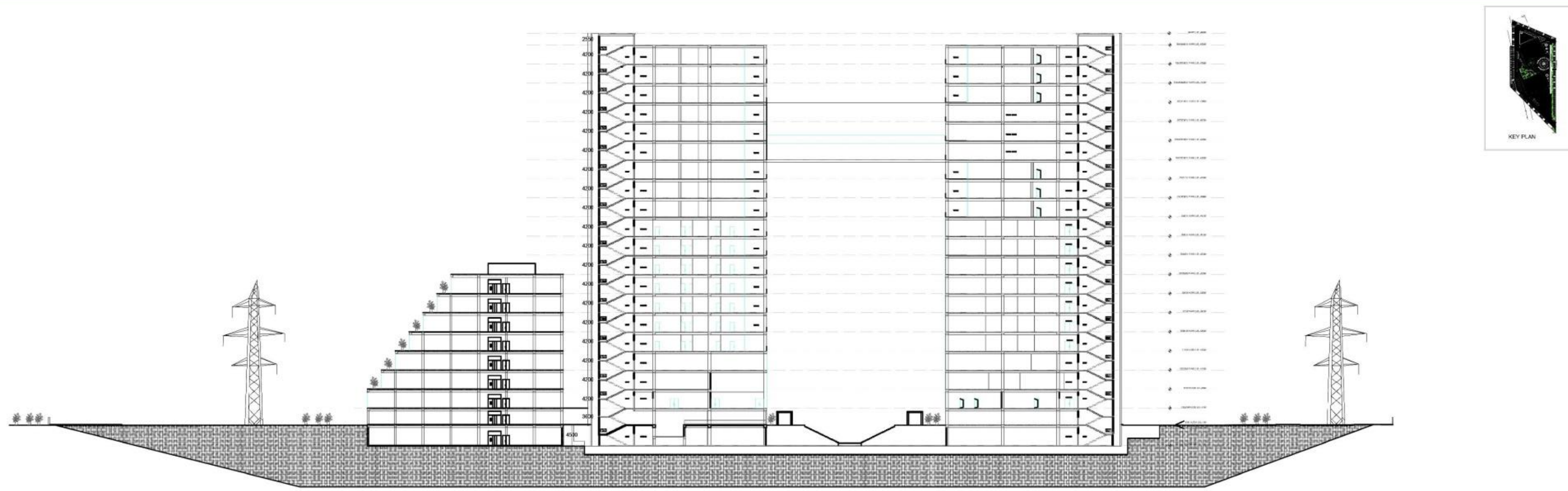
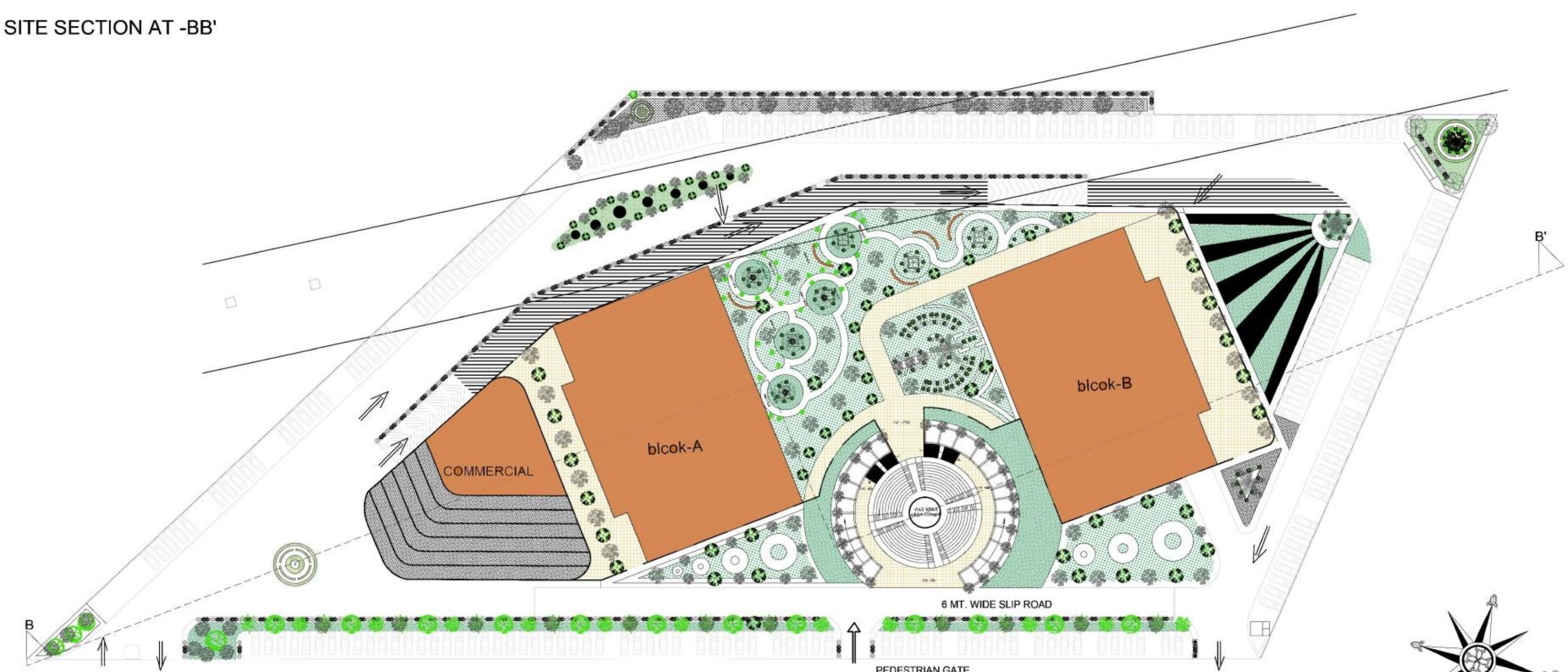
SITE SECTION AT BB'



SITE SECTION AT -BB'



SITE PLAN

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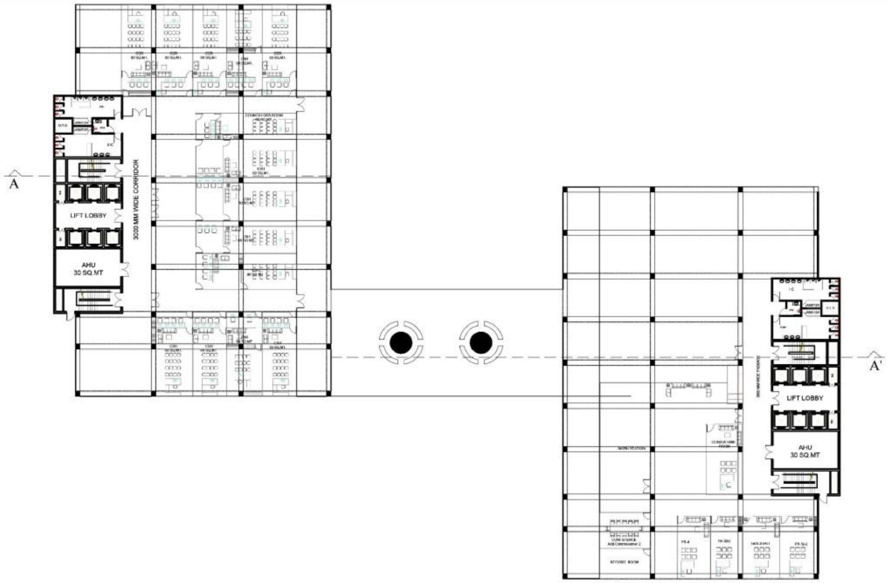
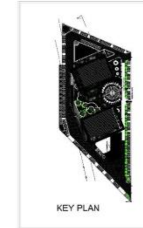
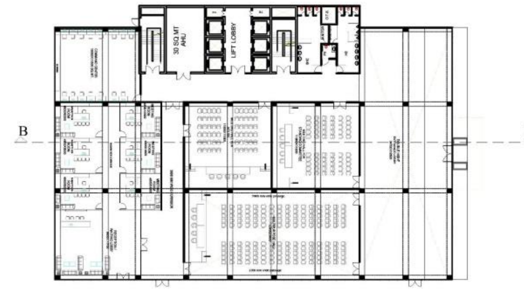
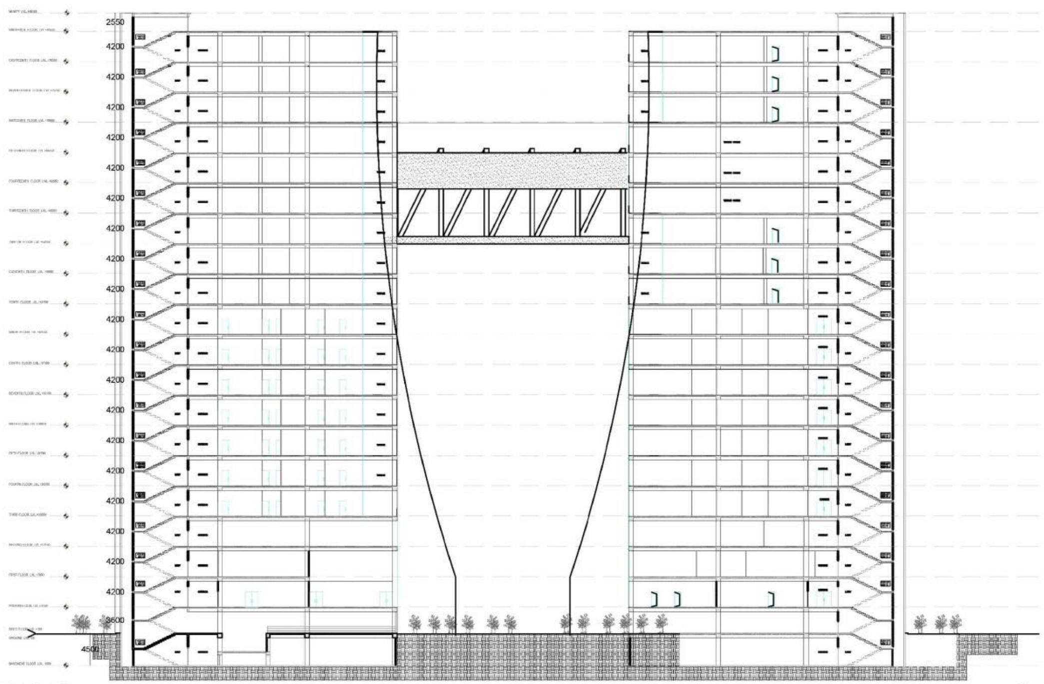
SECTIONS AT AA' & BB' OF BLOCK A & B

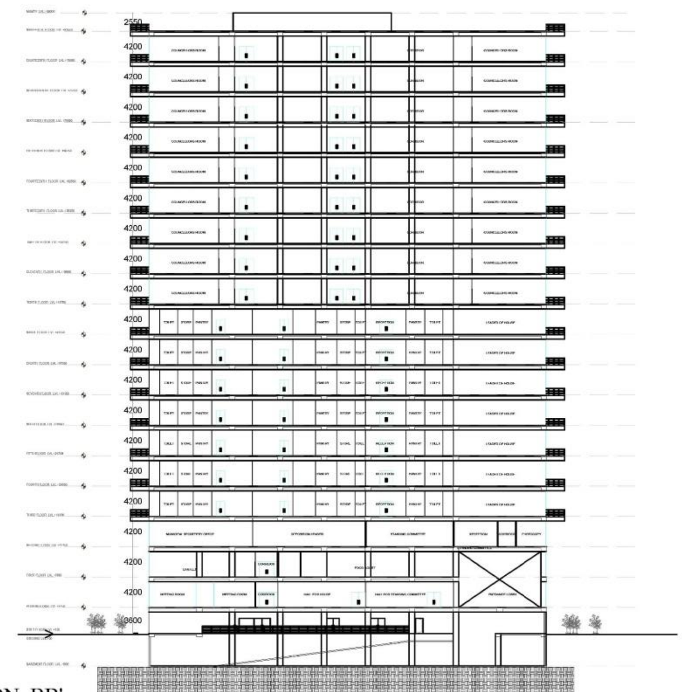








SECTION AA"



SECTION BB'

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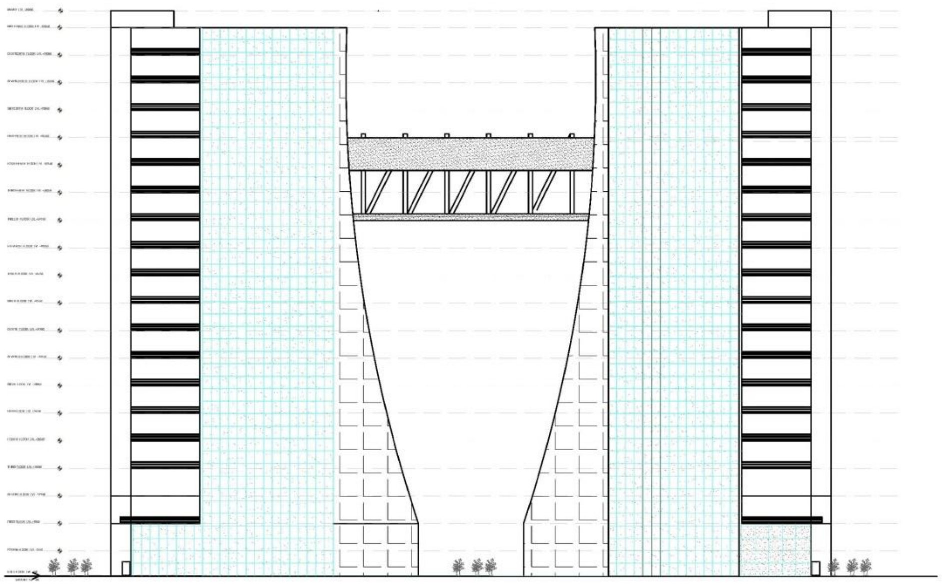
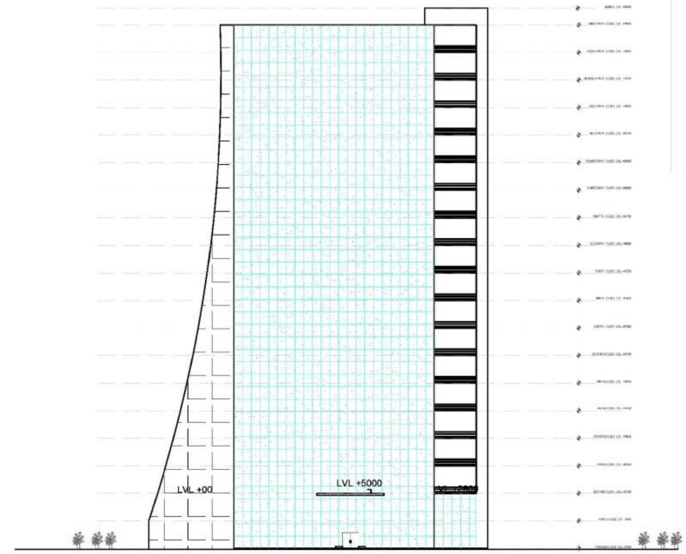
ELEVATIONS

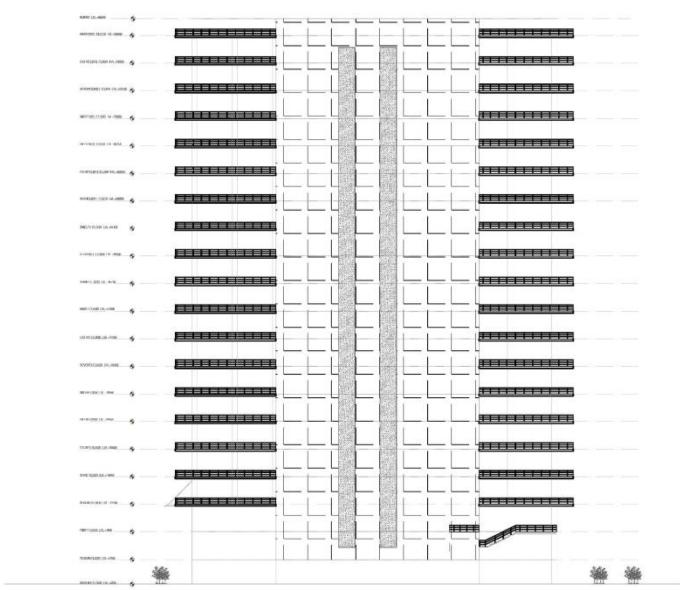


NORTH EAST SIDE ELEVATION

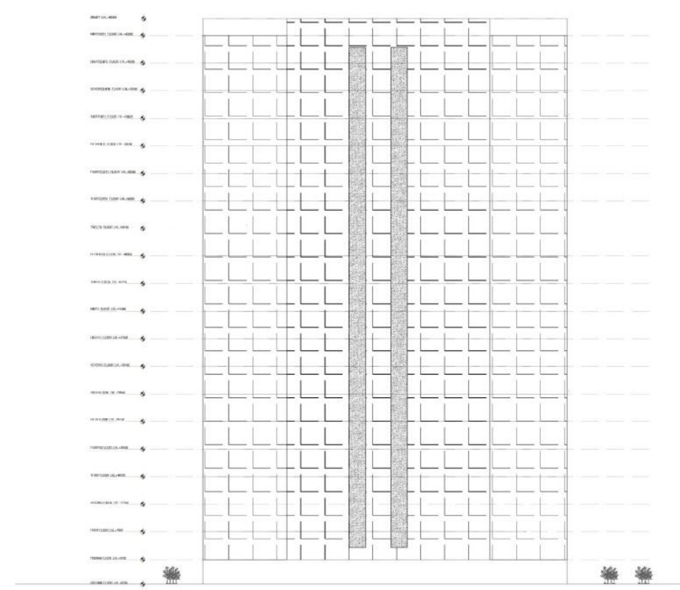


SOUTH WEST SIDE ELEVATION

KEY PLAN



SOUTH EAST SIDE ELEVATION



NORTH SIDE ELEVATION

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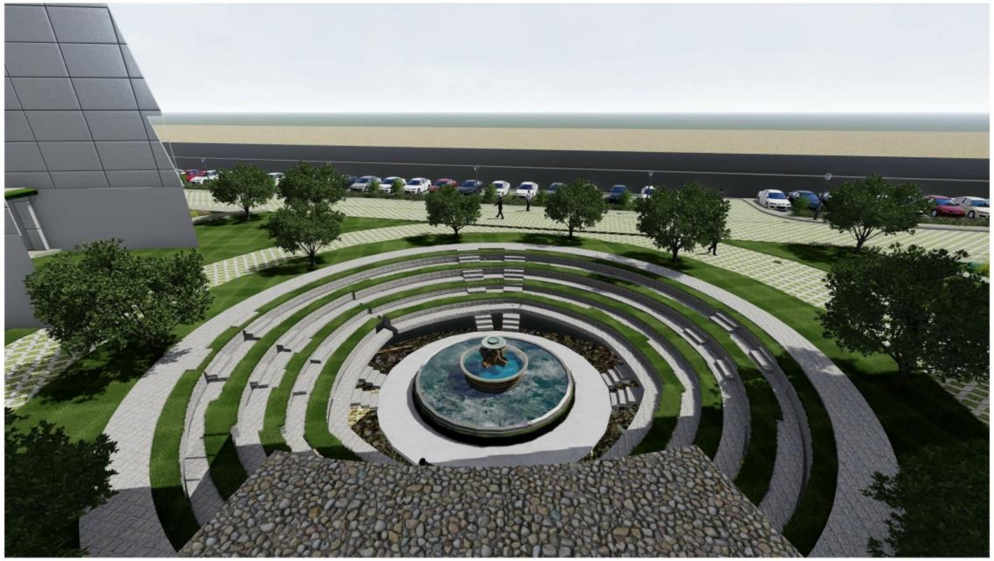
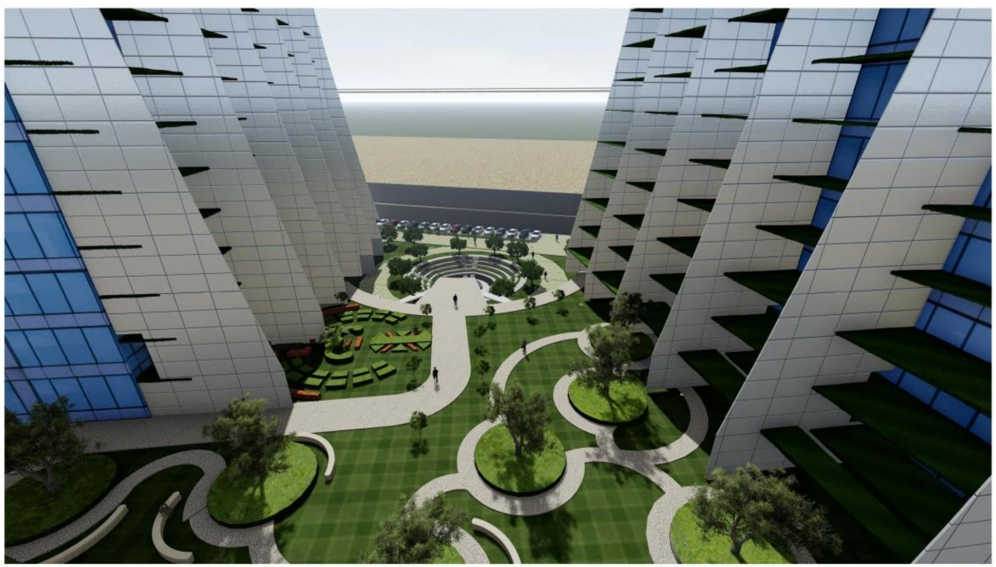
3D VIEWS





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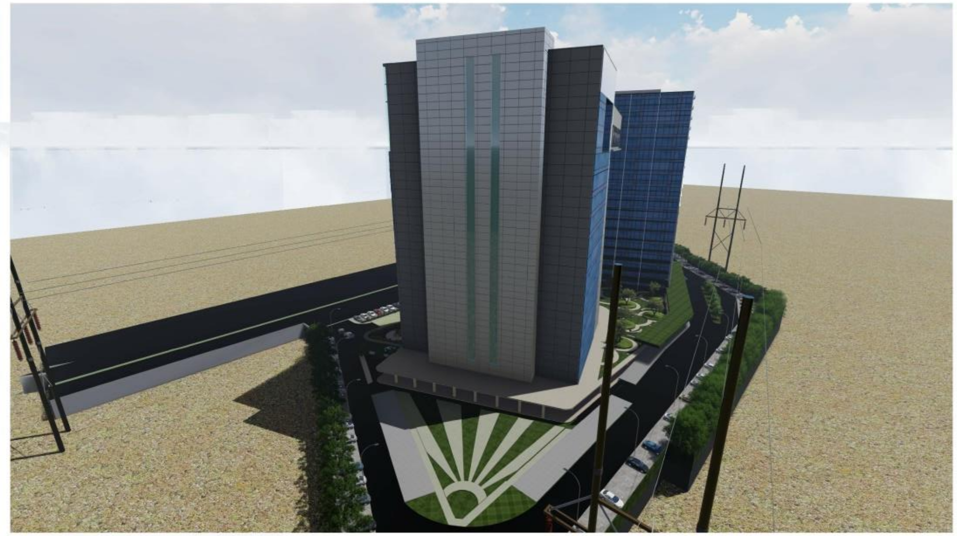
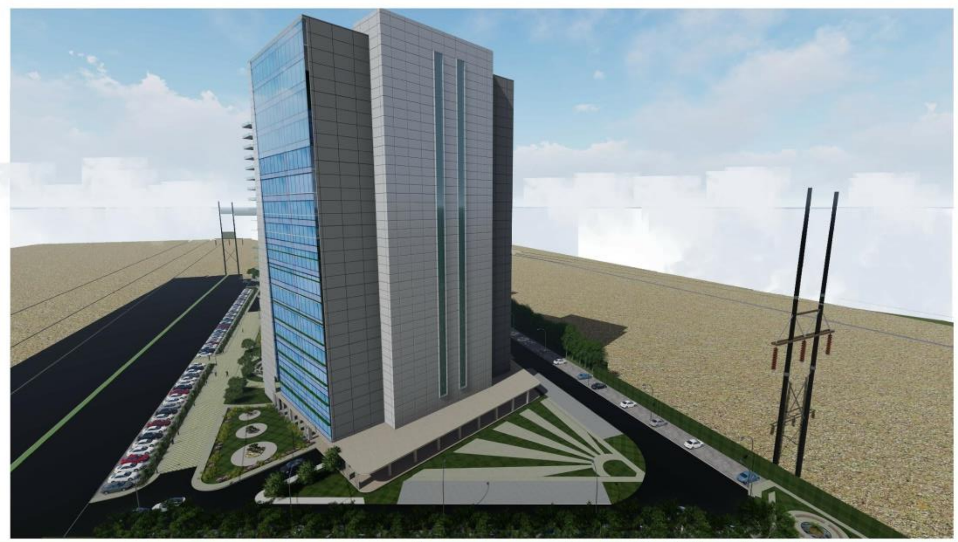
3D VIEWS





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