

THE ENERGY AND RESOURCE INSTITUTE
(Chennai)

A THESIS

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Architecture degree

By

DINESH CA
(39210020)



DEPARTMENT OF ARCHITECTURE
SCHOOL OF BUILDING AND ENVIRONMENT

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY) Accredited

With Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI,
CHENNAI - 600 119

MAY 2024



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BONAFIDE CERTIFICATE

This is to certify that Thesis Report is the bonafide work of **CA DINESH (39210020)** who carried out the Thesis entitled "**TERI CHENNAI**" under our supervision from December 2023 to May 2024.

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DECLARATION

I, **DINESH CA** hereby declare that the Thesis Report entitled "The Energy and Resource Institute (Chennai)" done by me under the guidance of **Ar.Catherine Selvaraj** (Internal Guide), **Ar.Mohana Gopiraj** (Internal Review Member) and **Ar.Maheshwaran** (External Guide) Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Architecture Degree.

DATE:

PLACE: Chennai



SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **Sathyabama Institute of Science and Technology** for their kind encouragement in doing this Thesis and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr.Devyani Gangopadhyay**, Dean and Head of the Department, School of Building and Environment, Our Design Chair **Dr.Suresh Kuppuswamy**, Thesis Coordinator **Ar.Mohana Gopiraj** for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Thesis Internal guide **Ar.Catherine Selvaraj**, Internal Review member **Ar.Mohana Gopiraj** and External Guide **Ar.Maheshwaran** their guidance, suggestions and constant encouragement which paved the way for the successful completion of my Thesis work.

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DINESH CA

THESIS SYNOPSIS

This thesis project delves into the intersection of sustainable design principles and the impactful work of The Energy and Resources Institute (TERI). By exploring how architectural design can serve as a tool to translate TERI's mission into a tangible physical environment, the project aims to make a significant contribution to the field of sustainable architecture.

Several potential avenues exist for this exploration. One approach could involve designing a brand new headquarters for TERI itself. This headquarters would become a physical manifestation of TERI's commitment to sustainability, incorporating cutting-edge features like energy-efficient building materials, renewable energy sources, and design elements that promote natural light and ventilation. The design would prioritize not only environmental sustainability but also social sustainability, fostering a collaborative and innovative work environment for TERI's staff.

Alternatively, the project could focus on reimagining existing TERI facilities. This might involve retrofitting existing buildings to achieve greater energy efficiency or incorporating new sustainable technologies like rainwater harvesting or solar panel arrays. This approach would showcase the potential for existing structures to be transformed into models of sustainability.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Chennai, a rapidly growing metropolis, faces significant challenges in securing its energy future and managing its resources responsibly. This thesis project proposes the design of an Energy and Resource Institute (ERI) dedicated to addressing these critical issues. This project envisions the ERI as a beacon of innovation, catalyzing Chennai's transition towards a more sustainable and resilient future.

TERI commits itself to academic excellence and will provide an environment that will encourage both personal and intellectual growth through teaching, creating, and sharing knowledge.

TERI offers various courses and programs through its TERI School of Advanced Studies (TERI SAS) located in New Delhi. These courses cover a wide range of topics related to sustainable development, environmental studies, and related fields.

1.2 NEED OF THE PROJECT

Research and development: Conducting cutting-edge research on renewable energy technologies, energy efficiency solutions, and sustainable resource management practices.

Education and training: Providing comprehensive educational programs to foster a skilled workforce in the energy and resource sector.

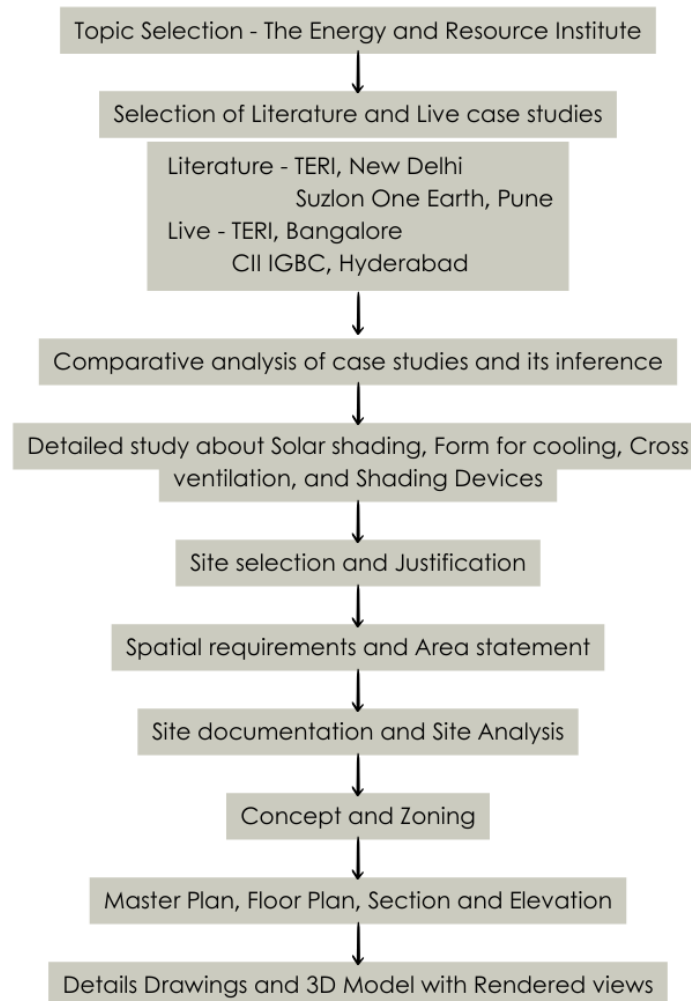
Outreach and community engagement: Raising public awareness about energy conservation, resource sustainability, and promoting responsible energy consumption practices.

1.3 AIM AND OBJECTIVE

The primary aim of this project is to design a comprehensive Energy and Resource Institute (TERI) for Chennai that addresses the city's critical energy needs and resource management challenges.

- (a) Achieving net-zero energy consumption
- (b) Implementing water conservation strategies
- (c) Promoting sustainable waste management practices

1.4 METHODOLOGY



CHAPTER 2

LITERATURE CASE STUDIES

2.1 TERI – BANGALORE

Location - Bangalore, India

Building type - Institutional

Area – 26,663 Sq.ft

2.1.1 ABOUT:

The Energy and Resources Institute, Bangalore is among South India's first energy-efficient and environmentally sustainable campuses. It houses work spaces for the staff, conference rooms, a library, a laboratory and a guest house. Dining and recreation facilities are shared between the offices and the guest house. It has the potential to serve as a model for future development in similar geographical and climatic conditions.

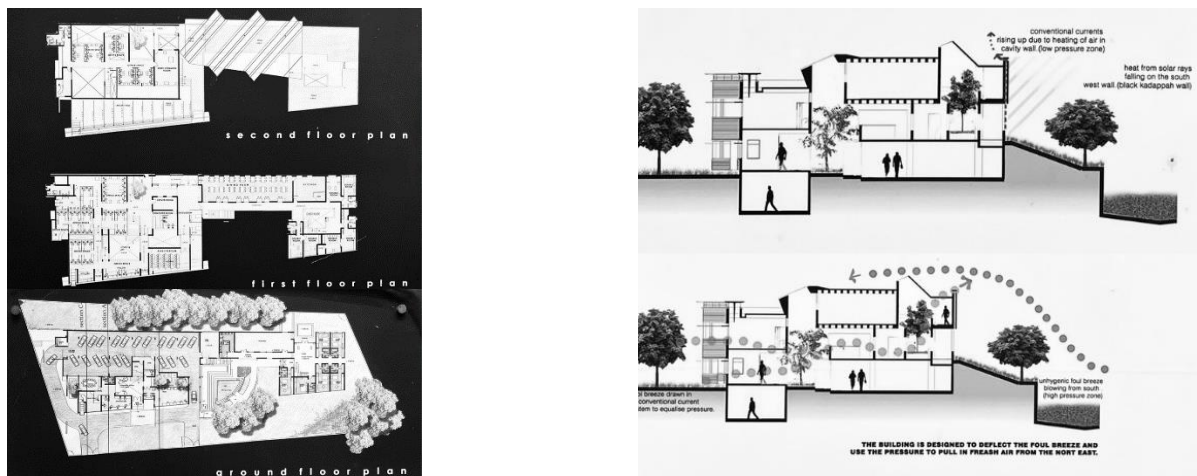


Fig 2.1: Plan & Section of TERI

2.1.2 MATERIAL & APPLIANCES:

As use of local materials reduces the energy consumed in their transportation, local materials and materials with low-embodied energy have been used wherever possible. The southern wall, for instance, is clad in local 'kadappa' stone. Energy-efficient lighting devices like CFL lights have also been used.

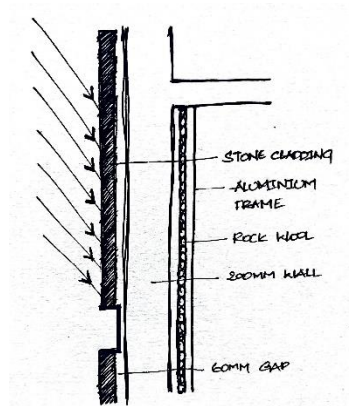


Plate 2.2: Cladding Wall Detail

2.1.3 VENTILATION:

A blank wall towards the south (facing the drain) allows the breeze to flow over the building. This creates a negative pressure which pulls fresh air from the north into the building.

The sections are designed such that hot air rises to the top and make the building breathe. Air in the cavity in the south wall on the south creates negative pressure, thereby enhancing the convection currents in the building.



Plate 2.3: Pictures of TERI

2.2 TERI – NEW DELHI

Location - New Delhi, India

Building type - Institutional

Area – 2 acres

2.2.1 ABOUT:

The TERI University established and constituted in 1998, dedicates itself to the study of environment, energy and natural resources for attaining the far-reaching goal of sustainable development. The campus is housed in a green building in New Delhi and is spread over two acres of land, and is one of the first in the country for a university and it further aims to minimize the ecological footprint.

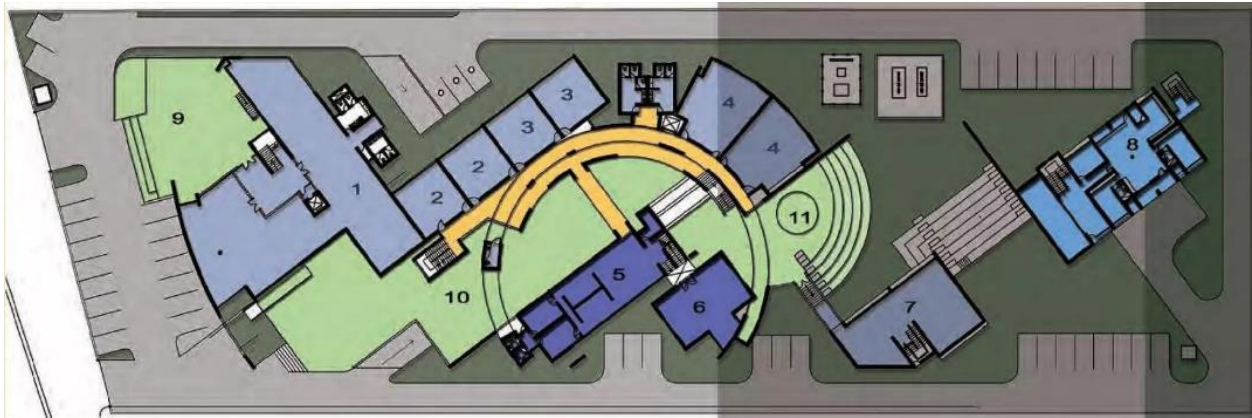


Fig 2.4: Plan of TERI, New Delhi

Elements of Design:

1. Sun
2. Sky
3. Air
4. Water
5. Earth



Fig 2.5(a),(b): Views of TERI, New Delhi

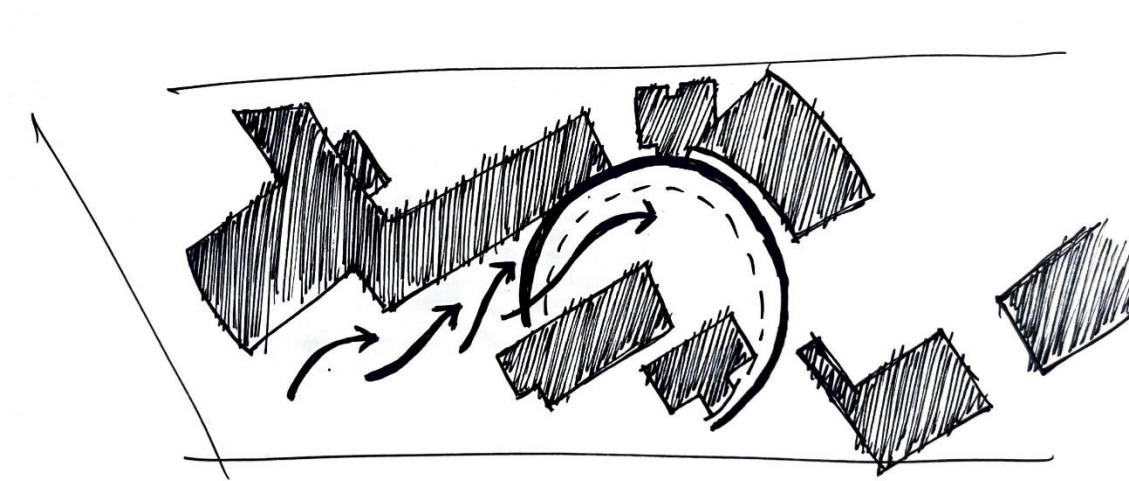


Fig 2.6: Air Circulation of TERI, New Delhi

2.2.2 ENERGY EFFICIENT LIGHTING:

Energy-efficient compact fluorescent lamps in the residential quarters, corridors, lobby & toilets.

The conference rooms enjoy glare-free daylight through skylights.

Time-based controls switch off lights at the present time.

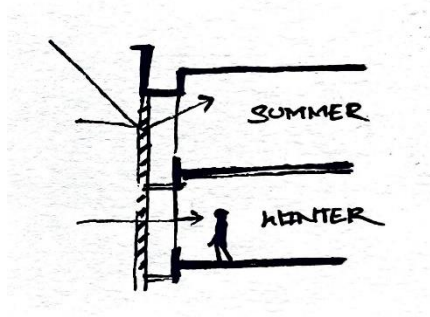


Fig 2.7: Façade Detail of TERI, New Delhi

The building on the campus is provided with low-flow fixtures such as dual flush toilets and sensor taps. This would result in 25% savings in water use.

2.3 CII IGBC – HYDERABAD

Location - Hyderabad

Type - Extensive

Area - 196019.95 Sq.ft

2.3.1 ABOUT:

This is India's greenest building and one of the most eco-friendly buildings in the world. Futuristic and energy-efficient, this unique building represents the changing face of an eco-friendly India. Located in Hyderabad, the CII-sohrajji Godrej Green Business Center received the prestigious LEED (leadership in energy and environmental design) platinum rating in 2003. The first LEED platinum-rated building in India - CII Godrej. This is the first platinum-rated green building outside the United States and the third building in the world to receive this rating.

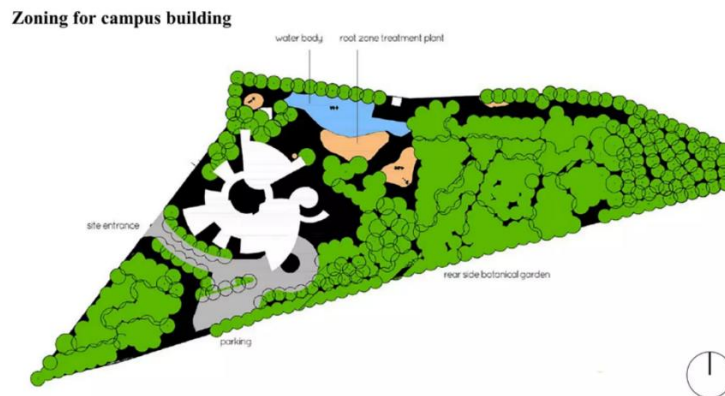


Fig 2.8: Master Plan of CII IGBC

2.3.2 MATERIALS & RESOURCES:

80% of materials are sourced within 500 miles of the site. Fly-ash bricks, glass, aluminum, and ceramic tiles, which contain consumer and industrial waste are used in construction. Office furniture made of bagasse-based composite wood. 96% of construction waste recycled within a building or sent to other sites & VOC - paints and adhesives used. The use of aerated concrete blocks for the facade reduces the load of air-conditioning by 15-20%.

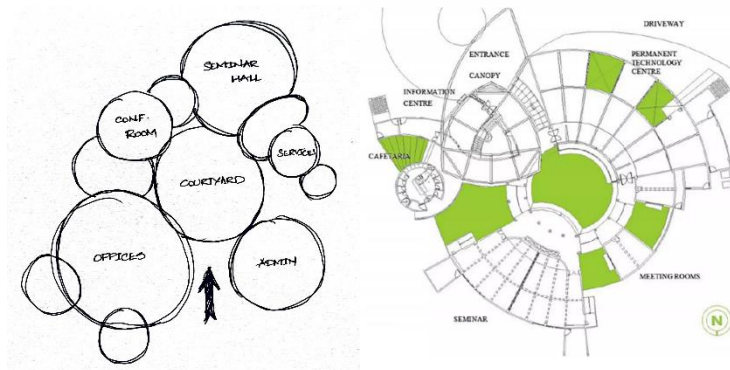


Fig 2.9 (a),(b): Zoning & Bubble Diagram of CII IGBC

The traditional India courtyard is built on the principles of vaastu shastra, which state that all spaces emerging from a single point, that is, the center of the house. All other activities revolve around this Centre, which has some divine power and energy associated with it. a courtyard acts as a bridge of common space for everyone and has many impacts social, security, privacy, micro-climate and articulation of space.

2.4 IIM – AHMEDABAD

Location - Ahmedabad, India

Type - Institutional

Built up area – 51,000 Sq.m

It was Balkrishna Doshi that believed Louis Kahn would be able to envision a new, modern school for India's best and brightest. Kahn's inquisitive and even critical view at the methods of the educational system influenced his design to no longer singularly focus on the classroom as the center of academic thought. The classroom was just the formal setting for the beginning of learning; the hallways and Kahn's Plaza became new centers for learning.

In much of the same ways that he approached the design of the National Assembly Building in Bangladesh, he implemented the same techniques in the Indian Institute of Management such that he incorporated local materials (brick and concrete) and large geometrical façade extractions as homage to Indian vernacular architecture. It was Kahn's method of blending modern architecture and Indian tradition into an architecture that could only be applied for the Indian Institute of Management.

2.4.1 MATERIALS:

Brick has been used as a primary building material for the entire complex walls, columns. Brick arches had been used for a wide spans. Use of concrete has been restricted to foundations, floor slabs, and ties for arches openings.

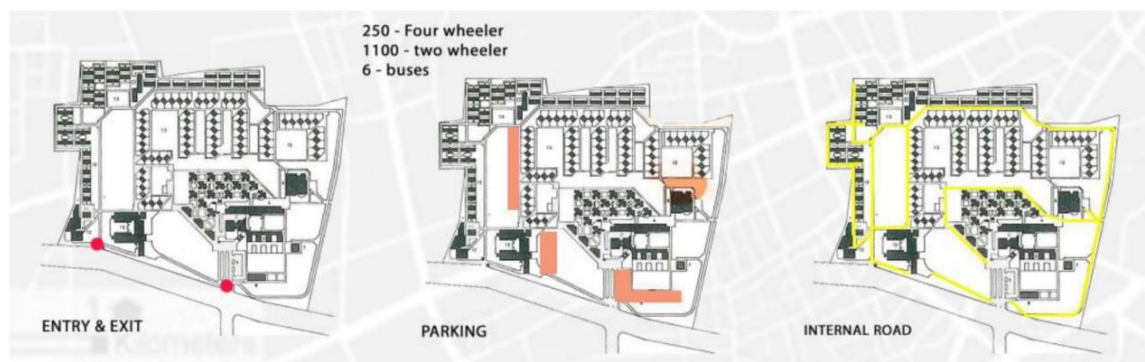


Fig 2.10: Plan of IIM Ahmedabad

2.4.2 VERTICAL CIRCULATION:

For easy access, new elevators have been installed including at the underpass that connects the new campus with the old. Elevators will be shortly installed for reaching classrooms. Two ramps per classroom have been built that take students directly into the class.



Fig 2.11: Pictures of IIM Ahmedabad

CHAPTER 3

SITE STUDY AND ANALYSIS

3.1 SITE STUDY:

Akkarai, nestled along the East Coast Road (ECR) in Chennai, India, is a charming sub locality known for its picturesque beaches, serene ambiance, and proximity to nature. It offers a unique blend of coastal charm, modern amenities, and historical significance, making it an attractive destination for tourists, residents, and investors alike.



Fig 3.1(a): Site Aerial View

3.2 SITE JUSTIFICATION AND FEASIBILITY:

Environmental Suitability: Unique coastal ecosystem, Renewable energy potential and Ecological restoration opportunities

Community Impact: Bridging knowledge gap, Live-in labs and demonstration projects, Educational and training opportunities

Accessibility and Visibility: Prominent location on ECR, Connectivity to urban centers, Potential for tourism and eco-tourism

Research and Learning Potential: Diverse case studies, Climate change resilience and Collaboration with local stakeholders



Fig 3.2(a),(b),(c): Site views

3.3 SITE ANALYSIS:

3.3.1 Neighborhood Context:

Site has single side road axes. which is from main highway road OMR – ECR connecting road. There is a gated residential to the west at a distance of 20 meters. Opposite to the site there are some commercial shops. In the east there are some residences throughout the street road.



Fig 3.3: Site Neighborhood

3.3.2 Site and Zoning:

Setbacks – South (Front) - 6m
 East - 6m
 West - 6m
 North - 6m

Height restriction – 18.5m

Parking - 1 car space for every 100sq.m of floor area or part thereof and 1 two-wheeler space for every 30sqm of floor area or part thereof.

FSI – 2.0

3.3.3 Land Use Map:

Selected site comes under Restricted Development Area. Permissible with special sanction of the CMDA.

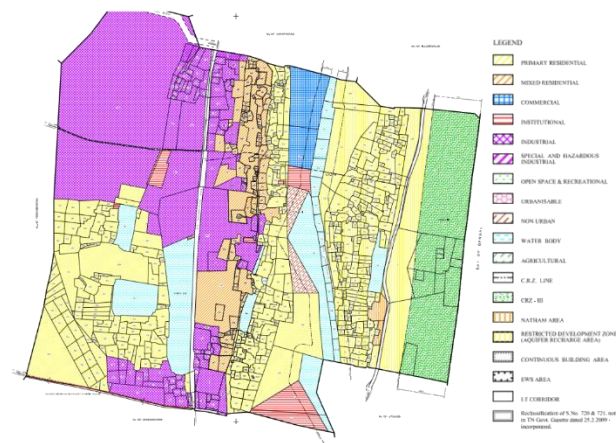


Fig 3.4: Land use Map

3.3.4 Site Features:



Fig 3.5 (a),(b),(c),(d),(e): Site Features

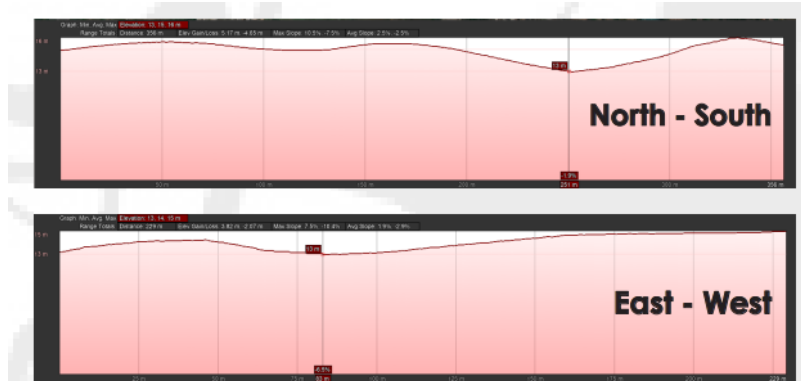


Fig 3.6: Site slope section

3.3.6 Climate of Chennai:

Warm and Humid: Chennai experiences a tropical savanna climate with warm temperatures year-round and distinct dry and wet seasons.

Average Temperatures: May (Hottest): Around 89°F (32°C) January (Coolest): Around 77°F (25°C)

Rainfall: Annual Average: Approximately 50 inches (1,250 mm)

Rainy Season: October to mid-December

Winds: Southwesterly winds dominate from May to September, bringing moisture and occasional cyclones.

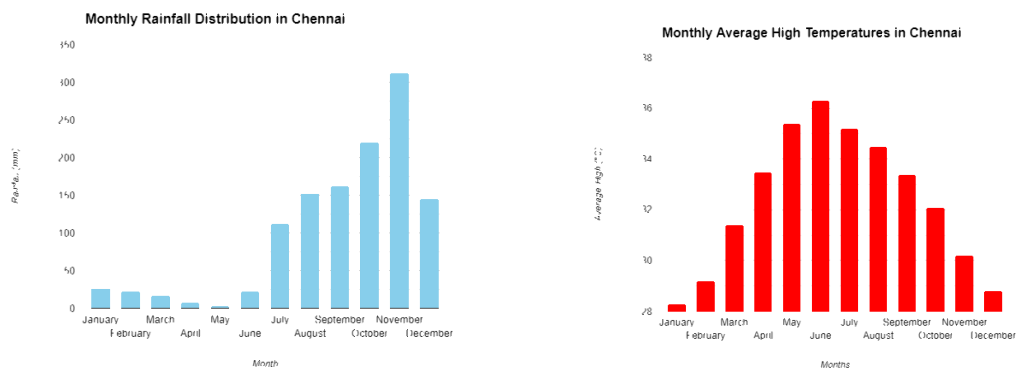


Fig 3.7: Climatic data of Chennai

CHAPTER 4

ARCHITECTURAL DESIGN

4.1 SPATIAL REQUIREMENTS

TERI, Chennai	Units	Area in Sq.mt	Total
Admin & Control			
Vestibule	1	50	50
Lobby	1	65	65
Admin Office	3	30	90
Education Head	1	25	25
Directors Office	1	25	25
Staff Room	1	65	65
Restroom	1	80	80
Pantry	1	25	25
			425
Institute			
Classrooms	36	55	1980
Laboratories	16	-	1120
Discussion Hall	2	200	400
Multipurpose Hall	1	400	400
Informal sitting	3	-	120
Conference Hall	2	65	130
Restroom	5	80	400
			4550
Library & Resource centre			
Library	1	750	750
Resource centre	1	55	55
Private Reading Room	1	55	55
Restroom	1	20	20
Store Room	1	20	20
			900
Event Centre			
Exhibition Hall	2	350	700
Gallery	2	110	220
Restroom	1	80	80
			1000
Sports Ground			
Sports Ground	1	1750	1750
Fitness Centre	1	350	350
Amphitheatre	1	600	600
Lawn	1	150	150
			2850
Cafeteria			
Dining area	1	100	100
Rooftop Dining area	1	250	250
Washing area	1	50	50
Kitchen	1	65	60
Serving Station	1	30	30
Handwash Area	1	20	20
			510
Accommodation			
Twin Bed Room	41	38	1560
Loung Area	1	100	100
Dining Area	1	60	60
Pantry	1	20	20
			1740
Parking			
Stilt Parking	1	900	900
Parking for Disabled	1	100	100
Visitors Parking	1	160	160
Service Parking	2	80	160
			1320
Total Area			13,295

Fig 4.1: Area requirements

4.2 CONCEPT

4.2.1 CLIMATE RESPONSIVE DESIGN

(Warm & Humid Climate)

Understanding the Local Climate, Passive Design Strategies, Building Envelope Design, Building Orientation and Material Selection.

Climate-responsive design for sandy soil in Akkarai, Chennai presents a fascinating challenge. Here are some ideas to consider for the project concept: to sunlight and also allows the interior to receive ample amounts of indirect natural light and help preventing solar heat gain

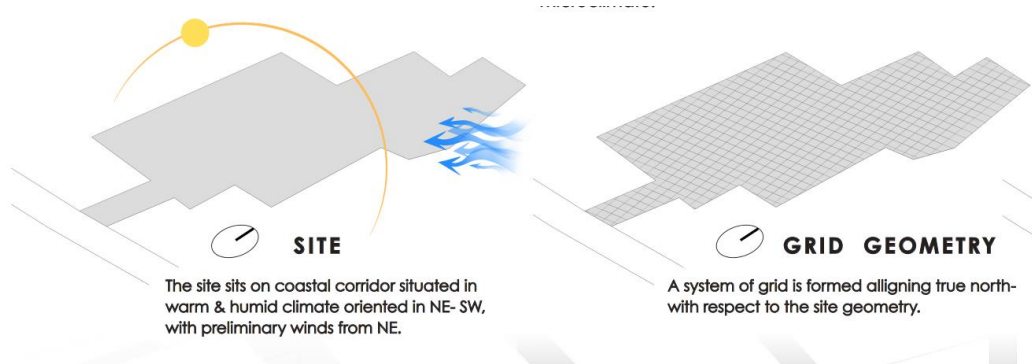


Fig 4.2: Design Evolution (a),(b)

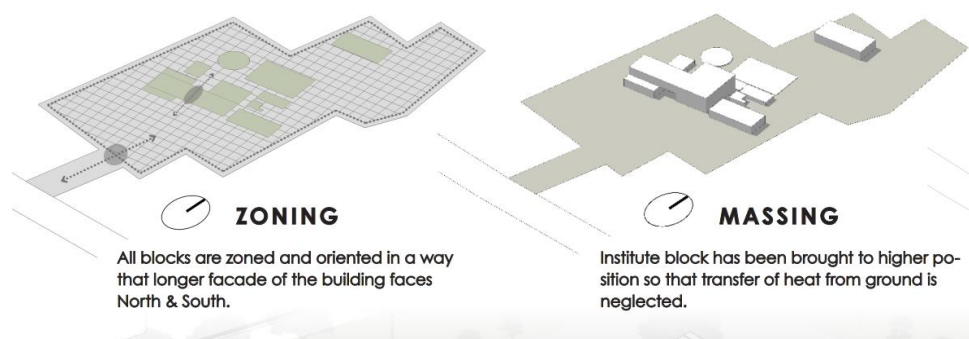


Fig 4.2: Design Evolution (c),(d)

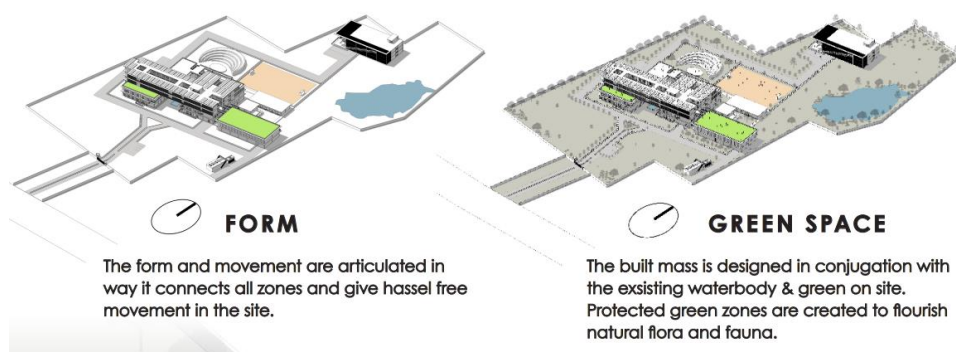


Fig 4.2: Design Evolution (e),(f)

4.2.2 Passive design strategies:

Maximize Natural Ventilation: Design with cross-ventilation principles to encourage air circulation. Utilize wind catchers and strategically placed openings to harness prevailing winds.

Shading Devices: Implementing deep overhangs, strategically placed trees, or louvers to block harsh sunlight and reduce heat gain within the building.

Courtyard Design: Courtyards or light wells to promote air circulation and natural light penetration.

Evaporative Cooling: Incorporating natural or mechanical evaporative cooling techniques to create a cooler microclimate.

4.2.3 Building Materials :

High Thermal Mass Materials: Utilize materials like brick, stone, or concrete for walls and floors to absorb and release heat slowly, providing a buffering effect. **Light-colored Reflective Roofs:** Opt for reflective or vegetated roofs to minimize heat absorption.

4.2.4 Concept Sketches:

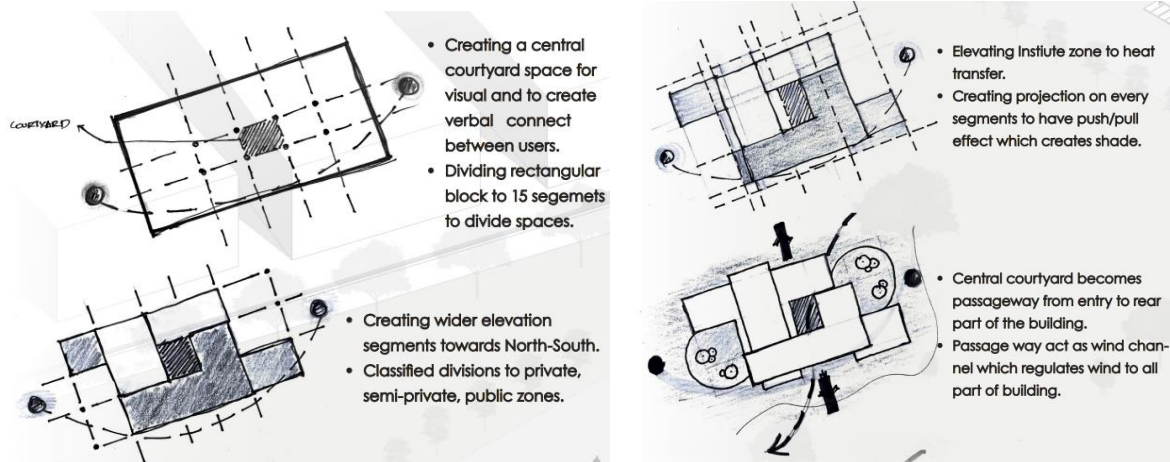


Fig 4.3 (a),(b): Conceptual sketch of design evolution

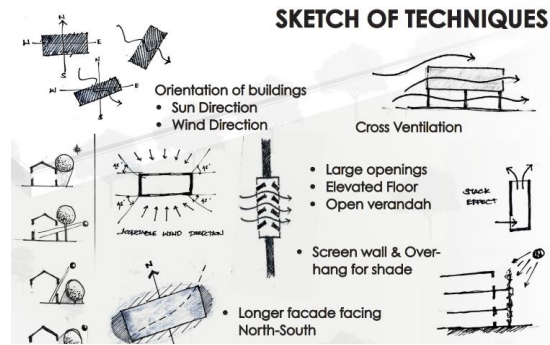


Fig 4.4: Sketch of techniques

4.2.5 Bubble Diagram & Zoning:

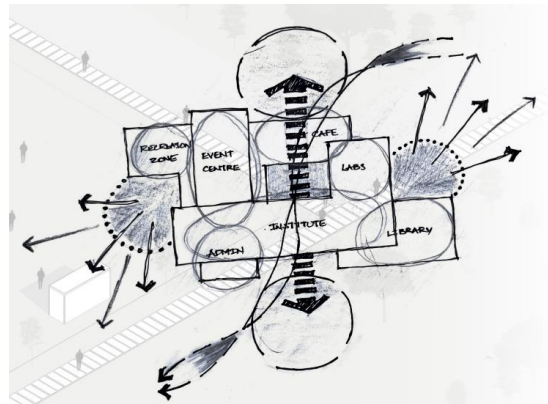


Fig 4.5: Bubble Diagram

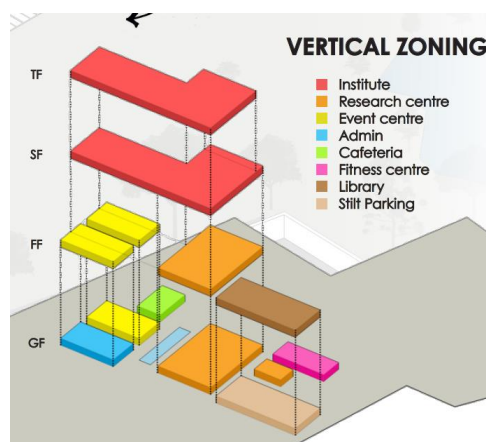


Fig 4.6: Vertical Zoning

4.3 DETAILED DRAWINGS

4.3.1 Site plan:

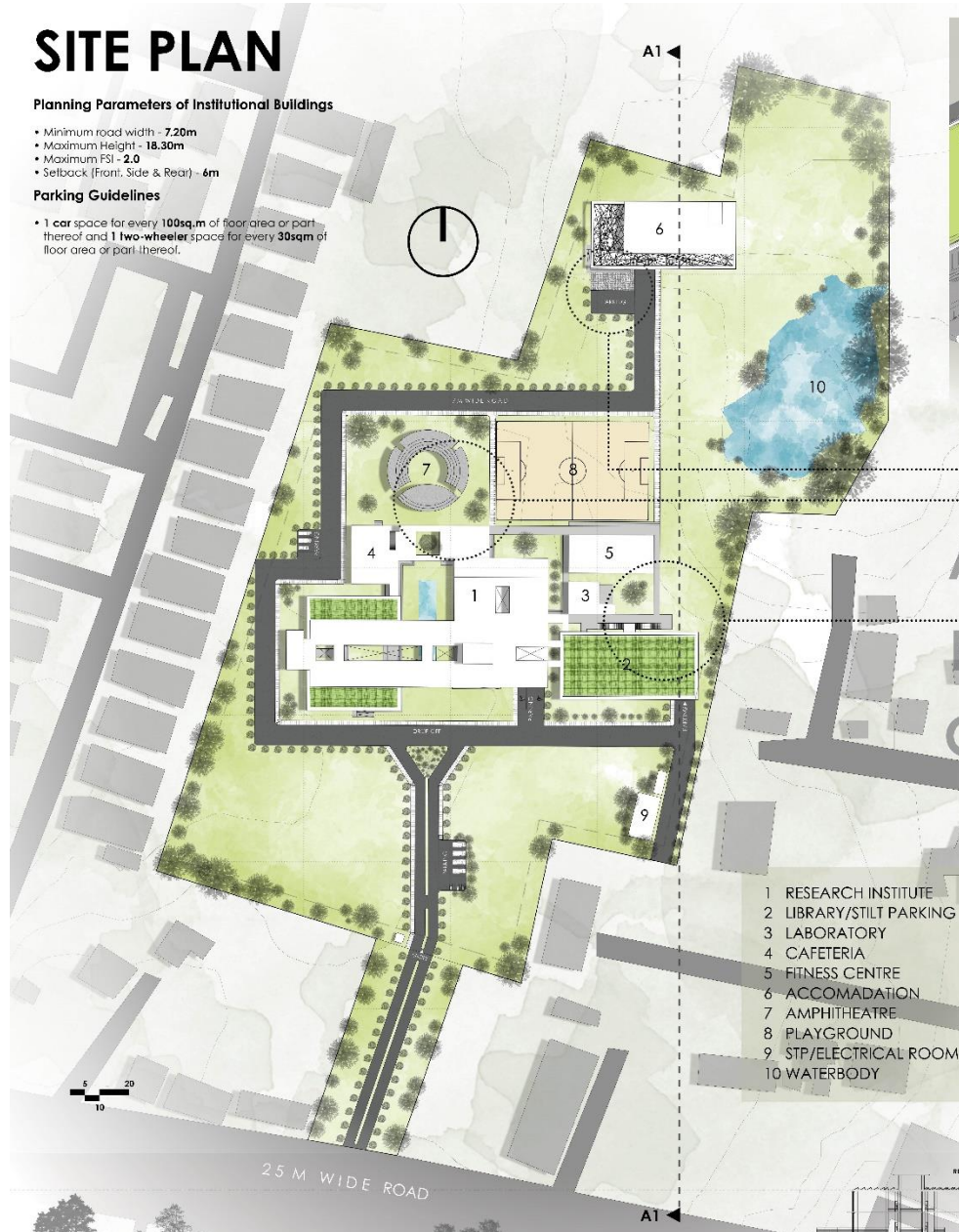


Fig 4.7: Site plan, and section



Plate 4.1: Research Institute (a)

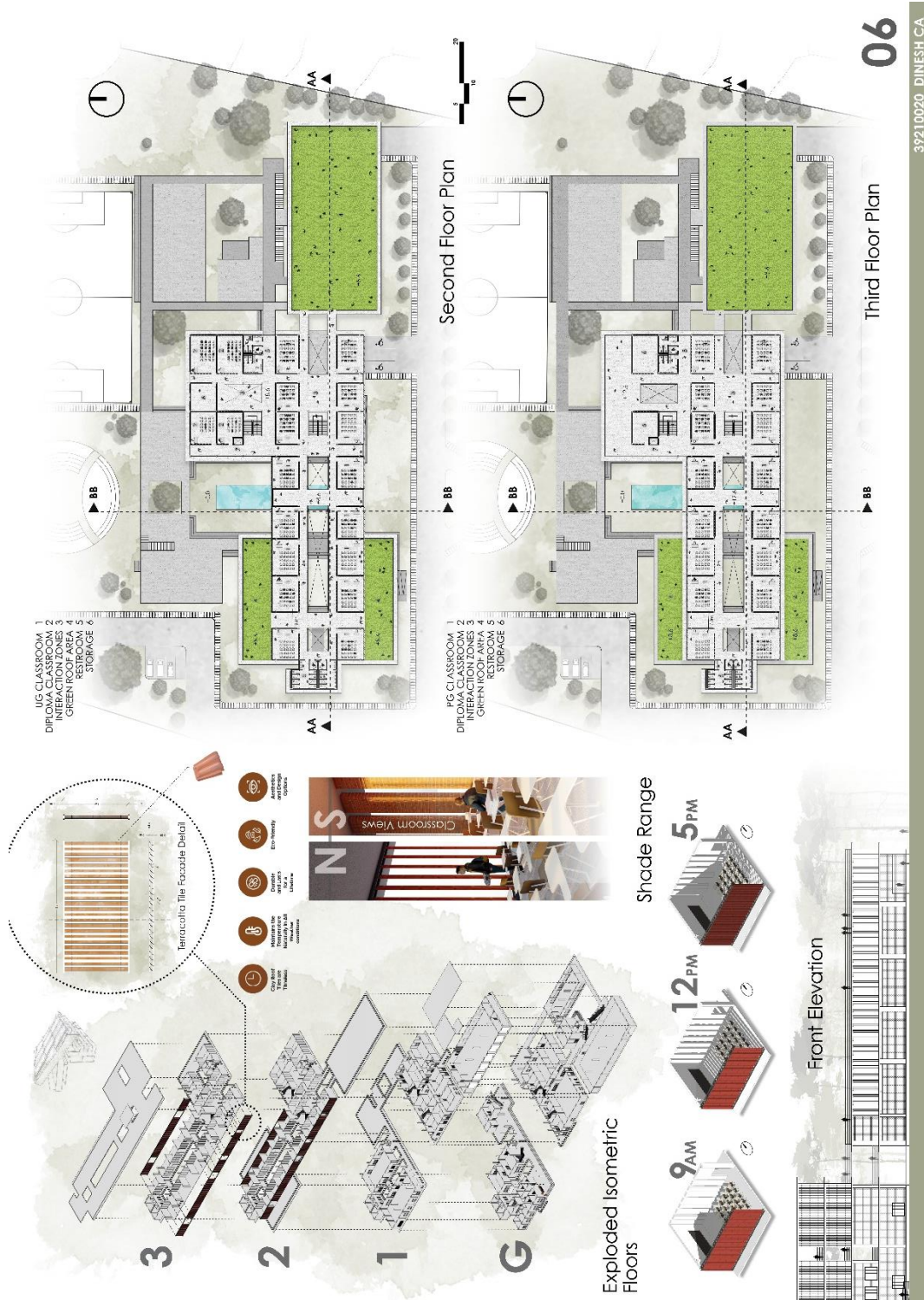
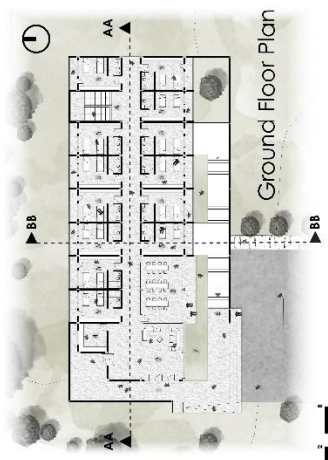


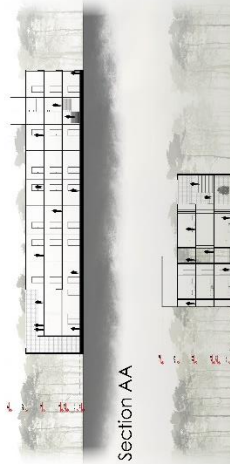
Plate 4.2: Research Institute (b)

ACCOMADATION

- 1 LOBBY
- 2 LOUNGE AREA
- 3 PANTRY AREA
- 4 PANTRY
- 5 ROOMS
- 6 STAIRCASE
- 7 PANTRY AREA
- 8 SEATING SPACE



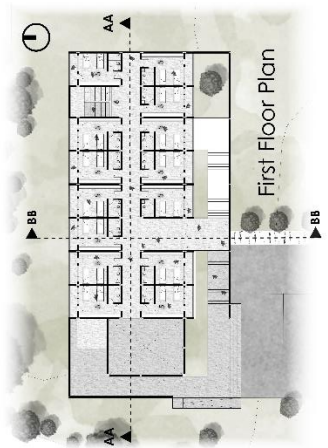
Ground Floor Plan



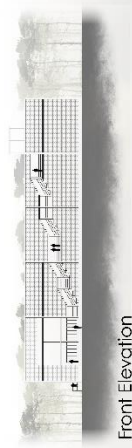
Section AA



Section BB



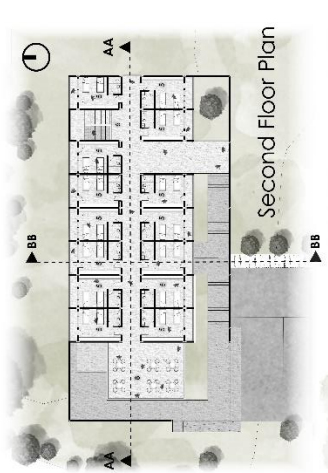
First Floor Plan



Front Elevation

Accommodation block sets on rear part of the site which is connected through road and pedestrian walkway from Institute.

The accommodation is planned to host around 80 guests which includes scientists, researchers, environmentalists, lecturers and many who come to visit the energy and research institute.



Second Floor Plan



Exploded Isometric

Staircase that connects all three floors has been planned for hassle free movement around the building. Also there is a central staircase which is as low with landscape and helps in heat exchange between interior & exterior.



07

BATCH 2019 - 2024

Plate 4.3: Accommodation

SA Credit 01 - Integrated Design Approach - 1 Point
 Ensuring that the project involves the following parties: team members, as applicable, at each stage of the project.

- 5A Credit 02 - Site Preservation - 2 Points
- Existing Topography / Landscape Retain at least 100% of the existing topography / landscape, without any disturbance whatsoever.
- 5B Credit 02 - Site Preservation - 2 Points
- Existing Trees: Design to integrate trees with new development, so as to preserve 75% of existing trees.
- Water Bodies and Channels: Retain 100% of water bodies and channels existing on the site.
- 5C Credit 02 - Business Accessibility - 2 Points

ASP Credit 31 • Basic Amenities • 1 Port
ATM / Bank • HFC Bank-ATM (50m)
Clinic / Hospital • Al-Mo'ayyad Health & Wellness Center (1km)
Grocery store / Supermarket • Five Star Supermarket (50m)
Park / Garden • Qadi Garden (40m)
Pharmacy • Apollo Pharmacy (40m)
Restaurant / Cafeteria • Al-Qadi Restaurant (20m)
Sports club / Fitness center / Gym • Al-Fitness Studio (50m)

WVA Credit 01: Landscape Design - 2 Points
Designed irrigation to ensure minimum water consumption. (Native Plants)
WVA Credit 02: Management of Irrigation System - 1 Point
Reference water demand to irrigation "tracking" water meter management.
Irrigation system must be installed and maintained.
Control Irrigation
Soil moisture sensors integrated with irrigation system
At least 75% of landscape pinning beds must have a auto irrigation system to reduce evaporation
Time based controller for the valves such that evaporation rate is minimized
Pressure regulating device(s) to maintain optimal pressure to prevent water loss

- WA Credit 03 - Rainwater Harvesting Roof - Non Roof - 2-4 Points
WA Credit 04 - Water Efficient Plumbing Fixtures - 1-5 Points
WA Credit 05 - Waste Water Treatment & Reuse - 1-5 Points
WA Credit 06 - Water Metering - 1-2 Points

- EE Credit 01 - Eco Friendly Refrigerants - 1 Point
- EE Credit 02 - Enhanced Energy Efficiency - 1-15 Points
- EE Credit 03 - Onsite Renewable Energy - 2-8 Points
- EE Credit 04 - Off-site Renewable Energy - 1-2 Points
- EE Credit 05 - Commissioning, Post-Installation of Equipment & Systems - 1-2 Points
- EE Credit 06 - Energy Metering & Management - 1-2 Points

Shillinganallur Water Tank - (300m)

- Option 2: Charging Facilities for Low-emitting Vehicles
Charging facilities for low-emitting vehicles, such as electric vehicles, at the site. In order of use, 5% of the total parking capacity has been provided.
- SSP Credit 04 - Natural Topography or Vegetation - 2 Points
The site is avoiding disturbance to the site by retaining natural topography and/or design vegetated spaces on the ground, for up to 20% of the site area.
- SSP Credit 05 - Preservation of Topical Anticipation of Trees - 1 Point

-

Option 2: Covered Parking Provided up to 80% of the parking spaces under cover.

- SSS' Credit 09 - Universal Design: 1 Point
 Ensuring that the building design caters to differently abled and

IGBC GREEN BUILDING GUIDELINES:

IGBC Green New Buildings rating system® addresses green features under the following categories:

- Sustainable Architecture and Design
- Site Selection and Planning
- Water Conservation
- Energy Efficiency
- Building Materials and Resources
- Indoor Environmental Quality
- Innovation and Development

City of origin	Number of visitors	Number of arrivals	Number of departures
London	100 000	100 000	100 000
Paris	50 000	50 000	50 000
Los Angeles	10 000	10 000	10 000
Other	40 000	40 000	40 000
Total	200 000	200 000	200 000

BMR Credit 01 - Sustainable Building Materials - 1-8 Points
BMR Credit 02 - Organic Waste Management, Post-occupancy - 1-15 Points
BMR Credit 03 - Handling of Waste Materials, During Construction - 1 Point
BMR Credit 04 - Use of Certified Green Building Materials, Products & Equipment - 1-5 Points

IEQ Credit 01 - CO₂ Monitoring - 1 Point
EQ Credit 02 - Daylighting - 1/2 Points
EQ Credit 03 - Outdoor Views - 1 Point
IEQ Credit 04 - Minimize Indoor and Outdoor Pollutants - 1 Point
IEQ Credit 05 - Low-emitting Materials - 1-3 Points
IEQ Credit 06 - Occupant Well-being Facilities - 1 Point
IEQ Credit 07 - Indoor Air Quality Testing, After Construction and Before Occupancy - 2 Points
IEQ Credit 08 - Return Air Quality Assessment - 2 Points

ID Credit 01 - Innovation in Design Process - 1-4 Points
ID Credit 02 - Optimisation in Structural Design - 1 Point
ID Credit 03 - Waste Reduction for Construction - 1 Point

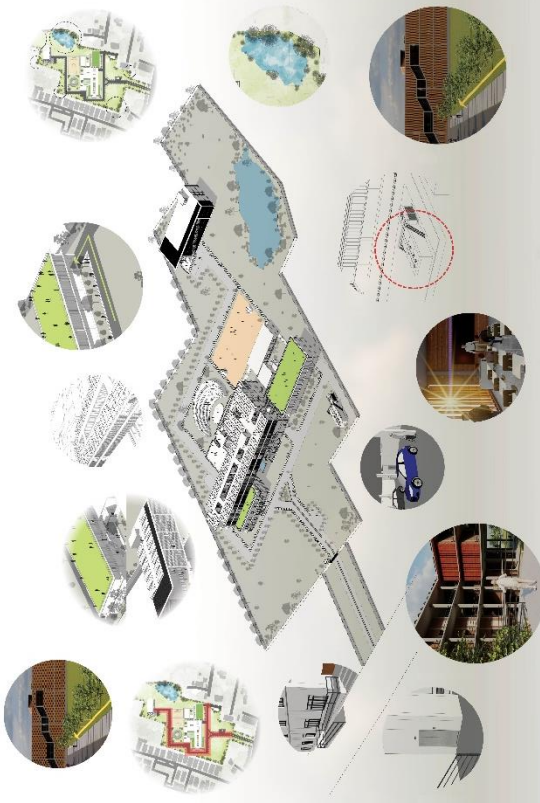


Plate 4.4: Certification

4.4 MODEL:



Fig 4.8: Views of Research Instiute



Fig 4.9: Views of Accomadation Block

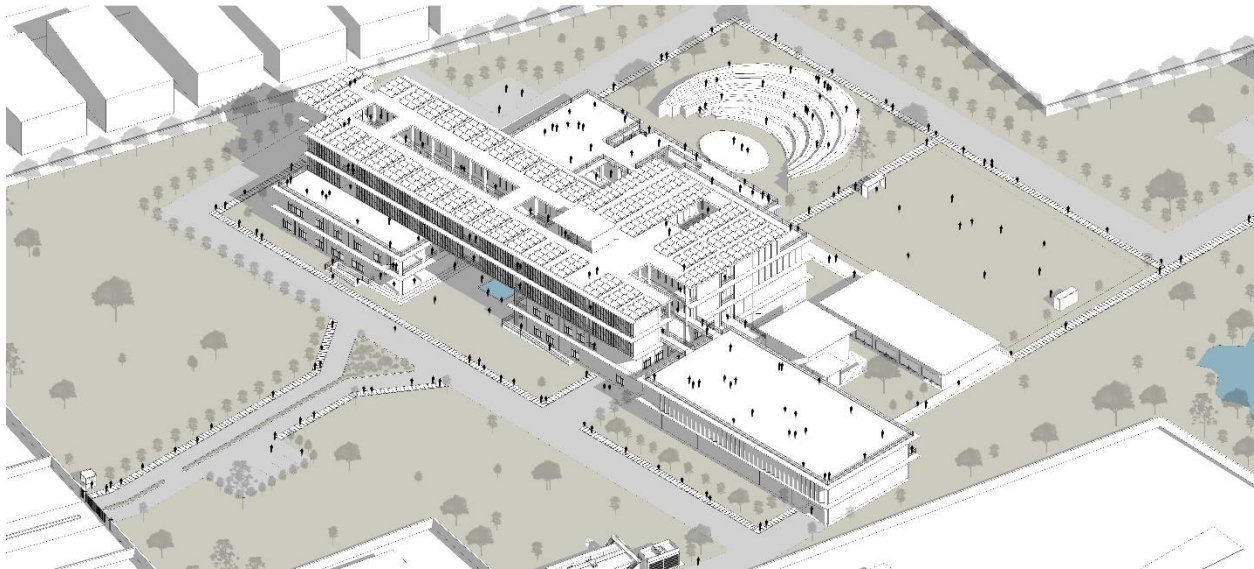


Fig 4.10: Overall view of TERI, Chennai

CHAPTER 5

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