Tender No. SBI/AMR/P&E/2025-26/08/12 **29.08.2025**

PART- D: DESIGN BASIS REPORT

CONSTRUCTION OF BUILDING FOR AO, SBILD & OTHER OFFICES AT TIRUPATI IN EPC MODE.

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SECTION 1 – PROJECT OVERVIEW

Project Title: Design and Construction of SBI Building for AO, SBILD and Other Offices at Tirupati.

Location: Sy. No. 189/1 (Part), 195/1 (Part), 223 (Part), Chennaiahgunta, Tirupati,
Andhra Pradesh – 517501

Executive Summary: State Bank of India (LHO Amaravati) proposes to develop a modern, future-ready Institutional Campus at Tirupati.
The project will be executed under the EPC (Engineering, Procurement, and Construction) mode and aims to deliver a high-performance, sustainable, and low-maintenance built environment for SBI's training, operational, and staff support infrastructure.

The project encompassing a **total built-up area of 16,009 square meters**, featuring the following components:

- The Block I Administrative Office Building of up to B+G/ Partial Stilt +4 floor ,
- The Block II SBILD & Hostel Block Building of B+ G / Partial Stilt + 4 floors.
- The Block III Dining & Library building of B + G + 1 floors.
- Central landscaped areas designed with small Amphitheatre and community recreation.

This site is supported by a robust infrastructure framework that includes Common basement parking and a stilt floor, ensuring efficient and seamless movement for both vehicles and pedestrians. The planning emphasizes functionality, comfort, and a strong connection to the natural environment, futher emphasized with the hill views. All buildings within the development shall be designed to meet the standards of the **IGBC platinum rating and BEE 5 *** Building, ensuring the highest standards of environmental performance and sustainability.

Project Objectives:
- Single-Point Responsibility through EPC delivery for efficient design, execution, and performance control
- Accelerated Construction Timeline without compromising on quality
- High Durability & Low Maintenance
- Energy-Efficient & Sustainable Design
- Integrated MEP and Smart Systems
- User-Centric Design
- Compliance with Statutory Approvals

Intent and Vision: The SBI Tirupati campus is envisioned to be a landmark institutional facility in Andhra Pradesh — a model of responsible infrastructure development combining sustainability, speed of execution, and intelligent building systems.

The architectural and engineering intent focuses on:
- Modern yet Contextual Design
- Smart Integration of Services (MEP, HVAC, Fire Safety, BMS)
- Landscape and Site Planning promoting ecological balance and well-being
- Ease of Operation & Maintainability

This campus shall stand as a symbol of SBI's trust, innovation, and institutional strength in South India by enhancing local iconic flavors

SECTION 2 – SCOPE OF EPC WORKS

1. Overview of EPC Scope

The scope of works under this EPC (Engineering, Procurement, and Construction) contract is comprehensive and includes the design, statutory clearances, construction, procurement, testing, commissioning, and handover of all facilities forming part of the **SBI Institutional Campus at Tirupati.**
The Contractor shall assume single-point responsibility for all project deliverables from inception to completion, including obtaining local approvals and fulfilling performance obligations post-handover.

2. Major Scope Components

a. Architectural and Engineering Design

Preparation of all design drawings and details (architectural, structural, MEP, and services)
- Design development based on conceptual drawings provided
- Integration of sustainability and energy-efficiency measures (targeting IGBC/BEE 5 STAR norms)
- Coordination and preparation of good-for-construction (GFC) drawings
- Preparation of coordinated shop drawings and as-built drawings

b. Statutory Approvals

- Preparation and submission of drawings for local authority approvals
- Liaison with municipal/statutory bodies to secure NOCs and building permits
- Coordination for fire NOC, lift license, pollution clearance, and occupancy certificate

c. Civil and Structural Works

- Site clearing, earthworks, excavation, and filling
- Foundations, plinth, superstructure (RCC/steel), slab casting, masonry, waterproofing
- Internal partitions, wall finishes, and roof works

d. Architectural Finishes

- Flooring, wall cladding, ceiling works, staircase finishes
- External façade treatments, including sun shading devices if required
- Joinery, doors, windows, and ironmongery

e. MEP Services

- Electrical HT/LT installations, panels, DBs, cabling, and light fixtures in common Landscaping.
- HVAC system including VRV/VRF/ as applicable **High side**
- Public health and plumbing works (cold/hot water, sewage, rainwater harvesting)
- Fire detection and suppression systems as per NBC/IS standards
- Building Management System (BMS), Access Control, CCTV, PA, and networking

f. Vertical Transportation

- Design, supply, and installation of passenger lifts
- Compliance with BIS/BEE/Green norms and energy-efficient lift systems

g. External Development and Infrastructure

- Roads, pathways, kerbs, and landscape development
- Storm water drains, culverts, and peripheral utilities
- Security cabin, main entry gate, signage, and boundary wall
- Electrification of external areas and street lighting

h. Site Utilities and Sustainability Features

- Rainwater harvesting systems
- Solar PV panels (if specified)
- Sewage treatment plant (STP) and water recycling
- Use of fly-ash bricks, energy-efficient lighting, low-VOC materials

3. Deliverables and Completion Obligations

- All works to be executed as per approved GFC drawings, BOQ, and specifications
- Adherence to the construction timeline and milestone chart
- Testing and commissioning of all services and equipment
- Training to client's facility management staff
- Submission of warranty documents, manuals, and as-built drawings
- Rectification of snags and defects during the DLP period (24 months)

4. Exclusions

All items necessary to deliver a functional and complete Institutional Campus are deemed included in the Contractor's scope unless specifically excluded.

5. Barrier-Free Access Specifications

The EPC Contractor shall ensure that the entire Enclave is designed and executed as a barrier-free, accessible campus for persons with disabilities, senior citizens, and all users, in compliance with applicable codes. The following provisions shall be mandatory:

6. Handicap Entry Ramps

- Gradient: 1:12 (max. 1:10 in constraints).
- Minimum clear width: 1200 mm (preferred 1500 mm).
- Landings: Every 9 m horizontal travel to have a level rest platform of minimum 1500 × 1500 mm.
- Surface Finish:
- Flamed finish granite
- Handrails: SS 304 grade, double height (700 mm & 900 mm), extending 300 mm beyond ramp ends.
- Edge Protection: 50–75 mm high kerb on open sides.
- Drainage: Side slope 1:50 with channel drain at bottom.
- Tactile tiles at top & bottom for visually impaired users.

7. Accessible Entrances

- At least 50% of entrances to all major buildings (AO, SBILD, Dining, Hostel) shall be accessible.
- Automatic/manual doors to have minimum clear opening of 900 mm.
- Thresholds not exceeding 12 mm height, chamfered/rounded.

9. Barrier-Free Toilets

- One accessible toilet on each floor of AO, SBILD, Hostel & Dining blocks.
- Location near lifts/stairs for easy access.
- Door: Minimum clear width 900 mm, outwards opening
- WC: Mounted at 480 mm seat height, with backrest.
- Grab bars: SS 304, horizontal & vertical, around WC & shower area.
- Wash basin: Mounted at 780 mm with knee clearance.
- Turning radius: 1500 mm clear inside toilet for wheelchair.
- Slip-resistant flooring.

10. Lifts

- At least one lift in each block to be accessible size:
- Minimum car size: 1100 mm × 2000 mm.
- Door width: 900 mm clear opening.
- Control panel at accessible height (900–1200 mm).
- Audio & Braille floor indicators.

6. Signage & Way-finding

- International symbol of accessibility to be displayed at all accessible facilities.
- Signages to be in raised letters + Braille.
- Directional signs with high colour contrast.

7. Parking

- Accessible parking bays near main entrances, at least 1 in every 25 car spaces.
- Bay size: 3600 mm (car space + side aisle).
- Accessible pathway from parking to building entrance.

8. Aluminium Glazing with Sliding System

8.1 . Aluminium Sections

- Alloy: Aluminium extrusions conforming to IS 733 & IS 1285 (6063-T6 grade).
- Minimum section thickness: 2.0 mm for framing members, 2.5 mm for structural members.
- Finish: Powder coated (minimum 60–80 microns) or anodized (minimum 15 microns).
- Colour shade as approved by Architect/PMC.

8.2. System Type

- Sliding windows/doors with 2-track / 3-track / 4-track systems as per design.
- Smooth, noiseless sliding on nylon/steel rollers with stainless steel ball bearings.
- Profiles to include drainage arrangements for rainwater discharge.

8.3. Glass

- Type: Toughened glass conforming to IS 2553 (Part 1).
- Thickness: 6 mm for small windows, 8–10 mm for larger spans/sliding doors.
- For energy efficiency: Use Double Glazed Units (DGUs) with Low-E/Reflective coating, 24 mm thick (6 mm + 12 mm air gap + 6 mm).
- Edges polished and sealed with primary + secondary sealants (silicone/PU).

8.4. Gaskets & Sealants

- EPDM / Neoprene gaskets for weatherproofing.
- Structural silicone sealants (Dow Corning / equivalent) for glass fixing.
- Joints to be watertight and airtight.

8.5. Hardware & Fittings

- Sliding rollers: Heavy-duty, stainless steel ball-bearing rollers.
- Handles/locks: Aluminium powder coated or SS finish with multipoint locking system.
- Wool pile / weather strips for air infiltration control.

8.6. Performance Standards

- Air Infiltration: ≤ 5 $m^3/hr \cdot m^2$ at 75 Pa.
- Water Tightness: No leakage up to 300 Pa.
- Wind Resistance: To withstand design wind pressures as per IS 875 (Part 3) for Tirupati (basic wind speed 50 m/s).
- Sound Insulation: ≥ 30 dB for double-glazed units.

8.7. Installation

- Frames anchored with SS fasteners and nylon plugs at max. 600 mm c/c.
- Proper packing and alignment to ensure plumb, level, and square positioning.
- All joints sealed with weather-grade silicone.

Note : Interior works like Panelling, Internal partitions, False Ceiling, Furniture, Light fixtures etc., are excluded from the scope of works.

Except common area, toilets, entrances and facade shall be shell and core. EPC contractor has to make necessary provision for Electrical and Plumbing works for areas under shell and core.

SECTION – 3 SCHEDULE OF FINISHES

Floor	Space / Room Name	Flooring + Skirting	Wall Finish	Ceiling Finish
Block 1 – AO Building				
Ground	Reception	Italian marble	Acrylic emulsion	6mm thick plaster
Ground	Entry Steps/Plaza	Polished Granite	Cladding	6mm thick plaster
Ground	Handicap Ramp (Slope 1:12)	Flammed Finish Granite	304 Grade SS railing	
Ground	Waiting Area	Italian marble	Acrylic emulsion	6mm thick plaster
Ground	Lift lobby	Italian marble	Acrylic emulsion	Gypsum board
Ground	Stilt (Parking)	Granite (Sand blustard & Polished combination 50 % - 50 %)	Acrylic emulsion	6mm thick plaster
All	Lift Walls	—	Granite wall cladding	
All	Staircase	Granite treads & risers	Acrylic emulsion to walls	Painted soffit
All	Toilet	Anti-skid ceramic	Full-height porcelain tile	FRP / moisture-resistant grid ceiling
Ground	SME Area	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
1ST	RASMEC	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
1ST	AMECC	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
2ND	RBO	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
2ND / 3RD	AO	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
3RD	FUTURE	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
Terrace		Water proofing with reflective tiles	Weather sheild paint	
Terrace	Mumty	Granite	Acrylic emulsion	6mm thick plaster
Basement		Trimix flooring	Acrylic emulsion	6mm thick plaster
Block 2 – SBILD Building				
Ground	Waiting Area	Italian marble	Acrylic emulsion	6mm thick plaster
Ground	Entry Steps/Plaza	Polished Granite	Granite Cladding	6mm thick plaster
Ground	Handicap Ramp (Slope 1:12)	Flammed Finish Granite	304 Grade SS railing	
Ground	Stilt	Polished Granite	Acrylic emulsion	6mm thick plaster
Ground	Admin	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
Ground	Agm	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
Ground	Mini Conference	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
Ground	Board room	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
Ground	Multi Utility Hall	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
Ground	Faculty	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
All	Toilet	Anti-skid ceramic / vitrified tile	Full-height ceramic/porcelain tile	FRP / moisture-resistant grid ceiling
All	Lift lobby	Italian marble	Acrylic emulsion	6mm thick plaster
All	Lift wall	-	Italian marble Cladding	6mm thick plaster
All	Staircase	Granite treads & risers	Acrylic emulsion to walls	Painted soffit
Ground	Corridor	Italian marble	Acrylic emulsion	6mm thick plaster
All	Staircase	Granite treads & risers	Acrylic emulsion to walls	Painted soffit
1st	Digital Class room	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster

1st	Discussion	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
1st	Class room	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
1st	Record room	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
2nd	Lounge	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
2nd	Room	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
2nd	Reception	Italian marble	Acrylic emulsion	6mm thick plaster
1st/2nd/3rd/4th	Corridor	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
2nd / 3rd / 4th	Hostel Room	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
2nd / 3rd / 4th	Dress	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
2nd / 3rd / 4th	Toilet	Anti-skid ceramic	Full-height porcelain tile	FRP / moisture-resistant grid ceiling
2nd / 3rd / 4th	Balcony	Anti-skid ceramic	Weather sheild paint +304 Grade Railing + laminated glass	6mm thick plaster
3rd	Gym	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
3rd	Lounge	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
4th	VIP Suite – Bedroom	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
4th	VIP Suite – Lounge	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
4th	VIP Suite – Living/Dining	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
4th	Kitchen	Anti-skid ceramic tile	Ceramic dado till 2.1 m	6mm thick plaster
Terrace		Water proofing with reflective tiles	Weather sheild paint (parapet wall)	
Terrace	Mumty	Granite	Acrylic emulsion	6mm thick plaster
Basement		Trimix flooring	Acrylic emulsion	6mm thick plaster
Block 3 – Dining Building				
Ground	SBILD Dining	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
Ground	SBILD -Kitchen Area	Anti-skid ceramic tile	Ceramic dado till 2.1 m	6mm thick plaster
Ground	Kitchen Counter	Counter top - Granite	Ceramic dado till 2.1 m	6mm thick plaster
Ground	AO Dining Area	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
ALL	AO Dining Area - staircase	Granite treads & risers	Acrylic emulsion to walls	Painted soffit
1st	AO - Kitchen Counter	Counter top - Granite	Ceramic dado till 2.1 m	6mm thick plaster
1st	AO - Kitchen Area	Anti-skid ceramic tile	Ceramic dado till 2.1 m	6mm thick plaster
1st	Library	Double charge vitrified tile	Acrylic emulsion	6mm thick plaster
Terrace		Water proofing with reflective tiles	Weather sheild paint (parapet wall)	
External Development and Basement				
Basement	Car Parking	Tremix concrete	Cement plaster & emulsion paint	Exposed concrete / paint
Basement	Ramp	Tremix concrete	Weather sheild paint	Exposed concrete / paint
Basement	Store	Anti-skid ceramic tile	OBD paint over plaster	6mm thick plaster
Basement	Lift Lobby	Granite flooring	Granite Cladding with emulsion paint	False ceiling grid
Basement	Electrical Room	Anti-skid ceramic tile	OBD paint over plaster	False ceiling grid
Basement	Pump Room	Epoxy-coated IPS	OBD paint over plaster	—

External development	Roads / Driveways	RCC / heavy-duty pavers	Kerbstone edging; paint on walls	Open to sky
External development	Pathways	Concrete / paver tiles	Paint on adjacent walls	Open to sky
External development	Open Parking	Paver blocks	Plastered & painted boundary	Open to sky
External development	Landscaped Areas	Grass / softscape	Boundary wall painted	Open to sky
External development	Water Body	Mosaic Tile	Mosaic Tile	Open to sky
External development	Compound Wall	—	Plastered & painted / stone cladding	—
External development	Gate		304 Grade SS gate	Open to sky
External development	Guard room	Kota Stone	OBD paint over plaster	6mm thick plaster
External development	Transformer Platform	Kota Stone		
External development	DG SET platform	Kota Stone		
External development	Meter room	Kota Stone	OBD paint over plaster	6mm thick plaster
External development	VCB Room	Kota Stone	OBD paint over plaster	6mm thick plaster

Section - 4 ARCHITECTURAL DESIGN

Master Planning Architecture Concept:

The master plan is designed with a thoughtful approach to spatial hierarchy, accessibility, landscape integration, and user-centric zoning. This spatial anchor promotes community interaction, improves ventilation, and enhances aesthetics. The layout ensures efficient zoning, balancing institutional, recreational, and service areas while integrating strong internal circulation and future-ready infrastructure.

- **Zoning:** Functional zoning divides administrative and training spaces into separate blocks.
- **Orientation:** Buildings positioned to maximize natural light and views of the hills.
- **Plaza:** A landscaped plaza acts as a shared community and spill-out space between blocks.
- **Circulation:** Separate vehicular and pedestrian routes for safety and efficiency.
- **Environmentally Conscious Design:** Buildings are oriented to **maximize natural daylight** and promote ventilation, thereby reducing energy consumption and enhancing occupant comfort.
- **Safety and Segregation:** Separate pathways and ramp accesses ensure **segregation of service vehicles**, resident entries, and emergency routes, promoting safety and operational efficiency.
- **Infrastructure and Utilities:** All essential utilities, including a **substation**, chiller plants, and pump room are integrated within the plan, ensuring self-sufficiency and uninterrupted services to the residents.
- **Futureproofing:** The layout accommodates scope for future expansion or infrastructural upgrades without disturbing the functional fabric of the site.
- **Harmonious Development:** The landscaping, road alignments, and building setbacks create a harmonious urban form, contributing to a clean, organized, and livable environment.
- **Emergency evacuation zone**: The central open space (Sign Avenue Plaza) acts as a safe congregation point during emergencies. All blocks can quickly evacuate toward this non-combustible open zone, away from vertical fire sources.
- A dedicated boundary wall shall be constructed around the office building to clearly demarcate and separate it from the adjoining residential complexes. Additionally, appropriate fencing shall be provided around the DG set and chiller plant to ensure safety, security, and restricted access.

3.1.1 Emergency evacuation zone

The **open space** acts as a **safe congregation point** during emergencies. All blocks can quickly evacuate toward this **non-combustible open zone**, away from vertical fire sources.

3.1.2 Fire-fighting access & manoeuvring

The plaza and surrounding open areas allow **fire trucks and emergency vehicles** to access the building's periphery. Wide internal roads (20 feet wide) ensure proper **turning radius and staging space** for firefighting equipment.

3.1.3 Green integration

- A large landscape **lies at** the heart of the layout, acting as a communal green lung that connects all blocks visually and **functionally.**

- **Layered Green Buffers** Multiple **pocket gardens and softscape zones** around buildings break the vertical massing, ensuring **human scale** and comfort at the ground level.
- **Functional Landscape Use** These green zones are not just visual—they serve as **interactive leisure spaces**, play zones, and seating areas, fostering social life within dense urban fabric.

Name	Area (in sq. m)	Area (in %)
Plot coverage	2,652.00	34.90%
Green/ open spaces	2757.50	36.29%
Roads	2189.00	28.80%
Site	7,598.50 Sq. m	100%

Table Area statement or Site

- Integrated Hard and Soft Landscaping: The central and peripheral zones feature a combination of paving (for walkways and driveways) and green patches, balancing functionality with natural aesthetics.
- A minimum of 36% of the site area shall be dedicated to green and open spaces, in line with sustainable site planning principles and to promote ecological balance and occupant well- being.
- An open-air amphitheater with a minimum seating capacity of 100 should be provided to support cultural events, gatherings, and community interactions. Additionally, a badminton court shall be included to encourage sports and active recreation, contributing to a well- rounded and inclusive living environment.
- Sustainable Green Planning: The landscape design likely supports sustainability through rainwater percolation zones, native plant selection, and minimal hardscaping—ensuring eco-friendly development within the urban fabric.

3.2 Project components

Project Scope Summary
The project involves the integrated development of a 1.85-acre site (approximately 7589.50 sq.m) including the following key components:

1. Main Buildings:
- Administrative Office (AO)
- SBI Learning & Development Centre (SBILD)
- Dining Hall

2. Utility Buildings and Infrastructure:
- Sub-Station Building
- HVAC system including VRV/VRF
- Pump Room
- Reticulated LPG Bank Building
- Security Cabins
- Other necessary utility structures

3. Site-Wide Development:
- Roads, roundabouts, and pavements
- Pathways and planters
- Parking areas
- Landscaping and horticulture
- External boundary walls

- Internal and external signage
- Green buffer wall and WPC segregation from adjoining institutional campus

5. MEP and Related Services

The EPC Contractor shall execute all site-wide civil and MEP services, including:
- Water supply and plumbing
- Storm water drainage
- External electrification (except HT works till the substation)
- Site lighting
- Associated civil provisions for services excluded from EPC scope
- High Side Electrical works
- DG Sets
- High side HVAC systems
- CCTV, LAN/Wi-Fi
- Light fixtures

However, the EPC Contractor shall provide all necessary base civil provisions (sleeves, conduits, space planning, etc.) to enable future execution of low side services without rework.

6. Design Compliance and Approvals

All works shall conform to:
- Applicable local building and development regulations
- Approved DBR, concept designs, and Master Plan
- Environmental and safety standards applicable to institutional developments

All designs shall be submitted to SBI/PMC for review and approval prior to execution.

Block I – Administrative Office building: B+G cum partial Stilt+4floors.

The proposed state-of-the-art office building is designed with Common basement levels, Ground with Partial stilt floor, and four upper floors, ensuring efficient vertical zoning for various departments. Ground Floors are allocated to SME branch & Parking, providing a consolidated space for administrative operations. Floors first are designated for RASMECC & AMSE, while Second floors accommodate the RBO. The uppermost levels, Third to Fourth floors are dedicated to AO Tirupati. This organized distribution supports functional clarity, operational efficiency, and optimal space utilization across the building. The building is equipped with comprehensive amenities to meet the demands of a modern corporate environment, ensuring a comfortable, efficient, and professional workspace.

Block II - SBILD building: B+G cum partial Stilt+4floors.

The proposed state-of-the-art office building is designed with Common basement levels, Ground with Partial stilt floor, and four upper floors, ensuring efficient vertical zoning for various departments. Ground Floors are allocated to SBILD & Parking, providing a consolidated space for administrative operations. Floors first are designated for Other Facilities, while Second & Third floors accommodate the Hostel room. The uppermost levels, Fourth floors are dedicated to Hostel room with VIP Suite room. This organized distribution supports functional clarity, operational efficiency, and optimal space utilization across the building. The building is equipped with comprehensive amenities to meet the demands of a modern corporate environment, ensuring a comfortable, efficient, and professional workspace.

Block III – Dining & Library building: B+G +1floors.

The proposed state-of-the-art office building is designed with Common basement levels, Ground, and First floors, ensuring efficient vertical zoning for various departments. Ground Floors are allocated to Dining hall for Hostel block & SBILD, providing a consolidated space for

administrative operations. Floors first are designated for Office Dining hall & Library, This organized distribution supports functional clarity, operational efficiency, and optimal space utilization across the building. The building is equipped with comprehensive amenities to meet the demands of a modern corporate environment, ensuring a comfortable, efficient, and professional workspace.

1. **Sub-station:**

- Located on the South East side of the site this placement ensures easy utility access while keeping infrastructure services isolated from the AO and SBILD areas.

2. **Parking & Circulation:**

- Dedicated ramp entries/exits to the basement are provided along the South sides, supporting ample underground parking and maintaining a vehicle-free surface for pedestrians. Driveways along all sides promote one- way vehicular circulation, minimizing traffic conflicts.
- Basement parking has been strategically planned to cater to both SBILD and office requirements. For the component, approximately **4146 sq.m** of basement area.
- The parking capacity has been designed to accommodate a minimum of 83 cars for the SBILD and AO block, ensuring adequate provision as per project requirements and applicable standards
- To enhance safety and minimize the risk of vehicle impact, column guards shall be provided around all structural columns located within the basement and driveway areas. In addition, high-visibility reflective signages shall be strategically installed throughout the basement and along the driveways to aid in traffic guidance, improve visibility in low-light conditions, and ensure smooth vehicular movement. The design and placement of these safety features shall comply with relevant safety codes and best practices.
- Ramps for pedestrian and vehicular access with code-compliant slopes.. Handrails and non-slip finish for universal accessibility to be provided for the ramp.

3. **Entrance Gate:**

- A total of four entrance/ exist gates (motorised sliding gate) are proposed along the front, Left & right side. Of these, one gate is designated as the main entrance to the office block, while the remaining two serve as exit points for both the office and SBILD block. Additionally, two entrance gates (without motorised sliding gate) are proposed along the 40 feet wide road,. These access points have been strategically planned to ensure efficient traffic circulation and separation of vehicular movement for different functional zones.
- The boundary wall design shall incorporate integrated security elements to ensure controlled access and perimeter safety. These provisions may include guard posts, surveillance infrastructure (such as CCTV mounting points), anti- climb features, and restricted entry mechanisms at designated gate locations. The design shall align with the overall security strategy of the site, providing a secure and defined perimeter around the residential, office, and utility zones

The Contractor shall prepare schematic drawings with concept (without deviating from the PMC's Concept), 3D models (designs) and Good for Construction (GFC) drawings for all relevant disciplines, including but not limited to Architecture, Structural, and MEP services, site development, etc. for review and approval by the Bank/PMC prior to commencement of the corresponding works.

It shall be the Contractor's responsibility to ensure that all drawings and documents requiring prior approvals are submitted sufficiently in advance to avoid any delay in project execution.

3.3 Design Consideration

Excavation, foundation and plinth in all types of Soil, Hard Rock and Anti termite treatment as per CPWD Specification & design criteria. Clearing jungle including uprooting of rank vegetation, grass, brush wood, trees and saplings etc. Earth work in surface excavation including getting out and disposal of excavated earth in all kinds of soil including bailing and pumping of water, strutting etc.

Anti-termite treatment as per necessity of ground shall be carried out as per relevant IS Codes / CPWD specifications

Structural / Non-Structural Grade slab as per the necessity at site/design requirement and as per the functional requirement of supported flooring shall be designed & provided accordingly.

Damp proof course shall be provided wherever as per CPWD specification.

Basement shall be designed as an integral part of superstructure and integrated with foundation system with suitable waterproofing system and measures for collection, pumping and disposal of water. Any extended basement beyond footprint of the Superstructure shall be designed and integrated with foundation system and its roof slab designed to carry all loads including fire tender load as required

Drainage and Plinth protection along the perimeter of the buildings shall be provided as per CPWD specifications or as per functional requirement.

Overall, the SBI Enclave will serve as a model for environmentally responsible development by integrating sustainable strategies that reduce resource consumption, lower operational costs, and enhance the health and well-being of its occupants.

3.4 Design Adherence:

The Contractor shall strictly adhere to the approved architectural concept and facade design; Minor modifications to internal floor plans may be considered prior to the commencement of construction, but only upon receipt of written instructions from the Bank/PMC.

Any proposed change in building orientation based on climatic or environmental analysis must be supported with detailed justification and shall be subject to prior written approval from the Bank/PMC.

3.4.1 Construction Methodology:

The EPC Contractor shall incorporate an integrated approach to structural system design, MEP coordination, and adopt fast-track construction techniques. These aspects must be reflected in the Contractor's pricing, scheduling, and execution methodology.

3.4.2 Facade Works (Office Block:

The facade system for Office buildings shall be executed using combination of stone cladding, textures paints, as approved by the Bank/PMC.

Sustainable Design Scope under EPC Contractor:

- The proposed buildings are to be constructed in compliance with IGBC Platinum and BEE

5* as part of the EPC contractor's scope of work.

- The project aims to achieve green building certification under IGBC, adhering to criteria for energy efficiency, water conservation, material selection, and indoor environmental quality. Meeting these standards supports the building's sustainability objectives while also qualifying for potential incentives or rebates.

3.4.3 Design and Execution Compliance Requirements

All works associated with the proposed project shall be designed and executed in full compliance with the relevant ISO standards, NBC, GHMC, applicable national and local codes, and statutory authority guidelines. The EPC Contractor shall be solely responsible for ensuring that all deliverables are completed in a fully functional, service-ready condition, without any compromise on performance, safety, or quality. The examples provided herein represent the minimum benchmark of the level of detail and quality expected.

3.5 Illustrative Example: Road Works and Associated Infrastructure

To outline the expected level of detail and execution, the following components serve as representative examples for road works. All items shall be implemented in accordance with relevant codes and guidelines such as GHMC regulations, IRC codes, ITDP standards, and other applicable statutory or technical standards.

3.5.1 Internal Roads

- Road design and geometry as per IRC norms
- Cement Concrete (CC) Road finish for durability and low maintenance
- Proper camber, shoulders, and gradient
- Kerb stones and saucer drains
- Rainwater drainage system, storm water inlets
- Underground utility ducts and service corridors
- Pedestrian crossings, tactile paving, road marking
- Speed tables, speed breakers, wheel stoppers
- Street lighting, bollards, boom barriers, signboards

3.5.2 Ramps and Shelter Structures

- Ramps designed for both pedestrian and vehicular access with compliant slopes per NBC standards.
- Mild steel handrails and non-slip surface finishes to support universal accessibility and safety.

3.5.3 Landscaping and Tree Plantation

- Installation of geotextile membranes and drainage layers above the basement slab to manage water flow.
- Topsoil thickness for soft scape areas minimum 450 mm on the podium deck.
- Tree planter boxes with a minimum internal depth of 1.2 m and diameter of 1.0 m, integrated with waterproofing and drainage.
- All landscape features and soft scape areas shall be supported by appropriate irrigation, drainage, and waterproofing systems.
- Water features near Dining Block.

Note:

The above-listed elements are not exhaustive and are intended to convey the expected standard of quality, completeness, and integration. When a specific item is mentioned in the scope, it shall not be interpreted as a bare minimum of only that item. Rather, it includes all associated components and ancillary works. The EPC Contractor shall ensure that all such comprehensive and integrated components are factored into their design, execution, and pricing. It is the EPC Contractor's obligation to ensure that all design and construction works comprehensively cover the scope, meet statutory requirements, and result in a fully code-compliant, functional, and integrated development.

All project deliverables must align with the client's expectations of performance, safety, operational readiness, and long-term sustainability.

Note:

1. Windows Shutters should be 3-Track Sliding UPVC Shutters with SS wire Mosquito Mesh & toughened DGU as per design.
2. Granite window jamb shall be provided with a nosing.
3. All Railing to be in Stainless Steel - 304 Grade.
4. All tiles will be laid with spacers on wall and floors and filled with Epoxy Grouting.
5. Aluminum reinforced PVC wall guard & SS Corner Guard to be provided as per design requirements.
6. Staircase and balcony railing to be provided in stainless steel (S.S.), as per design, with a height of 1.0 meter.
7. The overhead tank shall be provided with an extendable staircase made of MS for durability and corrosion resistance.
8. The provisions for differently abled toilet should also be considered for design and execution in the office.

3.6 EXTERNAL FINISHES:

1. Textured with Elastomeric Weatherproof Paint.
2. All Elements to be in Compliance with Energy Conservation Building Code.
3. Building Façade Lighting as per Required LUX Level.
4. Exterior finish shall be completed with paint in combination with architectural elevation / façade design,/ stone cladding as per drawings.

The items and specifications mentioned above are minimum requirements and subject to improvement. During the detailed design and engineering stage, the EPC Contractor shall undertake a comprehensive assessment to finalize the detailed requirements. Any improvement or enhancements shall be made in alignment with statutory norms and project objectives.

3.7 **Sanitary finishes schedule for Office:**

S. No	Fixture Description	Material	Finish	Colour	Mounting Type	Remarks	REF. Model	Location
					Wall hung wall mounted concealed	Dual flush	K-26998IN-0	As per Requirement by PMC/

1.	EWC	Vitreous China	Glazed Ceramic	White/Black	flush tank with Wrought iron chairs	concealed cistern		Bank
2.	Wash Basin	Vitreous China	Glazed Ceramic	White/Black	Countertop/ Wall	With overflow	K-26269IN-0	
3.	Basin Bottle Trap	Brass / PVC	Chrome-plated	Silver	Exposed	Decorative finish	K-75823IN-CP	
4.	Long Body Bib cock	Brass	Chrome-plated	Silver	Deck-mounted	Single lever	K-20070IN-4 CP	
5.	Mirror	Float Glass	Bevelled Edge	Clear	Wall-mounted	6mm thick, moisture-resistant backing	K-26052IN-CPL	
6.	Faucet (General)	Brass	Chrome-plated	Silver	Deck / Wall Mounted	Quarter-turn or sensor type	18656IN-ND	
7.	Floor Drain	Stainless Steel	Brushed SS	Silver	Floor-mounted	Removable grating, 100mm diameter	K-75422IN-CP	
8.	Urinal with Flush Valve with Sepaat or	Vitreous China	Glazed Ceramic	White	Wall-mounted	Infrared sensor Flush	K-26475IN-ER-0	
9.	Soap Dispenser	ABS / SS	Chrome / Matte	Silver	Wall-mounted	Manual or sensor-operated	K-10712D -CP	
10.	Toilet Paper Holder	Stainless Steel	Chrome - plated	Silver	Wall-mounted	With cover or open type	K-25071IN-CP	
11.	Angle Valve	Brass	Chrome - plated	Silver	Wall-mounted	Quarter - turn, used for WC and Basins	K-76389IN-9-CP	
12.	Bidet Shower (Healh Fauet)	ABS / Brass	Chrome - plated	Silver	Wall-mounted	With flexible hose & Holder	12927IN-CP	

Table - Sanitary finishes schedule for Office

General Notes

- All reference models mentioned above are from Kohler brand.
- All items must be water-saving compliant where applicable.
- Sanitary fixtures must conform to IS/ASTM/EN standards.
- Submit samples for approval before procurement.
- Installation to be per manufacturer's specifications and coordinated with MEP services.

The data provided above shall be considered as the minimum indicative requirement. The specific brands mentioned, are intended solely for benchmarking purposes and are not mandatory recommendations. Other makes specified in the technical specification may be proposed, provided they meet or exceed the specified benchmark in terms of quality, performance, and technical compliance.

The above list of sanitary fittings are indicative only. Additional items/equipment/fixtures/fittings may be identified during the detailed design phase and the EPC contractor has to execute the same. FAT shall include verification of safety features, protection coordination, control logic, and compliance with statutory and project specifications. The Employer/Consultant shall be notified in advance to witness the FAT as required.

Section -5 STRUCTURAL DESIGN BASIS REPORT (DBR)

Special Provisions for Heavy Load Areas

RCC Strong Rooms., of approx. 25-30 sqm):

The EPC Contractor shall design and construct strong rooms with RCC walls, floor, and roof of minimum 300 mm thickness (or as per SBI/IS standards).

Live load design: 3000 kg/sqm minimum.

Special reinforcement detailing, vibration-free flooring, and anti-burglary construction shall be adopted.

Location and sizes of strong rooms shall be confirmed with PMC.

Compactor Rooms (approx.185 - 200 sqm area each):

Floors shall be designed for live load to withstand heavy mobile storage compactor loads.

Adequate flooring reinforcement to be provided to avoid desflections.

write areas as in drg/ their brief

4.1 Introduction

The structure is designed for SBI AO, SBILD & Other Facilities, at Tirupati. This report covers minimum design specifications, which will form the overall design philosophy to be adopted in the structural design of the project. The Structural Design Basis Report (DBR) is prepared in reference with the relevant IS Codes and Architectural drawings. 3D wire frame models of the building are generated and analyzed for various loads and load combinations using ETABS design software. The loads and load combinations were considered as per relevant IS codes. The RCC Building consists of

S. No	Block Name	Total Height (m)	Floor Height Clear (m)	No of Floors

1	Administrative Office	18.0	3.45	B+ Ground with Partial Stilt + 4 floor
2	SBILD & Hostel Block	18.0	3.45	B+ Ground with Partial Stilt + 4 floor
3	Dining Hall & Library	8.8	4.05	B+ Ground + first floor

4.2 Site details

4.2.1 Project Location

The proposed project is located at Tirupati.

4.2.2 Soil Data

The soil investigation report provided as part of the tender documents is for reference and bidding purposes only.

Any confirmatory soil testing or additional geotechnical investigations deemed necessary for design and execution shall be carried out by the EPC Contractor at their own cost, within the quoted contract price, and in full compliance with relevant IS codes and standards.

4.3 Structural system

4.3.1 Foundation

Foundation Design

Foundations shall be designed considering soil investigation report findings, SBC (Safe Bearing Capacity), water table, and site strata conditions.

EPC Contractor shall provide suitable foundation types (isolated footings, raft, pile, or combined footing) based on geotechnical recommendations.

Minimum grade of RCC to be adopted: M25 for structural members and M30 for foundations, unless otherwise specified. Large span stru

Proper waterproofing, anti-termite treatment, and earthwork compaction shall be ensured in all foundations and substructures.

4.3.2 Super-Structure

The structural system for Institutional campus building should be designed as per Monolithic/Shear wall technology. The brick masonry shall be considered for kitchen and toilet internal walls (for ease of plumbing pipeline installations).

Basement

S.No.	Description	Floor to Ceiling Height(m)	Floor Functional Requirement
1	Common Basement	4.35	Car Parking

Block I – Administrative Office

S.No.	Description	Floor to RCC Ceiling Height(m)	Floor Functional Requirement
1	Ground floor with Partial Stilt	3.30	SME branch & Parking
2	First floor	3.30	RASMECCC & AMECC
3	Second Floor	3.30	RBO Office
4	Third & Fourth floor	3.30	AO Office
5	Terrace floor	3.0	Solar Panel & Outdoor Equipment

Block II – SBILD & Hostel

S.No.	Description	Floor to RCC Ceiling Height (m)	Floor Functional Requirement
1	Ground floor with Partial Stilt	3.30	SBILD & Parking
2	First floor	3.30	Facilities
3	Second & Third Floor	3.30	Hostel Room
4.	Fourth floor	3.30	VIP Suite room
5.	Terrace floor	3.0	Solar Panel & Outdoor Equipment

Note: A double height reception and entry halls should be considered by the EPC contractor as per the concept Architectural drawings.

Block III – Dining & Library

S.No.	Description	Floor to RCC Ceiling Height (m)	Floor Functional Requirement
1	Ground Floor	3.90	Dining hall for Hostel
2	First Floor	3.90	Dining hall for Office & Library for Hostel
3	Terrace floor	3.0	Solar Panel & Outdoor Equipment

Note: A double height SBILD reception floor should be considered by the EPC contractor as per the concept Architectural drawings.

The gravity floor system consists of reinforced concrete structural system. The floor system will be supported on reinforced concrete Columns.

- 4.1 Additional Instructions – Large Span Structural Design

Definition of Large Span

For the purpose of this contract, any structural system having a clear span exceeding 9.0 m (without intermediate supports) shall be treated as a large span structure.

Design Requirements

The EPC Contractor shall design large span structures using appropriate structural systems (RCC beams/slabs, post-tensioned concrete, or composite systems) to achieve both economy and performance.

Serviceability Criteria:

Maximum deflection not to exceed span/250 for RCC and span/325 for steel.

Control of vibrations in floors/slabs for human comfort and equipment stability.

Durability: Use higher grade of concrete/steel with appropriate cover to reinforcement in compliance with IS 456/IS 800.

Foundations and Supports

Columns supporting large spans shall be designed with adequate stiffness and stability against lateral buckling.

Foundations shall be designed to take eccentric loads, moments, and additional settlement considerations due to larger spans.

Seismic and Wind Considerations

Large span roofs shall be designed for uplift forces and seismic drift control as per IS 875 & IS 1893.

Proper bracing systems shall be provided to prevent lateral sway.

Coordination with Services

EPC Contractor shall coordinate large span designs with HVAC ducts, electrical cable trays, fire sprinklers, and acoustics to ensure proper integration.

Service openings in large beams/girders shall be designed with strengthening as required.

Scope

Structure to be designed as Large span RCC structure

Strong room area 250 Sq.ft construction

Compactor rooms area 1000 Sq.ft for heavier loads

4.4 Design codes and standards

Design Loads Other than Earthquake loads	
IS 875 (Part-1): 1987 Reaffirmed Year: 2018	Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures -Dead Loads
IS 875 (Part-2): 1987 Reaffirmed Year: 2018	Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures- Imposed Loads
IS 875 (Part-3): 2015 Reaffirmed Year: 2020	Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures- Wind Loads
IS 875 (Part-5): 1987 Reaffirmed Year: 2018	Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures- Special Loads and Combinations
Design for Earthquake Loads	
IS 1893 – 2016 (Part – 1) Reaffirmed Year: 2021	Earthquake Resistant Design Structures
IS 13920 – 2016 Reaffirmed Year: 2021	Ductile Detailing of Reinforced Concrete
IS 4326 – 2013 Reaffirmed Year: 2018	Earthquake Resistant Design and Construction of Buildings
Design of Concrete Structures	
IS 456: 2000 Reaffirmed Year: 2021	Code of Practice for Plain and Reinforced Concrete
SP 20: 1991	Handbook on Masonry Design and Construction
SP 23: 1982	Handbook on Concrete Mixes
SP 34: 1987	Handbook on Concrete Reinforcement and Detailing
IS 1904: 2021	Code of practice for General requirements for design and construction of foundations in soils
IS 2950: 1981 Reaffirmed Year: 2018	Code of practice for design and construction of raft foundations: Part 1 design
IS 2062: 2011 Reaffirmed Year: 2021	Steel for General Structural Purposes
IS 1786:2008 Reaffirmed Year: 2023	High strength deformed steel bars and wires for concrete reinforcement

IS 3370: 2021	Specifications for Liquid Containing Structures
IS 383: 2016 Reaffirmed Year: 2021	Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
IS 269: 2015 Reaffirmed Year: 2020	Ordinary Portland Cement – Specification
IS 1489: 2015 Reaffirmed Year: 2020	Portland Pozzolana Cement – Specification
IS 9103: 1999 Reaffirmed Year: 2018	Concrete Admixtures – Specification
IS 2185(Part 1):2005 Reaffirmed Year: 2020	Concrete masonry units - Specification: Part 1 hollow and solid concrete blocks
IS 6041:1985 Reaffirmed Year: 2020	Code of Practice for construction of Autoclaved Cellular Concrete block masonry
Design of Structural Steel Construction	
IS 800: 2007 Reaffirmed Year: 2022	Code of Practice for Construction in Steel
IS 11384: 2022	Code of Practice for Composite Construction in Structural Steel and Concrete
IS 816: 1969 Reaffirmed Year: 2019	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel
Design of Tall Concrete Buildings	
IS 16700: 2023	Criteria for Structural Safety of Tall buildings
Design of Prestressed Concrete	
IS 1343: 2012	Code of Practice for Prestressed Concrete

4.5 Construction materials

4.5.1 Concrete

Concrete mix design grades of specified cube strength to satisfy codal norms, will be adopted as per design requirement of the structure. The following grade of concrete is used in the design of RCC Building

S. No.	Element	Concrete Grade
1	Foundation, Retaining Wall	M30

2	Beams	M25/ M30
3	Column & Shear wall	M30
4	Slab	M25/ M30
5	PCC	M7.5/M10

Minimum cement content, water cement ratio etc. shall conform to IS 456:2000 provisions for durability and strength criteria.

4.5.2 Cement

Chemical and physical requirements for Ordinary Portland Cement of Grade 43, Grade 53 and Portland Pozzolana Cement shall be in accordance with IS 8112, IS 12269, IS 1489 (Part1) respectively.

4.5.3 Aggregate

Fine aggregate:

Fine aggregate shall be clean, hard and durable and shall be natural sand, crushed gravel sand or crushed rock sand complying with IS 383. The material shall pass through a 4.75 mm IS sieve, and the grading shall be in accordance with IS 383.

Coarse aggregate:

Coarse aggregate shall be clean hard and durable crushed rock, crushed gravel or natural gravel.

It shall be graded aggregate of nominal size 20 mm and 12 mm in accordance with IS 383.

4.5.4 Admixtures and additives

Admixtures of approved quality shall be mixed with concrete conforming to IS 9103. Self-compacting agents shall be used to enhance the performance of concrete in both fresh and hardened state.

4.5.5 Water

Water used for mixing and curing shall be clean and free from injurious quantities of alkalis, acids, oils, salts, sugar, organic materials, vegetable growth or other substance that may be deleterious to bricks, stone, concrete or steel and shall comply with the requirements of IS 456:2000. The pH value of water shall be not less than 6.

4.5.6 Reinforcement

For design of concrete elements, High Yield Strength Deformed (HYSD) having yield strength of 500 MPa & Above and minimum percentage elongation of 14.5% shall be used. It shall conform to IS 1786:2008.

General Assumptions for slab and Beam design

4.6 Design loads

The building is analysed for following basic load cases: -

- Dead Load (DL)
- Superimposed dead load (SDL)
- Live load (LL)
- Seismic load (EQ/Spec)
- Wind load (WL)

4.6.1 Dead Loads (DL)

The dead loads considered as per IS: 875 (Part 1)-1987

Self-weight of plain cement concrete	24 kN/m^3
Self-weight of reinforced cement concrete	25 kN/m^3
Self-weight of mortar	20 kN/m^3

4.6.2 Superimposed Dead Loads (SDL)

Load on Typical floor Slab (Residential Area)		
Thickness of the floor finish mortar & plastering	75mm	1.5 kN/m^2
Thickness of the floor tiles	25mm	0.5 kN/m^2
Total	2 kN/m^2	Total

Load on Typical floor Slab (Toilet Area)		
Thickness of the filling	250mm	5.0 kN/m^2
Thickness of the floor tiles and finishes	25mm	0.5 kN/m^2
Total		3.0 kN/m^2
AAC Wall on Typical Floor Beam		
200mm Thick wall	2.85m ht	5.244 kN/m
100mm Thick wall	3.15m ht	3.276 kN/m
200mm Thick wall	3.7m ht	6.808 kN/m
100mm Thick wall	4.0m ht	4.160 kN/m
Brick Wall		
230mm Thick wall	2.85m ht	14.82 kN/m
115mm Thick wall	3.15m ht	9.135 kN/m

4.6.3 Live Load.

The Live load considered as per IS:875 (Part 2)-1987

Room (Residence)	2 kN/m^2
Toilet	2 kN/m^2
Corridor, Balcony	3 kN/m^2
Staircase	3 kN/m^2
Conference Hall, Play Area	5 kN/m^2
Room (Commercial)	5 kN/m^2
EB Room	7.5 kN/m^2
Terrace Floor	5 kN/m^2

Live Load Reduction (IS 875 (Part-2): 1987- Clause 3.2.1 & Clause 3.2.1.1)
For floor supporting structural members, following reductions is assumed in total imposed

Loads on floors in designing columns, load bearing walls, piers, their supports and foundations:

No of Floors (including roof)	Reduction in Live load (%)
1	0
2	10
3	20
4	30

No reduction shall be made for any plant or machinery which is specifically allowed for, or in buildings for storage purposes, warehouses and garages. However, for other buildings where the floor is designed for an imposed floor load of 5.0 kN/m2 or more, the reductions shown above shall be taken, provided that the loading assumed is not less than it would have been if all the floors had been designed for 5.0 kN/m2 with no reductions.

In case if the reduced load in the lower floor is lesser than the reduced load in the upper floor, then reduced load of the upper floor will be adopted.

4.6.4 Seismic Loads

The following parameters are adopted for calculating seismic load as per IS 1893:2016.

Seismic Zone	III
Zone factor (Z)	0.16
Seismic importance factor (I)	1.5 (for Office Building); 1.2 (for SBILD Building)
Response reduction factor (R)	5.0 / 4.0 (3.0 for only low rise building)
Approx. fundamental time period (Ta)	Time period as per code
Soil type for estimating (Sa/g)	Type I as per IS 1893
Damping	5%
Mass participation	90%
Modal combination	CQC

Seismic weight	DL + SDL + 0.25 LL_1 (<3KPa) DL + SDL + 0.5 LL_1 (>3KPa)
Storey drift limitation	h_{story} / 250
Initial scale factor for Response spectrum to enhance the base shear	Ig/2R (In ETABS 'I/2R' is self-calculated, hence only 'g' to be applied)
Vertical earthquake shall be considered as per IS 1893 (Part 1):2016	

Percentage of Imposed Load to Calculate Seismic Weight		
S.No.	Imposed Uniformity Distributed Floor Loads	Percentage of Imposed Load
1.	Up to and including 3.0 kN/m^2	25
2.	Above 3.0 kN/m^2	50

Note:

1. It shall be ensured that the first three modes together contribute at least 65 % mass participation factor in each principal plan direction.
2. Response spectrum Analysis is performed, the Static design base shear (VB) shall be compared with Dynamic design base shear (VBT) is calculated using a fundamental time period Ta. If VB is less than VBT, all force quantities are multiplied by Scale factor.

4.6.5 Wind Loads

The following parameters are used for calculating wind load as per IS 875 Part 3-2015.

Basic wind speed, V_b	44 m/s
k1(probability factor)	1.07
Terrain category	Category 2
k2 = Factors to obtain Design Wind Speed Variation with Height in Different Terrains	Up to 10m – 1.00 10m to 15m – 1.05 15m to 20m – 1.07 20m to 30m – 1.12 30m to 50m – 1.17 50m to 100m – 1.24
k3 (Topography factor)	1.0
k4(Importance factor for cyclonic region)	1.0

Design wind velocity, V_z (m/s)	V_b x k1 x k2 x k3 x k4 Up to 10m – 47.08 10m to 15m – 49.4 15m to 20m – 50.4 20m to 30m – 52.7 30m to 50m – 55.1 50m to 100m – 58.4
Wind pressure at height z, P_z (kN/m^2)	0.6 x V_z^2 Up to 10m – 1.33 10m to 15m – 1.47 15m to 20m – 1.52 20m to 30m – 1.67 30m to 50m – 1.82 50m to 100m – 2.04
Wind lateral deflection limit	H/500
Design wind pressure, P_d	P_z x K_d x K_a x K_c > 0.7P_z
Where, K_d	Wind directionality factor
K_a	Area averaging factor
K_c	Combination factor

4.7 Load combinations

The following load combinations are used to design the structural elements.

S. No.	Load Combination	Load Factors					
		DL	LL	WLX	WLY	Scaled	
						SpecX	SpecY
1.	1.5 (DL+LL)	1.5	1.5	-	-	-	-
2.	1.2 (DL+LL±SpecX)	1.2	1.2	-	-	±1.2	-
3.	1.2 (DL+LL±SpecY)	1.2	1.2	-	-	-	± 1.2
4.	1.5 (DL ± SpecX)	1.5	-	-	-	±1.5	-
5.	1.5 (DL ± SpecY)	1.5	-	-	-	-	± 1.5
6.	0.9 DL ± 1.5(SpecX)	0.9	-	-	-	±1.5	-
7.	0.9 DL ± 1.5(SpecY)	0.9	-	-	-	-	± 1.5
8.	1.2 (DL+LL ± WLX)	1.2	1.2	±1.2	-	-	-
9.	1.2 (DL + LL ± WLY)	1.2	1.2	-	±1.2	-	-

10.	1.5 (DL ± WLX)	1.5	-	±1.5	-	-	-
11.	1.5 (DL ± WLY)	1.5	-	-	±1.5	-	-
12.	0.9 DL ± 1.5WLX	0.9	-	±1.5	-	-	-
13.	0.9 DL ± 1.5 WLY	0.9	-	-	±1.5	-	-

4.7.1 Serviceability Load Combinations

S. No.	Load Combination	Load Factors					
		DL	LL	WLX	WLY	SpecX	SpecY
1.	1.0 (DL + LL)	1.0	1.0	-	-	-	-
2.	1.0DL+0.8LL±0.8SpecX	1.0	0.8	-	-	± 0.8	-
3.	1.0DL+0.8LL±0.8SpecY	1.0	1.0	-	-	-	± 0.8
4.	1.0 (DL ± SpecX)	1.0	-	-	-	± 1.0	-
5.	1.0 (DL ± SpecY)	1.0	-	-	-	-	± 1.0
6.	1.0 (DL ± WLX)	1.0	-	± 1.0	-	-	-
7.	1.0 (DL ± WLY)	1.0	-	-	± 1.0	-	-
8.	1.0 DL + 0.8 LL ± 0.8 WLX	1.0	0.8	± 0.8	-	-	-
9.	1.0 DL + 0.8 LL ± 0.8 WLY	1.0	0.8	-	± 0.8	-	-

D.L.: Dead Load (Includes SDL); L. L: Live Load
WL: Wind Load; Spec/EQ: Seismic Load,
Suffixes X, Y and Z in the above table indicate the direction in which the force is applied.
All members will be designed for the largest value of the design forces obtained due to positive as well as negative values of reversible combination of forces (Earthquake and wind).

4.8 Lateral drift and member stiffness modifiers

The maximum inter-storey lateral drift under lateral load shall not exceed the following values:

Drift by	Load Combination	Limitation
Seismic Load	DL + 0.8 LL ± 0.8 Spec Spec shall be unscaled	H=storey /250
Wind Load	DL + 0.8 LL ± 0.8 WL	H /500 at Terrace

(The wind load used in the combinations is with return period of 100 years).

Cracked sectional properties of the concrete elements for Wind and Seismic drift (From IS 16700:2017) and stiffness modifiers to be considered in ETABS analysis shall be as follows:

Structural Element	odel as	Factored Loads		Stiffness Modifiers
		Area	Moment of Inertia	
Columns	ine	1.0 A_g	0.70 I_g	M22, M33
Walls	hell	1.0 A_g	0.70 I_g	M11, M12, M22
Beams	ine	1.0 A_g	0.35 I_g	M22, M33
Slab	hell	1.0 A_g	0.25 I_g	M11, M12, M22

Since the shear capacity of concrete is low, torsional effect can be redistributed to the adjoining members in flexure by assigning a torsion modifier of 0.01 to all the line elements (except a beam supporting a cantilever without back span which will be in pure torsion)

4.9 Service ability criteria

4.9.1 Durability and fire resistance

Concrete cover requirement for a fire rating of 2 hours for Shear wall/Columns, beams and slabs shall be as follows:

S. No.	Element	Cover Adopted (mm)
a	Foundation	**50**
b	Column	**40**
c	Beams & RC walls	**25 & 40**
d	Slabs	**15**

Minimum dimensions of reinforced concrete members for fire 2hr resistance shall be as follows:

S. No.	Element	Minimum thickness (mm) (Fire Criteria)	Minimum reinforcement
1	Columns	300	0.8 % of cross section area

2	Floor Slabs	125	0.12% of cross section area
3	Floor Beams	230	0.17 % of c/s area for Non-Ductile beams

Minimum water cement ratio and minimum cement content shall confirm to IS 456:2000 provisions of durability and strength.

4.9.2 Deflection control

• Short term deflection due to SDL+ Live load	<L /350 or 20 mm whichever is less
• Long term deflection	< L /250

Creep coefficients shall be taken as:

7 days	2.2
• Shrinkage coefficient	0.0003

As per IS 16700-2023 maximum Lateral drifts value

• Total drift at the topmost usable floor	<H /500
• For a single storey the drift limit	< hi /400
• For design earthquake force, the maximum inter-story drift	< hi /250

- hi - Inter-storey height of i th floor in the building
- H - Building height from its base to roof level

4.9.3 Crack width control

Underground rooms, retaining walls, all water retaining structures, including UGT, STP, overhead water tanks shall be designed as per IS 456 & IS 3370, with allowable crack width for moderate exposure.
In addition, water proofing of such structures to be carried out using appropriate technology.

4.10 Analysis

The structure was analysed for the different load combinations as mentioned above, and the capacity of the structural elements such as columns, beams and slabs were checked for the maximum forces obtained from ETABS design software.

4.10.1 Gravity Loads

Gravity loads develop by virtue of self-weight of the structure and superimposed loads due to occupancy, architectural features, services, etc. Resistance to gravity loads shall be provided by concrete slabs supported by a network of beams. Beams will transfer the loads to vertical elements like columns and walls.

4.10.2 Lateral Loads

Lateral loads on the structure develop primarily due to wind and seismic activity. Resistance to lateral loads shall be provided by reinforced concrete ductile shear walls/Columns
Design of shear walls and columns will incorporate ductile reinforcement detailing in accordance with IS 13920:2016.
Design for seismic loads shall be based on response spectrum analysis of the three-dimensional model of the structures as per IS 1893: 2016. Design for wind loads shall be based on IS 875:2015-PART -III.
Retaining walls and all other sub-structure members shall be designed based on the soil parameters specified in geo-technical report, with the aid of in-house design spreadsheets.

4.11 Design

The steel reinforcements in the foundation, columns, shear walls; beams and slabs are calculated for maximum forces obtained from the static and dynamic analyses for the critical load combinations.

4.11.1 Design of Sub Structure

Isolated foundation was recommended in the soil test report for this RCC building. The maximum axial load and moments acting on each column/shear wall were obtained from ETABS output. Based on the soil test report, the foundation was designed for the maximum axial load and moments by using SAFE design software.

4.11.2 Design of Super Structure

All structural members shall be designed following the guidelines of the codes mentioned in section 4.0. Structural design will be in conformance to the stability criteria prescribed in codes IS 456:2000 and IS16700:2023.

4.11.3 Design of Columns

Columns were designed for the maximum axial load and moments obtained from the analyses for the critical load combinations. The area of steel reinforcements obtained for columns from ETABS output were checked manually.

4.11.4 Design of Shear wall

Shear wall designed to resist lateral forces like wind and seismic loads. It acts as a vertical cantilever, transferring these forces to the foundation. Shear walls help prevent lateral sway and damage to buildings, making them particularly important in areas prone to earthquakes. The area of steel reinforcements obtained for shear walls from ETABS output were checked manually.

4.11.5 Design of Beams

Beams were designed for the maximum moments and shear forces obtained from analyses for the critical load combinations. The area of steel reinforcements obtained for beams from

ETABS output were checked manually.

4.11.6 Design of Slabs and Staircase

All slabs and staircase were designed as per IS 456:2000 with the aid of in-house design spreadsheets. All other structural elements and Retaining walls shall be designed based on the soil parameters specified in geo-technical report, with the aid of in-house design spreadsheets.

4.12 Conclusion

The design basis outlined in this document is based on currently available data issued by the client and architect and it covers all the codal norms for the geometry and usage of the structure. It will need to be updated if design objectives or assumptions are revised. 3D wire frame models of the building are generated and analyzed for various loads and load combinations using ETABS design software & BIM.

This design brief report deals with Rapid construction methodology like Aluminium formwork However Contractors shall explore other Rapid construction methodology like Precast Construction methodology may also be used for rapid construction, and corresponding Indian standard code for same shall be adopted.

All other guidelines or specific details will be given along with the working drawing and general drawing. Any perceived non-conformance with the project standards or expectations should be brought to our attention as early as possible.

Section – 6 Design Basis Report (DBR) for IGBC Platinum / BEE 5 star Compliance

This Design Basis Report (DBR) integrates the **Special Conditions of Contract for Green Building practices** and the discipline wise (Civil, Electrical, Plumbing, HVAC) specifications required in design, materials and Electro-mechanical equipment to optimally meet the performance targets set for this building. It shall be treated as a binding document for the EPC contractor and all subcontractors to ensure that the facility achieves, at minimum, IGBC New Construction – Platinum level / BEE 5 Star rating.

Section A-

SPECIAL CONDITIONS OF CONTRACT RELATED TO GREEN BUILDING PRACTICE

This building / project is targeted to obtain Green Building Certification at Platinum / BEE 5 star respectively and for achieving this the contractor shall strictly adhere to the following conditions as part of his contractual obligations:

Clause A:- Prevention of Air and Water pollution as per directives of National Green Tribunal

1. The contractor shall get prior approval from Engineer-in-charge for the area where the construction material or debris can be stored beyond the metalled road. This area shall not cause any obstruction to the free flow of traffic/inconvenience to the pedestrians. It should be ensured by the contractor that no accidents occur on account of such permissible storage. The contractor shall not store/dump construction material or debris on metalled road

2. The contractor shall take appropriate protection measures like Site barricading / raising wind breakers of appropriate height on all sides of the plot / area using CGI Sheets or Plastic and/or other similar material to ensure that no construction material and dust fly outside the plot area.

3. The contractor shall ensure that all the trucks or vehicles of any kind which are used for construction purpose or are carrying construction material like cement, sand and other allied materials are fully covered. The contractor shall take all necessary precautions that the vehicles are properly cleaned and dust free. to ensure that en-route their destination, the dust, sand or any other particles are not released in air/ contaminate air.

4. The contractor shall provide· ask to every worker working on the construction site and involved in loading, unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.

5. The contractor shall provide all medical help, investigation and treatment to he workers involved in the construction of building and carry of construction material and debris relatable to dust emission.

6. The contractor shall ensure that Construction and Demolition (C&D) waste is transported to the C&D waste site only and due record shall be maintained by the contractor.

7. The contractor shall ensure mandatory use of wet jet in grinding and stone cutting.

8. The contractor shall comply all the preventive and protective environmental steps as stated in the MoEF guidelines, 2010 / latest.

9. The contractor shall carry out on road inspection for black smoke generating machinery. The contractor shall use cleaner fuel.

10. The contractor shall ensure that all DG Sets used during construction if required comply emissions norms notified by MoEFCC.

11. The contractor shall use vehicles having pollution under control certificate. The emissions can be reduced by a large extent by reducing the speed of a vehicle to 20 KMPH. Speed bumps shall be used to ensure speed reduction. In cases where speed reduction cannot effectively reduce fugitive dust, the contractor shall divert traffic to nearby paved areas.

12. The contractor shall ensure that the construction material is covered by tarpauline. The contractor shall take all other precaution to ensure that no dust particles are permitted to pollute the air quality as a result of such storage.

13. The paving of path for plying of vehicles carrying construction material is more permanent solution to dust control and suitable long duration projects.

Clause B:- Protection of Top Soil and Natural features around and on the site

1. The contractor shall ensure that adequate measures are taken for the prevention of erosion of the top soil during the construction phase. The contractor shall implement the Erosion and Sedimentation Control Plan (ESCP) provided to him by the·Engineer in Charge as part of the larger Construction Management Plan (CMP). The contractor shall obtain the Erosion and Sed1mentatIon Control Plan (ESCP) Guidelines from the Engineer in Charge an then prepare working plan for the following month activities as a CAD drawing showing the construction management, staging & ESCP. At no time soil should be allowed to erode away from the site and sediments should be trapped where necessary.

2. The contractor shall ensure that all the top soil excavated during construction works in neatly stacked and is not mixed with the excavated earth. The contractors shall take the clearance of the Engineer in Charge before any excavation. Top soil should be stripped to a depth of 20cm from the areas to be disturbed, for example proposed area for buildings, roads, paved areas, external services and area required for construction activities etc. It shall be stockpiled to a maximum height of 40 cm in designated areas, covered or stabilized with temporary seeding for erosion prevention and shall be reapplied to site during plantation, landscaping etc. of the proposed vegetation. Top soil shall be separated from subsoil, debris and stones larger than 50 mm diameter. The stored top soil may be used as finished grade for planting areas.

3. In the event the site area and conditions do not permit stacking of top-soil and excavated soil, the contractor must arrange for donating fertile soil to nearby nursery / forest or engage authorized agencies to divert fertile soil to other nearby sites where landscaping needs arise. The Contractor must take prior approval from Engineer-in-charge and furnish valid documentation, proof of utilization of top-soil, certification and accreditation of the agency engaged and photographic evidence along with Truck load measurement of soil diverted from site.

4. Sub-grade Conditions: When no data is available of soil formation and depth of-water level of pro-pose works site the contractor should make his own arrangements of preliminary site investigation by actual inspection of the site and surrounding areas to assess the nature of soil and to foresee the difficulties that may arise during construction period. The contractor shall acquaint himself of the above before filling up of the tender.

5. No claim whatsoever will be entertained on any account of conducting these exploratory works or lack of investigation on the part of the Contractor.

6. The contractor shall carry out post-construction placement of topsoil or other suitable plant material over disturbed lands to provide suitable soil medium for vegetative growth. Prior to spreading the topsoil, the sub-grade shall be loosened to a depth of 50mm to permit bonding. Topsoil shall be spread uniformly at a minimum compacted depth of 50mm on grade 1:3 or steeper slopes, a minimum depth of 100mm on shallower slopes. A depth of 300mm is preferred on relatively flatter land.

7. The Contractor should follow the construction plan as proposed by the Architect /Engineer in charge to minimize the site disturbance such as soil pollution due to spilling. Use staging and spill prevention and control plan to restrict the spilling of the contaminating material on site. Protect top soil from erosion by collection storage and reapplication of top soil, constructing sediment basin, contour trenching, mulching etc.

8. No excavated earth shall be removed from the campus unless suggested otherwise by Engineer in Charge. All subsoil shall be reused in back-filling/landscape, etc as per the instructions of the Engineer in Charge. The surplus excavated earth hall be disposed of by the contractor at his own cost for reuse after approval from Engineer in Charge. A certificate of reuse as required by the Engineer-in-Charge shall be submitted by the contractor.

9. The contractor shall not change the natural gradient of the ground unless specifically instructed by the Engineer in Charge. This shall cover all-natural features like water bodies, drainage gullies, slopes, mounds, depressions, etc. Existing drainage patterns through or,into any preservation area shall not be modified unless specifically directed by the Engineer-in-charge.

10. The contractor shall not carry out any work which results in the blockage of natural drainage.

11. The contractor shall ensure that existing grades of soil shall be maintained around existing vegetation and lowering or raising the levels around the vegetation is not allowed unless specifically directed by the Engineer-in-charge

12. Contractor shall reduce pollution and land development impacts from automobiles use during construction.

13. Overloading of trucks is unlawful and creates the erosion and sedimentation problems, especially when loose materials like stone dust, excavated earth, sand etc. are moved. Proper covering must take place. No overloading shall be permitted.

Clause C- Construction management and facilities for workers

1. The contractor shall develop a Construction Management Plan (CPM) for every phase of the project including excavation, casting of slabs, facade works, finishing etc. The plan must be approved by the Engineer-in-charge and must be depicting the following:-

- Site entry for vehicles with wheel washing facility
- Sedimentation channel and holding tank for de-silting site run-off
- Site barricading and location of existing trees and natural features including drains, rivulets, nallahs etc. On the site that are to be left undisturbed and protected.
- Site office with meeting room / cabin for engineer and supervisor, first aid room.
- Designated Labor hutment with separate male and female toilets, creche for children, first aid facility, and other sanitation and hygene facilities including space for cooking and waste disposal
- Raw material storage yard - seggregated for each type of material (eg- Rebars, cement bags, blocks etc)
- Waste material stack yards- seggregated for each type of material (eg- Scrap steel, Bags, concrete debris) including dustbins for mixed waste at suitable locations
- Stacking of excavated soil
- Stacking of fertile top soil as per Clause B.

2. The contractor shall specify and limit construction activity in pre-planned/ designated areas and shall start construction work after securing the approval for the same from the Engineer in Charge. This shall include areas of construction, storage of materials, and material and personnel movement.

3. The contractor shall ensure that no trees, existing or otherwise, shall be harmed and damage to roots should be prevented during trenching, placing backfill, driving or parking heavy equipment, dumping of trash, oil, paint, and other materials detrimental to plant health. These activities should be restricted to the areas outside of the canopy of the tree, or, from a safe distance from the tree/plant by means of barricading. Trees will not be used for support; their trunks shall not be damaged by cutting and carving or by nailing posters, advertisements or other material. Lighting of fires or carrying out heat or gas emitting construction activity within the ground, covered by canopy of the tree is not to be permitted.

4. The contractor shall take steps to protect trees or saplings identified for preservation within the construction site using tree guards of approved specification.

5. The contractor shall conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity. Contractor should limit all construction activity within the specified area as per the Construction Management Plan (CMP) approved by PMC/ Bank. All the existing trees should be preserved, if not possible than compensate the loss by re-planting trees in the proportion of 1:3.

6. The contractor shall avoid cut and fill in root zone, through delineating and fencing the drip line (the spread limit of a canopy projected on ground) of all trees or group of trees. Separate the Zones of movement of heavy equipment parking, or excessive foot traffic from the fenced plant protection zones.

7. The contractor shall ensure that maintenance activities during construction period shall be performed as needed to ensure that the vegetation remains healthy. The preserved vegetated area shall be inspected by the Landscape Architect / Architect / Engineer-in- charge at regular intervals so that they remain undisturbed. The date of inspection, type of maintenance or restorative action followed shall be recorded in the logbook.

8. Contractor shall be required to develop and implement a waste management plan, quantifying material diversion goals. He shall establish goals for diversion from disposal in landfills and incinerators and adopt a construction waste management plan to achieve these goals. A project-vide policy of "Nothing leaves the Site" should be followed. In such a case when strictly followed, care would automatically be taken in ordering and timing of materials such that excess doesn't become "waste". The Contractor's ingenuity is especially called towards meeting this prerequisite/ credit . Consider recycling cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet and insulation.

9. Designate a specific area(s) on the construction site for segregated or commingled collection of recyclable material, and track recycling efforts throughout the construction process.

10. Identify construction haulers and recyclers to handle the designated materials. The diversion may include donation of materials to charitable organizations and salvage of materials on-site.

11. Contractor shall collect all construction waste generated on site. Segregate these wastes based on their utility and examine means of sending such waste to manufacturing units which use them as raw material or other site which require it for specific purpose. Typical construction debris could be broken bricks, steel bars, broken tiles, spilled concrete and mortar etc.

12. The contractor shall maintain record of all construction waste sent for recycling by means of site challans/receipts with waste quantity mentioned in weight or volume.

13. The contractor shall provide potable water for all workers. The contractor shall maintain monthly test reports highlighting that water is fit for drinking.

14. The contractor shall provide the minimum level of sanitation and safety facilities for the workers at their camp/labour·site.

15. The contractor shall ensure cleanliness of workplace with regard to the disposal of waste and effluent; provide clean drinking water and latrines and urinals as per applicable standard. Adequate toilet facilities shall be provided for the workman within easy access of their place of work. The total no. to be provided shall not be less than 1 per 30 employees in any one shift. Toilet facilities shall be provided from the start of building operations, connection to a sewer shall be made as soon as practicable. Every toilet shall be so constructed that the occupant is sheltered from view and protected from the weather and falling objects. Toilet facilities shall be maintained in a sanitary condition. A sufficient quantity of disinfectant shall be provided. Natural or artificial illumination shall be provided.

16. The ,contractor shall ensure that air pollution due to dust / generators is kept a minimum, preventing any adverse effects on the··workers and other people in and around the site. The contractor shall ensure proper screening, covering stockpiles covering brick and loads of dusty materials, wheel-washing facility, gravel pit, and water spraying.

17. Contractor shall ensure the following activities to prevent air pollution during construction:

- Clear vegetation only from areas where Work will start right away
- Vegetate / mulch areas where vehicles do not ply.
- Apply gravel / landscaping rock to the areas where mulching I paving is impractical
- Identify roads on-site that would be used for vehicular traffic. Upgrade vehicular roads (if these are unpaved) by increasing the surface strength by improving particle size, shape and mineral types that make up the surface & base.
- Add surface gravel to reduce source of dust emission. Limit of fine particles (smaller than 0.075mm)10 to 20%.
- Water spray, through a simple hose for small projects, to keep dust under control.
- Fine mists should be used to control fine particulate. However, this should be done with care so as not to waste water. Heavy watering can also create mud, which when tracked onto paved public roadways, must be promptly removed. Also, there must be an adequate supply of clean water nearby to ensure that spray nozzles dont get plugged.
- Water spraying shall be done on:
- Any dusty materials before transferring,. loading and unloading
- Area where demolition work is being carried out
- Any un-paved main haul road
- Areas where excavation or earth moving activities are to be carried out
- The contractor shall ensure that the speed of vehicles within the site is limited to 10 km/hr or 20 km/hr..
- All material storage should be adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust/ particulate emissions.
- Spills of dirt or dusty materials will be cleaned up promptly so the spilled material does not become source of fugitive dust and also to prevent of seepage of pollutant laden water into the ground aquifers.
- When cleaning up the soil, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained / leaned up immediately before they can infiltrate into the soil / ground or runoff in nearby areas.

- Provide barricading not less than 3 meters or higher as per direction of Engineer-in- charge, along the site boundary, next to a road, around batching plant or other public area.
- Provide dust screens, sheeting or netting to Scaffold along the perimeter of the building
- Cover stockpiles of dusty material with impervious sheeting
- Cover dusty load on vehicles by impervious sheeting before they leave the site.

18. Contractor shall be required to provide an easily the entire accessible area that serves building and is dedicated to the separation, collection and storage of materials for recycling including (at a minimum) paper, corrugated cardboard, glass, plastics, and metals. He shall coordinate the size and functionality of the recycling areas with the anticipated collections services for glass, plastic, office paper, newspaper, cardboard, and organic wastes to maximize the effectiveness of the dedicated areas. Consider employing cardboard balers, aluminum can crushers, recycling chutes, and collection bins at individual workstations to further enhance the recycling program.

19. The contractor shall ensure that no construction leachate (e.g. cement slurry etc.), is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against this including, reduction of wasteful curing processes, collection, basic filtering and reuse. The contractor shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant-laden water directly to the treatment device or facility (municipal sewer line).

20. Staging (dividing a construction area into two or more areas to minimize the area of soil that will be exposed at any given time) should be done to separate undisturbed land from land disturbed by construction activity and material storage.

21. The contractor shall comply with the safety procedures, norms and guidelines (as applicable) as outlined in the document Part 7 Constructional practices and safety, 2005, National Building code of India, Bureau of Indian Standards. A copy of all pertinent regulations and notices concerning accidents, injury and first-aid shall be prominently exhibited at the work site. Depending upon the scope & nature of work, a person qualified in first-aid shall be available at work site to render and direct first-aid to causalities. A telephone may be provided to first-aid assistant with telephone numbers of the hospitals displayed. Complete reports of all accidents and action taken thereon shall be forwarded to the competent authorities.

22. The contractor shall ensure the following activities for construction workers safety, among other measures as specified in NBC-2016:

- Guarding all parts of dangerous machinery.
- Precautionary signs for working on machinery
- Maintaining hoists and lifts, lifting machines, chains,ropes, and other lifting tackles in good condition.
- Durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.
- Ensuring that walking surfaces or boards at height are of sound construction and are provided with safety rails or belts.

- Provide protective equipment, helmets etc.
- Provide measures to prevent fires. Fire extinguishers and buckets of sand to be provided in the fire-prone area and elsewhere.
- Provide sufficient and suitable light for working during night time.

23. The storage of material shall be as per standard good practices as specified in Part 7, Section 2 - Storage, stacking and Handling practices, NBC-2016 and shall be to the satisfaction of the Engineer in Charge to ensure minimum wastage and to prevent any misuse, damage, inconvenience or accident. Watch and ward of the Contractor's materials shall be his own responsibility. There should be a proper planning of the layout for stacking and storage of different materials, components and equipment with proper access and proper maneuverability of the vehicles carrying the materials. While planning the layout, the requirements of various materials, components and equipment at different stages of construction shall be considered.

24. The contractor shall provide for adequate number of garbage bins around the construction site and the workers facilities and will be responsible for the proper utilization of these bins for any solid waste generated during the construction. The contractor shall ensure that the site and the workers facilities are kept litter free. Separate bins should be provided for plastic, glass, metal, biological and paper waste and labeled in both English and local language with suitable symbols.

25. Contractor should spray curing water on concrete structure and shall not allow free flow of water. Concrete structures should be kept covered with thick cloth/gunny bags and water should be sprayed on them.

26. Contractor shall do water ponding on all sunken slabs using cement and sand mortar.

27. The Contractor shall remove from site all rubbish and debris generated by the works and keep works clean and tidy throughout the Contract Period. All the serviceable and non- serviceable (malba) material shall be segregated and stored separately.

28. The malba obtained during construction shall be collected in well-formed heaps at properly selected places, keeping in a view safe condition for workmen in the area. Materials which are likely to cause dust nuisance or undue environmental pollution in any other way, shall be removed from the site at the earliest and till then they shall be suitable covered. Glass & steel should be dumped or buried separately to prevent injury.

29. The work of removal of debris should be carried out during day. In case of poor visibility artificial light may be provided.

30. The contractor shall prepare and submit spill prevention and control plans before the start of construction, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, and petroleum products.

31. Contractor shall collect & submit the relevant material certificates for materials with high recycled (both post-industrial and post-consumer) content, including materials like RMC mix with fly-ash, glass with recycled content, calcium silicate boards etc.

32. Contractor shall collect the relevant material certificates for rapidly renewable materials such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheat board, strawboard and cork etc.

33. Contractor shall adopt an lAQ (Indoor Air Quality) management plan to protect the HVAC system

during construction, control pollutant sources, and interrupt pathways for contamination. He shall sequence installation of materials to avoid contamination of absorptive materials such as insulation, carpeting, ceiling tile, and gypsum wallboard. He shall also protect stored on-site or installed absorptive materials from moisture damage.

34. The contractor shall ensure that a flush out of all internal spaces is conducted prior to handover. This shall comprise an opening of all doors and windows for 14 days to vent out any toxic fumes due to paints, varnishes, polishes, etc.

Clause D- Resource consumption during construction

1. The contractor shall ensure that the water and electricity is not wasted during construction. The Engineer in Charge can bring to the attention any such wastage and the contractor will have to ensure that such bad practices are corrected.

2. The contractor shall install necessary meters and measuring devices to record the consumption of water, electricity and diesel on a monthly basis for the entire tenure of the project.

3. The contractor shall ensure that all run-off water from the site, during construction is collected and reused to the maximum.

4. The contractor shall use treated recycled water of appropriate quality standards for construction, if available.

5. No lights shall be turned on during the period between 6:00 AM to 6:00 PM, without the permission of the Engineer-in-charge.

6. The contractor is encouraged to use bio-diesel in place of petroleum diesel for the running of generators during construction.

Clause E- Construction Waste

1. Contractor shall ensure that wastage of construction material is within 3%.

2. All construction debris generated during construction shall be carefully segregated and stored in a demarcated waste yard. Clear, identifiable areas shall be provided for each waste type. Employ measures to segregate the waste on site into inert, chemical, or hazardous wastes.

3. All construction debris shall be used for road preparation, back filling, etc, as per the instructions of the Engineer in Charge, with necessary activities of sorting, crushing, etc.

4. No construction debris shall be taken away from the site, without the prior approval of the Engineer in Charge.

5. The contractor shall recycle the unused chemical/hazardous wastes such as oil, paint, batteries, and asbestos.

6. If and when construction debris is taken out of the site, after prior permissions from the Engineer in Charge, then the contractor shall ensure the safe disposal of all wastes and will only dispose of any such construction waste in approved dumping sites.

7. Inert waste to be disposed of at Municipal Corporation/ local bodies landfill sites.

Clause F- Documentation for obtaining Green Building Certification

1. The contractor shall, during the entire tenure of the construction phase, submit the following records to the Engineer in Charge on a monthly basis:

1.1. Water consumption in litres

1.2. Electricity consumption in kWh units

1.3. Diesel consumption in liters

1.4. Quantum of waste (volumetric/weight basis) generated at site and the aggregated waste types divided into inert, chemical and hazardous wastes.

1.5. Digital photo documentation to demonstrate compliance of safety guidelines as specified here and in the Appendix on Safety Conditions.

2. The contractor shall, during the entire tenure of the construction phase, submit the following records to the Engineer in Charge on daily basis:

2.1. Quantities of material brought into the site, including the material issued to the contractor by the Engineer-in-charge.

2.2. Quantities of construction debris (if at all) taken out of the site Digital photographs of the works at site, the workers facilities, the waste and other material storage yards, pre-fabrication and block making works, etc. as guided by the Engineer in Charge.

2.3. No. of different categories of labours deployed at site for work (shift wise).

3. The contractor shall submit a document after construction of the buildings, a brief description along with photographic records to show that other areas have not been disturbed during construction. The document should also include brief explanation and photographic records to show erosion and sedimentation control measures adopted. (Document CAD drawing showing site plan details of existing vegetation, existing buildings, existing slopes and site drainage pattern, staging and spill prevention measures, erosion and sedimentation.

4. The contractor is required to submit following documents for IGBC / BEE 5 STAR / IGBC submission to achieve desired rating in due time.

Submission No	*Project Stage*
1	*Excavation Work Completed*
2	*Above Ground Structure 50% Completed*
3	*Structure Work 90% completed*
4	*Masonry Work 90% completed*
5	*Roof Insulation 100% completed*

6	*Interior Finishing 90% Completed* *(Flooring, False ceiling, Wall Tiles, Wall Panelling, paint, polish etc.) Titling & fixture*
7	*Low Side HVAC 90% completed*
8	*High Side HVAC 100% completed*
9	*External Glazing 100% Completed*
10	*Electrical Works 90% completed* *(Installation of Interior & exterior lighting, transformers, LT panels, energy meters etc)*
11	*STP Installation & commissioning completed*
12	Energy Systems Installation completed (Solar PV Panels, Solar Hot Water etc)
13	Outdoor Paving completed 100% (Open Parking, Footpath, Internal Roads etc)

14	Landscape Plantation 100% Completed (Trees, Plants, Grass, Ground Covers, Shrubs etc)
15	Project completion & All Electrical, Mechanical & Plumbing equipment commissioning

S.no.	Documents List	Submissions

1	Site Management Plan highlighting following strategies Excavation area for building foundations. Extent of construction activity area on site Area of stacked Top soil for preservation & its quantity in cubic meter Labour hutment & no. of workers (men/women) Drinking water near construction area and labour hutment Toilets for gents and ladies near construction area and labour hutment Crechefacility for labour children Site perimeter fencing Storm water drainage within site Storm water collection & sedimentation pit Vehicle wheel wash pit First aid facility Location of DG sets Location of all existing trees preserved at site Batching Plant location Cement Store location Raw material storage like steel, aggregates, sand stone dust, chemicals, bricks, concrete blocks, AAC Blocks, stone, tiles, paint drums, false ceiling, etc. Segregated waste collection areas for steel scrad empty cement bags, empty chemical drums, brokel bricks, scrap wood etc.	1,2,3,4,6, 13,15
2	Photographs of the above site management strategies	1,2,3,4,6,13,15
3	Photographs of construction waste materials segregated & collected at site	1,2,3,4,6,13,15
4	Purchase invoices of cement, Bricks, AAC blocks, Fly-ash bricks, concrete blocks etc	2,3,4,15
5	Purchase invoices of flush doors, fire rated doors, window frames & window glass	6,15
6	Purchase invoices of al interior finishing materials like flooring stone/tiles, false ceiling, wall	6,15
7	Purchase invoices & technical cutsheet of roof insulation, Duct & Pipe	5,7,8,15

	insulation	
8	Cement test report highlighting fly ash content	2,3,4,6,15
9	Test reports of drinking water at site	1,2,3,4,5,6,7,8,9, 10,11,12,13,14, 15

10	Air quality test report for site	1,2,3,4,5,6,7,8,9, 10,11,12,13,14, 15
11	Manufacturer certificate of fly-ash content in flash bricks, AAC blocks, concrete blocks etc	2,3,4,15
12	Purchase invoices & technical cutsheet of Glass used in project windows / exteriors	9
13	Site challans highlighting quantity of all sold scrap from site like steel, waste wood, plastic drums,	2,3,4,5,6,7,9,10, 11,13,15
14	Photographs of construction waste materials reused within site like broken bricks, broken tiles, stone	2,3,4,5,6,7,9,10, 11,13,15
15	Purchase invoices & technical cutsheet of Renewable Energy Systems	12
16	Photographs of Renewable Energy Systems installed in the project	12
17	Test report of STP treated water	11
18	Digital copies of Mechanical, Electrical & Plumbing equipment commissioning reports, Operation and Maintenance Manuals & Annual Maintenance Contracts	15
19	Purchase invoices of landscape trees, plans, shrubs & ground covers	14
20	Photographs of Landscape trees, plants, shrubs & ground covers	14

The contractor shall submit to the Engineer in Charge after construction of the buildings, a detailed as built quantification of the following:

Total materials used,

Total top soil stacked and total reused

Total earth excavated

(i) Total waste generated,

(ii) Total waste reused,

(iii) Total water used,

(iv) Total electricity consumed (viii)Total diesel consumed.

5. The contractor shall submit to the Engineer in Charge, before the start of construction, a site plan along with a narrative to demarcate areas on site from which top soil has to be gathered, designate area where it will be stored, measures adopted for top soil preservation and indicate areas where it will be reapplied after construction is complete.

6. The contractor shall submit to the Engineer-in-charge, a detailed narrative (not more than 250 words) on provision for safe drinking water and sanitation facility for construction workers and site personnel.

7. Provide supporting document from the manufacturer of the cement specifying the fly-ash content in PPC used in reinforced concrete.

8. The contractor shall submit the following information to the Engineer-in-charge at the end of construction, for all material brought to site for construction purposes, including manufacturer's certifications, verifying information, and test data where specifications sections require data relating to environmental issues including but not limited to:

(i) Source of products: Supplier details and location of the supplier.

(ii) Project Recyclability: Submit information to assist Owner and Contractor in recycling materials involved in shipping, handling, and delivery, and for temporary materials necessary for installation of products.

(iii) Recycled Content: Submit information regarding product post-industrial recycled and post- consumer recycled content, Use the Recycled Content Certification Form, to be provided by the Commissioning Authority appointed for the Project.

(iv) Product Recyclability: Submit information regarding product and products components recyclability including potential sources accepting recyclable materials where ever applicable.

(v) Provide final certification of well-managed forest of origin to provide final documentation of certified sustainably harvested status: Acceptable wood, certified sustainably harvested, certifications shall include:

(vi) Wood suppliers" certificate issued by one of the Forest Stewardship Council- accredited certifying agencies;

(vii) Suppliers" invoice detailing the quantities of certified wood products for project;

(viii) Letter from one of a certifying agency corroborating that the products on the wood supplier's invoice originate from certified well-managed forests.

(vi)Clean tech: Provide pollution clearance certificates from all manufacturers of materials

(vi) Indoor Air quality and Environmental Issues: Submit emission test data, sourced from the manufacturers, produced by acceptable testing laboratory listed in Quality Assurance Article for materials as required in each specific Specification section.

(vii) Certifications from manufacturers of Low VOC paints, adhesives, sealant and polishes used at this particular project site.

(viii) Certification from manufacturers of composite wood products/agro-fibre products on the absence of added urea formaldehyde resin in the products supplied to them to this particular site.

(ix) Submit environmental and pollution clearance certificates for all diesel generators installed as part of this project.

(x) The Contractor shall appoint a Green building Consultant with minimum 3 years of experience and degree in Architecture / Engineering + being an IGBC AP / BEE 5 STAR CP at his own expense for completing all Green Building Rating related formalities, including Registration, signing of forms, providing signed letters in the contractors letterhead whenever required. This consultant shall liaise with the Contracting team, PMC, architect and Consultants and other departments for creating and carrying out the documentation till the rating is achieved. The Official Registration fee shall be paid by the bank on demand directly to IGBC / BEE 5 STAR.

(xi) The Contractor shall follow all the Energy Conservation Building Code (ECBC) norms & IGBC / BEE 5 STAR targeted credits for minimum Platinum or 5 Star Rating. The Contractor shall give preference to materials and manufacturers who produce green building materials and who are able to supply green certificates for their materials while still emphasizing on the quality, strength and longevity of these materials. The contractor shall comply with Environment, Health and Safety (EHS) guidelines as listed below in Green building Practice guidelines.

9. To ensure energy efficiency during and post construction all pumps, motors and engines used during construction or installed, shall be comply to ECBC 2017.

10. All lighting installed by the contractor around the site and at the labour quarters during construction shall be CFL bulbs of the appropriate illumination levels. This condition is a must, unless specifically prescribed.

11. The contractor is expected to go through all other conditions of the IGBC / BEE 5 star rating stipulations. Failure to adhere to any of the above-mentioned items, without approval of the Engineer-in-charge, shall be deemed as a violation of contract and the contractor shall be held liable for penalty as per terms of the agreement.

12. In case any penalty is imposed by any Hon'ble Court, NGT or any other authority due to non-compliance of any statutory order, or law or guidelines or pollution control or environmental norms, the same will be borne by the contractor.

13. The contractor shall submit the detailed action plan for control of pollution and for adherence to all the environmental guidelines/Laws/statutes/Court Orders/NGT orders/orders of pollution control authorities through the entire period of construction at site. The detailed action plan shall be submitted to the Engineer-in-Charge within 15 days-of the stipulated date-of start of work.

14. The contractor shall arrange for control measures of all dust/noise/emission covers/dust trappers etc. as per guidelines/orders of the NGT/Court of law/ statutory work.

Section B-CONSIDERATIONS FOR CIVIL AND ARCHITECTURAL DESIGN AND MATERIALS

Clause G - Building Envelop Design for Climate responsiveness

1. The contractor shall ensure building envelop design including construction assembly, solar shading, window to wall area ratio, zoning of spaces to minimize need for Air conditioning and optimizing materials for lower embodied energy. Desing and proposed specifications should match and exceed the performance from a standard building developed as per Prescriptive requirements of ECBC 2017.

2. The following parameters must be followed:-

2.1. Ensure Peak Building Envelop heat gains, including Exterior walls, glazing and roof to be below **25 W/m2 (as per BEE 5 star v2019 manual table 7.1C for Office buildings 5 days a week operational in Warm-humid climate)**. Ensure the proposed building envelop with the help of passive design strategies reduces the overall Building Energy Performance Index (EPI) kWh/m2-year by **at-least 4%** over ASHRAE 90.1 2016 or ECBC 2017 baseline building.

2.2. Recommended building envelop specifications:-

2.2.1. Exterior Wall - U value < 0.65 W/m2K

2.2.2. Exterior Roof - U value < 0.3 W/m2K

2.2.3. Roof Solar Reflective Index (SRI) > 90%

2.2.4. Exterior Glazing - U value < 3 W/m2K (including Frame) , SHGC < 0.27, VLT - 35-45%

2.2.5. Maximum Window to Wall area ratio on a single facade - 40% (to be measured as a ratio of the total vertical wall area in a single plane to the total area of glazed surfaces inside the wall)

2.2.6. Maximum Skylight to Roof area ratio on a single roof - 2.5% (to be measured as a ratio of the total horizontal roof area in a single plane to the total area of glazed surfaces inside the roof)

2.2.7. Exterior Shading Projection factor > 0.5

The contractor can modify the proposed specifications provided performance benchmarks defined in Clause G point 2.1. and 2.2. are satisfactorily met. Detailed calculations and simulation model results from ECBC approved software to be submitted to PMC/ BANK for validating performance claims.

The contractor must submit Facade skin section along with U-value calculations and technical specifications sheet of the proposed materials to validate performance claims.

Clause H - Low Environmental Impact Building Materials and structural design

1. The contractor shall design the Building's structure such that it demonstrates atleast 5% reduction in the use of Steel and Cement by weight of the total building's structure compared to a baseline building. The structure design must confirm to all applicable strucutural safety standards and approved by competent authority and engineer-in-charge.

2. The baseline building to be used for comparison will be designed to carry identical live loads and dead loads, building shape and form, number of floors and basement. Baseline building is to be assumed to be constructed using RCC Framed structure using Ordinary Portland Cement and 9' Red brick walls for exterior and 4' Red brick for Interior walls.

3. Detailed Structural calculations using STAAD-PRO / TEKLA or other software must be submitted to approve and validate the claims.

4. The contractor must make use of Couplers and adhesives to extend Reinforcement instead of lapping to minimize use of Steel.

5. The contractor must prepare conduit drawings and carefully analyse clashes between routes of pipes and structural elements to minimize core-cutting. No core-cutting in the structure shall be permitted without approval of Engineer-in-charge.

6. The contractor must use cutter machines to create chase in walls to minimize construction waste.

7. Local Materials are those which are manufactured within a distance of 400 km. Assembly of building materials shall not be considered. Extraction and processing of raw materials need not be considered.

8. The contractor shall Ensure at least 30% of the total building materials (by cost) used in the building are manufactured locally within a distance of 400 km.

9. Recycled Content is the content in a material or product derived from recycled materials versus virgin materials. Recycled content can be materials from recycling programs (post-consumer) or waste materials from the production process or an industrial/agricultural source (pre-consumer or post-industrial).

10. The contractor shall use materials with recycled content in the building such that the total recycled content constitutes at least 10% of the total cost of building materials.

11. To promote recycling of construction and demolition waste the contractor shall comply with the following, unless otherwise over-ruled by Engineer- in- charge on grounds of structural stability and quality standards:-

    11.1. All cement used at site for reinforced concrete, precast members, etc. shall be OPC grade 43 mixed with Fly ash conforming to grade I of IS 3812 (Part-1) only be used as part

replacement of OPC as per IS : 456 as in proportions within safe limits for respective design mix as per IS IS 456:2000 or equivalent PPC (Portland Pozzolana Cement).

11.2. The contractor can use other compounds like GGBS (Ground Granulated Blast Furnace Slag) with prior approval from Engineer-in-charge, in place of Flyash in Reinforced cement concrete.

11.3. All cement used at site for mortar, plaster, building blocks, shall be PPC (Portland Pozzolana Cemet).

11.4. PPC must meet the requirements of IS 1488: 1991. Replacement of cement with fly ash in PPC (Portland Pozzolana Cement) used in the overall RC for meeting the equivalent strength requirements shall be carried out.

11.5. The contractor has to comply as per MoEF issued notification 8.0.763(E) dated 14th Sept.1999 containing directive for greater fly ash utilization, where it stipulates that every construction agency engaged in the construction of buildings within a radius of 50 km radius of a Thermal Power Plant, have to use of 100% flyash based bricks/blocks in their construction. Any brick/block containing more than 25% fly ash is designated as fly ash brick/block. As per IGBC / BEE 5 star credits, bricks / blocks should contain a percentage of fly ash.

11.6. The contractor is encouraged to use Recycled Concrete Aggregate (RCA) in Reinforced Cement concrete provided the design mix with RCA adheres to specifications of RCC as per IS 456:2000.

12. The contractor must ensure that at-least 5 type of Building materials are sourced from manufacturers having green certification from recognized agency including - CII Green Pro, BEE 5 STAR, and or having a valid Environmental Product Declaration issued by authorized agency (eg- UL or EPD International). The certification of the products must be valid at the time of building handover.

13. The contractor shall ensure at least 75% of all new wood based materials (by cost) used in the building (as per scope) are: Rapidly renewable (And / Or) Wood certified by Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC) or equivalent.

14. The contractor shall use all Paints, Adhesives, Insulation materials with Low Volatile Organic Compound (VoC) as per the following standards:-

Table 11 - VOC Limits for Adhesives

Type of Adhesives	VOC Limit (g/L less water)
Glazing adhesives	100
Ceramic tile adhesives	65
Drywall and panel adhesives	50
Wood substrata adhesives	30
Wood flooring adhesives	100
HVAC duct insulation	850
Indoor Carpet adhesives	50
Multipurpose construction adhesives	70

Table 10 - VOC Limits for Paints & Coatings

Type of Paints & Coatings	VOC Limit (g/L less water)
Non-flat (Glossy)	150
Flat (Mat)	50
Anti-corrosive/ Anti-rust	250
Clear Wood Finish: Varnish	350
Clear Wood Finish: Lacquer	550
Floor Coatings	100

Clause I - External Development, Stormwater management and Landscaping

1. The contractor shall design the exterior at-grade level of the building's exterior using materials that help to mitigate urban heat island effect.

2. The contractor must design the exterior areas such that atleast 75% of the non- impervious area of the site apart from the building footprint is either:- Covered with Light coloured paver blocks, Open Grid grass pavers, or Shaded by trees.

3. All exterior hard paving materials must be designed using a combination of light colour blocks or finishes such that they provide a Solar Reflective Index between 29 to 64.

4. The total area of the building roof, plus the roof of the Building Podium (slab over basement) excluding the Building footprint must be covered with a combination of High SRI > 90 finish and Vegetation (respectively) upto atleast 90 % of the total Roof area of the Building footprint and Podium slab combined.

5. The contractor must develop all landscaping under their scope with Horticulture using a minimum of 30% of Turf or Lawn area and atleast 30% of the vegetation using Native draught tollerant species and must provide the specifications of the native species to be used for approval with the Engineer-in-charge.

6. The contractor must provide a separate irrigation line using treated waste water for the landscape areas and use Drip irrigation system along with a central shutoff valve, timer control and pressure regulating valve on the Irrigation water supply line to minimize water wastage.

7. Landscape design must ensure daily irrigation consumption to be maintained less than 4 Lts/ sqm.

8. The contractor must design and provide all exterior lighting on Facade and exterior areas such that the total installed power of the light fixtures must be reduced by 30% of ASHRAE standard 90.1 - 2010 ,Section 9.4.3 or ECBC 2017 or latest baseline lighting power density, whichever is lower.

9. The outdoor lighting features must be designed such that no external light fixture emits more than 5% of the total initial designed fixture Lumens, at an angle of 90 degrees or higher from nadir (straight down).

10. The contractor must provision in the design dedicated resting space and wash room for service staff of the building including Security, Divers, Housekeeping personnel on Ground floor or basement level and provide adequate lighting and ventilation for the same.

11. The contractor must design a Rainwater Harvesting System to recharge or re-use up to 15% of Peak Monthly rainfall in a single day. The system must consider run-off from the building roof and exterior areas. The system should include a Sedimentation and Grease trap to filter out the debris from the rainwater before it can be recharged in the ground or stored for re-use.

12. The contractor must conduct a Soil percolation test report to identify the percolation rate in m3/hr for adequately designing rainwater harvesting systems to prevent flooding post construction. The following methodology must be used for conducting the percolation rate test:-

12.1. Percolation test helps in determining the rate at which the volume of water dissipates into the subsoil of a drilled hole from 1 m^2 surface area.

12.2. Dig the test hole: Dig a hole in the desired soil percolation rate testing area. The hole should be around 3–4 m deep and having a base of around 1 m^2 area. If the testing area is large, dig several holes, spacing them throughout the area.

12.3. Saturate the test hole: Fill the test hole, or holes, with water, and wait for the water to drain into the soil. The water may drain relatively rapidly, in less than 1 h, or it may take a number of hours to drain. Keep adding water for 8–12 h.

12.4. Refill the hole: After 8–12 h, completely refill the hole.

12.5. Measure the change in water–level: Return to the test hole in 30 min, and insert the yardstick or tape measure to the hole's bottom. Measure the new distance from the board to the water level. Write down the measurement along with the current time.

12.6. Repeat measurements: Continue to measure the distance between the water level and the board every 30 min for at least three additional measurements. Write down each new measurement and the time it was taken. After taking several measurements, determine how much the water level dropped between each measurement. The amount of change per hour is the soil's percolation rate. If, for instance, the water level dropped an average of 1 inch every 30 min, then the percolation rate would be 2 inches per hour.

Section C-CONSIDERATIONS FOR MEPF SERVICES

Clause J -Plumbing systems - Water Supply, Waste water management and treatment systems

1. The contractor shall provide low-flow water fixtures to minimize water demand by at-least 25% over the baseline flow rates as specified in IGBC / BEE 5 STAR criteria.

2. The following specification of Flow rate must be provided, measured at 3 bar Pressure:-

WC full flush	4 L / flush
WC half flush	2 L / flush
Health faucet	6 L /min
Faucet taps	6 L / min
Urinals (sensor based / waterless)	1.5 L /flush
Showers	10 L/min

The contractor must submit a schedule of fixtures installed along with the technical specifications and manufacturers test report of flow rates at 3 Bar pressure.

3. The contractor must design and provide on-site Waste water treatment system and provide a cost benefit feasibility along with sizing for adequate capacity based on water demand of the facility.

4. The waste water treatment system shall be able to handle 100% of the waste water generated on site

5. The treated waste water must be used to meet 100% of the on-site flushing, irrigation and cooling tower water requirements as applicable.

6. A separate overhead tank for treated waste- water along with dedicated water supply line feeding WCs and Irrigation line must be designed.

7. The contractor must submit a water quality test report as per IS 3025 to ensure both Treated waste water and Potable water supply meet quality standards as per relevant IS Standards.

8. The contractor must ensure installation of Digital water flow meters on the following points- I) Municipal Water supply, ii) STP inlet iii) Flushing water consumption, iv) Irrigation water

consumption. Water flow meters must be capable of integration with the Building Management System (BMS) via RS 485 connection over BACNET / MODBUS protocol.

Clause K - Mechanical and Electrical systems - HVAC, Power distribution, metering and renewable energy systems

1. The contractor must ensure compliance to all prescriptive measures for designing Electro- mechancial systems as per ECBC 2017.

2. The following specifications must be followed:-

(Table 1) Minimum Efficiency of M&E Systems

No.	Comfort Systems and Controls	Components	Mandatory requirement
	Minimum space conditioning equipment efficiencies	Variable Refrigerant Flow	Less than 40kW - EER (W/W) = 3.28, IEER (W/W) = 4.36 40-70 kW - EER (W/W) = 3.26, IEER (W/W) = 4.34 More than 70kW - EER (W/W) = 3.02, IEER (W/W) = 4.07
		Air conditioning and condensing units serving computer rooms	All types of computer room ACs Air/ Water/ Glycol, of any capacity must comply with: - Minimum SCOP-127 Downflow = 2.5 Up flow = 2.5 Sensible Coefficient of Performance (SCOP-127): A ratio calculated by dividing the net sensible cooling capacity in watts by the total power input in watts (excluding reheater and dehumidifier) at conditions defined in ASHRAE Standard 127-2012
2	Controls	Temperature controls	Provide a thermostat for temperature control in separate zones and separately for rooms or cabins less than 30m2. The controls should be able to start and stop the system under different time schedules, Or An occupant sensor or A manually operated timer or an interlock to a security system that shuts the system off when the security system is activated.

<table>
<tr><td></td><td></td><td>Occupancy controls act</td><td>To control the Minimum ventilation flow rate in a conference or meeting rooms when not in use

Occupancy controls shall be installed to de-energize or to throttle to minimum the ventilation and/or air conditioning systems when there are no occupants</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Piping and Ductwork</td><td>Piping insulation: Piping for heating, space conditioning shall meet the insulation requirements</td><td rowspan="2"><table>
<tr><td>Operating Temperature (°C)</td><td colspan="2">Pipe size (mm)</td></tr>
<tr><td></td><td><40</td><td>>=40</td></tr>
<tr><td></td><td colspan="2">Insulation R value (m².K/W)</td></tr>
<tr><td>Heating System</td><td></td><td></td></tr>
<tr><td>>94°C and <=121°C</td><td>0.9</td><td>1.2</td></tr>
<tr><td>>60°C and <=94°C</td><td>0.7</td><td>0.7</td></tr>
<tr><td>>40°C and <=60°C</td><td>0.4</td><td>0.7</td></tr>
<tr><td>Cooling System</td><td></td><td></td></tr>
<tr><td>>4.5°C and <=15°C</td><td>0.4</td><td>0.7</td></tr>
<tr><td><4.5°C</td><td>0.9</td><td>1.2</td></tr>
<tr><td>Refrigerant Piping (Split systems)</td><td></td><td></td></tr>
<tr><td>>4.5°C and <=15°C</td><td>0.4</td><td>0.7</td></tr>
<tr><td><4.5°C</td><td>0.9</td><td>1.2</td></tr>
</table>
<table>
<tr><td>Duct Location</td><td>Supply ducts</td><td>Return ducts</td></tr>
<tr><td>Exterior</td><td>R-1.4</td><td>R-0.6</td></tr>
<tr><td>Unconditioned Space</td><td>R-0.6</td><td>None</td></tr>
<tr><td>Buried</td><td>R-0.6</td><td>None</td></tr>
</table></td></tr>
<tr><td>Ductwork and plenum insulation: Ductwork and plenum shall be insulated as</td></tr>
<tr><td></td><td>Insulation exposed to weather shall be protected by aluminum sheet metal, painted canvas, or plastic cover.</td></tr>
<tr><td>4</td><td>System balancing</td><td>System balancing: System balancing shall be done for systems serving zones with a total conditioned area exceeding 500 m2</td><td>Applicable if any single conditioned zone exceeds 500m2
Air systems shall be balanced in a manner to first minimize throttling losses.</td></tr>
<tr><td>5</td><td>Lighting Power Density (LPD)</td><td>Maximum allowable Interior LPD as per Building area method is</td><td>Office spaces – 9 W/sqm Restrooms – 7.7 W/sqm
Corridors- 7.1 W/sqm
Lobby- 9.1 W/sqm
For other space types refer Table 6.4- Page 69 of ECBC 2017</td></tr>
</table>

6	Lighting control	Automatic lighting shutoff - 90% of interior lighting fittings by wattage, in building or space of building larger than 300 m2 shall be equipped with automatic control device	Provide occupancy sensors in- a. All habitable spaces less than 30 m2, enclosed by walls or ceiling height partitions. b. All storage or utility spaces more than 15 m2 c. public toilets more than 25 m2, controlling at least 80 % of lighting fitted in the toilet. The lighting fixtures, not controlled by automatic lighting shutoff, shall be uniformly spread in the area. d. In all Business and all conference or meeting rooms. Occupancy sensors shall turn off the lighting fixtures within 15 minutes of an occupant leaving the space. Light fixtures controlled by occupancy sensors shall have a wall- mounted, manual switch capable of turning off lights when the space is occupied.
		Space control	Each room must be provided with individual light switch
		Control in daylight areas	Provide automatic/manual controls that- i. Has a delay of minimum 5 minutes, or, ii. Can dim or step down to 50% of total power. Overrides to the daylight controls shall not be allowed. Light fixtures or Luminaires installed within 6m from the edge of the façade must have a separate manual switch or a daylight sensor to shutoff lights during potential daylit time of the day
7	(UPS)	UPS: UPS shall meet or exceed the energy efficiency requirements listed in Table 7-4	kVA< 20 Efficiency = 90.2% 20<=kVA <= 100 Efficiency = 91.9% kVA > 100 Efficiency = 93.8%
8	Motors		Three phase induction motors shall conform to Indian Standard (IS) 12615 and should have IE 2 (high efficiency) class or a higher class Motor horsepower ratings shall not exceed 20% of the calculated maximum load being served.

3. The contractor must provision for Electric vehicle charging facilities for at least 5% of the total Four wheeler and Two wheeler parking capacity on-site. The contractor must seek approval of Engineer- in-charge to decide between DC Fast chargers or regular AC charging with a cost benefit assessment.

4. The contractor must install Multi-functional energy meters digital multifunction energy meters for sub-metering of individual end uses including Lighting, HVAC systems (AHUs/Chillers), Elevators, Water & Fire Pumps, and External Lighting, Renewable energy system suitable for 110 - 480 V AC auxiliary

supply, with direct RS-485 communication interface for integration with Building Management System (BMS).

5. The contractor must install Multi-functional energy meters digital multifunction energy meters for sub-metering of individual end uses including Lighting, HVAC systems (AHUs/Chillers), Elevators, Water & Fire Pumps, and External Lighting, Renewable energy system suitable for 110 - 480 V AC auxiliary supply, with direct RS-485 communication interface for integration with Building Management System (BMS).
6. The meter shall measure and display on LCD screen the following parameters: Voltage (V), Current (A), Active Power (kW), Reactive Power (kVAR), Apparent Power (kVA), Frequency (Hz), Power Factor, and Energy (kWh) with Class 1 accuracy (IEC 62053-21).
7. Meter shall be compatible with 1A/5A CTs, have Modbus RTU protocol on RS-485 port, be panel-mounted, and factory-calibrated. All accessories like external CTs (as per load), cables, connectors, labeling tags, and testing equipment shall be included.
8. The meter shall be commissioned with appropriate CT ratio settings, unique Modbus IDs, and tested for accuracy and integration with BMS SCADA dashboard.

5. The contractor must ensure that all HVAC systems are designed with consideration of fresh air with minimum outdoor airflow rate complying with ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Standard 62.1 (2010 or higher).

6. Flow rate requirements are as follows: -

1. Office Spaces – 5 CFM (2.5 L/s) per person + 0.06 CFM/ ft2 (0.3 L/s/m2) per floor area

2.Reception / Lobby (same as Office)

3.Break rooms – 5 CFM (2.5 L/s) per person + 0.12 CFM/ ft2 (0.6 L/s/m2) per floor area.

7. The contractor must also submit a Design calculation report of the proposed Air side HVAC units indicating consideration of minimum fresh air flow rates. Along with this HVAC schematic drawings indicating the ventilation system / strategy must be submitted for approval and verification before installation.

8. The proposed HVAC system must use refrigerants that are CFC (Chloro Fluoro Carbon)-free. Fire suppression systems must be free from Halons or any other ozone depleting substances.

9. 10. The contractor must design and install an On-site Solar Photovoltaic System with annual energy generation sufficient to offset minimum 5% of the total Annual electricity demand or 2.5% of the connected load of the building whichever is higher. Along with this the contractor must submit a detailed energy simulation and renewable energy generation potential report. The system must be completed and commissioned along with Net-metering provision.

10. The contractor must must ensure that the following aspects of their premises are Audited and commissioned, along with Fault diagnosis and rectification before handover: -

10.1. HVAC systems – VRF System indoor and outdoor units

10.2.Temperature and RH measurements in individual spaces (Typical spaces)

10.3. Lighting systems

10.4. CO2 monitoring system (if applicable)

11. Contractor must engage a Third-Party Commissioning agency with a minimum of 3 years of relevant experience to conduct an Audit and report the following: -

Report specific observations and variations identified by commissioning authority for each equipment & system, with respect to commissioning plan and how they were addressed.

Submit measurement & verification plan for yearly reporting.

Submit post-occupancy survey to verify occupant comfort (lighting levels, temperature, relative humidity, noise levels, etc.,).

Report on green building performance of the equipment & systems listed in commissioning plan.

The report for each of the equipment & systems should cover the following:

- Equipment specifications
- Test results with specific comments from the Commissioning Authority, at the

  time of commissioning
- Key monitoring aspects to sustain performance
- Estimated energy consumption
- Scope for performance enhancing in future, and savings thereof

12. The contractor must provide and install an Organic Waste composter to cater to the daily organic and food waste generated from the facility to be treated on site.

Clause L - Performance Benchmarks

1. The contractor must ensure compliance to following performance benchmarks and submit detailed calculations and simulations to support compliance to the same:-

Performance Metric	Target Value	Standard for compliance
Total Energy Performance Index (kWh/m2) including all end-uses HVAC, Interior and exterior Lighting, Receptacles and Equipment, Hot water system)	120 kWh/m2	35% reduction over BEE Benchmark for Office buildings > 50% air conditioned in Warm and Humid Climate and ECBC 2017
Energy Performance Index kWh/m2(only HVAC, Interior and Exterior lighting systems, Hot water system)	63 kWh/m2	30% reduction over BEE 5 STAR v2019 benchmark for Office buildings 5 days operational in Warm and Humid climate
Peak Envelop Heat Gains W/m2 (Total heat gain during Summer design sizing conditions for Roof, Exterior wall and Glazing)	25 W/m2	BEE 5 STAR v2019 benchmark for Envelop heat gains for Office buildings 5 days operational in Warm and Humid climate zone
Maximum HVAC Design sizing (only on air conditioned area) Sqft / tonn of refrigeration	250 Sqft / tonn	Industry best practices. Client target
Maximum HVAC Design sizing (on total built up area including non air conditioned covered area) Sqft / tonn of refrigeration	500 sqft / tonn	Industry best practices. Client target
Peak Demand (W/m2) Including total building electrical demand from Lighting, equipment, lifts, pumps, HVAC systems, Water heating systems at Peak consumption	15 W/m2	Industry best practices. Client target (reference CIBSE Guide F)
Usefull Daylight Illuminance 100-200 lux in Regularly occupied areas for 90% of the daylight time from 10am to 5pm	55% of floor area	ECBC 2017
Point in time illuminance values on 21st September 12:00pm from **110-2200 lux** for all regularly occupied spaces	75% of floor area	IGBC Green New Building v3
Life cycle analysis for 50 years Return on Investment with high performance building design over a standard built as usual scenario considering inflation and depreciation	Maximum Payback period of 5 years	BEE 5 STAR V 2019.

ANNEXURE 1 -

WEATHER DATA AND DESIGN CONDITIONS FOR MEPF SERVICES

1. The contractor is required to follow the Design conditions for right - sizing of MEPF systems and properly planning Architectural features to minimize heat gains with passive design measures.

Location: Tirupathi, Andhra Pradesh

IND Web link for weather file: - https://climate.onebuilding.org/WMO_Region_2_Asia/IND_India/AP_Andhra_Pradesh/IND_AP_Tirupathi.432750_TMYx.2009-2023.zip

Climate Zone as per ECBC - Warm and Humid

Longitude: 79.583 Latitude: 13.667

Elevation above sea level: 105.0 m

Average yearly temperature: 27.7 °C

Hottest yearly temperature (99.6 %ile): 40.5 °C

Mean coincident wet bulb temperature: 31.15 °C

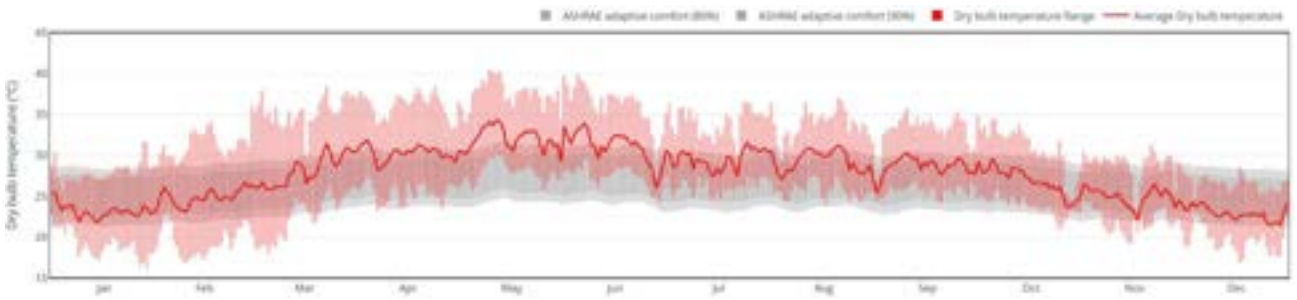
Temperature difference (diurnal) on peak summer day: 9.5

Outdoor air specific humidity on peak summer condition: 0.025 kg(moisture) / kg (air)

Outdoor air specific humidity (99.6 %ile) : 0.022 kg(moisture) / kg (air)

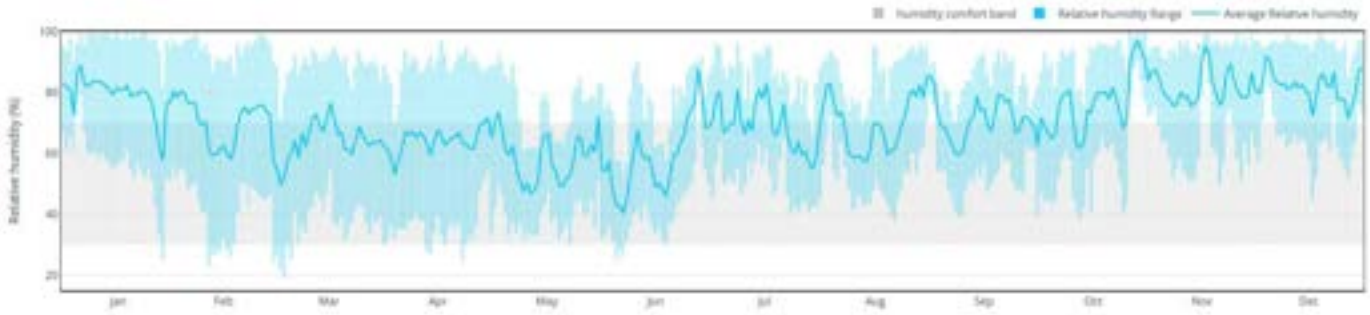
Coldest yearly temperature (0.4%ile): 18.1 °C

Dry-bulb temperature Annaul profile



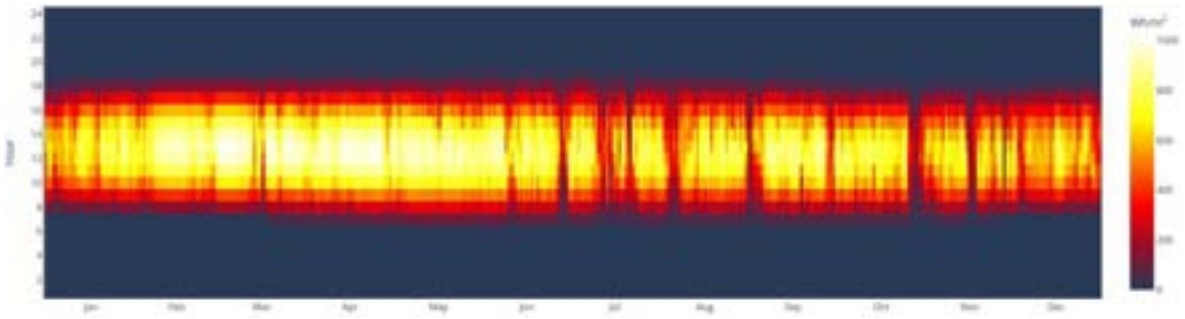
month	mean (°C)	std (°C)	min (°C)	1% (°C)	25% (°C)	50% (°C)	75% (°C)	99% (°C)	max (°C)
Jan	23.18	3.28	16	16.74	20.6	22.8	26.1	29.86	31.7
Feb	24.84	4.24	16.7	17.1	21.6	24.3	28.8	33.86	34.1
Mar	26.87	4.89	18	18.7	24.6	27.5	32.4	37.4	38.6
Apr	30.29	3.79	23.2	23.7	27.1	29.55	34	37.58	38.3
May	32.82	3.57	25.6	25.84	28.9	31.6	35.1	39.64	40.5
Jun	31.16	3.57	24.2	25.02	28.2	30.5	34.2	38.8	40
Jul	29.57	3	24.4	24.8	27.1	28.95	31.8	36.26	36.6
Aug	29.31	3.08	23.8	24.4	26.8	28.65	31.8	36.16	37
Sep	28.68	2.73	24.1	24.42	26.4	28	30.6	34.6	35.8
Oct	26.88	2.97	20.8	21.8	24.48	26.1	29.1	33.6	34.9
Nov	24.92	2.56	19.1	20.3	23	24.5	26.8	30.18	31.3
Dec	22.86	2.59	16.8	17.5	20.8	22.9	25.1	27.56	28.6
Year	27.66	4.52	16	18.1	24.7	27.4	30.6	37.5	40.5

Relative Humidity Annual profile

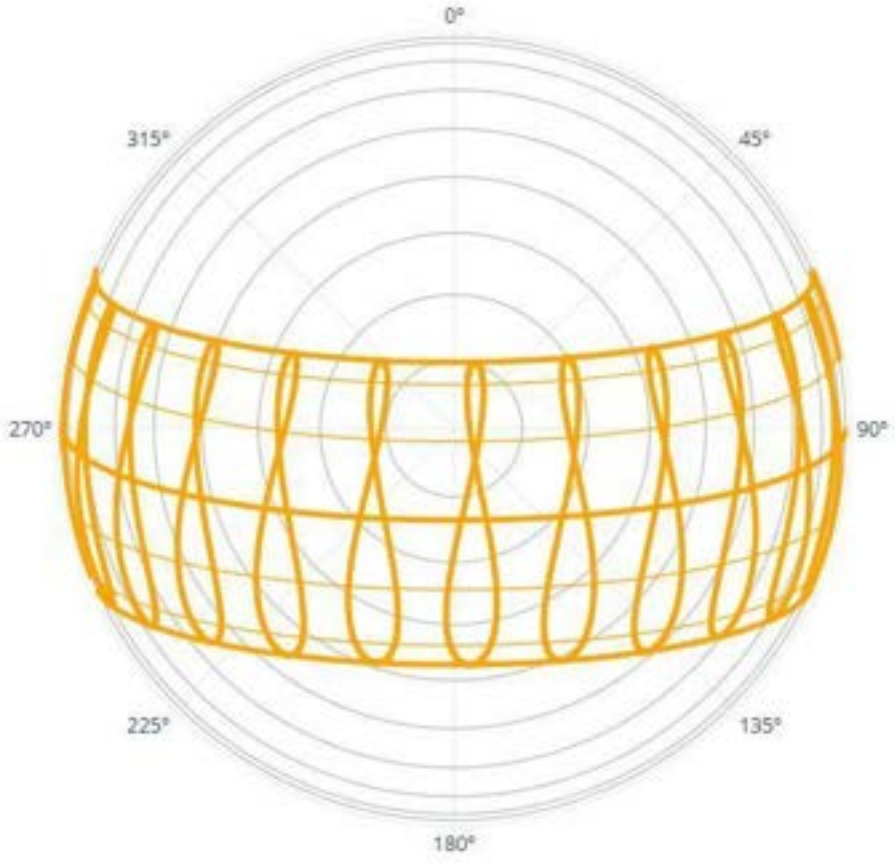


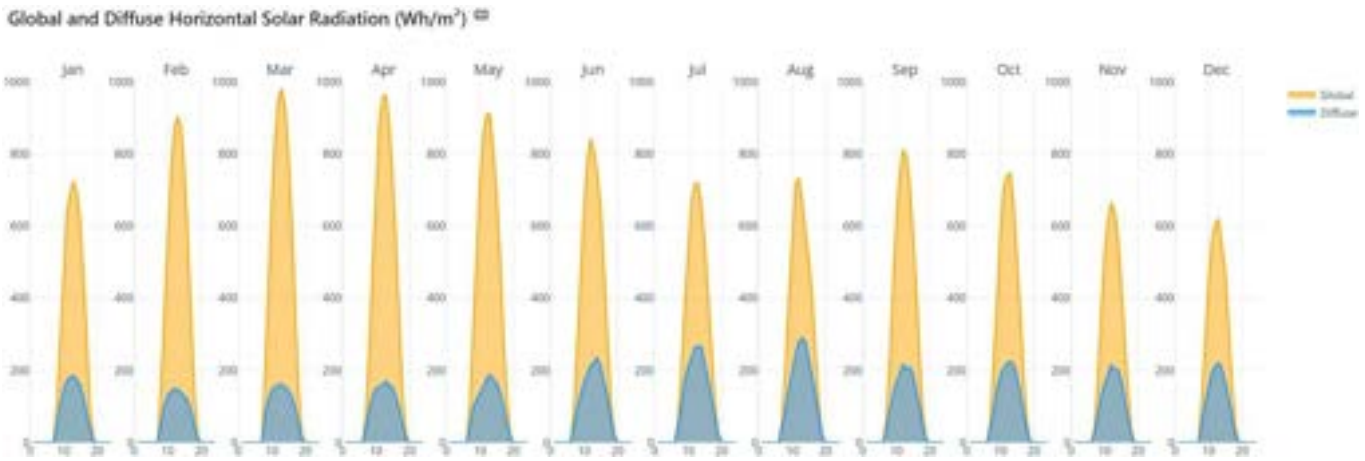
month	mean (%)	std (%)	min (%)	1% (%)	25% (%)	50% (%)	75% (%)	99% (%)	max (%)
Jan	79.32	16.22	25	35	66	84	93	100	100
Feb	78.81	20.43	23	27.71	55	75.5	89	98	99
Mar	64.06	19.42	19	25	46	67	82	93	95
Apr	64.15	19.04	25	31	45	67	81	93	97
May	58.74	15.04	30	33	46	58	70	90	93
Jun	58.46	16.33	25	30	45	57	71.25	90	92
Jul	69.19	13.63	40	42	59.75	70	79	94.57	96
Aug	69.76	14.8	38	42	58	71	82	95	96
Sep	71.29	12.34	39	42.19	63	73	81	92	94
Oct	76.11	16.05	38	41	64	79	90	100	100
Nov	81.92	12.57	50	51.19	72.75	86	92	99	99
Dec	81.89	12.12	45	52	71	85	92	98	100
Year	70.40	17.69	19	31	57	72	86	98	100

Global horizonatal Solar Radiation

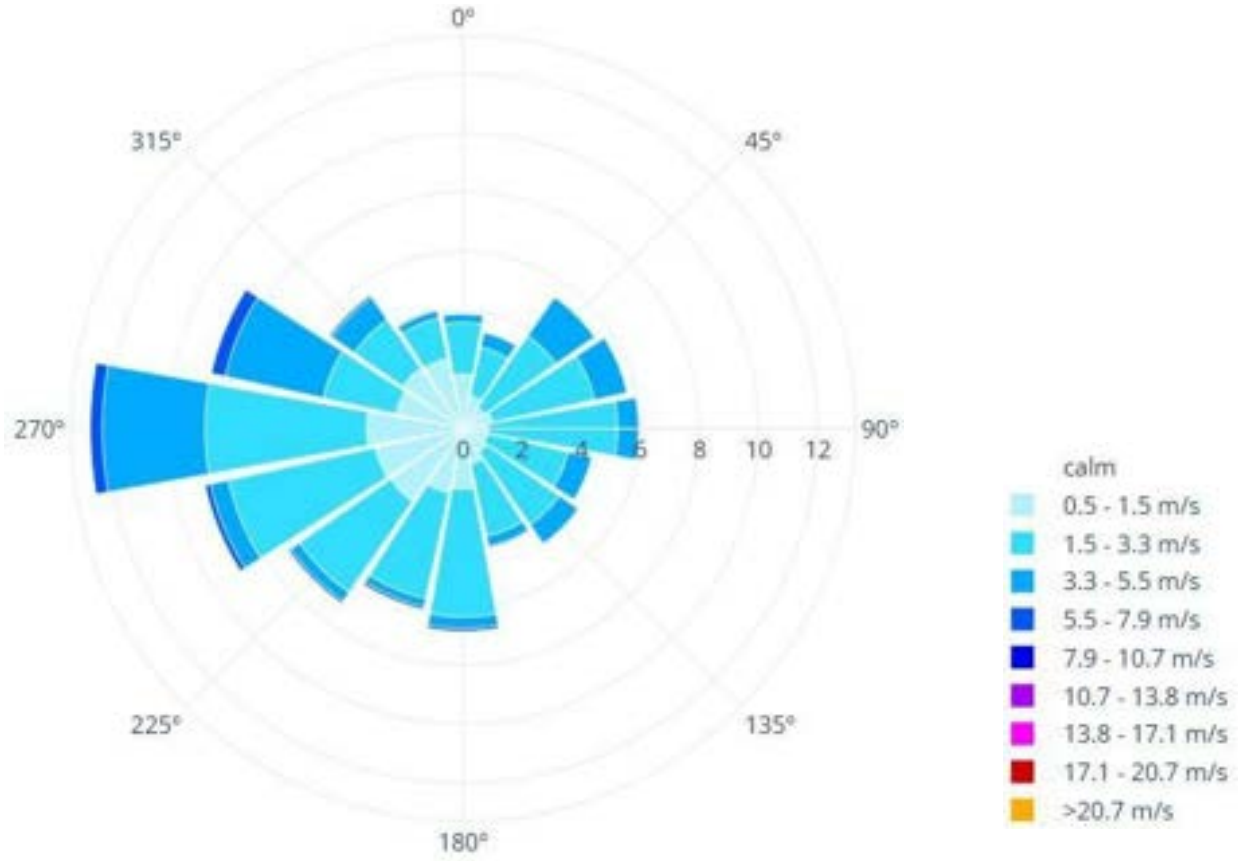


Sun Path diagram



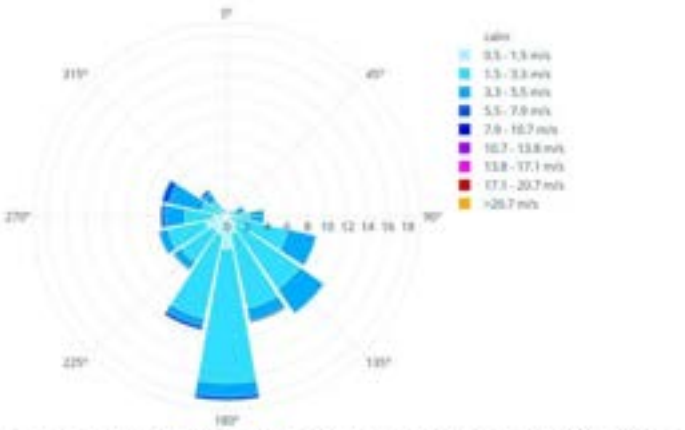


Wind Rose Profile -Annual



Seasonal Wind rose profile

Observations between the months of Dec and Feb between 01:00 hours and 24:00 hours. Selected observations 2160 of 8760, or 24 %. 1 observations have calm winds.



Observations between the months of Mar and May between 01:00 hours and 24:00 hours. Selected observations 2208 of 8760, or 25 %. 7 observations have calm winds.

Observations between the months of Jun and Aug between 01:00 hours and 24:00 hours. Selected observations 2208 of 8760, or 25 %. 57 observations have calm winds.

Observations between the months of Sep and Dec between 01:00 hours and 24:00 hours. Selected observations 2928 of 8760, or 33 %. 0 observations have calm winds.

Rainfall Data

Data source:-
https://hydro.imd.gov.in/hydrometweb/(S(0cm0gk55nrdxbk55o31baz3i))/DistrictRaifall.aspx

YEAR	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEPT		OCT		NOV		DEC	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2018	0	-100	14.4	90	28.5	189	20.9	-57	72	6	73.2	10	47.4	-52	58.9	-47	112.5	-20	59.7	-44	106.2	-25	13.4	-77
2019	9.4	39	2.3	-72	0	-100	12.1	-49	30	-54	56.7	-22	66.8	-23	144.5	29	228.4	50	226.6	36	41.7	-71	109	73
2020	14.8	112	0	-100	9.5	-36	54.4	120	21.2	-68	109.6	52	311.3	204	135.4	10	194.7	20	162.7	-2	206.7	120	104.7	65
2021	34.4	401	12.1	81	0	-100	59.7	67	40	-36	102.1	42	233.3	125	185.4	28	175.1	15	174.5	8	444.4	212	37.4	0
2022	21.4	1014	0	-100%	5.5	-55%	11.1	-54%	133.2	114%	114.5	59%	73.4	-32%	202.4	70%	98.8	-29%	127.1	-27%	140.2	-9%	104.7	150%

Maximum Monthly rainfall

	Max mm
2018	112.5
2019	228.4
2020	311.3
2021	444.4
2022	202.4
Avg	259.8

SECTION – 7 LANDSCAPE WORKS DBR

GENERAL GUIDELINES FOR LANDSCAPING WORKS

i) All landscaping works shall be designed by a reputed professionally qualified landscape architect, who has a minimum post qualification experience of 10 years.

ii) The landscaping works shall be of an international standard. Landscape Concept / and the designs shall be approved by the Department / Corporation. The selection of trees / shrubs / groundcovers / grass shall be approved by the Department / Corporation.

iii) Suitable hard spaces / soft spaces shall be developed.

iv) A modern irrigation system for the Complex shall be designed and implemented.

v) A screen of tall trees shall be placed between the Main Building and the Service Block. The grounds of the premises shall be profusely and nicely landscaped. The trees / shrubs / groundcovers / grass used shall be of the highest quality.

vi) Mounds shall be given in the landscaped spaces.

vii) Seating courts, amphitheatre, gazebos, and trellises with elder-friendly designs.

viii) Dustbins, and lighting installed as per specifications.

ix) Thermoplastic road paint, stainless steel signs, and transformer enclosures with fire safety measures.

x) Walkways must not be less than 1.5m in width.

Mound

Trellis/ Gazebo

Seating Court

Amphitheatre

Planting

Signages & Graphics

Lighting

14. GENERAL GUIDELINES FOR INTERNAL ROADS AND PATHWAY

i) Separate provision for car parking and 2-wheeler parking shall be made and provided at the site with Interlocking Pavers laid over a 50 mm sand bed, followed by a 100 mm thick M-30 PCC layer with dowel bars as per MORTH specifications (fifth edition). This will be placed over a GSB layer of required thickness as per design based on the CBR of the soil but not less than 250 mm, over an approved sub-base as required.

ii) GSB (250 mm minimum) as per CBR and traffic needs.

iii) M-35 grade kerb stones and PCC saucer drains for edges and drainage.

iv) ISI-marked M-30 pavers, bricks, or fine-dressed stone over approved sub-grade.

v) Tree pits should be designed for optimal growth.

vi) Drop-off: A designated drop-off zone shall be provided along the frontage, with a layoff area planned on the opposite side of the road to ensure smooth traffic movement and passenger convenience.

vii) Both steps and ramp shall be provided with sturdy railings on either side to facilitate safe pedestrian movement and support for differently-abled and elderly users.

Figure: Reference image for Road Design

Saucer Drain

Pavers

Road Painting

Tree Pit

Walkway

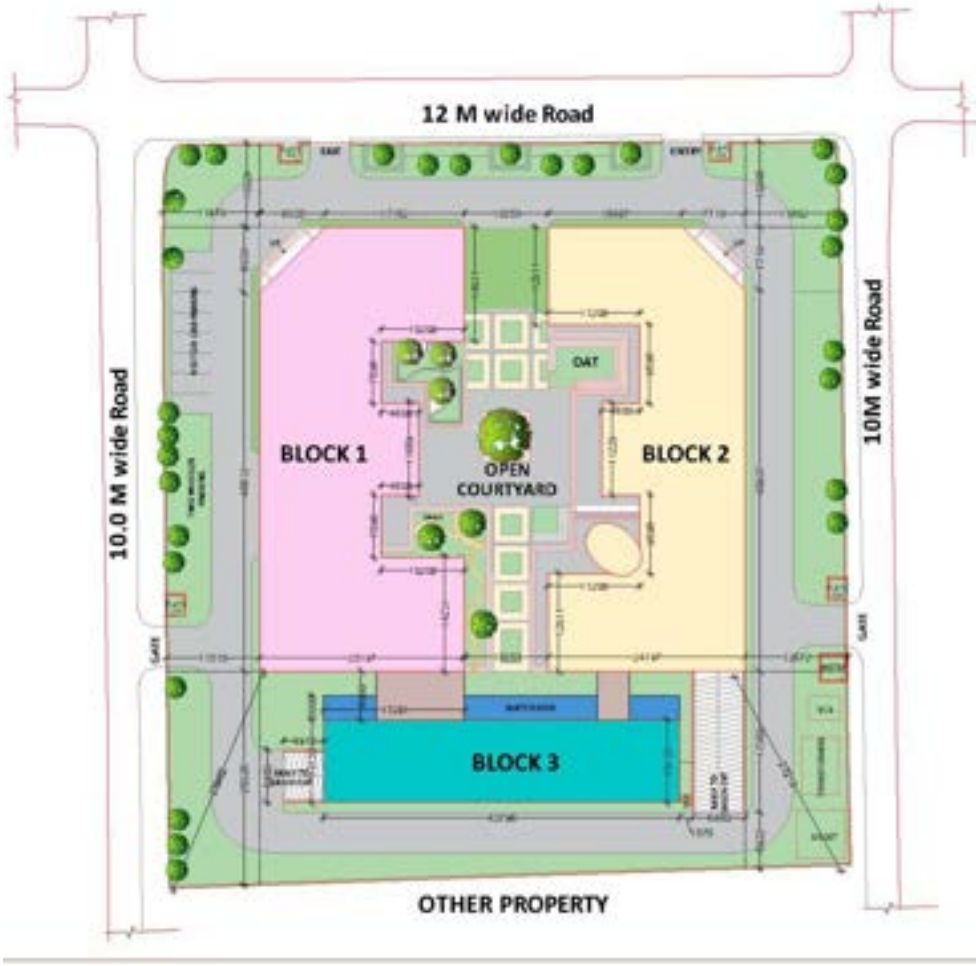


Figure: Master Plan

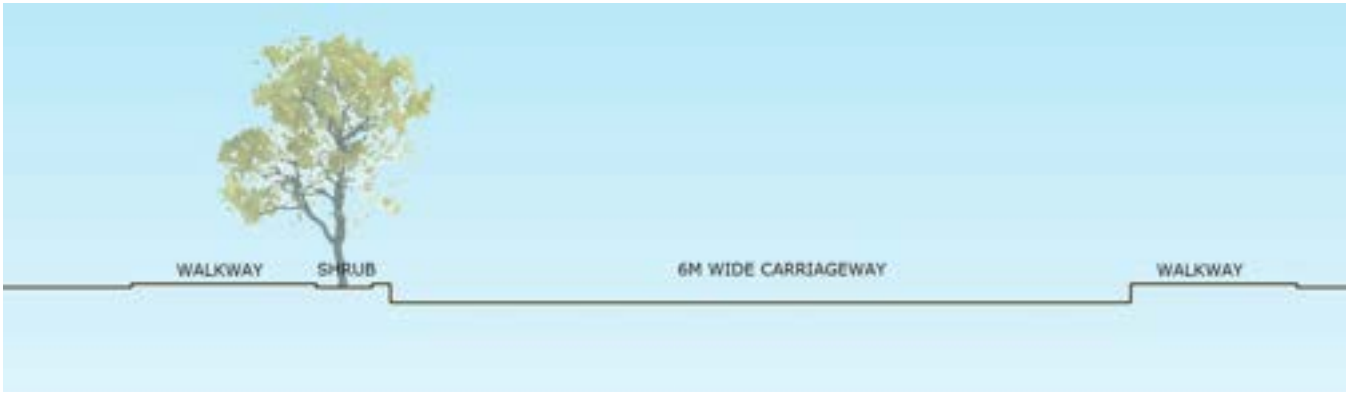


Figure: Section A

MINIMUM ACCEPTABLE SPECIFICATIONS FOR INTERNAL ROAD WORK

Sl. No.	Items of Work	Specifications
1.0	Internal Roads	Finished levels of road will be above the formation level. Earthwork has to be compacted accordingly as per approved longitudinal profiles.
1.1	GSB	Granular Sub Base as drainage layer minimum 250 mm based on CBR value & traffic and based on designs as per MORTH specification or higher.
1.2	Kerb Stone	High grade concrete precast block M-35 Grade as per drawings attached, finished as per detail.
1.3	Saucer Drain	At or near ground level factory made P.C.C. Saucer Drain channel of size as per detail fixed on 20 mm thick cement mortar 1:4 (1 cement: 4 coarse sand) over P.C.C. bed as per Drawing, in position to the required line, level and curvature, jointed with cement mortar 1:3 (1 cement: 3 coarse sand).
1.4	Inter-locking pavers	ISI Marked, Heavy duty pavers, shape & pattern in cement colour (red, green, grey, yellow etc.) M-30 Grade laid on 100mm PCC / sand filling as per specification, if required.
1.5	Road painting	75 mm wide thermo-plastic mark paint for indicating Parking spaces.
1.6	Tree Pits	Providing & Commissioning of all tree pits of size as per dwg with all necessary foundations, plates, connections as per view/dwg.
1.7	Pedestrian foot paths / EVs / Golf Carts	Machine made bricks of the required strength/ interlocking pavers, specially made for flooring purposes, over approved Sub Grade.
1.8	Walkway	Fine dressed stone/ concrete pavers flooring over approved Sub-Grade with joints finished flush.

1.9	Signature, Graphics & Dustbins	Outdoor signs of Stainless steel 316 having graphics & text in screen print for building name, traffic sign to be in channel letters, CRCA (Cold Rolled Close Annealed) sheet support structure having aluminum panels, powder coated with graphic and text. Providing of all dustbins required with all necessary attachments as per view/dwg.
1.10	Play courts- Badminton & Basketball	Synthetic sports surf1ace i.e. SPORTMASTER ULTRA CUSHIONED SYSTEM – 8 layers including 1 layer of resurfacer, 3 layers of dense cushion, 2 layers of fine cushion, 2 layers of color and court markings.
1.11	Gazebo, Trellis	Made of Hollow tubes, channels, plates etc., and fitting it with necessary nuts and bolts complete of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge, with 2 coats of anti-corrosive zynchromite yellow /red primer and 2 coats of approved DUCO paints with fastener and plates complete with MS column.
1.12	Seating Court- Elder's	Construction of seating courts with seating arrangement, including foundations, masonry, finishing work, and flooring, along with landscaping and drainage as per detailed dwg.
1.13	Amphitheatre	Construction of amphitheatre with seating arrangement, including foundations, masonry, finishing work, and flooring, along with landscaping and drainage required as per dwg.
1.14	Planting	Supply & Plantation of all trees, shrubs & ground covers at site with cleaning of plantation soil for depth of 600mm, well mixed with manure, application of pesticides as per dwg.
1.15	Transformers	Installation of fencing, warning signage, fire safety equipment, and proper access control, all in accordance with standards and regulations.
1.16	Lighting	Providing & Commissioning of all light fixtures of size as per dwg with all necessary foundations, plates, connections as per view/dwg.

15. STATUTORY APPROVALS

i) All statutory approvals from the Central / State Environmental Agency / Nagar Nigam / State Fire Officer / Airport Clearance / all other approvals required are in the Scope of the Bidder.
ii) All building byelaws of Andhra Pradesh Building Bye-Laws are to be complied with.
iii) All norms of Environment & Forest Department, Govt. of Andhra Pradesh are to be followed during site clearance and construction.
iv) Structural vetting of all the structures in the complex from NIT/ IIT/ other Institute is to be done by the EPC contractor. All Fees for structural vetting by NIT/ IIT shall be borne by the EPC Contractor.
v) Statutory/ Registration fees for SEA / municipal, fire, airport, any other approval shall be borne by concerned authority. However, the entire responsibility for the approvals lies with the EPC contractor.
vi) Consent to establish & consent to operate, wherever applicable to be taken from Andhra Pradesh Pollution Control Board.

16. GENERAL GUIDELINES FOR EXISTING SERVICES

Special precautions shall be taken by the Contractor to avoid damage to existing sewerage pipes, storm water drains, and pipes, storm water grids, and inlets, manholes, valve casings, water pipes and taps, fire hydrants, irrigation pipes and equipment, cables, completed landscaping works, telephone and light poles, vegetation and other services. Shifting of any and all services as required shall be included in the Scope of Work by the Bidder, without any extra cost.

- **Protection of Existing Property**

a. The Contractor shall take all necessary precautions against damage that might occur to any person, animal, building, structure, services, vegetation, vehicles etc.
b. Enough warning signs, railings, lighting etc. shall be placed around excavations, obstacles, and heaps.
c. Foot bridges, shall be placed over trenches, where necessary for the convenience of the public.
d. Construction activity is to be limited to pre-designated areas and with the prior approval
of the client's representative.

- **Guidelines for Trees to be removed**

Any existing trees identified as "to be removed" or any dead trees:

a. Contractor shall engage a suitably experienced arborist to undertake any tree works. Trees should be for removal or cut and fell, as close to the ground as possible;
b. Trunks to be cut to convenient lengths for removal or integration with the landscape works;
c. Root stumps to be removed to a minimum depth of 800mm below ground level, with lateral branches over 100mm in diameter removed from the site;
d. Any debris or material that comes from the above works shall be utilized in accordance with Waste Management Plan.

- **Guidelines for Trees to be retained**

a) All retained trees should be clearly identified "TO BE RETAINED" and information signs should be displayed on site in prominent positions at each entrance and noted on the Site Protection plan
b) All retained trees shall be marked by visible, durable tags, lettered to tree number or symbol (if any) on the drawings and these numbers should be clearly identified on the Site Protection Plan prepared by the Contractor
c) Trees should be fenced off the works area, if possible, in all cases tree trunk and roots should be protected from site works;
d) Protected area should be in a shape of a circle around each tree to the extent of the canopy drip line or to a radius of 3m, measured from tree trunk for trees under 5 mts in height.
e) Do not store any materials or allow site equipment or vehicles to pass under or near the trees to avoid soil compaction Prevent damage to tree bark; do not attach any items to trees.
f) Do not add or remove topsoil within the drip line of trees; do not fill against tree trunks even temporarily;
g) Open excavation under tree canopy should be carried for as short period as possible. If exposing roots unnecessarily, temporarily line excavation with polyethylene sheet to reduce evaporation;
h) Use only hand methods to locate, expose, and cleanly remove the soil around roots on the line of excavation. Root systems should be preserved intact.
i) When it is necessary to cut the roots bigger than 25mm diameter, make sure the cutting does not disturb remaining root system. Cut should be smooth with no ragged edges. Clean cut surface should be immediately treated with bituminous fungicidal sealant.

Concept Development for Inside the Residential Complex:

1. **Central Community Space:**

Green over Basement Slab:

The landscaped green area proposed over the basement slab shall be developed with a multilayered system to ensure durability and proper drainage. The treatment shall include:

(i) basement RCC slab with waterproofing membrane,
(ii) provision of protection screed,
(iii) installation of drain board with geotextile layer for filtration and drainage, and
(iv) placement of minimum 450 mm thick soil layer to support plantation and landscaping.

This system ensures water tightness, prevents root penetration, and provides adequate soil depth for healthy vegetation growth."

Design Elements:

a) Open lawn for community events like yoga, gatherings, or small festivals.
b) Seating zones with shaded benches and pergolas covered with climbing vines (e.g., bougainvillea or morning glory).
c) A children's play area with simple, durable equipment like slides, swings, and see- saws, surrounded by safety flooring (rubber or sand).
d) A small gazebo or pavilion as a focal point for relaxation and social interactions.

Figure: Reference image & Section for Amphitheatre

2. **Pathways and Circulation:**

Design Elements:

a) Wide, paved pathways with clean, geometric patterns, bordered with low- maintenance flowering shrubs like marigold, ixora, or hibiscus.
b) Wheelchair-accessible ramps integrated with the design for inclusivity.
c) Solar-powered streetlights to illuminate pathways while reducing energy consumption.

Figure: Reference image for Pathway

3. **Pocket Gardens:**

Design Elements:

a) Native trees like neem, gulmohar, and banyan for shade and environmental benefits.
b) Shrub beds with colorful flowering shrubs and groundcovers, such as jasmine, bougainvillea, and lilies.
c) Seating alcoves with simple wooden or concrete benches.

Figure: Reference image for Seating Court

4. **Recreational Facilities:**

Design Elements:

a) Outdoor gym equipment like pull-up bars and elliptical trainers.
b) Basketball or badminton court, with enough greenery to absorb noise and add aesthetic appeal.
c) A walking around the periphery, bordered by flowering plants or small hedges.

5. **Sustainability Features:**

Design Elements:

a) Rainwater harvesting pits integrated into the landscaping.
b) Composting bins for organic waste near garden areas.
c) Native plant species to minimize water usage and attract local birds and butterflies.

Figure: Reference image for Planting such as Flower Bed

Concept Development for Outside the Campus (Public Park and Landscaping):

1. **Public Park Design:**

Design Elements:

a) Central lawn area for gatherings, festivals, and community programs.
b) Walking and jogging paths, paved and lined with native trees like mango, peepal, or tamarind.
c) Ample shaded seating with pergolas and canopies made from bamboo or locally sourced materials.
d) Interactive spaces like open-air amphitheaters for cultural programs or storytelling sessions.

2. Elements of Landscaping:

a) Native and Low-Maintenance Plants:

- Focus on indigenous species like neem, Amaltas, or Champa for shade, combined with flowering shrubs and groundcovers like marigold, hibiscus, and roses for color.
- Grassy lawns with hardy grass species suitable for the local climate.

b) Water Features:

- A simple pond or water fountain as a focal point, using recirculating water systems to reduce water usage.

c) Pathways:

- Brick or natural stone pathways, edged with flowering shrubs and groundcovers for aesthetics and durability.

d) Lighting:

- Energy-efficient solar-powered lamp posts, strategically placed along pathways and near seating areas.

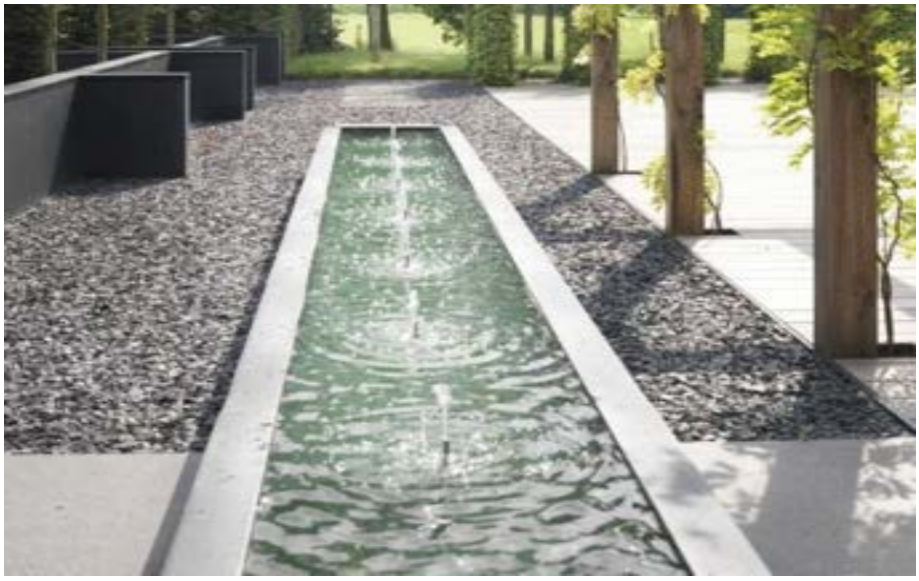


Figure: Reference image for Water Feature

3. Urban Integration and Accessibility:

Design Elements:

a) A tree-lined entry boulevard or portal leading into the public park, creating a welcoming approach.

b) Adequate public restrooms, designed with water-efficient fixtures.

Figure: Reference image for Portal leading into the Lawn

4. Sustainability Features

a) Native Plant Focus: Reduce dependency on excessive watering while supporting the local ecosystem.

b) Waste Segregation Units: Install bins for biodegradable and recyclable waste to maintain cleanliness.

TREES

Botanical Name	Common Name	Abbrev Used	Height (in m)
Anthocephalus cadamba	Kadamb	Ac	4-5
Bauhinia purpurea	Kachnar	Bp	1.8-2
Callistemon citrinus	Crimson bottlebrush	Cc	3-4
Cassia javanica	Pink Shower	Cj	3-4
Cassia fistula	Amaltas	Cf	3-4
Chorisia speciosa	Silk floss tree	Chs	3-4
Cordia sebestena		Cse	3-4
Delonix regia	Gulmohar	Dr	3-4
Erythrina crystagalli	Cockspur coral tree	Ec	3-4
Erythrina indica	Indian coral tree	Ei	3-4
Ficus black		Fb	1.5-2
Jatropha cuneata	Leatherplant limberbush	Jc	1.5-2
Jatropha pandurifolia		Jp	1.2-1.5
Jacranda Mimposifolia	Jacaranda	Jm	3-4
Lagerstroemia flos reginae	Pride of India	Lr	1.5-1.65
Lagestromia speciosa		Ls	1.5-2
Magnolia grandiflora		Mg	1.5-2
Mangifera indica	Mango	Mi	6
Michelia champaca	Champak	Mc	1.5-2
Plumeria alba	Safed Champa	Pa	1.5-2
Plumeria alba dwarf	Safed Champa	Pad	0.9-1.05
Plumeria rubra	Lal Champa	Pr	1.5-2
Plumeria pudica	Pudica	Pp	0.9-1.00
Saraca asoca	Sita Ashoka	Sa	3-4
Terminalia mantaly	Umbrella Tree	Tm	3-4

Table: Proposed Trees

NOTE: The given height is for trunks of the tree excluding height of bags.

Table: Proposed Shrubs

NOTE: The given height is for shrubs/ groundcov

SHRUBS/ GROUNDCOVERS

Botanical Name	Common Name	Abbrev Used	Height (in m)
Alpinia purpurata	Red ginger	Ap	0.45
Acalypha wilkensiana	Starburr	Aw	0.45
Bougainvillea	Paper flower	Bv	0.6
Caesalpinia gilliesii	Bird of Paradise	BOP	0.6-0.9
Canna indica L	Canna lily	Cl	0.75
Clerodendrum inerme	Inerme	Ci	0.3-0.45
Chlorophytum comosum		Cc	0.15
Dracaena colorama	Dragon Tree	Dc	0.6
Dracaena mahatma	Mahatma	Dm	0.6
Dracaena reflexa	Song of India	SOI	0.6
Polypodiophyta	Ferns	F	0.2
Ficus panda	Panda	Fp	0.3-0.45
Hamelia patens	Compacta	Hp	0.45-0.6
Hibiscus rosasinensis	Chinese hibiscus	Hr	0.45-0.6
Hymenocallis littoralis	Spider lily	Hl	0.45
Lagerstroemia indica	Crepe myrtle	Li	0.6
Lagerstroemia speciosa	Giant crepe-myrtle	Ls	0.6
Phyllostachys aurea	Golden bamboo	Gb	1.5
Plumbago capensis	Blue Plumbago	Pc	0.45
Rhapis excelsa	Lady palm	Re	0.9
Rhapis humilis	Slender Lady Palm	Rh	0.9
Russelia juncea	Fire cracker Plant	Rj	0.9
Schefflera arboricola	Dwarf umbrella	Sa	0.6
Schefflera arboricola variegated		Sav	0.6
Syngonium albo variegated		Sv	0.3
Syngonium podophyllum		Sp	0.3
Spathiphyllum wallisii	Peace Lily	Sw	0.6
Tecoma capensis	Cape honeysuckle	Tc	0.45-0.6
Tecoma gaudichaudi	Powder Puff	Tgc	0.6
Tabernae montana coronaria	Chandni Hari	Tmc	0.45-0.6
Tabernae montana coronaria variegated	Chandni variegated	Tmcv	0.45-0.6
Tradescantia zebrina pendula	Zebrina	Tzp	0.15
Wedelia trilobata		Wt	0.15

PUBLIC HEALTH ENGINEERING
(PHE-PLUMBING)

1. Reference Standards

1.1.1	National Building Code of India Part IX 2016	
1.1.2	American Society of Plumbing Engineers(ASPE)	Design Data Book Volume I to IV
1.1.3	Institute of Plumbing Engineers UK	Design Data Book – 2002
1.1.4	International Plumbing Code	2003 Edition
1.1.5	Uniform Plumbing Code of India	2008 Edition
1.1.6	Energy Conservation Building Code	2008 Edition
1.1.7	Handbook on Water Supply and Plumbing	SP35 (S & T)-1987
1.1.8	Code of Practice For Water Supply in Buildings	IS 2065-1983
1.1.9	Code of Practice For Building Drainage	IS 1742-1983
1.1.10	Code of Practice For Water Supply & Drains	IS 1200
1.1.11	Code of Basis Requirements For Water Supply, Drainage and Sanitation	IS 2065-1983
1.1.12	Plumbing In Multi-Storeyed Buildings	IS – 12183:1987:2004
1.1.13	Water Supply in Buildings	IS – 2065:1983:2001

2 APPROACH TO PLANNING

2.1 The Plumbing services for the project shall be designed keeping in view the following:

2.1.1 Requirement of Adequate and equal pressure of water in toilets, kitchen, and other designated areas.

2.1.2 The underground and overhead water storage tank capacities shall be designed to ensure availability of domestic water for 2.0 times of daily total water requirement (1.5 days consumption in UG storage tanks + half day's consumption in overhead storage tanks).

2.1.3 Water body recirculation & filtration system including its drainage water supply for Landscape.

2.1.4 Recycling of treated waste water (from sewage treatment plant) for flushing and for horticulture water consumption.

2.1.5 Rain water harvesting and water conservation faucets shall be provided based on requirement from MOEF.

2.1.6 Levels of roads / pavements and other services in the area.

2.1.7 Hot water supply through part solar water heaters along with electric driven heat pumps for entire SBI.

3 SYSTEM REQUIREMENTS

3.1 Water treatment plant (WTP) to ensure that the chemical and bacteriological parameters of water supply in the SBI are in accordance with World Health Organization (WHO) standards and US Safe Water Act requirements. Since, quality of water from municipal water authority / bore-well is presently not available.

3.2 WTP shall be very basic, comprising of carbon/sand filter, dosing Unit for disinfection and R.O Treatment. Water supply to laundry to be softened (Online softening Plant).However, WTP system design shall be verified for suitability prior to installation in accordance to latest water analysis report.

3.3 Domestic water supply through a set of VFD (variable frequency drive) booster pumping unit systems for making water available at minimal residual pressure of 40 PSI, the maximum pressure not to exceed 80 PSI, based on 's guidelines.

3.4 Sewage and Sullage collection & conveyance system based on ASPE standard and applicable guidelines by NBC and Standards. Each fixture in the system shall be vented to protection of trap seal against siphonage and for efficient performance of the installation.

3.5 Storm / Rain water drainage system from the roof terrace and open area shall be collected through rain water down-takes pipes and discharge in the catch basin.

3.6 Size and numbers of down take pipes shall be designed as per guidelines outlined in NBC for the maximum rainfall intensity in the area.

3.7 Rain water in open area such as hard court green area etc shall be collected through catch basin and drain channel, which shall be finally led to the Rain Water Harvesting (RWH) wells by gravity through a network sloping pipes. Overflow from the rain water harvesting wells, if any, shall be discharged into available municipal drain lines.

3.8 Basement area and all area below road level will be provided with a separate drainage system delivering the waste water into pre-designated sumps. Water will also be collected from ramps, air handling and ventilation rooms, pump room and other area required water supply land drainage facilities. Ramp drains will also be provided at the top and foot of the ramp. Provision of drainage sump and pumps is also a requirement of fire codes as basement are provided with sprinklers. Basement will be provided with covered channel with grating for pump room etc., where it is required. The drain will be located at appropriate locations as per architectural and structural configuration of the building.

3.9 Hot water system shall be from Heat pump along with Solar system. The system shall be sized to cater for simulation hot water requirement of all areas in the complex. In addition, solar collectors shall be provided on terrace for hot water pre-heating.

3.10 Swimming pool recirculation & filtration system complete with balancing tanks, filters, dosing system, Emergency shut off switches, Drain Channel with grating and Pump circulation system (Single or double) have minimum two approved section outlet with 3 feet of separation as per.

3.11 Sewage treatment plant for treatment of sewage & sullage waste. The plant shall comprise of preliminary, secondary (chemical & biological) and tertiary treatment units. The treated effluent shall be recycled and reused for flushing, for landscape. Complex and as per commitment to MOEF, it will be ensured earned to provide high flow UV System in tertiary treatment plant of STP.

4 WATER REQUIREMENT

4.1 The water requirement for the domestic and other uses in the building as described below is based on the provision of NBC – 2016 (Part – IX) and prevalent practice in the industry. The commitment made in the presentation for Environment Clearance has also been taken into account.

4.2 The daily water consumption of water as per National Building Code computed in Table 2.1

4.2.1 Daily Water Consumption

Table: 2.1

S.No.	Description	Total Number of Units/A	Population factor per units/loa	Total Population	Total water demand per	Total Water Requirement (LPD)	Domestic water demand	Flushing water demand	Hot water demand	Flow to sewer

		rea in sqm.	d factor.		perso n per day					(85% of Total DW)
i)	**Landscaping water requirement (Lumsum)**					**5000**				
	Total water required per day					**85.22**	**KLD**			
	Total domestic water required per day (Cold + Hot) say					**68.3**	**KLD**			
	Total flushing water required per day (Recycled Water from STP)					**18.4**	**KLD**			
	Total Flow to Sewer					**52.9**	**KLD**			
	Proposed STP Capacity (SAY)					**60**	**KLD**			
	TREATED WATER AVAILABLE FROM STP AFTER TERTIARY TREATMENT					**48**	**KLD**			
	BALANCE TO EXTERNAL SEWER AFTER TREATMENT					**29.2**	**KLD**			
	DAILY HOT WATER REQUIREMENT OF SBI					15.1	**KLD**			

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4.2.2 DAILY FRESH WATER REQUIREMENT

TABLE: 2.2

SL. NO.	DESCRIPTION	REQUIREMENT
1)	TOTAL WATER REQUIREMENT	85.22 KLD
2)	LESS RECYCLED WATER USING FROM STP (REFER TABLE 2.5)	18.4 KLD
	TOTAL FRESH WATER REQUIREMENT	67 KLD
IT IS THUS SEEN THAT THE DAILY FRESH WATER REQUIREMENT WOULD BE (SAY) 80 KL		

4.2.3 SIZE OF SEWAGE TREATMENT PLANT

TABLE – 2.3

VOLUME OF WATER ENTERING THE STP (WATER OTHER THAN CONSUMED / EVAPORATED ETC.)		
SL. NO.	DESCRIPTION	REQUIREMENT
1)	TOTAL WATER REQUIREMENT	85.22 KLD

2)	TOTAL QUANTITY OF WATER NOT ENTERING STP (NON DOMESTIC WATER)	
A)	LESS WATER REQUIREMENT FOR IRRIGATION PURPOSES	(-) 5.00 KLD
B)	LESS WATER FOR MOPPING AND WASHING	(-) 4.00 KLD
D)	LESS RO WATER	(-) 3.00 KLD
E)	LESS LOSS IN FILTRATION BACKWASH	(-) 4.00 KLD
	TOTAL (2)	(-) 23 KLD
	TOTAL (1) – (2)	62.22 KLD
	VOLUME OF WATER ENTERING THE STP @ 85% OF ABOVE TOTAL	52.89 KLD
	WE THUS PROVIDE AN STP TO HANDLE (SAY) 53 KLD	

4.2.4 USAGE OF RECYCLED WATER FROM STP:

Recycled water available from STP @ 90% of volume of water entering into STP
=52.89 x 90% = 47.60 KLD, Say = 48 KLD

4.2.5 USAGE OF RECYCLED WATER (SEE TABLE 2.1)

TABLE – 2.4

Sl. No.	DESCRIPTION	REQUIREMENT
A.	TOILET FLUSHING	18.4 KLD
B.	IRRIGATION PURPOSES	5.00 KLD
	TOTAL REQUIREMENT OF RECYCLED WATER	23.4KLD, Say 24 KLD

Note:- The balanced water will be used in cleaning the Solar panel, External Cleaning And remaining water will be recharge in the soil after filtration.

5 WATER SOURCE, STORAGE, TYPE & TREATMENT

5.1 Source of Water

5.1.1 It is expected that the daily potable domestic water requirement for the SBI Complex shall be met through municipal mains supply& bore well.

5.2 Water Storage Sizing

5.2.1 It is proposed to provide raw water & domestic water storage equivalent to 2 days water requirement for the entire SBI Complex. The incoming main from municipality/ bore-well (source of supply to be confirmed by Owner) water supply shall be led Fire water reserve tanks from where it shall be allowed to overflow in raw water tanks; thereafter the water shall be treated and stored in domestic water storage tanks. The water storage capacity tanks are shown in table 2.5.

5.2.2 Recycled water from STP will be Connected to Garden & flushing system.

5.2.3 Proposed Storage Tanks in Basement

TABLE - 2.5

SL. NO.	TANK DESCRIPTION	CAPACITY
1.	FIRE TANK	90+60 KL = 150 KL

2.	RAW WATER TANK	60 KL
3.	DOMESTIC TANK	60 KL
4.	TREATED WATER (10 PPM) TANK	44 KL
5.	R.O TREATED WATER TANK (S.S. CONSTRUCTION)	3 KL

5.2.4 Proposed Tanks in STP for Storage of recycled Water

TABLE – 2.6

SL. NO.	TANK DESCRIPTION	CAPACITY
1.	STP TREATED WATER (AFTER TERTIARY TREATMENT)	44 KL

5.2.5 Proposed Overhead Tanks at Terrace of SBI

TABLE – 2.7

SL. NO.	TANK DESCRIPTION	CAPACITY
1.	FIRE WATER TANK	1 x 20 KLD
2.	DOMESTIC WATER TANK	1 x 10 KLD
3.	FLUSHING WATER TANK	1 x 5 KLD

5.3 Water Type & Treatment

5.3.1 Following treatments are proposed for different category of water for make them fit for the applications. There shall be different tanks to store different category of water.

5.3.2 Municipal Water

5.3.2.1 The total water demand of the SBI complex is proposed to be met from the Municipal water supply source. However in case of short fall, water supply demand will be made up from the tube well and tanker supplies

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5.3.2.2 Incoming water supplies (municipal, bore well and tanker water) shall first be taken into underground fire water static storage tanks from where it shall overflow into raw water storage tanks.

5.3.3 Raw water from tube wells

5.3.3.1 Treatment for raw water from tube wells would consist of Sand Filtration, Filtration for Softening and UV sterilizer before storing it in Domestic Water Tank.

5.3.3.2 Soft water from softener shall be mixed with (before UV treatment) raw water to get final hardness between 10 ppm.

5.3.4 Water for human consumption

5.3.4.1 Water that will be consumed for drinking, food preparation, and ice cube machines etc. shall be treated with R.O. process. After the treatment it shall be stored in S.S. storage tank.

5.3.5 Irrigation Water

5.3.5.1 Treated water shall be supplied from STP treated water tank for Irrigation purpose. This shall be generated by filtration plant installed in STP Plant room.

5.3.5.2 There shall always be a bye pass connection from tube well water supply to treated water tank of STP (indirect connection with NRV) in case the shutting down of STP of insufficient availability of recycled water. It should be ensured there will not be any direct connection to STP Treated Water Tank.

5.3.6 Flushing Water

5.3.6.1 As acceptable by Standards and as per mandatory requirement of MOEF flushing water for the SBI Complex shall be sourced from the in-house sewage treatment plant (STP). The treated effluent for flushing shall be obtained after tertiary treatment at STP. The tertiary treatment shall comprise of multi-grade filters, activated carbon filters and UV units. Standby chlorine dosing unit shall also be provided in case of breakdown of UV units. The treated effluent shall be colour-less, odourless and shall be in acceptable chemical / bacteriological parameters as per local pollution control board laws.

5.4 Water Distribution

5.4.1 Water supply to the building shall be through Hydro-Pneumatic system to deliver water at desired minimum and maximum pressure of 40 psi and 80 psi respectively and minimize the use of PRVs to make pumping system most energy efficient on the other.

5.4.2 The Hydro-pneumatic system comprising three pumps peak demand and each pump has its own Variable Frequency Drive (VFD) control. The rated discharge of pumps for the building would be selected to take care of peak hour demand in the respective zones.

5.4.3 One supply main shall be taken from delivery headers of the pumps. Required numbers of risers shall be taken from this supply main through nearest shaft of wet areas. At each floor branches of required sizes shall be taken till the consuming point in the building.

5.4.4 A shut-off valve (and a PRV station two in parallel with bye-pass manifold, if required) shall be provided in main branch pipe near the tap-off point.

5.4.5 Hot Water from calorifier / mixing tank shall be supplied by VFD controlled hydro-pneumatic pumps in closed loop to all guest toilet, Kitchen & Laundry.

5.4.6 Irrigation shall be done through a network of pipes (garden hydrant) laid underground all along green areas. The network of these pipe shall be charged by a booster pump installed in STP. Operation and control of irrigation pump shall be manual.

5.4.7 Water supply for swimming pool and road washing area shall be through by gravity system from overhead Domestic water Tank.

5.4.8 Water supply to Overhead tank shall be done through a separate riser pipe, which will be connected to the main header pipe of common hydro-pneumatic pumps with the help of isolation valve.

5.4.9 The following piping materials are proposed for the project.

System	M.O.C
Fire Fighting Pipes (Underground and exposed)	G.I.(Class 'C')
Plumbing Pipes	
Underground water supply pipe (From tube wells to tanks)	D.I. (K-7)
Pipes in pump room	SS -304
Cold Water Pipes running through shaft & terrace	cPVC Pipes (schedule 40 & 80) and fittings

Pipes in toilet (wall chase/ceiling)	cPVC Pipes & fittings (SDR 11)
Hot water supply and return pipes (In wall chases/ceiling) suitable insulation for mechanical protection preferably AL sheet cladding.	cPVC Pipe & fittings (SDR 11) with insulation
Hot water supply and return pipes (In shafts / terrace) suitable insulation for mechanical protection preferably AL sheet cladding	cPVC Pipe (schedule 40 & 80) and fittings with insulation
Soft water pipe	cPVC Pipe (schedule 40 & 80) fittings.
R.O. water pipe	S.S. Pipe
Flushing Water Pipe (In wall chases/ceiling)	cPVC Pipes & fittings (SDR 11)
Flushing Water Pipe (In shafts / terrace)	cPVC Pipe (schedule 40 & 80) and fittings.
Soil and Waste pipe in shaft	CI Pipe (IS: 3989) / uPVC.Class B as/13552
Soil and Waste pipe running at basement ceiling	CI Pipe (IS:3989) / uPVC
Sewage pipe, under ground	Stoneware Pipe (S.W.) / R.C.C/SN8 DWC
Sewage pipe, (Where Road Crossing)	RCC (NP3) Pipe/DWC SN8
Rain water down take pipes	uPVC Pipe (IS : 4985, class 6Kg/cm2)
Storm Water Drainage pipe (underground)	RCC (NP3) Pipe/DWC SN8

5.4.10 The pipe sizing shall be based on fixture unit calculation as per ASPE standard. The pipe size of riser pipe shall be restricted to 100 mm to optimize on capital cost, and for ease of installation and maintenance. However, the maximum velocity in the water supply piping shall not exceed 2.4 m/second; whereas the limiting maximum velocity in hot water return piping shall be 1.2 m /second.

5.4.11 All inlets, outlets, washouts, vents, ball cocks, overflows control valves and all such other piping connections including level indicator shall be provided for underground water storage tanks.

5.4.12 Full way gate valves of approved make shall be provided as close to the underground tank as practicable on every outlet pipe from the storage tank, except the overflow pipe. Overflow and vent pipes shall terminate with mosquito proof grating.

5.4.13 The overflow pipe shall be so placed as to allow the discharge of water being readily seen. The overflow pipe shall be of size as indicated. A stop valve shall also be provided in the inlet water connection to the tank. The outlet pipes shall be fixed approximately 75mm above the bottom of the tank towards which the floor of the tank is sloping to enable the tank to be nearly emptied for cleaning.

5.4.14 Water meters shall be provided in identified areas for water consumption recording for efficient monitoring and assessment. Head losses through water meter shall be accounted for in water distributions calculations. Water metering shall be provided as per Guidelines as follows.

- Municipal Supply Line
- Each Tube Well Line
- Cold Water Supply Lines (By Hydro System)
- Hot Water Supply Lines (By Hydro System)
- Hot Water Return Line
- Cold Water Makeup Line For Mixing Tank
- House Laundry Cold Water Supply Line.

- House Laundry Hot Water Supply Line.
- House Laundry Hot Water Return Line.
- Kitchen Cold Water Supply Line.
- Kitchen Hot Water Supply Line.
- Kitchen Hot Water Return Line.
- STP Main Line For Gardening and Flushing.
- STP pumping line from fire tank.

5.4.15 Colour coding for flushing domestic and hot water (supply & return) water supply piping shall be ensured for clear identification of the piping as per specifications.

5.4.16 The landscape water supply system comprising of pumping, piping, water supply nozzles and control equipment shall be designed and built by the appointed irrigation water supply vendor. Water for irrigation of lawns for non-guest areas shall be sourced from recycled treated water from STP.

5.5 Appurtenant

5.5.1 Following appurtenant shall be included in the design of water supply system for efficient functioning:

5.5.1.1 **Domestic Air Vents**: Automatic air vent shall be provided on cold and hot water risers to eliminate possibility of air locking and to ensure efficient water floor/ pressure availability at the user outlets.

5.5.1.2 **Vacuum Breaker**: Vacuum breaker shall be provided on fixtures where cross connection to Sanitary system could occur.

5.5.1.3 **Backflow Prevention**: Double check valve type back flow prevention valve shall be provided on all connections to non-potable water systems such as pool, irrigation and flushing water supply for ensuring high hygiene standards.

5.5.1.4 **Flow Restrictors**: Appropriate flow restrictors shall be provided for economizing on water consumption. The flow resistors shall be typically sized for following flow / discharge.

5.5.1.5 **Ball Valve:** Full bore gun-metal ball valve shall be provided for isolation of cold and hot water supply for the designated area. Further chrome-plated angle valve shall be provided for cold / hot water isolation to wash basin faucets and for WC cistern & bidet water supply.

5.5.1.6 **Globe Valve**: Globe valve shall be provided on cold & hot water pipes where dual function of providing isolation for maintenance, and flow regulation is required.

5.5.1.7 **Water Metering**: Water metering shall be provided for Municipal, Tube-well, Cold water, Hot water supply, Hot water Return, Laundry cold water supply, Laundry hot water supply & return, Kitchen cold water supply, Kitchen hot water supply & Return, STP main line for gardening etc. and any other designated areas desired by the SBI and guide lines.

5.5.1.8 **Temperature Gauge**: Temperature gauge shall be provided on hot water supply and return line for efficient balancing and monitoring of the system.

5.6 HOT WATER SYSTEM

5.6.1 To meet the thermal demand of hot water for SBI guest rooms, it was decided to use heat pumps.

DAILY HOT WATER REQUIREMENT	=	15147 Lts/day
	=	631 Lts. / hr.
PEAK FACTOR	=	4
PEAK HOT WATER FLOW	=	2524 LPH

HEAT PUMP @ 80% OF PEAK HOT WATER FLOW = 2020 LPH

SOLAR PRE HEATING @ 20% OF PEAK HOT WATER FLOW = 505 LPH

CONSIDERING (∆T) AS 35 DEG. {COLD = 25 DEG, HOT = 60 DEG}

HEATING ENERGY REQUIRED IN KCAL/HR = PEAK HOT WATER FLOW x ∆T`

= 2524 LPH x 35

= 88340 KCAL/hr

= 102.65 KW

= 103 KW

The total Capacity of Heat Pump for Domestic = 103 KW
Providing 2 Nos. Heat Pump of 52 KW each.

SOLAR HEATING = 505 = 5 PANELS = 5 x 100 LPD = 500 LTS

5.6.2 Solar Water Heating System (Closed Loop)

5.6.2.1 Total hot water requirements (As established in Table 2.1) = 15147 Litres per day

5.6.2.2 It is mandatory to install Solar Water Heating Panel for 20% of this quantity of hot water i.e. for 505 Lit/day. This would require about 12 Sqm of total space on the terrace, assuming 100 Lit/day as output of one panel of 2.5 m X 1.2m.

5.6.2.3 It is proposed to use hot water from Solar Water Heating System to raise the temperature of feed water of clarifier for the most efficient and year round use of the system.

5.6.3 It is proposed to provide Solar Hot Water Panel as energy saving unit to ensure at least 20% energy sourcing from Solar System for effective energy saving and to optimize energy requirement from fossil fuel. The hot water requirement of the SBI shall be approximate 15147 LPD. It is proposed to provide solar panel to ensure 20% energy recovery from solar radiation. It is proposed to enhance capacity of hot water storage tank to ensure thermal storage of heat, as solar radiation timing and peak usage timing shall be different due to pattern of radiation availability and usage requirement.

5.6.4 It is proposed to provide Heat pump of 88340 Kcal/ HR rating to supplement hot water requirement of the SBI Complex. The capacity of the Heat pump is considering the peak hot water requirement at lowest ambient temperature and the rating is not compensated due to provision of solar panels as proposed above.

5.6.5 Independent plate heat exchanger (PHE) connected to its pressurized stainless steel Cement Lined (SS-304) hot water mixing tank and 2 Nos. secondary water recirculation pumps (1 working + 1 standby) shall be provided. It shall be ensured that the tank of each zone is sized for 2 x 50% capacity of hot water requirement of the respective zone. Independent recirculation circuit between solar panel and tank shall also be provided for energy efficient system for system functional requirement.

5.6.6 Hot water temperature at mixing tank shall be maintained at 55 deg to 60 deg C and at tap shall be ensured to be approximately 50 deg C, further return piping and pumping arrangement shall be made

for energy conservation and optimum system efficiency; it shall be ensured that the "dead-leg" of hot water supply piping does not exceed 4 meters to minimize delay in hot water supply when faucet is operated and to minimize water wastage. Booster heater for kitchen / food service area shall be included in scope of facility planning equipment supplier. Armstrong automatic re-circulation valves shall be provided.

5.6.7 Solar water heater shall meet the performance/ minimum efficiency level mentioned in IS 13129 Part (1&2) or Gas Instantaneous water heaters shall meet the performance/minimum efficiency level mentioned in IS 15558 with above 80% Fuel utilization efficiency. or Electric water heater shall meet the performance/ minimum efficiency level mentioned in IS 2082.

5.7 SEWAGE, SULLAGE AND STORM WATER DRAINAGE

5.7.1 Design Conditions

5.7.1.1 Termination of vent cowl at terrace level.2.0 m above parapet

5.7.1.2 Provision of adequate slope for horizontal header pipes in the ceiling level of the transfer floor for achieving self-cleaning velocity in the pipes.

5.7.1.3 Provision of cleanout plugs.

5.7.2 **Sewage & Sullage waste drainage**.

5.7.2.1 The soil and waste shall be carried down in separate independently vented pipes. Two pipe drainage systems shall be adopted as per ASPE standard. The sanitary, waste & vent system shall be water tight and gas tight designed to prevent escape of foul gas and odour from various fixtures. Provision of ASP vertical vent shall be made for hygiene, safety considerations, and to avoid entry of foul smell into occupied areas.

5.7.2.2 Vent system shall be designed to facilitate escape of gases and odour from all parts of sanitary and waste system to the atmosphere at a point above the building and to allow admittance of air to all part of the system, so that siphonage, aspiration or back pressure conditions do not cause loss of seal at traps.

5.7.2.3 It is proposed to use cast iron/uPVC pipe for soil / waste drainage and the horizontal header shall be subsequently connected to the vertical stack located inside the associated pipe shaft which shall be coordinated carefully with other services and in consultation with Architect. Care shall be taken to avoid pipe runs in electrical switch rooms, PABX rooms and other critical areas.

5.7.2.4 Provision for cleaning and rodding eyes shall be made at strategic locations to allow the system maintenance. These cleaning & rodding eyes shall be located in ceiling space and shall be remote from kitchen / pantry and other critical areas.

5.7.2.5 Stainless steel grease interceptors shall be provided for kitchen waste, located close to the source of grease. The design of grease inceptors shall be in accordance with ASPE standard and shall include cleanout at entry and exit. The cover shall be non-slip. Provision of independent vent shall be made to avoid odour / smell nuisance in the surrounding areas.

5.7.2.6 Drain channel shall be provided in the basement level car parking and plant room areas within the floor fill above the raft. Drain channels shall be provided with adequate slope to effect self-cleaning velocity and shall terminate in sumps. For each sump, 2 nos. submersible pumps (1 working + 1 standby) shall be provided for disposal of collected run-off. Pumps shall be installed in identified sumps and shall be operated by Hi-Lo level switches with automatic changeover between both pumps.

5.8 SANITARY FIXTURES & FITTINGS

5.8.1 All sanitary wares shall be selected by the Architect / Interior Designer.

5.8.2 Water closets (European pattern) shall be floor mounted or wall mounted vitreous china, having “S” or “P” trap. All water closets shall have low level cisterns with dual flushing of capacity 2 & 4 Litres. However, provision of flush valve shall be made for public area toilets.

5.8.3 All wash basins shall be of vitreous china, below-counter oval, with single lever basin fitting coming through the marble counter. Hot water return piping shall be provided to minimize hot water delay time thus benefiting in water & energy conservation. Pop-up waste and waste coupling with CP bottle trap shall be provided to the drain outlet. Inlet water connections shall be made thru CP angle stop cocks below the counter.

5.8.4 Showers in Guest Room & Health Club shall have single lever - thermostatic mixer arrangement to regulate water flow and temperature. It is proposed to provide thermostatic mixer on shower to ensure minimize wastage of hot water and for guest comfort. Thermostat mixer shall have cold & hot water inlet ports and temperature setting dial duly calibrated for desired temperature rating of the water at the outlet. The mixer shall have auto shut off of water supply in case of cold water supply failure. The shower arm and rose shall be of the throw-off type and the spray from the rose shall be adjustable by lever.

5.8.5 Provision of rain shower in designated area shall be made as per / Architect requirement. For rain showers, pipe size for water supply shall be increased to ensure availability of adequate water flow.

5.8.6 Urinals shall be flat back white vitreous china, with auto-flushing system and CP spreader. Provision of waste coupling with CP bottle trap, connected to deep sea floor trap, shall also be made.

5.8.7 Accessories such as toilet paper holder, towel rails, soap dispenser and hand drier shall be provided as identified by the Architect / Interior Designer.

5.8.8 Provision of Eye wash facilities as required shall be provided by the architect. Provision of water supply & drainage shall be ensured for all such eye wash facility stations accordingly.

5.8.9 Fixture flow rate are as follows

Fixture	Flow Rate
WC full flush	4 L/flush
WC half flush	2 L/flush
Health faucet	6 L/min
Faucet taps	6 L/min
Urinals (sensor-based / waterless)	1.5 L/flush
Showers	10 L/min
Indian Water Closet	4 L/ flush

5.9 SEWAGE TREATMENT PLANT

5.9.1 We shall provide sewage treatment plant of capacity 60 KLD, for treatment of sewage & sullage water, the treated effluent shall be of a quality suitable for use for flushing and for horticulture for external areas.

5.9.2 Following parameters shall be adopted for the design of sewage treatment plant.

5.9.3 Parameters for design of sewage treatment plant with MBR Technology.

5.9.4 Process

Parameters	Value	
	Before Treatment	After Treatment

pH	7.5 – 8.5	6.0 - 8.5
BOD	250 - 400 Mg/L	Less than 10 Mg/L
Suspended Solids	250-400 Mg/L	Less than 5 Mg/L
COD	400 - 600Mg/L	Less than 20 Mg/L
Oil & Grease	50 -100 Mg/L	Less than 10 Mg/L
Ammonical Nitrogen	350 - 400 Mg/L	Less than 5 Mg/L
Total Nitrogen (N total)	30 - 50 Mg/L	Less than 10 Mg/L
Phosphate (PO4 - P)	6 - 10 Mg/L	Less than 2 Mg/L

5.9.5 Description

5.9.5.1 The out fall sewer main from the last manholes, (60 M^3/ day) will be let into a screening chamber by gravity flow. Large solids particles shall be intercepted by a bar screen, preceded by a grease trap. The primary clarified wastewater is then further pre-treated by fine screening before entering the bioreactor portion of the SBR/MBR process. Fine screening shall be done by proposed bar screen.

5.9.5.2 The sewage after screening is collected in an oil & grease trap after that goes-in to the EQT. And from where. It shall be pumped out to Anoxic tank. The provision of air shall be kept in the EQT. Tank to break the solids in suspension and to homogenize the sewage.

5.9.5.3 The homogenized effluent is then pumped into the Biological reactor for the removal of BOD, COD, Posphate and Nitrates. The reactor is equipped to perform suspension growth of microorganism (Mixed Liquor) in 8000-10000 MLSS. The air shall be provided through an air diffusion system all-round the membrane to soccer the sludge & for biological treatment of sewage in the reactor.

5.9.5.4 The mixed liquor suspended solids from the bioreactor is then shuck through the polymeric hollow-fiber (flat sheet type) or reinforced (hollow sheet membrane module consists of S.S housing, air diffusion system, permeate water manifold & membrane elements. U.F. membrane (0.03 micron pore size) system shall be work to separate the sludge and the treated effluent. The treated water passed through U.V unit for disinfection purpose and stored in a Clear water tank for further reuse.

5.9.5.5 Depending on the MLSS to be retained in the Biological reactor the sludge is wasted. The wasted sludge is collected in sludge thicker and aerated with diffused aeration and then sludge shall be feed to Centrifuge where sludge shall be collected in the form of manure.

5.9.5.6 To avoid the membrane to get chocked due to bacteria generation in membrane & organic substance, chemical cleaning shall be carried out once in two to three months for removing substances polluting and clogging the membranes. Normal cleaners used are sodium hypo chloride and citric acid.

5.10 STORM WATER DRAINAGE

5.10.1.1 Separate and independent rain water drainage system shall be provided for collecting rain water from terrace, paved area, lawns and roads. Independent rain water down takes of appropriate size and number shall be provided in Guest room toilet shafts or external face of building duly approved by Architect. Perforated pipe drainage system shall be provided for open-to-sky courtyard/lawn. The storm water runoff from the basement ramp shall be separately collected and connected to sump at basement. No storm water ingress shall be allowed into basement. It shall be ensured to have electrical supply for all sump pump panel from electrical panel located at basement. The final disposal shall be in rain water harvesting pit with overflow connection to the available municipal drain.

5.11 BRIEF OUTLINE SPECIFICATION FOR MAJOR EQUIPMENT

5.11.1 CAST IRON PIPES

5.11.1.1 Cast iron pipes and fittings shall be of good and tough quality and dark grey on fracture. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surface being as nearly as practicable concentric. They shall be sound and nicely cast, shall be free from cracks, taps, pinholes and other manufacturing defects.

5.11.1.2 The pipes and fittings shall conform to IS: 3989 as called for. Fittings shall be of required degree with or without access door. All access doors shall be made up with 3mm thick insertion rubber gasket of white lead and tightly bolted to make the fittings air and water tight. The fittings shall be of the same manufacture as the pipes used for soil and waste.

5.11.1.3 Soil condition shall be checked prior to selection of CI pipes in external areas to check suitability of piping material and its adequacy.

5.11.1.4 All pipes and fittings before installation at site shall be tested hydrostatically to a pressure of 0.45 Kg/sq. cm without showing any sign of leakage, sweating or other defects of any kind. The pressure shall be applied internally and shall be maintained for not less than 15 minutes. Test certificate from manufacturers shall be obtained before despatch of material to site.

5.11.1.5 If required, Cast iron specialty items such as deep sea floor traps, urinal traps, trap integral pieces with integral inlet/outlet connections, manhole cover with frame, chamber cover etc. shall be fabricated to suit individual location requirements.

5.11.2 VALVES

5.11.2.1 All valves (gate, globe, check, safety) shall be of gun metal suitable for the particular service as specified. All valves shall be of the particular duty and design as specified. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Gate, globe and check valves shall conform to ASTM specifications.

5.11.2.2 Sluice valves, where specified shall be flanged sluice valves of cast iron body. The spindle, valve seat and wedge nuts shall be gunmetal. They shall generally have non-rising spindle and shall be of the particular duty and design as specified. The valves shall be supplied with suitable flanges, non-corrosive bolts and gaskets.

5.11.2.3 Ball valves with floats to be fixed in storage tanks, shall consist of cast brass lever arm having copper balls (26 SWG) screwed to the arm integrally. The copper ball shall have bronze welded seams. The closing/opening mechanism incorporating the piston and cylinder shall be non-corrosive metal and include washers. The size and construction of ball valves and float shall be suitable for desired working pressure operating the supply system. Where called for brass valves shall be supplied with brass hexagonal back nuts to secure them to the tanks and a socket to connect to supply pipe.

S.No	Type of Valve	Size	Construction	Ends
A.	Isolating Valve	15 mm to 50 mm 65 mm and above	Gun Metal Gun Metal	Single lever Screwed Flanged
B.	Sluice Valve & Butterfly Valve	65 mm and above	Cast Iron	Flanged
C.	G.M. non return valve	15 mm to 50 mm 65 mm above	Gun Metal Gun Metal	Screwed Flanged
D.	Flap Type – Non return valve	65 mm and above	Cast Iron	Flanged

5.11.2.4 All valves shall be suitable for the working pressure involved.

5.11.3 Pressure Gauge

5.11.3.1 The pressure gauge shall be constructed of die cast aluminium and stove enamelled. It shall be weather proof with an IP 55 enclosure. It shall be stainless steel Bourden tube type pressure gauge with a scale range from 0 to 16 Kg / cm square. Each pressure gauge shall have a siphon tube connection. The shut off arrangement shall be by Ball Valve.

5.11.4 Water Fittings

5.11.4.1 All Gunmetal fittings such as gate, globe, check & safety valves shall be fitted in pipe line with unions on both ends of the valve for easy replacement. The joints between fittings and pipes shall be leak-proof when tested to desired pressure rating. The defective fittings and joints shall be replaced.

5.11.5 CONNECTIONS TO VARIOUS MECHANICAL EQUIPMENT SUPPLIED BY OTHER AGENCIES

5.11.5.1 All inlets, outlets, valves, piping and other incidental work connected with installation of mechanical equipment supplied by other agencies all be carried out in accordance with the drawings, requirements for proper performance of equipment and it's for , manufacturer's instructions. The equipment to be supplied by the other agencies consist mainly for Kitchen, Laundry, Back-of-the-House area and other similar areas. The work of connections to the various equipment's shall be effected through proper unions and isolating valves.

5.11.6 CONNECTIONS TO WATER TANKS

5.11.6.1 All inlets, outlets, washouts, vents, ball cocks, overflows control valves and all such other piping connections including level indicator shall be provided for water storage tanks.

5.11.6.2 Full way gate valves of approved make shall be provided as close to the tank as practicable on every outlet pipe from the storage tank, except the overflow pipe. Overflow and vent pipes shall terminate with mosquito proof grating.

5.11.6.3 The overflow pipe shall be so placed as to allow the discharge of water being readily seen. The overflow pipe shall be of size as indicated. A stop valve shall also be provided in the inlet water connection to the tank. The outlet pipes shall be fixed approximately 75mm above the bottom of the tank towards which the floor of the tank is sloping to enable the tank to be nearly emptied for cleaning.

5.11.7 **PIPES HANGERS, SUPPORTS & CLAMPS**.

5.11.7.1 All vertical pipes shall be fixed by galvanized clamps and galvanized angle brackets truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

5.11.7.2 Horizontal pipes running along ceiling shall be fixed on galvanized structural adjustable clamps of special design as shown on the drawings. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully reset on them.

5.11.7.3 Contractor shall provide all sleeves, openings, hangers, inserts shall be provided during the construction by making such provisions in the structure as necessary.

5.11.7.4 All pipes clamps, supports and hangers shall be galvanized. Factory made prefabricated clamps shall be preferred. Contractor may fabricate the clamps of special nature and galvanize them after fabrication but before installation. All nuts, bolts, washers and other fasteners shall be factory galvanized.

5.11.8 PUMPS

5.11.8.1 Pumps shall be vertical, centrifugal directly coupled to motor. Provision of pump with pump head & base of cast iron and other parts in SS 304 shall be made. Impeller shall be hydraulically balanced and keyed to shaft. Pump base shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on vibration elimination pad. The pump shall be lubricated in strict accordance with the manufacturer's instructions and shall be factory aligned prior to shipment. All motors and bases shall be painted with approved finish shop coat of paint. The pump shall be selected for the lowest operating noise level and shall be complete with flexible connections, valves, and pressure gauges.

5.11.9 FRP COMPOSITE VESSEL FILTER

5.11.9.1 The filter shall be constructed of FRP material with inner shell of integrated polyethylene, polypropylene and other material as per manufacturer's standard.

5.11.9.2 The inter distribution system and the under bed draw off system shall be of Hub & Lateral type of polypropylene material. The filter shall be provide with manhole cover, hand whole, flanged outlet for piping / valve connection and adequate tripod with skid self-supporting structure for making the installation complete. The filter shall also be provided with vacuums breaking connection / accessories to avoid any collapse of internal lining. All filters shall be provided with manhole for media loading and lifting lugs.

5.11.9.3 The filter shall be suitable for 1.5 times the working pressure of pump.

5.11.9.4 Each filter shall be provided with following accessories :-

5.11.9.4.1 Inlet and outlet pressure gauge

5.11.9.4.2 Sampling cock / valve on raw water inlet and filter water outlet

5.11.9.4.3 Individual drain connection with gunmetal full way valve for each filter.

5.11.9.4.4 Air release valve with connecting pipe

6. RAINWATER HARVESTING

6.1 Part of the storm runoff i.e. from roof tops will be led into rainwater harvesting system since it is mandatory and as well as to facilitate in augmenting ground water levels in the vicinity. Balance surface run off from open areas will find its way into the storm water drains.

- Design of Internal drains for a discharge @ 0.5 cusecs per acre.
- Design of Major drains for a discharge @ 0.25 cusecs per acre.
- Final disposal point - Roof top rainwater into recharge wells and balance into external open drains

6.2 Appropriate rainwater harvesting system i.e. bore well with de-silting chamber shall also be provided as per requirements, at strategic locations of the drainage network system. Diameter of bore in each infiltration well shall be 350mm and the depth and avg. 35-40 meters. The depth may increase or decrease as per actual site conditions and ground/aquifer water levels. The recharge pipe shall be left 5 meter above of ground water table.

6.3 Rainwater harvesting Calculation:

S. No.	Type of Surface	Catchment's Area		Run off Coeff. [C]	Intensity of Rainfall (mm/hr)	Discharge (Run Off) [Q=10CIA] m3/hr	Total (m3/hr) [Q]
		sq. m	Ha.				
1	Building/Roof Top						
(a)	Area	6756	0.67	0.85	25	10X0.85X25X0.67	142.37
2	Paved Surface/ Road Surface						
(a)	Area	1101	0.11	0.5	25	10X0.50X25X0.11	13.75
Grand Total (1+2)							156.12

VOLUME OF STORM WATER DRAINAGE

Considering 12 min (0.200 Hr) Retention Period

Volume Required = 156.12 X 0.200

Volume = 31.22

= Say, 32 Cu.m/hr

VOLUME OF 1 RAINWATER HARVESTING PIT

Dia of Pit (D) = 3.0 m

Height of Pit (H) = 3 m

Volume of Pit = πr2h/4

= 3.14 x 3.0 x 3.0 x 3.0 / 4.0

= 21.20 cu.m.

Total No. of Rainwater harvesting pit 32 / 21.2 = 1.50 Nos.

Total No. of Rainwater harvesting pit provided = 2 Nos.

Hence, 2 nos. of Rainwater harvesting pit of size 3m dia and 3m depth with PVC slotted pipe is being proposed.

Note - Final Calculation will be shared as per the IGBC Certification credit point. As mentioned in the IGBC_DBR document considering rainfall data and Catchment area.

(B)
ELECTRICAL SYSYTEM

1. INTRODUCTION

The proposed SBI shall have 40 twins guest rooms along with Offices. The total area of site is approximately 10500 Sqmt.

The services systems for the SBI have been conceptualized based on past experience and acceptable SBI design standards. Conservation of energy, rainwater harvesting reuse of treated water on ZLD concept, optimization of resources and eco-friendly technology shall be the key factors in the design concept to ensure least downtime and reduce maintenance hassles.

Efforts shall be made to design, plan and install equipment in locations which shall tend to encourage routine preventive maintenance by providing easy access for operation personnel and for accommodating changes in future requirements. Manual isolation will be provided to enable servicing or renovation of any part of the system without interrupting the services in adjacent areas.

SALIENT FEATURES OF SITE:

The salient features of site of proposed are:

Temperature in May (Max) = 35^0 C
Temperature in Feb. (Min) = 18^0 C
Average Temperature = 26.5^0 C
Annual Rainfall = 923 mm (36.3 inches) Fab is the driest and Maximum rainfall in July (Rainfall period is Jun to Aug)
General RL above MSL of site = 160 m
Highest Flood Level of the site ……. (To be confirmed by Architect). Although site is reported to be above HFL.

2. SCOPE OF SERVICES SYSTEM IN EPC

The present scope for design of engineering services system installation undertaken includes following:

a) External Electrification including Substation Compound and street light.
b) Captive Power Plant -Emergency Power Generation: DG and Solar Power.
c) Elevators
d) Extra Low Voltage System comprising of Fire Detection & Alarm, CCTV, Public Address and Infrastructure for SBI Guidelines.
e) Public Health Engineering (Plumbing) including Water Treatment & Sewage Treatment Plant and reuse of treated water.
f) Hot generation by heat pumps and solar panels & supply and Domestic Water supply.
g) Rain Water runoff harvesting and disposal
h) Fire Fighting System.

3. PROJECT DESCRIPTION

The project comprises of Two block with Single basements having service areas like Underground Storage Tank, Pump Room, LT Panel Room, Engineering Maintenance etc.

Basement : **4146 sq.m area (Parking** Pump Room, Store & Electrical Panel Room).
Block-I : Total Built-up area **5729 sq.m** 5 floors of Offices
Block-II : 5 floors: institutional + 40 twin rooms+ kitchen/dining **5352 sq.m**
Block – III **:** 2 floors: Dining & Library + Kitchen/ dining **782 Sq.m**

Area Statement-A

S.NO.	FLOOR	AREA (SFT)	USE
1	BASEMENT	47990	PARKING, Pump room & electrical room
2	GROUND FLOOR LEFT SIDE	13063	STILT,SME PARKING RECEPTION.
3	GROUND FLOOR RIGHT SIDE	14505	SBILD KITCHEN,DINING,MULTI UTILITY HALL,STILT,ADMIN AGM.FACULTY,CONFERENCE ROOM.
4	FIRST FLOOR LEFT SIDE	12191	AMECC AND RASMEC
5	FIRST FLOOR RIGHT SIDE	15882	CLASS ROOM ,LIBRARY,RECORD ROOM,DIGITAL CLAASS ROOM,DISCUSSION
6	SECOND FLOOR LEFT SIDE	12191	RBO,
7	SECOND FLOOR RIGHT SIDE	11104	15 TWINS ROOM
8	THIRD FLOOR LEFT SIDE	12191	AO,
9	THIRD FLOOR RIGHT SIDE	11104	15 TWINS ROOM
10	FOURTH FLOOR LEFT SIDE	12191	FUTURE,
11	FOURTH FLOOR LEFT SIDE	12161	11 TWINS ROOM,LOUNGE,DINING LIVING KITCHEN

1. Reference Standards

The following standards and codes shall be followed / referred during detailed design of the services:

- National Building Code of India – 2016
- Energy Conservation Building Codes April 2017
- Relevant codes of Bureau of Indian Standards
- Institute of Electrical & Electronic Engineers (Design Hand Book)
- Illuminating Engineering Society of North America (Design Hand Book)
- IEC 60726/ IS: 2026 (Part 1 - IV)/ Specification of Power Transformers
- IEC 60831/ IS 13340 & IS 13341: Capacitors
- IS/IEC 60947: Specification for low voltage switch gear & control gear
- NFC 17-102: Advanced Lightning protection system
- BS 7430, IS 3043: Earthing & bonding
- BS 7671 requirements for electrical installation
- NEC – NFPA 70, National Electric Code
- NFPA 101, Life safety code
- NEC, National Electric Code of India
- NFPA 72 National Fire Alarm and Signalling Code
- Local By–laws

2 Design Calculations

The following design parameters given indicative only and the actual works to be carried out as per the Detailed Technical Specification and final design. The works should be carried out are to be suitable for obtention of green building certification. The works should also include necessary approvals for all the electrical installations, from concerned authorities of the State and Central like DISCOM, CEA etc.

3 Power Supply & Sources :

3.1 Estimated Electrical Power requirements are calculated and indicated in **Annexure-I**. It is understood that the complex will be supplied power from the State Electricity Board, however since the source is not reliable (risk of blackout or unacceptable voltage variation), it is proposed that the DG power backup for all the load except Banking Hall / office space ACs i.e. Power, Light, UPS, Lifts, Cabin & Conference room ACs etc. Some critical loads such as emergency lighting, head end equipment of ELV systems, etc shall be additionally backed up using UPS system.

3.2. State Electricity Supply / 11kV Switch yard

The electrical load for the Complex is estimated at **650 KW (800 KVA).** Based on the information available the power shall be available from the local DISCOM at 11 KV. However, specific confirmation shall need to be taken from the local DISCOM prior to system design. Metering should include necessary system for measuring Solar Power Plant exportation also i.e. net / gross meter, as decided at the time of final design. The metering to be provided by local DISCOM within the premises as per local norms. Necessary Liaoning to be done by the contractor.

3.3. Back up Power :

The Complex is provided with emergency power generation System by way of the DG Set(s) of 500 KVA capacity (Minimum 2 Nos of DG Sets of suitable capacity as per the final design). DG sets are proposed to be installed at Ground floor level in setback. The location as per local norms has to be as per the final lay out design.

3.4 All lighting, power, UPS and HVAC System of critical areas like Cabins, Conference rooms, VIP Lunch rooms etc. shall be backed up by DG sets and No DG Back up for

banking / office hall HVAC system. The DG sets shall be able to on operate through auto mains failure system and to switch off on restoration of power supply.

- Automatic start of the DG sets as required in case of mains failure.
- The number of DG sets started shall be based on the load requirement thus conserving fuel.
- Return of the system to normal and stopping of the DG sets after restoration of mains supply.
- Synchronization of running the DG sets has not been considered.

3.5 Residential silencer shall be provided for DG set. Independent flue pipe from each DG set shall be taken through a dedicated shaft to the terrace level and let out as per pollution control board requirements.

3.6 It may be noted that as per ruling diesel generator sets with ratings less than 1000 kVA, DG set has to be installed within an acoustic enclosure.

3.7 Due to non-availability of space at site for HSD yard, it is proposed to provide barrels for Diesel storage for DG sets beyond the allowable 990 litres in DG room/at ground level.

4 HT Power distribution Scheme

4.1 SUB-STATIONWORK (SH: SITC of 2x800KVA,1 substation Equipment's including RMU, GODO, HT Distribution panels, HT cabling and all Allied works including civil foundation works.

4.2 PRELIMINARY DESIGN

1. 2 nos. of x 800 KVA Transformers.
2. For Substation the incoming 11 KV HT supply to main HT Panel shall be feed through 3 x 185 (E) Sq. mm XLPE HT armoured Aluminium conductor cable of 11 KV grade and HT power from main HT Panel shall feed to 2Nos.800KVA OIL TYPE Outdoor type transformers through 3x240(E)Sq.mm XLPE HT cable of 11KV grade.
   a) The 11 KV line shall feed the incoming of this main HT Panel. 2 Nos. outgoing of this HT panel will feed to 2 Nos. 800 KVA Transformers and 1 No. Incomer.
   b) 2 Nos. of LT LBS to be provided with connecting bus bars between transformer LT side and LT LBS. LT LBS should have provision to terminate 4 to 6 nos. cable entry and terminations.

The above design is followed on preliminary basis only which may vary during detailed design and survey. The successful bidder shall do in consultation with local body if any, in case NOC from local body required for occupancy viz Fire Fighting system, Fire Alarm system, Electrical Sub-station etc) the detailed survey, planning, designing of the complete system and submit the same to the client / NIT Approving Authority/CEA for approval of the same before taking up any work in this sub-head. The work to be taken up on the basis of the detailed drawing approved by NIT Approving Authority. Necessary deduction shall be made if the submitted/approved design is below specification, size, parameter from this preliminary design; whereas no extra cost shall be paid if the submitted/approved design is above the specification, size, parameter from this preliminary design.

5. EARTHING

5.1. SCOPE

(i) This section covers specifications for earthing systems comprising of earth electrodes, earth leads and loop earthing conductors.
(ii) Separate earthing systems shall be provided for neutral earthing (of transformers and generators) and body earthing.
(iii) All the non-current carrying metal parts of electrical installations including metal conduits, trunkings, cable armour, switchboards, DBs, light fittings and all other non-current carrying parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system.
(iv) All three phase equipment shall have two separate and distinct body earths and single phase equipment shall have a single body earth.
(v) Separate earth leads of appropriate size shall be provided for.
- Main switchboards
- UPS system earth bus
- Computer system earth bus
- Telephone system earth bus

(vi) Wherever so specified the earth lead shall be PVC sheathed to provide a “clean” earth.
(vii) All metallic components and pipes within bathrooms, toilets and kitchens shall be connected to the earthing system by means of minimum 4 sq. mm PVC insulated (green/yellow) copper conductor wires.

5.2. STANDARDS

The earthing system shall be carried out in conformity with the updated and current edition of IS 3043 : 1987. In addition, relevant clauses of Indian Electricity Act 2003, India Electricity Rules 1956 and IEE Wiring Regulations (16th edition), as amended up to date, shall also be applicable.

5.3. EARTH ELECTRODES

- **Plate Earth Electrodes**
  The plate electrodes shall be of copper or GI as called for in the schedule of quantities. Minimum dimensions of the electrodes shall be 600 mm x 600 mm. Thickness of copper electrodes shall not be less than 3 mm and of GI electrodes not less than 6 mm.
- **Pipe Earth Electrode**
  Pipe electrode shall be fabricated from a 40 mm dia 4500 mm long class B (medium) GI pipe. The GI pipe shall be tapered at the bottom and shall be provided with 12 mm dia holes drilled at every 75 mm.

- **Galvanizing**
  Galvanizing of Earth Electrodes and Earthing Conductors shall conform to class – IV of IS 4736 : 1986.

5.4. EARTH PIT

(i) For plate electrodes

Plate electrode shall be buried in ground with its face vertical and top not less than 500 mm below ground level. The depth shall be increased if required so that permanently moist soil level is reached. The electrode shall be surrounded by alternate layers of charcoal and salt. A 20 mm dia class B GI pipe shall be provided for watering of the soil surrounding the electrode. The watering pipe shall have a watering funnel attachment with a wire mesh which shall be housed in the masonry inspection chamber. Main earth lead shall be securely terminated at the electrode by means of 2 bolts, nuts, check nuts and spring washers. The earth lead from the electrode up to the test link in masonry chamber shall be drawn in a suitable diameter class B GI pipe for mechanical protection. The GI pipe shall be provided

with a coat of bituminous paint or bituminized jute wrapping for additional corrosion protection. The lead shall terminate in a test link provided in the inspection chamber to enable the earth electrode to be isolated for measuring earth resistance.

(ii) For pipe electrodes

Pipe electrode shall be installed with its stop not less than 200 mm below ground level. The top shall be provided with a 40 mm x 20 mm reducer to fix watering funnel with mesh on top. The entire length of pipe below the inspection chamber shall be surrounded by alternate layers of charcoal and sand. Earth lead shall be provided as for plate electrode and shall be terminated using a though bolt, nuts, check nuts, spring washers etc.

(iii) Masonry inspection chamber

The watering funnel arrangement as also earth test links shall be accessible and shall be housed in a 400 mm x 400 mm x 400 mm deep masonry inspection chamber having a lockable 10 mm thick cast iron hinged cover plate attached to a galvanized steel frame work embedded in the chamber walls. The hinged cover shall be suitably marked on top so that it is conspicuously identifiable as an earth station.

(iv) Location of earth electrodes

Location of earth electrodes shall be based on following guidelines.

- Minimum distance between any electrode and building structure shall be 1.5 m.
- Minimum distance between two adjacent electrodes shall be 2 m.
- Electrodes shall be located in accessible locations. Entrances, pavements and roads shall not be used for locating earth electrodes.

5.5. EARTHING CONDUCTOR

(i) Main Earth Lead

Interconnections between earth bus provided on the main switchboard inside the building for body earthing / neutral terminals of transformers / generators for neutral earthing and test link provided in the earth electrode inspection chamber shall be laid at minimum 300 mm depth below ground (minimum 600 mm below road crossings and paved pavements).

For small installations where this lead is by means of GI / copper wire, the earth lead shall be drawn in a 15 mm dia class B GI pipe. For larger installations the GI pipe size shall be suitable for drawing the earth strip. GI pipe shall be provided with a coat of bituminous paint on the outside for minimizing corrosion. In locations where GI pipe protection cannot be provided, the earth conductor shall be wrapped with bituminous jute wrapping.

(ii) Earthing conductors

Earthing conductors shall be connected to form the earthing network throughout the installation for earthing of all non-carrying metal parts as below. Materials and sizes shall be as per schedule of quantities

- Main earthing conductors shall be taken from the earth connections at the main switchboards to all other switchboards in the network.
- Sub-mains earthing conductors shall run from the main switchboard to the sub distribution boards and to the final distribution boards.
- Loop earthing conductors shall run from the distribution boards and shall be connected to any point on the main/sub-main earthing conductor, or its distribution board or to an earth leakage circuit breaker.
- Conduiting systems and cable armouring shall be earthed at the ends adjacent to switchboards at which they originate, or otherwise at the commencement of the run by separate loop earthing conductors in effective electrical contact with cable Armor, switch boxes, accessories, lighting fitting etc.

(iii) Installation and Jointing of earthing conductors

- Earthing conductors shall be provided in longest possible unbroken length to minimize jointing of the conductors in between terminations.

- Strip conductors shall be secured to the building walls etc. with appropriate size of saddles at intervals not exceeding 900 mm. The saddle shall be gun metal for copper and GI for GI strips.
- Copper earth strips shall be joined by butt welding /brazing or the mating surfaces shall be tinned, riveted and soldered.
- GI earth strips shall be joined by GI bolts, nuts, check nuts and spring washers of appropriate size.
- All exposed joints shall be provided with 2 coats of anti-corrosive paint.
- Wires shall be joined by means of lugs of appropriate size connected by bolts, nuts, check nuts and washers. If the connection is on a painted surface, the paint shall be thoroughly removed, and the metal exposed for making effective electrical contact. Lugs and bolts shall be of brass for copper wires and for GI wires.

5.6. PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system.

5.7. RESISTANCE TO EARTH

No earth electrode shall have a greater ohmic resistance than 3 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 5 ohms. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate circuit breakers, and shall not exceed 1 ohm.

5.8. Maintenance free Earthing Electrode System/ Chemical Earthing

In maintenance free earthing copper bonded earthing rod electrode shall be of minimum 14.35 mm in diameter and 3-meter length. The rod shall be placed in a 150 mm dia an augured hole in the ground and then surrounded by ground enhancement material in either a dry form or premixed in a slurry. Once set, ground enhancement material becomes hard and as such holds positively to the rod as well as surrounding ground.

Earth rod offered shall have passed the test required of BS7430/ ANSI/ UL467 and confirm to the adhesion of the copper coating to the steel core (Design feature that prevents the ingress of moister and subsequently the integrity of the rod.

Minimum 0.25 mm thickness of copper shall be deposited over the steel core as per BS 7430/ UL 467. Average life of the ground rod shall be 30 years in most soil.

Ground enhancement material shall be as per IEEE-80 clause 14.5d with a resistivity of less than 0.12 ohm-meter. The ground enhancement material shall be permanent and not leach any chemicals in to the ground.

Minimum 30 Kg of ground enhancement material shall provided for each earth electrode.

Inspection chamber shall be of 400 x 500 mm with concrete base CI manhole cover with frame painted with bitumastic paint. 2 Nos. of 50 x 6 mm cross section & 300 mm long copper strip to be clamped with copper cladded rod electrode have sufficient nos.(But not less than 4 Nos.) of 10□ mm GI nuts & bolts for connection to the equipment / interconnection to the other pits to form equi-potential bonding.

5.9. TESTING AT SITE

(i) Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

(ii) Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

6. LIGHTNING AND SURGE VOLTAGE PROTECTION SYSTEM

6.1. ESE LIGHTNING PROTECTION SYSTEM (Advanced Lightning Protection System Based on NFC17-102)

The work to be done under this section comprises the supply & installation necessary for the complete installation of the lightning protection system.

The design of the components shall be traceable to field research, laboratory testing, fundamental analysis, and statistical levels of the lightning event. The design of the components shall be traceable to long term practical field studies laboratory testing, fundamental scientific principles and statistical levels of the lightning event as documented in international standard. The lightning protection system should complies in accordance with NFC 17-102 standard and shall be installed strictly to the manufacturer's instructions.

The advanced lightning protection system shall include components as follows:

ESE Air terminal
Mechanical supports
Down-conductors
Performance Recording Equipment
A low impedance Grounding system.

6.2. STANDARDS

Complete installation shall be engineering and constructed in accordance with the latest revision of the following :

- NFC-17-102
- IEC 61204

The details of the lightning protection system shall also confirm to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this specification and drawings, whichever is more stringent and acceptable to the engineer.

6.3. AIR TERMINAL

The air termination shall be of the type that responds dynamically to the appearance of a lightning down leader by creating free electrons between outer surfaces and an earthed central finial rod.

The Air terminal should work under **Early Streamer Emission (ESE) Technology** and the attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics. The Lightning conductor should deliver a unique gain time in efficiency, anticipating the natural formation of an upward leader. The Air terminal generates a leader that propagates rapidly to capture the Lighting stroke and conduct it towards the ground.

Arcing is not to be continuous and shall only occur during the progress of the lightning leader. The air termination shall not cause high frequency radio interference except during the millisecond intervals associated with the progress of the lightning leader and during the main return strike of lightning events in the region.

The materials of the air termination shall be non-corroding in normal atmosphere.

The air termination shall not be dependent upon batteries or external power supplies for any

part of its operation. The Height of the air terminal support mast should be minimum 2mts and the height will be increased as per the coverage design. The support shall be securely installed and guy wires shall be used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

6.4. DOWN CONDUCTOR

The down conductor should be used 25 x 3 mm copper strip. Two down conductors shall be used in case of the structure height is above 28mts and both should be connected with maintenance-free Grounding system.

The main copper conductor shall be connected directly to the air termination. The down conductor shall be installed in accordance with the manufacturer's instructions and should not be subject to sharper bends. The down conductor must be kept in constant physical contact with the structure via conductive mounting clamps.

6.5. LIGHTNING FLASH COUNTER

Each protection system shall be supplied with Lightning strike counter. The counter shall have a register that activates one count for every discharge where the peak current exceeds 400A at the 8/20us standard.

The lightning flash counter shall be robust and easy to install. The counter shall operate from the energy of the lightning discharge and should not work on external or battery power to operate.

The lightning flash counter shall be installed to the manufacturer's instructions in a readily accessible manner (always 2mts above the Ground) so that reading can be taken at regular intervals. It shall be positioned such that its operating temperature is within the range -20'C to + 60'C.

6.6. GROUNDING SYSTEM

(i) Maintenance free Earthing Electrode System/ Chemical Earthing

In maintenance free earthing copper bonded earthing rod electrode shall be of 14.35 mm in diameter and 3 meter length. The rod shall be placed in a 150 mm dia an augured hole in the ground and then surrounded by ground enhancement material in either a dry form or pre mixed in a slurry. Once set, ground enhancement material becomes hard and as such holds positively to the rod as well as surrounding ground.

Earth rod offered shall have passed the test required of BS7430/ ANSI/ UL467 and confirm to the adhesion of the copper coating to the steel core (Design feature that prevents the ingress of moister and subsequently the integrity of the rod.Minimum 0.25 mm thickness of copper shall be deposited over the steel core as per BS 7430/ UL 467. Average life of the ground rod shall be 30 years in most soil.Ground enhancement material shall be as per IEEE-80 clause 14.5d with a resistivity of less than 0.12 ohm-meter. The ground enhancement material shall be permanent and not leach any chemicals in to the ground. The pH value of the ground enhancement material shall be 6.9 to 7.2 of 100 gm/ lit @ 20 deg.C.

Minimum 30 Kg of ground enhancement material shall provide for each earth electrode.

Inspection chamber shall be of 400 x 500 mm with concrete base CI manhole cover with frame painted with bitumastic paint. 2 Nos. of 50 x 6 mm cross section & 300 mm long copper strip to be clamped with copper cladded rod electrode have sufficient nos.(But not less than 4 Nos.) of 10□ mm GI nuts & bolts for connection to the equipment / interconnection to the other pits to form equi-potential bonding.

7. Elevators

7.1 Elevator equipment shall be supplied and installed in accordance with ANSI / ASME.A17.1/CENEN 81-1(JIS) including latest supplement and local code requirements, whichever is more stringent. No degradation of ANSI / ASME.A17.1/CENEN 81-1(JIS) requirement shall be allowed simply on the basis of local code requirement.

7.2 All elevators shall be gearless type. Interiors of all guest / passenger elevators shall be designed by the interior designer and bare car is provided with 25mm recess for flooring by others. Interior of service elevators shall be provided with anti-scratch stainless steel and 5 mm thick Aluminium /SS chequered plate flooring, unless otherwise specified.

7.3 All elevators shall connect to normal and to emergency power supply. One elevator from

each bank of elevators in each group shall be key operated to be used as fireman's lift as per code. All elevators shall be provided with short duration emergency lights in each cabin supported by local dry cell rechargeable battery and necessary relays to give minimum 50 Lux at the floor level of the elevator. Automatic self-levelling feature shall be provided to bring the elevator car level within + 3 mm of the landing floor regardless of load or direction of travel.

7.4 **Car and Hoist way Door Operation:** For each elevator door, an electric door shall be provided to simultaneously open the car and the hoist way door when the car is at a landing, and also close both the doors simultaneously before the car leaves landing after a predetermined time interval has lapsed.

7.5 **Photo Electric Monitor:** Photo electric device shall be installed on each elevator. This device shall monitor traffic across the threshold of the door and shall initiate door closing two seconds after last beam interruption thus overriding door open period.

7.6 **Over Load Features:** All elevators shall be provided with the load weighing feature to illuminate "Over Load" fixture and defeat car's operating circuits when car load reaches 110% or more than the rated load. Car platform may require stiffening to minimize margin of error resulting from excessive deflection.

7.7 **Car Position Indicator**: Alpha numeric/ digital car position indicator shall be provided above each car operating panel.

7.8 **Hall Buttons**: At each terminal landing a single micro movement push button shall be provided, that is on the top most and the lowest floor landings; two micro movement buttons on a single plate shall be provided at each intermediate floor landing. When a hall call is registered by momentary pressure on a landing button, that button shall illuminate and shall remain illuminated until the call is answered.

7.9 **Lighting**: Lift car manufacturer shall make all provisions for installation of lighting fixtures specified by the interior designer, including integration of emergency lighting fixture. Necessary wiring shall be included in the car travelling cable for lighting and communication system.

7.10 **Noise Levels**: Noise from all stationary equipment shall not intrude into adjoining areas by more than 15 dB. Noise from moving equipment including door operation, car motion, fan, wind etc. shall not intrude into adjoining corridors by more than 20 dB.
Noise level inside the car shall not exceed 50 dB, without lift fan running. Noise level inside the car shall not exceed 55 dB, during door opening / closing.

7.11 **Architraves & Doors:** Doors, threshold, door hangers and electro mechanical locks as a system shall be fire rated for not less than 2 hours.
Control: AC variable voltage and variable frequency control system shall be provided for all elevators.

8. ON GRID SOLAR POWER PLANT

8.1 Scope

The vendor shall supply and install Roof integrated grid connected photovoltaic power system. Contractor shall ensure proper integration of the system as per site constraints/requirements.

8.2 References

8.2.1 Works should conform to all the latest MNRE Norms.

8.2.2 All equipment will comply with IS codes and standards, and other national and international codes of practice as listed below.

a. IEC 61215 - Crystalline silicon Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval.
b. IEC 61730-2 - Photovoltaic module safety qualification Part
c. The Inverter shall be designed to accept the PV array output and shall be listed to UL1741, IEEE 1547, IEEE 929 standards.

8.3 General Requirements

8.3.1 The works should consist of Supply, Installation, Testing & Commissioning of Solar Power Plant including cost free Comprehensive Annual Maintenance Contract for 5 Years, starting from the Date of Commissioning of the plant.

8.3.2 All PV Panels and materials shall of a quality accepted by the Client without any damage or breakage during transportation or installation. All metal parts shall be protected on site from rust, corrosion and dirt by properly storing, packing and covering.

8.3.3 The primary components of the PV System shall include rooftop integrated PV Array with auto tracking system, DC source circuit combiner boxes (outdoor duty – IP 65), DC disconnects (IP 65), electrical room disconnects and combiner, DC-AC inverter, necessary cabling, conduiting, panels etc

8.3.4 Solar panels shall be installed in shadow free area.

8.4 SITC System Requirements

8.4.1 SITC Photo voltaic panels shall be polycrystalline silicon technology. Solar Panels 530W shall be efficient & of suitable capacity to form an array of required capacity. Each module will be rated for maximum system voltage up to 1000VDC.

8.4.2 Solar panels shall be extremely light weight. Each solar module shall be provided with Anodized Aluminium frame to protect the module. The back of the module will be covered with a layer of mylar.

8.4.3 PV module Terminal box shall be IP65 with four terminal connection blocks.

8.4.4 PV module shall be suitable for roof temperature up to 85°C & shall be suitable for installation on roof having slope between 3° and 60°.

8.4.5 Each of PV circuit combiners will be designed and rated to combine series strings of Photo voltaic panels, as required. PV circuit shall be protected by DC MCBs of suitable rating. Each Circuit combiner will be provided with surge suppression device.

8.4.6 DC disconnects shall be designed and rated for DC power disconnecting under load. Each DC disconnect will be provided with surge suppression device.

8.4.7 Exterior and interior conduit associated with the PV system shall be of appropriate Diameter. Exposed PV module wiring shall be kept to a minimum, will be properly rated for sunlight & hot temperatures associated with the PV array.

8.4.8 All cables shall be 1.1 KV, stranded copper, HR PVC insulation and continuous Power cables will be sized for a voltage drop of 1 % or less between PV modules and inverter.

8.4.9 The DC to AC Power Inverter shall be 3-phase, 50Hz, 415VAC.The inverter shall be a grid-interactive, non battery-based, IP65, operating temperature range – 40 deg C above ambient. The inverter peak efficiency shall not be less than 95%.

8.4.10 The inverter shall start, synchronize, operate, and disconnect automatically without the need for user action or intervention.

8.4.11 The inverter shall be protected for AC over/under voltage, AC under/over frequency, over temperature, AC and DC over current, DC over voltage etc.

8.4.12 Inverter will be provided with LCD display, RS485 communication.

8.4.13 The PV system shall have dedicated meter that records only the AC Output from the inverter of the PV system. All system components, including meters, shall comply with all applicable codes& standards.

8.5 Technical Specification of Module Mounting Structure

8.5.1 Modules shall be mounted on a non-corrosive support structure suitable for site conditions (extreme site conditions are taken into account). Support structure design and foundation or fixation mounting arrangements shall withstand minimum horizontal wind speed relevant to specific norms.

8.5.2 The array structure is hot dip galvanized (MS) of 70micron thickness. All nuts & bolts shall be of very good quality stainless steel.

8.5.3 The frames and leg assemblies of the module mounting structures shall be of Mild Steel hot dip galvanized of suitable sections to meet the design criteria. All hardware considered for fastening modules with this structure shall be of very good quality of Stainless Steel. The

module mounting structure shall be designed in such a way that it will occupy minimum space without sacrificing the output from SPV panels at the same time it will withstand severe wind gust up to a maximum 180 kmph.

Technical Specification- Module Mounting Structure	
AREA	2200 SQ METER
ESTIMATED CAPECITY	230KWP
NET METER	SCOPE OF EPC CONTRACTOR.
Cost Free Comprehensive Annual Maintenance Contract Period (Including Warranty Period)	5 YEARS
Life of SOLAR PV PANEL.	25 YEARS
NORMS	MNRE

9. STREET AND FACADE LIGHTING :

9.1 High efficiency LED Hybrid Solar light fixtures with minimum 24 hours backup shall be provided in external road Street lighting.

9.2 LED Light Fixtures (Bollard/Post top) for compound/landscape lighting. The lighting control /operation for external Lighting shall be automatically controlled with digital timer control switch through outdoor type Feeder Panels.

9.3 Medium / High mast LED lights with Suitable Poles shall be provided for external lighting of large open areas, amphitheater, and miscellaneous Sports areas etc.

9.4 Road / Compound Lighting / Landscape Lighting / Facade Lighting shall be designed as per NBC & ECBC Codes. Road / compound lighting shall be provided with outdoor type light fittings (IP-65).

9.5 All Street Light/ Compound lighting Poles shall be made out of hot dip Galvanized Iron (GI) Octagonal shape. Poles shall be suitable for single / double side arms or as required.

9.6 Poles shall have a service window at the bottom comprising connector terminal & MCB. Poles can be mounted on foundation with Anchor bolts of suitable size & quantity. All the poles should be Provided with Double earthing. The height & spacing of the street light poles pole will be designed to achieve illumination Lux levels. The height & spacing of pole and illumination Lux level should be as per latest CPWD Specifications, NBC 2016 and other relevant norms.

9.7 Suitable outdoor type feeder panel with digital time controlling shall be provided for power distribution of various circuits of Street Lighting Poles/ High Mast /Bollard /Façade light etc.

9.8 Façade lighting will be as per the finalized building requirements.

Special Note :

1. EPC Contractor shall design and provide civil foundations, trenches, and embedded supports for Solar PV Panels (roof-top or site-mounted as per DBR), DG Sets (foundations, fuel tank bases, cable trenches, vibration isolators). Lifts (lift shafts, machine room slabs, pit foundations, guide rail supports, opening sleeves).

2. The installation of Solar Panels, DG Sets, and Lifts shall be carried out only after completion of interior works.

3. The warranty period of such equipment shall commence from the date of testing and commissioning, not from the date of delivery at site.

ANNEXURE-I

LOAD SHEET

Sl. No.	Description	Connected Load (kW)	Demand Factor	Demand Load (kW)	Remarks
1	**Lighting & power load**				
i)	Lighting Load	47.4	0.7	33.18	Assumed
ii)	Conventional Power	40.2	0.3	12.06	
iii)	Equipment load	70	0.4	28	
2	**SBI Room**				
i)	Lighting load	27.3	0.7	19.11	Assumed
ii)	Conv. Power load @ 2850 W / Room	282.15	0.3	84.645	Assumed
3	**Lift Load**				
i)	Elevators (4 Nos. @ 12 kW each)	48	0.9	43.2	Assumed
4	**External Development lighting**	10	0.9	9	Assumed
5	**HVAC Load**				
i)	AC Load (VRV-HVAC)	500	0.7	350	Refer Annex – I(b)
ii)	Ventilation Load	25	0.8	20	Refer Annex – I(b)
6	**Plumbing load and Fire Fighting**				
i)	Plumbing load	50	0.7	35	Refer Annex – I(a)
ii)	Fire Fighting Load (only Jockey Pump load considered)	10	0.75	7.5	Refer Annex – I(a)
7	**Kitchen& equipment Load**				
i)	Kitchen Equipment's Load	100	0.7	70	Assumed
8	**UPS Load**				
i)	UPS Load	50	1	50	Assumed
	Total Load in kW	**1260.05**		**761.695**	
	Maximum Demand in kW with applied diversity Factor		**0.8**	**609.356**	

Transformer Selection		
Considering power factor @ 0.9	**610.00**	kVA
Considering loading Factor @ 85%	**801.17**	kVA
(1+1) X 800 kVA, 11/0.433KV, Out Door Sub-station with Oil filled Transformer having ON LOAD Auto Tap changer.		

ANNEXTURE – I (a)

Power requirement for plumbing & Fire Fighting

S. No	Description	Quantity	Working Load (HP)	Total connected load
1	Filter water feed Pumps	2 nos. (1W+1S/B)	2.5	5
2	Hydro-Pneumatic Pump for SBI	3 nos. (1W+1S/B)	13	19.5
3	Bore well Pumps	1 nos. (1W)	10	10
4	Sump pumps			
i)	Basement Drainage Sump (Optional)	2 nos. (1W+1S/B)	1	2
ii)	Pump Room Sump	2 nos. (1W+1S/B)	1.5	3
iii)	STP Sump	2 nos. (1W+1S/B)	1.5	3
iv)	Kitchen Sump	2 nos. (1W+1S/B)	1.5	3
5	Sewage treatment plant (1x 60 KLD)	1 Nos (1W)	20	20
6				
7	Flushing Water Transfer Pumps	2 nos. (1W+1S/B)	3	6
8	Swimming Pool	2 nos. (1W+1S/B)	2	4
9	Miscellaneous Load		15	15
	Total Load HP		**76**	**95.5**
	Say (HP)		**80**	**100**
	Total Load (KW)		**59.68**	**74.6**
	FIRE FIGHTING			
1	**Sprinkler Pump**	1 Nos.		92
2	**Fire Hydrant Pump**	1 Nos.		92
3	**Jockey Pump**	1 Nos.	10	10
	Total Load (HP)		**10**	**194**
	Total Load (KW)		**7.46**	**144.7**

		ANNEXURE – I(b)
Power requirement for HVAC		
S. No.	**DESCRIPTION**	**LOAD (KW)**
AC LOAD		
1	Inverter driven DC compressors VRF/VRT outdoor condensing unit (450HP)	360
2	Treated Fresh Air Unit DX System (75 TR X 1.3 kW/TR)	110
3	Indoor Units	30
	Total	**500**
Ventilation Load		
4	Ventilation for Basement, Toilets and Kitchen	25
	Total	**525**

ACCEPTABLE MAKES OF SUBSTATION EQUIPMENTS

SL. No	Item	Makes
1	Transformer	Kirloskar / ABB / Schneider / Essennar / (to be approved by local DISCOM)
2	HT Panel/VCB	ABB / Schneider / Siemens / Megawin [OEM or Authorized channel partner of OEM]
3	Makes of accessories of HT Panel	As per standard practice of manufacturer.
4	Air Circuit Breaker, MCCB, MCB, Contactor.	ABB/ Siemens/Schneider/Legrand/L&T
5		
6	FRLS PVC insulated copper conductor (ISI Marked)	Polycab / RRKabel /Havells/ Finolex /KEI
7	HT / LT Cable (ISI Marked)	Polycab / RRKable / Havells/KEI/GLOSTER
8	Cable jointing kit	3M/ Raychem
9	Cable Lugs / Glands	Dowels/Asian
10	Octagonal / Decorative Pole	Bajaj/Crompton/Philips/Surya/ Volmont
11	DWCHDPE Pipes	Tirupati/Rex/ Duraline / Gemini
12	GI Pipe (ISI Marked)	Tata/Jindal /Bansal(Utkarsh)
13	Fire Extinguisher and Accessories	Life Guard/Getech / Omex / FireShield /Minimax/ Ceasfire

(C)
Fire Fighting Systems

1. REFERENCE STANDARDS

Fire Protection System shall be designed keeping in view the following criteria:

1.1 Local Bye-Laws applicable .

1.2 National Building Code 2016 : Part IV for Fire Protection

1.3 NFPA & TAC Manual (for reference and guideline).

1.4 Relevant BIS codes: Specifically IS: 3044, IS: 5290 and IS: 5312, IS: 908 and IS: 2190, IS: 3844, IS: 15105.

1.5 Consultation with local Chief Fire Officer.

2. BASIS / CONCEPT OF DESIGN

2.1 The Fire Fighting arrangement shall be designed as per the requirement of, NBC-2016, local guidelines, NFPA & engineering design standard.

2.2 The entire fire safety installation shall be compliant with the most stringent codes / standard for the entire building to ensure the highest safety standard and uniformity of system. Further, before property is opened to public, the fire protection shall be fully operated and tested under simulated conditions to demonstrate compliance with the most stringent standards, codes and SBI guidelines.

2.3 The building height is 21m from ground up to terrace of last habitable floor and its comes under category of SBI building (A) category A-5 (upto 4 star category) page 42, height above 15 meter and up to 30 meter. Following functional system shall be provided, strictly in compliance with the listed reference standards:

2.4 Following functional system shall be provided; strictly in compliance with the listed reference standards:

- Fire water static Storage : Fire water static storage has been provided in accordance to National Building Code of India-2016 Part-IV requirement.

  Developer Portion
  Fire water static storage of 150 cum for hydrant system and 50 cum for water curtain system shall be provided.

  Provision of swimming pool drain connection to the fire water tank shall also be made, if feasible, to have pool water availability for firefighting requirement.

- Fire Pumping system : Pumping system comprising of one set of pumps i.e. two no's electric pumps each of capacity 2280 lpm, one standby diesel engine pump of capacity 2280 lpm and two no's of electric jockey pumps each of capacity 180 lpm, one no. Water Curtain pump has been proposed as per NBC / Local Fire Authority norms.

- Piping System : Piping system as per NBC conforming to IS: 1239 – MS

heavy class.

- Hydrant system : Internal hydrant complete with hose reel.
- Sprinkler system : Sprinkler system shall be provided in Complete SBI Building. Sprinkler rating and type shall be selected for respective area of installation. LT panel room will have sprinklers as per guidelines

➢	Trolley mounted CO_2 System	:	For Transformer Room / LT Panel Room / DG Set Room, as per local bye-laws.
➢	Hand held fire extinguishers	:	Strategically placed at designated areas.

3. PROPOSED FIRE PROTECTION SYSTEM DESCRIPTION

3.1 Fire Water Storage

3.1.1 The fire water storage is provided in one location/zone below ground to cater to the entire complex.

3.1.2 There is only 1 zone which has 2 hydrants, as per the area. Landing valve with 2 hoses and one hose reel shall be provided as per NBC. For SBI building, the static underground water storage shall be provided at the Basement level in two compartment 90 KLD & 60 KLD.

3.1.3 Fire department connection shall also be provided on the external wall of the property near the Road. These shall comprise of 4 Nos. 63 mm dia male outlets capable of directly feeding the ring mains through non return valves or directly filling the static fire storage tanks.

3.2 Fire Pumps

3.2.1 Fire Pump capacity shall be follows at the following capacity, with minimum efficiency of 75%:-

Sprinkler Pump	@ 2280 LPM 80 Mt head
Hydrant Pump	@ 2280 LPM 80 Mt head
Jockey Pump (Two Nos.)	@ 180 LPM 80 Mt head
Diesel Pump	@ 2280 LPM 80 Mt head

3.2.2 Main electrical driven pump shall provide adequate flow for catering requirement of hydrant system. Diesel engine driven fire pump shall be provided for ensuring operation & performance of the system in case of electrical power failure. Jockey pumps are proposed to compensate for pressure drop and line leakage in the hydrant and sprinkler installation.

3.2.3 Provision of PRS/ orifice plate shall be made in sprinkler riser to restrict pressure on sprinkler system. Suction lines shall be drawn from the fire reserve tanks at the basement level and connected to common fire suction header.

3.2.4 Suction lines shall be drawn from the fire reserve tanks at the basement level and connected to fire suction header. The electric fire pump, diesel engine driven fire pump and the jockey pumps, Curtain Pump shall all draw from the suction header.

3.2.5 The delivery lines from various pumps shall also be connected to a common header in order to ensure that maximum standby capacity is available. The ring main shall remain pressurized at all times and Jockey pumps shall make up minor line losses. Test line on the deliver side/header with water flow meter shall also be provided.

3.3 Sprinkler System

3.3.1 Hydraulically balanced automatic sprinkler system shall be provided for residential basements and commercial basement area only. The system shall be suitably zoned for its optimum functional performance.

3.3.2 The sprinkler system shall be provided with control valves, flow and tamper switches at suitable location and shall be connected to control module of the fire alarm system for its monitoring and annunciation in case of activation. Delay timer shall also be introduced on the sprinkler line

3.3.3 Sprinkler type along with its bulb rating shall be selected based on the requirement of the space and shall be specified accordingly. Inspector's test valve assembly with sight glass shall be provided at remote end with discharge piped to drain outlet / pipe.

3.4 Fire Hydrant System

3.4.1 The entire complex shall be provided with internal hydrants with landing valve, hose reel, first aid hose reels, complete with all associated accessories.

3.4.2 Recessed cupboard / fire hose cabinet shall be strategically located for firefighting requirement. Location of cabinets shall be accessed as per compartmentation plan in consultation with the Architect / Interior Designer. Provision of fire man's axe shall be made for internal hydrant.

3.6 Hand Held Fire Extinguisher

3.6.1 The appliances shall be so distributed over the entire floor area, that a person is not required travel to more than 15 m to reach the nearest extinguisher.

3.6.2 Portable fire extinguishers of water (gas pressure); Carbon-di-oxide and foam type shall be provided as first aid fire extinguishing appliances. These extinguishers shall be suitably distributed in the entire public as well as service areas.

3.6.3 These shall be placed or hung on wall in a group on several suitable places. Classification of extinguishers shall be as per the following table:

Class of Fire	Description	Suitable Type of Appliances
Class A Fires	Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.	water, water mist, foam, dry powder, wet chemical
Class B Fires	Fires in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.	water mist, foam, dry powder, CO2, some wet chemical
Class C Fires	Fires that involve energized electrical equipment.	water mist, dry powder
Class D Fires	Fires in combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium.	specialist dry powder
Class K Fires	Fires in cooking appliances that involve combustible cooking media (vegetable or animal oils and fats).	

3.6.4 The rooms containing electrical transformers, switchgears, motors and of electrical apparatus, minimum 2 Nos. dry powder or carbon di oxide type/sand buckets extinguishers

shall be additionally provided within 15 m of the apparatus.

4. BRIEF SPECIFICATION FOR EQUIPMENT

4.1 Fire Pump

The fire pump shall be split casing horizontally mounted. It shall have a capacity to deliver. The pump casing shall be of cast iron and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be of stainless steel. Provision of mechanical seal shall also be made. Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure. The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

4.2 Piping

Mild Steel pipes (heavy class) as per IS: 1239 shall be provided throughout the building. All pipe clamps and supports shall be fabricated from MS steel sections and shall be factory galvanized before use at site. Welding of galvanized clamps and supports shall not be permitted. Pipes shall be hung by means of expandable anchor fasteners. The hangers and clamps shall be fastened by means of galvanized nuts and bolts. The size/diameter of the anchor fastener and the clamps shall be suitable to carry the weight of water filled pipe, dead load normally encountered and all concurrently acting loads.

Pipes buried below ground shall be suitably lagged with 2 layers of 400 micron polythene sheet over 2 coats of bitumen. The piping system shall be tested for leakages at 2 times the operating pressure or 1.5 time shut-off pressure, whichever is highest including testing for water hammer effects. Flanged joints shall be used for connections for vessels, equipment, flanged valves and also on two straight lengths of pipelines of strategic points to facilitate erection and subsequent maintenance work.

4.3 Automatic Sprinkler

The sprinklers shall have 15mm nominal size of the orifice for ordinary hazard. The orifice size shall be marked on the body or the deflector of the sprinkler.
Sprinkler heads shall be made of brass/quartzoid bulb sufficiently strong, in compression to withstand any pressure, surge or hammer likely to occur in the system. The yoke & body shall be made of high-quality gun metal brass with arms streamlined to ensure minimum interference with the spread of water. The deflector of suitable design shall be fitted to give even distribution of water over the area commanded by the sprinkler.

The bulb shall contain a liquid having a freezing point below any natural climatic figure and a high coefficient of expansion. The temperature rating of the sprinkler shall be stamped on the deflector & the colour of the liquid filled in the bulb shall be according to the temperature rating as per NFPA standard. The sprinkler heads shall be of type & quality approved by the local fire brigade authority. The inlet shall be screwed.

4.4 Installation Procedure

Sprinkler heads (fully recessed or semi-recessed) shall be quick response type, located in positions in approved drawings. Slight relocation may result from building as per site conditions, the maximum spacing between sprinkler heads and coverage area shall not exceed those stipulated in the NBC / NFPA 13 Rules.

The Fire Protection Services Trade shall co-ordinate with the ceiling Trade to set out the sprinkler locations to suit the site location of the unit grid. In general, all sprinklers shall be located at the centre of the ceiling unit and a provision of about 10% more sprinklers.

Chrome plated wire mesh guards shall be used to protect the sprinkler heads which are liable to accidental or mechanical damage.

4.5 Flow Requirements

The flow requirement for sprinkler heads shall be specifically approved for the designated area of installation.

4.6 Orifice Plates

For restricting pressure at lower levels in the sprinkler system, orifice plates of appropriate sizes shall be fitted at different floor levels, at the branching points from Riser Main.

The Diameter of such orifice shall not be less than 50% of the dia of pipe into which it is to be fitted, which shall not be less than 50mm dia. These orifice plates must be of stainless steel with plain central hole without burrs, and the thickness shall be 3mm for pipe size up to 80 mm, 6 mm for pipes from 80 to 125 mm dia and 9 mm for pipes greater than 125 mm dia. Such orifice plate must have a projecting identification tag.

The orifice plate shall fitted not less than two pipe internal diameters downstream of the outlet from any elbow or brand.

4.7 Installation Control Valves

Each installation shall be provided with a set of installation control valves comprising:-
An Alarm Valve.
A Water Motor Alarm & Gong.

Installation valves shall be installed on the sprinkler circuits as shown on the drawings. Contractor shall submit detailed shop drawings showing the exact location, details of installation of the valves/alarm in all respects. Installation valve shall comprise of a cast iron body with gunmetal trim, and double seated clapper check valves, pressure gauges, test valve and orifice assembly and drain valve with pressure gauges, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system. A cast iron isolation valve with lock and chain at the inlet of the installation valve shall be provided.

4.8 Inspection and Test Valve Assembly

Inspection and testing of the automatic starting of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, and bye-pass valve with delay timer and orifice assembly as per approved drawing.

4.9 Flow Switch

Flow switch shall have a paddle made of flexible and study material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket.

The Switch shall be potential free in either NO or NC position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head.

4.10 The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring the seat shall be of S.S to the Annunciation Panel. The flow switch shall have IP: 55 protections.

4.11 The flow switch work at a triggering threshold bandwidth (flow rate) of 4 to 10 GPM. Further, it shall have a 'Retard' to compensate for line leakage or intermittent flows.

5. FIRE HYDRANTS

5.1 Internal Hydrants:-

5.1.1 Internal hydrant shall be provided on each landing and other locations as required by NBC with single headed gunmetal landing valve with 80 mm dia inlet, with shut off valves having cast iron wheels. Landing valve shall have flanged inlet and instantaneous type outlets.

5.1.2 Each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric lined hose pipes with gunmetal male and female instantaneous type coupling machine would with GI wire, fire hose reel, gunmetal branch pipe with nozzle shall be provided.

5.1.3 Each internal hydrant hose cabinet shall be provided with a drain in the bottom plate. The drain point shall be lead away to the nearest general drain. Each internal hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner and a Fireman's Axe. The cabinet shall be recessed in the wall as directed.

5.1.4 Standard fire hose reels of 20mm dia high pressure Dunlop rubber hose 36.5 m long with gunmetal nozzle, all mounted on a circular hose reel of heavy-duty mild steel construction having cast iron brackets shall be provided. Hose reel shall be connected directly to the wet riser with an isolating valve. Hose reel shall be mounted vertically.

5.1.5 Each hose cabinet shall be conspicuously painted with the letters "FIRE HOSE".

5.1.6 Hose reel shall be heavy duty, 20 mm dia length shall be 36-metre-long fitted with gun metal chromium plated nozzle, mild steel pressed reel drum which can swing upto 170 degree with wall brackets of cast iron finished with red and black enamel complete.

Basis of internal hydrant system for all floors including basements and ground floor shall be as follows:

Max. Distance covered by an internal fire hydrant / hose reel	: 30M
Max. Distance between two internal fire hose cabinets	: 45M
Type of internal hydrant	: Single outlet.
Type of External hydrant	: Single outlet.
Min. Outlet pressure at internal fire hydrant outlet (SBI & Convention hall)	: 3.5 Kg. / cm2
Pressure reduction in the system achieved by	: Orifice plates.
Basis of External hydrant system shall be as follows:	
Max. Distance covered by single hydrant	: 30M
Max. Distance between two external fire hydrants	: 45M
Type of external hydrant	: Single outlet
Min. Outlet pressure at internal fire hydrant outlet	: 3.5 Kg. / cm2
Pressure reduction in the system achieved by	: Orifice plates.

5.2 External Hydrants

5.2.1 External hydrants shall be provided all around the Complex. The hydrants shall be controlled by a cast iron sluice valve or butterfly valve. Hydrants shall have instantaneous type 63mm dia outlets. The hydrants shall be Single outlet with C.I duck foot bend and flanged riser or

required height to bring the hydrant to correct level above ground.

5.2.2 For each external fire hydrant two numbers of 63mm dia. 15 m long controlled percolation hose pipe with gunmetal male and female instantaneous type couplings machine wound with GI wire, gunmetal branch pipe with nozzle shall be provided. This shall be measured and paid for separately.

5.2.3 Each external hydrant hose cabinet shall be provided with a drain in the bottom plate.

5.2.4 Each hose cabinet shall be conspicuously painted with the letters “FIRE HOSE CABINET (FHC)”. Fire Hydrant-External Type shall also be provided at terrace of the building

5.3 LOCATION & SIZE OF FIRE PUMP

The fire pump room is proposed to be adjacent to Underground Fire Water tank. The base of the water tank shall be kept at a level preferably 450 to 600 mm above the level of base of the Fire pump so that the pumps operate under positive suction conditions and the entire water capacity is above the body of the fire pumps as per best fire engineering practice.

5.4. LOCATION OF FIRE CONTROL ROOM

Fire control room shall be located on Ground (Stilt) floor near the main entrance. The size of the room shall be approx. 4 m x 5m. This may be suitably increased if it is proposed to be combined with the security office.

5.5 ACCESS TO FIRE TENDERS

While setbacks as proposed are found in order, for access to fire/rescue tenders, a clear motorable approach as per NBC or state authority requirement for the movement of fire tenders all around the tower. The width of the main entrance to the complex shall not be less than 5.5 M and the height of any arch or canopy shall not be less than 5M from the ground level.

5.6 COMPARTMENTATION

Access to all staircases and left lobbies shall be through fire doors of at least one hour fire rating. All vertical shafts shall be sealed at each floor level.

All Electrical areas like Transformer Rooms, LT/HT panel rooms, DG set room etc. (if in basement) shall be properly compartmented with 4 hours rated walls and openings protected by 2 hours rated fire doors.

AS PER NBC – 2016 PART – IV, Table No. –7 – Fire Protection

FIRE FIGHTING REQUIREMENTS FOR SBIS AS PER NBC – 2016 Part IV , Table no.- 7 - Fire Protection			
(Category of (d) SBIs (A-5) (3) above 15m in height but not exceeding 30 m , PAGE 43)			
S. No	**Fire Fighting Equipment's / Installation**	**Requirement as per NBC**	**Provision Made**
1	Fire Extinguisher	Required	Provided
2	Hose Reel	Required	Provided
3	Dry Riser	Not Required	Not Provided
4	Wet Riser	Required	Provided
5	Down corner	Not Required	Not Provided
6	Yard Hydrant	Required	Provided
7	Automatic Sprinkler System (In The Entire Building)	Required to be installed in entire building.	Shall be installed in entire building.
8	Manually Operated Electric Fire Alarm System	Required to be installed in entire building.	Shall be installed in entire building.
9	Automatic Detection & Alarm System	Required to be installed in entire building.	Shall be installed in entire building.
10	Under Ground Static Water Storage Tank	Required, 150000 lts capacity.	Proposed 1,50,000 litres capacity
11	Terrace tank	Required, 20,000 lts capacity.	Proposed 20,000 litres capacity
12	Fire Pumps near Under Ground storage Tank	Required two electrical and one diesel pump of capacity 2280 lpm and one electrical pump of capacity 180 lpm for entire SBI	Proposed two electrical and one diesel pump of capacity 2280 lpm and one electrical pump of capacity 180 lpm for entire SBI with 100m Head
13	Pump at the terrace tank level	Not Required	Not Proposed

1.0 FIRE DETECTION AND ALARM SYSTEM INCLUDING EMERGENCY PAGING AND EMERGENCY TELEPHONE AND MANUAL SMOKE CONTROL

1.0.1 GENERAL

The fire alarm system shall consists of four subsystems:

a. Fire alarm system
b. Emergency paging system
c. Emergency telephone system
d. Smoke control system

These systems shall be integrated into a comprehensive system, to provide the functional performance described as follows:

1.0.1.1 Fire Detection and Alarm System

The fire detection and alarm system shall monitor and display the activation of each device in the system, such as heat detector, smoke detector, manual break-glass unit, sprinkler water flow switch and sprinkler valve tamper switch or any other input device which may be required.

The system shall initiate output functions such as automatic alarm annunciation via sounder / hooter, fans shutdown, automatic notification to the Fire Brigade and activation of pocket paging system. The system shall include remote annunciators in areas monitored 24 hours by property employees (Security, AYS, PABX room, Reception Desk) in locations approved by the governing authority.

The system shall be of the addressable analog multiplexed type, completely supervised, such that a break in any wire (loop) shall not prevent any device from operating, with multiplexing cabinets installed in appropriate approved locations in the SBI. The system shall be of the type such that each device connected to the system shall be provided with unique address and separately identified at the Main control panel (MCP).

The wiring shall be monitored against faults such as opens, shorts, earth's or data transmission failure. Detection addressable loops shall be "Style 7" (Class "A") and therefore return to the control panel.

All materials, appliances and equipment's shall be UL (Underwriters Laboratories) listed and shall comply with Life Safety Requirements of ADA (Americans with Disabilities Act)

1.0.1.2 Emergency Telephone

The emergency telephone system shall provide two way communications capability between the main control panel and jacks for emergency telephone handsets. The emergency telephone handsets shall be furnished as part of the overall system.

- ard" check printer uses standard guest checks.
- Include dedicated electric power with isolated ground.

g. **Food and Beverage Order Printer:**

- Large, 2-color print.
- Dedicated electric power with isolated ground shall be provided.
- Printers shall be chained together for easier cabling.

h. **Hand-Held Workstation:**

- Wireless, hand-held workstation for food and beverage ordering shall be provided.
- Base station shall have cable back to central processor.

2.0 System Setup Features – Equipment

A **Pantry:**

- 1 Cashier workstation at Pantry with guest check printer and cash drawer.
- 1 Server workstation with guest check printer per 20 tables.

3.0 MATV SYSTEM

A. General Requirements:

RF television distribution system shall be provided throughout the property public spaces and guestrooms for delivery of television programming.

Infrastructure: Both analog and digital RF and digital IP network infrastructure shall be provided for guestroom entertainment.
The MATV infrastructure does not provide data service or high-speed internet access for guests.
The MATV infrastructure shall be designed to accommodate digital television (DTV) and high definition television (HDTV) programming.
MATV Distribution System: shall be designed to receive and deliver local, satellite, premium and locally originated television programming.
The MATV distribution system includes a “sub-return” feature that accepts and delivers sub-channel signals from distribution taps back to the headed.

B. Features & Functions

Television Channel Signal Sources: Provide programming from multiple sources; the intent is to provide programming redundancy to minimize guest impact of any single source failure.
Reception of local broadcast programming including CBS, NBC, ABC, FOX, PBS and other significant local channels shall be provided.
Reception of premium channels including HBO, CNN, ESPN, Disney, etc. shall be provided. This programming may be from local cable, from satellite or from the pay-per-view programming vendor.
The MATV system shall accommodate the pay-perview programming, video information system programming, special channel programming (Spa, Golf Club, etc.), interactive gaming and other locally originated programming.

Section – D: Cables – Design Basis Report

a) For DC cabling, XLPE insulated and sheathed, UV-stabilized single-core multi-stranded flexible copper cables shall be used. Multi-core cables shall not be used. All DC cables shall comply with IS 7098 (Part 1), IEC 60228, and IEC 62930/EN 50618 for solar PV applications, latest revisions.

b) For AC cabling, XLPE insulated and PVC sheathed single or multi-core multi-stranded flexible copper cables shall be used. Outdoor AC cables shall be armored and provided with a UV-stabilized outer sheath.

c) All DC cables shall be rated for UV protection and conforming to relevant IS 7098 Part-1 / IEC 60228 / IEC 62930 standards, latest revisions.

d) In three-phase systems, the size of the neutral conductor shall be equal to the size of the phase conductors.

e) All control wires shall be FRLS or LSZH PVC insulated copper wires conforming to IS 1554 – Part 1 / IS 694, latest revisions. Minimum size of the control wires shall be 2.5 sq.mm.

f) Cables of appropriate size to be used in the system shall have the following characteristics:

I. Shall meet IEC 60227/IS 694, IEC 60502/IS 1554 standards
II. Voltage rating: 1000V
III. Excellent resistance to heat, cold, water, oil, abrasion, UV radiation
IV. High flexibility

g) Sizes of cables between array interconnections, array to junction boxes, junction boxes to inverter, etc. shall be selected to minimize voltage drop and power loss in the entire solar system.

h) All cables/wires shall be routed in outdoor-rated cable trays or heavy-duty U-PVC conduits and suitably tagged/marked with good quality ferrules or other means for easy identification.

i) The cable shall be selected such that it remains compatible throughout the design life of the solar PV panels (minimum 25 years).

j) The bidder shall calculate and indicate size and length as per system design requirements. All cables required for the plant shall be provided by the bidder.

k) The size of each type of DC cable selected shall be based on minimum voltage drop; however, the maximum drop shall be limited to 1.5%. Cable sizing shall also consider short-circuit withstand capacity as per IEC 60949.

l) The size of each type of AC cable selected shall be based on minimum voltage drop; however, the maximum drop shall be limited to 2%. Cable sizing shall also consider short-circuit withstand capacity.

m) Cables used for extending strings of solar PV modules shall be provided with TUV-approved

solar PV connectors (MC4 type).

n) Identification tags indicating the size of the cable and feeder designation shall be securely attached at both ends of the cable. Tags shall also be provided at intervals of 50 meters. The details shall be punched on 25x3mm aluminum strip.

o) Cable route markers shall be provided wherever necessary.

p) When cables are laid vertically, they shall be clamped on proper cable trays fixed on walls or routed through properly sized U-PVC conduits. Adequate spacing shall be maintained to prevent buckling. Clamp spacing shall not exceed 1.0 m horizontally and 1.5 m vertically.

q) When cables are to be laid underground, a minimum depth of 0.75 meters shall be maintained. Where cables cross roads, storm drains, etc., they shall be protected by Hume or GI pipes of suitable dimensions. Warning tapes shall be laid above the sand cushioning for all underground cables.

r) Excavations of trenches shall be carried out as per relevant IS standards. The work shall be in accordance with CPWD specifications for external electrical works. All cables shall be manufactured and tested as per IS 7098 (Part 1), latest revisions.

s) Before laying cables in trenches, the trench bottom shall be cleared of stones and sharp materials and filled with a 150 mm sand cushion.

t) All cables shall be laid as per applicable latest CPWD specifications for external electrical works. Minimum bending radius shall be maintained as per manufacturer's recommendations.

u) No cables shall be laid below water and sewage lines.

v) All cable trays shall be provided with covers and accessories.

w) Cable terminations shall be carried out using suitable double compression glands. Bimetallic washers shall be used wherever cables, lugs, and switch terminals are of dissimilar metals. Wherever possible, cables and lugs shall be of the same material.

x) All cables shall have identification marking at every 10-meter interval. Factory test certificates (routine, type, and acceptance tests) shall be furnished by the manufacturer. Pre-commissioning tests including insulation resistance, continuity, and hi-pot tests shall be conducted before energizing.

Section – E: Data Cabling – Design Basis Report

a) **Cable Type**

- All data cabling shall be CAT-6A U/FTP or S/FTP (shielded) LSZH cables conforming to ISO/IEC 11801, TIA/EIA-568-C.2, and EN 50173 standards, latest revisions.
- Fiber optic cables, where required, shall be loose-tube, armored, UV-resistant, LSZH sheathed, and conforming to IEC 60794 / ITU-T G.652D (single mode) or G.657A standards.

b) **Performance**

- Copper cabling shall support up to 10 Gbps Ethernet over 100 m permanent link.
- Optical fiber shall support at least 1 Gbps and scalable to 10/40 Gbps.

c) **Cable Installation**

- All data cables shall be installed in separate conduits/trays, segregated from power cables as per TIA-569-C.
- Minimum bend radius and pulling tensions shall comply with manufacturer's recommendations.
- Horizontal cable runs shall not exceed 90 m from patch panel to outlet; patch cords limited to 5 m each.

d) **Pathways & Containment**

- Data cables shall be routed in indoor-rated PVC conduits, GI raceways, or perforated cable trays with covers.
- Outdoor data cables shall be laid in HDPE ducts or armored conduits with proper mechanical protection.

e) **Terminations**

- All copper cable terminations shall be on factory-certified patch panels and faceplates, with modular jacks conforming to TIA-568-C.2.
- Fiber cables shall be terminated in rack-mounted fiber LIUs (fiber termination boxes) with SC/APC or LC connectors.
- Keystone jacks and patch panels shall be of the same make as the cable to ensure system warranty compliance.

f) **Identification & Labeling**

- All outlets, patch panels, and cables shall be uniquely labeled as per TIA-606-B standard.
- Labels shall be permanent, machine-printed, and resistant to heat/UV.

g) **Testing & Certification**

- 100% of copper cabling links shall be tested with Level-III certified cable analyzer (Fluke DTX or equivalent) for NEXT, RL, ACR, delay skew, and attenuation.
- Optical fiber links shall be tested with OTDR and power meter.
- Test reports shall be submitted in soft and hard copies for client approval.

h) **System Warranty**

- The structured cabling system shall carry a minimum 20-year performance warranty from

the OEM covering cable, connectors, patch panels, and workmanship.

i) **Separation from Electrical Works**

- Data cables shall be routed with a minimum clearance of 300 mm from electrical power cables and shall cross at right angles where necessary.

j) **Earthing and Bonding**

- All racks, patch panels, and metallic raceways shall be properly bonded to the building earth as per IS 3043 and ANSI/TIA-607-C grounding standards.