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PROPOSED INCITE FACILITIES AT GUJARAT BIOTECHNOLOGY UNIVERSITY

DESIGN BASIS REPORT

REPORT NO.: 202210-GBU-S4-INC-DBR-01 **DATED:** 02.05.2026

CLIENT

GUJARAT BIOTECHNOLOGY UNIVERSITY

ARCHITECTS

SGA DESIGN LAB

SURESH GOEL AND ASSOCIATES

	R1	02.05.2026
OBSERVATION	**REVISION**	**DATE**

1. DESIGN BASIS REPORT-ARCHITECTURE

The purpose of this report is to establish the criteria of Design Basis Report for Construction of INCITE Building at Gujarat Biotechnology University, Gandhinagar.

1.1. INTRODUCTION

The Construction of Incite building at Gujarat Biotechnology University, Gandhinagar.

1.2. SITE ANALYSIS

1.2.1. Location and Description

Gandhinagar, the capital city of Gujarat, is located at a distance of around 23 km from Ahmedabad on the western bank of Sabarmati river. It carries the rich Gujarati legacy through its culture that is presented by the amazing craftsmanship like wood carvings, terracotta work and ethnic wears. It enjoys exotic festivals like Uttarayan, Navratri and Diwali. The native tribes in Gandhinagar specialize in making exclusive ethnic jewellery and terracotta work.

1.2.2. Existing Landscape and Vegetation

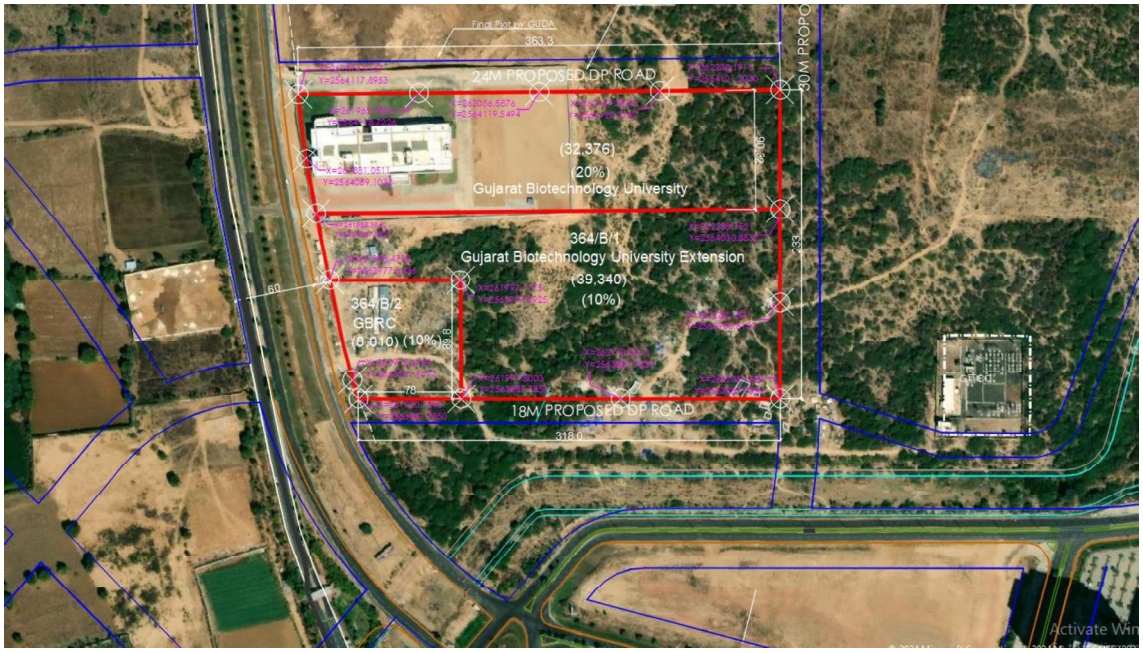

Image 1 *Existing master Plan Aerial View*

1. **Surrounding**

Image 2 *Site Context and Surroundings*

2. **Proposed Site Plan**

Image 3 *Proposed Site Plan*

Image 4 Proposed Site Plan

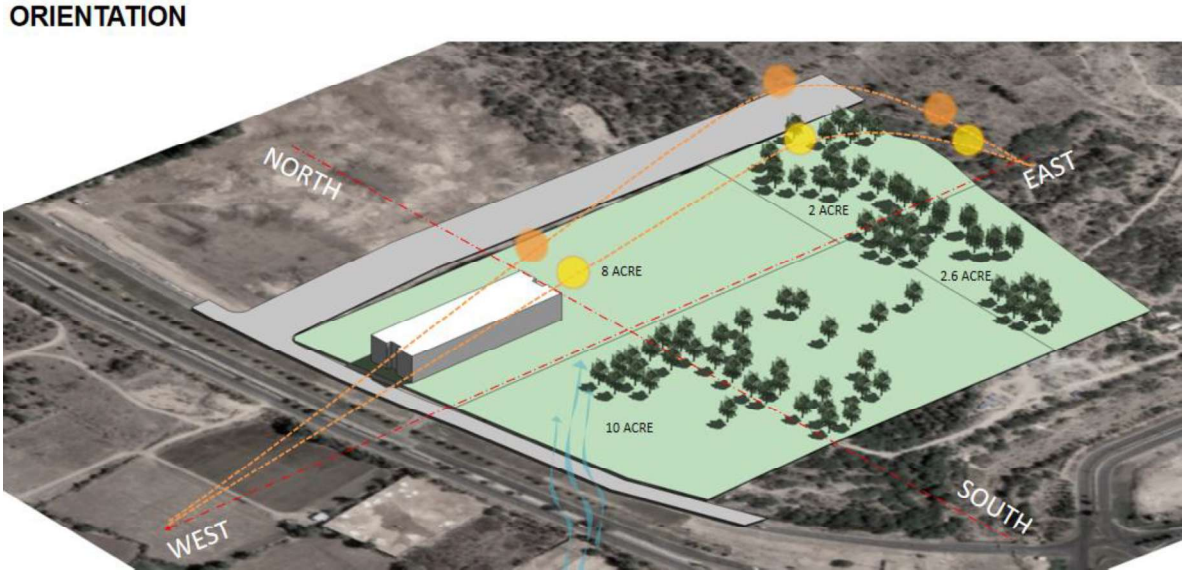

Image 5 Placement and Orientation

1.1 NEED OF THE PROJECT

The need of the project is to develop GBU into a self sustaining research institute comprising of the following facilities.

1. Growing Demand for Advanced Educational & Research Infrastructure

- GBU Gandhinagar's academic mission is to foster excellence in education, research, and innovation. With increasing student enrollment and a growing number of faculty engaged in research activities, there is a strong and rising demand for more **specialized laboratories, research facilities, and incubation spaces**.

2. Facilitating Interdisciplinary Research & Innovation

- Modern scientific and technology research often requires cross-disciplinary collaboration, advanced instrumentation, and controlled environments
- The presence of incubation spaces will allow startups, student-led ventures, and spin-off projects to be nurtured within the campus environment. This will accelerate translation from academic research to applied innovation, technology transfer, and entrepreneurship aligning with the broader institutional vision of fostering innovation.

3. Creating a Dedicated Ecosystem for Incubation & Start-ups

- With dedicated incubation floors, collaboration zones, meeting rooms, and support infrastructure (power backup, HVAC, safety systems, ELV, etc.), the building will serve as a **self-contained innovation ecosystem**. This supports not only academic research but also commercialization of research outcomes, encouraging entrepreneurship among students, researchers, and faculty.
- Having incubation and research under one roof encourages synergy between researchers, innovators, and administrators, promoting mentorship, collaboration, resource sharing, and faster project development.

4. Upgrading Institutional Capabilities & Competitiveness

- In a competitive academic landscape, having modern, well-equipped laboratories and incubation infrastructure enhances the institution's profile — aiding in **attracting high-quality students, faculty, research funding, and collaborations** with industry and other institutions.
- It positions GBU Gandhinagar to offer advanced courses, research programs, and collaborative projects that require specialized facilities — thereby expanding its academic offerings and research footprint.

1.2 INCITE BUILDING

The proposed development consists of a **Basement + Ground + 9-storied (B+G+9)** building designed to house **educational laboratories, research laboratories, and incubation laboratories**, along with a variety of supporting administrative, collaborative, and public spaces.

The facility incorporates a wide range of functional zones distributed vertically across the building:

- **Ground Floor:**
  Exhibition spaces, reception and waiting areas, heavy equipment storage space, dining area, and cafeteria.

- **First Floor:**
  Executive offices, officer cabins, open office areas, meeting rooms, a 50-seater conference room, and a board room.
- **Second Floor to 4th floor:**
  Laboratories, cold rooms, equipment rooms, and ancillary laboratory support spaces, library, eupment spaces etc.
- **Upper Floors (5th to 9th Floors):**
  Incubation spaces, meeting rooms, collaboration/interaction zones, and support offices to facilitate innovation and research incubation.

An **integrated basement** is proposed to accommodate essential support services, utility areas, and structured vehicular parking.

The building will be constructed using an **RCC framed structural system** with masonry infill panels and all supporting civil, architectural, mechanical, electrical, and specialized laboratory provisions. The facility is envisioned as a high-performance, code-compliant structure suitable for modern laboratory operations, advanced research activities, and incubation programs.

2. General Description of Works

The scope of work encompasses the **complete construction, installation, integration, and commissioning** of all civil, architectural, electrical, mechanical, instrumentation in proposed Incite Building. This includes fixed equipment, essential services, safety systems, and utilities necessary for achieving state-of-the-art laboratory and incubation environments.

The main categories of works include:

- Civil & Structural Works
- Architectural & Interior Fit-out Works
- Electrical Systems Works
- HVAC & Mechanical Systems Works
- Public Health Engineering (PHE) Services
- Life Safety, Fire Protection & Fire Alarm Systems
- Low Voltage & ELV Systems (BMS, Access Control, etc.)
- Testing, commissioning, and handover

3. Detailed Scope of Work

3.1 Civil & Structural Works

- Construction of RCC framed structure including foundations, columns, beams, slabs, shear walls, and structural cores.
- Execution of basement structure with waterproofing, retaining walls, ramps, parking layouts, and service rooms.
- Masonry works including block/brick partitions, infill walls, and internal load-bearing partitions where required.
- Structural openings, cut-outs, and embedments for MEP services.
- Complete plastering, flooring, skirting, dado, and internal finishes as per architectural specifications.
- External façade works including plaster, paint, cladding (if any), windows, glazing, and waterproofing systems.
- Site development works such as pathways, peripheral drains, external lighting bases, and landscaping preparation.

3.2 Architectural & Interior Fit-Out Works

- Laboratory-grade panel partition systems, modular partitions as per BOQ items and drawings
- Internal doors (as per BOQ items and drawings
- False ceiling systems as per BOQ items and drawings

  Ground Floor:

  - Reception lobby, exhibition halls, waiting lounge
  - Dining area, cafeteria interiors
- Heavy equipment storage areas with industrial flooring as per as per BOQ items and drawings

  First Floor:

  - Executive cabins, officer cubicles, general office spaces
  - Meeting rooms, 50-seater conference room, board room

  Second Floor:

  - Laboratory rooms, cold rooms, equipment rooms, support labs

  Upper Floors (Incubation Floors):

  - Incubation units, co-working areas, shared meeting rooms
  - Interaction/collaboration zones, breakout spaces

3.3 Electrical Systems

- HT/LT electrical distribution network including transformers, panels, switchgear, LT rooms, and power cabling.
- General lighting, emergency lighting, and task lighting for laboratories, offices, and public areas.
- Internal power wiring, socket distribution, UPS circuits, isolators, and DB installations.
- Earthing, bonding, and lightning protection systems.
- Cable trays, raceways, supports, labeling, and as-built documentation.

3.4 Mechanical & HVAC Systems

Complete supply, installation, testing & commissioning of:

- Central HVAC plant including chillers
- AHUs, TFAs, exhaust systems, and fume extraction units.
- Laboratory ventilation systems with pressure zoning, high-efficiency filtration,
- Ducting, insulation, dampers, grills/diffusers, and associated accessories.
- Building automation integration with BMS.

3.5 Public Health Engineering (PHE) Works

- Internal plumbing, drainage, and water supply pipelines (toilets civil work already completed).
- Laboratory waste disposal systems including acid-resistant pipelines and neutralization systems (where required).
- RO/soft water systems based on laboratory needs.
- Pumps, underground/overhead tanks, and pressure systems.
- Stormwater and sewage integration in basement with existing external networks.

3.6 Fire Detection, Fire Alarm & Fire Fighting Systems

- Addressable Fire Detection & Alarm System (FDAS) including detectors, MCPs, hooters, panels.
- Fire extinguishers
- Fire suppression pipelines (hydrant lines, sprinklers, risers) as applicable.
- Fire-rated partitions and doors for egress routes.
- Emergency signage and evacuation route marking.
- Integration with Building Management System (BMS).

3.7 ELV, ICT & Security Systems

- Access control systems for secure laboratory and incubation areas.
- Door interlocks for restricted laboratory zones.
- CCTV system with NVR storage and monitoring.
- Building Management System (BMS) integrating HVAC, electrical, fire alarm, and utilities.
- IT and networking infrastructure including conduits, cabling, racks, and fiber backbones.

3.8 Laboratory-Specific Utilities & Fixed Equipment

- HVAC systems, AHUs, exhaust units, filters, and related controls.
- Air compressor system.
- UPS systems with battery backup for critical loads.
- Emergency safety showers and eyewash units

3.9 Testing, Commissioning & Handover

- Pre-commissioning tests for all building systems.
- Integrated testing of electrical, HVAC, ELV, safety systems, and automation.
- O&M manuals, maintenance manuals, as-built drawings, and warranties.
- Training for facility management personnel.
- Final snag rectification and formal handover.

4. Deliverables

- Completed RCC structure with full architectural, MEP, and laboratory infrastructure.
- Ground floor exhibition, public, dining, and support spaces fully functional.
- First-floor administrative, conference, and executive office suites.
- Second-floor advanced laboratories with cold rooms and equipment areas.
- Upper floors with operational incubation offices, meeting rooms, and interaction spaces.
- Fully functioning laboratories ready for occupancy.
- Integrated basement with parking and support utilities.
- Fully operational building services including HVAC, UPS, BMS, access control, FDAS, and life safety systems.

STRUCTURAL DESIGN BASIS REPORT

OF

INCITE BUILDING AT GANDHINAGAR

Document No: - MCE/SGA/GBU/DBR/ST/-1200-R0

CLIENT	CONCTRACTOR
ARCHITECT	**STRUCTURE CONSULTANT**

Revision	Description	Date	Design By	Checked By	Approved By
R0	First Issue	01-10-2025	Umar	M. Anwar	Mushahid

Table of Contents

1) DESIGN BASIS REPORT- STRUCTURAL

The purpose of this report is to define the structural design basis for the Construction of **INCITE BUILDING at Gandhi Nagar Gujarat**. The aim of the project is to have the analysis and design of buildings using conventional technology i.e., RCC material as per the Indian Standards.

1.1) Scope of Design Basis Report (DBR)

This DBR covers design basis with design parameters and assumptions to be adopted in load calculations, structural modelling, load combinations, analysis, design of foundations (sub- structure) & super-structures for the Proposed buildings. The provisions of this document are the minimum requirements to be followed by the consultant/contractor. The value additions in terms of better practice, construction ease and fabrication quality can be suggested to client within the time frame and cost. The materials used for the design / construction shall be as per the approved make list.

1.2) General Project Information

The proposed buildings are as under:

- Block A (B + Ground + 4 storey)
- Block B (B + Ground + 9 storey)

The primary arrangement of the structure shall consist of monolithic RCC foundation, column/shear wall, beam and slab that resist the induced gravity and lateral loads with required strength, rigidity, robustness, ductility, durability, construction sequencing, fatigue, fire protection etc. as per the latest and relevant Indian standards. This DBR covers the below data for the structural requirements for the proposed buildings.

a) Code list

b) Material parameters

- Cement
- Concrete (M25 - minimum grade)

- Structural steel (Fe350, Fe250)

- Reinforcement (Fe500D)

c) Loading considerations

- Dead load (IS-875 Part-1)
- Super imposed dead load (IS-875 Part-1)
- Live load (IS-875 Part-2)
- Seismic load (IS-1893 Part-1)
- Wind load (IS-875 Part-3)
- Temperature load (IS-875 Part-5)

d) Load combinations (IS-456:2000, IS-1893:2016)

e) Analysis methods

- Static method (IS-1893:2016 Part-1, IS-875: Part-3)
- Dynamic method (IS-1893:2016 Part-1, IS-875: Part-3)

f) Design parameters

- Limit state of strength (IS-456:2000, IS-800:2007)
- Limit state of serviceability (IS-456:2000, IS-800:2007)
- Dynamic analysis and Mathematical modelling (IS-1893:2016 Part-1)

g) Design methodology

1.3) Site Particular

Locations = Gandhi Nagar

Seismic Zone = III as per Annex E of IS-1893 (Part-1) 2016 Basic wind speed = 39 m/s as per Annex A of IS-875 (Part-3) 2015 Rainfall season = June to September (IMD / Local database) Type of structures = Educational and Institutional

1.4) Units

The main units used for design shall be: [m], [mm], [t], [KN/m2], [MPa], [°C], [rad].

1.5) Code list

All relevant codes as listed in DBR shall be of latest revision including all amendments & corrections.

IS-456:2000 Plain and Reinforced Concrete (Code of practice) IS-800:2007 General Construction in Steel - Code of Practice

IS-875:1987/2015 (Part 1, 2 and 3) Code and Practice for Design Loads (Other than earthquake) for Building and Structures like Dead, Imposed, Wind and other Loads

IS-875 (Part 5):1987 Code of Practice for design loads (other than Earthquake) for buildings and structures – Special loads and combinations

IS-13920:2016 Ductile detailing of reinforced concrete structure subjected to seismic forces

IS-1904:2021 General requirements for design and construction of foundation in soils – Code of practice

IS-1786:2008 Specification for high strength deformed steel bars and wires for concrete reinforcement

SP-38 Handbook of typified Designs for structures with steel roof trusses SP-16 Design aids for Reinforced concrete Structure

SP-34 Handbook on Concrete Reinforcement and Detailing

IS-15988:2013 Seismic Evaluation and Strengthening of Existing Reinforced Concrete IS-3370:2021 Concrete Structures for

Storage of Liquids- Code of Practice

IS-1893:2016 (Part-1) Criteria for Earthquake resistant deign of Structures

IS-18168:2023 Earthquake resistance Design and Detailing of Steel Buildings-Code of Practice.

IS-1080:1985(2021) Code of Practice for Design and Construction of Shallow Foundations in Soil (Other than raft, ring and shell)

IS-12070:1987(2020) Code of Practice for Design and Construction of Shallow Foundations on rocks

IS-8009:1976(2023) Code of Practice for Calculations of Settlement of Foundations IS-10262:2019 Concrete Mix Proportioning Guidelines.

IS-4000:1992(2017) High strength Bolts in Steel Structures Code of Practice

IS-16172:2023 Reinforcement couplers for Mechanical Splices of Bars in Concrete-- Specifications.

IS-3067:1988(2020) Code of Practice for General Design Details for Preparatory Work for Damp Proofing and Water proofing of Building

SP-7 National Building code of India 2016 (NBC-2016)

2) DESIGN SPECIFICATIONS MATERIALS AND ITS PARAMETERS

2.1) Cement

The 43/53-grade ordinary Portland cement (OPC) conforming to IS 8112 / Portland Pozzolana Cement (PPC) conforming to IS: 1489 (Part-I) as required in the work, from reputed manufacturers of cement such as ACC, Ultratech, Vikram, Shree Cement, Ambuja, Jaypee Cement, Century Cement & J.K. Cement or from any other reputed cement.

2.2) Concrete

As per clause 6.2.3, 6.2.5, 6.2.6, 7.1, and 8.2.2 of IS:456 in case of Plain and Reinforced Concrete structures. The minimum grade of concrete and PCC for building construction shall be M25 grade and M7.5 grade

respectively unless noted otherwise (u.n.o) / as required. The concrete with maximum 25% cement replacement is allowed with cementitious material GGBS/Flyash/Silica-fume as per the mix design prescribed as per IS-10262:2019.

- Tensile strength of concrete

$fcr = 0.7\sqrt{f_{ck}}$ (MPa) …. (pg.16, Cl.6.2.2, IS-456:2000)

f_{ck} = characteristic cube compressive strength of concrete in MPa

• Modulus of Elasticity

$Ec = 5000\ \sqrt{f_{ck}}$ (MPa) …. (pg.16, Cl.6.2.3.1, IS-456:2000)

• Density

$\gamma c,\ dry = 2400\ \frac{kg}{m^3}$ $\gamma c,\ wet = 2600\ \frac{kg}{m^3}$ …. (IS-875 Part-1)

• Time dependent characteristic of material

o If the effects of shrinkage, creep and temperature are liable to affect material safety and serviceability of the structure, these shall be accounted for in the design calculations.

o The shrinkage strain may be taken as recommended in IS 456 (Cl.6.2.4) or as per specialized literature.

o The effect of creep of concrete on the internal forces can be accounted by using effective modulus of elasticity of concrete, as recommended in IS 456 (Cl.6.2.5), by considering the creep and the age of concrete at the time of loading.

S.No	Element	Grade (Mpa)
1	Foundation	M30
2	Column	M45/M40
3	Beams	M30
4	Slab	M30
5	Water Tank	M30
6	Retaining wall	M30

2.3) Reinforcement Steel (Rebar)

Thermo-Mechanically Treated (TMT) reinforcement bars of Fe-500D grade, confirming to IS- 1786 to be used for the structures.

Young's modulus E = 200000 MPa

Yield stress fy = 500 MPa

Density γs = 78.5 kN/m3

Tensile strength fu = > 600

MPa Minimum % elongation =

14.5%

2.4) Structural Steel

Structural steel conforming to IS-2062:2011(2021) and shall be adopted for the structural requirements.

- Bend test not required for thickness > 25 mm for grades E 300 to E 650. 't' is the thickness of the test piece.
- Chemical composition of structural steel used for the construction to be as per Table-1, IS- 2062:2011
- The quality of structural steel used for the fabrication and construction in the proposed buildings to be mentioned in the DBR submitted by the contractor/consultant with due regard to the Indian standards and local climatic conditions.
- The structural steel must have the mechanical properties for the grades of structural steel mentioned as below.

Young's modulus E = 200000 MPa

Yield stress fy = 250/310/345 MPa

Density γs = 78.5 kN/m3

Tensile strength fu = > 410/440/490

MPa Minimum % elongation = 14.5%

- The structural steel classification for the regular steel members shall be as per Table-1, IS- 800:2007.

2.5) Concrete mix-design

The guidelines to be followed for the proportioning of the concrete mixes to be as per IS- 10262:2019.

The aspects covered in IS-456:2000 for the concrete requirements must also be adhered to maintain the quality of concrete.

2.6) Cover to reinforcement - Durability & Fire protection

The durability requirements for concrete (Cl.8, IS-456:2000) and steel elements (Sec-15, IS- 800:2007) to be employed along with the fire requirements (Table-16, IS-456:2000, Sec-16, IS-800:2007).

Column / Structural Wall :

40mm

Beams :

25mm

Slabs : 20mm

Raft/Grade Slab : 50mm

Footing top :

50mm

Footing (bottom, side) :

50mm

Exposure conditions	**Classification**
Member in contact of ground	: Moderate
Member in interior environment	:
Mild Members in above-ground exterior environment	:
	Mild

The buildings should have good drainage system to not allow for stagnation of water and moisture protection for elements that are hard to access.

3) LOADS TO BE CONSIDERED FOR DESIGN (GRAVITY & LATERAL LOADS)

Following are the various loads to be taken into consideration for analysis and design of structures as prescribed in IS-875 (Part-1,2,3,5), IS-1893:2016, IS-800:2007, and IS-456:2000.

3.1) Dead Load

Dead load shall be based on the actual cross section area and unit weight of materials and shall include the weight of the materials that are structural components which are permanent or semi-permanent in nature.

The dead loads calculated shall confirm to the unit weights of material given in IS 875 (Part 1). Unit weights of various elements are given below.

Materials	Density
• Concrete	: 25 kN/m3
• Steel	: 78.5 kN/m3
• Saturated soil	: 20 kN/m3
• Water	: 10 kN/m3
• Glass	: 27.2 kN/m3
• Aluminium	: 27 kN/m3
• Aerated light weight blocks mm	: 10 kN/m3
• Dry wall partitions (102mm thk.)	: 7 kN/m3 / As actual
• Solid block masonry (SBM)	: 22 kN/m3
• Brickwall with 20mm plaster	: 20 kN/m3
• Floor finish	: 24 KN/m3
• Façade	: As actual
• Light weight Partitions wall	: 7 kN/m3
• Soil dry	: 18 kN/m3

- Soil wet : 20 kN/m3
- Screed / Lean concrete : 24 kN/m3
- Red brick filling material : 18 kN/m3

3.2) Super Imposed Dead Load

Super imposed dead loads include all the weights of materials on the structures that are not structural elements but are permanent. It includes weight of brick work, parapet, floor finish, solar panels, etc.

NOTE:

- The floor finish type and thickness to be referred from the Architectural drawings.
- The location of solar panels to be referred from the Architectural drawings.
- The sunk areas to be referred from the Architectural drawings.
- The size of the water tanks to be referred from the Architectural / MEP drawings and DBR.
- The areas with light weight filling shall be marked and loading to be estimated based on the

sunk thickness.

- Dry wall partitions details to be referred from the Architectural drawings / DBR for load estimation.
- The details of the external façade to be referred from the Architectural drawings / DBR for

load estimation.

- Parapet loading (1.2m height) to be considered and Architectural

drawings to be referred for details.

- Capacity of overhead tanks shall be considered as below.

Fire tanks = 25 K

Domestic tank = 25 K

Flushing tank = 20 K

3.3) Live Loads / Imposed Loads

Live loads on the entire floor shall comprise all loads other than dead loads. The minimum live loads on different occupancies to be considered as per IS: 875 (Part 2).

Bed rooms, wards, dressing rooms and dormitories: 2

kN/m^2 Kitchen, laundries and laboratories : 3

kN/m^2 X-ray Operating rooms, general storage area

–to be calculated but not less : 3 kN/m^2

Dining rooms, cafeteria and restaurants : 4 kN/m^2

Office rooms and OPD rooms : 2.5 kN/m^2

Toilet and bathrooms : 2 kN/m^2

Corridor, Lobby and Staircase : 4 kN/m^2

Terrace : 1.5 kN/m^2

3.4) Seismic Parameters and Loading

The purpose of this section is to summarize the methodology and the assumptions that shall be used for the seismic analysis as per IS-1893:2016 (Part 1) for Buildings.

- The buildings are to be designed and detailed considering the requirements of strength and ductility for the RCC and Steel buildings as laid out in IS-13920:2016.

- The earthquake resistant design of the buildings must meet the adequate seismic performance under the earthquake scenarios will complete compliance to the requirements of structural planning to get the efficient performance, regular behavior, torsional irregularities, design eccentricity, time period estimation, stiffness modifiers (where applicable), drift limits and analysis routines as laid out in IS-1893:2016 (Part-1).

Design horizontal seismic coefficient (Ah)

The design horizontal seismic coefficient for a structure shall be determined as below

$$A_h = \frac{Z}{2} \cdot \frac{I}{R} \cdot \frac{S_a}{g}$$

Where,

A_h = horizontal seismic coefficient to be considered in design (Cl.6.4.2, IS-1893:2016) Z = peak ground acceleration or zone factor = 0.16, as per Annex E, IS-1893:2016

I = importance factor = 1.5 as per Table 8, IS-1893:2016 Part-1 R = Response modification factor = 5, as per Table 9

Sa/g = Design acceleration coefficient for different soil types, normalized with peak ground acceleration corresponding to natural period T of structure.

Soil type = Rocky profile Type-I and Medium Stiff soil Type-II as per Geotech Report to be considered

Time period estimation (Ta)

Time Period (s) of the building shall be estimated using the empirical formula. o RCC Moment Resisting Frames

Ta = 0.075. h0.75 …. (Cl.7.6.2a, IS-1893:2016 Part-1)

P-Δ Effects

The secondary effects due to interaction of vertical loads with the lateral displacement of building resulting from seismic effects must be considered in the structural analysis. The gravity loading part shall be 1.2Dead Loads (DL) + 0.5 Live Loads (LL).

3.5) 3.5. Wind Loads

The purpose of this section is to summarize the methodology and the assumptions that shall be used for the wind load estimation as per IS: 875 (Part-3) and wind pressure calculation done as follows:

Parameters for wind load estimation

Vb = Basic wind speed = 39m/s , Annexure-A

$K1$ = Probability factor or Risk coefficient = 1.0 pg.5, Table-1

$K2$ = Terrain roughness and height factor = Terrain Category-2

Ht (h)	V_b (m/s)	K_1	K_2	K_3	K_4	V_z (m/s)	pz (KN/m^2)
10	39	1	1.00	1	1	39.00	0.91
15	39	1	1.05	1	1	40.95	1.01
20	39	1	1.07	1	1	41.73	1.04
30	39	1	1.12	1	1	43.68	1.14
40	39	1	1.15	1	1	44.66	1.20

Ht (h)	K_a	K_c	K_d	Min. pd (KN/m^2)	pd (KN/m^2)

1.00 (up to 10m ht.)

1.05 (up to 15m ht.)

1.07 (up to 20m ht.)

1.12 (up to 30m

ht.) 1.1575 (up to

40m ht.)

1.17 (up to 50m ht.) pg.5, Cl.6.3.2.1 pg.8, Table-2

$K3$ = Topography factor = 1.0 pg.8, Cl.6.3.3

$K4$ = Importance factor for cyclonic regions = 1.00 (Other buildings) pg.8, l.6.3.4

Vz = Design wind speed

= $VbK1K2K3K4$ m/s pg.5, Cl.6.3

pz = Wind pressure = 0.6 $Vz2$ N/m2 pg.9, Cl.7.1, 7.2

kd = Wind directionality factor = 0.9 pg.9, Cl.7.2.1

ka = Area averaging factor = 0.8 pg.10, Table-4

kc = Combination factor = 0.9 pg.16, Cl.7.3.3.13

pd = Design Wind Pressure = $kdkakcpz$ N/m2pg.9, Cl.7.2

$\mathbb{V}$ 0.70pz

	20	1	1.07	1	0.73	1.12
	30	1	1.12	1	0.80	1.28
	40	1	1.15	1	0.84	1.37
	50	1	1.17	1	0.87	1.46

Note: the wind load estimation must be done by the independent agency designing the building and submit their calculations in standard format.

Dynamic effects

The dynamic effects of wind to be considered for the buildings defined the category as below according to the geometry and time period requirements that necessitate to consider these effects (refer pg.45, Cl.9.1). The wind gust to be considered for the design of buildings and elements as necessary.

- Building and closed structures with a height to minimum lateral dimension ratio of more than about 5.0 or
- Buildings and structures whose natural frequency in the first mode is less than 1.0Hz.

3.6) Temperature Load

For the RCC building of length more than 45m, steel, or areas exposed to sun; thermal analysis shall be done for seasonal and diurnal temperature variations. The temperature loading is as per IS-875:1987 (Part-5).

- Average temperature = 25°C
- Differential temperature = ±15°C
- The effects of differential temperatures within an element and or member, due to part exposure to direct sunlight shall also be considered.

construction material and erection equipment, including all loads due to operation of such equipment shall be considered as erection loads. The stability of the building and parts or joints or floors shall be ensured as part of the design (refer. pg.16, Cl.3.3, IS-800:2007).

4) LOAD COMBINATIONS WITH PARTIAL SAFETY FACTOR FOR LOADS

As per Table-18, of IS-456:2000, Table-4 of IS-800:2007, IS-875:1987 (Part-5) and, partial safety of factor for loads considered for building analysis and design is given below

• Limit state of serviceability: partial safety factor for loads

Load comb	DL/SIDL	LL	EQ (X, Y, Z)	Wind (X, Y)
DL+LL	1.0	1.0	-	-
DL+EQ	1.0	-	1.0	-
DL+LL+EQ	1.0	0.8	0.8	-
DL+Wind	1.0	-	-	1.0
DL+LL+wind	1.0	0.8	-	0.8

• Limit state of collapse: partial safety factor for loads

Load comb	DL/SIDL	LL	EQ (X, Y)	Wind (X, Y)
DL+SIDL+LL	1.5	1.5	-	-
DL+SIDL+EQ	1.5	-	1.5	-
DL+SIDL+EQ	0.9	-	1.5	-
DL+SIDL+LL+EQ	1.2	1.2	1.2	-
DL+SIDL+WIND	1.5	-	-	1.5
DL+SIDL+WIND	0.9	-	-	1.5
DL+SIDL+LL+WIND	1.2	1.2	-	1.2

Note:

• The identification, estimation and combination of loading to be done for each building as per the areas planned in the Architectural drawings.

• The earthquake (static & dynamic) and wind loading in each direction to be considered both ways (±).

• If the actual loading is more than that specified in this DBR, then actual loading shall be considered.

- The envelope cases for strength and serviceability to be considered for design (u.n.o).

Where,

DL = Dead Load SDL = Super Imposed Dead Load

LL = Live Load EQX = Seismic Load

(X-dir EQY = Seismic Load (Y-dir.)

EQZ = Seismic Load (Z-dir.)

Wind = Wind Load (X/Y-dir.)

5) STRUCTURAL ANALYSIS & METHODS

The structural analysis for the entire building shall be performed as per the governing guidelines IS-456:2000, IS-800:2007 and IS 1893:2016 or other relevant and latest Indian Standards for the sub-structure and superstructure to the best/quality of the industry practices in the established

Commercial software.

- CSi ETABS : Extended Three Dimensional Building Analysis and Design Software
- CSi SAFE : Slab Analysis by the Finite Element Method
- Bentley Systems Staad.Pro Connect: Structural Analysis and Design

The analytical models must be representative of the assumptions used for modeling the elements, loading conditions, load combinations, restraints, analysis routine, code compliance and must ensure stability in all components and the overall building. The local level stability checks must be submitted separately.

5.1) Methods for seismic analysis of buildings

The seismic analysis of the building considering the static and dynamic methods must satisfy the requirements laid out in the IS-1893:2016 (Part-1). The few of the aspects are as listed below:

• Center of mass (CM) and Center of rigidity (CR) must be estimated based on the inertia forces and the stiffness of lateral force resisting elements in the software using static method of analysis.

- The corresponding design eccentricities must be captured in the analysis through the

  Response Spectrum Load Cases in both the principal plan directions (X,Y).

$$edi = 1.5esi + 0.05bi \quad \text{....(case with positive eccentricity)}$$

$$edi = esi - 0.05bi \quad \text{... (case with negative eccentricity)}$$

- The torsional irregularities must be addressed as per IS-1893:2016 (pg.14, Table-5(i).

- The torsional mode time period (Rx, Ry, Rz) in the analysis shall be separated adequately from the time periods in the principal plan directions (X,Y) and not be the first two modes of vibration of the building.

- The building in general to be planned as regular/simple building to achieve better earthquake performance and in case the irregularities as per Table-5 (Plan Irregularities) and Table-6 (Vertical Irregularities) of IS-1893:2016 arise, then the analysis model must be representative of them and the efficient and adequate solution to be developed for the buildings.

- The time period of the buildings to be estimated as per the correct empirical formulas

mentioned in the IS-1893:2016 for RCC MRF buildings and buildings with structural walls.

- The rigid diaphragm action for the composite floors and its system to be ensured.

- The minimum overall thickness of the slabs to be 150mm.

- The stiffness modifiers for the RCC elements to be taken as per the IS-1893:2016 (Part-1) for the proposed buildings.

5.1.1) Equivalent Static Load Method (pg.21, Cl.7.6, IS-1893:2016 Part-1)

This method uses the code based empirical time-period formulas specific to the building type and the fundamental mode of the building to estimate the static base shear using the acceleration coefficients and seismic weight estimated for the building as per the governing clauses of IS-

1893:2016 (Part-1). The response spectrum for static load case to be used for estimating the Sa/g values (pg.13, Fig.2A) for the soil type of Rocky / Medium stiff strata as per geotechnical reports.

- Design lateral force = VB

= AhW (kN) …. (pg.17, Cl.7.2.1)

- The minimum design lateral force = (VB) min = 1.1% …. (pg.19, Table-7, Cl.7.2.2)
- Seismic weight = W

= Full dead loads + Appropriate amount of Imposed Loads …. (pg.20, Table-10, Cl.7.3.2)

- Vertical distribution of base shear to different floor levels ….

(pg.21, Cl.7.6.3) $2WihQi$ = (i 2) $VB\sum Wjhjnj$=1

5.1.2) Response spectrum method –dynamic analysis (pg.23, Cl.7.7.5, IS-1893:2016 Part-1)

The response spectrum method of analysis for the multi-storey buildings having height more than 15m is mandated by the code. The estimation of the base shear requires use of modal super-position method to combine the responses of each mode of vibrations (SRSS / CQC) using the Eigen / Ritz vectors.

- Considering the rigid diaphragm action, 3 number of modes per story to be considered in

the analysis.

- The building must have more than 90% mass participation in each direction.
- The participation of first three modes in each of the principal plan

directions shall be more 65%.

- The fundamental lateral natural periods of the building in the two principal plan directions

to be separated by 10%.

- The first two modes shall not be torsional modes of vibration for the proposed buildings.
- The estimated design base shear (VB) shall not be less than (VB). Scaling of base shear to be done to match the design base shear estimated using the fundamental period (Ta) in both the principal plan

directions.

- The design lateral force at each floor in each mode = $Qik = Ak\phi ikPkWi$
- Storey shear in each mode = $Vik = \sum Qiknj = i+1$

- The elements that are either steel or concrete shall be dealt as per IS-800:2007 and IS- 456:2000.

- The foundation analysis consisting of independent or combined RCC footings with pedestals must be developed in the FEM software or standard worksheets.

- The S.B.C to be considered from the latest geotechnical investigation carried out for the buildings.

6) DESIGN CHECK FOR BUILDINGS

6.1) Drift and Deflection Limits

The overall structure and its components tend to have some deflections and or movements when subjected to lateral loads. This shall be studied and checked against the allowable tolerances, for which there will not be any problems regarding strength, damage to finishing or perception related issues.

- Deflections of beams is calculated as per Annex C of IS 456:2000 (pg.88, Cl.22.3.2, Cl.23.3.1, Cl.42.1).

- Cracking in the structural and non-structural members must not happen in the routine conditions of loading or vibrations (human or machine induced).

- The aspects of deflection / vibrations under human loading, fatigue and machine loading to be considered in the required locations for the proposed buildings.

- The table below gives the global as well as local limits on the deflections, set out by the Indian standards.

Global Displacement	Seismic inter storey drift	H/250
	Wind case for overall structure	H/500

Element deflection	Vertical direction short term	Minimum (L/350 or 20 mm)
	Vertical direction – long term	L/250

6.2) Irregularities and Torsion

Vertical and horizontal irregularities check of the building to be done as per Table-5, Table-6 of IS 1893:2016, for the seismic performance of the structure.

6.3) Detailing for Ductility

The ductility provisions as laid down in IS-13920-2016, IS 800:2007, IS-18168:2023 in order to improve the seismic response of the structures to be complied.

- RCC special structural walls to be of minimum 200mm thickness and

be classified as the requirements of IS-13920:2016 (pg.14, Cl.10).

- The single RCC structural walls must be slender category having minimum ratio of length of

wall to its thickness as 4.0. Otherwise, the wall to be categorized as a column.

- The RCC core walls shall provide adequate rigidity to the building and resist the earthquake

forces considering the detailing requirements of flanged sections as mentioned in ACI-318.

- The minimum reinforcement in the RCC structural walls to be provided as

per IS-13920:2016 (pg.15, Table-1)

- The precedence of yielding of the structural elements RCC / Steel to be decided to achieve

the required seismic performance of building with adequate ductility.

6.4) Crack width

For serviceability condition (DL+LL), crack width of the structure element is calculated as per Annex F of IS 456:2000.

- IS.456 restricts the crack width to 0.3mm for the normal environment conditions and for the members which are contact with soil or water, the code restricts the crack width to 0.2mm.

- For water tanks and underground sumps, crack width shall be limited to

0.2mm and for STP

it shall be limited to 0.1mm as per IS-456:2000 (Cl. 35.3.2) and IS-3370.

7) DESIGN METHODOLOGY

7.1) Structural Design

The following consideration are taken for the design of the buildings and corresponding structures to perform satisfactorily during their intended life.

1. Structure safety and stability during / after construction
2. To meet the demands of aesthetics conceived by the architect
3. Availability of material, equipment and expertise
4. Constructability and ease of maintenance
5. Durability
6. Economy / Cost
7. Fire resistance
8. Serviceability
9. Fatigue

The limits states of design as prescribed for the RCC (IS-456:2000), Steel (IS-800:2007) elements and buildings to be followed by the design engineer.

- Ultimate limit state
- Serviceability limit state
- Fatigue limit state

7.2) Structural System

The structural system of Proposed building is monolithic RCC shear wall/column, beam slab. The structural system is considered as dual system or special moment frames having the required ductility and performance to meet the requirements for lateral forces.

7.3) Design

Approach Super

Structure:

The building shall be analyzed by generating 3-Dimensional model in the specified software to get the global and local design of buildings and its components. The structure is analyzed and designed for all possible combinations of gravity loads (dead and live loads), and lateral loads (seismic load and wind load), erection loads, accidental loads and temperature loads as per relevant Indian Code of practice for civil works IS-456:2000, IS-800:2007, IS-875:2015, IS- 1893:2016, IS-13920:2016.

The buildings to be designed and checked for the dynamic load cases (earthquake / wind) to ensure adequate modal responses and expected performance. Dynamic wind load estimation for façade and building to be considered where applicable.

Substructure:

The sub structure analysis and design for all load combinations to be carried out for stability and forces in the specified software or tools. The foundations to be considered as independent or combined footings with pedestals at the required height. The SBC shall be as per geotechnical report. The settlement of the footings to be as per the relevant foundation types to be used for the buildings.

- The S.B.C to be decided as only one value for the building under consideration. The S.B.C of

slightly, moderately and other weather rocks to be identified correctly before use for the design of foundations.

- The bore hole numbers must be suggested considering the requirements for the excavation

  and re-design of foundations to be mitigated to the extent possible.

- The depth of foundations to be minimum 1m for the buildings and non-building areas.

- The ground water table to be considered at ground level for stability checks.

MAC CONSULTING ENGINEERS STRUCTURAL DESIGN BASIS REPORT

Pedestals:

The design of RCC pedestals must be carried out considering the following requirements:

- Pedestal classification as per IS-456:2000 (pg.49, Note) i.e., compression member in which the effective length does not exceed three times the least lateral dimension.
- Nominal reinforcement of 0.15% to be provided in pedestals in which the reinforcement is not taken into account. Otherwise, the reinforcement calculations and ductile detailing of pedestals to be carried out in the software as per the requirements of IS-13920:2016 for all load cases.
- The detailing of reinforcement, stirrups tying and bending in the pedestal should be workable.
- The base of the columns to be fixed condition (u.n.o) for all buildings and structures.

RCC Beams:

The RCC beams used in the design and construction of proposed structures if any to meet the requirements of IS-456:2000 and IS-13920:2016 for modeling, loading, analysis, detailing and stability conditions.

- Width of the beam shall not be less than 200 mm (pg. 4 clause 6.1.2 of IS 13920).
- Minimum longitudinal steel ratio at any face shall not be less than

$$P_{min} = 0.24\frac{\sqrt{f_{ck}}}{f_y}$$

Where,

f_{ck} = Characteristic strength of the concrete f_y = Yield strength of the reinforcement

- Maximum longitudinal steel ratio at any face shall not be higher 0.025 (pg. 5 of IS 13920:2016).
- The spacing of stirrups shall be as per clause 6.3.5 of IS 13920:2016.

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Design Basis Report – MEP Services

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CLIENT **ARCHITECT**

Executing Agency

Construction of Incite Block at GBU, GUJARAT

Design Basis Report (DBR) E & M Services

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DESIGN BASIS REPORT

A. Design Basis Report- Electrical and LV works

1. GENERAL

a) The scheme covers the complete Electrification of the proposed Incite block at GBU, Gujarat. All Electrical work shall be done as per code of practice for Electrical installations and meeting the requirements of Indian Electricity Rules/Act, applicable I.S. Codes/Rules and relevant I.S./CPWD Specifications, Special requirements of State Electricity Board latest up to date.

b) The rating and capacity of equipment indicated herein below are minimum to be provided. However during detailed designing, if required and found necessary, the capacity / rating of the equipment may be upgraded.

c) Adequate measures shall be considered in design and detailed Engineering for safety of men & material for all services during construction, testing, commissioning, operation & maintenance.

2. SCOPE OF WORK

Electrical & Allied Services' required for proposed Incite building covers Electric Sub Stations, D.G Set work, Internal Electrical Installations, HT/ LT Panels, Distribution Boards, External Electrical Installations, 11/0.433 KV HT and LT Cables, Road/Compound Lighting, Solar Lighting Poles, Centralized UPS system, Internal & External Electrical Distribution work. It shall also include IP-based Telephones System, LAN Networking & Wi-Fi System, CCTV system, Fire Alarm System, Public Address System and Lifts etc.

Suitable size shafts, cutouts, Niche etc. shall be provided to facilitate installation of Cables/Rising mains, Pipes, Cable trays, ducts etc. in all floor slabs of building for various service areas, as required.

All Services as required like electrical power, telephone points, LAN/Data points, UPS points, raw/ soft/ hot water supply, drainage, plumbing, HVAC provisions, ducting etc. shall be provided as required in the complex.

3. ELECTRICAL POWER REQUIREMENT

The Electrical Load requirement has been calculated on the actual point's basis of building as per the drawings.

Load for the Air Conditioning, Services, Lifts, Pumps, UPS, Fire Fighting, External Lighting, STP, WTP etc. has also been taken in to account.

Maximum demand for electrical load works out to approx. **2126 KVA**.

The Electrical load calculation sheets are provided at Annexure **–** A.

4. SOURCE OF SUPPLY

Gujarat State Electricity Board shall provide normal and stand by electric supply on 11 kV for meeting electrical load requirements of GBU Gujarat. 1 Nos. 11 KV connection is already there

in the campus for Residential Buildings which has 2 incoming and 3 Outgoings. Out of 3, one outgoing is spare which will be used for this proposed building Transformer connection.

5. **ELECTRIC SUB-STATIONS**

To meet the electrical load of Incite building, Existing 11/0.433 KV substation will be augmented with one no. 2500 KVA transformer and LT Panel with required accessories.

5.1. Electric Sub Station:

A. ESS-01:-

ESS-01 shall be augmented to meet the electric load requirement of Incite including services as required. The projected peak load demand of proposed building is 2126 KVA. To meet this load requirement the capacity of the substation shall be 1 X 2500 KVA. The transformers will be Oil Type Transformers with ON Load Tap Changer.

Light Load & Emergency services shall have 100% backup DG supply.

Capacity of ESS and DG sets loads shall be as per table below:-

S. No.	ESS-1 TR CAPACITY	DG SET CAPACITY
1.	1 x 2500 KVA	1 x 750 KVA

The substation shall be complete with 11KV panel board, Transformers, HPFC panel, AMF/Synchronization Panel, DCDB and other equipment as required and shall have necessary provisions and space to augment its capacity for future.

GENERAL REQUIREMENT FOR SUBSTATION

The proposed Substation shall be indoor Type Sub-Station complete with 11 KV panel board with fault passage indicator, AMF/synchronization panel, Transformers, DG Sets, Sandwich bus-ducts, LT Switch Board, Capacitor Panels and all other accessories as required. DG Sets shall have facility for auto & manual start/ stop, auto changeover, auto load management. The transformers & DG Sets shall be connected to respective LT Panels through suitable size indoor/outdoor sandwich bus ducts in the substation.

The substation will have 11 KV Panel board of suitable Nos. of feeders with 20% spare feeders. Adequate measures shall be considered in design and detailed Engineering for safety and interlocking shall be provided to prevent paralleling supply.

Main LT Panel in Substation and all other Electrical Panel shall be compliant to IEC-61439 and other Relevant IS Codes, ECBC /NBC norms. Panels should be suitable for monitoring and control with BMS/ SCADA System. Suitable BMS Integration Cards shall be provided to achieve BMS compatibility of HT & LT Panels. Suitable size trenches shall be provided for installation of HT/LT/ Capacitor Panels etc. and also for Laying of HT/LT Power cables & Control Cables. Substation shall comprise of all ancillary equipment like Battery Charger etc. Suitable size MS Chequered Plates, duly painted of minimum thickness 6 mm shall be provided for trenches inside the panel room as required. Hot Dip Galvanized Cable trays of suitable size shall be used as required.

All armoured HT/LT power cables, control cables, telephone cables, signal cables etc. shall be laid underground preferably along the roads & pathways at suitable depth as per CPWD specifications. Adequate no. of NP-2/3/4 as per IRC code, RCC Pipes/Hume pipes/DWC HDPE Pipes having suitable diameter with spare shall be laid across the roads/pathways etc.

Maximum allowable transformer losses at 50% & 100% load shall comply with ECBC 2017 norms (latest upto date). All Substation/HT/LT Panel Rooms/Floor panel Rooms shall be provided with safety equipment/items like suitable elastomeric mat (as per relevant IS codes), fire buckets, fire extinguishers, hand gloves, danger plates (HT/LT rating), First Aid Box, Gas Masks, Instructions charts in Hindi & English, safety charts, framed Schematic/SLD etc. Suitable civil foundation/trenches etc. for all substation equipment shall be provided as per design load of respective equipment. All LT Panels shall have 20% spare (in numbers minimum 1) outgoing feeders for different rating of feeders.

5.2. DG Set For Backup Supply

Diesel Generator set is proposed to be provided for back up supply in case of electricity failure. Provision of DG Back up supply shall be as following:

a) 100% Light Load, AHU Load, UPS Load of Incite building including all Emergency services shall be on DG Set.

All DG Sets shall be provided with suitable AMF/PLC and Synchronizing relay/ PCCM controller for achieving automatic start/stop, automatic load sharing and synchronization function. Additional provision for manual start/ stop of DG Sets shall also be provided. Transformer Incomer ACBs, DG Incomer ACBs and Bus Couplers shall be electro-mechanically interlocked with provision of auto and manual mode operation. Required control cabling/wiring in HT Panel, Transformers, DG Sets, and LT Panels etc. shall be provided as per requirement.

All DG Sets shall be outdoor type with residential type silencer, acoustic enclosure as per CPCB IV+, and other relevant norms & with provision of DG sets proper shading.

All DG Sets shall be Radiator cooled type,

The Rating & No. of Transformers, DG sets and APFC panel is summarized as below:-

S.NO.	SUB STATIONS	TRANSFORMERS	DG SETS	APFC PANEL
1	ESS-1	1 X 2500 KVA (1W)	1 x 750 KVA	1 X (800 KVAR)

Exhaust Stack of the DG Sets shall be as per CPCB IV+/CPWD/Local Bye-Laws standards and self-supporting MS Exhaust stack structure duly synthetic enamel paint of suitable height to support the exhaust pipes with expansion bellows at required location has to be provided. Contractor shall submit the detailed structural drawing of stack & foundation for approval with detailed design calculation considering the wind pressure & soil bearing capacity of site.

All DG sets shall have individual Day Oil tank of suitable capacity to be provided.

5.3. Power Factor Improvement & Harmonics Suppression:

Real time Automatic power factor control panels with ultra-heavy duty capacitors, Thyrister switched, 14 % detuned harmonic filters are proposed to be provided in the substations to achieve overall power factor 0.97 (lagging) from existing Power Factor, as per ECBC 2017 with operation in both Auto and Manual mode. Power factor Correction Panel shall be BMS Compatible. The capacitor panels with Hybrid Harmonic filters shall be provided in each substation to achieve THD less than 3%. Connection from Main LT Panel to Capacitor Panel is to be provided through Aluminium sandwich bus duct/XLPE cable. Automatic switching off of Capacitor Panel is to be considered during Power supply availability from DG Sets.

6. ELECTRICAL POWER DISTRIBUTION

The Electrical Power Distribution for electric supply shall be as detailed below.

Change over where ever being used shall be done through Automatic Transfer switching. Maximum allowable transformer losses at 50% & 100% load shall comply with ECBC 2017/relevant IS or amended up to date.

All Panels with incomer's ≥630 Amps shall be Certified Tested Assembly as per IEC 61439 and as per technical specifications. All Tested Assemblies shall be smart type having switchgears (ACB, MCCB) communicating their release data over Ethernet. Main LT panel shall be provided with all accessories required for panel and all metering shall be done through HMI being connected to each breaker release mounted on the panel door to achieve better fault tolerant system.

There shall be adequate measures considered for power factor correction and harmonic mitigation by using HPFC Panel.

a. Indoor/Outdoor type Compact Aluminum Sandwich Bus Duct of suitable capacity shall be provided from Transformers and, Synchronizing Panels to Main LT Panel, Adequate runs of XLPE insulated armoured Aluminium conductor cables shall be laid from Main LT Panel to LT Panels of the building.

b. Separate distribution system shall be provided for Lighting load, Power, UPS & AC Load. Each distribution system shall be with Electrical panels, rising mains/XLPE cables, Floor panels, Double door MCB Type DB's, VTPN DBs etc**.** Various LT Panels & UPS panels installed block shall be interconnected with each other with suitable change over switches**.** All TPN MCB DB's shall be PPI type**.**

c. The building shall have a LT room to receive power from the substation through armored cable and distribute power to the entire building through a Main LT Panel located in the LT room.

d. The building shall have suitable Nos. of rising mains/Cables for catering to loads of Lighting, HVAC equipment, Power, UPS etc. connected to Main LT Panel, as applicable.

e. Each rising main shall have Tap off at every floor, feeding the floor panels with incoming & outgoing MCCBs of required capacities and numbers feeding the double door DBs/VTPN DBs.

f. Sub mains from floor panel to DBs shall be connected with CU armoured cable on surface/cable tray.

g. The power cabling shall be sized so that the distribution losses do not exceeds 3% of the total power uses in buildings. Voltage drop for feeders shall not exceed 2% at design load and for branch circuit; it shall not exceed 3% at design load.

h. Meter Box & Energy Meters- Meter Box with energy meters (single / Double source) shall be provided for shops as below:

i) Food court/Shops (if any) - Three phase, Single source Energy meter of 40/5A TPN.

7. EARTHING NETWORK

Earthing with Maintenance free Chemical earthing system/GI Earthing System/Copper Earthing system, as required, shall be provided for earthing sub stations equipments, Electrical Panel boards, UPS and other Equipment /installations in each building. Earthing shall be in conformity with provisions of rule 32, 61,61, 67 & 68 of Indian Electricity Rules 1956 & as per IS-3043 as amended up to date. Copper/GI earth strips shall be used for connecting the Electrical equipments with Earth pits as required. Earth Leakage circuit breakers shall be provided in the DBs for individual units. Separate and distinct earth stations with insulated electrode shall be provided for the following:

- HT Panels- Copper Plate Earthing
- Main LT Panels – Copper Plate Earthing
- LT Distribution Panels-GI Plate Earthing
- UPS system – Body & Neutral- Copper Plate Earthing
- EPABX & LAN Server – Copper Plate Earthing
- Transformers - Neutral & Body –Copper Plate Earthing
- DG Sets - Neutral & Body- Copper Plate Earthing
- Lifts- GI Plate Earthing
- External Lighting Poles & Pillar– GI Pipe Earthing
- Any other equipment as required

All three phase electrical installations shall be provided with double Earth connection and single phase electrical installations with one Earth connection as per latest CPWD specifications & NBC 2016.

8. LIGHTNING PROTECTION SYSTEM

Lighting protection of various buildings and blocks shall be provided as per IS/ IEC-62305-1:2010 (latest as amended), CPWD Specifications 2023 and NBC 2016 norms by Rolling Sphere method. The main and most effective measure for protection of structures against physical damage is considered to be the lightning protection system (LPS). An external LPS which consists of air-termination system, down-conductor system and earthing system is intended to:

a) Intercept a lightning flash to the structure (with an air-termination system),

b) Conduct the lightning current safely towards earth (using a down-conductor system), and

c) Disperse the lightning current into the earth (using an earth-termination system).

Accordingly a standard lighting protection system will be provided in all the buildings as per NBC 2016 Standards, using single prone finials, horizontal and down comer earthing strips of suitable size, terminating in the Earth Pits. Aviation Obstruction Light (AOL) shall be provided in the buildings as per Civil Aviation regulations, NBC norms & CPWD Specifications as applicable.

All Aviation Obstruction Lights shall be fed with UPS supply. Surge protection devices shall be provided in the incomers of all LT Panels of all buildings.

9. **Internal Electrification, LV & Allied works**

Following works shall be carried out in coordination with the civil work within the buildings complete in all respects as per latest IS Codes and CPWD Specifications 2023.

i. Wiring & Conduiting (PVC Conduits) for internal electrification, LV & Allied works.

ii. LED Light fixtures, Fan (Ceiling & Wall) & Exhaust Fans.

iii. 6A Light Point /UPS Modular Switch & Socket Outlets.

iv. 16A/20A Power/UPS Modular Switch & Socket Outlets

v. L.T. Cables and Sub main wiring, circuit wiring.

vi. Cable Tray & Raceways.

vii. Rising Mains / Bus Trunking

viii. Floor Panels, Distribution Boards & VTPN DBs.

ix. Earthing

x. Extra Low Voltage system like Telephone/IPBAX, LAN & Wi-Fi, Fire Detection & Alarm System, CCTV System, Public Address system, Fire Suppression etc.

Following points shall be generally followed for internal and external electrification of various areas:

a. Internal areas like rooms, corridors, staircases, terraces, washrooms etc. of building shall be adequately illuminated conforming to provisions stipulated in NBC 2016, ECBC and CPWD technical specifications maintaining the indicated Lux levels and Light Power Density.

b. The Internal Electrification work shall be carried out in recessed/surface mounted MS/PVC conduits/Raceway/UPVC Trunking in accordance with CPWD General Specifications for Electrical Works Part-I (Internal)-2023 and Part-II (External)-2023 with up to date amendments.

c. PVC Conduits shall be concealed or laid on MS angle/channels with suitable hanging supports in areas wherever there is false ceiling provision. In case there is no provision for false ceiling, PVC Conduits shall be concealed in concrete during slab casting. Wiring for lighting/power/LV works shall be done in PVC Conduits/Raceway/UPVC trunking whereas wiring for Fire Alarm & PA system works shall be done in MS conduits unless stated otherwise.

d. FRLSH PVC insulated Copper conductor wires will be used for points, circuit & copper armoured cable for sub-main wiring conforming to relevant IS-Codes.

e. Agency shall execute the work after obtaining necessary approval of the layout for internal electrification of all services. The staircase lighting shall be in group control system.

f. Modular type switches, sockets and stepped type electronic fan regulators, bell push button along with matching mounting boxes of same make shall be used.

g. Colour coding of the conduits, switches, sockets shall be provided for Normal & UPS power supply as per NBC 2016.

h. TV outlet point wiring shall be terminated in suitable size of G.I. box along with splitter at every floor. The interconnections of all splitter boxes fixed at all floors shall be done properly with conduits to form proper distribution system with the prior approval of Engineer-in- charge/Consultant.

i. LED Type Lighting fixtures with inbuilt harmonic suppression mechanism shall be provided. Special Lighting scheme shall be got approved from Engineer In Charge before executing. 10-15 % lighting shall be on UPS.

j. Suitable size & capacity Exhaust Fans shall be provided as per NBC 2016 provisions. Suitable size & capacity Ceiling Fans (White/Off White color) shall be provided in the office, cafeteria, shops and other areas of building, as required,

k. Separate shafts shall be provided for laying of pipes for Electrical, ELV, Mechanical and Fire Services.

l. RCC/DWC HDPE / Hume pipes for road crossing or in pucca portion & CC path etc. for Electric / Telephone / LAN/ street lighting cables complete with adequate number of cable chambers shall be provided by the agency.

m. After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2023 & Indian Electricity Rules 2005/NBC-2016, shall be recorded and submitted. The results shall be within the permissible limits.

n. Aviation Lights (LED Type) shall also be provided as per prevalent norms & IS-Codes.

o. GI Raceways in floor only and on surface at other places wherever required Raceway shall be of Aluminum /PVC Raceways with accessories shall be provided on floors of building as per requirements**.** The cover plate of raceways' junction boxes shall be

stainless steel (SS 304 or SS 316).

p. Suitable illumination with LED light fixture shall be provided on terraces of building.

q. Power Points, LAN points, UPS power point, Telephone Point (with telephone instrument as required) shall be provided in all areas as required.

r. Requisite size of raceways shall be provided in slabs with fillers, wherever required for drawing the wires and cables for the work stations.

s. **CONDUCTOR SIZE.**

Wiring shall be carried out with following sizes of PVC insulated stranded single core copper conductor wire/cable.

i. Light Point. - 1.5 sq.mm

ii. Ceiling /Cabin/Exhaust Fan Point - 1.5 sq.mm

Iii. Call Bell Point - 1.5 sq.mm

iv. Circuit Wiring - 2.5 sq.mm

V. General Power Point **–** 4 sq.mm

VI 20A Socket Outlet **–** 6 Sq mm

Vii Special Power Point **–** 6 Sq mm

Viii A/C Box with 32A MCB- 6 Sq mm

9.1. Lighting Design & Lighting Fixture

LED lighting fixtures shall be provided with inbuilt Harmonic suppression system in different areas of building will be provided to achieve the illumination levels conforming to latest IS Code, NBC 2016, ECBC latest up to date. All LED lighting Fixture shall have luminous efficacy of more than 110 Lumens per watt. Lighting Power Density (LPD) shall be achieved for areas as per lighting simulation requirements as per GRIHA & ECBC norms. Occupancy/Movement sensors and light dimmers shall be provided for automatic lighting control in areas as required under NBC and latest ECBC norms and as directed by Engineer In charge.

9.2. SOLAR PHOTOVOLTAIC POWER SYSTEM:

Direct Online Grid connected Solar Photo Voltaic Power system of 100 KWp capacity minimum shall be provided in the proposed building as per GRIHA/ECBC/NBC 2016. The generated power will be directly connected to the Power grid/Distribution Panel of respective Building for load sharing during day time. The average area requirement per kWp shall be 8-10 sq. Mtr on roof Top.

9.3. Computer / LAN/ Security/Wi-Fi Points

1. LAN Architecture

RJ 45 data outlet points will be provided for Computers, Networking, Telephones, Wi-Fi, CCTV/ LED Screens etc. as per requirement in rooms and other areas at various floors in the building.

The Data Outlet points shall be connected to Rack with 4 pair CAT-6A wiring in Raceways, recessed/ surface conduit as required. UPS Power supply shall be provided to Network Rack, Servers & Computers wherever required.

The maximum length of the Cat 6A cable from end user point to the Hub or Edge switches shall not be more than 90 M. Beyond 90 M length Fibre Optic Cable, media converters etc. complete as required shall be used.

The Network Rack at various floors will be connected to Main rack of the building/ block with Fibre Optic Cable through conduit or raceways on surface/ recess.

Suitable Server room shall be established in the Building which comprises both LAN server & IPABX server. There shall be proper redundant (24 X 7) cooling facility in the Server room to maintain the desired temperature, humidity & Indoor air quality for smooth operation of the System.

The server shall be connected to Distribution switch through Optical Fibre cable. Distribution switch shall be connected to Edge switches of building/ block with optical fiber cable in underground DWC HDPE pipe of suitable size for outside connectivity or in cable raceway/conduit inside the building.

The Server shall have Firewall protection, Bandwidth management & required client Access license. The incoming Fibre cable from Service provider for the Campus Broadband connectivity shall be terminated in the Server room. The laying and termination of Fibre optic cable with proper numbering/ferruling/splicing within the campus shall be provided.

All the Racks in the building shall be comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, Trans-receivers, Fiber patch cord etc.

LAN Infrastructure at different Floors of building shall be used commonly for IPABX, BMS, Access Control System, CCTV, etc. along with LAN.

Brick masonry manholes with covers shall be provided at suitable lengths to facilitate easy wire/cable pulling.

2. Wi – Fi Campus

The entire complex is to be made Wi-Fi enabled with high-speed internet connection to allow the students and other staff to access the internet no-matter wherever they are in the building. All the websites browsed by the users are to be regularly monitored with proper access restrictions to prohibited websites. The

devices MAC has to be binded for regular monitoring and prohibiting unauthorized access.

3. Server Room:

A Server Room shall be constructed for whole LAN storage, Monitoring & Control of the system.

The Server Room shall be with the facility like Fire Suppression system, Fire Detection System, UPS, Access Control, CCTV and other IT equipments.

9.4. IPABX System

The IP based voice solution has been designed. The voice architecture will comprise of centralized IP PBX servers. IP based voice telephony will be used for all voice communication.

- An entry level basic IP SIP phone with a 10/100 network is proposed for users at all the locations in the building.
- The IP based communication solution should also have ability to handle mobility such that any user can be reached on an IP/Video Phone and on mobile phone simultaneously.

9.5. Fire Detection / Alarm System

DESIGN

The System shall consist of 32-bit Microprocessor based Intelligent Addressable Main fire alarm panel with digital voice command system, Fire fighters telephone, amplifier, zone selector keypad and announcement console, networkable repeater panels, all fire alarm panels connected as peer to peer through Network Communication Cards (Wire/Fiber). Class A cabling to loop all detectors, devices & MCP‟s to control panel**.** Coverage per detector shall be as per latest edition of NFPA 72 considering > 60 ACH. OR Coverage area per detectors may be taken as 50 sq. mtr. System integration (Soft integration) with all standalone panels such as agent release panels for deluge valves, Pre-action panels, lift switchboard, DG fresh air switchboard, etc. VESDA (Very Early Smoke Detection Apparatus) to cover the false flooring and room void areas of all Critical areas like server room etc.), Emergency communication system, integral with the Main FACP, including voice alarm system components, microphones, amplifiers, zone selector keypads and tone generators, Audible Alarm Notifications, Fire fighters telephone system as part of main fire alarm system which is two-way, supervised voice communication proposed to link

between the MFACP and remote fire fighters' telephone stations throughout the building (at all staircases at all levels).

Addressable Intelligent fire detection and Alarm system of latest technology with Analogue Addressable Fire alarm panels,Multi Sensor detectors (Photo thermal) (Carbon Monoxide + Smoke + heat + Infrared) Smoke detectors, Heat detectors (Rate of rise cum fixed temperature), Addressable Beam detectors, Duct Detectors, Response indicators, Manual call point and Addressable Hooters, light strobe, Hooter cum strobe shall be provided. It shall meet the requirement of NBC 2016/CPWD Specifications/ State By laws. License/Approval of Local Fire Authorities shall be provided for the complex. There shall be the proper Zoning & Networking of the complex/buildings considering the Non Critical & Critical areas in the buildings. Addressable detector shall be immune from nuisance alarms caused by EMI and RFI. Repeater panel shall be provided in building which is manned 24X7 as required.

There shall be Independent Integrated fire panel with inbuilt Voice evacuation and Two Way Communication system.. For Central Monitoring of all the Fire Panels, necessary devices like PC, Printer, modules & Graphics Software etc. of latest technology with minimum 1 TB hard disk shall be provided in the Control room. Fire Alarm Control Panel shall have Minimum 120 devices and 120 detectors in one loop. The details of the system proposed shall be as follows:

a) Addressable intelligent Spot type Fire Detectors is suggested.

b) Detectors should be with standard base and address switch manual addressing. Detectors should be installed as per coverage defined in NFPA 72 standard. It should include all rooms, halls, storage areas, attics, lofts, and spaces above suspended ceilings including plenum areas utilized as part of the HVAC system. In addition, coverage should include all closets, elevator shafts, enclosed stairways, dumbwaiter shafts, chutes, and other subdivisions and accessible spaces.

c) Suitable numbers of input/ output (C/M) relay modules are suggested for connecting other equipment like Electrical Panels, lifts, firefighting system, AHUs, Ventilation Fans, Pressurization Fans, Fire Dampers, Access Control, Water flow Detector etc.

d) Spacing between two detectors shall not be more than 7.5 Mtr or it shall be as per relevant code & manufacture standards.

e) Cabling shall be with Fire Survival Armoured copper cable/2Cx1.5 sq.mm copper cable in steel conduit.

f) Suitable addressable sounders/ hooters/Strobes for 80 dBA @ 3m for Audible annunciation and 115cd flashing at 1 Hz for visual indication sound level are suggested.

g) Addressable manual call boxes, Fire Fighter Jacks shall be provided near all exits, stair cases lift lobbies etc. as per relevant Norms.

h) The Response Indicators shall be used in the waiting areas, Corridors, Common Area, or in other areas as per the requirement & NBC 2016/CPWD Specifications.

i) Microprocessor fire alarm control panel (CPU redundancy or Degrade Mode in FACP) for number of required loops with 24 hrs. Battery backup with Minimum 854 Character LCD display, printer etc. shall be located in the fire control room.

j) Fire Alarm Panels shall be integrated with BMS also through BACnet /Modbus Cards.

k) Two Way communication Fire Fighters Telephone Jack & Handset with necessary accessories are to be provided in the building as required and shall be inbuilt in Fire Alarm Panels and should be of same make of Fire Alarm System.

9.6. Public Address System (Digital Voice Communication System):

PA system shall be provided in building as required. Speakers in the Ceiling/Wall shall be provided in corridors, lift lobbies and other common areas as per NBC 2016/relevant IS codes.

The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.

The system shall support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.

Each designated zone shall transmit separate and different alarm, supervisory and trouble Signals to the Fire Command Center (FCC).

Speakers in the Ceiling/Wall shall be provided in corridors, lift lobbies and other common areas as per NBC 2016/relevant IS codes.

a) Wall Mount Box type speaker shall be provided in the entrance lobby.

b) Horn/Wall type speaker are suggested in the basement.

c) Ceiling Type Recessed speakers in the false ceiling areas.

d) The speakers shall be of same make as that of the Class D Amplifiers and shall have a Rugged, high impact, flame retardant thermoplastic housings.

e) Proper zoning are to be done considering the user requirement, critical areas & floor etc.

f) System shall have the facility to make announcement on all floors simultaneously or on individual floors.

g) Wiring shall be done with twin twisted tinned copper wire in the steel conduit.

h) Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.

i) Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.

j) Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.

9.7. Closed Circuit Television System (CCTV System)

1. CCTV Cameras

The surveillance system will be a combination of Dome /Bullet and PTZ IP cameras. The CCTV cameras will be installed at all sensitive locations entry/exit Points, Corridors, Lift Lobbies, reception, Staircases, Parking locations, Waiting Areas, Boundaries etc.

The CCTV System shall be based on a digital network solution that enables video, data and/or audio streaming over an IP network. The proposed system should capture, store and analyze Video images.

The overall Video system shall be connected via a secured LAN network and shall be built using fiber optic & CAT6A communication cables utilizing standard TCP/IP Protocols.

The system shall be able to select any cameras to any monitors. However, the System Administrator shall be able to control the viewing rights of individual users.

The cameras will work on 24 X 7 basis and transmit quality video feeds to the CCC would capture the video feeds at minimum 25 FPS during entire duration of day. The cameras should support Tripple-Quad streaming.

The System shall have facility of PTZ Camera Live stream and fixed camera live with recording in full Camera resolution and full fps as well as in any desired combination and system shall allow recording resolution and frame rate for each camera user programmable.

The proposed cameras will be rugged and weatherproof, suitable for outdoor installation and will support day-night vision. The System shall have facility to send auto e-mail / SMS facility on predefined address/Number in case of specific user defined Alarms generated in alarm Audit file/Events file.

Basically, the entire campus should be covered & monitored from the surveillance control center.

Video Analytics

Analytics software shall bring significant benefit to review the incidences and look for suspicious activity in both live video feeds and recorded footages.

The solution shall enable simultaneous network video recording from network, intelligent video analysis and remote access to live and recorded images from any networked computer. It shall and classify objects such as cars and people and push content to the respective security personnel as required for real time analysis. The system shall also have display of timeline, customizable site map, live video, video playback, integrated site map, remote live view, multi-site capability, encryption, watermarking and event-based recording.

The wiring inside the building shall be with CAT- 6A cable in conduit and for Outdoor connectivity Armoured fiber Optic Cable shall be used. Optical fiber cable shall be laid underground in HDPE pipes with suitable Manholes for easy pulling and proper Maintenance. PTZ cameras can be installed on Poles with necessary mounting arrangements in external areas**.** The Video wall/no**.** of 55" LED displays shall be provided according to all the no. of cameras at final execution. The video management server should have minimum 30 days storing capacity and lifetime licenses for all cameras from day 1.

9.8. UPS:

UPS units of capacity **1 x 200 KVA** Three phase power supply shall be provided. UPS shall be installed for Emergency lighting, Data, CCTV Racks loads, Screens & other all ELV services as required in the building. Microprocessor Based True online Double conversion **Modular UPS** with latest **IGBT technology** with isolation Transformer is to be provided for uninterrupted power supply for Emergency requirements.

The UPS System shall be for **30 Min** Backup with Maintenance Free batteries and Bypass system. The system shall have the incoming and outgoing switchgear panel. The system shall include the interconnection of UPS Input/output power supply Panels & UPS units, UPS & Batteries through flexible copper cables of suitable size. UPS shall be equipped with communication card for data monitoring on BMS System.

B. Design Basis Report- LIFTS

1. **GENERAL**

Passenger lifts, service lifts etc. shall be provided in the building. The installation shall be carried out as per rules & regulation of local bodies and IS Codes that governs the requirement of installation of the lift. The voltage and frequency of the supply shall subject to variation permissible under Indian Electricity Act and Rules. For better use of lifts /service Personal Occupant Requirement Terminal technology should be applied where more than 2 lifts installed in the single lift lobby.

Passenger cum Bed lifts, Passenger lifts, service lifts shall be provided, as per details given below:

Lift Car shall be as per NBC - 2016 part 8 and OEM Standards.

The list provided in the DBR is Indicative & minimum to be provided. Lifts shall be provided as per the Traffic Analysis of individual building as per NBC 2016 and relevant IS Standard.

INCITE AT GBU, GUJARAT - Lift Details						
SL No.	**Building Block**	**Floor to Floor Height in Mtr**	**Goods Lift (1Ton)**	**Passenger Lift (13P)**	**Passenger Lift (20P)**	**Remarks**
1	Incite Building	4.2			2	B+G+9

2	Incite Building	4.2		1		G+9+T
3	Incite Building	4.2	1			B+G+5
4	Incite Building	4.2	1			G+10
	Note: 1. All Lifts will be Gearless type without Machine Rooms. 2. All standard type accessories like ARD, Voice Announcement etc. shall be provided. 3. Speed shall be considered 1MPS upto G+4 floors.					

Note:

1. Lift well; Car Size, Lift Pit Depth, Overhead, and Clear Entrance Width & Height dimensions shall conform to NBC 2016 or OEM Standards/ recommendations. All lifts shall be Gearless Type without Machine room & Centre Opening.

1. Passenger Lift Speed: for building height upto G+5 - 1 mtr/sec

   For building height upto G+6 floors & above - 1.5 **–** 2.5 mtr/sec

2. Anti-skid SS Chequered plate flooring of suitable thickness shall be provided in all the lifts.

Lifts shall be complete in all respect as per technical specifications and directions of Engineer-in-Charge/Consultant.

INCITE – GBU					**Annexure-A**	
Details of Connected Load/ Max. Demand						
S.NO.	**TYPE OF FITTINGS**	**WATTAGE**	**Qty**	**LOAD (WATTS)**	**Div.**	**DEMAND LOAD (WATTS)**
A	**LIGHT LOAD**					
1	6 W LED D/L	6	290	1740	0.8	1392
2	12 W LED D/L	12	124	1488	0.8	1190.4
3	15 W LED D/L	15	1232	18480	0.8	14784
4	45 W LED D/L	45	0	0	0.8	0
5	10 W LED BATTEN (SURFACE/CEILING)	10	115	1150	0.8	920
6	18/20 W LED BATTEN (SURFACE/CEILING)	20	290	5800	0.8	4640
7	40 W LED BATTEN (SURFACE/CEILING)	40	379	15160	0.8	12128
8	120 W LED FLOOD LIGHT	120	0	0	0.8	0

9	36 W 600 X 600 LED	36	1737	62532	0.8	50025.6
10	10 W SPOT LIGHT	10	0	0	0.8	0
11	9 W BULK HEAD	9	53	477	0.8	381.6
12	6 W Exit Light	6	120	720	0.8	576
13	1200 / 1400 MM CEILING FANS	40	1272	50880	0.8	40704
14	400 MM WALL BRACKET FANS	55	0	0	0.8	0
15	EXHAUST FANS (300MM/ 450 MM)	80	121	9680	0.8	7744
	TOTAL LIGHT LOAD					**134486**
B	**POWER LOAD**					
16	6A LIGHT PLUG POINTS	100	20	2000	0.8	1600
17	16A POWER PLUG POINTS	500	2850	1425000	0.5	712500
18	30 A TPN POWER POINTS- LABS	1500	139	208500	0.5	104250
	TOTAL POWER LOAD			**1635500**		**818350**
C	**UPS LOAD**					
19	2X6A LIGHT PLUG POINTS FOR COMPUTETRS	150	1524	228600	0.8	182880
20	16A POWER PLUG POINTS - UPS	500	28	14000	0.8	11200
	TOTAL UPS LOAD			**242600**		**194080**

INCITE AT GBU **Annexure-A**

ELECTRICAL LOAD REQUIREMENT

S.No.	Description	Max demand of Light Load in KW	Max. Demand of Power Load in KW	Total Max. Demand Load in KW	Load on DG Set	Remarks
1	Incite Building	134	818	953	134	Light Load taken on DG Set
2	UPS Load			194.08	194.08	100 % Load taken on DG Set
2	HVAC (780 TR)			975	243.75	AHU Load taken on DG Set
3	Fire Fighting Pump			20	20	100 % Load taken on DG Set
4	Water supply Pumps			20	20	100 % Load taken on DG Set
5	STP/ETP			20	20	100 % Load taken on DG Set
6	External Lighting			2	2	100 % Load taken on DG Set
7	Lifts (5 Nos.)			75	75	100 % Load taken on DG Set
		Total Load in KW		**2259**	**709**	
		Overall Diversity		**0.80**	**0.80**	
		Total Load in KW		**1807.13**	**567.45**	
		Total Load in KVA		**2126.04**	**667.59**	
		Transformer /DG Capacity Required (80 % Loading)		**2657.55**	**834.49**	
		Transformer /DG Capacity Proposed		**1 X 2500 KVA (1W)**	**1 X 750 KVA**	

INCITE BUILDING

AT

GUJRAT BIOTECHNOLOGY UNIVERSITY

AT GANDHINAGAR, GUJRAT

Design Basis Report for HVAC Design

CLIENT

GBU

Dated: 02nd December 2025 (R0)

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DESIGN BASIS REPORT – HVAC

1.1. Objective

The purpose of this report is to establish the design basis for the HVAC system required for the Incite Building at Gujrat Biotechnology University, Gadhinagar.

The design philosophy is to ensure fulfillment of all fundamental requirements in accordance with Design Guidelines, Relevant Standards and Codes as well as local Bye Laws.

The Design approach shall be sensitive to environmental issues. The main thrust shall be laid on Energy Conservation, Safety and Ease of Maintenance and current technical development.

The HVAC system must ensure temperature control, humidity regulation, ventilation, and filtration that meets safety, operational efficiency, and environmental compliance.

1.2. Standard & Codes

The applicable standards/ codes are: -

2.1 ASHRAE Standard.

2.2 ASHRAE 62.1 – Indoor Air Quality

2.3 National building codes – Building Services.

2.4 IS: Codes.

2.5 ECBC 2017

2.6 CPWD HVAC Specification.

2.7 ANSI/AIHA Z9.5 (Laboratory Ventilation)

2.8 ISHRAE Standard.

2.9 SMACNA

1.3. System Description

DBR for this project shall have description of HVAC system for Incite buildings consist of Basement, Ground, First to Ninth Floor.

1.4. Design Principles

- Objective of HVAC System Design is to ensure proper thermal comfort & Indoor Air Quality as per design standards mentioned above along with Energy Efficiency, Flexibility of Operation, Cost Optimization, BMS Compatibility and Green Building Rating Compliances.
- The ratings and capacities of various equipment are indicative and subject to up gradation/revision during detailed designing stage. However, chillers and capacities of major equipment specified in the tender shall be minimum & any enhancement in the capacity of chillers & other equipment if required shall be done as per the engineer in charge without any extra cost.
- Equipment sizing of HVAC system shall take into account factors such as geographical location, climatic conditions, water availability & quality etc.
- The cooling requirements shall be achieved through efficient air-conditioning system.
- One number standby (n+1 configuration) shall be considered for Chillers, all type of Pumps, Cooling Towers etc.
- HVAC Plant Room shall be provided with safety equipments / items like suitable elastomeric mat (as per relevant IS codes), fire buckets, fire extinguishers, hand gloves, safety charts, framed Schematic / SLD etc.
- Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Pipelines, Ducts etc. in all floor slabs of various buildings for various service areas, as required. All shafts, cutouts, Niche, openings etc. provided on floor slabs shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.
- Provide adequate ventilation based on lab classification.

- The laboratories will be considered as normal lab and designed accordingly. In these laboratories will be having AHUs which will have return air and it will be mixed to the AHUs.
- Faculty rooms - 1 Way cassette/Hi-wall unit with individual control.
- The air conditioning will be provided 24/7 in fire & UPS/Server room.
- Chillers and cooling towers shall be housed in the service blocks, cooling towers in the roof top.
- Fire/smoke integration:

  Smoke extraction system with the the provision of exhaust air axial flow fan in auditorium having capcity 1000 person is propsed. The fresh air will be supplied at bottom level as per provision.

  The NBC Code 2016 for smoke extraction system is shown below with highlighted in yellow.

4.5 Compartmentation

4.5.1 *General*

a) It is important to limit the spread of a fire in any building. The usual method is to use fire barriers. In some instances these barriers need to be penetrated for ductwork, plumbing and electrical systems, and in such cases, use of passive fire protection measures shall be done so that the integrity of these barriers is not compromised.

b) Floor(s) shall be compartmented with area as given below.

4.5.2 All floors shall be compartmented/zoned with area of each compartment being not more than 750 m^2. The maximum size of the compartment shall be as follows, in case of sprinklered basement/building:

Sl No.	*Use*	*Compartmentation Area* m^2
(1)	(2)	(3)
i)	Basement car parking	3 000
ii)	Basements (other than car parking)	2 000
iii)	Institutional buildings: Subdivision C-1	1 800
iv)	Institutional buildings: Subdivision C-2 and C-3	1 125
v)	Mercantile and assembly buildings	2 000
vi)	Business buildings	3 000
vii)	All other buildings (Excluding low hazard and moderate hazard industrial buildings and storage buildings)[1)]	750

[1)] Compartmentation for low hazard and moderate hazard industrial buildings and storage buildings shall be done in consultation with local fire department.

In addition, there shall be requirement of a minimum of two compartments if the floor plate size is equal or less than the areas mentioned above. However, such requirement of minimum two compartments shall not be required, if the floor plate is less than 750 m^2.

Compartmentation shall be achieved by means of fire barrier having fire resistance rating of 120 min.

4.6 Smoke Control

4.6.1 *Smoke Exhaust and Pressurization of Areas Above Ground*

Corridors in exit access (exit access corridor) are created for meeting the requirement of use, privacy and layout in various occupancies. These are most often noted in hospitality, health care occupancies and sleeping accommodations.

Exit access corridors of guest rooms and indoor patient department/areas having patients lacking self preservation and for sleeping accommodations such as apartments, custodial, penal and mental institutions, etc, shall be provided with 60 min fire resistant wall and 20 min self-closing fire doors along with all fire stop sealing of penetrations.

Smoke exhaust system having make-up air and exhaust air system or alternatively pressurization system with supply air system for these exit access corridors shall be required.

Smoke exhaust system having make-up air and exhaust air system shall also be required for theatres/auditoria.

Such smoke exhaust system shall also be required for large lobbies and which have exit through staircase leading to exit discharge. This would enable eased exit of people through smoke controlled area to exit discharge.

All exit passageway (from exit to exit discharge) shall be pressurized or naturally ventilated. The mechanical pressurization system shall be automatic in action with manual controls in addition. All such exit passageway shall be maintained with integrity for safe means of egress and evacuation. Doors provided in such exit passageway shall be fire rated doors of 120 min rating.

Smoke exhaust system where provided, for above areas and occupancies shall have a minimum of 12 air changes per hour smoke exhaust mechanism. Pressurization system where provided shall have a minimum pressure differential of 25-30 Pa in relationship to other areas.

The smoke exhaust fans in the mechanical ventilation system shall be fire rated, that is, 250°C for 120 min.

For naturally cross-ventilated corridors or corridors with operable windows, such smoke exhaust system or pressurization system will not be required.

4.6.2 *Smoke Exhaust and Pressurization of Areas Below Ground*

Each basement shall be separately ventilated. Vents with cross-sectional area (aggregate) not less than 2.5 percent of the floor area spread evenly round the perimeter of the basement shall be provided in the form of grills, or breakable stall board lights or pavement lights or by way of shafts.

Alternatively, a system of mechanical ventilation system may be provided with following requirements:

a) Mechanical ventilation system shall be designed to permit 12 air changes per hour in case of fire or distress call. However, for

1.5. Other Consideration

- In HVAC systems, duct and AHU room acoustics play a vital role in maintaining indoor comfort by minimizing noise levels. Sound generated by fans, motors, and air turbulence can transmit through ducts and into occupied spaces. To reduce this, acoustic lining within ducts, flexible connections, and vibration isolators are provided. AHU rooms are acoustically treated with sound-absorbing panels, silencers, and double-skin partitions to

contain mechanical noise. Proper placement of AHU away from sensitive areas, along with resilient mounts, further ensures quiet operation. These measures collectively create a comfortable, distraction-free environment while maintaining airflow efficiency and system performance.

- All ducting shall be GSS / GI construction as per SMACNA standard or IS-655.
- There will be expose ducting of G.S.S. factory fabricated insulated spiral duct made in two layers with insulation sandwitched in between two layers, finished with silver powder coat. The ducting shall comply with the latest IS / SMACNA standard and complete with spliter, damper, vanes etc as required complying with standard secifications and as per approved shop drawings. The insulation used shall be of closed cell, Fire-retardant, self-extinguishing type crossed linked polyethylene insulation of 25 mm thick, density not less than 24 Kg/cu.m, 'K' value not more than 0.028 Kcal/degC with adhesive tape etc. Oval ducting is a type of HVAC duct system that combines the space-saving advantage of flat-oval or round ducts with the airflow efficiency of circular ducts. Made from galvanized steel, aluminum, or stainless steel, it allows higher airflow rates at lower pressure drops compared to rectangular ducts, while fitting better into tight ceiling spaces. Its streamlined shape reduces turbulence and noise, ensuring quieter operation. Commonly used in commercial buildings, malls, offices, and airports, oval ducts also offer aesthetic appeal when left exposed. They comply with ASHRAE, ISHRAE, NBC, and BIS standards, ensuring energy efficiency, IAQ, and code-compliant HVAC performance.
- Closed-cell nitrile rubber (fire-retardant type) insulation shall be provided in addition to polyethylene insulation wherever specified.

  The insulation material shall have the following minimum properties:

  -Thermal conductivity (K value): 0.037 W/m·°K @ 20°C

  -Density: 40–60 kg/m³

  -Water vapor permeability (μ): greater than 7000

  The insulation shall be of sufficient thickness to prevent condensation and minimize thermal losses. The material shall conform to relevant fire-retardant and thermal performance standards suitable for HVAC duct applications.

Fig- Oval Duct

- The exhaust ducting of lab will be done for a critical chemistry lab by **Fiberglass Reinforced Plastic (FRP) exhaust ducting.**

- It is chosen for its excellent corrosion resistance, lightweight construction, and high mechanical strength. Often, a dual-laminate construction is used, with an inner chemical-resistant layer (like Polypropylene (PP) or Vinyl Ester) for handling corrosive fumes and an outer FRP structural layer for durability and impact resistance. Critical labs require duct materials with low smoke and flame ratings for occupied spaces, and specialized FRP blends can provide this along with the necessary chemical resistance.
- The exhaust ducting of lab will be done for a general lab by **PPGL (Pre-Painted Galvanized Iron) pipes.**
- In laboratory exhaust systems, PPGL (Pre-Painted Galvanized Iron) pipes are widely used in HVAC applications due to their durability, corrosion resistance, and cost-effectiveness. They ensure reliable conveyance of contaminated air, fumes, and particulates from labs to exhaust outlets while maintaining system integrity. The pre-

coated surface enhances longevity against chemical exposure, making it suitable for moderate lab conditions. Lightweight and easy to fabricate, PPGL piping supports efficient installation with minimal maintenance. While suitable for general laboratory exhaust, critical applications involving highly corrosive gases may still require specialized materials like FRP or stainless steel for compliance with safety and IAQ standards.

- Fire paint, or intumescent coating, is a passive fire protection applied to HVAC ducts. When exposed to high heat, it swells to form a thick, insulating foam layer that slows heat transfer to the underlying ductwork and surrounding materials, preventing structural compromise and providing crucial time for evacuation and firefighting. It helps ducts maintain performance during a fire by preventing heat from reaching and damaging the duct material.
- **PRE-FILTER (G4)**

Pre-filters (G4 class) are the first stage of air filtration in HVAC systems, designed to capture large dust particles, fibers, and debris, thus protecting fine filters and equipment. As per ASHRAE 52.2, G4 corresponds to MERV 7–8 efficiency, ensuring removal of ≥90% of particles ≥10 microns. ISHRAE and NBC/IS codes recommend their use for maintaining acceptable IAQ in commercial, institutional, and residential buildings. BIS standards (IS 7613, IS 3588) also guide filter performance and testing. G4 pre-filters are washable, economical, and durable, serving as an essential element in energy-efficient, code-compliant, and healthy HVAC system design.

- **FINE-FILTER (F7)**

Fine Filters (F7 class) are medium-to-high efficiency filters used in HVAC systems to remove fine dust, pollen, spores, and particulate matter, ensuring improved Indoor Air Quality (IAQ). As per EN 779 classification, F7 corresponds to MERV 13–14 under ASHRAE 52.2, with efficiency of 80–90% for 1–3 micron particles. ISHRAE guidelines and National Building Code (NBC/IS standards) recommend F7 filters in spaces like hospitals, laboratories, auditoriums, and offices where enhanced air cleanliness is

essential. BIS standards (IS 14295, IS 7613) define performance and testing protocols. F7 filters complement pre-filters, ensuring code-compliance, occupant health, and energy-efficient HVAC operation.

- Air distribution duct system shall have duct damper, splitter damper, collars / volume control dampers at terminals etc for control and balancing of designed CFM.

Fig:- Damper

- CBRI approved Fire damper on the AHU rooms' walls at supply and return path of the air shall be installed.
- Where ever working and standby air distribution equipment is connected with same plenum then at equipment mouth, motorised duct damper shall be installed which will open and close as per the running condition of equipment.
- All Grilles double / single louvers, Continuous Linear Grills, Square Diffusers, Slot Diffusers, Round Diffusers, Helical Diffusers, Displacement Diffuser, Long Throw Jet Nozzles, Ventilation Supply / Exhaust Air Valves, Air Volume Controllers etc. shall be in aluminium anodised construction in powder coated finish & type of grills / diffusers / nozzles / air valves / volume control dampers shall be selected as per interior design / Engineer in Charge / Consultant / Architect.
- For independent area depend upon their usage, there will be independent AHU. The AHU selected make sure that its duct should not consider to one other fire zones.
- To make sure there is no condensation in the area, there should not be any air leakage above false ceiling area by providing air tight partition above the false ceiling.

1.6. Energy Efficiency

1.4.1 The air conditioning systems operate between a minimal demand of 40% and up to a maximum demand of 95% for a major part of the year.

1.4.2 Hence, the selection proposed is such that the overall power requirement remains consistent with the demand, avoiding all possible energy waste.

1.4.3 This will be seen in the main features explained later.

- High-Efficiency Equipment: Employ high-efficiency chillers, heat pumps, and other HVAC equipment with high Seasonal Performance Factor (SPF) or Energy Efficiency Ratio (EER).
- Variable Speed Drives (VSDs): Utilize VSDs for chillers, pumps, and fans to optimize energy consumption based on actual load requirements.
- Optimized Ductwork: Design and install ductwork with minimal friction losses to reduce energy consumption for fan operation.
- Energy Management System (EMS): Implement an EMS to monitor and control HVAC systems, optimizing energy usage and identifying areas for improvement.
- Cooling and Heating Load Calculation: Perform accurate calculations to determine the cooling and heating loads of the building to ensure that the HVAC system is sized properly and operates efficiently.
- Thermal Comfort: Ensure that the HVAC system maintains thermal comfort conditions as specified in NBC 2 (BIS)/ASHRAE 55 for 100% of all occupied hours in air-conditioned areas.

1.7. Ventilation:

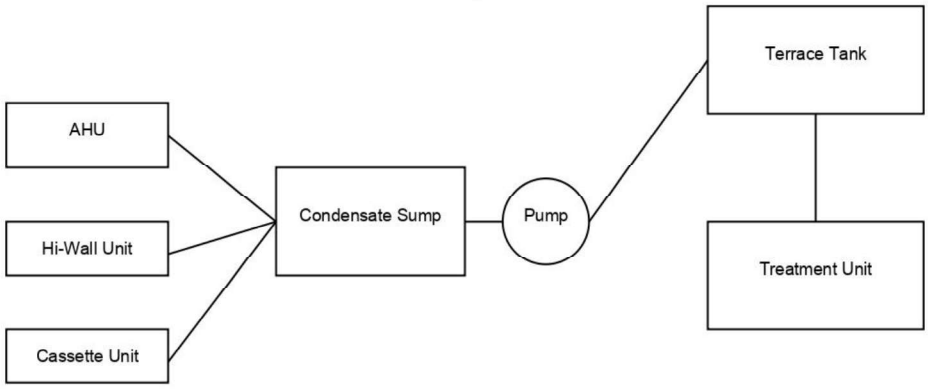
- Natural Ventilation: Maximize natural ventilation to reduce reliance on mechanical ventilation, especially in non-air-conditioned areas.
- Proper Ventilation Design: Design and install a ventilation system that provides adequate fresh air supply and removes stale air efficiently.

1.8. Water Management:

- In HVAC systems, condensate water is generated from AHUs, Hi-wall units, and cassette units etc. during dehumidification. To efficiently manage this, a sump is provided to collect the condensed water from all units. From the sump, the water is pumped to the terrace level where it undergoes appropriate treatment and filtration. Post-treatment, this water is converted into potable quality, ensuring sustainable reuse. This provision not only prevents drainage issues but also promotes water conservation by recycling a by-product of the cooling process. It is an environmentally responsible practice aligning with green building and sustainability standards in modern HVAC design.

HVAC Condensate Water Recovery System

Schematic Diagram & Notes



1. Condensate from AHUs, Hi-wall, and cassette units drains into sump.
2. Pump lifts the collected water to the terrace tank.
3. Terrace tank water undergoes filtration and purification.
4. Treated water is reused as potable drinking water.
5. System supports sustainability and water conservation.

1.9. Green Building

- A green building depletes the natural resources to the minimum during its construction and operation.
- The aim of a green building design is to minimize the demand on non-renewable resources, maximize the utilization efficiency of these resources, when in use, and maximize the re-use, recycling, and utilization of renewable resources.
- For a building to achieve a 4-star GRIHA rating, HVAC systems should prioritize energy efficiency, utilizing technologies like high-efficiency chillers, variable speed drives, and optimized ductwork, while also ensuring occupant comfort with proper ventilation and thermal comfort control.

1.10. Indoor Air Quality (IAQ):

- Filter Selection: Use high-efficiency filters to remove dust, pollen, and other pollutants from the air.
- Ventilation Rates: Ensure that ventilation rates are adequate to maintain IAQ.

- Ultraviolet Germicidal Irradiation (UVGI) is incorporated within the HVAC system to enhance indoor air quality by inactivating airborne microorganisms such as bacteria, viruses, and fungi. The system utilizes UV-C light (typically at 254 nm wavelength) installed within Air Handling Units (AHUs) or ductwork.The UVGI units are positioned downstream of cooling coils to irradiate the air stream and maintain coil cleanliness by preventing microbial growth. This improves heat-transfer efficiency, reduces maintenance, and supports a healthier indoor environment. The design complies with relevant ASHRAE guidelines for UV-C intensity, exposure time, and safety measures. All UVGI components are selected to ensure long operational life, energy efficiency, and safe access for maintenance without UV exposure risk.

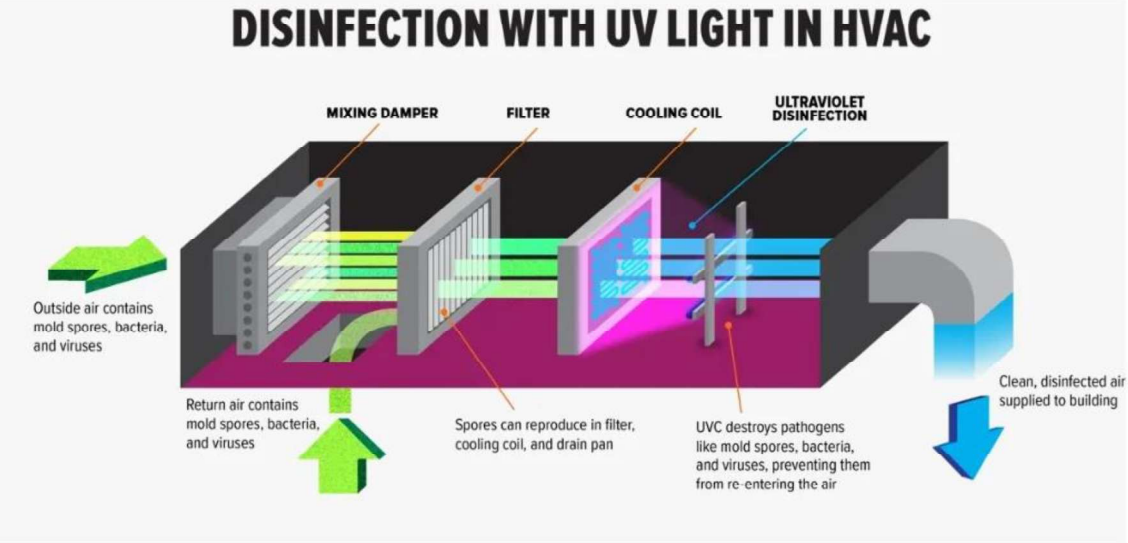


Fig- UVGI System

- **Online Chemical Treatment System**

An online chemical treatment system is provided in the chilled water piping network to ensure continuous water quality control and protection of the HVAC system. The system automatically doses corrosion inhibitors, scale-prevention chemicals, and biocides into the circulating water to maintain required chemical levels as per industry standards.The treatment unit includes a dosing pump, chemical storage tanks, flow controls, and monitoring instruments to ensure accurate dosing based on system demand. This prevents scaling, corrosion, and microbial growth inside pipes, heat exchangers, and equipment, thereby improving heat-transfer efficiency, reducing maintenance, and extending system life.Regular testing of water samples and adjustment of chemical concentration will be carried out as part of the operation and maintenance procedure.

1.11. Basis of Design

The Air conditioning System has been designed on the following design parameters

Site location.	:	Gandhinagar
Latitude.	:	23.2°N
Altitude.	:	81 meters

1.11.1. Outside Conditions

As per ISHRAE Data

- Summer : 43.3^{O}C DB; 25.6^{O}C WB
  110^{O}F DB; 78^{O}F WB
- Monsoon : 32.2^{O}C DB; 29.4^{O}C WB
  90^{O}F DB; 85^{O}F WB
- Winter : 10.0^{O}C DB ; 6.1 ^{O}C WB
  50.0^{O}F DB; 43.0^{O}F WB

1.11.2. Inside Conditions

- General : 24^{O}C +/- 1^{O}C DB
  (summer & winter) : RH not exceeding 60% in all areas.
- Labs : 24^{O}C +/- 1^{O}C DB
  RH should be less than 60%

1.11.3. Lighting Load:

Laboratory	-	10.2 W/SqMt
Faculty room/Offices	-	10.2 W/SqMt
Corridor	-	10.2 W/SqMt

1.11.4. Equipment Load:

Laboratory	-	As per requirement
Faculty room/Offices	-	5 W/SqMt

1.12.5 Fresh Air:

Laboratory	-	10 CFM / Person +0.18CFM /sqft
Other areas	-	1 Air changes per ASHRAE 62.1-2022
Common areas	–	Airconditioned

1.12.6 Occupancy : 60 sq.ft. per person / As per seating Plan

1.12.7 Building Construction Data

The building shall be designed for following are the details

1.12.7.1 Climate Zone as per ECBC: Warm & Humid.

1.12.7.2 Roof U value 2.3 W/Sqm K (0.41 Btu/ h-ft2-°F)

1.12.7.3 Walls U value 2.2 W/Sqm K (0.38 Btu/ h-ft2-°F)

1.12.7.4 Glass U value 3.47 W/Sqm K (1.1 Btu/ h-ft2-°F)

1.12. Mechanical Ventilation

- For Mechanical Ventilation designing, NBC 2016 (National Building Code of India) guidelines shall be followed
- Lab shall be ventilated as per ASHRAE guidelines.
- There will be no return air from research lab in science block. The exhaust of fume hood to be part of A/C system through dry air scrubbers. The exhaust of remaining lab will be through exhaust fans on the terrace.
- Box type acoustically insulated Inline fan shall be used for toilet ventilation of larger toilet area. For smaller toilet / toilet on external I / toilet with single WC / private toilet, circular inline fan /propeller fan shall be used.
- There will be a provision of centralised exhaust air fan for toilet which can be placed on the terrace if the toilet is on vertical stack one above each other. There should be stand by provision for the central exhaust as it will be 24X7 operational.
- Pressurization of Lift Lobby, Lift Well & Staircase (for internal)
  - All the lift well shall be pressurized through multi-level air injection to maintain 50 Pa pressure.
  - All the lift lobby shall be pressurized through multi-level air injection to maintain 25 Pa pressure.
- Latest NBC norms prevailing at the time of approval & execution to be followed.
- Dampers shall be installed at each exhaust air grill from toilet to ensure the required quantity of exhaust.
- Separate exhaust duct shall be provided for toilets, pantries, and dirty utility areas.
- These shall not be combined with each other or with any other exhaust ducts of AC System.

- Exhaust outlets shall be located at a minimum height of 3 m away from ground level and away from doors, occupied areas and operable windows.

1.13. Type of Air Conditioning System

The calculated heat load are as follows:-

S. No.	Description	Area (Sq.ft)	Occupancy	Inside Temp. (°C)	Relative Humidity (%)	Light load (Watts/Sqft)	Total equipment load (W)	Fresh Air (CFM)	Dehumidified CFM (Summer)	Tonnage Summer	Tonnage Monsoon
1	MEETING,HEAVY INSTRUMENT,BANKING,CONSULTANCY, WAITING AREA	10550	264	23.3 ± 1	55	1.0	3500	2286	22844	54.13	44.40
2	EXHIBITION AREA,CORRIDOR	5704	143	23.3 ± 1	55	1.0	2500	1236	12366	29.29	24.04
3	DINING,CAFE	2658	65	23.3 ± 1	55	1.0	1000	576	7692	16.90	13.13
	Total	**18912**	**471**					**4098**	**42902**	**100**	**82**
1	BOARD ROOM	1911	28	23.3 ± 1	55	1.0	1000	418	6391	13.23	10.42
2	DG ROOM	619	10	23.3 ± 1	55	1.0	1000	135	1810	3.86	3.10
3	PA ROOM	92	2	23.3 ± 1	55	1.0	250	20	163	0.40	0.39
4	DG ANTE ROOM	115	5	23.3 ± 1	55	1.0	250	32	516	1.12	0.83
5	PA ROOM 2	186	4	23.3 ± 1	55	1.0	250	41	704	1.46	1.02
6	EXECUTIVE ROOM 4 Nos	1538	28	23.3 ± 1	55	1.0	1000	336	3153	7.38	6.01
7	STAFF ROOM	144	4	23.3 ± 1	55	1.0	250	31	511	1.09	0.85
8	HOD ROOM 2 Nos	188	4	23.3 ± 1	55	1.0	500	41	758	1.55	1.11
9	TYPE 2, TYPE 3	986	21	23.3 ± 1	55	1.0	500	216	1820	4.45	3.69
10	STAFF ROOM	112	4	23.3 ± 1	55	1.0	250	27	559	1.15	0.81
11	TYPE 1 (2 Nos)	2130	45	23.3 ± 1	55	1.0	500	466	3787	9.37	7.79
1	HOD ROOM 2Nos	192	4	23.3 ± 1	55	1.0	500	42	650	1.37	1.08

2											
13	STAFF ROOM 2 Nos,HOD ROOM 2 Nos	440	12	23.3 ± 1	55	1.0	1000	96	1564	3.32	2.55
14	LIFT LOBBY	231	5	23.3 ± 1	55	1.0	250	51	561	1.27	0.94
15	CORRIDOR,WAITING	5324	20	23.3 ± 1	55	1.0	1000	1164	9008	20.68	15.92
16	MEETING ROOM,CABIN 2 Nos	338	8	23.3 ± 1	55	1.0	750	74	1211	2.54	1.87
17	MEETING ROOM,CABIN 2 Nos	366	8	23.3 ± 1	55	1.0	750	80	1461	2.99	2.17
18	TYPE 2 Nos	2026	48	23.3 ± 1	55	1.0	750	443	3236	8.40	7.55
19	STAFF ROOM, HOD ROOM 8Nos	901	24	23.3 ± 1	55	1.0	2000	197	3228	6.83	5.23
20	COMPACTOR ROOM	329	5	23.3 ± 1	55	1.0	250	72	865	1.88	1.34
21	PA ROOM	160	2	23.3 ± 1	55	1.0	250	35	225	0.57	0.55
22	EXECUTIVE ROOM	337	2	23.3 ± 1	55	1.0	250	74	1548	2.99	2.06
23	50 SEATER CONFERENCE HALL	1535	50	23.3 ± 1	55	1.0	1000	342	5316	11.55	9.23
24	EXECUTIVE ROOM	323	8	23.3 ± 1	55	1.0	500	71	1351	2.77	2.06
25	PA ROOM	114	3	23.3 ± 1	55	1.0	250	25	311	0.70	0.53
	Total	**20637**	**354**					**4528**	**50707**	**113**	**89**
1	MICROBIOLOGY LAB	319	8	23.3 ± 1	55	1.0	500	326	1350	3.85	3.92
2	MICROSCOPY	195	5	23.3 ± 1	55	1.0	500	43	577	1.26	1.08

3	MICROSCOPY	180	5	23.3 ± 1	55	1.0	500	39	542	1.18	1.01
4	MICROBIOLOGY	334	8	23.3 ± 1	55	1.0	500	334	1381	3.94	4.02
5	INSTRUMENTNROOM, CABIN	388	8	23.3 ± 1	55	1.0	500	85	856	1.99	1.69
6	MICROBIOLOGY LABS	1890	60	23.3 ± 1	55	1.0	1000	1045	4205	12.85	13.42
7	INSTRUMENT CABIN	350	8	23.3 ± 1	55	1.0	500	77	806	1.87	1.59
8	MULTIPURPOSE HALL	878	22	23.3 ± 1	55	1.0	1000	192	2103	4.85	3.94
9	MICROBIOLOGY,CABIN,INSTRUMENT,RESEARCH AREA	2958	75	23.3 ± 1	55	1.0	2500	1699	7301	21.61	21.11
10	COLD,COMMON EQP,CABIN,STREAM LAB,INSTRUMENT,INVIROMENT BIO	3290	82	23.3 ± 1	55	1.0	3000	1415	7587	20.64	19.82
11	LIFT LOBBY	231	5	23.3 ± 1	55	1.0	250	51	561	1.27	0.94
12	CORRIDOR, INTERACTION	5300	25	23.3 ± 1	55	1.0	1000	1159	10629	23.52	17.86
13	TISSUE CULTURE ROOM ,CABIN,INSTRUMENT	2490	70	23.3 ± 1	55	1.0	2000	1728	7045	20.79	22.00
14	MEETING ROOM,CABIN 2 Nos	338	8	23.3 ± 1	55	1.0	750	74	1211	2.54	1.87
15	MEETING ROOM,CABIN 2 Nos	366	8	23.3 ± 1	55	1.0	750	80	1461	2.99	2.17
	Total	**19507**	**397**					**8345**	**47615**	**125**	**116**
1	MICROBIOLOGY LAB	319	8	23.3 ± 1	55	1.0	500	326	1350	3.85	3.92
2	MICROSCOPY	195	5	23.3 ± 1	55	1.0	500	43	577	1.26	1.08
3	MICROSCOPY	180	5	23.3 ± 1	55	1.0	500	39	542	1.18	1.01
4	MICROBIOLOGY	334	8	23.3 ± 1	55	1.0	500	335	1381	3.95	4.03
5	INSTRUMENTNROOM, CABIN	388	8	23.3 ± 1	55	1.0	500	85	856	1.99	1.69

6	MICROBIOLOGY LABS	1890	60	23.3 ± 1	55	1.0	1000	1045	4205	12.85	13.42
7	INSTRUMENT CABIN	350	8	23.3 ± 1	55	1.0	500	77	806	1.87	1.59
8	MULTIPURPOSE HALL	878	22	23.3 ± 1	55	1.0	1000	192	2103	4.85	3.94
9	MICROBIOLOGY,CABIN,INSTRUMENT,RESEARCH AREA	2807	75	23.3 ± 1	55	1.0	2000	1643	6664	19.88	20.37
10	COLD,COMMON EQP,CABIN,STREAM LAB,INSTRUMENT,INVIROMENT BIO	3290	82	23.3 ± 1	55	1.0	3000	1415	7587	20.64	19.82
11	LIFT LOBBY	231	5	23.3 ± 1	55	1.0	250	51	561	1.27	0.94
12	CORRIDOR, INTERACTION	5300	25	23.3 ± 1	55	1.0	1000	1159	10629	23.52	17.86
13	TISSUE CULTURE ROOM ,CABIN,INSTRUMENT	2490	70	23.3 ± 1	55	1.0	2000	1728	7045	20.79	22.00
14	MEETING ROOM,CABIN 2 Nos	338	8	23.3 ± 1	55	1.0	750	74	1211	2.54	1.87
15	MEETING ROOM,CABIN 2 Nos	366	8	23.3 ± 1	55	1.0	750	80	1461	2.99	2.17
	Total	**19356**	**397**					**8290**	**46978**	**123**	**116**
1	LIBRARY,CABIN	2960	74	23.3 ± 1	55	1.0	1500	647	6713	15.73	12.78
2	GYM AREA	2368	59	23.3 ± 1	55	1.0	2000	1610	5727	17.82	19.15
3	COMPUTER LAB	2419	60	23.3 ± 1	55	1.0	2500	1396	5700	16.89	17.46
4	LIFT LOBBY	231	5	23.3 ± 1	55	1.0	250	51	561	1.27	0.94
5	CORRIDOR, INTERACTION	4800	25	23.3 ± 1	55	1.0	1000	1050	9513	21.16	16.44
6	MEETING ROOM,CABIN 2 Nos	338	8	23.3 ± 1	55	1.0	750	74	1211	2.54	1.87
7	MEETING ROOM,CABIN 2 Nos	366	8	23.3 ± 1	55	1.0	750	80	1461	2.99	2.17
8	COLD,COMMON EQP,CABIN,STREAM	3290	82	23.3 ± 1	55	1.0	3000	1896	7698	22.87	23.51

	LAB,INSTRUMENT,INVIROMENT BIO										
9	TISSUE CULTURE ROOM ,CABIN,INSTRUMENT	2490	70	23.3 ± 1	55	1.0	2000	1728	7045	20.79	22.00
	Total	**19262**	**392**					**8532**	**45629**	**122**	**116**
1	OPEN INCUBATION SPACE	871	15	23.3 ± 1	55	1.0	1000	190	2409	5.22	4.38
2	ELECTRICAL ENGG AI LAB	776	19	23.3 ± 1	55	1.0	1500	530	2166	6.34	6.90
3	OPEN INCUBATION SPACE	930	23	23.3 ± 1	55	1.0	1000	203	2631	5.83	4.84
4	LIFT LOBBY	231	5	23.3 ± 1	55	1.0	250	51	561	1.27	0.94
5	CORRIDOR	2700	25	23.3 ± 1	55	1.0	1000	590	5508	12.40	9.42
6	MEETING ROOM,CABIN 2 Nos	322	8	23.3 ± 1	55	1.0	750	70	1196	2.50	1.84
7	MEETING ROOM,CABIN 2 Nos	366	8	23.3 ± 1	55	1.0	750	80	1461	2.99	2.17
8	INCUBATION LAB 1-8	3504	80	23.3 ± 1	55	1.0	5000	2092	8522	25.05	25.95
9	MEETING ROOM & INTERACTION	204	8	23.3 ± 1	55	1.0	500	52	1482	2.91	2.33
	Total	**9904**	**192**					**3859**	**25936**	**65**	**59**
1	OPEN INCUBATION SPACE	871	15	23.3 ± 1	55	1.0	1000	190	2409	5.22	4.38
2	ELECTRICAL ENGG AI LAB	776	19	23.3 ± 1	55	1.0	1500	530	2166	6.34	6.90
3	OPEN INCUBATION SPACE	930	23	23.3 ± 1	55	1.0	1000	203	2631	5.83	4.84
4	LIFT LOBBY	231	5	23.3 ± 1	55	1.0	250	51	561	1.27	0.94
5	CORRIDOR	2700	25	23.3 ± 1	55	1.0	1000	590	5508	12.40	9.42
6	MEETING ROOM,CABIN 2 Nos	322	8	23.3 ± 1	55	1.0	750	70	1196	2.50	1.84
7	MEETING ROOM,CABIN 2 Nos	366	8	23.3 ± 1	55	1.0	750	80	1461	2.99	2.17

8	INCUBATION LAB 1-8	3504	80	23.3 ± 1	55	1.0	5000	2092	8522	25.05	25.95
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1	OPEN INCUBATION SPACE	871	15	23.3 ± 1	55	1.0	1000	190	2409	5.22	4.38
2	ELECTRICAL ENGG AI LAB	776	19	23.3 ± 1	55	1.0	1500	530	2166	6.34	6.90
3	OPEN INCUBATION SPACE	930	23	23.3 ± 1	55	1.0	1000	203	2631	5.83	4.84
4	LIFT LOBBY	231	5	23.3 ± 1	55	1.0	250	51	561	1.27	0.94
5	CORRIDOR	2700	25	23.3 ± 1	55	1.0	1000	590	5508	12.40	9.42
6	MEETING ROOM,CABIN 2 Nos	322	8	23.3 ± 1	55	1.0	750	70	1196	2.50	1.84
7	MEETING ROOM,CABIN 2 Nos	366	8	23.3 ± 1	55	1.0	750	80	1461	2.99	2.17
8	INCUBATION LAB 1-8	3504	80	23.3 ± 1	55	1.0	5000	2092	8522	25.05	25.95
9	MEETING ROOM & INTERACTION	204	8	23.3 ± 1	55	1.0	500	52	1482	2.91	2.33
	Total	**9904**	**192**					**3859**	**25936**	**65**	**59**
1	OPEN INCUBATION SPACE	871	15	23.3 ± 1	55	1.0	1000	190	2409	5.22	4.38
2	ELECTRICAL ENGG AI LAB	776	19	23.3 ± 1	55	1.0	1500	530	2166	6.34	6.90
3	OPEN INCUBATION SPACE	930	23	23.3 ± 1	55	1.0	1000	203	2631	5.83	4.84
4	LIFT LOBBY	231	5	23.3 ± 1	55	1.0	250	51	561	1.27	0.94
5	CORRIDOR	2700	25	23.3 ± 1	55	1.0	1000	590	5508	12.40	9.42
6	MEETING ROOM,CABIN 2 Nos	322	8	23.3 ± 1	55	1.0	750	70	1196	2.50	1.84
7	MEETING ROOM,CABIN 2 Nos	366	8	23.3 ± 1	55	1.0	750	80	1461	2.99	2.17
8	INCUBATION LAB 1-	3504	80	23.3 ± 1	55	1.0	5000	2092	8522	25.05	25.95

	8										
9	MEETING ROOM & INTERACTION	204	8	23.3 ± 1	55	1.0	500	52	1482	2.91	2.33
	Total	**9904**	**192**					**3859**	**25936**	**65**	**59**
1	OPEN INCUBATION SPACE	871	15	23.3 ± 1	55	1.0	1000	190	2786	5.86	4.81
2	ELECTRICAL ENGG AI LAB	776	19	23.3 ± 1	55	1.0	1500	615	2521	7.30	7.94
3	OPEN INCUBATION SPACE	930	23	23.3 ± 1	55	1.0	1000	203	3034	6.51	5.30
4	LIFT LOBBY	231	5	23.3 ± 1	55	1.0	250	51	661	1.44	1.05
5	CORRIDOR	2700	25	23.3 ± 1	55	1.0	1000	590	6678	14.39	10.76
6	MEETING ROOM,CABIN 2 Nos	322	8	23.3 ± 1	55	1.0	750	70	1336	2.74	2.00
7	MEETING ROOM,CABIN 2 Nos	366	8	23.3 ± 1	55	1.0	750	80	1620	3.26	2.35
8	INCUBATION LAB 1-8	3504	80	23.3 ± 1	55	1.0	5000	2472	10126	29.39	30.61
9	MEETING ROOM & INTERACTION	204	8	23.3 ± 1	55	1.0	500	52	1570	3.06	2.44
	Total	**9904**	**192**					**4324**	**30332**	**74**	**67**
	SUB TOTAL	**147194**	**2969**					**53555**	**367907**	**916**	**821**

Caulated load- 916 TR

Proposed load- 720 TR (Diversity 85%)

1.14. HVAC Equipment & Materials

- AHRI certified water-cooled centrifugal chiller with VFD & Active Harmonic Filters (COP 6.7 & IPLV 9.1) with THDI less than 5% as per IEEE519. The chilled water inlet/outlet temperature shall be 54 deg F/44 deg F respectively

with chilled water circulation rate at 2.4GPM/TR. The Condenser water inlet/outlet temperature shall be 90 deg F/100 deg F respectively with circulation rate at 3.8 GPM/TR.

Fig:- Centrifugal Water Cooled Chiller

- Chiller Plant Optimizer- CPO shall be provided for sequencing, remote monitoring, controlling and report generation of all equipments in AC plant room/high side. Plant room manager shall be of the same make as chiller. Selected controller shall have capability to meet all the equipments of AC plant room. Supervisory controller for management level interface in MS Enclosure

  SWG thickness, powder coated Siemens grey for Supervisory Controller, IO Cards (with accessories like Transformer, MCBs, internal wiring and Relays with bases). Workstation PC i7 computer 3000 Mhz with 2 TB hard disk, 21" TFT monitor, 104 windows key board, mouse, serial and parallel ports with laser color printer. This must have software integration on chillers with 3rd party interface available on BACNET including cabling & conduit work as required with card. Chiller plant optimizer shall essentially be able to perform the following functions:

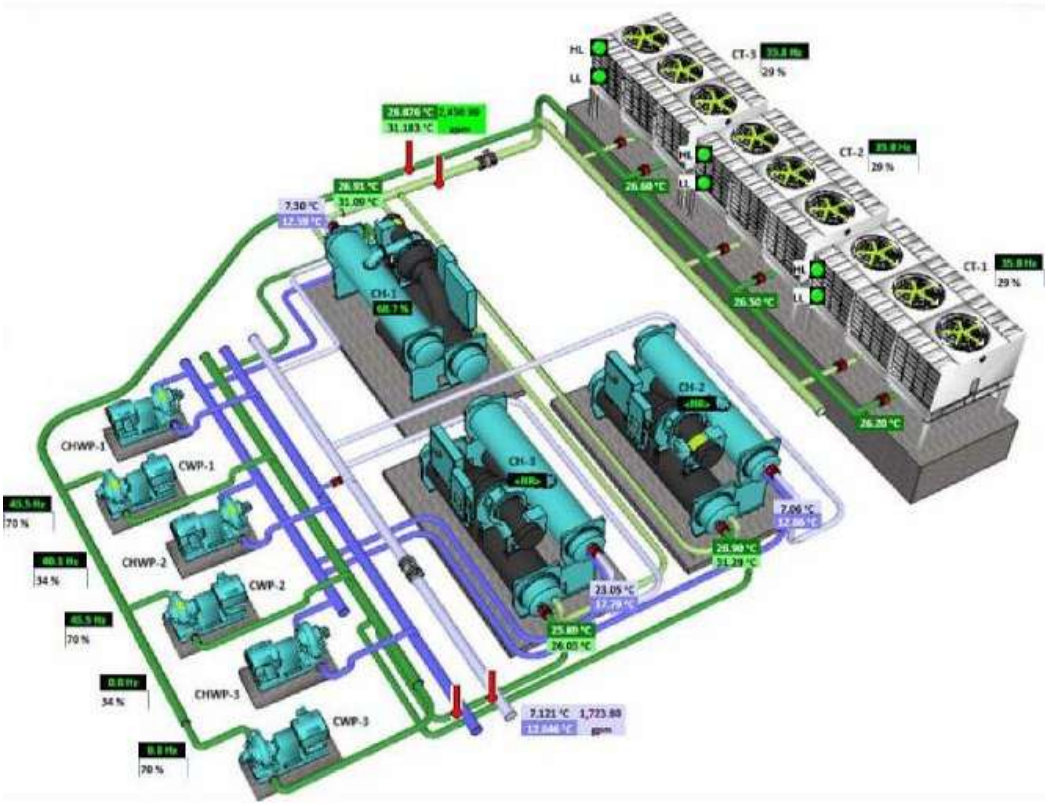


Fig:- Chiller Plant Optimizer

- Chillers start and stop operation.
- Chillers auto sequencing.
- Optimizing chillers operation with optimization software and logic.
- Auto start and stop of condenser water pumps.
- Auto start and stop of cooling towers.
- Auto start and stop of primary chilled water pumps.
- On and off operation of motorized butterfly valves at chiller outlet, at condenser outlet and at cooling tower inlet.
- Having capability for Software integration with secondary chilled water pumps panel.
- Having capability to interface with 3rd party BMS system over Bacnet / IP.
- Having capability to monitor, operate and generate reports from remote location.

Chiller plant manager shall be suitable to manage:

- Chillers
- Condenser water pumps.
- Primary, secondary chilled water pumps.
- Motorized Cooling towers Fans.
- Motorised Chilled water valves.
- Motorised Condenser water valves.

- Cooling tower valves.

1.15. Continuous Monitoring and Building Automation Systems (BMS):

- Accurate and comprehensive monitoring of environmental support equipment and in- room conditions is extremely important in a cleanroom environment. The monitoring system used must effectively assess the room conditions, or it will provide an inaccurate representation that can lead to inappropriate actions or ill-founded assumptions. The following considerations should be addressed.
- The facility's building automation system (BAS) requires the ability to monitor and control the set points as determined by the design team and documented in the project basis of design.
- Temperature, humidity sensors, filter monitoring differential switches, dust particle counters must provide a detailed and representative profile of room conditions. If a single point of reference is used, it will not give an accurate picture of the room's profile. If a single sensor is placed in an area with appropriate conditions, such as on a column directly above a perforated tile, the monitoring system would be indicating that room conditions are appropriate even though this may not be the case.
- The BAS must be capable of indicating and recording alerts and alarms when the critical processing temperature/humidity/pressurization is not to specification.
- All required Instruments and Necessary cabling / cable trays, Cable terminations etc with supporting arrangement for instruments / Control Panel mountings.
- Room Pressure / Differential pressure monitoring
- The system should have historical trend capabilities. The data gleaned from analysis of historical psychrometric information can be instrumental in determining seasonal changes or other outside influences.
- The system should include sequential particle counter for stringent cleanrooms, which can continuously monitor the cleanliness of the room.
- The system configuration and data should be periodically examined and evaluated by trained personnel to ensure that they are appropriate for the

current room demands, and to identify any problems missed in the day-to-day operations of the room.

- The cleanroom/critical lab should include automatic smoke detection units and fire protection (extinguishing system) involving “INERGEN” gas cylinders (combination of nitrogen, argon and CO2 gases) for quick extinguishing of fire and remote switches for switching off the blower in case of fire emergencies.
- An integrated building monitoring system should be used to track conditions in all of the building systems. This would include not only the in-room air conditioners and humidifiers, but also the cooling support systems, power back-up, fire detection and suppression, water detection, security and other building infrastructure and life-safety systems.

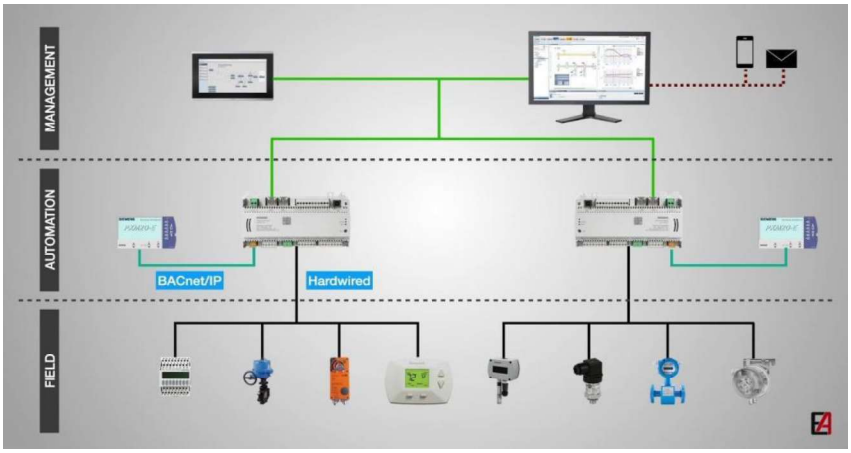


Fig:- BMS System

Fig:- Cooling Tower

- CTI Certified low noise Induced Draft Cooling Towers.
- All the electrical work related to HVAC system shall be in accordance with Electrical DBR.
- Water Circulation Pumping System shall consist of following types of pumps:

  i) **Primary Chilled Water Pump -** Split casing end suction back pulls out /vertical inline with pump efficiency more than 80% for Chilled water pumps with IP 55 TEFC induction motor with class F insulation, IE-3 efficiency class and suitable continuous duty (S1). Pumps shall include channel base with vibration isolators, coupling, coupling guard etc along with cladded insulation and anti-corrosive coating inside and outside casing etc. for the water pump.

  ii) **Condenser Water Pump -** Split casing end suction back pull out /vertical inline with pump efficiency more than 80% with IP 55 TEFC induction motor with class F insulation, IE-3 efficiency class and suitable continuous duty (S1). Pumps shall include channel base with vibration isolators, coupling, coupling guard etc along with cladded insulation and anti corrosive coating inside and outside casing etc. for the water pump.

  iii) **Secondary Chilled Water Pump -** Split casing end suction back pull out /vertical inline with pump efficiency more than 80% having IP 55 TEFC induction motor with class F insulation, IE-3 efficiency class and variable load duty for continuous operation. Pumps shall include channel base with vibration isolators, coupling, coupling guard etc along with cladded insulation and anti corrosive coating inside and outside casing etc. of chilled water pump. Pumps must also consist of 1 No. dedicated microprocessor-based pump logic controller for each set of pumps with parallel pumping software duly down loaded and capable of controlling up to 5 pumps in parallel / accepting 2 analogue input from zone sensor and should be capable of communicating with Building Management System by both hardware and software integration. Control software and networking hardware and software for integration and compatibility with BMS (BACNET Protocol) from the pump supplier. All pumps to be provided with separate VFD's (variable frequency drives). Separate control panel for each zone/set. Panel should also consist of cooling fan. Suitable no. electronic Differential Pressure Transmitters and separate PLC s for each set. Making necessary flanged suction and delivery headers in C-Class MS.

Fig:- Verical Inline Pump

- Suitable Capacity pressurized expansion tank with dosing pumps & vacuum degasser for Chilled and Hot water circuits shall be provided on each building terraces - Supply, installation, testing and commissioning of pressurized closed type Expansion tank with air separator and dosing pumps (1w+1s) separately for chilled water and hot water circuits. The expansion tank shall be complete with all necessary valves, vent connection. Quoted price shall include of 50 mm thick 32 kg/mt cu density TF quality Expanded polystyrene insulation and cladded with 24-gauge aluminum sheet for chilled water tank and glass wool insulation as per specifications with aluminium sheet cladding for Hot water tank. Tank shall be equipped with 15 mm dia vent, 450 mm dia manhole with cover, 40 mm dia make up with overflow connection (ball valve should be provided at the make up line), 50 mm dia drain and over flow with necessary valves and 50 mm dia insulated pipe connection to nearest chilled water return line.

Fig:- Closed Type Expansion Tank

- Dirt Separators as per the specifications on the return water line located at the pump suction or a suitable location as suggested and suitable for water flow as required shall be provided on each building terraces. The separator should be

complete with air vent, service valve, flanges, drain valve etc. The separator should be capable of removing dirt particles upto 5 micron size.

Fig:- Air Dirt Seprator

- Double skinned air handling units (AHU) with AHRI / Eurovent certified coils Supply, installation, testing & commissioning of DOUBLE SKIN, FLOOR MOUNTED, sectionalized construction, draw through type, THERMAL BREAK DESIGN with EC/Plug type fan air handling unit (AHU) as per the requirement. The AHU fan motor should comply with EC-4 standard. The air handling units shall consist of mixing box with return air & fresh air duct connection flanges. Fresh air port will have a volume control damper. Return air duct connection will have a fire-retardant flexible connection and a motorised damper. Controls for AHUs comprising of a set of PN-16 rating 2 Way pressure independent dynamic balancing cum control valve of required size fitted with modulating actuators having manual override facility on each AHU along with wiring for interconnections with 1.5 sq. mm Cu Conductor multicore armoured complete as required. The actuator shall have required shut off capability of minimum 4 bar rating. The actuator shall be compatible with BMS. The valve actuator shall be capable of accepting 2-10 volt DC, 4-20 mA electric signal and shall provide similar transduced feedback output signal to control system. Each AHU shall comprise of minimum 2 stage filtration system for all the areas etc is to be provided. Accordingly Pre-filter section with MERV-8 filters. (Synthetic Fiber Pre-filter) (90% down to 10 micron shall be provided. Cooling coil section with 6/8 Row deep copper tubes & aluminum fins cooling coil. Minimum 2 bend GSS/PVC eliminators. The AHU shall also consist of Fan section with AMCA certified low noise high efficiency DIDW Centrifugal fan, Backward Curved, direct/belt driven with fire retardant flexible

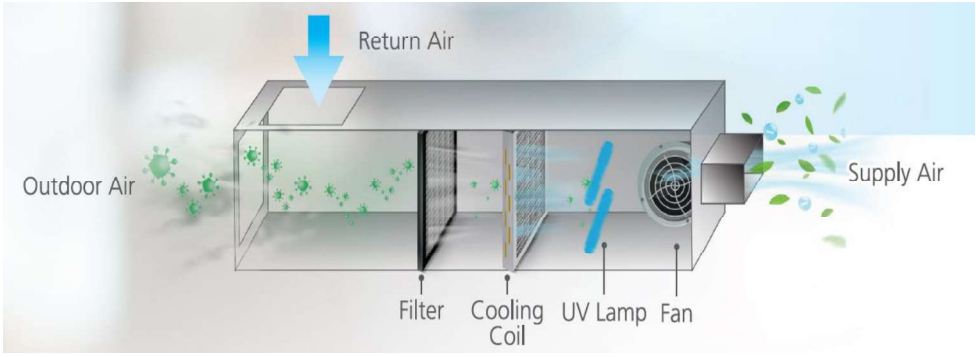
connection at fan outlet. Each AHU shall have High efficiency 'IE3', continuous duty (S1), IP55 squirrel cage induction motor suitable. Motor shall be suitable for VFD operation. AHUs shall be complete with V-Belt drive/direct drive package. Fan & motor shall be mounted on a common base frame with motor sliding rails & complete base frame mounted on the AHU casing with vibration isolator/spring isolators. Necessary vibration isolators & supporting arrangement. Fresh air intake arrangement, necessary water drain & air purge valves wherever required etc. The unit shall be provided with water resistance marine light and limit switch with power cabling. Canvass connections, necessary foundations, 2 nos pressure gauge, 2 nos thermometer etc. Insulated SS 304 Drain pan, drain connection. The unit shall be BMS compatible.

- The sound level of the AHUs should be less than 65 db at 1 meter.
- Pressure Sensor:
  Each AHU with VFD-controlled supply air fan shall be equipped with a differential pressure sensor to regulate fan speed automatically and maintain the required static pressure in the duct.
- Thermostat:
  A space temperature sensor (thermostat) shall be provided to control the two-way motorized chilled water valve for precise temperature regulation based on room conditions.
- CO_2 Sensor:
  A CO_2 sensor shall be installed in the return air path to monitor indoor air quality and modulate the motorized fresh air damper accordingly, ensuring adequate ventilation and maintaining acceptable CO_2 levels.

Fig:- Air Handling Units

- Variable air volume (VAV) boxes with digital display type thermostat for individual room temperature control. The Noise level for the VAVs shall be less than 30 dB for office areas.
- Low noise Fan Coil Units/hydronic type hi-wall/cassette unit with valves & fittings in selected areas only with temperature control and valve accessories set.

- Toilet ventilation suction Grills, inline fans etc as required.
- Fume hoods and Biosafety cabinet exhaust fan etc wherever required.
- Ultra Violet Germicidal Irradiations, (UVGI) System for Improvement of Indoor Air Quality and Energy Saving on AHU's Coil shall be provided for critical lab areas for maintaining indoor air quality. The UVGI System shall consist of UV lamps, reflector with its mounting assembly and control panel. The Control Panel shall be mounted outside the AHU and should consist of ballast, hour meter, MCB, Indicating Light. The ballast and UV lamps shall be of instant start type. Including inter connected wiring between the UVGI lamps and panel. Alternatively, the ballast may also be installed inside the reflector assembly itself depending on manufacturer's design.



- Complete Building Management System (BMS) with controls and monitoring.
- All Electrical Motors min IE-3 efficiency ratings.
- Motor Control Centre, Sub Panel, Power & Control Cabling, Earthing etc.as per IS standards.
- Air Distribution – FRP ducting for fume hood exhaust, GSS Ducting, GI Ducting for Kitchen Exhaust, Aluminium Construction Grilles Double / Single Louvers, Continuous Linear Grills, Square Diffusers, Slot Diffusers, Round Diffusers, Helical Diffusers, swirl diffusers, plaque diffusers, Displacement Diffuser, Long Throw Jet Nozzles, Ventilation Supply / Exhaust Air Valves, Air Volume Controllers etc. GSS Ducting can be rectangular, circular, elliptical, spiral.
- Fire paint shall be applied on fire-rated ducts (kitchen exhaust, staircase pressurization, and smoke extraction ducts) to restrict spread of fire and smoke. The coating swells under high temperature, forming a protective char layer and ensuring 2–4 hours fire resistance. Application shall comply with NBC 2016, NFPA 90A, and ISHRAE guidelines, with manufacturer's test certification.
- Motorized Fire & Smoke Dampers shall be CBRI approved (250deg, 2hrs).
- Chilled, Condenser, Drain Water Piping with insulation Valves & Fittings, HVAC system controls etc.
- Chilled Water & Condenser Water Pipe, Fittings & valves shall be joined through grooved end technology for the sizes 20NB and above.
- Insulation / Lining – Duct Insulation & Duct Acoustic Lining, Plant Room, DG Room Acoustic Lining, Chilled / Drain Water Pipe & Fittings Insulation with aluminum

cladding, Factory Insulated Valves in Chilled Water Pipes or Site Insulation with aluminum cladding etc.

- Supply, Installation & Commissioning of Air Conditioning & Mechanical Ventilation System.
- Testing- commissioning & Balancing of Water & Air System complete.
- A **Dry Air Scrubber** is an advanced filtration device used in HVAC systems to remove gaseous contaminants, odors, and fine particulate matter without the use of water or liquid media. Unlike wet scrubbers, it employs impregnated activated carbon, chemical adsorbents, or dry media cartridges that chemically react or adsorb pollutants such as SOx, NOx, VOCs, and formaldehyde.

Fig: - Dry Air Scrubber

Air passes through these high-surface-area media beds where harmful gases are neutralized, while fine particulates are simultaneously trapped. According to ASHRAE guidelines (62.1 & 145.2), dry scrubbers are recommended for spaces requiring stringent Indoor Air Quality (IAQ), such as hospitals, laboratories, airports, and clean manufacturing. ISHRAE standards and the National Building Code (NBC) of India also emphasize gaseous contaminant control in critical facilities. BIS codes (IS 14295, IS 7613) specify requirements for air-cleaning equipment, ensuring efficiency, safety, and testing procedures. A typical dry scrubber introduces an additional static pressure loss of 150–300 Pa, depending on media thickness and face velocity, which must be considered in fan and duct design. Widely applied in healthcare, pharmaceutical, semiconductor, and commercial buildings, dry air scrubbers are vital for sustainable, code-compliant HVAC design ensuring occupant safety and environmental protection.

- An **Axial Flow Fan** is a mechanical device used in HVAC systems to move large volumes of air along the axis of the fan, providing ventilation, exhaust, and air circulation. It consists of a rotor with blades mounted on a central hub, housed

within a casing or duct. When the blades rotate, air is accelerated along the fan axis, generating airflow with relatively low static pressure. Some designs include adjustable or fixed pitch blades to optimize efficiency for specific applications.

Fig:- Axial Flow Fan

Axial fans are widely applied in exhaust systems, cooling towers, air handling units, and general ventilation, where high airflow at low to moderate pressure is required. According to ASHRAE standards, axial fans are suitable for applications where energy-efficient, high-volume air movement is critical, such as industrial halls, auditoriums, and labs. ISHRAE and NBC/IS codes provide guidelines for selection, installation, and noise control, ensuring compliance with ventilation and IAQ requirements. BIS standards (IS 9007, IS 4665) specify fan performance, testing, and structural safety. Axial fans generally operate at low static pressure (50–250 Pa), making them ideal for short duct runs or open-area ventilation. Proper sizing and selection ensure optimal airflow, reduced energy consumption, and quiet operation, making axial flow fans a reliable and cost-effective solution for both commercial and industrial HVAC systems.

1.16. Design Parameters for HVAC Equipment

A) **Air-handlers**

a) Maximum Face velocity across cooling coil MPM	:	152
b) Maximum face velocity across filters MPM	:	152
c) Maximum water pressure drop across the coil in Mt.	:	4.6
d) Maximum water velocity through coil in MPS	:	2.5
e) Maximum Fan outlet velocity MPS	:	10.0

B)	**Ducting**			**Work**
	a) Method of Duct Design	:	EFM	
	b) Maximum air velocity in supply duct (AC) MPM	:	450	
	c) Maximum air velocity in return duct (AC) MPM	:	400	
	d) Friction loss in duct (Maxm.) MM Wg in 100 Mt run.	:	8.33	
	e) Maximum Velocity at supply air grill outlet (AC) MPM	:	150.00	
C)	**For Water-cooled Water Chilling Machine**			
	a) Temperature of chilled water entering the Chillers ºF	:	54.00	
	b) Temperature of chilled water leaving the Chillers ºF	:	44.00	
	c) Fouling factor of Chillers (MKS)	:	0.0001	
	d) Maximum Pressure Drop Chillers in Meter	:	7.0	
	e) Temperature of water to inlet of condenser ºF	:	90	
	f) Temperature of water leaving the condenser ºF	:	100	
	g) Fouling factor of Condenser MKS	:	0.0002	
	i) Maximum Pressure Drop Condenser in Meter	:	7.0	
	j) Maximum water velocity MPS	:	2.5	
D)	**Piping**			**Work**
	a) Friction loss (Maxm.) Mt / 100 Mt lengths	:	5.0	
	b) Flow velocity (Maxm.) Mt / Sec.	:	2.50	
E)	**Air**			**Washer**
	a) Maximum Face velocity across cooling media MPM	:	152.0	
	b) Maximum face velocity across filters MPM	:	152.0	
	c) Thickness of fill (in mm).	:	200.0	
	d) Efficiency of air-washer.	:	90	%
	e) Fan Speed (Maximum) of air washer unit RPM.	:	960	
	f) Maximum Fan outlet velocity MPS	:	10.0	
F)	**Axial Fan (Long Casing)**			
	a) Fan Outlet Velocity (Maxim) in Meter / Sec.	:	12.0	
	b) Drive For Axial Fan.	:	Direct	
	c) Fan Motor RPM, Max			

5. SCOPE OF MAINTENANCE & SERVICES

Note:-

The below mentioned scope of maintenance in this section shall be applicable to all the aforementioned categories of works.
The Contract shall maintain the gallery as per the Good Industry practice.
The maintenance lists and equipment are indicative, it shall be further updated during the submission of Maintenance Manual which shall become an integral part of the contract.

After completion of the main job, the Contractor will provide comprehensive operation and maintenance with the deployment of required skilled personnel, supervisor and Engineer as required on the basis of quoted rates and terms and conditions of the agreement for operation and maintenance.

A comprehensive Operation & Maintenance (O&M) scope covering a period of 5 (Five) years shall be strictly adhered to by the Contractor.

Any other work related to uninterrupted working of the incite building shall be treated as a part of scope of the bidder.
Round the clock On-site Operation and Comprehensive Maintenance for 60 months after successful validation and handing over the new incite building to GBU authority:

Deployment of adequate and qualified manpower throughout the O&M period shall be mandatory and shall be aligned with actual operational requirements, over and above the minimum manpower specified.

All cost to be included except cost of water and electricity. The staff will wear proper uniform, shoes and provided with mobile phones within tendered rates. The work will be executed as per Manufacturers recommendations and direction of the Engineer-in-charge primarily guided by preventive maintenance considerations. All servicing (Civil, MEPF), cleaning, painting, minor/ major repairs, replacement of parts etc. will be included. In case of any mishap or accident, the Department will not take any responsibility and the Contractor will bear all such financial or otherwise responsibility.

The incite building should never be stopped mainly the stipulated HVAC , BMS access control, Fire and safety system.

5.1. Quantum of staff for Maintenance:

Operation and Comprehensive Maintenance of the Incite including providing of skilled operator cum technicians in each shift (round the clock) with one supervisor and one operator in general shift including reliever, for operation and maintenance of the facility round the clock (7 days x 24hrs, 365 days/year) to operate, maintain and run the facility without any break down. Periodical Operation and Maintenance test report duly signed by authorized user scientist of GBU should be submitted in the pre-approved format at the end of every third month. Yearly facility validation should be conducted by the contractor in coordination with user scientists.

Operation and CMC activities include:

- High Side comprising of Chiller, Compressors, with all accessories
- Low Side comprising of AHUs, EXUs, Air distribution system (ducting with insulation), Air control devices like VCD, Registers, Grilles, Louvers, Terminals with filters, coils, heaters etc.
- Refrigerant piping system including control devices, flow balancing and Insulation
- Total Electrical System comprising of MCC and connected components, Cabling with all associates and Protection devices
- All civil, carpentry, plumbing, waterproofing, painting works, etc. and any other work shall be carried out as directed by the Engineer-in-Charge.
- The Contractor shall ensure that manpower availability is maintained at all times. Any shortage, absenteeism, or inadequacy shall be immediately rectified without affecting operations.

5.2. Complaints:

The contractor shall receive calls for any or all problems experienced in the operation of the system under this contract, attend to these within four hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

5.3. Repairs:

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of mechanical maintenance runs as per operation and mainatance period, all replacement parts and labor shall be supplied promptly free of charge to the owner.

5.4. Uptime Guarantee:

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the operation and mainatance period, the defects liability period gets extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period the contract shall get extended by a month for every month having the shortfall and no reimbursement shall be done for the extended period.

The contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperature. Pressure, humidity, power consumption starting and stopping times for various equipment, daily service rendered for the system alarms, maintenance records of unusual observations etc.

Contractor shall also submit preventive maintenance schedule.

A clearly defined penalty mechanism shall be applicable in case of:

- Non-performance of systems
- Delay in complaint resolution beyond specified timelines
- Shortfall in uptime below 98%
- Non-availability or shortage of required manpower

The penalty shall be imposed as per Contract conditions and may include financial deductions, extension of contract period without payment, or any other action deemed appropriate by the Authority.

5.5. Service & maintenance requirements

- CMA shall be responsible for full operation and maintenance of all MEPF systems, which shall include but not limited to piping systems, storages, machinery, S.T.P. and other related structures for defect liability period as mentioned in the contract.
- The Contractor shall, always, operate and maintain the Project in accordance with the provisions of the Contract, Applicable Laws and permits. In particular, the Contractor shall, always during the Maintenance Period, conform to the service and maintenance requirements set forth in this Schedule
- The Contractor shall repair or rectify any defect or deficiency set forth in this Schedule within the time limit specified therein and any failure in this behalf shall constitute a breach of the Contract. Upon occurrence of any breach hereunder, the Authority shall be entitled to recover as per contract.

All spare parts and consumables required for smooth functioning of the facility shall be fully included within the scope of the Contractor (CMA), and no additional payment shall be made on this account.

5.6. Other Maintenance Requirements

S. No.	Activity	Description
a)	Electric Meter (Multimeter, Earth Tester, Meggar etc.)	The Contractor shall check all meters once in a month time to ensure that they are functioning and are showing correct readings.
b)	Standby Power Supply	The Contractor shall have arrangement of standby power supply by DG sets which shall be available 24 hours.
c)	Safety	Any fault in the electrical equipment like switches, receptacles, wiring etc. shall be identified, tested and repaired within 24 hours of detection to prevent accidents.
d)	Fire Fighting Facilities	The Contractor shall provide the required firefighting equipment and facilities including fire exits, fireproof doors, etc conforming to relevant standards and the applicable rules and regulations.
e)	Facilities for Physically Challenged Persons	The Contractor shall provide all the necessary facilities to the entry/exit seating and movement of physically challenged persons including wheelchairs, ramps etc.
f)	Equipment	The Contractor shall ensure the equipment and component parts conform to the relevant standards by Bureau of Indian Standards (BIS) wherever available.

5.7. Repair / rectification of defects and deficiencies

The obligations of the Contractor in respect of Maintenance Requirements shall include repair and rectification of the defects and deficiencies specified in CMC within the time limit set forth therein.

5.8. Other defects and deficiencies

- In respect of any defect or deficiency not specified in contract, the Contractor shall undertake repair or rectification in accordance with Good Industry Practice and within the time limit specified by the DTA/Authority.
- In respect of any defect or deficiency not specified in contract, the Authority/DTA may, in conformity with Good Industry Practice, specify the permissible limit of deviation or deterioration with reference to the Specifications and Standards, and any deviation or deterioration beyond the permissible limit shall be repaired or rectified by the Contractor in accordance with Good Industry Practice and within the time limit specified by the Authority

5.9. Extension of time limit

Notwithstanding anything to the contrary specified in this Schedule, if the nature and extent of any defect or deficiency justifies more time for its repair or rectification than the time specified herein, the Contractor shall be entitled to additional time in conformity with Good Industry Practice. Such additional time shall be determined by the Authority and conveyed to the Contractor and the Authority with reasons thereof.

5.10. Emergency repairs / restoration

Notwithstanding anything to the contrary contained in this Schedule, if any defect, deficiency or deterioration in the Project poses a hazard to safety or risk of damage to property, the Contractor shall promptly take all reasonable measures for eliminating or minimizing such danger.

5.11. Daily Inspection by the Contractor

The Contractor shall, through its engineer, undertake a daily visual inspection of the Project and maintain a record thereof in a register to be kept in such form and manner as the Authority/DTA may specify. Such records shall be kept in safe custody of the Contractor and shall be open to inspection by the Authority/DTA.

5.12. Scope of maintenance-general

- The general scope of work includes operations, monitoring team and maintenance related works. The manpower deployments considered are to carry out equipment operations & maintenance works and attend to breakdowns as and when required.

Also, the maintenance schedules shall be prepared by the Contractor and the site-based team shall carry out the equipment related works as per schedules & instructions.

- The basic tools required for maintenance, access ladders including special tools & tackles, measuring instruments, access ladders beyond 6 feet, scissor lift / boom lift for high access, etc and PPE's are included in the scope of Contractor and this is included as part of operation cost.
- All necessary logbooks, computers, office space, tables, chairs, registers & stationeries for report generation shall be arranged and provided by Contractor
- High access ladders (above 10 feet), scaffolding, boom lift / scissor lift etc shall be provided by Contractor as and when required.
- Storage space / Cupboards shall be provided by the Contractor for keeping the tools and tackles and other instruments.
- All equipment spares shall be provided by Contractor and has to monitor the spares & if stock of spares is less, the same should be arranged and provided by the contractor.
- Contractor has to ensure the Tools & PPE's quantity as much as sufficient for the trouble-free service.
- In case of any defect in materials, workmanship or structural defects (strength and serviceability) of any element or the building, the Contractor shall make good, rectify or replace the element/structure.
- Maintenance technicians should be qualified (B.E / Diploma / ITI) and experienced in the related field. Persons deployed should be approved / confirmed by Authority, if persons deployed are found unsatisfied by Authority after necessary communication to Contractor, they have to replace the person immediately.
- Any increase in the manpower employed shall be communicated by Authority in writing.
- Helper person should be having 2-3 years of relevant experience in the field (Persons deployed should be approved / confirmed by Authority, if persons deployed are found unsatisfied by Authority after necessary communication to Contractor, they have to replace the person immediately.
- Contractor has to prepare / follow the standard operating sheet / operation control procedure for all Maintenance work – should get approval from the Authority.
- All people should undergo regular training for the operation and maintenance of the plant & safety measures. The same shall be arranged and ensured by the Contractor.
- Contractor has to submit the manpower detail and shift wise details & get approval from the Authority.
- Contractor has to supply sufficient manpower after considering weekly offs and statutory leaves in a month.
- Electrical supervisor should have a valid license –C license & electrical technician should have a valid B license.
- Housekeeping in a good manner at maintenance work spot and in the event of waste Generated from maintenance activity, same shall be collected properly and sent to storage location by Contractor employees as per hazardous & nonhazardous

waste segregation process and as instructed by the Authority.

- In case of any safety deviation Authority can enforce % of penalty or Contractor has to replace the person who may have violated safety standards.
- Contractor should maintain all necessary documentation and records such as logbook / sheets, inventory registers, daily report, weekly report, monthly report, performance reports and all such other related documentation as per Authority requirement.
- Contractor should maintain accounts for receipts, consumption and inventory of all consumables & spares as per the consumption pattern.
- Contractor should prepare / adhere to the Authority maintenance schedule for mechanical, electrical & instrumentation should be approved by the Authority.
- Carrying out routine, preventive and break down maintenance in mechanical, electrical and instruments category and record to be maintained and submitted to Authority periodically.
- Before taking up major maintenance, the Contractor should inform and obtain Permission from the Authority and proper approval shall be obtained and further approvals in the form of Electrical clearance / LOTO procedures shall be adopted.
- Spares shall be procured and supplied by the Contractor as per requirement.
- The damaged / repaired equipment (Mechanical / Electrical / Instrument equipment/exhibit/) which are coming under warranty & guarantee the Contractor has to co– ordinate with supplier and get it replaced / serviced at free of cost from the equipment manufacture / supplier.
- Contractor should periodically check equipment, lubrication, adjustments etc. to ensure proper performance as per Project Manager Check sheet.
- Contractor has to follow getting a safety & security permit from Authority safety for the necessary job.
- Contractor should ensure that the Maintenance activities are conducted without affecting the production. However, it is the responsibility of the Authority to ensure availability of the equipment requested for maintenance by the Contractor.
- Environmental best practices to be followed as required by the Authority. Best environmental practice like Energy conservation, advance methodology in Pollution prevention etc., will be given appreciation to the Contractor.
- All Engineering spares, consumables like bulbs, fuses, contactors, chemicals, other materials etc, shall be provided by CMA.
- The rate includes the cost of services like cost of communication, transportation, tools etc. in our pricing.
- All costs related to testing of equipment as per statutory requirements and obtaining statutory clearances etc. shall be in the scope Contractor.

he Contractor shall maintain detailed documentation throughout the O&M period, including but not limited to:

- Daily logbooks (temperature, pressure, humidity, equipment status)
- Preventive maintenance schedules and records
- Breakdown and repair logs

- Inventory registers for spares and consumables
- Energy consumption reports
- Calibration records
- Safety inspection reports
- Training records and attendance logs
- Incident and corrective action reports

All records shall be maintained in both hard copy and digital formats and shall be made available for inspection by the Authority at any time

5.13. Manpower estimation

S.No.	Designation (Maintenance Staff)	Minimum Qualification of Maintenanace Staff	Discipline	Minimum Experience (in years)	Nos.
1	Supervisor/Engineer	Graduate Engineer	Electrical/Mecahnical	5	1
2	HVAC Plant Operator	Diploma ITI	HVAC	5	1
3	Plumber	Diploma ITI	Plumbing	5	1
4	Electrician/Wireman	Diploma ITI	Electrical	5	1
5	Technician	Diploma 3 year in IT/Electronics	ELV	5	1
6	Helper			5	4

Note:

- The above given manpower estimates during the O & M phase are minimum. CMA shall estimate and deploy additional personnel if required to ensure smooth operations of the facility. Before the deployment of manpower at site, the CMA will have to submit the CVs of all the proposed manpower to the Authority for approval. Based on the submitted CV or interview, the Authority shall provide the approval on the deployment or ask the CMA to provide alternate CVs.
- During the term of deployment, if the conduct of the deployed manpower is not as per standards, the Authority may ask the CMA to change the manpower.
- The contractor, at their own cost, must provide the biometric machine specified by GBU officials for regular attendance of manpower deputed for work on a daily

basis. The contractor shall maintain a personnel file in respect of all the staff that is deployed in GBU campus.

- The manpower deployed should wear color coded uniforms with Gujarat Biotechnology University Logo. The uniforms need to be pre-approved by the Authority. Further, the agency will provide 2 pairs of uniforms to their male and female staff including shoes. For Monsoon adequate clothing like Raincoat will be provided by Contractor. In addition to that, CMA shall provide microphones to all the visitor guides.
- Annual training plan must be drawn by the CMA and implemented for the team deployed at Gujarat Biotechnology University. The trainer deployed by the CMA must follow and conduct based on the points mentioned below:
  - Review and update Human Resources Training, Structured Training, Mentorship Training to address current organizational requirements and ensure compliance with GBU.
  - Provide support and guidance to provide a series of (trainer) instructor-led training on formal mentorship to all manpower on their responsibilities and job profile.
  - Minimum training hours for staff = 24 Hours/year.
  - Staff training register should be maintained, and all training should be registered in the book.
  - Feedback form should also be maintained by the CMA.

A separate Security Deposit equivalent to 3% of the total tender cost or actual executed cost, whichever is higher, shall be submitted by the Contractor specifically for Operation & Maintenance (O&M) works prior to release of the final bill payment. This Security Deposit shall remain valid for the entire O&M period and shall be liable for deductions in case of any non-performance, deficiencies, or contractual breaches.

The said Security Deposit shall be released only after successful completion of the entire Operation & Maintenance period of 5 (Five) years, subject to satisfactory performance and certification by the Authority.

Special condition for operation and maintenance:

If the Contractor fails to perform the required operation and maintenance services within seven (7) days of receipt of notice, GBU shall have the right to engage another agency at the risk and cost of the Contractor. The expenses incurred shall be recovered from the 3% security deposit submitted for operation and maintenance as per actual payment made by GBU to another agency.

Non-compliance with the deployment of designated manpower for operation and maintenance shall be treated as a default by the Contractor. A penalty of ₹10,000 (Rupees Ten Thousand only) per day shall be levied and deducted from the Contractor's 3% security deposit submitted for operation and maintenance.