TECHANICAL SPECIFICATIONS

Intended
IBC

Document Type
Report

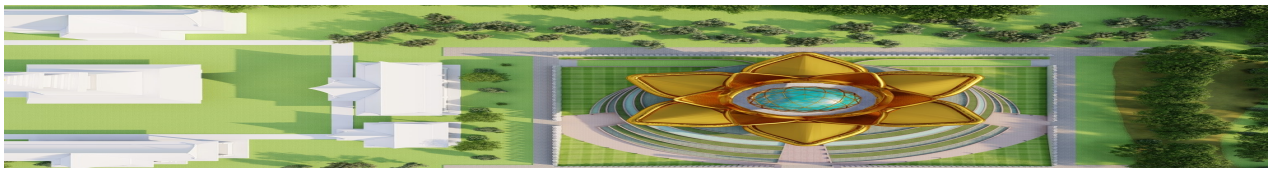
Date
08-05-2022

Document No

LUMBINI

India International Centre for Buddhist Heritage and Culture.

MEP DESIGN BASIS REPORT



India International Centre for Buddhist Heritage and Culture.

MEP DBR CONTENT

S.NO	DESCRIPTION	PAGE NO
1	MECHANICAL	6 TO 17
2	ELECTRICAL	18 TO 32
3	PHEF	33 TO 43

CONTENTS

1. Introduction
2. Design Standards
3. Design Parameters
3.1 Project configuration
3.2 Site Conditions
3.3 Sustainable Initiatives
3.4 Building Envelope
4. Project Bidding Brief
4.1 Design Prameter MT Chiller.
4.2 Design Parameter LT chiller
4.3 Air Source Chileer
4.4 Air Handling Units
4.5 Duct Design
5. Mechanical Services
5.1 Building Loads
5.2 Acoustics
5.3 Cooling System
5.4 Ventilation
5.5 Interpertation Centre Cooling and Heating
5.6 Common Area Cooling
5.7 Amenities Area Ventilation and Cooling
5.8 Car Park Ventilation
5.9 Plant Room Cooling
5.10 Transformer Room Ventilation
5.11 Fire Pump Ventilation
5.12 Life Safety Ventilation
6. Electrical General
7. Design Philosophy
8. Energy Conservations
9. System Design
10 Basic of Design
10.1 Electrical Details of Incoming Supply
10.2 L.T. Power Distribution System
10.3 Low Voltage System
10.4 Emergency Lighting (With UPS)
10.5 Control Supply for Electrical System
10.6 PowerSupply Load Control/Distribution Panel
10.7 Painting Panel
10.8 Painting of Cable Tray and Structure Steel
11. Power Improvement System
12 Referene Standards For Electrical System
13 System Selection for Present Requirement

14	LT Power Distribution Sytem .
15	Recommended Illumination Levels.
16	System of Wiring
17	Lighting Protection System
18	System Earthing
19	Emergency Lighting Installation
20	Telephone /Communication System
21	Street / Ooutdoor Lighting System
22	Saftey & Security
23	Electrical Load
24.	Code & Standards
25.	M.V. Distribution Boards
26	LED & LED Based Products
27	M.V. Cables and Cable Trays
28	Earthing System
29	Introduction
30	Salient Features of the Project
31	Scpe of Work
32	Water Supply System
32.1	Water Demand Calculation
32.2	Source of Water
32.3	Tank storahes
32.3.1	UGT Storage
33.	Water Treatment System
33.1	Pumping, Storage & Distribution System
33.2	Horticulture water distribution system
34	Sewerage System
35	DRAINAGE & RAINWATER HARVESTING SYSTEM
35.1	Proposed Storm Water Drainage System
35.2	Planning of the Drainage System
36.	INTERNAL PLUMBING SYSTEMS
36.1	Plumbing System Adopted
37.	FIRE FIGHTING SYSTEM
37.1	Design Reference for Fire Fighting
37.3	Wet Riser, Down Comer& Hydrants System
37.4	Fire Pumps
37.5	Sprinkler System
37.6	Fire Extinguishers
37.7	Fire Brigade connection

1.INTRODUCTION

India International centre for Buddhist Heritage and culture is a (G+1) Museum building. The purpose of this report is to describe the basis of design for the Mechanical, Electrical, and Public Health services (MEP Services) proposed for this development. Unless otherwise specified by the client, the enclosed criteria will be used throughout the design.

Net zero approach

Net-zero buildings combine energy efficiency and renewable energy generation to consume only as much energy as can be produced on site. Although achieving zero-energy and buildings is ambitious, it is an increasingly achievable goal.
Net Zero Energy Buildings are still connected to the electric grid, allowing electricity from grid to be used when renewable energy generation cannot meet the building's energy load.

A Zero Energy Building (ZEB), also known as a Net Zero Energy (NZE) building, or a Zero Net Energy (ZNE) building, is a building with net zero energy consumption, meaning the total amount of energy used by the building on an annual basis is equal to the amount of renewable energy created on the site or in other definitions by renewable energy sources offsite, using technology such as efficient cooling and heating system, high efficiency windows and insulation, solar panels, high efficient lighting, equipment etc.

Sustainable Initiatives

Air Conditioning Systems

1. Heat pipes and thermal wheels specified for energy recovery in fresh air handler units.
2. Condensate recovery to be used for irrigation or cooling tower make up water.
3. Variable speed pumps and fans to be used where appropriate to save energy. These include carpark supply and extract fans and chilled water circulation pumps.

Facade Performance

4. High facade performance will greatly increase the building efficiency. Cooling loads will be reduced in apartments and hence cooling plant size and running costs will be reduced.

Lighting Control System

5. An intelligent lighting control system comprising of movement sensors, twilight sensors in some areas to control lights.
6. High efficiency compact fluorescent luminaires with high frequency ballast shall be provided wherever possible.

HVAC

ABBREVIATION

SR NO	ABBREVIATION	MEANING
1	% Rh	Relative Humidity Percentage
2	˚ C / ˚ F	Degree Centigrade / Degree Fahrenheit
3	ACPH	Air Changes Per Hour
4	ADP	Apparatus Dew Point Temperature
5	AHU	Air Handling Unit
6	ASHRAE	American Society of Heating Refrigeration and Air Conditioning Engineers
7	BTU	British Thermal Units
8	CFM	Cubic Feet Per Minute
9	CMH	Cubic Meter Per Hour
10	DBT	Dry Bulb Temperature
11	DDC	Direct Digital Controller
12	EA	Exhaust Air
13	EAF	Exhaust Air Fans
14	FA	Fresh Air
15	FCU	Fan Coil Units
16	GPM	Gallons Per Minute
17	HRW / ERW	Heat Recovery Wheel / Energy Recovery Wheel
18	HVAC	Heating Ventilation and Air Conditioning
19	HW	Hot Water
20	IAQ	Indoor Air Quality
21	kPa	Kilo Pascal
22	MP Panel	Microprocessor Based Panel
23	P&I Dia	Process and Instrumentation Diagram
24	PCHW	Primary Chilled Water Pump
25	RA	Return Air
26	SC	Shading Co-efficient for Glass
27	SCHW	Secondary Chilled Water Pump
28	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
29	SI	System Integrator (for 3rd party interfacing on BMS)
30	Sq FT	Square Feet
31	TFAU	Treated Fresh Air Unit
32	U	Thermal Transmission Co-efficient
33	VFD	Variable Frequency Drive
34	VSPS	Variable Speed Pumping System
35	WBT	Wet Bulb Temperature
36	ETS	Energy Transfer Station
37	PHE	Plate Type Heat Exchanger
38	CHW	Chilled Water
39	HTW	Hot Water

1. DESIGN STANDARDS:

The applicable Standards/Codes are:

- National Building Code of India - 2016 (NBC)
- Relevant Bureau of Indian Standards (BIS) codes
- Indian Society of Heating, Refrigeration, and Air Conditioning Engineers (ISHRAE) Hand Book
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- Air filters as per ASHRAE Standard 52.2 – 2007
- NFPA 92B for Standard for Smoke Management Systems in Malls, Atria, and Large Spaces
- Duct construction standard as per SMACNA.
- National Electrical Manufacturers' Association (NEMA)
- Air Conditioning and Refrigeration Institute (ARI)
- Air Diffusion Council (ADC)
- Air Movement and Control Association, Inc. (AMCA)
- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- American Society for Testing and Materials (ASTM)
- American Water Works Association (AWWA)
- Underwriters Laboratories, Inc. (UL)
- British Standard European Norm (BSEN)
- The following IS codes shall be applicable:

S. No.	Material/item of Work	Standard/Code
1.	Ducting Fabrication	IS: 655 (Latest Rev.)/ BIS Code Ducting GSM 275
2.	Galvanized Sheets/Wires	IS: 277-1977
3.	Aluminum Sheets/Wires	IS: 737
4.	Horizontal Centrifugal Pumps	IS: 1620
5.	Mild Steel, ERW Pipes	IS: 1239, IS: 3589
6.	Pipe Fittings	IS: 1239
7.	Steel Pipe Flanges	IS: 6392
8.	Gate, Globe & Check Valves	
	a) Upto 40 mm gun metal	IS: 778
	b) Butterfly valves of 50 mm and Above (cast iron)	IS: 780, IS: 2906
	c) Balancing Valves	IS: 778
	d) Non Return Valves	IS: 5312
9.	Color Code for Identifications of pipes	IS: 2379-1963
10.	3 Phase induction motors	IS: 325
11.	Burden type pressure gauges	IS: 3624
12.	PVC insulated electric cables	IS: 1554
13.	HRC cartridge fuse links	IS: 2208
14.	Starters sheets/wires	IS: 8555
15.	Specific requirements for Direct switching of motors	IS: 4064 (Part II)
16.	Inspection and testing of Installation	IS: 732 (Part III)
17.	Glossary of terms used in refrigeration and Air-conditioning	IS: 3615

18.	Hot die zinc coated steel pipes	IS: 4736-1968
19.	Expanded polystyrene	IS: 4671
20.	Glass wool	IS: 8183

Safety codes

The following safety codes as laid down by ISI shall be followed:

a)	Safety code for mechanical refrigeration	IS : 660
b)	Safety code for air-conditioning	IS : 659
c)	Safety code for scaffolding and ladders	IS : 3696
d)	Code for practice for safety and health Requirements in electrical and gas Welding & cutting operations	IS: 3696
e)	Code of safety procedures and practices	

3.1 BASIS OF DESIGN

Project configuration

India International centre for Buddhist Heritage and culture is a cultural showcase consisting of Basement and G+1 floors. It has Interpretation centre Conference room, board room, Staff, Kitchen, Guest room, Library, Meditation, Prayer, Café etc.

Site Conditions

Building Location

Weather Station	Lumbini
Latitude	27.28 N
Longitude	83.16 E
Altitude/Elevation	160 m

Ambient Temperature

Summer Design Temperatures	109°C Dry Bulb / 79°C Wet Bulb
Monsoon Design Temperatures	94°C Dry Bulb / 83°C Wet Bulb
Winter Design Temperatures	48°C Dry Bulb / 43°C Wet Bulb
Peak Month	MAY

Construction U-Values

Type	U-Value (BTU/h-ft²C)	Shading Coefficient	Standard
Wall	0.089	-	To be confirmed with Architect
Glazing	0.17	0.21	To be confirmed with Architect
Roof	0.04	-	To be confirmed with Architect
Floor	0.57	-	To be confirmed with Architect

Indoor Design Condition

Area	Temp. (F)	RH %	Outside Air
Conference room	24 ± 2	55 ± 5	5 cfm/person + 0.06cfm/sqft
Meditation hall	24 ± 2	55 ± 5	5 cfm/person + 0.06cfm/sqft
Library	24 ± 2	55 ± 5	5 cfm/person + 0.06cfm/sqft
Prayer hall	24 ± 2	55 ± 5	7.5 cfm/person + 0.06cfm/sqft
Reception	24 ± 2	55 ± 5	5 cfm/person + 0.06cfm/sqft
Offices	24 ± 2	55 ± 5	5 cfm/person + 0.06cfm/sqft
Guest rooms	24 ± 2	55 ± 5	50 cfm for each Guest room
Corridor	26 ± 2	55 ± 5	0.06cfm/sqft

Ventilation Rates

Public and executive Toilet		To be maintained at a negative pressurewith respect to adjacent areas. Air to be transferred through air transfergrilles located on the wall or the doors. 10-15 total air changes would bemaintained.
Pump room/Plant room		At 15 ACPH
Service / dry Pantry		To be maintained at a negative pressurewith respect to adjacent areas. Air to be transferred through air transfergrilles located on the wall or the doors. 5-10 total Air changes would be maintained.
Kitchen		At 30 ACPH
Basement Parking		Normal ventilation: 06 ACPH exhaust Fire smoke evacuation :12 ACPH exhaust

4.0 DESIGN PARAMETERS

4.1 MT Chiller:

4.1.1 Performance rating of the chilling units shall be based on following design parameters:

4.1.2 Temperature of chilled water entering chiller:68° F

4.1.3 Temperature of chilled water leaving chiller :62.6° F

4.1.4 Fouling factor for chiller in FPS unit : 0.0005

4.1.5 Temperature of water entering condenser :87° F

4.1.6 Temperature of water leaving condenser :97.0° F

4.1.7 Fouling factor for condenser in FPS unit :0.001

4.2. LT Chiller:

4.2.1 Performance rating of the chilling units shall be based on following design parameters:

4.2.2 Temperature of chilled water entering chiller :54° F

4.2.3 Temperature of chilled water leaving chiller : 44° F

4.2.4 Fouling factor for chiller in FPS unit : .0005

4.2.5 Temperature of water entering condenser : 87° F

4.2.6 Temperature of water entering condenser : 97.0° F

4.2.7 Fouling factor for condenser in FPS unit : 0.001

4.1.C **Air source reversible Chiller: Summer Case**

4.1.1 Performance rating of the chilling units shall be based on following design parameters:

4.1.2	Temperature of chilled water entering chiller	:	68°F/54°F
4.1.3	Temperature of chilled water leaving chiller	:	62.6°F/44°F
4.1.4	Heat Rejection/Absorption	:	1470 kW
4.1.5	Air flow rate	:	450000 m3/h

4.1.C **Air source reversible Chiller: Winter Case**

4.1.1 Performance rating of the chilling units shall be based on following design parameters:

4.1.2	Temperature of hot water entering chiller	:	77°F
4.1.3	Temperature of hot water leaving chiller	:	73.4°F
4.1.4	Heat Rejection/Absorption	:	996 kW
4.1.4	Air flow rate	:	450000 m3/h

4.2	**Air Handling Units**		
	Maximum velocity across pre-filters		152 M / Min.
	Maximum face velocity across cooling coils		152 M / Min.
	Maximum fan outlet velocity for fans above 300mmdia		550 M / Min.
	Maximum fan speed for fans upto 300 mm dia		1450 RPM
	Maximum fan speed for fans above 300 mm dia		1000 RPM
	Type of fan & motor		Direct driven AC/EC fan
4.3	**Centrifugal Fans**		
	Maximum fan outlet velocity for fans upto 450 mmdia		550 M / Min.
	Maximum fan outlet velocity for fans above 450 mmdia		700 M / Min.
	Maximum fan speed for fans upto 450 mm dia		1450 RPM
	Maximum fan speed for fans above 450 mm dia		1000 RPM
4.4	**Pipe Sizing**		
	Maximum Velocity Maximum Friction		2.5 M / Sec 5 M / 100 M Run

4.5	**Duct Design**		
	Maximum flow velocity		7.5 M / Sec
	Maximum Friction		1 cm WG/100 m run or (0.1inch per 100 Ft)
	Maximum Velocity at supply air outlet		2.5 mps (500 FPM)

5.SYSTEM PROPOSED

1 no. of Electrical Screw Water cooled Chiller with 1 no. Air cooled reversible Chiller as Standby shall be provided with dedicated primary and condenser water pumps.

A 3D computer model using IES/Energy plus/HAP software will be used for the project. Every air-conditioned space will be entered into the model.

The computer model will be used to calculate the peak sensible and latent cooling loads for each space. This data will then be used to select room airflow rates and cooling coil loads.

The model will then be used to calculate the peak total coincident cooling load for the whole building to allow the optimum selection of the main mechanical plant.

The chilling units along with associated equipment like primary variable type pumping system, condensing water pumps, chilled/condensing water piping with valves, electrical panel, wiring, control wiring & earthing shall be located at Plant Room in Basement, Cooling towers for air conditioning system shall be placed outside in open area as shown in the site plan drawing. All motors for air-conditioning system shall be energy efficient type, suitable for 415 + 10% volts incoming power supply.

Plant machinery in the plant room shall be placed on PCC/RCC foundation and provided with vibration isolation arrangement.

Floor drain channels with CI / Epoxy coated MS gratings and dedicated drain pipes in slope shall be provided within plant room space for effective disposal of waste water.

System shall provide sufficient capacity to meet peak cooling loads but must be capable of operating efficiently at part-load conditions without excessive amounts of spare capacity.

Chilled water system shall be designed by motorized valves installed in major branch pipes and at each AHU for fine tuning at the time of final balancing of the chilled water system. All pipes within plant room shall be supported off the floor.

Cooling towers for air-conditioning system shall be selected for minimum drift loss and minimum noise. These shall be FRP construction induced draft type.

All mechanical equipment such as chilling units, pumps, AHU's and larger ventilation fans shall be provided with energy efficient motors in order to attain energy savings, since all these equipment shall operate for extended periods of time.

Mechanical Plant rooms such as HVAC plant room, Pump room, and plumbing plant room shall be provided with mechanical ventilation system.

All chilled & condensing water pipes shall be MS Class 'C' and drain pipe shall be CPVC/GI Class 'B' construction.

5.1. Cooling System

Cooling shall be provided to the building via a chilled water system which will be supplied to radiant slab cooling/heating and also for FCUs, AHUs. The cooling load for the building will be estimated by contractor.

Chilled water will be provided from high voltage water cooled chillers. The system will comprise the following:

- Water cooled semi hermetic reciprocating /scroll/screw chillers and primary pumps located in basement.
- Cooling Tower located on Roof/Landscape area.
- AHUs mounted on ceiling and on floor.
- Chilled water pressurisation and fill equipment and water treatment.
- All associated chilled water distribution pipework. Assumed delta T of 3 degree C for Radiant system and 6 degrees C for dehumidification.
- 2 pipe fan coil system.

The proposed piping material for the chilled water and condenser water piping is steel black.

All secondary chilled water pumps will incorporate variable speed drives that will modulate the pump speed such that the chilled water flow rate matches the building cooling load to conserve pump energy.

5.2. Ventilation

Complex will be ventilated by three ducted systems:

- Toilet extract
- Kitchen extract
- Fresh air supply

The supply and extract ventilation systems will operate on a continuous basis with no local control required by the occupants and variable operation in office and meeting rooms. It is assumed that there are no dedicated laundry rooms and that washing machines are in the kitchen or bathroom.

Air handler units will be located on ceiling or floor. These will cool and filter fresh air before distributing to all apartments and common zones. Supply ducts will be terminated within the hotel room at the back of the fan coil unit.

Ventilation will be provided on the following basis:

The supply air rate noted above ensures the apartment will be positively pressurised and provides fresh air above the minimum rates outlined in ASHRAE 62.1 2007.

To conserve energy, the outside air handling units will incorporate thermal wheels for recovery of 'coolth' from the air extracted from the building. Wrap around heat pipes will first pre-cool the air and after full cooling will sensibly reheat air to the design supply condition.

5.3. Interpretation centre and guest house Cooling and Heating

Interpretation centre will be cooled via high temperature radiant slab in conjunction with chilled water fan coil units (FCUs). The base cooling load will be met by high temperature Radiant slab and FCU will support the radiant system in extra cooling and dehumidification of air. At least one FCU will be provided per main room (i.e., living room, bedroom, dining room, study, etc. Bathrooms will not be directly cooled but will be provided with extract ventilation which will draw in from adjacent cooled rooms. Radiant slab will be controlled via floor temperature sensor and each FCU will be controlled by a local, stand alone, modulating controller. The

temperature sensor/controller will be wall mounted and in a location that is away from direct sunlight and is not in the supply air path of an FCU. Heating will be provided to hotel via low temperature radiant floor pipes.

5.4. Common Area Cooling

High temperature Radiant slab cooling and low temperature Radiant slab heating in conjunction with ceiling mounted FCUs will be provided to cool closed corridors and lift lobbies. Ductwork branches will be taken from these FCUs to supply cooled air to electrical, telecom, and mechanical rooms. Return air will be via an aperture (with fire damper) above the ceiling void connecting the room to the ceiling void that contains the FCU. Return air paths will be via ceiling mounted return air grilles or diffusers.

5.5. Amenities Area Ventilation and Cooling

High temperature Radiant slab cooling and low temperature radiant floor heating with dedicated air handler units will be provided to supply fresh air to the gym and meeting room areas. Fan coil units will be provided within the spaces to locally cool the respective area.

5.6. Car Park Ventilation

Car park floors are considered to be the following: Basement level

The car park will be ventilated using a combination of natural ventilation and mechanical ventilation. Wherever possible natural ventilation will be implemented.

Natural Ventilation

Wall openings equal to 5% of the floor area permanently open.

Mechanical Ventilation

Normal Operation – 6ACH

Mechanically Ventilated Car Parks

As per NBC VOL I Basement will be provided with mechanical supply and exhaust.

As per NBC VOL I, for enclosed underground car parks without provision for natural ventilation, a minimum ventilation rate of six air changes per hour shall be provided to keep containments within acceptable hygiene limits. In large basements, each compartment shall be independently ventilated at the minimum rate of 6 ACPH.

In the event of smoke in the car park, all extract air will be concentrated on the affected floor by closing the motorized dampers behind the grilles on the non-affected floors. In this case, the main extract fans will operate at high speed (12 ACPH) from the affected zone/level, thus providing improved visibility, which will greatly assist the operation of the Fire Service.

A standby power supply to operate in the event of mains power failure is required. The fans must be

rated to run at 250 degrees centigrade for a minimum of 120 minutes and the ductwork must have a melting point of not less than 350 degrees centigrade.

The car park ventilation system will be provided with CO sensors to ramp up the fan speed when the CO levels rise. The car park ventilation system has been designed to provide a healthy environment.

The Car Park Pollution Control system for this car park is based on the NBC Vol I and NBC Part 4 "**Fire and life Safety**". A summary of the operation is shown in the table below:

Car park sequence of operation

CO Level	ACPH	Axial Fans Speed
CO Level <20ppm	Up to 3	Low
20ppm< CO Level < 35ppm	Up to 3	Low
35ppm< CO Level < 50ppm	Up to 6	High
CO Level >50ppm	Up to 6	High
Fire Mode	12	High

5.8 Life Safety Ventilation

A smoke ventilation system shall be provided as per National Building Code for the, guest room, Corridor. Lift well will be provided with pressurisation ventilation so that these areas do not become smoke logged during a fire.

Smoke extract shall be provided through smoke extract fans located at roof levels. Smoke control will be configured so that during a fire only the fire floor has the smoke extract automatically actuated. Untreated supply air will be provided to the floors above and below the fire floor.

Smoke dampers will be provided on ductwork that has the ability to transfer smoke to a means of escape from an adjacent or other area. Unless the ductwork is required for smoke control purposes, these dampers will close in the event of a fire. Locations of these will be coordinated with the fire strategy drawings.

Air conditioning and ventilation plant operation in event of fire shall be according to NFPA, NBC and local fire Authority approval.

All life safety fan systems shall have duty and standby.

ELECTRICAL

2.0 ELECTRICAL SERVICES

2.1 General

2.2 Design Codes and Standards

2.3 Applicable IS Codes & Standards

2.4 Load Calculations & Equipment Selection

2.5 System Design

2.6 Source of Power Supply

2.7 Main Power Distribution (Up to Project DB)

- DG Distribution

2.8 Wiring & Accessories

- Lighting & Power wiring indoor the building
- Lighting & Power wiring for Common Areas
- Lighting & Power Distribution Boards
- Lighting Design & Controls

2.9 Emergency Power Installation

- Common Area Lighting
- Basement Ventilation
- Fire pumps

2.10 Solar System

2.11 LV Distribution System

2.12 Earthing

2.13 Lightning Protection

2.1 General

Preliminary design scheme including basis of design for Power distribution to proposed construction of India International Centre for Buddhist Heritage and Culture.

2.2 Design Codes and Standards

Following codes & standards are the basis for ELECTRICAL Design:

Energy Conservation Building Code (ECBC – 2007 / User Guide 2011)

National Building Code (NBC – 2016, Section 8)

Bureau of Indian Standards (BIS) / IS Codes

National Electrical Code (NEC - 2011)

Indian Electricity rules (IER - 1956)

Local Electrical Supply Company Rules & Regulations

2.3 Applicable IS Codes & Standards

All the relevant IS codes and standards shall be strictly followed for the design. In the event of any standard or code inapplicable, the corresponding IEEE/IEC code and standards shall be followed.

The following standards and codes shall be followed:

- IS: 732 Code of practice for electrical wiring installation (System voltage not exceeding 650 V).
- IS: 1646 Code of practice for fire safety of buildings (General Electrical installation)
- IS: 2667 Fittings for rigid steel conduits for electrical wiring
- IS: 3480 Flexible steel conduits for Electrical wiring
- IS: 3837 Accessories for rigid steel conduit for electrical wiring
- IS: 694 PVC insulated cables
- IS: 2509 Rigid - non-metallic conduits for electrical wiring
- IS: 6946 Flexible (Pliable) non-metallic conduits for electrical installation
- IS: 12933 Pin plugs and sockets
- IS: 8130 Specifications for conduits for electrical installation
- IS: 3854 Switches for domestic purpose
- IS: 3415 Fittings for rigid non-metallic conduits
- IS: 4648 Guide for electrical layout in residential building
- IS: 9537 Conduits for electrical installation

- IS: 302 General and safety requirements for household and similar electrical appliances
- IS: 3043 Code of practice for earthing
- IS: 5216 Guide for safety procedures and practices in electrical work.

  Indian Electricity Act and Rules

❖ M.V. DISTRIBUTION BOARDS:

- IS4237-83 General requirements for switch gear and control gear for voltages not exceeding1000V.
- IS5578-85 Guide for marking of insulated conductors.
- IS11353-85 Guide for uniform system of marking and identification of conductors and apparatus terminals.
- IS2147-62 Degree of protection provided by enclosures for low voltage switch gear and control gear.
- IS2675-83 Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000V.
- IS2551-82 Danger notice plates.
- IS2516 Circuit breakersPart1. Requirements (Part I/Sec 1) and tests:
- Section1.Voltages not exceeding 1000V ac or 1200Vdc.

  Disconnector and fuse
- IS4064-78 Air break switches, air break disconnector, air break switch combination units for voltages not exceeding 1000V ac or 1200Vdc.
- IS1818-72 Alternating current isolators (disconnector) and earthing switches.
- IS8623-77 Factory built assemblies of switchgear and control gear for voltages up to and including 1000V AC & 1200V DC.
- IS8828-78 Miniature air break circuit breakers for voltages not exceeding1000V.
- IS9926-81 Fuse wires used in rewire able type electric fuses up to 650Volts.
- IS8544-79 Motor starters for voltages not exceeding 1000 Volt A.C. or 1200 Volt D.C.
- IS2959-85 Contactors for voltages not exceeding 1000 Volt A.C or 1200 Volts D.C
- IS9224-79 Low Voltage fuses.
- IS12640-89 Residual current operated circuit breakers.

- IS1248-83 Direct acting indicating analogue (all parts) electrical measuring Instruments and their accessories.
- IS2705-81 Current transformers. (All parts)
- IS4201-83 Application guide for voltage transformers.
- IS8197-76 Terminal markings for electrical measuring instruments and their accessories.

❖ LED & LED BASED PRODUCTS:

- IS -16101 General Lighting - LEDs and LED modules
- IS – 16102 (Part-1) Self- Ballasted LED Lamps for General Lighting Services Part 1 Safety Requirements
- IS – 16102 (Part-2) Self- Ballasted LED Lamps for General Lighting Services Part 1 Performance Requirements
- IS – 16103 (Part-1) Led Modules for General Lighting Part1SafetyRequirements
- IS – 16103 (Part-2) Led Modules for General LightingPart2 Performance Requirements
- IS – 15885(Part-2) Safety of Lamp Control GearPart2
- IS – 16104 DC or AC Supplied Electronic Control Gear for LED Modules - Performance Requirements
- IS – 16105 Method of Measurement of Lumen Maintenance of Solid-State Light (LED)Sources
- IS – 16106 Method of Electrical and Photometric Measurements of Solid-State Lighting (LED)Products
- IS –16107(Part-1) Luminaries Performance Part 1General Requirements
- IS –16107(Part-2) Luminaries Performance Part 2ParticularRequirements Section 1 LED Luminaries
- IS –16108 Photo biological Safety of Lamps and Lamp Systems

❖ M.V. CABLES AND CABLE TRAYS:

- IS1554-88 PVC insulated (heavy-duty) electric cables Part I for working voltages up to and including 1100V.
- IS8130-84 Conductors for insulated electric cables and flexible cords.
- IS3961-67 Recommended current ratings for cables: (Part 2): PVC insulated, and PVC sheathed heavy-duty cables.
- IS5831-84 PVC insulation and sheath of electric cables.

- IS7098-89 Cross-linked polyethylene insulated PVC sheathed cables.

❖ EARTHING SYSTEM:

- IS3043 Code of practice for earthing.
- IS/IEC 62305(Part2) Code of practice for lightning & surge protection.

2.4 Load Calculations & Equipment Selection:

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE AND CULTURE(IICBHC)

PRELIMINARY ELECTRICAL LOAD ESTIMATE						Sheet:		1 of 1
Project:	INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE AND CULTURE(IICBHC)					Date:	18-Aug-22	
Location:	LUMBINI,NEPAL						SUB TOTAL kW	
ZONE	AREA	LIGHTING LOAD		SMALL POWER LOAD		TCL	MD	
Ancillaries		w/m²	Total	w/m²	Total			
Convention Center	4,269	13	55.50	30	128.07	183.57	146.85	
Parking Garage	2,640	3	7.92	5	13.20	21.12	16.90	
Load for projectors/screens etc						300.00	240.00	
Total GFA	6,909	TOTAL LIGHTING + SMALL POWER:			TCL	505		
					ADMD		404	
HVAC Load	MECHANICAL EQUIPMENT							
Building Type			PD(W/M²)		TCL	DIVERSITY	ADMD kW	
Convention Center			100		264	0.50	132	
	FIRE PUMP				50	1.00	10	
	MTR				15	1.00	15	
	GSM				5	1.00	5	
	EXTERNAL LIGHTING & SIGNAGE				10	0.80	8	
Lift Load	No of Lift		2					
PER Lift Load	Low Rise(1-20 Floor)			20	40	1.00	40	
			kW :		384		210	
ESTIMATED TOTAL CONNECTED ELECTRICAL LOAD kW:						889		
ESTIMATED TOTAL DEMAND ELECTRICAL LOAD kW:						614		
WATTS PER METRE SQUARE (W/Sq.m2):						89		

- Equipment Selection
  - Transformer – 1 x1000 kVA ONAN Type Transformers selected with 80% Loading
  - DG – 1 x 750kVA kVA DG and 1 x 250 kVA sets selected with 100% Loading

- Solar – 1500 KW Solar system, this power generation shall be directly synchronized to Power Control Centre (Grid at 415V AC) supplied.

2.5 System Design

The total connected load on the area basis is worked out to 889 KW and the Peak Demand Load is 614 KW

overall diversity factor (assumed). The power at 11 KV will be received from 11 KV switchyard with two power sources for reliable power located in same campus or nearby substation.

From this point on wards power shall be transferred to proposed Substation HT 3 Panel board via, HT Trivector Meter. Power shall be distributed in the building after getting it converted from 11 KV to 415 Volt s by a step-down distribution Transformer. It will consist of HT panel distribution transformer and the Main LT Panel shall be installed in the L.T room. It is also proposed that the HT Panel shall be with Vacuum type Circuit Breaker and the Transformer shall be dry type indoor.

As the demand load is estimated to be 1040 KVA, it is proposed to have 1000 KWP as Photovoltaic solar power to meet the requirements.

2.6 Source of Power Supply

Incoming Supply from State Electricity Board:

Local State Electricity board rules & guidelines:

The voltage at which supply has to be availed by:

i) HT consumers, seeking to avail supply on common feeders shall be:

For Total Contracted Demand with the Licensee and all other sources.	
Upto 1500 kVA	11 kV
1501 kVA to 5000 kVA	33 kV
Above 5000 kVA	132 kV or 220 kV as may be decided by Licensee

ii) HT Consumers seeking to avail supply through independent feeders from the substations where transformation to required voltage takes place shall be:

For total contracted Demand with the licensees and all other sources.	
Upto 2500 kVA	11 kV
2501 kVA to 10,000 kVA	33 kV
Above 10000 kVA	132 kV or 220 kV as may be decided by Licensee
The relaxations are subject to the fulfillment of following conditions: i) The consumer should have an exclusive dedicated feeder from the substation where transformation to required voltage takes place. ii) The consumer shall pay full cost of the service line including take off arrangements at substation. iii) In case of HT-I, HT-II and HT-III consumer categories, for whom the voltage wise tariff is applicable, the Licensee shall levy the tariff as per the actual supply voltage.	

As per (local Electrical Supply Company rules & regulations,) it is proposed to tap the grid power at (33kV) in ring main configuration from tap off points suggested by (NEA). Suitable infrastructure provisions shall be considered to cater the requirements from Tap-off point to Transformer yard located inside the Premises.

2.7 Main Power Distribution

Incoming HT cable from (NEA)Sub-station / tap-off point terminated in 3 module RMU Panel located inside the Site premises for Each Phase.

Incoming 33kV Voltage from the HT Panel will be stepped down to 433V 3phase 4wire with Outdoor type Transformers located at Ground level.

433V 3phase Power supply from LT Kiosk is fed to the Main LT Panel located at Basement.

Main LT panel with suitable capacity of Incomer, outgoings and other feeders like ELEC. HVAC, WTP, Fire Pumps, External Lighting, Lifts & APFCR are planned.

Each Floor we have Electrical room consists of Sub panel & Ups panels further distribution

Clearance all around the panel shall be as per CEIG guidelines.

Electrical & Communication shafts are located in the lobby / common area at each floor level with a clear access to the shaft from lobby / common area to facilitate easy maintenance.

DG-Distribution

100% power backup is considered.

Essential power in case of EB failure is supplied through DG sets at 415V, 50Hz. DG sets shall be with acoustic enclosure along with inbuilt fuel tank, batteries and engine mounted AMF control panel. Sufficient Ventilation (Hot Air & Fresh Air) shall be taken into account during design to ensure fresh air and hot air exhaust.

- Maximum demand on DG for the entire campus is worked out by considering different diversity factor for different type of loads, power factor of 0.8 and maximum loading of 85%
- DG sets shall be of prime duty and with acoustic as per CPCB norms located at Basement-1 level.

- DG sets will have AMF, Auto load sharing & synchronization facility from PCC 3300 or Equivalent command Centre
- The noise level shall be limited to 75 dB as per CPCB norms.
- DG sets shall have their inbuilt day tank of DG sets.
- Exhaust pipe diameter and height are sized to take care of back pressure recommended by the supplier and to meet the PCB (Pollution Control board) norms
- DG will have separate exhaust pipe with stack point as per PCB norms.

2.8 Wiring & Accessories

Lighting & Power wiring considered is as per NBC Section 5.6 & 5.6.2

❖ Lighting & Power Wiring Indoor the Building

SI.NO	FROM	TO	WIRE SIZE
1	DB	Switch Box (Lighting Circuit)	3Rx2.5Sq.mm FRLS Copper Wires In PVC Conduits
2	Switch Box	Switch Box (Lighting Circuit)	3Rx1.5Sq.mm FRLS Copper Wires In PVC Conduits
3	Switch Box	6A Independent Socket (Lighting Circuit)	3Rx1.5Sq.mm FRLS Copper Wires In PVC Conduits
4	Switch Box	Individual Switch/Light/Fan Point	3Rx1.5Sq.mm FRLS Copper Wires In PVC Conduits
5	DB	6/16A Sockets (Max. 3Nos)	3Rx4Sq.mm(Primary) + 3Rx2.5Sq.mm (Secondary) FRLS Copper Wires In PVC Conduits
6	DB	25A Sockets (AC)	3Rx4.0Sq.mm FRLS Copper Wires In PVC Conduits
7	DB	16A Sockets (Geyser)	3Rx4.0Sq.mm FRLS Copper Wires In PVC Conduits
8	Tapp of Box	DB	6Rx6Sq.mm FRLS Copper Wires In PVC Conduits

❖ Lighting & Power Wiring for Common area

SI.NO	FROM	TO	WIRE SIZE
1	DB	Switch Box (Lighting Circuit)	3R x 2.5Sq.mm FRLS Copper Wires In FRLS PVC Conduits
2	Switch Box	Switch Box (Lighting Circuit)	3R x 2.5Sq.mm FRLS Copper Wires In FRLS PVC Conduits
3	Switch Box	6A Socket (Lighting Circuit)	3R x 1.5Sq.mm FRLS Copper Wires In FRLS PVC Conduits
4	Switch Box	Individual Switch/Light/Fan Point	3R x 1.5Sq.mm FRLS Copper Wires In FRLS PVC Conduits
5	DB	1st Light Point(MCB Control)	3R x 2.5Sq.mm FRLS Copper Wires In FRLS PVC Conduits
6	1st Light Point	Looping Points (MCB Control)	3R x 1.5Sq.mm FRLS Copper Wires In FRLS PVC Conduits
7	DB	6/16A Sockets	3R x 2.5Sq.mm FRLS Copper Wires In FRLS PVC Conduits
8	DB	6/16A Sockets & 16A Sockets (Max 2nos)	3R x 4Sq.mm(Primary) + 3R x 2.5Sq.mm (Secondary) FRLS Copper Wires In FRLS PVC Conduits
9	DB	25A Sockets (AC) (Max. 1No)	3R x 2.5Sq.mm FRLS Copper Wires In FRLS PVC Conduits

❖ Lighting & Power Distribution boards

➢ In Indoor Boards

- For Building shall be protected by RCBO followed by MCB
- Outgoing Feeders shall be 6/10A SP MCB for Lighting Circuits
- Outgoing Feeders shall be 16A/25A SP MCB for Power Circuits
- The DB shall be Metal Finish as per Client Requirement

➢ Façade & Street Lightings

- Each phase shall be protected by ELCB followed by MCB for LDB.
- Outgoing Feeders in LDB shall be 6/10A SP MCB
- Outgoing Feeders in PDB shall be 16A/25A SP MCB
- The DB shall be of Double door type with Metal Finish

❖ Lighting Design & Controls:

Lighting for Indoor & Outdoor area are designed based on the following aspects.

Functional lighting as per NBC & Aesthetic lighting as per interior design

As per NBC functional lighting designed for the various areas are as below:

S. N	Area Description	Types of Lighting	LUX Level
1	Corridor & General Circulation area	LED lamps	50-150 Lux
2	Services' room, Conference & Meeting rooms	LED lamps	200-250 Lux
4	Toilets	LED lamps	50-100 Lux
5	Office/Room	LED lamps	400-600 Lux
6	Staircase	LED lamps	100-160 Lux
7	Covered Parking floor	LED lamps	20-50 Lux
8	Ticket booth	LED lamps	300 Lux
9	Control booth	LED lamps	150-200-300 Lux
10	Outdoor parking	LED lamps	5-20 Lux
11	Pantry	Shatter proof lamps fixture	300-500 Lux

Basement Parking:

Basements and car park areas inside the building would be lit using tube light fixtures to provide an illumination level of 20 – 30 – 50 lux.

Wiring will be done to suit 3 zone lighting to operate lighting as 1/3rd, 2/3rd& 100% lighting.

DBs will be provided with timer to suit building operation & season

Sl. No.	Location	Recommended light fixtures	Remarks
1	Driveway	LED	Batten / T8 type
2	Parking	LED	Batten / T8 type
3	Lift landings	Circular LED	LED Down lighter
4	Stairs	Circular LED	LED Down lighter
5	Corridors	Circular LED	LED Down lighter

Staircases:

Staircases in the building are proposed with tube light fixtures at every landing and mid landing.

Building entrances and common areas:

The building entrance is proposed to be lit using compact fluorescent lamps depending on the architectural features and requirements.

Common area viz., toilets, pump rooms etc., are proposed to be lit with tube light/LED type down Light fixtures.
Car parking space, ramps, driving ways, entrance & exits shall be provided with local switch / MCB for controlling lightings.

Basement Corridors / Lift Lobby & Staircase shall be controlled by MCB located at easily accessible area in the basement.

External Lighting System:

Lighting scheme will be designed to suit landscape layout as prepared by Landscape Architects. Building lighting will be done using LED light fixtures. Cabling for all the light fixtures will be executed using multi-core PVC armoured cable. General external light fixtures are proposed with control using 24-hour timers.

Voltage Drop

- The steady state voltage drop shall be < 5% at farthest point.
- For all motors < 10% during starting conditions and < 3% during running conditions.

2.9 Emergency Power Installation

Emergency lighting shall be provided to achieve the following minimum coverage.

- 100% of the stairway and 50 % of corridor lift lobby & general indoor & utility This area shall be provided through UPS power supply.

- Entry & exit area shall also be on UPS supply

❖ **Basement ventilation**

A dedicated feeder is proposed from the DG panel to basement ventilation panel. So that in case of fire Basement ventilation panel will continue to work even the EB source is cut-off as per fire requirement.

❖ **Fire pumps**

A dedicated feeder is proposed from the DG panel to Fire-fighting panel. So that in case of fire, fire panel will continue to work even the EB source is cut-off as per fire requirement.

2.10 Solar System

Solar Energy, offers the best alternative energy solution. The freely and abundantly available light from the SUN can be utilized as Photovoltaic Energy or Heat (Thermal) Energy through special devices developed and manufactured by sophisticated and high technology processes. Solar Inverter is cost effective and easy to install solution to cater the growing needs of the power. On grid solar system is proposed for the project without batteries.

The system consists of solar panels and Power control Unit (PCU) inverter with solar/ Main Hybrid charge Controller. The PCU converts Solar DC power into AC. When solar energy is low, the mains charger is turned ON automatically. Next day, when solar radiation is available, the cycle repeats.

Solar energy is an apt advanced technology that produces renewable energy. Solar Street Lights function with the help of Solar Energy. They get charged during the day when the sun is out working and photocells or timers help them to identify dusk and get switched on from dusk till dawn. They are well exposed on roads to the sun and so receiving solar energy is quite easy.

Sunlight is received by the photoelectric panels during daytime and solar cells convert the solar energy into electrical energy. The solar panels have adequate number of solar cells to perform this job of converting the energy derived from sunlight into electrical energy. These processes make solar street lamps a reliable and effective technology that is easy to install, energy efficient, compatible with various environments, consistent in working, long lasting, low in maintenance, etc.

2.11 LV Distribution System

SUB-Panels/ Equipment Floor Panels for and distribution boards will be installed for isolating the system at any point in case of fault at that level. Design of distribution system shall be such that maximum voltages drop at farthest point from Transformer will be 5% of declared supply voltage. At sub-station, switchgears will be rated 35 KA fault current for 1 second. Sub-Panels Will be provided with switchgears of adequate fault current rating to withstand as per requirement. It is proposed that a LT cable shall be used to distribute the power for each zone up to common facility. It will reduce the quantity of cables, which in turn reduce the maintenance requirement. It will also reduce the distribution losses because of the diversity among all the areas.

All the Electrical panels, distribution boards/sub distribution board shall be installed in the Electrical Cabinets in proposed common utilities areas for two zones. Parking & landscape area shall have distributed through outdoor type of proper IP feeder pillars. Distribution Boards having Isolator/MCB as incomer and ELCB of 30/100mA sensitivity will be provided in each phase for earth leakage. All riser/shaft, opening at each floor/area shall be sealed and all wall penetration shall be sealed by using fire sealant as a fire protection measure

- **Telephone / Communication System:**

It is proposed to have modern structured cabling network for telephone system, to have latest facilities for Internet and data cabling. MS/PVC Conduit, race way shall be used for wire for low current services. CAT-6 wire is proposed for Telephone Network System. Every zone shall have its own Tel. Tag block, which will be connected to Main tag block/ EPABX in Reception area server room at ground floor, using 20 pair CAT-6 cable.

Main Tag block for P&T/ Reliance/ Tata Telecom landline facilities will be installed in Security Control area ground floor itself.

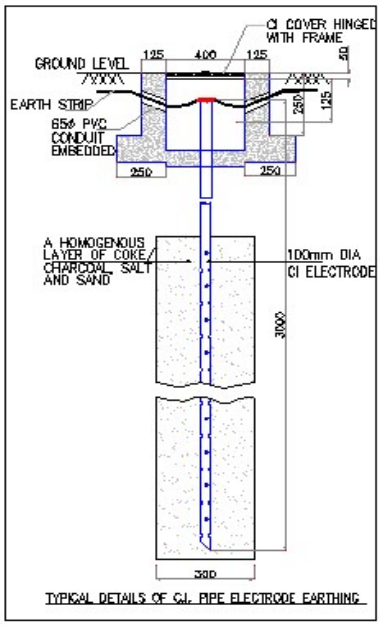
CAT-6 wire in PVC conduit or MS raceway laid in floor shall be used for DATA Network and these wires shall be directly terminated to Patch panel in server row.

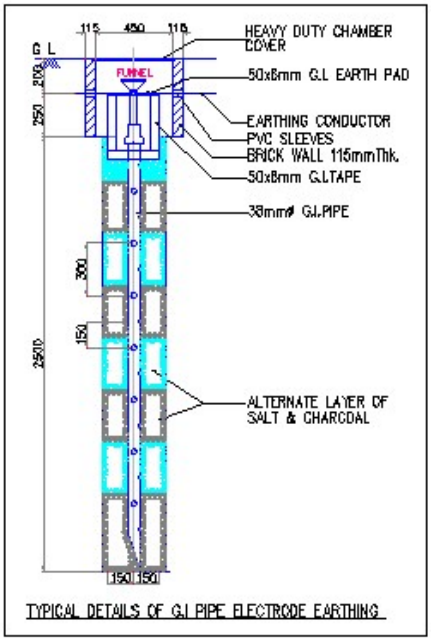
2.12 Earthing

Earthing system shall be designed based on Electrical Soil Resistivity report furnished by Developer testing authority.

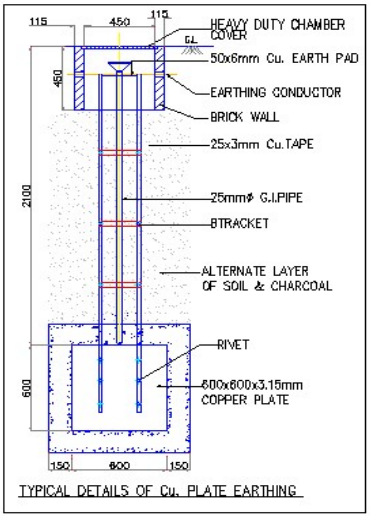
Protective grounding and service grounding shall be connected together to create a common grounding system with dedicated earth pits for Equipment's.

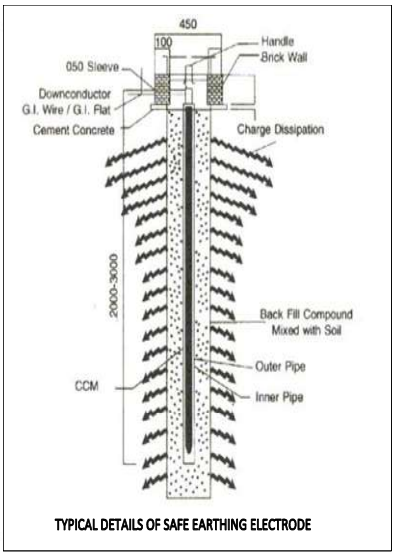
For body earthing of Transformers, Generators, LT Panels, Lift equipment's, Cable trays GI / CI pipe electrode earth pits shall be considered. The construction of GI / CI pipe electrode shall be as per IS 3043.





For neutral earthing of Transformers, Generators & Lightning Arrestor Copper Plate earth pits shall be considered. The construction of copper plate earth pits shall be as per IS 3043.





If the soil strata is of rocky in nature it is preferred to have a chemical compound type earth pits for effective earthing.

All 3-phase electrical equipment shall have two separate and distinct connections to the ground bus. Each motor frame / Distribution Board / Panel shall be connected to the main grounding bus bar. Cable Armour shall be grounded on both ends of the cable. Cable shield shall be grounded only on one side (panel side or source side) of the cable. Steel structures shall be grounded with common earthing grid.

The grounding resistance of common grounding system shall be maintained to less than five ohm. All the earth pits shall be inter connected to have equi-potential at all the locations.

Grounding conductor / strip used for body earthing of Transformers; Generators & LT Panels shall be with GI. Neutral earthing of Transformers, Generators & Lightning Arrestors shall be with copper conductor.

2.13 Lightning Protection

The ideal lightning protection for a structure and its connected services would be to enclose the structure within an earthed and perfectly conducting metallic shield box and in addition provide adequate bong of any connected services at the entrance point of the shield. This in essence would prevent the lightning current and the induced electromagnetic field into the structure.

Conventional Lightning arrestor system is proposed for the project. The following constitute the system

1.) Air terminal (as per rolling sphere or mesh or protective angle method or any combination thereof.)

The role of air termination system is to capture the lightning discharge current and dissipate it harmlessly to earth via the down conductor and earth termination system. Air termination conductors shall be positioned at roof edges, on roof overhangs and on ridges of roof. No metal installation shall protrude above the air termination system.

2.) Down conductor

Down conductors should within the bounds of practical constraints take the most direct route from the air termination system to the earth termination system. The greater the number of down conductors the better the lightning current is shared between them.

3.) Earthing

Vertical earth electrodes connected to down conductor shall be fixed on the mother earth at a sufficient distance from the structure.

PLUMBING

FIRE FIGHTING (PHE)

2. SALIENT FEATURES OF THE PROJECT

2.1	Type of the buildings	--	Assembly building
2.2	Categories as per NBC	--	Group-D (Assembly building)
2.3	Height of building	--	Less than 10m height

3. SCOPE OF WORK

The report in particular is intended to cover engineering and technical details relating to the following heads in Public health Engineering services:

- **External Water Supply System**
  - Source development
  - Treatment
  - Storage
  - Distribution system

- **Sewerage System**
  - Collection
  - Conveyance
  - Disposal to external sewerage system
  - Sewage Treatment Plant
  - Ecoloo Toilet

- **Storm Water Drainage System & Rainwater Harvesting**
  - Collection
  - Conveyance
  - Disposal to external storm water drainage system
  - Rain water harvesting

- **Garden Hydrant System**
  - External Garden Hydrant system

- **Internal Plumbing System**

  - Internal Plumbing
  - Internal Water Supply System
  - Soil, waste and Rain water pipes
  - Disposal to 1st Manhole

- **Fire Fighting System**

  - Wet Riser/Down comer System
  - Fire Pumps
  - Fire Hydrant System
  - Sprinkler System in Basement
  - Portable Fire extinguishers

4. WATER SUPPLY SYSTEM

4.1 Water Demand Calculation:

PROJECT: BUDHA MONESTRY

SUBJECT: POPULATION & WATER DEMAND CALCULATIONS

S. No.	Description	Category of Building	Area (Sqm)	Total Population	LPCD for Potable water	LPCD for Flushing water	Potable Water Demand	Flushing Water Demand	Total Water Demand (l/day)
(A)	**DOMESTIC WATER DEMAND**								
1	**FIRST FLOOR**								
	Total nos. of Rooms @10			20	90	45	1,800	900	2,700
	Total Population @28 Sqm/person	Assembly Building	**1200**	43					
	Total Fixed Population @10%			4	20	25	86	107	193
	Total Floating Population			39	10	5	386	193	579
2	**SECOND FLOOR**		**2000**						
	Total Population @28 Sqm/person	Assembly Building		71					
	Total Fixed Population @10%			7	20	25	143	179	321
	Total Floating Population			64	10	5	643	321	964
	TOTAL in litre/day						**3,057**	**1,700**	**4,757**
	Add 15% misc. & cont.						**459**	**255**	**714**
	Grand Total in litre/day						**3,516**	**1,955**	**5,471**
	TOTAL in cubic metre /day						**5**	**5**	**10**
(B)	**SOFT WATER DEMAND**								
	Total Soft water requirements (As Confirmed by HVAC consultants) (ltrs/day)								45000
	Total in cubic metre /day								**45**

(C)	**HORTICULTURAL WATER DEMAND**	
	Total site area approx. 2 Acre (Assumed 30% area covered for horticulture) considering 10000 ltr./Acre	6000
	Say in (Cum/day)	**6**
TOTAL WATER DEMAND FOR ALL PURPOSES IN M3/DAY		**61**

4.2 Source of Water:

The source of water shall mainly be from:

(i) Municipal/Tanker/Any local sources water supply connection as maximum as possible to meet the requirements, from the local Authorities. Necessary confirmations / applications should be obtained by the Client in this regard, and the relevant details forwarded to our office.

(ii) Boring tubewell as per prevailing practice and conditions of site & after obtaining the necessary permissions from all the concerned authorities. (It is recommended that the hydro geological survey of the site needs to be done to identify the quantity of water available from the underground resources).

(iii) By recycling the treated effluent of the STP for Flushing and horticultural purposes. (Refer Attached Water Balancing Equation).

(iv) Rainwater shall be harvested into the form of infiltration wells, to replenish the underground water aquifer.

4.3 Tank storages:

4.3.1 Underground tank storage:

The capacities of underground tanks shall be as follows, to meet an approximate total requirement of minimum one-day storage capacity.

PROJECT: BUDHA MONESTRY **SUBJECT: TOTAL WATER DEMAND, WATER TANK CAPACITIES & SPACE REQUIREMENTS**			
I.	**TOTAL WATER REQUIREMENT**		
S. No.	**Description**	**Water Requirement**	**Unit**
1	**Domestic Water Demand**	**10**	m^3/day

a)	*Domestic Potable Water Demand*	5	m^3/day
b)	*Flushing Water Demand*	5	m^3/day
2	**Soft Water Demand**	**45**	m^3/day
3	**Horticultural Water Demand**	**6**	m^3/day
	Total Water Demand (For all purposes)	**61**	**m^3/day**
	Total Water Demand (Excl. Horticulture)	**55**	**m^3/day**
II.	**UNDERGROUND WATER TANK CAPACITIES**		
S. No.	**Description**	**Capacity of Tank**	**Unit**
1	UG Fire Water Tank Capacity	50	m^3
2	UG Raw Water Tank Capacity	40	m^3
3	UG Domestic Tank Capacity	10	m^3
4	UG Soft Tank Capacity	25	m^3
	Total UG Tanks Capacity	**125**	**m^3**
6	Max. Depth of Water Considered	4	Meters
7	Area Required for UG Tanks (Incl. for Structure/walls)	34	m^2
8	***Approx. Area Required for UG Tanks (Say)***	70	m^2
9	**Approx. Area for Plant Room (Adjacent to UG Tanks)**	104	m^2
10	**Total Area required for water tanks and plant room**	**110**	m^2
III.	**SEWAGE QUANTITY & SEWAGE TREATMENT PLANT**		
S. No.	**Description**	**Total sewage generation**	**Unit**
1	Total quantity of Sewage Generated (@ 90% of Domestic Water requirements)	9	m^3/day
2	As per MOEF guideline add 10% Extra	10	m^3/day
3	Total Capacity of Sewage Treatment Plant proposed	10	m^3/day
4	Area Required for STP	25	m^2

4.4Water Treatment System

The water from various water sources will be brought into the underground raw water tank to overflow into the fire static tank. Water from this tank shall be treated in the water treatment plant, consisting of filtration, chlorination and optional softening units, located at ground/underground floor in the plant room. Domestic water shall be supplied after filtration and chlorination. A certain amount of water may also be softened and blended with the domestic water to reduce the water hardness to permissible levels. The domestic water shall be stored in the domestic water tank. After softener, soft water shall be stored into soft water tank and use for HVAC purposes.

However, efforts should be made to get water connection of the maximum size from the authority which can be directly used depending on the quality of water with minimum treatment of Chlorination, etc.

4.5 Pumping, Storage &Distribution System

- The domestic water stored in the underground domestic water tank at water treatment plant shall be pumped directly to each wet areas as per the requirement through a dedicated set of Hydro- pneumatic pumping system.

- Similarly, the flushing water stored in the flushing water tank at sewage treatment plant shall be pumped directly to each WC and Urinal's as per the requirement through a dedicated set of Hydro- pneumatic pumping system. This separate system for flushing shall ensure that the treated effluent from the STP is re-used. Emergency connection for Domestic Water supply shall also be made into flushing water storage tank.

- Similarly, the soft water stored into the soft water tank at plant room shall be pumped directly to cooling Tower.

- The system shall be designed to ensure that the following pressures are available at the toilets/kitchens:

  - Minimum Range -0.8 to 1.0 kg/cm^2
  - Maximum Range -2.8 to 3.0 kg/cm^2

- It is proposed that all mechanical equipment's shall have normally 100 % backup to prevent any breakdown in the system.
-

4.6 Horticulture water distribution system

A separate external water supply ring (Garden Hydrant Ring) consisting of treated effluent from STP shall also be provided for the master plan. Tap off points from this garden hydrant ring for Horticulture / Irrigation shall be provided in the landscape area with Garden Hydrants tap off at certain intervals.

5 SEWERAGE SYSTEM

5.1	Total domestic sewage produced	--	Approx. 9 m^3/day
5.2	Type of distribution	--	Generally all flow shall be by gravity up to the final disposal point.
5.3	Treatment of sewage	--	To the proposed Sewage Treatment Plant (STP) of 10 m^3/day capacity based on MBBR technology.
5.4	Kitchen Effluent	--	Kitchen wastes shall be passed through grease traps / Oil separators before discharging into the sewer line.
5.5	Final Disposal of Treated Effluent	--	The treated effluent from the Sewage Treatment plant shall be recycled for Flushing, Soft Water and Gardening purposes etc. The surplus treated effluent, if any, shall be disposed into the external Municipal sewer line as per site condition.

6 DRAINAGE & RAINWATER HARVESTING SYSTEM

6.1 Proposed Storm Water Drainage System

The system has been proposed after studying the site conditions and considering the following factors:-

- The pattern of slopes of terrain of site.
- The existing conditions of site and surrounding.
- The final levels and patterns of different type of roads.
- The need for incorporation of rainwater harvesting within the site area.
- Final disposal to external drainage system as per site.

6.2 Planning of the Drainage System

- Depending upon the final section of roads and its surrounding local conditions, the storm water drainage network may be provided on single / both sides of all roads.
- The storm water from buildings/surface area inside the plots shall be collected by road gully chamber/catch pit/inlets or surface flow as per the internal design of each building. The systems shall flow preferably in gravity.
- The drainage from each building shall ultimately connect to the external drain as per the Master plan which would be located adjacent to the building.
- At the Master plan level, the drainage shall be carried through a network of catch basins, Manholes and RCC pipe network, as per requirements, following the contour levels of the Master plan.

- We have proposed the rain water harvesting well for collecting the storm water runoff and for recharging the underground aquifier. It is proposed to Ultimately collect the final disposal of the storm water to the external manhole as per site.

- Provisions shall be made for the final overflow to be connect with outside the site, in case of excessive heavy rainfall.
- It is proposed to provide treatment through filtration and de-silting before the runoff enters the impounding reservoir.

7. INTERNAL PLUMBING SYSTEMS

7.1 **Plumbing System Adopted**: Two pipe (stack) system as recommended in code of practice for soil and waste pipes above ground (I.S: 5329 – 1964). This implies there are separate vertical stacks as per the following:

- ***Soil Pipes*** shall carry the wastes from WC's & Urinals. Soil pipes shall connect directly to manhole outside the building.

- ***Waste Pipes*** shall carry the wastes from Washbasins, Sinks, Floor Drains, etc. Waste pipes shall connect to Gully Traps outside the building, which shall in turn be connected to the external manholes.

- ***Rainwater Pipes*** shall also be provided which shall dispose outside the building into the external catch – basin chambers / external drains.

7.2 To ensure that the plumbing system is unhindered, all wet – areas shall be designed with the following structural provisions:

S. No.	• Details	• Requirements
a)	Wet Areas slab to be partially sunk	(i) Only approx. 125 to 150 mm sunken area required in wet areas for connection of Wash Basins, Sinks & Floor Drains. (ii) For balconies also, 125mm sunken area is required. (iii) All Traps & Soil & Waste pipes shall be hanging at ceiling level below, by hanging the pipes with G.I structural supports/dash fasteners and proper clamping etc. with proper slope (1:60). (iv) Cleanout plugs shall be provided at the ceiling level below as per detailing. (v) All structural Beams at ceiling level should be inverted (Upwards oriented) (vi) Cutouts for traps and WC soil pipes shall be marked and provided for execution. (vii) In case any Indian WC's are provided 450mm sunken slab shall be required for that area. viii) This option is recommended for most wet areas from the point of view of easy cleaning and maintenance of the plumbing systems, as all pipes are accessible from below.

7.3 Ecoloo Toilets

Ecoloo biodegradable toilets will be installed at site which are flush less and saves a lot water wasted in flushing. It makes the fertilizer of the solid waste which can be sell out in market as a fertilizer.

Water body

Treated water will be supplied to water body and water will pumped back to water body. The water will not stagnant instead it will be floating from the steps and from lower step it will be accumulated in Water body tank and then filtered and treated in filter plant. A balancing tank will also be installed to incorporate the loss of water due to evaporation.

PRODUCT	DESCRIPTION 1 year warranty applies on all ECOLOO products supplied	PURPOSE
	INDOOR/OUTDOOR ECO DELUXE • Base: FRP, Weight: 50kg • Dimension without box: 835mm (W) x 865mm (L) x 635mm (H) • Dimension with box: 850mm (W) x 880mm (L) x 665mm (H) • Items included: Toilet Seat, Toilet Lid, Dry Flush, Wind Ventilation Fan, Drop Bed.	• Indoor purp • Inside trans • Off grid hou Tent) • One family

	INDOOR/OUTDOOR ECO BASIC
	• Material: FRP, Weight: 90kg
	• Type: ECO BASIC
	• Dimension: 1100mm (W) x 750mm (H) x 1350mm (L)
	• Capacity:
	  ○ Upper: 450L (Solid)
	  ○ Bottom: 250L (Liquid)
	• Items included: Toilet Seat + Lid, Dry Flush, Wind Ventilation Fan, Drop Bed. **(Mechanical Waste Cover is Optional)**
		• Outdoor pu
		• Schools
		• Up to 15 vis 24/7 (200+
		• Can be used for bigger t with partiti
		• Proper hous structure ca around the for outdoor

	OUTDOOR ECO CLASSIC • Type: ECO BASIC + Structure • Total Weight: 160kg, Knock Down (D-I-Y) • Structure: Light Composite 38 mm insulated Panels (normally used for cold rooms and trucks), Door, Roof • Optional: Mechanical Waste Cover, Solar Panel & Lighting, Hand bidet, Hand grab, Toilet Paper Holder, Hand Sanitizer, Fertilizer Pump .. etc. • Dimension: 1100mm (W) x 2200mm (H) x 1350mm (L)	• Outdoor pu • D-I-Y Struct installed wi 1 hour • Up to 15 vis 24/7 (200+
	OUTDOOR ECO TENT	

8.0 FIRE FIGHTING SYSTEM

8.1 Design Reference for Fire Fighting

For planning/designing the firefighting system, following considerations/ design guidelines/references have been adopted:

(a) National Building Code of India - (Latest Edition, March 2016 -- Part-IV, Fire & Life Safety)

-

(b) I.S:3844-1989 - Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises.

(c) I.S:13039-1991 - Code of practice for external hydrant system provision and maintenance.

(d) I.S:2190-1992 - Code of practice for selection, and maintenance of first aid fire extinguishers.

8.2 Category of Building as per National Building Code of India 2016

(i) Category of Building -- Assembly Building (Group D)

(ii) Maximum height of the building -- Less than 10 m

8.3 Wet Riser, Down Comer& Hydrants System

The firefighting system shall be provided mainly as per latest National Building Code of India Part IV 2016 and other relevant I.S codes and it shall be consisting of:

(i) As per NBC 2016, (25+5) Cum Terrace Fire tank is required with (900+450) LPM Terrace Fire pump. But as per building profile, Terrace Fire Tank with Pump is not possible put at Terrace Level. Accordingly, we proposed Centralized Static Underground storage fire tanks of 50 m^3 capacity as per building nature.

(ii) As per NBC 2016, down comer system is required but we proposed wet - riser system with single outlet landing hydrant valves and fire hose cabinet @ 1000m^2 area minimum, and as per staircases/landing details of final architectural layouts. (As per recommendations of IS: 3844:1989, Code of practice for installation of Internal Hydrants).

(iii) Each Fire Hose Cabinet shall be consisting of:

- 2 nos., 63mm dia and 15m long rubberized fabric lined hose pipe as per I.S.:636 Type-II.
- Gun metal/Stainless Steel (S.S.) male and female instantaneous type coupling as per I.S:903 with I.S. specifications.
- Gun Metal/Stainless Steel (S.S.) branch pipe with nozzle as per I.S:901.
- First-aid fire hose reels with 20mm dia 36.5m long with 5mm bore gunmetal nozzle as per I.S:884 - 1969.
- Fire Man's Axe

8.4 Fire Pumps

(i) Considering the multiple number of buildings of assembly building, it is recommended to provide the following Fire Pumps:

- 1 No. of Main Electrical fire pump of 1620 lpm capacity (to give a minimum pressure of 3.5 kg/cm^2 at the farthest point)
- 1 No. of Electrical Jockey pump of 180 lpm capacity
- 1 No. of Diesel operated fire pump of 1620 lpm capacity

(ii) All fire pumps shall be with positive suction arrangements.

(iii) All the fire pumps shall cut-in automatically based on the pressure settings, so as to ensure that the entire fire main line, risers etc. are pressurized on a continuous basis.

(iv)The jockey pump shall automatically cut-out based on the pressure settings. However, the remaining fire pumps shall off only in the manual mode.

8.5 Sprinkler System

(i) Sprinkler System shall be provided for the basement areas.

(ii) Pendant sprinklers shall be used @9m^2 of built up area, with a center to center spacing not to exceed approximately 3.0 meters. Sidewall sprinklers shall be used as per detailing.

(iii) Upright sprinklers shall be provided for any areas greater than 800mm in height.

(iv) The sprinklers shall be automatically activated at 68^0 C by breaking of the glass bulb in the event of fire.

(v) The sprinkler line of the basement shall be always energized on a 24-hour basis by automatic system consisting of an Electrical sprinkler pump.

(vi) Necessary accessories such as Alarm Valves, Flow Switches and Inspection Test Assemblies etc. shall be provided as per the detailed requirements.

(vii) Generally, for sprinkler system design, IS 15105:2002 shall be followed (Indian Standard for Design & Installation of Fixed Automatic Sprinkler Fire Extinguishing Systems) and where required, guidelines of the Tariff Advisory Committee (TAC), as well as relevant NFPA Codes shall be consulted.

8.6 Fire Extinguishers

The following type of portable fire extinguishers shall be provided at all levels of the towers, at strategic locations as per requirements, generally to follow IS – 15683:

- 9 lit. water expelling type as per I.S:15683-2006
- 6 kg, CO_2 type as per I.S: 15683-2006
- 4.5 kg ABC Powder Type as per I.S:15683-2006

8.7 Fire Brigade connection

- Fire Brigade connection to be provided in plant room and rising main.

END

India International center for Buddhist Heritage and culture(IICBHC)

Tender Documents

VOLUME-I

Technical Specifications

TECHNCIAL SPECIFICATIONNS FOR 11 KV PANELS AND ALLIED ITEMS

1. GENERAL

The technical specifications cover the equipment to be supplied for a 11 kV Switchboards suitable for 11 kV 3 phase Earthed System. 50 HZ AC supply with a fault level of 350 MVA at 11kV. The equipment shall be suitable for continuous operation at the stipulated ambient conditions.

2. STANDARDS AND CODES

The following Indian Standards Specifications and Codes of Practice shall apply to the equipment covered by this Contract. In addition, the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rule 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government Regulations. Necessary Test Certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

11000-volt Circuit Breaker	**IS** 13118:1991
Metal Enclosed Switchgear and Control gear for voltages above 1000 volts	**IS** 3427:1969
Electrical Relays for Power System Protection	**IS** 3231:1986
Voltage Transformers	**IS** 3156:1992
Current Transformers	**IS** 2705:1992
Rubber Mats for Electrical Works	**IS** 5424:1969
Danger Notice Plate	**IS** 2551:1982

3. 11000 VOLT CIRCUIT BREAKERS

3.1 Technical Parameters

The 11000-volt circuit breakers shall be triple pole Vacuum type suitable for indoor mounting and shall comply with the requirements of the relevant Indian Standards. The Circuit Breakers shall be suitable for operation at 11000 volts 3 phase 50 Hz supply system and shall have a certified symmetrical breaking capacity of 350 MVA at 11000 volts or as stipulated in schedule of Quantities.

3.2 Technical Specifications

The Circuit Breakers Shall be Vacuum Type and Shall Consist of Three Identical single pole Vacuum interrupter units which shall comprise of a pair of butt contacts enclosed within a Sealed ceramic body with SS end plates. The moving contacts shall be sealed into the Enclosure via a SS steel bellow which shall permit axial movement of the contact. The contact Arrangement shall be surrounded by SS sputter shield to prevent condensation of metal on the inside of the insulating envelop and also to provide good voltage grading across the gap and the outer envelope. The contact material and the contact geometry shall be suitable for the purpose so as to attain current chopping at minimum current to prevent build-up of unduly High over voltages and to prevent the arc to cause localized high spots on the contact.

The Circuits Breaker shall be suitable for switching Duty of Transformer.

4. CIRCUIT BREAKER CONSTRUCTIONAL FEATURES

The 11000-volt circuit breaker shall be flush front, metal clad, truck mounted, Fix type and fully interlocked. The truck that carries the Circuit Breaker shall be of rigid fabricated construction. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

All electrical connections on the truck shall be brought to secondary plugs which engage similar sockets in the housing.

The Circuit Breakers shall be of the double break type. Interphase barriers and tank lining of insulating material shall be provided.

All current carrying parts in the Circuit Breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts.

Isolating contacts of the spring loaded self-aligning pattern shall be provided for the Circuit Breaker. Suitable arc control devices shall be mounted around the fixed contacts.

Terminal insulators of synthetic resin bonded paper shall be provided suitable for the specified short circuit level

Sheet steel barriers shall be provided between

- Instrument Panel and Potential Transformer
- Instrument Panel and Current Transformers
- Bus bar chamber and Circuit Breaker compartments

5. CIRCUIT BREAKER OPERATING MECHANISM

The Circuit Breaker shall be trip free and equipped with a motor power operated closing mechanism. The operating mechanism shall be such that the Circuit Breaker is at all times free to open immediately the trip coil is energized.

Mechanical ON/OFF position indication shall be provided on the front of the circuit breaker.

The operating mechanism shall be mounted on the front panel of the truck.

The operating handle and the mechanical trip push button shall be at the front of and integral with the Circuit Breaker.

The operating mechanism shall provide four distinct and separate positions of the Circuit Breaker on the cradle

- Service
- Test
- Isolated
- Maintenance

6. CIRCUIT BREAKER INTERLOCKING

Each Circuit Breaker shall be provided with the following mechanical safety interlocks to ensure protection to the equipment and the operator.

The Circuit Breaker cannot be closed unless it is in the 'PLUGGED IN' position.

The Circuit Breaker cannot be withdrawn from or pushed into the housing unless the main contacts are open.

The Circuit Breaker cannot be put into service without making the secondary connections between the truck and housing.

The cover of the draw out voltage transformer cannot be opened unless the transformer is Isolated.

7. CIRCUIT BREAKER AUXILIARY CONTACTS

The Circuit Breaker shall have a minimum of 6 N.O. and 6 N.C. auxiliary contacts rated at 5 amps. These contacts shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is lowered.

8. PROTECTIVE RELAYS

The Circuit Breaker shall have overcurrent, earth fault protection and auxiliary relay devices as specified in the Schedule of Quantities. These relays shall be mounted flush on a separate compartment with access from the rear for wiring and maintenance.

9. POTENTIAL AND INSTRUMENT TRANSFORMERS

A draw out type cast resin voltage transformer shall be mounted in the panel and connected to the line. The tank shall be arranged for horizontal isolation.

The Circuit Breaker shall have the required current transformers as specified in the Schedule of Quantities for metering and protection mounted outside the Circuit Breaker compartment but within the free-standing cubicle. The transformers shall comply to the relevant Indian Standards. All current transformers for metering shall be Accuracy Class I and of capacity and ratio as required. Separate sets of current transformers shall be provided for metering and protection.

10. INSTRUMENTATION

Instruments and indicating lamps as required in the Schedule of Quantities shall not be mounted on the Circuit Breaker compartment door. A separate adequate compartment shall be provided. The instruments and relays shall be accessible for testing and maintenance without danger of accidental contact with live parts in the Switchgear Panel.

Square pattern flush mounting meters and selector switches of the three way and OFF pattern complying with the requirements of the relevant Indian Standards shall be used.

The current transformers for metering and protection shall be mounted on the solid bus bars with proper supports.

Neon type indicating lamps shall be provided for phase and other operational indications.

11. TYPE TEST CERTIFICATES

The Contractor shall submit type test certificates of the Circuit Breakers complying to the relevant Indian Standards from a recognized Test House.

12. 11 KV SWITCHGEAR PANEL

12.1 General

The switchgear panels shall be suitable for operation at 11000 volts 3 phase 50 Hz supply system with a short circuit withstand of 350 MVA at 11,000 volts and a corresponding short time rating for 3 second.

The Switchgear panels shall comply with the requirements of the latest edition with up to date amendments of the relevant Indian Standards Specifications, Indian Electricity Rules and Regulations.

12.2 Switchgear Configuration

The panel shall be configured with 11,000-volt Circuit Breakers, associated metering and protective devices and other equipment as called for in the Bill of Quantities.

Each 11,000-volt Circuit Breaker shall be housed in an individual panel in single tier formation.

12.3 Equipment Specifications

All equipment used to configure the Switchgear Panel shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and the detailed technical specifications as included in this tender document.

12.4 Constructional Features

The 11000 volts Switchgear Panel shall be totally enclosed, dead front, metal clad, cubicle pattern, floor mounting, extensible on both sides and suitable for indoor use.

The Switchgear Panels shall be totally enclosed and completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the

joints dust and vermin proof. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.

The Switchgear Panels shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA Sheet Steel of thickness not less than 1.6 mm. Joints of any kind in sheet steel shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.

Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self-threading screws shall not be used in the construction of the Switchgear Panels.

12.5 Switchgear Panel Limitations

A base channel of 75 mm x 5 mm thick shall be provided at the bottom.

The Switchgear Panel height shall normally be restricted to a maximum of 2300 mm.

12.6 Switchgear Panel Compartmentalization

The Switchgear Panels shall be divided into distinct separate compartments comprising

A completely Enclosed Ventilated Dust and Vermin Proof Bus Bar Compartment for the Vertical and Horizontal Bus Bars.

Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

Separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, protective relays, control fuses etc. as required. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts.

A horizontal wire way with screwed covers shall be provided at the top to take interconnecting control wiring between vertical sections.

Cable compartment shall be of adequate size for easy termination of all incoming and outgoing cables. Adequate and proper supports shall be provided in the compartment for supporting the cables.

12.7 Switchgear Panel Bus bars

The main horizontal and vertical interconnection bus bars shall be Aluminum Bus Barr and of rectangular cross sections suitable for full rated current. The current density for Aluminum shall be 0.8 amps per sq. mm. and suitable to withstand the electromagnetic and thermal stresses of a 350 MVA fault level at 11,000 volts for 3 second.

The bus bars and interconnections shall be insulated with fiber glass sleeves.

The bus bars shall be extensible on either side of the Panels.

The Bus Bars Shall be Supported on Non-Breakable, non-hygroscopic insulated supports at regular intervals to withstand the stresses of a 350 MVA fault level.

All bus bars and interconnections shall be color coded.

The main horizontal bus bars shall run through the entire length of the Switchgear Panels.

12.8 Switchgear Panel Interconnections

All interconnections shall be with solid electrolytic copper of adequate size to carry the full rated current and fiber glass insulated.

12.9 Switchgear Panel Interlocks

Each group of bus bars and feeder connections shall be fitted with automatically operated safety shutters with positive opening and closing when the Circuit Breaker is raised or lowered.

Facility shall be provided for hand operation of the shutters and latching in either open or closed position.

Padlocking provision of the shutter in the closed position shall be included for maintenance purposes.

12.10 Instruments and Protection Relays

Instruments, indicating lamps and all protection and control relays shall not be mounted on the Circuit Breaker compartment door. A separate adequate compartment shall be provided. The instruments and relays shall be accessible for testing and maintenance without danger of accidental contact with live parts in the Switchgear Panel.

Neon type indicating lamps shall be provided for phase and other operational indications.

The current transformers for metering and protection shall be mounted on the solid copper bus bars with proper supports.

12.11 Switchgear Panel Internal Wiring

All wiring for relays and metering shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 2.5 sq.mm.

All control circuits shall be provided with 10 kA MCB's Instrument testing plugs shall be provided for testing the meters.

12.12 Cable Terminations

Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the location of the incoming and outgoing cables.

The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located in the cable chamber at the rear of the Panels.

12.13 Space Heaters

The Switchgear Panel shall have in each panel thermostatically controlled space heaters with a controlling 16-amp 230-volt socket outlet with MCB to eliminate condensation.

12.14 Earthing

Two main earth bars of copper as required shall be provided throughout the length of the Switchgear Panels with a provision to make connections on both sides to the sub-station earths.

12.15 Designation Labels

Suitably engraved white on black name plates and identification labels of metal for all Panels and circuits shall be provided. These shall indicate the feeder number and the designation

12.16 Sheet Steel Treatment and Painting

Sheet steel materials used in the construction of the Switchgear Panels should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognized phosphating process. The sheet steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

All sheet steel work shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stove and the paint thickness shall be not less than 50 microns.

12.17 The circuit breakers shall be provided with following accessories.

i) Auxiliary switch with 5NO + 5NC contacts.
ii) Mechanical operation counter
iii) Spring charging handle
iv) Recharging in/out handle
v) Foundation bolts
vi) Maintenance manual
vii) Instruction manual

12.18 Auxiliary supply

a) The tipping shall be at 24 V DC through a power pack unit

b) Space heater, Indication and other auxiliary supply shall be through to 230 V AC

12.19 Factory & Site Test

Acceptance tests are carried out according to contractual standards, for each Switchgear, with all the panels of the same Switchgear assembled together.

a) Preliminary, at manufacturer-premises before delivery:

1) Visual: general compliance with the contractual documents and with good execution;

2) Mechanical operation of doors, shutters, switching devices;

3) Ratio and polarity of measuring transformers (to be tested at transformer's manufacturer's place and will be witnessed by Client).

4) Electrical voltage, at Ui and fn 50 Hz, of main and auxiliary circuits;

5) Electrical insulation, of main and auxiliary circuits by megger and HV;

6) Pick-up and drop-off test of auxiliary relays;

7) Functional test of control circuits;

8) Simulation and operation of protection relays at set points. A)

SUBHEAD -2

RELAYS, CT'S, PT'S INDICATION LAMPS ETC

1. 0 GENERAL

This section covers specifications for Protection and Control Relays for breakers, Instrument Transformers, Measuring Instruments, Push Buttons, Indicating Lamps etc. required in LT and HT switchboards.

2.0 STANDARDS AND CODES

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition, the relevant clauses of the Indian Electricity Act 2003, Indian Electricity Rules 1956, National Building Code 1994, National Electric Code 1985, Code of Practice for Fire Safety of Building (general): General Principal and Fire Grading – IS 1641 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

Application guide for Current Transformers	IS 4201:
Application guide for Voltage Transformers	IS 4140:
Application guide for Relays	IS 3842:
Electromagnetic Relays	IS 5051:

3.0 PROTECTION AND CONTROL RELAYS

The Circuit Breaker shall have protection and control relays as specified in the schedule of quantities. Relays shall be approved types complying to relevant ISS and having approved

characteristic. Relays shall be flush mounted in dust proof cases. Relays shall be arranged so that adjustments, testing and replacement can be affected with minimum of time and labor.

In case of C.T. operated thermal overload and magnetic instantaneous short circuit release, the overload releases shall be such that each phase can be individually set depending on the phase unbalanced currents. The releases shall have inverse time current characteristics and the magnetic release shall be time delayed with a minimum setting of 25 ms varying up to 300 ms for discrimination without effecting the breaking current capacity of the ACB.

4.0 CURRENT TRANSFORMERS

Separate sets of CTs shall be provided for metering and protection. C/Ts shall confirm to IS 2705 (part -I, II and III) in all respects. All C/Ts used for medium voltage application shall be rated for 1 kV. C/Ts shall have rated primary current, rated burden and class of accuracy as specified in Schedule of Quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 and for protection class 5P10. C/Ts shall be capable of withstanding magnetic and thermal stresses due to short circuit faults as applicable. Terminals of C/Ts shall be paired permanently for easy identification of poles. C/Ts shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each C/T shall be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor FRLS PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner. Facilities for shorting terminal shall be provided.

5 POTENTIAL TRANSFORMERS

PT's shall conform to IS 3156 (Part I, II and III) in all respects. Primary and secondary circuit wiring star connected and voltage ratio shall be 11 kV /□3/110/□3 or 415/□3/110/□3 as specified in Schedule of Quantities. Class of accuracy shall be 0.5 or better accuracy and certified by the manufacturer. Over voltage factor shall be 1.2. Transformer of capacity of 500KVA and above would be equipped with additional metering class current transformers (CTs) & Potential transformer (PTs) additional to requirements of Utilities so that periodic loss monitoring study may be carried out.

6 MEASURING INSTRUMENTS

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 0.5 class. Meters shall be suitable for continuous operation between -10^{o} C and +45^{0}C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Suitable selector switches shall be provided for ammeters and volt meters used in three phase system unless otherwise stipulated, 144mm x 144 mm instrument shall be used. The rating type and quantity of meters, instruments and protective device shall be as per Schedule of Quantities /drawings. Ammeter on motor circuit shall be provided with suppressed scales to take care of shorting surges.

6.1 Ammeters

Ammeters shall be of moving iron type. Moving part assembly shall be with jewel bearings. Jewel bearings shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. Ammeters shall be manufacture and calibrated as per IS 1248. Ammeters shall normally be suitable for 5 A secondary of current transformers. Ammeters shall be capable of carrying substantial over loads during fault conditions. Ammeters of motor circuits shall be provided with suppressed scale to cater for starting current. Wherever so stipulated in schedule of quantities, ammeter shall be digital type

6.2 Voltmeters

Voltmeters shall be moving iron / digital type range of 3 phase 415-volt voltmeters shall be 0-500. Volt meters shall be provided with protection MCB.

6.3- Watt meter

Wattmeter shall be of 3 phase electro dynamic/digital type and shall be provided with a maximum demand indicator if required.

6.4 Power factor meters

3 phase power factor meters shall be of electro dynamic / digital type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% readings. Phase angle accuracy shall be $+4^0$.

6.5 Energy and reactive power meters as per the griha 4 rating

Trisector meters shall be two elements, integrating type, KWH, KVA, KVARH meters. Meters shall confirm to IEC 170 in all respects. Energy meters, KVA, and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy consumption of 500 hours corresponding to maximum current at rated voltage and unity power factor. Meters shall be suitable for operation with current and potential transformers available in the panel.

7.0 INDICATING LAMPS

Cluster LED type indicating lamps shall be provided for indication of phases and Breaker position as required in the schedule of quantities. Lamps shall be easily removed and replaced from the front of the panel by manual means not requiring the use of extractors.

8.0 PUSH BUTTONS

Push buttons shall be of non-hygroscopic material, non-swelling and fitted to avoid any possibility of sticking. Contacts shall be of adequate strength and have a positive whipping action when in operation

HT CABLES -

Construction

All HT Cables Shall be 11kv. grade XLPE Earthed Insulated & PVC Sheathed flat Steel Wires

Strips Armored Electrical Purity Aluminum Conductor Cables Shall be Manufactured & Tested in Accordance with IS Specification.

Terminal Joints

Terminal joints Shall be Carried out as per IS Specification. Heat Shrink Cable Termination Kit Shall Be used for Termination.

1.1. ELECTRICAL WORKS

1.1.1. Switchgears & Switchboards

Standards and codes

	Specification for low voltage switchgear and control gear	
	• General Rules	IS 13947 Part-1: 1993
	• Circuit breaker	IS 13947 Part-2: 1993 IEC-62271
	• Switches, disconnectors, switch disconnectors and fuse combination units	IS 13947 Part-3: 1993

	• Low voltage switchgear and control gear Specification - Control circuit devices and switching elements	IS 8623
	➢ Electro mechanical control circuit devices	IS 13947 Part-5: Sec-1: 2004
	➢ Proximity switches	IS 13947 Part-5: Sec-2: 2004
	Guide for uniform system of marking and identification of conductors and apparatus terminals	IS 113553: 1985
	Electrical relays for power system protection	
	General introduction and list of parts	IS 3231 Part-0: 1986
	• General requirement	
	➢ Contact performance	IS 3231 Part-1: Sec-1: 1986
	➢ Insulation tests	IS 3231 Part-1: Sec-2: 1986
	➢ High frequency disturbance test for static relay	IS 3231 Part-1: Sec-3: 1986
	• Requirements for principal families	
	➢ All or nothing relays	IS 3231 Part-2: Sec-1: 1987
	➢ General requirement for measuring relay	IS 3231 Part-2: Sec-2: 1987
	➢ General requirements for thermal relay	IS 3231 Part-2: Sec-3: 1987
	• Requirements for particular group or relays: Biased (percentage) differential relay	IS 3231 Part-3: Sec-3: 1987
	• Requirements for particular group or relays: Directional relays and power relays	IS 3231 Part-4: Sec-3: 1987
	Specification for low voltage switchgear and control gear assemblies:	
	• Requirements for type tested and partially type tested assemblies	IS 8623: Part 1: 1993
	• Particular requirements for bus bar trucking system (bus way)	IS 8623: Part 2: 1993
	• Particular requirements for equipment where unskilled person have access for their use	IS 8623: Part 3: 1993

	Code of practice for selection, installation, and maintenance of switchgear and control gear	
	• General	IS 10118 Part-1: 1982
	• Selection	IS 10118 Part-2: 1982
	• Installation	IS 10118 Part-3: 1982
	General requirement for switchgear and control gear for voltage not exceeding 1000-volt AC or 1200-volt DC	IS 4237: 1982

1.1.1.1. **Switchgear**

A. Molded case Circuit Breakers (MCCB)

- Type Molded case circuit breaker
- Operating voltage 415/690-volt 3 phase 50 Hz
- Insulation Voltage - 690 volts
- Current rating - as per Schedule of Quantities
- Fault Level withstand Ices - As per Schedule of Quantities
- Icu - 100% Ics
- Icw - 100% Ics
- Isolation function - as per IEC 60947-2 Section 7.12
- Insulation - class II insulation between the front panel and internal power circuits
- Cubicle mounting - Fixed unless otherwise specified
- Operating mechanism - Trip free
- Independent Manual spring closing (IMS) or motor wound spring closing mechanism (MWS) as per Schedule of Quantities
- No of Poles - 3 or 4 as required
- All current carrying parts - Silver plated
- Arcing contacts shall be provided to protect the main contacts and shall be separate from the main contacts and easily replaceable.

- Arc chutes shall be provided for each pole, and shall be suitable for being lifted out for the inspection of the main and the arcing contacts.
- Common Operating handle required for three phase MCCBs for simultaneous operation and tripping of all the three phases.
- Indications and Operations integral with ACB on front
    a. Mechanical ON/OFF/ Tripped indication
    b. Operating handle
    c. Mechanical trip push button
- Accessories - Following accessories shall be provided as required
    i. Under voltage trip
    ii. Shunt trip
    iii. Alarm switch
    iv. Auxiliary switch
- Circuit Breaker Interlocking - Interlocks shall be provided to ensure the following:
    i. Handle interlock to prevent unnecessary manipulations of the breaker.
    ii. Door interlock to prevent door being opened when the breaker is in ON position.
    iii. DE interlocking device to open the door even if the breaker is in ON position.

    Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.
- Protection Microprocessor based releases and/or thermal magnetic releases shall be provided for the Circuit Breakers as stipulated in the Schedule of Quantities
- Electrical endurance Upton 250 amps minimum 10,000 operations
- For 400 amps & above minimum 4,000 operations
- Type test certificates Submit Certificates from a recognized test house for the Circuit Breakers offered.

1.1.1.2. Switchboard

- Supply System Three phase 4 wire, 415-volt, 50 Hz, Indian TN-S system.
- Short circuit level withstands as per Schedule of Quantities.

- Ingress protection IP 42 as applicable.
- Metal based neoprene gaskets between all adjacent units and beneath all doors and covers shall be provided to render the joints dust and vermin proof.
- Pressure relief devices shall be provided to minimize danger to operator during internal fault conditions.

Panel Compartmentation

- Compartment Tier 3A as per IEC 6043 (Part-I) unless otherwise stated in Schedule of Quantities.
- Circuit Breaker Metering Separate segregated compartment shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, bus bars and connections.
- Control wiring compartment a horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

Panel Configuration

- Panel configuration - MCCB's arranged multi-tier formation.
- Air Circuit Breakers - Single or double tier formation.
- Spare Space provision - The Switchboards shall have a provision of 25% spare space to accommodate possible future additional switch gear.
- Extensible shall be extensible on both sides.

Panel Construction

- Metal clad totally enclosed,
- Dead front
- Floor mounted
- Free standing type
- Modular extensible design
- Suitable for indoor mounting.

Switchboard cubicles, doors and covers - Fabrication with CRCA Sheet Steel

Cubicles - Thickness shall be 3.0 mm for load bearing compartments and 2.0 mm for non-load bearing compartments, folded and braced to ensure rigid support for all components.

Doors/ covers - Thickness not less than 1.6 mm & should be properly earthed.

Joints - Seam welded

Welding slag - Ground off

Welding pits - Wiped smooth with plumber metal.

Switchboard frames Fabrication

With electro galvanized MS sheets 'U' Channel switchboard frames of 2.5 mm thick

All joints should be neatly formed and finished flush with adjacent surfaces, No joints shall be located in corners. Bare edges shall be round/covered.

Structural members and bracings where ever required shall be welded or bolted to the frame. The frame shall be of modular design and extensible.

Cable compartment Rear Access switchboards

All cabling from rear, Front access switchboard, Separate vertical cable accessible from front only.

Adequate space shall be provided for ease of installation and maintenance with safety for working without coming into contact with any live parts.

The cable chambers shall be complete with

- Adequate support for cables.
- Tinned brass cable sockets,
- Tinned brass compression glands,
- 3 mm thick gland plates,
- Supporting clamps and brackets etc. for termination of 1,100-volt grade aluminum conductor XLPE cables.
- Door handles Good quality door handles fitted with toggles to operate rods to latch with suitable slots in both top and bottom of switchboards shall be provided. Latching rods and associated brackets shall be cadmium plated.
- Operating handles all operating device shall be located in front of switchgear only.
- Fixing Screws Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self-threading screws shall not be used in switchboards.
- Dimensional Limitations

    i. Base channel 75 mm x 5 mm thick shall be provided at the bottom.

ii. Minimum 200 mm blank space between the floor of switchboard and bottom most unit shall be provided.

iii. Overall height shall be limited to 2,300 mm unless otherwise stipulated.

iv. Height of the operating handle, push buttons etc. shall be restricted between 300 mm and 1,700 mm from finished floor level.

Switchboard Bus Bars, Interconnections etc. rating

- Rating of Bus Bars, interconnections and to feeders these shall be designed as per requirements in Schedule of Quantities to-Carry full load current for phase and neutral bus bars Withstand the stresses of fault level. For aluminum & copper current density shall be of minimum cross section of 0.6 & 1.0 amp per sq. mm respectively.

Switchboard Bus Bars

- Bus Bar material High conductivity, high strength aluminum alloy, complying with requirements of grade E 91E of IS 5082 – 1981

  Alternatively, Electrical grade 99.99% pure copper as per Schedule of Quantities

- Bus Bar Insulation Heat shrunk PVC sleeking of 1.1 kV grade and bus bar joints provided with clip-on shrouds.

- Bus Bar supports Non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports able to withstand operating temperature of - 25°C to 130°C (degree of protection IP 65 IEC 60529) at regular intervals, to withstand the forces arising from a fault level as stipulated in schedule of quantities.

- Color coding all bus bars shall be color coded.

- Auxiliary Bus Electrolytic Copper Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These shall be insulated, adequately supported and sized to suit specific requirement.

Switchboard Interconnections

- Interconnection material Unit ratings up to 100 amps,

- FRLS PVC insulated copper conductor wires with crimped terminations.

- Rating of 100 amps and above solid copper/aluminum connections PVC sleeved

- Interconnection jointing all connections, tapings etc.

- Shall be made to ensure minimum contact resistance.

- Shall be firmly bolted and clamped with even tension before assembly.
- Joint surfaces shall be filed or finished to remove burrs, dents and oxides and

  Silvered to maintain good continuity at all joints.

All screws, bolts, washers shall be cadmium plated.

Approved spring washers shall be used with cadmium plated high tensile steel bolts with BSF threads.

- Instrument and control wiring all wiring for relays and meters shall be with ZHFR PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. All power circuit wiring shall be minimum 2.5 sqmm and control circuit wiring shall be of minimum 1.5 sqmm and for CT & PT minimum 4sqmm copper cable shall be considered.

Earthing

Continuous earth bus sized for prospective fault current shall be provided with arrangement for connecting to station earth at two points. Hinged doors / frames shall be connected to earth through adequately sized flexible braids.

Space Heaters

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 5°C operation interlocked with switchgear.

- Sheet Steel Treatment and Painting Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute Sulphur acid and a recognized phosphating process after which a coat of primer paint comp actively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50-micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.
- Labels Suitable engraved white on black metal identification labels shall be provided for each switchgear cubicle in front and back identifying the circuit, switchgear type, rating and duty.

Testing at manufacturers works

Following testing must be completed before dispatch of equipment at site, if required Engineer-In-Charge may call for factory inspection to ensure all testing are completed.

- All wiring checks and connections
- Relay adjustment
- Interlock function check
- Continuity checks of wiring, fuses
- Insulation resistance test
- Trip test
- High voltage test
- Testing and commissioning
- Assembly of various sections of panels
- Grounding the units
- Bus bar termination on switchgear
- Insulation test with 500 volts megger. The insulation resistance should be more than 100 mega ohms
- Local Authority Requirements. All requirements by the local Authority including those listed below shall be complied with
- Provision for Gas nozzles within each cubicle
- Danger Notice Plate
- Rubber floor mat of minimum 6 mm thickness and 1 m width provided for the full length of the switchboard.
- A dry chemical type fire extinguisher of required capacity with approved label

1.1.1.3. Relays, CTs, PTs, Meters, Indicating Lamps etc.

General

This section covers specifications for Protection and Control Relays for breakers, Instrument Transformers, Measuring Instruments, Push Buttons, and Indicating Lamps etc. required in LT and HT switchboards.

Standards and codes

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition, the relevant clauses of the

Nepal Electricity Board or Indian Electricity Act 2003, Indian Electricity Rules 1956, National Building Code 2016, National Electrical Code (SP30: 2011), Code of Practice for Fire Safety of Building (general):

General Principal and Fire Grading – IS 1641 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

Application guide for Current Transformers	IS 2705
Application guide for Voltage Transformers	IS 3156
Instrument Transformers (Current & Voltage Transformers)	IEC 61869
Application guide for Relays	IS 3842
Electromagnetic Relays	IS 5051
Microprocessor Relays	IEC 60255

1.1.1.4. Protection and control relays

The Circuit Breaker shall have protection and control relays as specified in the bill of quantities. Relays shall be approved types complying to relevant ISS and having approved characteristic. Relays shall be flush mounted in dust proof cases. Relays shall be arranged so that adjustments, testing and replacement can be affected with minimum of time and labor.

In case of C.T. operated thermal overload and magnetic instantaneous short circuit release. The overload releases shall be such that each phase can be individually set depending on the phase unbalanced currents. The releases shall have inverse time current characteristics and the magnetic release shall be time delayed with a minimum setting of 25 ms varying up to 300 ms for discrimination without effecting the breaking current capacity of the ACB.

1.1.1.5. Current transformer

Separate sets of CTs shall be provided for metering and protection. C/Ts shall confirm to IS 2705 (part -I, II and III) in all respects. All C/Ts used for medium voltage application shall be rated for 1.1 kV. C/Ts shall have rated primary current, rated burden and class of accuracy as specified in Bill of Quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 and for protection class 5P10. C/Ts shall be capable of withstanding magnetic and thermal stresses due to short circuit faults on the bus. Terminals of C/Ts shall be paired permanently for easy identification of poles. C/Ts shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each C/T shall be provided with rating plate indicating:

i. Name and make
ii. Serial number
iii. Transformation ratio
iv. Rated burden

v. Rated voltage

vi. Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor FRLS PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

1.1.1.6. Potential transformer

PTs shall confirm to IS 3156 (Part-I, II and III) in all respects.

1.1.1.7. Measuring instruments

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 0.5 for ammeters. Meters shall be suitable for continuous operation between -5-degree C and +50-degree C above ambient temperature. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mold. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in color and shall have Zero position adjustment device operable from outside. Direction of deflection shall be from left to right. Suitable selector switches shall be provided for ammeters and volt meters used in three phase system. The rating type and quantity of meters, instruments and protective device shall be as per Schedule of Quantities /drawings.

Ammeters

Ammeters shall be of moving iron type. Moving part assembly shall be with jewel bearings. Jewel bearings shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. Ammeters shall be manufacture and calibrated as per IS 1248.

Ammeters shall normally be suitable for 5 A secondary of current transformers. Ammeters shall be capable of carrying substantial over loads during fault conditions.

Voltmeters

Voltmeters shall be moving iron type range of 3 phase 415-volt voltmeters shall be 0-500. Volt meters shall be provided with protection fuse.

Watt meter

Wattmeter shall be of 3 phase electro dynamic type and shall be provided with a maximum demand indicator if required.

Power factor meter

3 phase power factor meters shall be of electro dynamic type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% readings. Phase angle accuracy shall be +40.

Energy and reactive power meters

Trajectory meters shall be two elements, integrating type, kWh, kVA, kVArh meters. Meters shall confirm to IEC 170 in all respects or NEB STANDARDS. Energy meters, kVA, and kVArh meters shall be provided with integrating registers. The registers shall be able to record energy conception of 500 hours corresponding to maximum current at rated voltage and unity power factor. Meters shall be suitable for operation with current and potential transformers available in the panel.

1.1.1.8. Indicating lamps

Neon type indicating lamps shall be provided for indication of phases and Breaker position as required in the bill of quantities. Lamps shall be easily removed and replaced from the front of the panel by manual means not requiring the use of extractors.

1.1.1.9. Push buttons

Push buttons shall be of non-hygroscopic material, non-swelling and fitted to avoid any possibility of sticking. Contacts shall be of adequate strength and have a positive whipping action when in operation.

1.1.1.10. Battery and Battery Charger

General

This section covers specifications for lead acid batteries and float cum boost battery chargers. DC is considered as unearthed system.

Standards and codes

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition, the relevant clauses of the Indian Electricity Act 2003, Indian Electricity Rules 1956, National Building Code 2016, National Electrical Code (SP30: 2011), Code of Practice for Fire Safety of Building (general): General Principal and Fire Grading – IS 1641 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

Electrical vocabulary secondary cells and batteries	IS 1885
Lead Acid SMF VRLA Batteries	JIS C8702
Stationary valve regulated lead acid	IS 15549:2005
Water for storage batteries	IS 1069

Sulfuric Acid for storage batteries	IS 266
General requirements for tests for lead acid storage batteries	IS 8320
Rubber and Plastic containers for batteries	IS 1146
Synthetic Separators	IS 6071
High performance planet cells	BS 6290 (Part II)
IE recommendations for sizing of large lead acid storage batteries	IEEE 485
Design and installation of storage batteries	IEEE 484
Stationary lead acid batteries	IEC – 896 (Part I)

Battery

The battery shall be sealed maintenance free / valve regulated led acid (SMF/VRLA) battery. The batteries shall be manufactured using "absorbent glass matt" technology in which the electrolyte is in absorb condition, held within the pores of the glass matt separator. The separator is packed tightly between the positive and negative plates. "Led Calcium Tin Alloy" shall be used in the plate grid structure to eliminate harmful effect of early gassing. The container and the lid of the battery shall be of high-grade polypropylene. The vent plugs shall be provided with self-resealing relief valves. The battery shall be rated for minimum 100 AH at 24-volt DC unearthed system. The battery sizing calculation to be carried out by vendor during detailed engineering stage and to be submitted to Electrical consultant for verification and approval.

Battery Charger

General

The battery charger shall be float cum boost type, thermistors controlled. The charger shall have selector switch for auto float – boost/manual, float /manual boost mode of operation. During auto float – boost mode, automatic changeover shall take place from float mode to boost mode and vice versa. This means that when the batteries are fully charged the charging shall automatically change from boost charge to trickle charge.

Construction feature

The float cum boost charger and DC distribution board shall be housed in sheet steel cubicle of angle iron frame work with panels of 2.0 mm thickness, louvers for ventilation, glands plate will be provided for cable entry from front bottom. The cubicle shall be painted in siemens grey shade. Four wheels/2 nose channels shall be provided at the base.

Performance

The DC output voltage of float /boost charger shall be stabilized within ± 2% for AC. Input variation of 230 V ± 10%, frequency variation of 50 Hz ±5% and DC load variation of 0-100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response IGBT. The ripple content in output will be within 3% of DC output nominal voltage.

There shall be provision to select auto float/manual float /manual boost modes. During auto float mode the battery charging shall automatically changeover from boost mode to flat mode and vice versa. During manual float/boost modes it shall be possible to set the output volts by separate potentiometers. The battery charger shall have automatic output current limiting feature.

Components

The battery charger shall essentially comprise of the following

- 1 no. double pole ON/OFF MCB at AC input
- 1 no. pilot lamp to indicate charger ON.
- 1 no. main transformer: Double wound, naturally air cooled, having copper windings.
- 1 no. rotary switch to select auto float / manual float / manual boost. During auto float mode automatic changeover shall take place from float mode to boost mode and vice versa.
- 1 set solid state constant potential controller to stabilize the DC output voltage of the float cum boost charger at ±2% of the set value for AC input voltage variation of 230 V ± 10%, frequency variation of ±5% from 50 Hz and simultaneous load variation of 0-100% and also complete with current limiting circuit to drop the float charger output voltage upon overloads to enable the battery to take over.
- 1 no. electronic controller to automatically changeover battery charging from boost

  to float and vice versa 1 no. DC ammeter and toggle switch to read charger output current and battery charge/discharge current.
- 1 no. moving coil DC voltmeter to read the DC output voltage.
- 2 set potentiometers to adjust the output voltage during manual/auto float and boost modes.
- 1 no. double pole ON/OFF MCB at charger output. DC distribution board.
- Alarm annunciation

Visual and audible alarm with manual accept/ reset facility shall be provided for the following:

i. AC mains fail
ii. Charger fails

iii. Load / output over volt

iv. Potential free contact for BMS connectivity for maintaining battery status.

1.1.2. **Technical Specification of 11KV 200Amp. (3-Pole/2-Pole) Air Break Switch**

1.1.2.1. Scope

This specification covers manufacturing, testing and supply of 11KV 200Amp. 50Hz Air Break switches for outdoor installation in horizontal configuration. The switches are suitable for operation under off-load conditions only and are intended for use on Distribution Sub-stations and tapping sectionalizing points of 11 KV lines.

1.1.2.2. Description of the materials

The 11KV A.B. Switch sets shall confirm to the following parameters: -

a)	Number of poles	3
b)	Number of Post insulator per pole	2nos. 12KVpostinsulator.
c)	Nominal system voltage	11KV
d)	Highest system voltage	12KV
e)	Rated frequency	50Hz
f)	System earthling	effectively earthed.
g)	Rated nominal current	200amps
h)	Altitude of installation	Not exceeding1000M

The post insulators used in the A.B. Switches shall have the following ratings: -

a)	Power frequency withstand voltage(dry)	25KV(RMS)
b)	Power frequency withstand voltage (wet)	35KV(RMS).
c)	Implies with stand voltage(dry)	75KV
d)	Power frequency puncture withstand	1.3

1.1.2.3. Standards

The AB Switch Set shall conform to the following standards: -

i) IS-9920 (Part-I to V)

j) IS-2544/1973 (for porcelain post insulators)

k) IS-2633, (for galvanization of ferrous parts.) or its latest amendments if any.

1.1.2.4. Insulator makes

11KV post insulators complete with post and cap duly cemented to be used in the AB Switch Set conforming to IS-2544/1973.

The bidder shall furnish the type test certificate of the post insulators from their manufacturer for reference and scrutiny.

The bidder shall mention make, type of insulation materials, metal fittings, Creepage distance, protected Creepage distance, tensile Strength, compressing strength, torsion strength and cantilever strength.

1.1.2.5. Climatic condition

The A.B. Switch set shall be suitable for operation under the Lumbini, Nepal climatic conditions.

1.1.2.6. Other technical details

- General: - The 11KV A.B. Switch Set shall be the gang operated rotating single air break type having 2 post insulators per phase. The operating mechanism shall be suitable for manual operation from the ground level and shall be so designed that all the three phases shall open or close simultaneously. The Switches shall be robust in construction, easy in operation and shall be protected against over travel or staining that might adversely affect any of its parts. The required base M.S. Channel (hot dip galvanized) phase coupling rod, operation rod with intermediate guide braided with flexible electrolytic copper, tail piece of required current carrying capacity and operation mechanism with "ON" & "OFF "positions shall be provided. The operation rod shall be medium gage of 32mm diameter nominal bore G.I. pipe single length 6 meters. The phase coupling rod for gang operation shall be of medium gauge 25 mm dia. nominal bore G.I pipe. The Rating post insulators shall be provided with suitable bearing mounted on a base channel with 8mm dia thrust collar and 6mm split pin made out of stainless steel. The operating down rod shall be coupled to the spindle (minimum) dia – 32mm for gang operation through another suitable bearing by two numbers 10mm dia stainless steel bolts with double nuts. All the bearings shall be provided with grease nipple. All metal (ferrous) parts shall be galvanized a polished. The pipe shall be galvanized in accordance with IS-4736/1968.The post insulators should be fixed with the base channel using Galvanized Nuts and Bolts.

- Mounting: - The A.B. Switches shall be suitable for horizontal mounting in double pole sub-station structures. MS Galvanized base Channel & base support channel should be of min. size 75x40x6 mm.

- Switching Blades: - It shall be made out of electrolytic copper with silver plated. The approximate size shall be 220mm X 50X 6 mm. The Switch shall have such a spring mechanism so as to ensure that the speed of the opening of contact is independent of speed of manual operation.

- Fixed Contracts: - The fixed Jaw type female contracts shall be made of electrolytic copper (minimum 95% copper composition) duly silver coated controlled by stainless-steel high-pressure spring housed in robust G.I. Cover. It is essential that provision shall be made in fixed female contracts to take the shock arising from the closing of move contract blade without the same being transmitted to the post insulator. The arrangement made in this regard shall be specifically shown in the drawing.

- Arcing Horn: - As the switches are generally meant for isolating transmission line and distribution transformers, suitable arcing horns shall be provided for breaking the charging current horn shall be made of 10mm dia. G.I. Rod with spring assisted operation.

- Terminal Connectors: - Terminal connectors shall be robust in design. The size of fixed connector shall be (80 X 50 X 6 mm) and size of movable connector shall be of (80 X 50) X (80 X 50) X 6 mm of copper casting with uniform machine finishing duly silver plated made out of minimum 95% copper composition with 2 nos. 12mm dia holes provided with suitable brass bolts and double nuts, flat washers & 2nos. bimetallic solder less sockets suitable up to 80 mm^2conductor.

- Spacing: - The minimum clearance between phases to the switch shall be 760mm. The operation down rod shall be at a transverse distance of 300mm from the outer limb of the switch. The Centre spacing between two post insulators of the same phase shall be 380mm. In the open position of the A. B. switches the moving blade shall rotate through 90^o. This shall be exhibited in the drawing.

- Sample, Drawing & Literatures: - Sample of each items 11KV 200 amps. A.B. Switch shall be furnished and three copies of drawings item similar to the sample shall be furnished along with the tender.

- The details of construction and materials of different parts of the A.B. Switch shall clearly be indicate in the tender and illustrative pamphlet / literature for the same shall be submitted along with the tender.

1.1.2.7. Test & Test Certificate

- Type Test: -Certificate for the following type tests conducted (within five years proceeding to the date of opening of the tender) on a prototype set of A.B. Switch in a NABL approved test house/CPRI shall have to be submitted along with offer.

- Dielectric Test (impulse and one minute were power frequency withstand voltage test.)

  i. Temperature rise test (for contracts and terminals)
  ii. Shorts Time current and peak withstand current test.
  iii. Mainly active load breaking capacity test.
  iv. Transformer off-load breaking capacity test.
  v. Line charging breaking capacity test.
  vi. Cable charging breaking test.
  vii. Operation and mechanical endurance test.
  viii. Mechanical strength test for post insulator, as per IS-2444/1937 shall be furnished.
  ix. Test for galvanization of metal (ferrous)parts.

1.1.2.8. Routine /Acceptance Test

The inspection may be carried out by the Purchaser at any stage of manufacture. The successful bidder shall grant free access to the Purchaser's representative at a reasonable time when the work is in progress. The following routine tests shall have to be conducted on each set and results are to be furnished for consideration of deputing inspecting officer for inspection and conduction testing of the materials at the works of the manufacturer. The supplier shall give fifteen days advance intimation to the Purchaser to enable him to depute his representative for witnessing the tests.

a. Power frequency voltage dry test.
b. Measurement of resistance of main circuit.
c. Tests to prove satisfactory operation.
d. Dimension Check
e. Galvanization test.
f. Operational test.

1.1.2.9. Guaranteed Technical Particulars

The bidder shall furnish the guaranteed technical particular duly filled in the format along with the tender.

1.1.2.10. Completeness of Equipment

All fittings, accessories of apparatus which may not have been specifically mentioned in this specification but which are usual or necessary in equipment of similar plat shall be deemed to be included in the specification and shall be supplied by the Tender without extra charge. All plant and equipment shall be completed in all details whether such details are mentioned in the specification or not.

1.1.3. **Technical Specifications for Transformer**

DRY TYPE TRANSFORMERS

1.0 GENERAL

The step down double wound core type transformers shall be suitable for Indoor mounting with a voltage ratio of 11000/433 volts and of the naturally cooled Resin type (Dry) with a Delta/Star configuration. The transformer shall comply with the regulations of IEC 76, B.S. 171 and I.S. 11171 as amended up-to-date. & losses as Per ECBC GUIDELINES (AS PER ECBC GUIDELINE TABLE NO. 8.1) refer data sheet for Transformer

2.0 TRANSFORMER DETAILED SPECIFICATIONS

2.1 TRANSFORMER OPERATION

The transformer shall be suitable for operation on 11 kV, 3 phase 50 cycle earthed system, connected Delta on H.V. side and star on the L.V. side with neutral brought out for independent earthing (Vector Group DY II). The transformer shall be suitable for continuous operation at the rated capacity under Site conditions.

2.2 TRANSFORMER MATERIAL

The material used in the manufacture of the transformer shall be of the best quality of their respective kind available as per standard specifications.

2.3 CORE MATERIAL

The magnetic iron core shall be made of high-grade alloy, low loss grain oriented cold rolled steel stampings (CRGO) The maximum false density at any point in core and winding shall not exceed 1.6 tesla on the normal rated Tap Voltage and Frequency.

2.4 CORE WINDINGS

The high voltage and low voltage windings shall be of copper conductors completely impregnated and cast under vacuum into moulds.

2.5 INSULATION CLASS

The insulation material used shall be insulation class 'H'.

2.6 TRANSFORMER TAPPINGS

The transformer shall be provided with an off load externally hand operated switch as per Schedule of Quantities +5% to -10% in step of 2.5% on HV side so as to give a constant voltage at L.V. side.

2.7 TRANSFORMER CHARACTERISTICS

The no load voltage ratio of the transformer shall be 11000/433 volts and the percentage impedance shall 6%. / As per ISI

2.8 ENCLOSURE

The transformer shall be provided with a sheet steel enclosure with adequate provision for ventilation. The degree of protection of enclosure shall be IP 33 and thickness of enclosure shall be minimum 2 mm M.S. sheets provided with powder coating finish after rigorous cleaning and surface treatment.

2.9 COOLING

The transformer shall be design for normal cooling (AN)

2.10 TRANSFORMER TERMINATIONS

The transformer shall have cable boxes with suitable glands and cable sockets for receiving 11,000-volt grade XLPE cables on the H.V. side as required.

On the L.T. side the transformer shall have a suitable terminal arrangement with extended busbars to receive 415-volt Bus Duct with aluminium busbars as specified.

2.11 TAPPING

Off circuits tap links on 11 kV side. The range of off circuits tap links on HV side shall be +5% to -10% in steps of 2.5%

2.12 TEMPERATURE RISE PARAMETERS

Thermistor sensors shall be embedded in the low voltage winding for warning and tripping, for temperature control. The temperature detectors shall be suitable for 24 volts D.C. The temperature rises when continuously operated of windings by resistance method shall not exceed 115 degree Cover 50-degree C ambient.

2.13 TRANSFORMER FITTINGS

The transformer shall be manufactured in accordance with the requirements as specified in the Standards stated above and shall be fitted with:

01. Rating and diagram plate One
02. Earthing terminals Two
03. Lifting Lugs Four
04. Off Circuit Tap Links One
05. Separate Neutral Bushing One
06. HV Cable Box One
07. LV Cable Box One
08. Bi – directional roller Four
09. Winding Temperature Indicator (Scanner Type) One
10. Marshalling Box One
11. M.S. Enclosure One

2.14 TRANSFORMER GUARENTEED TECHNICAL PARTICULARS

The following guaranteed technical particulars of the transformer shall be intimated.

a) Core loss
b) Load loss
c) Percentage Impedance

2.15 TRANSFORMER TESTING

Prior to acceptance and dispatch of the transformer, the Client reserves the right to witness the routine tests at manufacturers works.

The transformer shall be subjected to the following tests as per IS 2026-1962 at the manufacturers Works. The test certificates shall be submitted to the Clients for approval prior to dispatch.

ROUTINE TEST

a) Measurement of Winding Resistance

b) Ratio polarity and phase relationship

c) No load and load losses

d) Impedance voltage

e) No load and load current

f) Insulation resistance

g) Induced over voltage withstand

h) Separate source voltage withstands

TYPE TESTS

Type test certificate of CPRI of similar rating of transformer to be submitted along with approval of drawings.

a) Temperature Rise

b) Impulse voltage withstands.

2.16 INSTALLATION

The transformer shall be installed as per the manufacturers instruction manual and shall conform to the requirements of IS 1886-1967.

The transformer foundations shall be cast as required. If any lifting is required, the same shall be done by all the lifting lugs to avoid any imbalance.

The transformer wheels shall be locked by suitable locking arrangement to avoid accidental movement after testing and commissioning.

The transformer cable end boxes shall be sealed to prevent entry of moisture.

The transformer neutral and body earthing shall be as per the requirements of IS 3043-1966 and the Local Inspecting Authorities

2.17 COMMISSIONING TESTS

The following tests shall be carried out prior to commissioning at site by third party

a) Insulation resistance of the winding between phases and phase and earth on the H.T. side.

b) Winding resistance of all the windings on all tap positions.

c) Voltage ratio test shall be carried out by applying low voltage on H.T. side and measuring the voltage between phases and phase and neutral on the L.T. side for every tap setting.

d) If necessary the transformer shall be heated by applying low voltage on the H.T. side and shorting the L.T. side. This shall be done for a period of 48 hours or till all the moisture has been removed from the transformer.

e) On commissioning of the transformer, the following readings shall be taken

- L.T. side voltages at all tap settings

- Temperature rise under no load conditions

1.1.4. **Technical Specifications for UPS**

(Nominal output active power at PF=1) True Online UPS having IGBT based rectifier & with Inbuilt Isolation Transformer compatible for parallel redundant configuration designed for having no single point of failure even for communication. UPS should be CE marked, 3 Phase 415V (+10% -15%), 50 Hertz ±10% input & 3 phase 415V, 50Hz output with selection for 380/400/415V AC. UPSs operating in parallel redundancy load need to share load equally during normal mode and also to be capable of handling Electronic short-circuit protection, current limit to: 2.7 times In for 200 ms between phase and phase and 4.0 times In for 200 ms between phase and N/PE and also overload of 125% for 10 Mins & that of 150% for 1 min. IGBT Based rectifier should be capable of restricting input current harmonics (THDi) to < 3 % and maintaining the Input power factor ≥ 0.99 above 25% of load . Scalability should be feasible & for that each UPS should have its own built in static bypass as well as manual bypass arrangement. Static switch should be fully rated for continuous duty & whereas built in manual bypass should be of make before break type. AHMI comprising of LCD features of web-enabled Monitoring and Management through SNMP protocols for multi-OS environments should be integral part of the UPS.

	General
	Scope
1	These specifications describe requirements for an Uninterruptible Power System (UPS) consisting of single modules UPS units connected in parallel, redundant mode/stand alone with manual bypass switch. The UPS shall automatically maintain AC power within specified tolerance to the critical load, without interruption, during failure or deterioration of the mains power supply. Each UPS shall be complete with 12-plus operation IGBT based PWM design inverter and IGBT based charger, built-in-static bypass switches and built in communication ports and LCD display based keypads. Each unit shall be designed for three phase and neutral input and output. The UPS shall be expandable by paralleling additional modules of the same rating, to provide for module redundancy or load growth requirements. It shall include all equipment's to properly interface the AC power sources to the intended load and be designed for unattended operation.
1.2	**Technical specification**

Sl. No.	Description	Parameters required
1	**Capacity**	As per BOQ
2	**Environment Characteristics**	
2.1	**Working temperature**	0º to 40º C (Continuous)
2.2	**Storage temperature**	-10 º to 50 º C
2.3	**Humidity**	95% non-condensing
2.4	**Standards**	EN50091-2/IEC 62040-2
3	**General Characteristics**	
3.1	Overall Efficiency of the UPS under following conditions:	Not less than 90% under specified conditions
a)	Lowest input Volts to Highest Input Volts	
b)	Lowest Input Frequency to Highest Input Volts	
c)	AC/AC total efficiency @ 75% load	
d)	AC/AC total efficiency @ 100% load	
3.2	Noise level @ 1 Mtr. distance	< 70db
3.3	Conversion technology	True-Online & Double conversion
3.4	Configuration	Compatible to Single, Parallel, Dual Bus arrangement.
3.5	No. of systems that can be paralleled	3 or more
4	**Input Electrical Characteristics**	
4.1	Type of rectifier	SCR Based –Power Factor Corrected
4.2	Input Voltage (3 phase)	360-460V
4.3	Input Frequency	50 Hz to ± 1%
4.4	Input Power factor @ 50 to 100% load	0.98 or better
4.5	Input voltage band	360 to 460 V

4.6	**Input Current harmonic distortion (THD)**	Less than 3%
5.1		IGBT based PWM design
5.2	Output Voltage (3 phase)	380V/400V/415V (user selectable)
5.3	Output waveform	Sinusoidal

5.4	Static output voltage variation under following conditions	± 1%
a)	No load to Full load/full load to No load	
b)	0.5 lag to unity p.f	
c)	Minimum to Maximum DC input volts	
d)	Input Frequency from 46 to 54 Hz	
e)	Full Input Voltage range	
5.5	Output Voltage variation	
a)	At balance load	± 1%
b)	At 100% load step (Dynamic Regulation)	± 1%
5.6	Voltage adjustment- Manual	Required
5.7	Output frequency	50Hz
5.8	Frequency regulation	± 0.2 %
5.9	THD at Output	≤ 2% for liner load & ≤ 5%for non- linear load.
5.10	Phase displacement (a) in balance load	120º, ± 1%
5.11	(b) in 100% unbalanced load	120º, ± 2%
5.12	Overload capacity	
	At 110%	For 60 minutes
	At 125%	For 10 minutes
	At 150%	For 1 minutes
5.13	Crest Factor	3:1
5.14	Voltage Transient Recovery Time	≤ 20 ms
6	**Static bypass arrangement**	**To be provided**
7	**Battery details**	
7.1	Type of batteries	SMF battery
7.2	Back-up	30 minutes

7.3	AH of the battery	By Vendor
7.4	Life of battery	> 3 years
7.5	Battery temperature sensor	By Vendor
7.6	No. of Batteries provided	By Vendor
7.7	Battery Monitoring in YPS	By Vendor
7.8	Battery mounting	By Vendor
7.9	Dimensions of battery cabinet (LXBXH)	By Vendor
7.10	Weight of battery cabinet	By Vendor
7.11	Base Frames for UPS & battery racks	By Vendor
8	**Communication**	
8.1	BMS compatibility	Required
8.2	SNMP	Required
8.3	OastEvebts& Trend Analysis	Required
8.4	Life Cycle Monitoring of Fans , DC/AC Capacitors, Batteries	Required
9	**Charger**	
9.1	Type	**SMPS**
9.2	Nominal Voltage Regulation	±1%
9.3	Ripple (without batteries)	<1%
9.4	Charging Method	Constant Voltage Constant Current
10	**General :**	
	Indicate the make, capacity & other technical characteristics of the devices used.	
	Input reverse phase sequence protection is to be provided. UPS should work on main mode in case of input reverse phase sequence.	
	Built in Galvanic Isolation (Neutral Isolation) through double-wound transformer at output.	

Mode of Operation

The UPS shall be designed to operate as Double conversion True ON LINE VFI as per IEC 62040-3:-

a)	**Normal-**	The critical AC load is continuously supplied by the UPS Inverter. The rectifier/Charger derives power from AC input source and supplies DC power to the Inverter while simultaneously charging power reserve battery.
b)	**Emergency-**	Upon failure of AC Input power, the critical AC load is supplied by the inverter which without any switching obtains power from the batteries. There shall be no interruption in power to the critical load upon failure or restoration of AC input source.
c)	**Recharge-**	Upon restoration of AC input power during the emergency mode of operation, the rectifier/charger shall automatically restart, walk-in and gradually assume the inverter and battery recharge loads.
d)	**Bypass-**	UPS must have for static bypass switch in addition to manually operated maintenance bypass switch. Manual switch should be incorporated into UPS cabinet that will connect the load to AC power source bypassing the rectifier/charger, inverter and static transfer switch.
e)	**Off-Battery-**	If the battery system only is taken out of service for maintenance, it is disconnected from the rectifier/charger

and inverters by means of (an) external disconnect breaker(s). The UPS shall continue to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.

f) SNMP (Simple Network Management Protocol) - Web enabled Adopter card with smart software for server shutdown shall be Provided by UPS vendor.

g) Parallel Operation All the UPS shall work in synchronization mode & share the entire load equally by each UPS. In case of failure of any UPS the same, shall be disconnected automatically from the system and the load shall be transferred to the other healthy UPSs equally and there should be no interruption of supply during this transferring operation.

Maintenance Free Battery Requirements

Battery banks connected to different KVA UPS shall be designed to provide 30 minutes back-up at full load. The UPS module should be automatically disconnected when the battery reaches to the minimum discharge voltage level or when signaled by other control functions.

During normal operation batteries shall be continuously float charged & the charging current is electronically controlled for the limiting purpose.

UPS Delivery submittals

The specified UPS shall be supplied with one (a) user manual to include details of

a) Functional description of the equipment with block diagrams.

b) Detailed installation drawings, including all terminal locations for power and control connections for both the UPS and battery system.

c) Safety precautions.

d) Step-by-step operating procedures

e) General maintenance guidelines

f) The UPS & Battery's shall be supplied with a record of pre-shipment final factory test report. & Certificate shall be provided by manufacturer

Construction and Mounting

The UPS unit comprised of Input Isolator, Rectifier/Charger, Inverter, Static transfer switch, Maintenance Bypass switch and static bypass input switch shall be housed in a free standing steel enclosure with key lockable doors. Front/rear access shall be required for expedient servicing, adjustments and installation. The enclosure will be built to comply with IP 20. The UPS shall be constructed of replaceable sub-assemblies. Printed circuit assemblies shall be plug-in type.

Cooling

Cooling of the UPS shall be by forced air ventilation. Low velocity fan shall be used to minimize audible noise output. Fan power shall be provided by the UPS output. Temperature shall be monitored by thermal censors.

Cable Entry.

Standard cable entry for the UPS module shall be from the bottom/top as required through detachable gland plate.

Static Transfer Switch

General

A static transfer switches and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be naturally commutated high-speed

static (SCR type) devices rated to conduct full load current continuously and shall have naturally commutated high-speed static antiparallel SCR's in the output of the inverter circuit as well as in the static bypass line to enable the critical load to be connected to the inverter output or bypass power sources. The static transfer switch control logic shall contain and automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass sources, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

The Static bypass switch must automatically assumes the critical load to mains supply without interruption after logic senses one of the following conditions:-

- Inverter overload beyond
- Battery run time expired and bypass available
- Inverter failure
- Battery circuit breaker open
- Fatal error in control system.

The short circuit withstanding capability of static Bypass path should be 1430% for 20 millisecond & 1000% for 5 cycles (1000 millisecs)

Uninterrupted Transfer

The transfer control logic shall automatically turn on the static transfer switch, transferring the critical ac load to the bypass sources, after the transfer logic senses any of the following conditions.

- Inverter overload capacity exceeded
- Critical AC load over voltage or under –voltage.
- UPS fault condition.

The transfer control logic shall inhibit and automatic transfer of the critical load to the bypass sources if any of the following conditions are present.

Uninterrupted Retransfer

Retransfer of the critical AC load from the bypass sources to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

- Bypass out of synchronization range with inverter output
- Inverter/bypass voltage different exceeding pre-set limits.
- Overload condition exists in excess of inverter full load rating
- UPS fault conditions present.

Maintenance Bypass Isolator

General

A manually operated maintenance bypass isolator shall be incorporated into the UPS cabinet to directly connect the critical load to the input AC power sources, bypassing the rectifier/charger, inverter and static transfer switch.

Maintenances Capability

Without the critical load powered from the maintenance bypass circuit, it shall be possible to check out the operation of the rectifier/charger, inverter, battery and static transfer switch.

Display and Controls

Monitory & controlling – The UPS shall be provided with a microprocessor based unit status display & controls section designed for convenient and reliable user operation. A system power flow diagram, a percentage load and battery time remaining display shall be provided as part the monitoring and controls sections which depict a single-line diagram of the UPS illuminated visual indicators. Shall be of long life LED type. All of the operator controls and monitors shall be located on the front of the UPS cabinets

The following parameters shall be displayed.

Display Parameter

- DC Voltage
- Battery voltage
- Battery charger & discharge current
- Input voltage and frequency
- Output AC voltage line-to-line and line to neutral and 1% load used of nominal
- Output frequency
- Active Power (KW) Apparent Power (KVA)
- Temperature- Ambient, battery, inverter and transformer

Warning and Alarm Messages

- Normal Operation, Input breaker open
- Output breaker open
- Battery breaker open
- Bypass absent, Bypass over limits.
- Bypass under limits, Bypass freq. over limit
- Bypass inhibit
- Load on bypass
- Rectifier off or failed
- Inverter off or failed
- UPS unsynchronized
- D.C. Volts over voltage
- D.C. under voltage and end of discharge pre-alarm
- DC Bus over volts Battery Low
- Emergency stop

- UPS Overload

Controls

Four pushbuttons shall be located on the operator control panel.

- Enter
- Escape
- UP
- Down

The push buttons shall permit the operator either to select options from a menu for display on the LCD winder or to change the value of some parameters. One pushbuttons –alarm silence switch

1.1.5. **Technical Specifications for Computer Jack RJ 45**

RJ45 Jack of Category 6, for the establishing of transmission channels of class E with up to 4 plugged connections, complies with Category 6 requirements of the standards ISO/IEC 11801:2nd edition, EN 50173-1, DIN EN 50173-1: 2002 as well as ANSI/TIA/EIA 568-B.2-1, de-embedded tested in acc. with IEC 60603-7 (603-7), interoperable and backwards compatible with Cat.5e and Cat.5.
Suitable for 10GBase-T applications in acc. with IEEE 802.3an up to 500 MHz and 55 m.
Compatible with RJ standard plugs (RJ11, RJ12, RJ45), PCB- and tool based connection of installation cables AWG 24 – 22 (0.5 mm – 0.65 mm) and flexible cables AWG 26/7 – AWG 22/7.
IDC termination should feature nil crossover in acc. with EIA/TIA 568-A/B, gold-plated bronze contacts for >750 mating cycles, >200 insertion cycle
Material: RoHS complied
Housing material: Polycarbonate (UL-94-V0)
Should be available with or without dust protection feature
Should be 3P certified

1.1.6. **Technical Specifications for CCTV**

Technical Specification of Dome Camera

S. No	Features	Specifications
1	Form Factor	DOME
2	Certification	UL,CE,FCC
3	Housing	IP67 and IK10 or better

4	System Compatibility	ONVIF profile S ,G & T
5	Max Resolution	5MP(2592 X 1944)
6	lens	2.7mm to 12 mm motorized varifocal length
7	Focus	Auto focus
8	Image sensor	1/2.8" or larger
9	H-FOV	99 ~ 30°
10	Min illumination	0.01 Lux @ (F1.2,AGC ON), 0 Lux with IR
11	Shutter speed	1/5 s ~1 / 100,000 s
12	Video compression	H.265+ ,H.265 ,H.264+ H.264
13	Video bit rate	256 Kbps to 8 Mbps
14	Noise reduction	2D / 3D DNR
15	Video Streams	Quad stream , Each stream should support H.265+ compression
16	IP filter	Should support IP filter for security purpose
17	Frame rate	Main stream up to 5MP@25fps , sub stream up to 2MP@25fps , third and fourth stream up to VGA@25fps
18	ROI	Should Support ROI for Better bandwidth consumption
19	BLC	Support
20	Day & Night	IR cut filter with auto switch
21	Day / Night Switch	Auto / Schedule / Triggered by Alarm In
22	Edge analytics	Motion Detection, Perimeter Intrusion, Line Crossing, Stationary Object, Pedestrian detection, Face detection (deep learning) ,Cross counting
23	Image setting	Flip, Rotation, Corridor mode, Saturation, Brightness, Contrast, Hue, Sharpness adjustable
24	Rotate Mode	Yes
25	WDR	120 dB WDR
26	Alarm	1 input, 1 output
27	Audio	1 input, 1 output
28	SD Card support	upto 128 GB
29	Protocols	TCP/IP,HTTP,DHCP,DNS,DDNS,RTP/RTSP,PPPoE,SMTP,NTP,UPnP,SNMP, HTTPS,FTP,

30	Video output	1 X BNC
31	Reset button	Available
32	Security	Flash-prevention, dual stream, heartbeat, password protection, privacy mask, IP address filtering
33	Digital Zoom	Should have the capability to digitally zoomed in web browser by selecting the area using mouse
34	Factory Default	Should have the option of setting the configuration to factory default except network settings.
35	Privacy Zones	Min 4 Nos of selectable privacy Zones
36	User accounts	Should support 1 admin and 6 user accounts
37	Firmware upgrade	Firmware upgrade shall be done through web browser
38	Remote Update	Camera IP and firmware should be upgradable through the device search tool/Software without directly logging in to the camera. Firmware should also be upgradable through web browser
39	Defog	Should support Defog mode
40	IR Distance	Min IR distance 40 meters
41	Vandal resistant	IK10
42	Operating Temperatur e	-30°C ~ 60°C Humidity 95% or less (non-condensing)
43	General	OEM should not be blacklisted nationally or internationally

Technical Specification of 32 Channel NVR

S.No	Features	Descriptions
1	Channels	32 IP Cameras
2	Certifications	UL,CE,FCC
3	Compatibility	ONVIF profile S & G
4	Power Supply	Power adaptor must be supplied with NVR
5	Smart Phone Support	iOS, Android
6	Remote Viewing & Monitoring	Smart phone and Desktop client software
7	Recording Bandwidth	Max 320Mbps
8	Recording Mode Supportable	Normal , Motion , Alarm
9	Instant play back	Supported
10	Email	E-mail alert on video loss
11	Firmware Upgrade	Firmware upgrade through USB/web browser

12	Compression Support	H.265 , H.264
13	HDD	Support 2 SATA HDD , Each HDD capacity of upto 8 TB
14	Users	Support 6 user accounts and one admin
15	Digital Zoom on live view	Support digital Zoom on live view
16	Digital zoom on playback	Support digital zoom on playback
17	PTZ Support	Support PTZ Cameras with Pan , tilt and Zoom functionality
18	Analytics	Edge analytics of proposed cameras should be integrated with NVR .
19	Recording Resolution	8MP (4K), 5MP, 3MP ,2MP(1080P), 1.3MP (960P), 1.0MP (720P)
20	Recording backup USB	Support recording download by directly connecting USB pen drive to NVR
21	Recording backup web browser	Support downloading of recording through web browser on workstation/PC .
22	Display Split	1/4/6/8/9/10/13/14/16
23	Output Interface	1 HDMI (up to 4K), 1 VGA
24	Display Resolution	1024*768,1280*720,1280*1024,1440*900, 1920*1080,1680*1050,1600*1200,1900*1200, 2560*1440,3840*2160
25	Alarm Input/out	16ch in / 1ch out
26	Ethernet	RJ-45 port (1000M)
27	RS485	supported
28	Line In	yes
29	USB	1x3.0 USB for backup / upgrade, 2x 2.0 USB for mouse

Technical Specification of 24 Port PoE Switch

S.No	Features	Specifications
1	Port Configuration	24 Nos of 10M/100M/1G RJ45 Port ,4 Nos of1G/10G SFP+ Port , 1 Nos of DB9 Console Port .
2	PoE Function	IEEE802.3at (PoE+ 30W) ,IEEE802.3af (PoE 15.4W)
3	PoE Port	24
4	Available PoE Power	370W

5	Switching Bandwidth	128 Gbps
6	Forwarding Performance	95.232 Mpps
7	MAC Address	32 K
8	Jumbo Frames	10056 Bytes
9	Spanning Tree	IEEE802.1D (STP),IEEE802.1W (RSTP),IEEE802.1S (MSTP)
10	VLAN	802.1Q VLAN , Port-Based ,Private VLAN , Voice VLAN ,Guest VLAN, Q-in-Q , 802.1v Protocol VLAN , MAC-Based VLAN ,IP Subnet-Based VLAN
		4K VLAN Entries
11	IEEE 802.3ad LACP	Dynamic Trunk , Static Trunk
12		GARP/GVRP , IGMP Snooping , MLD Snooping ,Multicast VLAN Registration (MVR)
16	L3 Features	Static Route , DHCP Server
17	Class of Service	Port Based , 802.1p ,DSCP, TCP/UDP Port
18	Rate Limiting	Ingress , Egress
19	Priority Queue Scheduling	WRR , Strict Priority
20	Hardware Queues	8
21	ACLs	L2/L3/L4 , IPv6 Support
22	Security	Port Security (MAC-based) , IP Source Guard ,Storm Control ,RADIUS Authentication 802.1x , TACACS+ Authentication ,HTTPs and SSL (Secured Web) ,BPDU Guard ,STP Root Guard ,DHCP Snooping,Loop Protection
23	DHCP	Client , Relay , Option 66 , Option 67 , Option 82

24	Event/Error Log	Syslog , SMTP (RFC821)
25	Management Access Filtering	SNMP , Web , Telnet , SSH
26	PoE Management	Scheduling ,Auto-Checking ,Power Delay
29		SNMP (v1, v2c, v3) , RMON (1,2,3 & 9 Groups) , Software Upgrade
32		Configuration Export/Import , Port Mirroring ,
34		LLDP (IEEE802.1AB)
35		LLDP-MED (IEEE802.1AB)
36		CDP Aware ,sFlow ,IPv6 Management , NTP
40	Device Management	Topology View , Floor View ,Map View , Dashboard ,Traffic Monitoring , Cable Diagnostics
41	Operating Temperature	0°C to 40°C
42	Operating Humidity	10 to 90% RH
43	Storage Temperature	-20 to 70°C
44	Storage Humidity	10 to 90% RH
45	AC Input	100V-240V
46	Certifications	EN61000-4-5 (for RJ45 Port, Surge 6KV) ,CE/FCC Class A

1.1.7. Technical Specifications for Octagonal Pole

This specification is intended to cover design manufacture assembly, testing at manufacturer's works, supply and delivery of Octagonal Poles as per ISO 9001, ISO 14001 and OSHAS 18001 certified factory taking care of all aspects of design, quality, environment and safety. The Contractor should ensure that manufacturer of Octagonal Poles must have minimum 12 years of manufacturing experience.

The poles have to be manufactured by CNC Controlled plasma sheet cutting and bending machine and fully Automated Submerged arc welding machine for longitudinal welding of shaft and welding to be carried out by experienced and certified welders.

Pole should be tested as per BSEN 40-2-1 & 3 for steel test and test certificate shall be submitted showing silicon content less than 0.04%.

Poles, bracket, foundation bolts, and fixture should be of one make. Test certificate of steel manufacturer and Pole manufacturer specifying grade of steel used for Poles.

The Octagonal Poles shall be designed to withstand the maximum wind speed as per IS 875. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BSEN 40-2- 1 & 3.

Pole Shaft - The pole shaft shall be made from sheet steel confirming to BSEN 10025 having yield strength of 355 N/sqmm and silicon content less than 0.04%. The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by Submerged Arc Welding (SAW) process.

Octagonal pole shafts shall be provided with the rigid flange plate manufacture from MS FE410 confirming to IS: 2062 of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding shall be done as per qualified MMAW process approved by Third Party Inspection agency.

Door opening: The octagonal Poles shall have door of approximate 500 mm length at the elevation of 500 mm from the Base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Welding: The welding shall be carried out confirming to approve procedures duly qualified by third party inspection agency. The welders shall also be qualified for welding the octagonal shafts.

Pole sections: The Octagonal Poles shall be in single section (up to 12 Mtrs). There shall not be any circumferential weld joint.

Galvanization: The poles shall be hot dip galvanized as per BSEN ISO 1461 standard with average coating thickness of 70 microns. The galvanizing shall be done in single dipping.

Fixing Type: The Octagonal Poles shall be bolted on a pre-cast foundation with a set of four foundation bolts for greater rigidity.

Top Mountings: The galvanized mounting bracket shall be supplied along with the Octagonal Poles for installation of the luminaries.

Pole Testing Facility: The Manufacturing unit shall have in house pole testing facility for validation for structure design data. The Pole testing facility shall be as per BSEN 40 – 2 1 & 3.

TECHNICAL SPECIFICATIONS

2.1 WIRING

1 GENERAL

Technical Specifications in This Section Cover The Internal Wiring Installations Comprising of :-

- Wiring for lights and Convenience Socket Outlets etc. in Concealed/Surface Conduit/Raceways.
- Wiring for Telephone outlets.
- Wiring for Fire Detection System
- Sub main Wiring.

2 STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract Or equivalent International standards can be followed.. In addition the relevant clauses of the Nepal Electricity rules as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

660/1100 V grade PVC insulated wires.	IS 694 : 1990
Rigid steel conduits for electrical wiring.	IS 9537 : Part I 1980
	IS 9537 : Part II 1981
Accessories for rigid steel conduits.	IS 3837 : 1990
Flexible steel conduits for electrical wiring.	IS 3480 : 1990
Switch socket outlets.	IS 4615 : 1990
Switches for domestic and similar purposes.	IS 3854 : 1997
Boxes for the enclosure of electrical accessories.	IS 5133 : Parts I &II 1969
Code of practice for personal hazard fire safety of buildings.	IS 1644: 1998
Code of practice for electrical installation fire safety of buildings.	IS 1646 : 1997
Code of practice for electrical wiring installations.	IS 732 : 1989

3 CONDUITS/ RACEWAYS

3.1 PVC Conduits

PVC conduits shall be high impact, rigid, FRLS PVC, heavy-duty type and shall comply with relevant Indian Standards.

Conduits up to 32mm dia shall be 2mm thick and above that shall be 2.5mm thick.

Plain conduits shall be joined by slip type of couplers with approved sealing cement. All conduit Entries to outlet boxes are to be made with adaptors female thread and screwed male bushes. Conduit Fittings and accessories such as inspection boxes, draw boxes and junction boxes shall be of heavy Duty Rigid PVC Installed in Such a manner that they can remain accessible for existing wires or for the Installation of the additional wires. Fan hook box shall be of M.S. Inspection boxes shall be covered with suitable covers.

Conduit runs shall be so arranged that the cables connected to separate main circuits shall be enclosed in separate conduits and that all lead and return wires of each circuit shall be run with the same circuit.

PVC conduits shall be smooth in bore, true in size and all ends where conduits are cut shall be made carefully smooth. Sharp edges shall be trimmed. All joints between lengths of conduits or between conduits and fittings and boxes shall be held firmly together and glued properly. All joints shall be fully water tight. All jointing of PVC conduits shall be by means of adhesive jointing.

3.2 PVC Raceways

Wiring for power convenience socket outlets over work tables in laboratories shall be carried out in 100 mm x 50m PVC raceways in surface on wall just above the laboratory table top as directed by Engineer in charge. The raceway shall be fabricated from superior quality engineering plastics and shall be complete with all standard accessories like couplers, end caps, bends, tees and mounting frames suitable for fixing modular wiring accessories. The raceway and accessories shall be as described in the Schedule of Quantities. Wiring upto the raceway shall be brought in MS conduit and approved adapter box to connect the conduit to the raceway shall be provided. Combined 6/16 amp modular switch socket outlets shall be provided on the raceway at modular intervals or as indicated in layout drawings. Each 6/16 amp outlet shall be wired to a separate circuit.

Individual circuits in the raceway shall be bunched separately. Installation of the raceway wiring system shall be carried out as per manufacturers recommendations.

3.3 Laying & Fixing of Conduits

Conduits shall be installed so as to avoid steam and hot water pipes. Conduits for LV systems shall be at least 150mm away from the electrical conduits.

Conduits concealed in the ceiling slab shall run parallel to walls and beams and conduit concealed in the walls shall be vertical or horizontal.

The chase in the walls required for the recessed conduit system shall be neatly made and shall be of ample dimensions to permit the conduits to be fixed in the manner desired. Conduits in chase shall be held by steel clamps of approved design. The chase shall be filled up neatly after erection of conduits and brought to the original finish of the wall with cement plaster/cement concrete. The spacing between each clamp shall be 60 cm center to center.

Surface conduits shall be fixed by means of spacer bar saddles at intervals of not more than 500 mm from both sides of fittings/accessories. The saddles shall be of 3mm x 19mm galvanized M.S. flat properly treated, primed and painted securely fixed to support by means of nuts & bolts / raw plugs and brass machine screws.

Where conduits cross expansion joints in the buildings, adequate expansion fittings shall be used to take care of any relative movement.

Separate conduits shall be laid for the following systems:

a) Normal light, Fan and 6 A socket outlets.
b) Power points.
c) TV outlets.
d) PA system.
e) Telephone points
f) Fire alarm system
g) CCTV System

h) Emergency Lighting

Contractor shall submit the conduit layout to PMC / Owners for approval before start of work. While laying conduit, care should be taken that water, mortar and dirt etc. do not enter the conduits and boxes.

Conduiting system should be such that it shall facilitate easy drawing of new wires/additional wires at any stage. All junction boxes/pull boxes/ draw boxes shall be completely accessible for inspection, maintenance or for future expansion. While drawing of wires, care shall be taken to avoid damage to the wire insulation.

All joints in the wiring shall be made only at switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joint shall be made in conduits and junction boxes.

3.4 Bends

Large right angle bends (more than 75 mm radius) or non right angle bends in conduit runs shall be made by means of conduits bending machines carefully so as not to cause any crack in the conduit. Small right angle bends in conduits runs can be made by standard conduit accessories (solid/inspection bends/elbows) no run of conduits shall have more than four right angle bends from outlet to outlet. Bends in multi runs of conduits shall be parallel to each other and neat in appearance, maintaining the same distance as between straight runs of conduits.

3.5 Conduit Accessories.

3.5.1 Standard accessories

Heavy duty black enamel painted standard conduit fittings and accessories like standard/extra-deep circular boxes, looping in boxes, junction boxes, normal/ inspection bends, solid/inspection elbows, Solid/inspection tees, couplers, nipples, saddles, check nuts, earth clips, ball socket joints etc. shall be of superior quality and of approved makes. Heavy duty covers screwed with approved quality screws Shall be used. Superior quality screwed PVC bushes shall be used Samples of all conduits fittings and Accessories shall be got approved by Owners/Architects before use.

3.5.2 Fabricated accessories

Where Ever required, outlet/junction boxes of required sizes shall be fabricated from 1.6 mm thick MS Sheets excepting ceiling fan outlet boxes which shall be fabricated from minimum 2 mm thick Sheets. The outlet boxes shall be of approved quality, finish and manufacture. Suitable means of fixing Connectors etc., if required, shall be provided in the boxes. The boxes shall be protected from rust by Zinc Phosphate primer process. Boxes shall be finished with minimum 2 coats of enamel paint of Approved colour. A screwed brass stud shall be provided in all boxes as earthing terminal.

3.5.2.1 Outlet Boxes For Light Fittings.

These shall be minimum 75mm x 75mm x 50mm deep and provided with required number of threaded collars for conduit entry. For ceiling mounted florescent fittings, the boxes shall be provided 300 mm off centre for a 1200 mm fitting and 150 mm off centre for a 600 mm fitting so that the wiring is taken directly to the down rod. 3 mm thick Perspex/Phylum sheet cover of matching colour shall be provided.

3.5.2.2 Outlet Boxes For Ceiling

Outlet boxes for ceiling fans shall be fabricated from minimum 2 mm thick MS sheet steel. The boxes shall be hexagonal in shape of minimum 100 mm depth and 60 mm sides. Each box shall be provided with a recessed fan hook in the form of one 'U' shaped 15 mm dia rod welded to the box and securely tied to the top reinforcement of the concrete slab for a length of minimum 150 mm on either side. 3 mm thick Perspex/phylum sheet cover of matching colour shall be provided.

3.5.3 Boxes For Modular Wiring Accessories

3.5.3.1 Switch Boxes - Modular Type

Switch boxes suitable to house modular type switches of required ratings, and fan regulators as required shall be provided. In case the number of switches in one box is not tallying with that available in standard manufacture, the box accommodating the next higher number of switches shall be provided without any extra cost. In case fan regulator/regulators is /are to be provided at a later dated, suitable provision for

accommodating such regulators shall be made in the switch boxes and blank off covers shall be provided without any extra cost.

Switch boxes shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, check-nuts and screwed bushes at conduit entries etc... The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be attached to conduits by means of check-nuts on either sides of their walls. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be fixed by means of counter sunk chromium plated brass machine screws. No timber shall be used for any supports. Switch boxes shall be located with bottom at 1200 mm above floor level unless otherwise indicated.

3.5.3.2 Modular Type Boxes For Socket/ Telephone/Call Bell Outlets

Outlet boxes shall be suitable for housing modular type switched socket outlets/ telephone outlets/ buzzers and any other outlet as required. These shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, check nuts and screwed bushes at conduit entries etc. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. These shall be attached to conduits by means of check nuts on either sides of their walls. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be used to mount the outlets and shall be fixed to the outlet M.S. boxes by means of counter sunk chromium plated brass machine screws. No timber supports shall be used. Boxes shall be located at skirting level or bottom at 1200 mm from floor or inside raceways on laboratory work tables., as indicated in drawings and/or as directed.

3.6 Cross Section

The conduits shall be of ample sectional area to facilitate simultaneous drawing of wires and permit future provision also. Total cross section of wires measured overall shall not normally be more than half the area of the conduit. Maximum number of PVC insulated 660/1100 Voltage grade copper conductor cable conforming to IS - 694 - 1990 as per table give below.

Maximum no of PVC insulated 660/1100 V grade aluminium/copper

Conductor cable conforming to IS : 694 - 1990

Normal Cross Sectional area of conductor in sq. mm	20 mm		25 mm		32 mm		38 mm		51 mm		64 mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1	2	3	4	5	6	7	8	9	10	11	12	13
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	3	4	8	7	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25					3	2	5	3	8	6	9	7
35							3	2	6	5	8	6

Note :

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw boxes and which do not deflect form the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect form the straight by an angle of more than 15 degrees.
3. Conduits sizes are the nominal external diameters.

4. WIRES

Wiring shall be carried out with PVC insulated 660/1100 volt grade unsheathed single core wires with electrolytic annealed stranded copper (unless otherwise stated) conductors and conforming to IS 694/1990. All wire rolls shall be ISI marked. All wires shall bear manufacturer's label and shall

be brought to site in new and original packages. Manufacturer's certificate, certifying that wires brought to site are of their manufacture shall be furnished as required.

5 COAXIAL CABLES

The coaxial cables shall be of vide band type with operation up to 300 MHz capability. Aging resistance shall comply with DIM 472.52 part 2 i.e maximum 5% increase in attenuation at 200 MHz measured by artificial aging (14 days at 80o C) cables shall meet all exceed following specifications

Center core Dia	0.8 mm
Dielectric Dia	4.8 mm
Dielectric	PE
Outer Conductor Dia	5.4 mm
Outer Dia	7.0 mm
Bending radius	more than 30 mm
Impedance	75 ohms
D.C Resistance	50 ohms/KM
Screening factor	more than 50
Attenuation	
50 MHz	6.5
100 MHz	9
200 MHz	13
300 MHz	16

6 LAYING OF CONDUITS

- Conduits shall be laid either recessed in walls and ceilings or on surface on walls and ceilings or partly recessed and partly on surface, as required.

- Same rate shall apply for recessed and surface conduiting in this contract.
- Stranded copper conductor insulated wire of size as per schedule of quantities shall be provided in entire conduiting for loop earthing.
- GI wire of suitable size to serve as a fish wire shall be left in all conduit runs to facilitate drawing of wires after completion of conduiting.

6.1 Recessed Conduiting

Conduits recessed in concrete members shall be laid before casting, in the upper portion of slabs or otherwise as may be instructed, so as to embedd the entire run of conduits and ceiling outlet boxes with a cover of minimum 12 mm concrete. Conduits shall be adequately tied to the reinforcement to prevent displacement during casting at intervals of maximum 1 meter. No reinforcement bars shall be cut to fix the conduits. Suitable flexible joints shall be provided at all locations where conduits cross expansion joints in the building.

Conduits recessed in brick work shall be laid in chases to be cut by electrical Contractor in brick work before plastering. The chases shall be cut by a chase cutting electric machine. The chases shall be of sufficient width to accommodate the required number of conduits and of sufficient depth to permit full thickness of plaster over conduits. The conduits shall be secured in the chase by means of heavy duty pressed steel clamps screwed to MS flat strip saddles at intervals of maximum 1 meter. The chases shall then be filled with cement and coarse sand mortar (1:3) and properly cured by watering.

Entire recessed conduit work in concrete members and in brick work shall be carried out in close coordination with progress of civil works. Conduits in concrete members shall be laid before casting and conduits in brick work shall be laid before plastering. Should it become necessary to embedd conduits in already cast concrete members, suitable chase shall be cut in concrete for the purpose. For minimizing this cutting, conduits of lesser diameter than 25 mm and outlet boxes of lesser depth than 50 mm could be used by the Contractor for such extensions only after obtaining specific approval from Architects/Owners. For embedding conduits in finished and plastered brick work, the chase would have to be made in the finished brick work. After fixing conduit in chases, chases shall be made good in most workmanlike manner to match with the original finish.

Cutting chases in finished concrete or finished plastered brick work for recessing conduits and outlet boxes etc shall be done by the Contractors without any extra cost.

6.2 Surface Conduiting

Wherever so desired, conduit shall be laid in surface over finished concrete and/or plastered brickwork. Suitable spacer saddles of approved make and finish shall be fixed to the finished structural surface along the conduit route at intervals not exceeding 600 mm. Holes in concrete or brick work for fixing the saddles shall be made neatly by electric drills using masonry drill bits. Conduits shall be fixed on the saddles by means of good quality heavy duty MS clamps screwed to the saddles by counter sunk screws. Neat appearance and good workmanship of surface conduiting work is of particular importance. The entire conduit work shall be in absolute line and plumb.

6.3 Fixing of conduit fittings and accessories

For concealed conduiting work, the fittings and accessories shall be completely embedded in walls/ceilings leaving top surface flush with finished wall/ceiling surface in a workman like manner.

Loop earthing wire shall be connected to a screwed earth stead inside outlet boxes to make an effective contact with the metal body.

6.4 Painting and Colour coding of conduits

Before laying, conduits shall be painted specially at such places where paint has been damaged due to vice or wrench grip or any other reason.

If so specified, surface conduits shall be provided with 20 mm wide and 100 mm long colour coding strips as below

Use	**Code colour**
Low voltage	Grey
Fire alarm	Red
Telephone	Black

PA system	Brown
Earthing system	Green
Control system lighting	Purple

6.5 Protection of Conduits

To safeguard against filling up with mortar/plaster etc. all the outlet and switch boxes shall be provided with temporary covers and plugs which shall be replaced by sheet/plate covers as required. All screwed and socketed joints shall be made fully water tight with white lead paste.

6.6 Cleaning of Conduit Runs

The entire conduit system including outlets and boxes shall be thoroughly cleaned after completion of erection and before drawing in of cables.

6.7 Protection Against Dampness

All outlets in conduit system shall be properly drain and ventilated to minimise chances of condensation/sweating.

6.8 Expansion Joints

When crossing through expansion joints in buildings, the conduit sections across the joint shall be through approved quality heavy duty metal flexible conduits of the same size as the rigid conduit.

6.9 Loop Earthing

Loop earthing shall be provided by means of insulated stranded copper conductor wires of sizes as per Schedule of Quantity laid alongwith wiring inside conduits for all wiring outlets and sub-mains. Earthing terminals shall be provided inside all switch boxes, outlet boxes and draw boxes etc.

7 LAYING AND DRAWING OF WIRES

7.1 Bunching of Wires

Wires carrying current shall be so bunched in conduits that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

7.2 Drawing of Wires

The drawing of wires shall be done with due regard to the following precautions:-

- No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Burrs in cut conduits shall be smoothen before erection of conduits. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Approved type bushes shall be provided at conduit terminations.

- Before the wires are drawn into the conduits, conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits if necessary..

- While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which cause breakage of conductors.

- There shall be no sharp bends.

- The Contractor shall, after wiring is completed, provide a blank metal/sunmica plate on all switch / outlet / junction boxes for security and to ensure that wires are not stolen till switches / outlets etc.. are fixed at no extra cost the contractor shall be responsible to ensure that wires and loop earthing conductors are not broken and stolen. In the event of the wire been partly / fully stolen , the contractor shall replace the entire wiring alongwith loop earthing at no extra cost to the Owners. No joint of any nature whatsoever shall be permitted in wiring and loop earthing .

7.3 Termination /Jointing of Wires

- Sub-circuit wiring shall be carried out in looping system. Joints shall be made only at distribution board terminals, switches/buzzers and at ceiling roses/connectors/lamp holders terminals for lights/fans/socket outlets. No joints shall be made inside conduits or junction/draw/inspection boxes.

- Switches controlling lights, fans or socket outlets shall be connected in the phase wire of the final sub circuit only. Switches shall never be connected in the neutral wire.

- Wiring conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any special reason shall be made by approved connectors. Specific prior permission from Architect/Owners in writing shall be obtained before making such joint.

- Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or wringing.

- Strands of wires shall not be cut for connecting terminals. All strands of wires shall be twisted round at the end before connection..

- Conductors having nominal cross sectional area exceeding 4 sq. mm shall always be provided with crimping sockets.

- At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used.

- Brass nuts and bolts shall be used for all connections.

- The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.

- Switches controlling lights, fans, socket outlets etc. shall be connected to the phase wire of circuits only.

- Only certified valid license holder wiremen shall be employed to do wiring / jointing work.

7.4 Load Balancing

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

7.5 Colour Code of Conductors

Colour code shall be maintained for the entire wiring installation - red, yellow, blue for three phases, black for neutral and green for earth.

8. MEASUREMENT AND PAYMENT OF WIRING

Wiring for lights, fans, convenience socket outlets and telephone outlets etc. shall be measured and paid for on POINT BASIS as itemized schedule of quantities and as elaborated as below unless otherwise stated.

8.1 Primary and Secondary light point wiring

In respect of group control of lights (more than one light controlled by one switch or MCB), wiring upto the first light in the group shall be measured and paid for as a primary light point. Wiring for other lights looped in one group for switch controlled as also MCB controlled lights shall be measured and paid for as secondary light points. Primary light points for switch controlled lights shall include the cost of control switch whereas primary light points controlled by MCBs shall not include the switch cost. The cost of MCB controlling such lights shall not be included in the primary light point rate since the MCB shall be paid for in the item of DB.

The point wiring basis shall assume average wiring length and average conduiting length per point based on parameters stipulated in Para 8.2 below. The average wiring length and average conducting length forming the basis of point wiring payment, shall take the electrical layouts of the entire project into consideration. Tenderers are advised to seek clarifications, if they so desire, on this aspect before submitting their tenders. No claim for extra payment on account of electrical layouts in part or whole of the project requiring larger average wiring and conduiting length per point, whether specifically shown in tender drawings or not, shall be entertained after the award of contract.

8.2 Parameters: Wiring shall be carried out as per following parameters in recessed/ surface conduit system.

- Only looping system of wiring shall be adopted throughout. No joints excepting at wiring terminals shall be permitted.
- All accessories shall be flush type unless otherwise stated.
- For estimation of load, following loads per point shall be assumed.

Light points	100 Watts.

6 amps socket outlet points	100 Watts.
Fan points	60 Watts.
Exhaust fan points	300 Watts or as specified.
16 amp socket outlet points	1000 Watts.

- Lights, fans and 6 amp socket outlets may be wired on a common final such circuit. Such circuit shall Not normally have more than a total of ten lights, fans or socket outlets or a load of 800 watts whichever is lesser.
- Power circuits shall normally have maximum one 16 amps socket outlet unless otherwise stated. Separate circuit shall be run for each geyser, kitchen equipment, window air conditioners and similar appliances.
- Wiring rates shall include painting of conduits and other accessories as required.
- Wiring rates shall include cleaning of dust, splashes of colour wash or paint from all fixtures, fans, fittings etc. at the time of taking over of the installation.
- Wiring rates shall include blanking of outlet boxes to prevent damage/pilferage of wires as elaborated in Para 7.2.

8.3 Definitions

8.3.1 Wiring for Lights

Primary Light Points : Wiring for primary light points, as defined in Para 8.1 above, shall commence at the Distribution Board terminals and shall terminate at the ceiling rose/connector in ceiling box/lamp holder via the control switch (for switch controlled lights). Rates for primary light point wiring shall be deemed to be inclusive of the cost of entire material and labour require for completion of primary light point thus defined including : .

- Recessed / surface Conduiting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required,

- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.

- Control switch with switch box and cover plate of specified type including fixing screws, earth terminal etc. complete as required. Cost of this switch is applicable only for switch controlled points. This cost shall not be applicable for DB controlled points.

- Loop earthing with insulated copper wires.

Secondary Light points :

Secondary light points, as defined in Para 8.1 above, shall cover the cost of interconnection wiring between group controlled light fittings and shall be deemed to be inclusive of the cost of entire materials and labour required for completion of the secondary light point thus defined including

- Recessed / surface Conduiting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required,

- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.

- Loop earthing with insulated copper wires.

8.3.2 Wiring for Ceiling Fans

Wiring for ceiling fan points shall be same as for primary light points and shall, in addition, include ceiling outlet box with recessed fan hooks and provision in the switch box for mounting the fan regulator.

8.3.3 Wiring for Exhaust Fans

Wiring for exhaust fan points shall be same as for primary light points and shall in addition include the cost of providing a 3/5 pin 6 amp socket outlet near the fan and a 6 amp control switch at convenient location near the room entry.

8.3.4 Wiring for Call Bell Points

Wiring for call bell points shall be the same as for primary light points and shall in addition include the cost of a call bell/buzzer of approved type and make in the required location and a call bell in lieu of the control switch at a convenient location as required.

8.3.5 Wiring for Telephone Outlets

Wiring for telephone outlets points shall include the entire wiring and conduiting from the telephone tag block to the telephone outlet including the telephone outlet complete as required and as itemized in the Schedule of Quantities

8.3.6 Wiring for Convenience Socket Outlets

3/5 pin 6 amps and 3/6 pin 16 amps single phase switched convenience socket outlets shall be provided in the building as indicated in the layout drawings. In addition, combined 3 pin 6 / 16 amps socket outlets at modular intervals in special PVC raceway over the work tables in laboratories shall be provided. Wherever required, 20/32/50 amps single phase and 32/50 amps 3 phase outlets shall also be provided.

Wiring for 3/5 pin 6 amps convenience socket outlets

Point wiring for 3/5 pin 6 amps socket outlets (in locations other than over the laboratory work tables) on point wiring basis shall be the same as primary light point defined in Para 8.3.1 and shall in addition include 3/5 pin 6 amp socket outlet with 6 amp control switch in MS box with cover. Including loop earthing of the third pin complete as required as itemized in scheduled of quantities.

Wiring for 3/6 pin 16 amps convenience socket outlets

Point wiring for 3/6 pin 16 amps socket outlets (in locations other than over the laboratory work tables) on point wiring basis shall be the same as primary light point defined in Para 8.3.1 and shall in addition include 3/6 pin 16 amp socket outlet with 16 amp control switch in MS box with cover. Including loop earthing of the third pin complete as required as itemized in scheduled of quantities.

Wiring for combined 3 pin 6/16 amps socket outlets in laboratories

Wiring for 3 pin 6/16 amp combined socket outlets in existing PVC raceways (provided over laboratory work tables) on point wiring basis shall include the cost of wiring from DB terminals to the outlets along with loop earthing of the earth pin and the switched combination 6/16 amp outlet with 16 amp control switch housed in the existing raceway, as indicated in layout drawings and as itemized in schedule of quantities. PVC raceway/conduit required for this wiring shall be paid extra as itemized in the schedule of quantities.

Wiring for special socket outlets

In addition to the above, special convenience outlets of 20/32/50 amps single phase and 32/50 amps three phase, required in few locations as indicated in the layout drawings, shall be paid for on linear basis as itemized in schedule of quantities. Outlets only shall be paid separately in numbers as per actuals. Wiring alongwith loop earthing shall be paid separately on running meter basis and conduiting /PVC raceway shall be paid separately on running meter basis.

9. ROUTINE AND COMPLETION TESTS

9.1 Installation Completion Tests

At the completion of the work, the entire installation shall be subject to the following tests:

1. Wiring continuity test
2. Insulation resistance test
3. Earth continuity test
4. Earth resistivity test

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

9.2 Wiring Continuity Test

All wiring systems shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energized.

9.3 Insulation Resistance Test

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all fuses in place and all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the

neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 mega ohms divided by the number of points provided on the circuit the whole installation shall not have an insulation resistance lower than one mega ohm.

The insulation resistance shall also be measured between all conductors connected to one phase conductor of the supply and shall be carried out after removing all metallic connections between he two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant Standard specification or where there is no such specification, shall not be less than half a mega ohm or when PVC insulated cables are used for wiring 12.5 mega ohms divided by the number of outlets. Where a whole installation is being tested a lower value than that given by the above formula subject to a minimum of 1 Mega ohms is acceptable.

9.4 Testing Of Earth Continuity Path

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

9.5 Testing Of Polarity Of Non-Linked Single Pole Switches

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three of four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Architect as well as the local authorities.

9.6 Earth Resistivity Test

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

9.7 Performance

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.

9.8 Tests And Test Reports

The Contractor shall furnish test reports and preliminary drawings for the equipment to the Architect/owners for approval before commencing supply of the equipment. The Contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc., required by the local Inspectors or any other Authorities would be supplied by the Contractor without any extra charge.

TECHNICAL SPECIFICATIONS

11 KV AND MEDIUM VOLTAGE CABLES

1. GENERAL

Technical specifications in this section covers supplying and laying of :

- 11 kV cables
- Medium voltage cables.

2. STANDARDS AND CODES

All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended upto date and as below. In addition, relevant clauses of the Nepal Electricity Board as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

Equipments certified by Bureau of Indian Standards / NEB shall be used in this contract in line with government regulations. Test certificates in support of this certification shall be submitted, as required.

It is to be noted that updated and current standards shall be applicable irrespective of dates mentioned along with ISS's in the tender documents.

PVC insulated heavy duty cables	IS 1554 - 1988
Cross link polyethylene insulated PVC (sheathed XLPE cables)	IS 7098 - 1985
Code of practice for installation and maintenance of power cables	IS 1255 - 1983
Conductors for insulated electrical cables	IS 8130 - 1984
Drums for electrical cable	IS 10418 - 1982
Methods of test for cables	IS 10810 - 1988
Recommended current rating	IS 3961 - 1987
Recommended short circuit rating of high voltage PVC cables	IS 5891 - 1970

3. CABLES

3.1 11 kV Cables

11 kV cable shall be aluminium conductor with cross linked polyethylene (XLPE) insulation, galvanized steel armouring and PVC sheathing conforming to IS 7098. Conductors shall be sector shaped, made from electrical purely aluminium of 3 x 4 H or H temper conforming to IS 8130 XLPE insulation of high purity shall be extruded on the conductors with screen a layer of semi-conducting material shall be applied over the XLPE insulation to prevent partial discharge at

insulation surface. This shall be followed up by metallic aluminium tape screen the cores shall be discharged tested. Built up cores shall then be laid up and filler codes added. Combined core shall be provided with extruded PVC sheathing. Galvanized steel wire of strip armouring shall then be provided protected by an overall extruded black PVC sheet. The outer sheath shall bear the manufacturer's name and trade mark at every meter length.

3.2. Medium Voltage Cables

Medium voltage cables shall be aluminium conductor PVC insulated, PVC sheathed armoured conforming to IS 1554. Cables shall be rated for a 1100 Volts. The conductor of cables from 16 Sq. mm. to 50 Sq. mm. shall be stranded. Sector shaped stranded conductors shall be used for cables of 50 sq. mm and above. Conductors shall be made of electrical purity aluminium 3/4 H or H temper. Conductors shall be insulated with high quality PVC base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanised compound. Armouring shall be applied over outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer's name and trade mark at every meter length. Cores shall be provided with following colour scheme of PVC insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Core	:	Red and Black
3 Core	:	Red, Yellow and Blue
3 1/2 /4 Core	:	Red, Yellow, Blue and Black

Current ratings shall be based on the following conditions.

a) Maximum conductor temperature 70 0 C

b) Ambient air temperature 450 C

c) Ground temperature 300 C

d) Depth of laying 1000 mm

Short circuit rating of cables shall be as specified in IS 1554 Part-I.

Cables have been selected considering conditions of maximum connected loads, ambient temperature, grouping of cables and allowable voltage drop. However, the contractor shall recheck the sizes before cables are fixed and connected to service.

4. DELIVERY, STORAGE AND HANDLING

Cable drum shall be stored on a well drained, hard surface, preferably of concrete, so that the drums do not sink in ground causing rot and damage to the cable drum. The cable drum shall conform to IS 10418. During storage, periodical rolling of drums, in the direction of arrow marked on the drum, shall be done once in 3 month through 90o C Both ends of cables shall be properly sealed to prevent moisture ingress Drums shall be stored in well ventilated area protected from sun and rain. Drums shall always be rested on the flanges and not on flat sides. Damaged battens of drums etc. shall be replaced. Movement of drums shall always be in direction of the arrow marked on the drum. For transportation over long distance, the drums shall either be mounted on drum wheels and pulled by ropes or they shall be mounted on trailers etc. drums shall be unloaded preferably by crane otherwise they shall be rolled down carefully on suitable ramps. While transferring cable form 1 drum to another, the barrel of the new drum shall have diameter not less than the original drum. Cables with kinks or similar visible defects like defective armouringetc shall be rejected. Cables shall be supplied at site in cut pieces as per actual requirements.

5. LAYING OF CABLES

Cables shall be so laid that the maximum bending radius is 12 times the overall diameter of the cable for medium voltage cables and 15 times the overall diameter for 11 kV cables. Cables shall be laid in masonry trenches, directly on walls/cable trays, directly buried in ground or in pipes/ducts as elaborated below. Cables of different voltages and also power and control cables shall be laid in different trenches with adequate separation. Wherever available space is restricted such that this requirement cannot be met, medium voltage cables shall be laid above HT cables.

5.1 In Masonry Trenches

Wherever so specified, cables shall be laid in indoor/outdoor masonry/RCC trenches to be provided by Owners. Cables shall be laid on MS supports fabricated from minimum 38mm x 38mm x 6mm painted / galvanized angle iron supports grouted in trench walls at intervals not exceeding 600 mm. If required, cables shall be arranged in tier formation inside the trench. Suitable clamps, hooks and saddles shall be used for securing the cables in position and dressing properly so that the clear spacing between the cables shall not be less then the diameter of the cable. Trenches shall be provided with chequered plate/RCC covers. Wherever so specified, trenches shall be filled with fine sand.

5.2 On Trays/Walls

Wherever so specified, cables shall be laid along walls/ceiling or on cable trays. Cable shall be secured in position and dressed properly by means of suitable clamps, hooks, saddles etc. such that the minimum clear spacing between cables is diameter of the cable. Clamping of cables shall be at minimum intervals as below.

Type of cables	Size	Clamping by	Fixing intervals
MV	Upto and including 25 sq mm	Saddles 1 mm thick	45 cm
MV & HV	35 sq mm to 120 sq mm	Clamps 3 mm thick 25 mm wide	60 cm
MV & HV	150 sq mm and above	Clamps 3 mm thick 40 mm wide	60 cm

Note : The fixing intervals specified apply to straight runs. In the case of bends, additional clamping shall be provided at 30 cm from the center of the bend on both sides.

Cable trays, of sizes as per schedule of quantities and drawings shall be of perforated doubled bend channel/ladder design unless otherwise stated. Cable trays shall be fabricated from minimum 2 mm

thick sheet steel and shall be complete with tees, elbows, risers, and all necessary hardware. Cable trays shall comply with the following:

Trays shall have suitable strength and rigidity to provide proper support for all contained cables. Trays shall not have sharp edges, burrs or projections injurious to cable insulation. Trays shall include fittings for changes in direction and elevation. Cable trays and accessories shall be painted with one shop coated of red oxide zinc chromate primer and two side coats of aluminium alkyd paint or approved equivalent. Cable trays shall not have sharp edges, burrs or projection that may damage the insulation jackets of the wiring. Cable trays shall have side rails or equivalent structural members.

Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out ensuring the following :

Cable tray mounting arrangement type to be as marked on layout drawing. Assembly of tray mounting structure shall be supplied fabricated, erected & painted by the electrical contractor. Tray mounting structures shall be welded to plate inserts or to structural beams as approved by the Owners/Architects. Wherever embedded plates & structural beams are not available for welding the tray mounting structure electrical contractor to supply the MS plates & fix them to floor slab by four anchor fasteners of minimum 16 mm dia having minimum holding power of 5000 Kg at no extra cost. Maximum loading on a horizontal support arm to be 120 Kg. metre of cable run. Width of the horizontal arms of the tray supporting structures to be same as the tray widths specified in tray layout drawings, plus length required, for welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers shown in tray layout drawings. Spacing between horizontal supports arms of vertical tray runs to be 300 mm. Cable trays will be welded to their mounting supports. Minimum clearance between the top most tray tier and structural member to be 300 mm. Cables in vertical race ways to be clamped by saddle type clamps to the horizontal slotted angels. Clamps to be fabricated from 3 mm thick aluminium strip at site by the electrical contractor to suit cable groups. The structural steel (standard quality) shall be according to latest revision of IS : 226 & 808. Welding shall be as per latest revisions of IS : 816. All structural steel to be painted with one shop coat of red oxide and oil primer followed by a finishing coat of aluminium alkyd paint where any cuts or holes are made on finished steel work these shall be sealed against oxidation by red oxide followed by the same finishing paint.

Steel sheet covers wherever indicated to be similarly painted. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. Trays shall be supported adequately by means of painted MS structural members secured to the structure by dash fasteners or by grouting. The entire cable tray system shall be rigid. Each run of cable tray shall be completed before laying of cables. Cable trays shall be erected so as to be exposed and accessible.

5.3 Buried Directly In Ground

5.3.1 General

Cables shall be so laid that they will not interfere with under ground structures. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded as directed by Architects/Owners. Surface of the ground shall be made good so as to conform in all respects to the surrounding ground to the satisfaction of Architects/ Owners.

5.3.2 Routing of cables

Before cable laying work is undertaken, the route of the cables shall be decided with the Architects/Owners. While shortest practicable route shall be preferred, cable runs shall follow fixed development such as roads, footpaths etc with proper off-sets so that future maintenance and identification are rendered easy. Whenever cables are laid along well demarcated or established roads, the LV/MV cables shall be laid further from the kerb line than HV cables. Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted, LV/MV cables shall be laid above HV cables. Where cables cross one another, the cables of higher voltage shall be laid at a lower level than the cables of lower voltage. Power and communication cables shall as far as possible cross at right angles. Where power cables are laid in proximity to communications cables the horizontal and vertical clearances shall not normally be less than 60 cm.

5.3.3 Width Of Trench

The width of trench shall be determined on the following basis. The minimum width of trench for laying single cables shall be 350 mm. Where more than one cable is to be laid in the same trench

in horizontal formation, the width of trench shall be increased such that the inter-axial spacing between the cables except where otherwise specified shall be at least 200 mm. There shall be a clearance of at least 150 mm between axis of the end cables and the sides of the trench.

5.3.4 Depth Of Trench

The depth of trench shall be determined on the following basis:

- Where cables are laid in single tier formation, the total depth of the trench shall not be less than 750 mm for cables upto 1.1 kV and 1250 mm for cables above 1.1 kV.
- When more than one tier of cables is unavoidable and vertical formation of laying is adopted, the depth of trench shall be increased by 300 mm for each additional tier to be formed.

5.3.5 Excavation Of Trenches

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature of 12 times the overall diameter of the largest cable shall be provided. Where gradients and changes in depths are unavoidable these shall be gradual. Excavation should be done by any suitable manual or mechanical means. Excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench. Adequate precautions shall be taken not to damage any existing cables, pipes or other such installations during excavation. Wherever bricks, tiles or protected covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Architects/ Owners. Existing property exposed during trenching shall be temporarily supported or propped adequately as directed by the Architects/ Owners. The trenching in such cases shall be done in short lengths, necessary pipes laid for passing cables therein and the trench refilled as required. If there is any danger of a trench collapsing or endangering adjacent structures the sides shall be well shored up with timbering and/or sheathing as the excavation proceeds. Where necessary these may even be left in place when back filling the trench. Excavation through lawns shall be done in consultation with the Architects/ Owners. Bottom of the trench shall be level and free from stone, brick, etc. The trench shall then be provided with a layer of clean dry sand cushion of not less than 80 mm in depth.

5.3.6 Laying Of Cable In Trench

The cable drum shall be properly mounted on jacks or on a cable wheel at a suitable location. It should be ensured that the spindle, jack etc are strong enough to carry the weight of the drum

without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks or strains. The entire cable length shall, as far as possible, be laid in one stretch. However when this is not possible the remainder of the cable shall be removed by flaking i.e. making one long loop in the reverse direction. After the cable is uncoiled and laid over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 metres apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cables and then laid in the trench in a reasonably straight line. For short runs and cable sizes upto 50 sq mm 1.1 kV grade the alternative method of direct handling can be adopted with the prior approval of the Architects/ Owners. If two or more cables are laid in the same trench care should be taken to preserve relative position. All the cables following the same routes shall be laid in the same trench. Cables shall not cross each other as far as possible. When the cable has been properly straightened the cores shall be tested for continuity and insulation resistance. The cable shall be measured thereafter. Suitable moisture sealing compound/tape shall be used for sealing of the ends. Cable laid in trenches in a single tier formation shall have a covering of clean dry sand of not less than 170 mm above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid a sand cushion of 300 mm shall be provided over the initial bed before the second tier is laid. If additional tiers are formed each of the subsequent tiers also shall have a sand cushion of 300 mm. The top most cable shall have a final sand covering not less than 170 mm before the protective cover is laid. A final protection to cables shall be laid to provide warning to future excavators of the presence of the cable and also to protect the cables against accidental mechanical damage. Such protection shall be with second class bricks of not less than 200 mm x 100 mm x 100 mm (normal size) laid breadth wise for the full length of the cable to the satisfaction of the Owners /Architects. Where more than one cable is to be laid in the same trench this protective covering shall cover all the cables and project at least 50 mm over the sides of the end cables. In addition bricks on edge shall be placed along the entire run on either side of the cable run. The trenches shall then be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered in successive layers not exceeding 300 mm. Unless otherwise specified a crown of earth not less than 50 mm in the centre and tapering towards the side of the trench shall be left to allow for subsidence. The crown of earth should however not exceed 100 mm so as not to be a hazard to vehicular traffic. Where road berms or lawns have been cut or kerb stones displaced the same shall be repaired and made good to the satisfaction of the Clients and all surplus earth and rocks removed to places as specified.

5.3.7 Laying In Pipes/Closed Ducts

In locations such as road crossings, entry to buildings/poles in paved areas etc., cables shall be laid in pipes or closed ducts. Spun reinforced concrete pipes shall be used for such purposes and the pipe shall not be less than 100 mm in diameter for a single cable and not less than 150 mm for more than one cable. These pipes shall be laid directly in ground without any special bed. Sand cushioning and/or brick tiles need not be used in such installations. Unless otherwise specified the top surface of pipes shall be at a minimum depth of 1000 mm from the ground level when laid under roads, pavements etc. The pipes for road crossings shall preferably be on the skew to reduce the angle of bend as the cable enters and leaves the crossing. Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing. No deduction shall be made for sand and bricks not used for cables passing through RCC Hume pipes or for parts of vertical cables at the lighting poles. Wherever so required, cables shall be laid at the bed of the lake through existing PVC pipe as itemized in bill of quantities.

5.3.8 Laying Of Cables In Floors

Laying of cables directly in floors shall be avoided and GI pipes of adequate size shall be used wherever necessary. However if the cables have to be laid direct in the floor specific written approval of architect/ Owners shall be obtained and the Contractor shall cut chases, lay the cables and make good the chases to original finish.

5.3.9 Cable Entry Into Buildings

Cable entry into buildings shall be made through RCC pipes recessed in the floor. RCC Hume pipes shall be provided well in advance for service cable entries. The pipe shall be filled with sand and sealed at both ends with bitumen mastic to avoid entry of water. Suitable size manholes shall be provided wherever required to facilitate drawing of cables as per requirements.

6 TERMINATION/JOINTING OF CABLES

Soldered jointing/termination shall be totally avoided. Solderless terminations by using Dowel crimping tools and suitable legs shall be adopted for all cable terminations. Any terminations may without use of proper crimping tool is shall be liable to be rejected. In the case of aluminium conductors, it is to be ensured that the conductor oxidation is cleaned by means of emery paper and then a thin coat of tin is applied before pinching into any equipment. Heat shrinkable Raychem type or approved equivalent terminations shall be provided for High Voltage cables and Siemens make or approved equivalent make brass double compression glands shall be provided for Medium Voltage cable terminations. Straight through jointing of Medium Voltage or High Voltage cable shall normally be totally avoided. If absolutely unavoidable, such jointing shall be carried out as per procedure to be got specifically approved from Architect/Owners.

7. MEASUREMENT OF CABLE RUNS

The cable runs shall be measured upto the outer end of the boxes without any allowances for over lap in joints. The actual run of the cables shall be measured and the rate shall include all the above mentioned material, labouretc for laying as required.

8. CABLE LOOPS

At the time of the installation approximately 3 meters of surplus cable shall be left

- at each end of the cable
- on each side of underground straight through/tee/termination joints.
- at entries to buildings
- and such other places as may be decided by the architects/owners.

This cable shall be left in the form of a loop.

Wherever long runs of cable length are installed cable loops shall be left at suitable intervals as specified by the architect/owners.

9. BONDING OF CABLES.

Where a cable enters any piece of apparatus it shall be connected to the casting by means of an approved type of armoured clamp or gland. The clamps must grip the armouring firmly to the gland or casting, so that in the event of ground movement no undue stress is placed on to the cable conductors.

10. TESTING

10.1 Tests At Manufacturer's Work

The cables shall be subjected to shop test in accordance with relevant standards to prove the design and general qualities to the cables as below (as per IS 10810) :

- Routine test on each drum of cables.
- Acceptance tests on drums chosen at random for acceptance of the lot.
- Type test on each type of cables, inclusive of measurement of armour DC resistance of power cables.

10.2 Site Testing

- All cables before laying shall be tested with a 500 V Megger for 1.1 kV grade or with a 2,500/5,000 V Megger for cables of higher voltages. The cables cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armour and insulation resistance between conductors.
- All cables shall be subject to above mentioned test during laying, before covering the cables by protective covers and back filling and also before the jointing operations.
- After laying and jointing, the cable shall be subjected to a 1.5 minutes AC/DC pressure test.
- In the absence of facilities for pressure testing in accordance with clause__ above it is sufficient to test for one minute with 1000 V Megger for cables of 1.1 kV grade and with 2,500/5,00 V Megger for cables of higher voltages.

10.3 Test Witness

Tests shall be performed in presence of representative of Owners/Architect. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

TECHNICAL SPECIFICATIONS

MEDIUM VOLTAGE DISTRIBUTION BOARDS

1 GENERAL

This section covers specification of Dbs.

2. STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition, the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Miniature Air Circuit Breakers for AC circuits IS 8828 : 1978

Degrees of Protection provided by enclosures for low voltage switchgear IS 2147 : 1962

Code of Practice for installation and maintenance of switchgear not exceeding 1000 volts IS 10118 : 1982

General requirements for switchgear and control gear for voltages not exceeding 1000 volts IS 4237: 1982

3. MINIATURE CIRCUIT BREAKERS

- The MCB's shall be of the completely molded design suitable for operation at 240/415 Volts 50 Hz system.
- The MCB's shall have a rupturing capacity of 10 KA at 0.5 pf.
- The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with H.R.C. fuse/PVC cable characteristic.
- Type test certificates from independent authorities shall be submitted with the tender.

4. FINAL DISTRIBUTION BOARDS

- Final distribution boards shall be flush mounting, totally enclosed, dust and vermin proof and shall comprise of miniature circuit breakers, earth leakage circuit breakers, neutral link etc. as detailed in the schedule of quantities.

- The distribution equipment forming a part of the Distribution Boards shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and as per detailed specifications included in this tender document.

- The board shall be fabricated from 14 gauge CRCA sheet steel and shall have a hinged lockable spring loaded cover. All cutouts and covers shall be provided with synthetic rubber gaskets. The entire construction shall give a IP 42 degree of protection.

- The bus-bar shall be of electrical grade copper having a maximum current density of 1.6 ampere per square mm and PVC insulated throughout the length.

- All the internal connections shall be with either solid copper PVC insulated or copper conductor PVC insulated wires of adequate rating.

- All the internal connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.

- All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a frame work for easy removal and maintenance.

- The sheet steel work shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.

- All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Owners.

- A sample of the completed board is to be got approved by the architects/owners before commencement of supply and erection.

5 SHEET STEEL TREATMENT AND PAINTING

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a

recognized phosphating process. The steel work shall then receive two costs of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

- All sheet steel shall after metal treatment be given powder coated finish painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stove and the paint thickness shall not be less than 50 microns.

6. NAME PLATES AND LABELS

- Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

TECHNICAL SPECIFICATIONS

EARTHING

1. GENERAL

All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits, trucking, cable sheaths, switchgear, distribution fuse boards, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing shall be in conformity with Indian Electricity Rules or Equivalent.

The Earthing System shall in totally comprise the following: -

a) Earth Electrodes

b) Earthing Leads

c) Earth Conductors

All three-phase equipment shall have two separate and distinct body earths and single phase equipment shall have a single body earth.

2. STANDARDS

All equipment's, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended up to date and as below. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 or Equivalent International Standards as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

Equipment's certified by Bureau of Indian Standards shall be used in this contract in line with government regulations. Test certificates in support of this certification shall be submitted, as required.

It is to be noted that updated and current standards shall be applicable irrespective of

dates mentioned along with ISS's in the tender documents.

3. EARTHING MATERIAL

Materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the schedule of quantities and shall comply to the following requirements:

- Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian standard specifications.
- Galvanized Steel - Galvanized steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309:1969.
- The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

4 EARTH ELECTRODES

- **Plate Earth Electrode**

The plate electrodes shall be of copper/ GI as called for in the schedule of quantities. The minimum dimensions of the electrodes shall be 600 mm x 600 mm. Thickness of copper electrodes shall not be less than 3 mm and of GI electrodes not less than 6 mm.

The electrode shall be buried in ground with its face vertical and top not less than 4 meters below ground level.

- **Earth Electrode Pit**

Method of Installing Watering Arrangement

In the case of plate earth electrode, a watering pipe of 20 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 1000 x 500 x 600 mm. A precast RCC frame & cover shall be suitably embedded in the masonry enclosure.

Location Of Earth Electrode

The following guidelines shall be followed for locating the earth electrodes

An earth electrode shall not be situated less than 5 meters from any building.

The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.

The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.

Entrances, pavements and road ways shall not be used for locating the earth electrode.

Number Of Earth Electrodes

In all cases the relevant provision of rule 33, 61 & 67 of the Indian Electricity Rules 1956 or Equivalent as amended shall be complied with.

Metallic covers or supports of all medium or H.T. apparatus or conductors shall, in all cases be connected to not less than two separate and distinct earth electrodes.

5. EARTHING LEADS

The strip earthing leads shall be connected to the Earth Electrode at one end and to the metallic body of the main equipment at the other end. The earthing lead shall connect to the earthing network in the installation.

- **Earthing Lead Sizes**
  Strip earthing leads shall be of copper/GI and as per specifications.

- **Earthing Lead Installation**

The length of buried strip earthing lead shall be not less than 15 meters and shall be buried in trench not less than 0.5 m deep.

If conditions necessitate use of more than one earthing lead, they shall be laid as widely distributed as possible preferably in a single straight trench or in a number of trenches radiating from one point.

- **Method Of Connecting Earthing Lead To Earth Electrode**

In the case of plate earth electrode the earthing lead shall be securely bolted to the plate with two bolts, nuts, checknuts and washers as required by IS 3043 : 1987.

All materials used for connecting the earth lead with electrode shall be GI in case of GI Pipe and GI plate earth electrodes or tinned brass in case of Copper plate electrode.

- **Protection of Earthing Lead**

The earthing lead from electrode onwards shall be suitably protected from mechanical injury and corrosion by a 15 mm dia GI pipe in case of wire and 100/40 mm dia medium class GI Pipe

The portion of the G.I. pipe within ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing or pavements). The portion within the building shall be recessed in walls and floors to adequate depth.

6. EARTHING CONDUCTORS

Earthing conductors shall form the earthing network throughout the installation for earthing of all non- carrying metal parts.

- **Connection Of Earthing Conductors**
  - Main earthing conductors shall be taken from the earth connections at the main switch boards to all other switchboards in the network.
  - Sub-mains earthing conductors shall run from the main switch board to the sub distribution boards and to the final distribution boards.

- Loop earthing conductors shall run from the distribution boards and shall be connected to any point on the main/sub-main earthing conductor, or its distribution board or to an earth leakage circuit breaker.
- Metal conduits, cable sheathing and armoring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing, Switches, accessories, lighting fitting etc shall be effectively connected to the Loop Earthing Conductors. These though rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered earthed, even though the run of metallic conduit is earthed.

- **Earthing Conductor Installation**

The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size.

Joints shall be riveted and brazed in approved manner.

Sweated lugs of adequate capacity and size shall be used for termination. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned.

- **Sizing Of Earthing Conductors**

All fixtures, outlet boxes and junction boxes shall be earthed with Bare copper wires as specified.

All 3 phase switches and distribution boards upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper/6 mm dia GI wires. All 3 phase switches and distribution boards upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper/8 mm dia GI wires. All switches, bus bar, ducts and distribution boards of rating 200 amps and above shall be earthed with a minimum of 2 Nos. separate and independent 25 mm x 3 mm copper/25mm x 6 mm GI tape.

7. PROHIBITED CONNECTIONS

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

8. RESISTANCE TO EARTH

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

TECHNICAL SPECIFICATIONS FOR SOLAR SYSTEM

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below

IEC 60146	Semiconductor converters
IS 13947	Low voltage switchgear and control gear
IS 8623	Low voltage switchgear and control gear assemblies
IEC 60529	Degree of protection provided by enclosure
IS 4540	Mono crystalline semiconductor rectifier assemblies and equipment
IS 3136	Polycrystalline semiconductor rectifier equipment
IS 2147	Degree of protection provided by enclosure for low voltage
IEC 60747	Semiconductors devices
IEC 62485	Safety requirements for secondary batteries and battery installations
IEEE 946	IEEE recommended practice for the design of DC auxiliary
IEC 60947	Low voltage switchgear and control gear
IEC 61439	Low voltage switchgear and control gear assemblies

FOR ILLUMINATION SYSTEM OF THE RESOURCE CENTRE, IT IS MANDATORY TO FOLLOW CIBSE -UK GUIDELINES.

SOLAR PV POWER PLANT - TECHNICAL SPECIFICATION FOR CUMULATIVE CAPACITY OF 1500 kwp (ROOF TOP)/ Boundary wall

SCOPE AND BRIEF DESCRIPTION OF WORK

Roof Top based Solar Power Plant has been planned of a cumulative capacity of 1500KWp.

This power generation shall be directly synchronized to Power Control Center (Grid at 415V AC) supplied by the tenderer himself.

Following are various buildings of this Package to be considered for solar power Plant:

i) Size of Plant on building shall be as per the availability of roof area

However, the cumulative capacity shall be 1500kWp.

Power generated from the solar panel of individual building shall be taken from Array junction box and further to Main Junction Box (MJB) of the building.

Main Junction Box of building shall be connected to Power conditioning unit (placed in the building) through DCDB.

Solar System shall be designed to work GRID supply as well as DG Supply.

Solar grid interactive Power Plant associated with Grid Supply shall take care the load as per following:

a) Solar plant (I priority) as per generation and balance by Grid/DG Set.

b) In night and in day when solar plant is out then Grid supply /DG Set shall take care of the load.

c) In case of the solar generation excess to the load, excess generated power shall be transferred to grid. .

Necessary arrangement for AJB/MJB of individual building shall also be considered in the roofs of each building.

The scope of work includes the design, detailed engineering, construction /manufacture or procurement of solar panel electrical equipment, shop testing, packing, transportation, loading and unloading, delivery at site, storage at site, handling, erection, pre-commissioning tests and commissioning of all equipment/system including preliminary acceptance test, performance guarantee and post commissioning services and insurance during transit, storage, erection and commissioning.

The job shall be done on turnkey basis including Civil and Structural jobs.

Bidder shall comply with complete scope of work given in Tender specification.

This Package is on complete turnkey basis. Hence, entire equipment/system stipulated in Tender is in the scope of Tenderer. Entire system is in the scope of Tenderer. The scope shall include provision of commissioning spares required during testing and commissioning.

All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of Nepal or India or equivalent.

All approval from statuary authorities required for the solar power plant shall be under the scope of bidder.

Major equipment covered under scope of work for Solar PV Plant in all buildings shall be as follows:

1. Solar PV modules in array including mounting frames, structures, foundation bolts and nuts for holding structures and module inter connection.
2. Array Junction boxes/ Main junction Box, distribution boxes and fuse boxes. MCBs, Surge Arrestors.
3. Power Conditioning Units (PCU) with SCADA, & Weather Monitoring system to check Solar Irradiation, Wind Speed & Ambient Temperature. The rating of solar inverters shall be of same rating of the capacity Solar Power Plant (Roof top) installed respective building. There shall be isolation transformer and breaker between PCU and Grid.
4. LT Power Interfacing Panel (with all Metering and protection), Plant Monitoring Desk, D C Distribution board.

5. LT Power and Control Cables including end terminations and other required accessories for both AC & DC power. Cable trestle, supporting structures, conduits, Galvanized steel rigid/flexible conduits and accessories, Hume pipes, ferrules, lugs, glands, terminal blocks, galvanized sheet steel junction boxes, cable fixing clamps, nuts and bolts etc. as required. , cable identification tags, and all other hardware material as per requirement.

6. Data acquisition system with remote monitoring facilities.

7. Lighting arrestors.

8. GI Pipes and accessories/trenches.

9. Tool kit (including all instruments for metering such as digital voltmeter, Clamp meter etc.) and Earthing kit.

10. Metering set and protection /Isolation systems,

11. Earthing system for complete system including PV Array, DC power system, Power control Unit etc. All equipment's in the system shall be properly earthed. Separate earthing for AC & DC System.

12. Lightning protection system with separate treated earthing pit.

13. Fire extinguishers, danger plates, name boards etc.

14. Trivector Meter (Metering Cubicle) with Main & Check Meter.

15. Transportation of equipment's from Works to Site.

16. Unloading, loading of all supplied Equipment's on Foundations at their respective places.

17. Training of executive/technician.

18. Illumination facility for roof and equipment room

19. Control room equipment's related to solar system etc.

20. Installation, erection accessories.

21. Safety items like hand gloves, shock treatment charts, rubber mats, danger/caution boards etc. in sufficient quantity as per statutory norms/ standards.

22. Mandatory spares for 2 years.

The detailed specification and schedule of quantities also covering the minor equipment shall be worked out by the Tenderer for the total implementation of the job.

The Tenderer shall refer to General Technical Specification (GTS) for Electrics, detailed specification of equipment/components not indicated in the TS.

This Technical Specification (TS), General technical Specification and other attached documents considered, as a whole shall comprise the complete Tender Specification.

These are complementary and anything laid down in one and not in other will be deemed as binding, as though laid down in the Tender specification as a whole.

In case of conflict between the technical specification and GTS, the technical specification (TS) shall prevail.

Tenderer to note that this is a turnkey package and consolidated Bill of materials and single line diagram if furnished by the Tenderer in their offer for various equipment / system is not binding and shall be treated as indicative.

Tenderer shall include all equipment / system as per TS and as per actual site requirement.

Any other items not specifically mentioned in the specification but which are required for erection, testing and commissioning and safe and efficient operation and guaranteed performance of

the solar power plant are deemed to be included in the scope of the specification unless specifically excluded on turnkey basis without any extra cost.

Equipment Room for PCU, DCDB/ACDB, changeover etc. along with necessary arrangement including ventilation, illumination shall be under the scope of bidder.

Necessary arrangement in the PDB/MLDB of the individual building shall be done to interface with the solar system.

Pre-commissioning & Commissioning of all supplied Equipment's including Test running of Grid Connect Solar Power Plant as well as load trials at site, prior to handover be under the scope of tenderer.

Bidder shall provide all relevant documents to the Government for claiming subsidy Central and State governments.

The bidder shall use adequate capacity of SPV module, PCUs, Junction boxes etc. to ensure generation of power as per design estimates.

This is to be done by applying liberal de-rating factors for the array and recognizing the efficiency parameters of PCUs, transformers, etc.

The output at Invertors (s) will be considered for verification purpose. Bidder should indicate procedure and details of software or formula for demonstration of capacity of plant in tender itself. For other purpose the meter reading will be considered.

In addition to above, the Bidder is required to measure the Solar Radiation and other climatic conditions himself. The major categories of site-specific assessment required are:

Global Solar Radiation ("GSR")

Diffuse Solar Radiation ("DSR")

Sunshine Duration

Atmospheric Turbidity

Temperature & Humidity

Wind Speed

Bidder shall also note the following:

a. Use of equipment and systems with proven design and performance that have a high availability track record under similar service conditions.

b. Selection of the equipment and adoption of a plant layout to ensure ease of maintenance.

c. Strict compliance with the approved and proven quality assurance norms and procedures during the different phases of the project.

d. Proper monitoring in the synchronizations which ensures the availability of power to the grid. Generation voltage of 415V has to fed to grid voltage at the point of interconnection.

e. The injection of DC power in to Grid shall be avoided by using suitable isolation transformer etc at output of inverter.

f. Ripple content must not exceed 3% on DC side

g. Limits for harmonics as per CEA technical standard on Grid connectivity are as follow:

Total voltage harmonics distortion not more than 5% Individual voltage harmonics distortion not more than 3 %

Total current harmonics distortion not more than 8%

h. The power plant has to operate in parallel with the grid system which is infinite electrical system.

Thus the Solar Power Plant has to protect its equipment against any of possible fault or other disturbances from the grid.

i. Very fast microprocessor based Directional and Reverse power flow protection should be provided to insure isolation of the solar power plant from the grid at the time of any fault or/and any additional suitable protection.

The basic and detailed engineering of the plant will aim at achieving high standards of operational performance especially considering following:

a. Optimum availability of modules during the day time.

b. Ensuring module layout to prevent shading.

c. Selection of PCUs with high track record and readily availability of requisite spares.

d. Careful logging of operation data / historical information from the Data Monitoring Systems, and periodically processing it to determine abnormal or slowly deteriorating conditions.

e. SPV power plant should be designed to operate satisfactorily in parallel with the Grid within permissible limits of high voltage and frequency fluctuation conditions, so as to export the maximum possible units to the grid.

f. Flat plate arrays are held fixed at a tilted angle and face towards the equator, are most common. The angle of tilt should be approximately equal to the angle of latitude for the site. A steeper angle increases the output in winter; while a shallower angle more output in summer. It should be arranged in such a manner that optimize generation is achieved.

g. Based on the Solar Insolation data, the solar PV system should be so designed that it shall take into account the mean energy output after allowing for various losses, temperature corrections, on an average day for each month of the year.

h. Bidder should use the modules and other material which is eligible for subsidy from department. The supplier/manufacturer shall submit the detail design of the complete solar generating system by using their software to optimize the combination of modules considering the specific location, isolation, nature of load etc.

Make & Interchangeability This specification is issued for procurement of specified equipment and system preferably from indigenous suppliers who may make use of imported systems / sub-systems / equipment / parts and who have valid collaboration agreement with reputed foreign suppliers with experience in design and supply of similar systems as specified.

The Tenderer shall furnish division list of supplies from foreign and Indian sources indicating the name of the agency or make against the respective items.

It shall be the responsibility of the Tenderer to arrange the import license for the imported items offered and to co-ordinate the supply of equipment from foreign and Indian sources and execute the Tender within the agreed time schedule.

Makes of all other equipment and accessories as per preferred make list.

Similar equipment and components shall be of same make; equipment of same type and rating shall be interchangeable.

The IFC has the option of selecting the manufactures of equipment, instruments and controls and any other specialized items in the interest of standardization and the Tenderer shall have to supply equipment of particular make, if so required.

02. Electrical system design

General The design, manufacture, assembly and testing as well as performance of the equipment shall conform to the relevant IS specifications (latest revision) and other relevant standards. In case the Tenderer is not in a position to comply fully with certain IS specifications, or in respect of certain items for which there are no IS specifications, the Tenderer may base his proposals on IEC/BS/VDE/DIN recommendations or other reputed national or international standards.

All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of Nepal.

Climatic Electrical Equipment selection and derating shall generally be based on ambient temperature of 500C.

For specific hot areas the ambient temperature conditions shall be taken into consideration and equipment suitably derated where necessary.

In hot areas of higher temperature conditions, the equipment shall be adequately protected against damage from radiant heat and hot air.

The equipment offered shall be suitable for smooth, efficient and trouble free service in the climate prevailing at Lumbini.

Where explosion hazard due to fuel gas/oil is present, dust proof and flame proof/ increased safety type apparatus shall be used.

All such equipment shall be certified by recognized statutory authority as fit for use that in particular location.

Symmetrical short circuit ratings

The three phase symmetrical short circuit ratings of the switchgear at different voltage levels envisaged are as follows:

	Breaking Capacity	Making Capacity
415 V	50 kA	105 kA
220 V DC	10 kA	--------

Painting of Electrical Equipment As per GTS.

Technical Specification SPV Modules:

1. SPV Mono/ Poly crystalline modules (Manufactured in Nepal or India) to be supplied should have minimum declared output of 325 Watt peak or more. Number of modules to be supplied shall be worked out accordingly.

2. Stabilized output of the Solar Power Plant should not be less than cumulative solar power Under Standard Test Condition after one year of operation from date of Commissioning of solar plant.

3. Peak power point voltage and the peak power point current of any supplied module and/or any module string (series connected module) shall not be more than 3% from the respective arithmetic means for all modules and/or for all module strings, as the case may be.

4. Each module shall have low iron tempered glass front for strength & superior light transmission. It shall also have tough multilayered polymer back sheet for environmental protection against moisture & provide high voltage electrical insulation.

5. The module frame shall be made of aluminium or corrosion resistant material, which shall be electrically compatible with the structural material used for mounting the modules.

6. Solar modules offered shall be certified as per IEC 61215 and qualify IEC 61730 and IEC61701 amended up to date or equivalent Standard.

7. SPV module shall contain mono/poly crystalline high power silicon solar cells. The solar cell shall have surface anti-reflective coating to help to absorb more light in all weather conditions.

8. Solar PV module array shall consist of high efficiency Solar Modules utilizing mono/Poly Crystalline Silicon Solar PV cells. Power output Guarantee offered for the SPV Module shall not be less than 25 years. Individual Solar Module rating shall not be less than 240 Wp at Standard test conditions. PV module shall contain crystalline silicon high efficiency (≥15%) solar cells.

9. Solar module shall be laminated using lamination technology using established polymer (EVA) and Pedlar/Polyester laminate.

10. The solar modules shall have suitable encapsulation and sealing arrangements to protect the silicon cells from the environment. The arrangement and the material of encapsulation shall be compatible with the thermal expansion properties of the Silicon cells and the module framing arrangement/material. The encapsulation arrangement shall ensure complete moisture proofing during life of the solar modules.

11. Photo conversion efficiency of SPV Module should be greater than 14%. Module shall be made of high transmittance glass front surface giving high encapsulation gain.

12. Cell used in offered module should of repute make. The bidder should specify the make in Bid itself cell to be used and before supply same should be got approved from ELETRICITY BOARD.

13. Module rating is considered under standard test conditions; however Solar Modules shall be designed to operate and perform under site condition including high temperature & dust (sometimes).

14. All materials used shall be having a proven history of reliable, light weight and stable operation in external outdoor applications and shall have service life of more than 25 years.

15. Solar PV Module design shall conform to following requirement: a. Weather proof DC rated MC connector and a lead cable coming out as a part of the module, making connections easier and secure, not allowing for any loose connections. b. Resistant of water, abrasion, hail impact, humidity & other environment factor for the worst situation at site.

16. The offered module shall have a Power warranty of 25 years with degradation of power generated not exceeding 20% of the minimum rated power over the 25 years period and not more than 10% after ten years period. 17. The fill factor of module shall not be less than 0.70 (typical).

18. The V-I curve of each PV module with Sl. Nos. should be submitted along with Modules meeting the required specifications.

19. Identification and Traceability: Each PV module used in any solar power project must use a RF identification tag. The following information must be mentioned in the RFID used on each module. This can be inside or outside the laminate, but must be able to withstand harsh environmental conditions.

a. Bidder shall provide data sheet for Solar PV Module (Under Standard Testing Condition) along with their offer as per Guarantee Technical Particular

21. Entire drawings, detailed test reports of the offered modules should be submitted for approval to Department

PV ARRAY CONFIGURATIONS:

The Solar array shall be configured in multiple numbers of sub-arrays, providing optimum DC power to auditable number of sub arrays.

The bidder shall submit their own design indicating configuration of PCU and respective sub arrays and bill of material.

MODULE MOUNTING STRUCTURE (FIXED):

The structure design shall be appropriate and innovative and must follow the existing structure and profile.

The bidder may choose to offer module mounting structure as per their design/ economics. The module alignment & tilt angle shall be calculated to provide the maximum annual energy output. This shall be decided based on the location of array installation. MMS shall be designed for minimum wind speed of 150km/hr.

The structure shall be designed to allow easy replacement of any module and shall be in line with site requirement The Ground mounted structure shall be designed for simple mechanical and electrical installation.

It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the base properly.

The mounting steel structure shall be as per latest BIS 2062 (amended up to date) and galvanization of mounting structure shall be in compliance of BIS 4759 (amended up to date). The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels at the same time. Nut & bolts, supporting structures including Module Mounting Structures shall have to be adequately protected from atmosphere and weather prevailing in the area.

All fasteners shall be of stainless steel of grade SS 304. The array structure shall be grounded properly using maintenance free earthing kit. The support structure & foundation shall be so designed to withstand speed for wind zone of the location as given in relevant Indian wind load codes/ standards. IS 800-2007 shall be followed for structural design.

Bidder/tenderer shall submit the DBR and STADD calculations along with the structural design for approval of Department

SPV module mounting structure

a. Type: Fixed

b. Azimuth: 0-degree True south

c. Tilt Angle: At altitude or as per site requirement

Hot dipped Galvanized Steel Structural must be considered for all type of structural steel proposed for the power plant.

STRING COMBINER BOX OR ARRAY JUNCTION BOXES: The junction box shall be dust, vermin, and waterproof and made of FRP/ABS Plastic.

The terminal will be connected to copper bus-bar arrangement of proper size to be provided.

The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables.

Suitable markings shall be provided on the bus-bars for easy identification and cable ferrules will be fitted at the cable termination points for identification.

The junction box shall be with protection class IP 65 for mounting outside in Open weather condition.

Each Array junction Box will have suitable Reverse Blocking Diodes of maximum DC blocking voltage of 600 V with suitable arrangement for its connecting.

The Array junction Box will also have suitable surge protection device. The junction Boxes shall have suitable arrangement for the followings (typical):-

o Combine groups of modules into independent charging sub-arrays that will be wired into the controller.

o Provide arrangement for disconnection for each of the groups.

o Provide a test point for each sub-group for quick fault location.

o to provide group array isolation.

The current carrying ratings of the junction boxes shall be suitable with adequate safety factor, to inter connect the Solar PV system corresponding to 1500kWp.

POWER CONDITIONING UNIT (PCU)

Power Conditioning Unit (PUC), grid interactive in nature, shall consist of MPPT controller, inverter, associated control and protection devices etc. all integrated into PCU. The rating of solar inverters shall be of same rating of the capacity Solar Power Plant (Roof top) installed respective building.

There shall be isolation transformer and breaker between PCU and Grid

It shall provide necessary protections for Grid Synchronization and Data Logging/Monitoring. The PCU should convert DC power produced by SPV modules in to AC power and must synchronize automatically its AC output to the exact AC Voltage and frequency of Grid.

The bidder may choose the inverter as string/Central as per their Design/ Project Philosophy.

The DC energy produced has to be utilized to maximum and supplied to the bus for inverting to AC voltage to extract maximum energy from solar array and provides 3- ph, 415V AC/ (+15% to – 10%), 50+/-1.5 Hz with total harmonic voltage distortion less than 3% to synchronize with local grid.

DC voltage ripple content shall be not more than 3%.

The PCU shall be of very high-quality having efficiency not less than 97% and shall be capable of running in integrated mode.

Degree of protection of the indoor PCU shall be at least IP-31 and that of outdoor at least IP-55.

Built in with data logging to remotely monitor plant performance through external PC shall be provided (PC shall be provided along with SPV Plant).

The PCU shall be designed for continuous, reliable power supply as per specification. The PCU should be designed to be completely compatible with the SPV array voltage and Grid supply voltage.

The dimension, weight, foundation details etc. of the PCU shall be clearly indicated in the detailed technical specification.

The system should be capable of providing all the data including that of meter and PCU to the central software on IEC-104 protocol.

All the equipment's /hardware /software for complying to the same will be in the bidders scope.

The PCU shall be capable of complete automatic operation, including wake-up, synchronization & shut down independently& automatically. Both AC & DC lines shall have suitable fuses, Metal Oxide Arrestors/surge arrestors and contactors to allow safe start up and shut down of the system. Fuses used in the DC circuit should be DC rated.

PCU shall operate in sleeping mode when there will no power connected.

Protections:

Over voltage both at input & output.

Over current both at input & output.

Over/under grid frequency.

Heat sink over temperature.

Short circuit.

Protection against lightening.

Surge arrestors to protect against Surge voltage induced at output due to external source. Anti-Islanding Protection

• Neutral voltage displacement

• Over current

• Earth fault

• And reverse power

It should have user friendly 4X40 LED/LCD display for programming and view on line parameters such as:

- Inverter per phase Voltage, current, kW, kVA and frequency,

- Grid Voltage and frequency,

- Inverter (Grid) on Line status,

- PV panel voltage,

- Solar charge current and ambient temperature,

- Individual power stage heat sink and cabinet temperature,

- Solar Radiation (with external pyranometer with in scope)

- Inverter Import export kWh summation

- Solar kWh summation

- Inverter on

- Grid on

- Inverter under voltage/over voltage

- Inverter over load

- Inverter over temperature.

The PCU shall have arrangement for adjusting DC input current and should trip against sustainable fault downstream and shall not start till the fault is rectified. The 3 phase PCU shall be from internationally reputed firms, which will incorporate latest Technological advance to provide highly reliable and efficient energy conversion from DC to AC. PCU shall be capable to synchronize independently & automatically with Discom grid power line frequency to attain synchronization and export power generated by solar plant to grid.

The PCU shall be capable of complete automatic operation, including wake-up, synchronization & shut down. Typical failure analysis report of PCUs and recommended list of critical components shall be provided by the bidder while submitting their offer.

The PCU shall be capable of operating in parallel with the grid utility service and shall be capable of interrupting line fault currents and line to ground fault currents.

The PCU shall be able to withstand an unbalanced load conforming to IEC standard and relevant electricity condition.

The PCU shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of PCU component failure or from parameters – beyond the PCU‟s safe operating range due to internal or external causes.

The self-protective features shall not allow signals from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the PCU, including commutation feature, shall be cleared by the PCU protective devices and not by the existing site utility grid service circuit breaker.

The PCU shall go to shutdown/standby mode, with its contacts open, under the following conditions before attempting an automatic restart after an appropriate time delay.

When the power available from the PV array is insufficient to supply the losses of the PCU, the PCU shall go to standby/shutdown mode.

The PCU control shall prevent excessive cycling of shut down during insufficient solar radiance.

Detailed technical description of the complete unit of offered PCU should be furnished with bid document Following Technical documents of PCU shall be supplied for approval after placement of order.

Detailed technical description of the complete unit

Instructions for installation and operation

Electrical diagrams of all internal cabling, necessary for installation, maintenance and fault finding.

Description of electrical and mechanical characteristics of units.

Maintenance and fault-finding procedures.

Safety precautions.

Software for data monitoring with detailed description.

Details of data acquisition

Details of Telemetry linking

Factory test reports in details on various parameters.

Trouble shooting procedures.

All maintenance requirements and their schedules, including detailed instructions on how to perform each task.

Detailed schematics of all power instrumentation and control equipment and subsystems along with their interconnection diagrams. Schematics shall indicate wiring diagrams, their numbers and quantities, type and ratings of alt components and subsystems.

A detailed bill of materials which shall list components model numbers, quantities and manufacturer of each supplied item.

All documents and write ups shall be in English. They shall be clean and legible, and must be checked, signed, approved and dated by a competent representative of the bidder/tenderer.

DC DISTRIBUTION BOARD (DCDB)

DC distribution board shall be provided in between solar array and PCU. It shall have MCCB of suitable rating for connection and disconnection of array section. It shall have meters for measuring the array voltage and array current.

DCDB can also be integrated into PCU for space saving.

AC DISTRIBUTION BOARD (ACDB)

a. Power conditioning unit installed in a control room converts DC energy produced by the solar array to AC energy. The AC power output of the inverter shall be fed to the ACDB (metering panel & isolation panel) which also houses energy meter. The 415V AC output of the isolation panel shall be fed to the grid. AC energy is then synchronized with the grid and power is consumed by load or may export to the grid.

b. ACDB shall be floor mounted type and shall have all the measuring instruments such as voltmeter, ammeter, frequency meter, Energy Meter {for measuring the deliverable units {kWh} for sale, selector switches and Mimic panel. All the power cables shall be taken through top/ Bottom of the panel as per site requirement.

c. The ACDB shall fitted with suitable rating & size copper bus, MCCB, HRCfuses/circuit breaker/isolator, indicators for all incomer and outgoing terminals, LED voltmeter & Ammeter with suitable selector switches to monitor & measure the power to be evacuated.

d. Nut & bolts including metallic shall have to be adequately protected against atmosphere and weather prevailing in the area.

e. The overall dimension, weight, sheet thickness, painting etc. should be indicated by the Bidder/tenderer.

PLANT MONITORING DESK

Computer aided data acquisition unit shall have features for simultaneous monitoring and recording of various parameters of different sub-systems, power supply of the Power Plant at the DC side and AC side.

Computer Aided Data Acquisition Unit shall be a separate & Individual system comprising of different transducers to read the different variable parameters, A/D converter, Multiplexer, De-multiplexors, Interfacing Hardware & Software, Industrial Type PC, which will be robust & rugged suitable to operate in the Control Room environment.

Reliable sensors for solar Radiation, Temperature & other electrical Parameters are to be supplied with the data logger unit.

The PC Shall of Industrial type, rugged & robust in nature to operate in hostile environment. The PC has minimum Intel Core i5 processor having 500 GB HDD with8 GB RAM. The PC shall also have 21" TFT colour monitor, DVD Drive with writer, multimedia kit and UPS with 4 hours Power back up.

The printer shall be of industrial type, rugged & robust in nature. The printer shall be equipped for printing, scanning, copying and fax. Latest Higher version computer will also be acceptable.

The data acquisition system shall perform but not limited to the following operations

Inverter per phase Voltage, current, kW, kVA and frequency,

Grid Voltage and frequency,

Inverter (Grid) on Line status,

PV panel voltage,

Solar charge current and ambient temperature,

Heat sink and cabinet temperature,

Solar Radiation (with external pyranometer with in scope)

System summation

Inverter Import export kWh

Solar kWh summation

Hours Run

Ambient air temperature near array field

Control room ambient air temperature

Module back surface temperature

Wind speed at the level of array plane

Solar irradiation incidental to array plane

Inverter efficiency Solar system efficiency

Display of I-V curve of solar system dc bus output

DC injection (one time measurement) in to Grid shall be also made at the time of installation.

All data shall be recorded chronologically date wise. The data file should be MS Excel compatible. The data logger shall have internal reliable battery backup to record all sorts of data simultaneously round the clock. All data shall be stored in a common work sheet chronologically. Representation of monitored data shall be in graphics mode and/or in tabulation form. All instantaneous data can be shown in the Computer Screen.

The Bill of Materials associated with the equipment must clearly indicate especially the detail about the PC, Modems, etc.

The data acquisition system should be housed in a desk made of sheet steel. The performance and generation data shall be required to be recorded using a Computer.

The monitoring system shall comprise of the following main components:

1. PCU to log the inverter performance data and transmits the same to the computer.

2. PC Data logging software should enable automatic long-time storage of measured data form PV-Plant. It should allow visualization, monitoring, commissioning and service of the installation.

3. Communication interface the entire system can be operated and monitored via various interface viz. (RS232, RS485, MPI, Profit-bus, Telephone modem), in addition to the information indicated on the operator panel.

4. Communication interface shall be an integral part of inverter and shall be suitable to be connected to local computer and also remotely via the web using WIFI modem.

Full fledge SCADA system for solar PV plant shall be provided.

METERING AND DATA MONITORING OF POWER PLANT:

The bidder shall install metering arrangement in accordance with the provisions in the matter of determination of generic tariff for sale of electricity in the state to the distribution licenses from solar power plants, including roof top SPV systems.

The meter used for the purpose of import/ export shall be of accuracy class 0.2S as per relevant IS/IEC.

WIRING:

All instruments and Panel wiring shall be of heat resisting and self-extinguishing type in compliance with IS. Plastic or porcelain cleats of the limited compression type shall be used for holding wiring runs.

All wires shall be suitable for bending to meet the terminal studs at right angles. Metal cases of all apparatus mounted on panels shall be separately earthed by means of copper wire or strips.

The following colour scheme of the wiring shall be used as per IS: 375.

a) AC three phase circuits:

i) No.1 Phase: Red. No.2 Phase: Yellow. No.3 Phase: Blue

ii) Neutral Conductor: Black

iii) Connection to Earth: Green

b) D.C. circuits: Grey

CABLES AND ACCESSORIES

LT CABLES:

1.1kV Grade, Al. Conductor PVC Armored Cables in AC SIDE shall be used for all LT Power Cables between Power & Motor Control Cubicles, MCC, Respective feeders, etc.

These cables shall be laid on structural supports and using Galvanized Cable trays of adequate strength.

The cable shall be terminated using Al. Lugs of adequate cross section area.

The PMCC‟s and the MCC‟s shall be located in the Basement with cable entry on top.

CONTROL CABLES AND DC SIDE CABLES:

1.1kV Grade, Cu. Conductor, PVC Armored Cables shall be used for all control cables required for the Solar Power Plant.

These cables shall be laid on structural supports and using Galvanized Cable trays of adequate strength.

The cable shall be terminated using Cu. Lugs of adequate cross section area.

a. Cu. Conductor, PVC Armored with miller insulation between each pair and tinned copper screening. All cables shall be PVC insulated with appropriate grade conforming to IS.

b. Only copper conductor cables of reputed make shall be used in DC side of plants between interconnection equipment.

c. The wiring for module inters connection shall be with hard PVC conduit of approved make. All Tees, bends etc., shall be approved make. Before procurement, approval for materials should be obtained from consultant.

Cables of appropriate size to be used in the system shall have the following characteristics:

Will meet IS 694/1554 standards

Temp. Range –10 degree centigrade to +80 degree centigrade.

Voltage rating 660/1000V

Excellent resistance to Heat, Fire, oil, cold, water, abrasion, UV radiation.

Flexible Cabling on DC side of the system shall be as short as possible to minimize the voltage drop in the wiring.

Components and hardware shall be vandal and theft resistant. All parts shall be corrosion resistant. The system description, general/technical requirements etc. are given for general guidance only.

CABLE ACCESSORIES

Only terminal cable joints shall be accepted. No cable joints to join two cable ends shall be accepted.

Cables inside the control room shall be laid in suitable Cable Trays of approved type.

Cable terminations shall be made with suitable cable lugs & sockets etc., crimped properly and passed through brass compression type cable glands at the entry and exit point of the cubicles.

The panels‟ bottoms should be properly sealed to prevent entry of snakes/lizard etc. inside the panel.

The terminal end of cables and wires are to be fitted with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.

EARTHING

a. Each array structure of the SPV shall be grounded properly. The array structure is to be connected to earth pits as per IS standards. Junction boxes, lighting conduits shall be connected to the main earthing conductor/ electrode.

b. Earthing system installation shall be in strict accordance with the latest editions of Electricity Rules, relevant Indian Standards and code of practices and the local statutory authority regulations.

c. Neutral points of system metallic enclosures and frame works, not forming part of electric supply shall be connected to main earthing system.

d. Necessary Test Point provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

e. In compliance to Rule 33 and 61 of Indian Electricity Rules, 1956 (as amended up to date) or equivalent Norms of Government all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.

f. Earth resistance of the earth pits shall be tested in presence of the ELECTRICITY AUTHORITY

LIGHTNING & OVER VOLTAGE PROTECTION

a. The SPV Power Plant should be provided with Lightning and over voltage protection connected to proper earth mats. The main aim of over voltage protection is to reduce the over voltage to a tolerable level before it reaches the PV or other sub- system components. The source of over voltage can be lightning or other atmospheric disturbance.

b. The bidder shall ensure adequate lightning and over voltage protection to provide and acceptable degree of protection as per IS for the array yard/Shed.

c. The lightning Masts / Conductors shall be made as per applicable Standard/International Standard in order to protect the entire Array Yard/ Shed from Lightning stroke.

d. Necessary concrete foundation for holding the lightning conductor, in position, to be made after giving due consideration to maximum wind speed and maintenance requirement at site in future.

e. The lightning masts / conductor shall be earthed through flats and connected to the Earth mats as per applicable Indian Standards with earth pits. Each Lightning Conductor shall be fitted with individual earth pit as per required Standards including accessories, and providing masonry enclosure with cast iron cover plate having locking arrangement, watering pipe using charcoal or coke and salt as per required provisions of IS.

f. Design calculations and detailed explanations (in 4 sets) shall be provided for approval of consultant within 15 days of order.

PV MODULES:

The PV modules must conform to the latest edition of any of the following IEC/equivalent BIS Standards for PV module design qualification and type approval: Crystalline Silicon Terrestrial PV Modules IEC 61215 / IS14286 Concentrator PV Modules & Assemblies IEC 62108. In addition, the modules must conform to IEC 61730 Part 1- requirements for construction & Part 2 - requirements for testing, for safety qualification.

PV modules to be used in a highly corrosive atmosphere must qualify Salt Mist Corrosion Testing as per IEC 61701.

BALANCE OF SYSTEM (BoS) ITEMS/ COMPONENTS: The Bos items / components of the SPV power plants/ systems deployed Under the Mission must conform to the latest edition of IEC/ equivalent BIS Standards as specified below**:

Item/component	Applicable IEC/equivalent BIS Standard
Standard Description	Standard Number
Power Conditioners/ Inverters*	Efficiency Measurements
Environmental Testing	IEC 61683
IEC 60068 2 (6,21,27,30,75,78)	
Charge controller/ MPPT units*	Design Qualification
Environmental Testing	IEC 62093
IEC 60068 2 (6,21,27,30,75,78)	

Cables :General Test and Measuring Methods PVC insulated cables for working Voltages up to and including 1100 V-Do-, UV resistant for outdoor installation IEC 60227 IS 694/ IS 1554 IEC 60502 Switches/ Circuit Breakers/Connect ors General Requirements Connectors-safety IS/IEC 60947 part I,II,III EN 50521 Junction Boxes/Enclosures General Requirements IP 65 (for outdoor)/IP 21 (for indoor) IEC 62208 SPV System Design PV Stand-alone System design verification IEC 62124 Installation Practices Electrical installation of buildings Requirements For SPV power supply system's IEC 60364-7-712

*Must additionally conform to the relevant national/international Electrical Safety Standards.

AUTHORIZED TESTING LABORATORIES/ CENTERS

The PV modules must be tested and approved by one of the IEC authorized test centers.

Test certificates can be from any of the NABL/ BIS Accredited Testing /Calibration Laboratories. Qualification test certificate as per IEC standard, issued by the Solar Energy Centre for small capacity modules up to 37Wp capacity will also be valid.

Test certificates for the BoS items/ components can be from any of the NABL/BIS Accredited Testing-Calibration Laboratories approved test centers.

The list of approved test centers will be reviewed and updated from time to time.

WARRANTY

The mechanical structures, electrical works including power conditioners/ inverters /charge controllers/ maximum power point tracker units/ distribution boards/digital meters/ switchgear/ storage batteries, etc. and overall workmanship of the SPV power plants/ systems must be warranted against any manufacturing/ design/installation defects for a minimum

period of 5 years. PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

IDENTIFICATION AND TRACEABILITY

Each PV module used in any solar power project must use a RF identification tag (RFID), which must contain the following information.

The RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions. A

. Name of the manufacturer of PV module

b. Name of the Manufacturer of Solar cells

c. Month and year of the manufacture (separately for solar cells and module)

d. Country of origin (separately for solar cells and module)

e. I-V curve for the module

f. Peak Wattage, Im, Vm and FF for the module

g. Unique Serial No and Model No of the module

h. Date and year of obtaining IEC PV module qualification certificate

i. Name of the test lab issuing IEC certificate

j. Other relevant information on traceability of solar cells and module as per ISO 9000 series.

SPECIFICATION FOR TESTING & COMMISSIONING

The testing and commissioning for all electrical equipment at site shall be according to the procedures listed below:

a) All electrical equipment shall be tested, installed and commissioned in accordance with the latest relevant standards and code of practices published by Indian Standards Institution wherever applicable and stipulations made in relevant general specifications.

b) The testing of all electrical equipment as well as the system as a whole shall be carried out to ensure that the equipment and its components are in satisfactory condition and will successfully perform its functional operations. The inspection of the equipment shall be carried out to ensure that all materials, workmanship and installations conform to the accepted design, engineering and construction standards, as well as accepted code of practices and stipulations made in the relevant general specifications.

c) The bidder/tenderer in the presence of NEB/ Consultant of shall carry out all tests using his own calibrated instruments, testing equipment as well as qualified testing personnel.

d) The results of all tests shall conform to the specification requirements as well as any specific performance data, guaranteed during finalization of the contract.

PREPARATION OF THE EQUIPMENT FOR COMMISSIONING;

a) After completion of the installation at site and for the preparation of plant commissioning, the bidder/tenderer shall check all the equipment and installation in accordance with the agreed standards, latest relevant code of practices of Indian Standards and specific instructions furnished by the particular equipment suppliers as well as N.E.B.

b) Checking required to be made on all equipment and installations at site shall comprise, but not limited to, the following:

Physical inspection Modules for removal of any foreign bodies, external defects, such as damaged, loose connection in Junction Boxes & PCU etc . loose foundation bolts etc.

Check for the free movement of mechanism for the circuit – breaker, rotating parts of the rotating machines and devices.

Check for tightness of all cable joints and busbar termination ends as well as earth connections in the main earthing network.

Check for clearance of live bus bars and connectors from the metal enclosure.

Check for proper alignment of all the modules etc.

Continuity checks in case of power and control cables.

Checking of all mechanical and electrical interlocks including tripping of breakers using manual operation of relay.

Checking of alarm and annunciation circuits by manual actuation of relevant relays.

Check and calibrate devices requiring field adjustment/calibration like adjustment of relay setting etc.

Check for proper connection to earth network of all noncurrent carrying parts of the equipment and installation.

c) The relevant tests shall be carried out in accordance with relevant IS of latest issue. The tests which are to be carried out on the equipment shall include, but not be limited to, the following:

i) Check for completeness of installation.

ii) Each pole to earth insulation resistance test.

d) Cables

i) Insulation resistance test shall be conducted by Megger for cables rated up to 1.1kV grade. ii) All 1.1 kV cables shall be subjected to high voltage test after joining and terminating but before commissioning as per relevant standards.

iii) In each test, the metallic sheath / screen / armour should be connected to earth.

iv) Continuity of all the cores, correctness of all connections as per wiring diagram, correctness of polarity and phasing of power cables and proper earth connection of cable glands, cable boxes, armour and metallic sheath, shall be checked.

e) Earthing

i) Tests to ensure continuity of all earth connections.

ii) Tests to obtain earth resistance of the complete network by using earth tester. The test values obtained shall be within the limits (less than 3 ohms).

DRAWINGS/DOCUMENT TO BE SUBMITTED BY THE TENDERER

Data/Drawings to be submitted by supplier after placement of order The Tenderer shall furnish the following documents / data in soft copy and specified number of hard copies for approval.

On approval, the same shall be supplied as soft copies in CDs, in addition to specified number of hard copies.

Calculations

1. Sizing of all equipment within 4 weeks of placement of order

2. Calculations for voltage drop.

3. Sizing calculations of Power factor improvement equipment like Capacitor, etc.

4. Calculations for lux level of illumination for various premises/area.

5. DC Power generation calculation.

6. Calculation w.r.t. Cable/ busduct sizing, temp rise and insulator spacing.

Drawings and documents

1. Single line diagram indicating all electrical equipment like CT, meters, cable sizes, details of CT ratio, VA burden Vk value, type and nominal and short time ratings of breakers, busbars etc. complete network (composite drawing).

2. Single line diagram of each MCC/DB, etc indicating drive, feeder details, protection, metering and control elements.

3. GA arrangement drawing showing busbar equipment mounting arrangement and dimensions of the MCC/DB.

4. Schematics of control and protection panels of all AC/DC Panels.

5. Relays for LT protection.

6. Control schematics with all interlocks and bill of materials.

7. Foundation plan and fixing details for each equipment

8. Type test reports for short ckt, temp. rise, enclosure class etc.

9. Equipment Layout drawing for all areas in battery limit.

10. Drawing marking phase sequence from transformer to switchgear.

11. Cable tray layout

12. Front view and GA diagrams for all DBs including DCDB.

13. Earthing layout drawing covering external grid internal/external rings and connections to equipment, structures etc.

14. Sequence of annunciator and list of annunciation points.

15. Lighting layout for each plant outdoor areas, type of fittings, wiring arrangement, switching of fittings and single line diagram.

16. Sequence of inspection plan and dispatch of materials to site.

17. List of electrical inputs/outputs to/from Instrument Power Conditioner Unit

18. Terminal plan of all feeders of DBs

19. Quality Assurance plan for each major equipment

20. Control and schematics drgs. for local/remote control/ protection for each equipment and drives.

21. Details Control scheme for LT Switchgear showing Details of protection logic (various class tripping) indicating list of electrical and mechanical protection leading to tripping of switching devices/equipment.

22. DC distribution scheme with SLD.

23. Working operation, commissioning and troubleshooting manuals.

24. Layout of electrical premises and bus ducts.

25. Cable tray layout

26. Earthing layout drawing covering external grid internal/external rings and connections to equipment, structures etc.

27. Auto change over arrangement for LT switchboard

28. Sequence of annunciation and list of annunciation points

29. Technical data sheet of all equipment including Power Conditioner Unit, SPV, AJB, cables etc.

30. Complete schematic diagram of DC systems

31. Complete schematic diagrams of electrical actuators

For Information

1. Exact dimensional details and weights of each and every equipment

2. Static & dynamic loading of each equipment.

During detailed engineering

1. Details of painting for all equipment

2. Panel-wise bill of material indicating type make and brief technical particulars of all items/ accessories mounted on the panels as per manufacturer's standard.

3. Cable schedule indicating type of cables, from to via. route, total length, size of each cable and a final summary sheet indicating total requirement of all types of cables (for control, instrumentation). Core-wise control cable termination details indicating ferrule no./ terminal block no. for each cable / each equipment.

4. Catalogues for each type of equipment like relays, meters etc.

5. Vk. Value and RCT value of CTs used in differential protection

6. Type test certificates for all major equipment.

7. Copies of test results conducted at works for all equipment

8. Details of test results conducted at site for all equipment

9. Installation and commissioning manuals for each equipment / device.

10. Operation and maintenance manuals indicating trouble-shooting procedure for all equipment.

11. LT ACB hard bound manuals with complete parameter list. It shall include technical reference manual, application operator and commissioning manual.

12. Details of transport arrangement and maximum size of transportable section (weight and overall dimensions) for electrical equipment.

13. Details of agency proposed to be fixed for doing erection, testing and commissioning job.

14. Overall GA of all the panels/equipment

15. As built drawings incorporating site changes along with reproducible as well as in electronic form in CDROM/DVDROM.

16. All the type test certificates, routine test certificates and site test results bound separately in requisite copies. Instruction Manuals Minimum four ten copies of Instruction manual shall be furnished by the Tenderer in addition to soft copy in CDROMs/DVDROMs.

Instruction manual shall give step by step procedure for:

1 Erection, testing and commissioning

2 Operation

3 Maintenance and

4 Repair.

Maintenance instruction shall include:

1 Diagnostic trouble shooting / fault location charts

2 Tests for checking of proper functioning.

Instruction manual shall also contain:

1. Manufacturer's catalogues with ordering specification for all items.

2. List of consumables with specifications, brand names and annual consumption figures.

3. Drawings relevant for erection, operation, maintenance and repair of the equipment.

4. Procedure for erection, storage, welding technique, material for construction, instrumentation, limits and tolerances, alignment, structures etc.

5. Procedure for ordering spares.

6. Operation and maintenance manual.

7. Quality manual covering quality related aspects and As Built Status.

8. List of spares supplied with individual equipment

9. As built drawings incorporating all changes till handing over the installation to the Owner.

10. Detailed technical specification of all the equipment's.

11. General arrangement an assembly drawing.

12. Solar Insolation Data

13. Quality assurance plans.

14. Test report (for type, acceptance, and routine tests).

2.9 METERING SYSTEM

The Operator shall maintain the Metering System. The Metering System will be designed and installed conforming to requirements of State utility so as to measure power delivered by the solar power plant to the LT Bus / outgoing energy to the State grid and also for the import of energy. Metering equipment's shall comply with the requirements of State utility Grid Code but shall not be inferior to 0.2/0.5 accur Acy Class as applicable. Wherever required, Meter reading shall be done jointly with Power Utility Engineer on monthly basis or at mutually agreed time interval.

2.10 TESTING OF METERS The Owner shall have the right to carryout inspections of the Metering Systems from time to time to check the accuracy. All testing and metering equipment shall conform to the relevant IS standards. If either the Operator or the Owner finds any inaccuracy in the Metering System, the operator or the Owner, as the case may be, shall not if the other party in writing within 24 hours for ajointin section and testing from any agreed agency.

2.11 SEALING AND MAINTENANCE OF GRID CONNECTED METERS The Grid Connected Metering System and Solar power recording meter shall be sealed in the presence of both parties. When the Metering System and/or any component thereof is found to be outside the acceptable limits of accuracy or otherwise not functioning properly, it shall be repaired, re-calibrated or replaced by the Operator on priority. Breaking of meter seals shall not be done except in case of any requirement by State power utility for testing/calibration. Evening such case, the Operator shall immediately inform the Owner of such requirement to enable Owner

for deputing its representative. All testing's/calibration of metering system shall be done by State power utility officials only.

PROPOSED

India International Centre for Buddhist Heritage and Culture

Tender Documents

VOLUME-I

Technical Specifications

MECHANICAL

PROJECT

India International Centre for Buddhist Heritage and Culture

SUBJECT

TENDER FOR MECHANICAL WORK.

TECHNICAL SPECIFICATIONS – MECHANICAL

1.INSTRUCTION TO BIDDERS

➢ All items of work under this contract shall be executed strictly to fulfill the requirements laid down under "**Basis of Design**" in the specifications. Type of equipment, material specification, methods of installation and testing and type of control shall be in accordance with the specifications, approved shop drawings and the relevant Indian Standards, however capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.

➢ The unit rate of all equipments or materials shall include cost in RUPEES for equipment and materials including all taxes and duties and also including forwarding, freight, insurance and transport into contractor's store at site, storage–installation, testing, balancing, commissioning and other works required.

➢ The rate of each item of work included in the schedule of quantities shall, unless expressly stated otherwise, include cost of:

- All materials, fixing materials, accessories, appliances tools, plants, equipment, transport, labor and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of work called for in the item and as per Specifications and Drawings.

- Wastage on materials and labor.

- Loading, transporting, unloading, handling/ double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labor necessary in and or the full and entire execution and for the job in accordance with the contract documents, good practice and recognize principles.

- Liabilities, obligations, whether such requirements are mentioned in the item or not. The specifications and drawings where available, are to be read as complimentary to and part of the Scheduled of Quantities and any work called for in one shall be required for all.

- All requirements of Specifications, whether such requirements are mentioned in the item or not. The Specifications and Drawings where available, are to be read as complimentary to and part of the Scheduled of Quantities and any work called for in one shall be taken as required for all.

➢ In the event of conflict between Schedule of Quantities and other documents including the Specifications, the most stringent shall apply. The interpretation of the Consultant/ project manager shall be final and binding.

➢ All equipments, quantities and technical data indicated in this Schedule are for the Contractor's guidance only, these are based on the documents prepared by the Consultant. This schedule must be read in conjunction with other documents. The contractor shall be paid for the actual quantity of work executed by him in accordance with the approved Shop Drawings at the contract rates.

➢ The schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in **INK** including **NIL** items.

- Any error in totaling in the amount column and in carrying forward total shall be corrected. Any error, in description or in quantity, omission of items from this Schedule shall not vitiate this Contract but shall be corrected and deemed to be variation required buy the Consultant/ Project Manager.

- Rates have been called for a number of items of works, as alternatives, which, for the present do not form part of the total value of tender. However the rates for these items shall be quoted, with due care so that in the event of choice of an alternative item of work, said rate shall form part of the contract any way

- The contractor shall procure and bring Materials/ Equipment to the site only on then basis of drawings approved for construction and shop drawings and not on the basis of Schedule of quantities , which are provisional only. This also applies to the Contractor's requisition for owner-supplied materials.

- THE MODE OF MEASUREMENT SHALL BE AS SPECIFIED IN THIS BOOK.

- THE MOST IMPORTANT ASPECT IS THE INTENT OF THE SPECIFICATION. THIS NEEDS TO BE FOLLOWED AND THE CONTRACTOR SHALL DO ALL THAT IS REQUIRED TO MEET THE INTENT. THE ACOUSTICS, VIBRATION CONTROL FORM A MAJOR REQUIREMENT OF THIS INTENT, BESIDES THE FUNCTIONAL REQUIREMENTS.

1. BASIC MECHANICAL REQUIREMENTS

This Section includes Basic mechanical requirements specifically applicable to HVAC System

2.1 **REFERENCES / STANDARDS:**

2.1.1 **National Building Code of India –2016**

2.1.2 **ANSI**: American National Standard institute **(Wherever applicable)**

2.1.3 **BIS**: Bureau of Indian Standards (This code will supercede in case of any ambiguity or misinterpretation)

2.1.4 **ARI**: Air conditioning and Refrigeration Institute (for chiller certification).

2.1.5 **ASHRAE**: American Society of Heating Refrigeration and Air conditioning Engineers.

Fundamentals 2005.

Systems & Equipment 2004

Application 2003.

2.1.6 **ASME**: American Society for Mechanical Engineers

2.1.7 **SMACNA / BIS**: For Duct construction standards.

2.1.8 **UL**: Underwriters' Laboratories INC. for fire protection and ratings / testing

2.1.9 Air filters as per ASHRAE Standard 52.1 – 1992

2.1.10 Indoor Air Quality as per ASHRAE Standard 62.1 – 2007/2010 (NA,or Its as per client decision)

2.1.11 Motors, cabling, wiring and accessories as per BIS codes / IE Rules / IS codes

2.1.12 Recognized / approved manufacturer's standards.

2.1.13 Motors, cabling, wiring and accessories as per BIS codes/ IE Rules / IS codes / ITC Electrical Guidelines

2.2 SUBMITTALS: Vendor to cross check the Heat Load Estimations / Design Data Summary and point out any discrepancy at the time of bidding.

2.2.1 Under provisions of sample approval before the commencement of the project.

2.2.2 Includes products mentioned in the Approved list of manufacturers as per the mode of approval mentioned in the list.

2.2.3 Submit shop drawings and product data grouped to include complete submittals of related Systems products, and accessories in a single submittal.

2.3 **SHOP DRAWINGS**

Submit a copy of the shop drawings, including:

2.3.1 Actual duct routes after the site survey.

2.3.2 Automatic temperature /Pressure control system.

2.3.3 Inertia pads and foundations for the various equipments.

2.3.4 Fire protection systems (Fire / Smoke dampers: Motorized) (Relief dampers, smoke extract system, pressurization system)

2.3.5 Layout of the AHU / Plant room including dimensions of the room and the foundations and the sizes and all necessary construction details required on site.

2.3.6 Location of the allied equipments and the requirements from other agencies.

2.3.7 Trench locations if any.

2.3.8 Sump location and size.

2.3.9 Sleeve location if any.

2.3.10 Ventilation air / exhaust air locations.

2.3.11 Location of wall mounted equipment (If any)

2.3.12 Any structural inputs.

2.4. **Brochures**:

Submit manufacturer's product data and brochure including :

2.4.1 Complete description.

2.4.2 Illustrations.

2.4.3 Rating data, accessories, dimensional data.

2.4.4 Capacities stated in the terms specified.

2.4.5 Performance curves of the fans and pumps.

2.5 **PROJECT/SITE CONDITIONS**

Mechanical layouts indicated on drawings are diagrammatical . Co-ordination (final) shall be required with other trades prior to installation. Install all works as shown on the drawings, unless prevented by project conditions.

Prepare drawings showing proposed rearrangement of work to meet the project conditions, Obtain permission from of architect / consultant before proceeding.

Place anchors, sleeves and supports prior to pouring concrete on installation of masonry works.

Keep roads and site clear of debris and scrap.

PAINTING AND SERVICE IDENTIFICATION

SCOPE

The scope of this section comprises of identification of service for each piece of equipment and allied works.

5.1 **VALVE TAGS AND CHARTS**

5.1.1 Each valve shall be provided with a tag indicating the service being controlled together with a reference number corresponding with that shown on the valve chart and as fitted drawings. The labels shall be made from 3 ply (Black/White/Black) trifoliate material showing white letter and figures on a black background. Labels to be lied to each valve with chromium plated linked chain.

5.1.2 A wall mounted glass covered plan to the Architect / Engineer shall be provided and displayed in each plant room showing the plant layout with pipe work. Valve diagram and valve schedule indicating size. Service duty etc.

5.1.3 Pipe work and duct work shall be identified by color bands 150 mm. Wide or color triangles of at least 150 mm / side. The bands of triangles shall be applied at termination points. Junction, entries and exits of plant room. Walls and duct, and control point to readily identify the service but spacing shall not exceed 5.0 meters.

5.2 **Pipe Work Service**:-

For pipe work service and its insulation the color of the bands shall be company with BS. 1710:1971.

Basic color for pipe line identification:-

Pipe Line Contents	BS 4800 Color Reference	Color
Water	12 D 45	Green
Steam	10 A 03	Grey
Oils	06 C 39	Brown
Gas	08 C 35	Yellow/brown
Air	20 E 51	Blue
Drainage	00 E 53	Black
Electrical	06 E 51	Orange

Color code indicator bands shall be applied as color band over the basic identification color in the various combination as listed below:-

	Pipe Duty	Color Bands to BS. 4800
5.2.1	Water service	
	Cooling	00 E 55
	Ventilation/ drinking	18 E 53

	Boiler feed	04 D 45/ 00 E 55 / 04 D 45
	Condensate	04 D 45/ 14 E 53/ 04 d 45
	Chilled	00 D 55/ 14 E 53/ 00 D 45

	Pipe Duty	**Color Bands to BS. 4800**
5.2.2	Central heating service	18 E 55/04 d 45 / 18 E 53
	Below 100 degree C	04 D 45/ 18 E 53/ 04 D 45
	Above 100 degree C	
5.2.3	Cold water storage	
	Tanks	00 E 55/18 E 53/ 00 E 55
	Hot water supply	00 E 55/ 04 D 45/00 E 55
5.2.4	Steam service	Basic Color Only
5.2.5	Drainage and other fluids:	Basic Color Only
5.2.6	Electrical service:	Basic Color Only

5.2.7 In addition to the color band specified above all pipe work shall be legibly marked with black or white latter to indicate the type service and the direction of flow. Identified as follow:-

High temperature hot water	HTHW
Medium temperature hot water	MTHW
Low temperature hot water	LTHW
Chilled water	CHW
Steam	ST
Condensate	CN

Pipe shall have the letter **F** and **R** added to indicate flow and return respectively as well as directional arrows.

5.3 **Duct work service :**

For duct work service and its insulation the colour of the triangles shall comply with **BS. 1710 : 1971**. the size of the symbol will depend on the size of duct and the viewing distance but the minimum size should
not be less than **150 mm** length per side. One apex of the triangle shall point of the direction of air flow.

Service	**Color**	**BS. 4800 Color Reference**
Conditioned air	Red and Blue	04 E 53/ 18 E 53
Ward air	Yellow	10 E 53

Ventilation air	Green	14 E 53
Exhaust / extract Recalculated air	Gray	AA 0 09
Foul air	Brown	06 C 39
Dual duct system hot Supply air	Red	04 E 53
Cold supply air	Blue	18 E 53

In addition to the color triangle specified above all duct work shall be legibly marked with black or white letter to indicate the tope of service identified as follows:-

Supply air	S
Return air	R
Ventilation air	F
Exhaust air	E

The color banding and triangle shall be manufactured from self adhesive cellulose tape laminated with a layer of transparent ethyl cellulose tape.

6-GOOD ENGINEERING PRACTICES FOR HVAC WORKS

6.0 **Mechanical noise control:** All good engineering practices involved in controlling the noise of equipment within permissible limits shall be adopted by the contractor.

Vibration Control: All good engineering practices involved in controlling the vibrations of equipment within permissible limits shall be adopted by the contractor.

Equipment at the best operating parameters and acoustical performance alongwith the necessary isolation devices for vibration control shall be adopted by the manufacturer and the contractor.

6.1 **INTENT in general pertaining to this section is as follows**:

The vibration isolators for certain equipments although have been specified and quantified in the BOQ, how-ever, as a precautionary measure, if any additional safeties are required to fulfill the intent of this basic mechanical requirement, then the same shall be provided by the manufacturer/contractor, at no additional cost.

6.1.1 Mechanical service shall generally be designed and installed with provisions to contain noise and the transmission of vibration generated by moving plant and equipment schedules to achieve acceptable noise rating specified for occupied areas.

6.1.2 In addition to the provision specified in the specification particulars attention must be given to the following detail at time of ordering plant and equipment and their installation:-

6.1.2.1 All moving plant, machinery and apparatus be statically and dynamically balance at manufactures work and certificate issued.

6.1.2.2 The isolation of moving plant. Machinery and apparatus including lines equipment from the building structure.

6.1.2.3 Where duct work and pipe work service pass though walls floor and ceiling or where supported shall be surrounded with a resilient acoustic absorbing material to prevent contract with the structure and minimize the outbreak of noise from plant room.

6.1.2.3 The reduction of noise breakout from plant room and the section of externally mounted equipment and plant to meet ambient noise level requirement of the specifications.

6.1.2.4 Electrical conduits and connection to all moving plant and equipment shall be carried out in flexible conduit and cable to prevent the transmission of vibration to the structure and nullify the provision of anti–vibration mountings.

6.1.2.5 All duct connection to fans shall incorporate flexible connections. Except in cases where these are fitted integral within air handing unit.

6.1.2.6 All resilient acoustic absorbing materials shall be non flammable vermin and rot proof and shall not tend to break up or compress sufficiently to transmit vibration or noise from the equipment to the structure.

6.1.2.7 Where practicable silencer shall be built into walls and floor to prevent the flanking of noise the duct work system and their penetrations sealed in the manner previously described.

6.1.2.8 Where this is not feasible the exposed surface of the duct work between the silencer and the wall subjected to noise infiltration shall be acoustically clad as specified.

7-SYSTEM DESCRIPTION

7.1 **General:**

7.1.1 Central Chilled water air conditioning system (thru tri generation concept) is envisaged for the said premise for maintaining year round inside environmental conditions pertaining to temperature / humidity / Air Quality / Air cleanliness etc.

7.1.2 The system shall consist of 1 nos. TR Water cooled chillers and 1 no. air source reversible chiller with dedicated chilled/Hot water pumps (having a redundant pump on each circuit). Pumping system shall be primary with VFD pumping system , And Same system reverse function in winter heating .

7.1.3 Various Air handlers / Fan Coil Units are placed at suitable location and shall be fed with chilled water to effect cooling by means of chilled water piping traveling in the dedicated chilled water risers. The cooling towers shall be of forced/induced draft type and are located on the terrace .The return air shall be collected in the void above the false ceiling or ducted and brought back to the AHU rooms for necessary filtration and re-circulation after mixing with the ventilation air. Radiant Cooling /heating Piping system which is connected to chilled water system thru manifold and all radiant pipes run under floor or in slab.

7.1.4 Combined smoke and fire dampers shall be provided at suitable location in the supply air ducts and return air spaces at AHU rooms. All fire escape staircases shall be provided with pressurization system consisting of fans installed on terrace. These fans shall be actuated upon receiving signal from the fire panel.

7.1.5 The exposed roof shall be insulated by other agencies as per the requirement detailed in system design criteria.

7.1.6 One coil (Two pipe) system is proposed for all areas at all floors.

7.2 **Chilled Water Generation and Distribution:**

The chilled water generation plant (i.e. VCM, chilled water pumps) are installed in the basement lvl. Chilled water shall be made available at the specified temperature and pressure to all the above–mentioned area Air handlers to effect the air conditioning of the said space.

The system design is based on variable volume water flow concept. The contractor shall provide Two port control valves on all the AHUs/FCUs. The flow of water through the said AHUs/FCUs shall be controlled by the modulating motor depending upon the set point of the return air thermostat.

The design chilled water temperatures are :

Chilled water flow	:	6.6/17 Deg C
Chilled water return	:	13.3/20 Deg C

ACOUSTIC & VIBRATION CONTROL

8.0 **ACOUSTICS MEASURES FOR NOISE CONTROL AND VIBRATION CONTROL MEASURES:**

8.1 **INTENT in general pertaining to this section is as follows**:
The vibration isolators for certain equipments although have been specified and quantified in the BOQ (If Any), how-ever, as a precautionary measure, if any additional safeties are required to fulfill the intent of this basic mechanical requirement, then the same shall be provided by the manufacturer/contractor, at no additional cost.

8.2 **STANDARD**
The testing of the all noise control equipment and the method use in measuring the noise rating of air conditioning plant and equipment shall be in accordance with the relevant section of the following British standards unless otherwise stated :

BS 4718 : 1971	Method of test of silencer for air distribution systems.
BS 2750: Parts 1-9:1980	Laboratory and field measurement of airborne sound insulation of various building element. Recommendation for field laboratory measurement of airborne and impact sound transmission in building.
BS 3638 : 1987	Method of measurement of sound adsorption in a reverberation room.
BS 4773: Part 2: 1976	Acoustic performance without additional ducting of forced fan convection equipment.
BS 4857: Part1978 (1983)	Acoustic testing and rating of high pressure terminal reheat units.
BS 4954: Part 2: 1978(1987)	Acoustic testing and rating of induction units.
BS 5643:1984	Glossary of Refrigeration, Heating Ventilation and Air Conditioning terms.

8.3 **INTENT in general pertaining to this section is as follows**:

8.3.1 Mechanical service shall generally be designed and installed with provisions to contain noise and the transmission of vibration generated by moving plant and equipment schedules to achieve acceptable noise rating specified for occupied areas.

8.3.2 In addition to the provision specified in the specification particulars attention must be given to the following detail at time of ordering plant and equipment and their installation

8.3.3 All moving plant, machinery and apparatus be statically and dynamically balance at manufactures work and certificate issued.

8.3.4 The isolation of moving plant. Machinery and apparatus including lines equipment from the building structure.

8.3.5 Where duct work and pipe work service pass though walls floor and ceiling or where supported shall be surrounded with a resilient acoustic absorbing material to prevent contract with the structure and minimize the outbreak of noise from plant room.

8.3.6 The reduction of noise breakout from plant room and the section of externally mounted equipment and plant to meet ambient noise level requirement of the specifications.

8.3.7 Electrical conduits and connection to all moving plant and equipment shall be carried out in flexible conduit and cable to prevent the transmission of vibration to the structure and nullify the provision of anti – vibration mountings.

8.3.8 All duct connection to fans shall incorporate flexible connections. Except in cases where these are fitted integral within air handing unit.

8.3.9 All resilient acoustic absorbing materials shall be non flammable vermin and rot proof and shall not tend to break up or compress sufficiently to transmit vibration or noise from the equipment to the structure.

8.3.10 Where practicable silencer shall be built into walls and floor to prevent the flanking of noise the duct work system and their penetrations sealed in the manner previously described.
Where this is not feasible the exposed surface of the duct–work between the silencer and the wall subjected to noise infiltration shall be acoustically clad as specified.

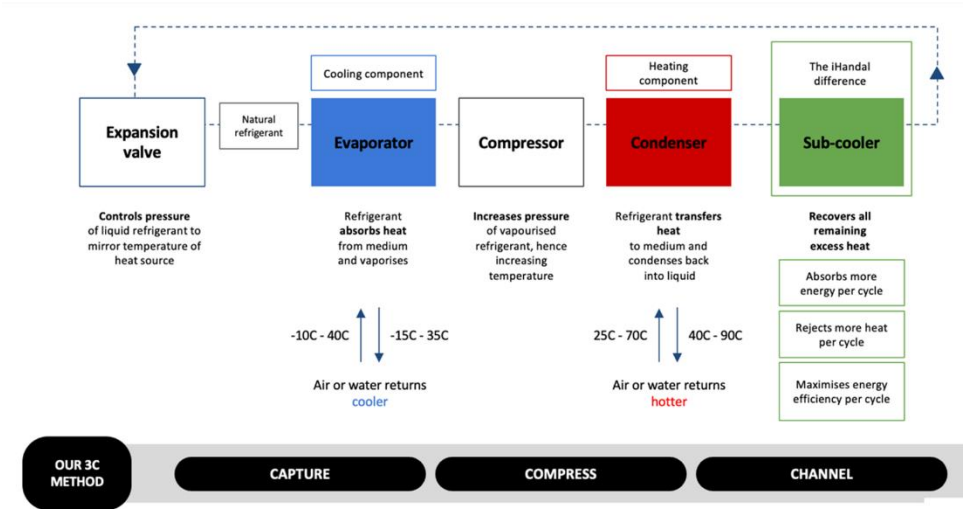
CHILLERS AND ASSOCIATED WORKS

TECHNICAL SPECIFICATIONS.
Scope:

The scope of work includes design, manufacture, SITC, delivery to site as per standards..

Water Cooled Chiller Specification
The Principle of Heat fuse – Concentrate Energy from any Heat Source Efficiently
Heat Fuse™ Water-to-Water range of Heat Pumps and Chillers consist of the following main components

- GEA Bock® and Bitzer® Semi Hermetic Reciprocating Compressor
- High Performance SWEP® Brazed Plate Heat Exchangers Condensers and Evaporators
- Carel E^3V Electronic Expansion Valves
- Internal Heat Exchanger for Internal Heat Recovery for Maximum C.O.P.
- Carel Control Systems
- Integrated PLC for System Staging, Load Balancing, Performance Monitoring and Troubleshooting



An Electronic Expansion Valve will inject refrigerant into the evaporator at a reduced pressure and a super-cooled temperature. The refrigerant fluid will then absorb the energy from the warmer return chilled water, thus completely changing phase from liquid to a superheated gaseous form and returning the chilled water at a cooling temperature. The compressor will compress the superheated gas to a higher pressure and temperature before it enters the condenser. It passes through the gas cooler where the gas will transfer its heat to the cooler medium, water for a water cooled unit or air for an air cooled unit.

In a standard unit, the still warm refrigerant (50-60 deg Celsius) after the (condenser) is returned to the expansion valve and its energy wasted. However, with the HeatFuse's internal heat recovery, we recover this heat by heating up the suction gas to maximize efficiency and Coefficient of Performance.

1. Heat Fuse ™ Series.

(a) Water to Water Range

The unit will be of a water-to-water design meaning it will be both exclusively use water as cooling and heat rejection mediums. The heat source is derived from the return chilled water. The unit shall be designed for 100% gas cooled operation for maximum heat transfer for achieving a high instantaneous co-efficient of performance (COP).

1.1 Cabinet

The cabinet shall be constructed for outdoor use and be made of a galvanized finishing or optionally specified, stainless steel 304, for corrosion protection and shall have three (3) separate compartments:

- The compressor, heat exchangers, expansion valve, and other accessories
- The electrical components and controls
- The base for the cabinet and access panel shall have a minimum thickness of 1.5mm. The base section under the evaporator heat exchanger shall have a stainless steel drip pan for the condensation with a proper outlet drainpipe for easy connection.

2. Refrigerant

Refrigerant used will be as per the specification sheet designed for Low GWP and ODP.

3. Expansion Valve – Carel E^3V Electronic Expansion Valve

The expansion valve shall be specially designed for the intended application with a field adjustable superheat feature and MOP (maximum operating pressure) type power element. The Expansion Valve shall be motor driven with a panel mounted DC24V driver.

4. Compressors

The compressors provided shall be of a Semi Hermetic Reciprocal Unit as per the specification sheet. The number of compressors and stages will be selected depending on the load profile and redundancy requirements for each project as per the selection sheet and client discussions ranging from one (1) to four (4). They will be equipped with capacity control solutions that include Variable Frequency Drives and/or slide valves. Protection for continuous operation from phase loss, phase reversal, phase imbalance and incorrect phase sequence apart from overload and under load protection will be part of the control circuit.

5. Compressor indication and Control Devices

The compressor controls shall include protection devices that allows for manual reset and comes complete with wiring terminals for series connection with compressor motor wiring. The operation of any of the following safety devices will stop compressor operation and prevent re-starting until reset.
The compressor controls and accessories per compressor set are as follows:

- High / Low Pressure safety cut off Switch
- Suction Pressure Gauge
- Discharge Pressure Gauge
- Indication Lights For
  - (a) Power “On”
  - (b) Compressor Status (Run, Stop, Low Pressure Trip, High Pressure Trip, Overload Trip)
  - (c) System Stand-by Status
  - (d) Phase loss, Phase reversal, Phase imbalance and Incorrect phase sequence.

1.6 Heat Exchangers

The heat exchanger shall be suitable for high temperature and mains pressure operation with the following design parameters.

	Condenser	**Evaporator**
Type	Direct Expansion Plate Heat Exchanger (Optionally Specified: Tubular Fin or Shell & Tube)	
Flow Type:	Counter-Current	

Pressure Drop:	50 kPa	65 kPa
Max. Operating Pressure:	40 bar (120 bars for R744) for Refrigerant 10 bar for Water	
Manufacturers	APV / SWEP	

1.7 Monitoring Solutions

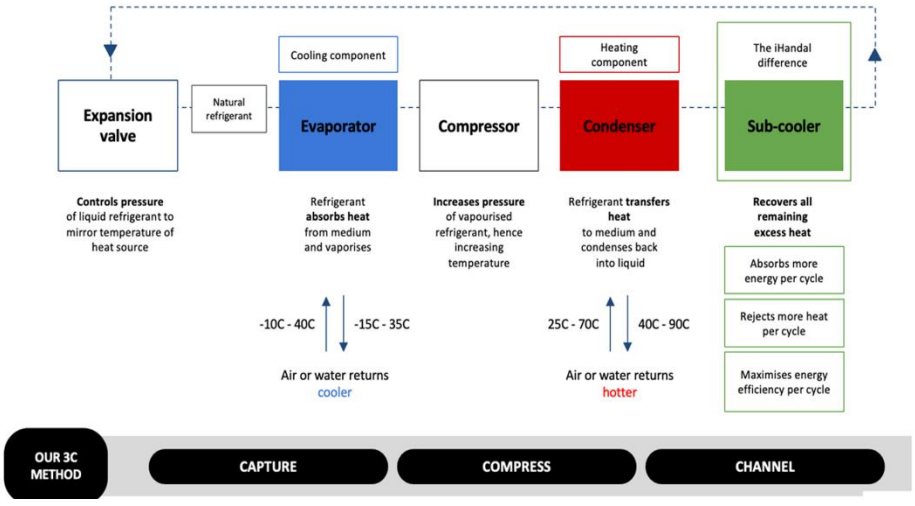
The unit comes with a ModBus interface that will enable the end-user to monitor the system performance in real-time and perform logging functions. Temperatures, power consumption, running hours, COP and other information will be available for download. A network cable needs to be provided by the end-user to take advantage of remote access and trouble-shooting.
Specified Brands of PLC include Siemens and Allen Bradley and are chosen depending on the complexity of the control logic and connectivity requirements for each client.

Technical Specifications for Air source Reversible Chiller

The Principle of Heatfuse – Concentrate Energy from any Heat Source Efficiently

HeatFuse™ Reversible range of Dual Function Heat Pump and Chiller consist of the following main components:EA Bock® and Bitzer® Semi Hermetic Reciprocating Compressor

- High Performance SWEP® Brazed Plate Heat Exchangers Condensers and Evaporators
- Carel E^{3}V Electronic Expansion Valves
- Internal Heat Exchanger for Internal Heat Recovery for Maximum C.O.P.
- Carel Control Systems
- Integrated PLC for System Staging, Load Balancing, Performance Monitoring and Troubleshooting



An Electronic Expansion Valve will inject refrigerant into the evaporator at a reduced pressure and a super-cooled temperature. The refrigerant fluid will then absorb the energy from the warmer return chilled water, thus completely changing phase from liquid to a superheated gaseous form and returning the chilled water at a cooling

temperature. The compressor will compress the superheated gas to a higher pressure and temperature before it enters the condenser. It passes through the gas cooler where the gas will transfer its heat to the cooler medium, water for a water cooled unit or air for an air cooled unit.

In a standard unit, the still warm refrigerant (50-60 deg Celsius) after the (condenser) is returned to the expansion valve and its energy wasted. However, with the HeatFuse's internal heat recovery, we recover this heat by heating up the suction gas to maximize efficiency and Coefficient of Performance.

The unit is equipped with an additional 3-way valve and specifically designed condenser and evaporators that allow reversed operation in different weather conditions to allow for year-round usage in seasonal conditions.

1. HeatFuse ™ Series.

(b) Reversible Heat Pump Range

The unit will be of a reversible water to air design meaning it will be both use water and air depending on the operation mode as cooling and heat rejection medium. The unit shall be designed for 100% gas cooled operation for maximum heat transfer for achieving a high instantaneous co-efficient of performance (COP).

1.1 Cabinet

The cabinet shall be constructed for outdoor use and be made of a galvanized finishing or optionally specified, stainless steel 304, for corrosion protection and shall have three (3) separate compartments:

- The compressor, heat exchangers, expansion valve, and other accessories
- The electrical components and controls
- The base for the cabinet and access panel shall have a minimum thickness of 1.5mm. The base section under the evaporator heat exchanger shall have a stainless steel drip pan for the condensation with a proper outlet drainpipe for easy connection.

6. Refrigerant

Refrigerant used will be as per the specification sheet designed for Low GWP and ODP.

7. Expansion Valve – Carel E^3V Electronic Expansion Valve

The expansion valve shall be specially designed for the intended application with a field adjustable superheat feature and MOP (maximum operating pressure) type power element. The Expansion Valve shall be motor driven with a panel mounted DC24V driver.

8. Compressors

The compressors provided shall be of a Semi Hermetic Reciprocal Unit as per the specification sheet. The number of compressors and stages will be selected

depending on the load profile and redundancy requirements for each project as per the selection sheet and client discussions ranging from one (1) to four (4). They will be equipped with capacity control solutions that include Variable Frequency Drives and/or slide valves. Protection for continuous operation from phase loss, phase reversal, phase imbalance and incorrect phase sequence apart from overload and under load protection will be part of the control circuit.

9. Compressor indication and Control Devices

The compressor controls shall include protection devices that allows for manual reset and comes complete with wiring terminals for series connection with compressor motor wiring. The operation of any of the following safety devices will stop compressor operation and prevent re-starting until reset.
The compressor controls and accessories per compressor set are as follows:

- High / Low Pressure safety cut off Switch
- Suction Pressure Gauge
- Discharge Pressure Gauge
- Indication Lights For
  - (e) Power "On"
  - (f) Compressor Status (Run, Stop, Low Pressure Trip, High Pressure Trip, Overload Trip)
  - (g) System Stand-by Status
  - (h) Phase loss, Phase reversal, Phase imbalance and Incorrect phase sequence.

1.6 Heat Exchangers

The heat exchanger shall be suitable for high temperature and mains pressure operation with the following design parameters.

	Condenser	**Evaporator**
Type	Direct Expansion Plate Heat Exchanger (Optionally Specified: Tubular Fin or Shell & Tube)	
Flow Type:	Counter-Current	
Pressure Drop:	50 kPa	65 kPa
Max. Operating Pressure:	40 bar (120 bars for R744) for Refrigerant 10 bar for Water	
Manufacturers	APV / SWEP	

1.7 Monitoring Solutions

The unit comes with a ModBus interface that will enable the end-user to monitor the system performance in real-time and perform logging functions. Temperatures, power consumption, running hours, COP and other information will be available for

download. A network cable needs to be provided by the end-user to take advantage of remote access and trouble-shooting.
Specified Brands of PLC include Siemens and Allen Bradley and are chosen depending on the complexity of the control logic and connectivity requirements for each client.

COOLING TOWER

COOLING TOWERS

SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of cooling towers in accordance with requirements of Drawings and of the Schedule of Quantities.

TYPE
Cooling Towers shall be induced draft /forced draft in accordance with requirement of Drawings and of the Schedule of Quantities.

INDUCED DRAFT COOLING TOWER – Single / Multi cell

Cooling Towers shall be suitable for outdoor use. Tower shall be vertical, induced draft, counter/cross flow type. FRP construction, in rectangular/ square /octagonal profile, complete with fan, motor, diffusion deck spray section, eliminators, steel supports, and sound attenuation equipment where called for in Schedule of Quantities.

a. Capacity

The cooling tower capacities shall be as per the Drawings and Schedule of Quantities.

b. Side Casing

This shall be made out of FRP construction of minimum 3 mm thick and UV stabilized with smooth surface on both sides for minimum resistance to air flow. It shall have sufficient structural strength to adequately withstand high wind velocities and vibration. The casing may be installed in the reinforced cement concrete basin if so identified in drawings, or in Schedule of Quantities. The tower supporting structure shall be made out of hot dipped galvanized tubular frame. Air intake shall be all along the sides so that tower can be installed quite independent of prevailing wind direction. Anodized aluminium or PVC louvers integrated with fill UV stabilized PVC fill and backed up by galvanized bird screen / FRP Louvers shall be provided at air intake. Sufficient clearance between casing and adjoining structures shall be provided to enable servicing and periodic cleaning.

c. Cold Water Basin

Cold water basin shall be a deep sump and made out of 5 mm thick FRP construction and UV stabilized on which cooling tower super structure shall be supported. RCC suction tank with easily removable double brass strainers may be provided with this basin, if separately identified in drawings or in Schedule of Quantities.

Basin fittings shall include the following:

i. Bottom outlet.
ii. Screened suction assembly.

iii. Drain connected to the side / underside of basin.
iv. Overflow connected to the side of basin.
v. Built-in bleed off attached to inlet header discharging through polyethylene tube into overflow pipe.
vi. Ball type automatic make up water valve.
vii. Quick fill connected to the side of basin.
viii. Equalizing connection and balancing valve for multiple CTs.

d. Distribution System

Hot water distribution system shall comprise of header and branch arms system or open pan gravity flow system.

e. Filling

Fillings shall be made of corrosion proof and rigid PVC film in honeycomb design and arranged in square / rectangular form. Fill sheets shall be suspended from H.D.G steel structural tubing supported from the lower structure & shall be elevated above the floor of the cold-water basin to facilitate cleaning and easy replacement. They shall be arranged in such a manner to ensure negligible resistance to airflow and to eliminate backwater spots and prevent fouling through scales that may form. In order to reduce carry-over losses through entrainment of moisture drops in air stream, PVC drift eliminator shall be installed.

f. Mechanical Equipment

The tower shall be provided with low speed fan running at less that 360 RPM through gear reducer. Direct driven fan speed shall not exceed 700 RPM. Fan shall be of the propeller type lightweight rotor fitted with multiple aerofoil blades. The entire fan assembly shall be statically and dynamically balanced. Fan shall be driven by 415±10% volts, 3 phase, 50 cycles, AC supply, and energy efficient motor totally-enclosed, fan-cooled, weather-proof construction, designed and selected to operate in humid air stream. Fan shall be protected by a fan guard and bird screen of galvanized steel construction to prevent birds from nesting during idling period & shall be easily accessible for inspection and maintenance. A service ladder (Aluminum construction) shall also be provided for greater convenience. The mechanical equipment assembly shall be adequately supported on a rugged steel base welded to tubular support assuring vibration-free support. Fan guard and bird screen (of galvanized steel construction) shall be provided to prevent birds from nesting during idling periods. Gear-reducer shall be of spiral bevel type. G.S.S canopy shall be provided over the fan motor for protection against rainwater. Care shall be taken that fan air is not restricted. Motor terminal box shall be made water tight.

PERFORMANCE DATA

Complete performance ratings and power consumption at varying loads and outdoor wet bulb temperatures, shall be submitted and verified at the time of testing and commissioning of the installation.

TESTING

Capacity of the cooling tower shall be computed from the measurements of water flow, incoming/outgoing water temperatures and ambient air wet bulb temperature using accurately calibrated mercury-in-glass thermometers. Computed ratings shall conform to the specified

capacities and quoted ratings. Power consumption for cooling towers shall be computed from measurements of incoming voltage and input current.

TECHNICAL REQUIREMENTS

Block - 1

Sl. No.	Description		INDUCED DRAFT CROSS/COUNTER FLOW TYPE COOLING TOWERS
A	PERFORMANCE		
01	Nominal capacity	:	TR x nos – Chiller Capacity.
02	Circulating Flow Rate		US Gpm
03	Hot Water Temperature		97.0 deg F
04	Cold Water Temperature		87.0 deg F
05	Approach		5 Deg C
06	Drift Loss - % of flow		0.005 (MAX)
07	Evaporation Loss - % of flow		0.8 (MAX)
B	MATERIAL OF CONSTURCTION		
01	Casing		G-235 heavy mill galvanized steel
02	Hot Water Basin		FRP
03	Cold Water Basin		FRP
04	Fan Cylinder		
05	Frame Work		G-235 heavy mill galvanized steel
06	Fan		Aluminium Alloy
07	Fills		Rigid Vacuum Formed PVC
08	Louvers		PVC Integral with fills
09	Drift Eliminators		PVC Integral with fills
10	Nozzles		Polypropylene
C	MOTOR & FAN – IE 3 Rated		
01	Type of Fan		Axial Fan
02	Number of Fans		One
03	Number of Blades		Five (Suggested Value)
04	Fan RPM		450 (Suggested Value)
05	Drive System		System 5 Gear reducer
06	Fan Motor		TEFC- IP55.
07	Motor power		As per OEM
08	Variable Frequency Drive		Required
D	Accessories		
01	Handrail		Required
02	Gear reducer Drive		Required
03	Vibration Isolators		Required
04	Air Inlet Screens		Required
05	Solid state water level control package		Required
06	Handrail and ladder		Required
E	Control System		
01	Control System for operating through BMS		Yes required. All necessary hardware & software should be part of scope.
F	Certification		
01	CTI Certification		YES

TECHNICAL REQUIREMENTS

DATA TO BE PROVIDED BY THE VENDOR ALONG WITH HIS OFFER

Sl.	Description		

No.			
A	PERFORMANCE		
	Type of the Cooling Tower		
B	PERFORMANCE		
01	Nominal Refg tons Offered	:	
02	Circulating Flow Rate Considered		
03	Hot Water Temperature Considered		
04	Cold Water Temperature Considered		
05	Ambient Wet-Bulb Considered		
06	Drift Loss - % of flow		
07	Evaporation Loss - % of flow		
C	MATERIAL OF CONSTURCTION		
01	Casing		
02	Hot Water Basin		
03	Cold Water Basin		
04	Fan Cylinder		
05	Frame Work		
06	Fan		
07	Fills		
08	Louvers		
09	Drift Eliminators		
10	Nozzles		
D	MOTOR & FAN		
01	Type of Fan		
02	Number of Fans		
03	Number of Blades		
04	Fan RPM		
05	Drive System		
06	Fan Motor		
07	Variable Frequency Drive – Is it Considered along with the Offer		
E	Accessories Considered along with offer		
01	Handrail		
02	Gear reducer Drive		
03	Vibration Isolators		
04	Air Inlet Screens		
05	Solid state water level control package		
06	Handrail and ladder		
F	Control System		
01	Control System for operating through BMS		
G	Certification Considered for the Tower		
01	CTI Certification		

AIR SIDE EQUIPMENT & ASSOCIATED WORKS

L-1 ENTHALPY RECOVERY WHEEL WITH SUPPLY AIR AND EXH. AIR FAN SECTION

1 SCOPE

The scope of this section comprises of the supply of double-skin "Dedicated Outdoor Air Units conforming to the following specifications .The manufacturer or their principals shall have at least 10 years of designing and manufacturing experience directly in the product i.e. energy recovery devices, with a two tier, two air stream unit design in India. The heat recovery wheel, Passive Desiccant Dehumidification Wheel & Coil box should be from the same manufacturer. The manufacturer of the wheel should have manufacturing units in India.

2 TYPE

The Dedicated Outdoor Air units shall be two stream units in double skin construction, comprising of supply air section, return air section and Heat Recovery Section. The supply air section shall include the following sections if defined in the Bill Of Quantities:

3 CAPACITY

The Dedicated Outdoor Air units shall be of such capacities and static pressures as mentioned in the Bill of Quantities.

4 CASING (Recommended –standard AHU casing specifications)

The units shall be made of extruded Aluminium hollow profile frames. The profile box size shall be of thermal break type. The unit should be devoid of any welded construction and should be of cabinet type. All the frames should be assembled using glass fibre reinforced nylon joints/corners to make a self-supporting frame. The Casing leakage shall be in accordance with relevant EUROVENT standard that is CLASS B. Casing Strength shall be Class-1A

The panels shall be of double skin construction with both inner and outer steel sheets being minimum 0.8mm thick. Outside sheet shall be pre coated & plasticized and inner sheet will be galvanized with 43 mm thick fire retardant, PUF insulation.

The Inspection and access panels shall be hinged type . The hinges shall be casted, powder coated Zinc alloy. Flushed Locks and Handles shall be of glass fibre reinforced polyamide. Other panels will be screwed on to the frame with sealant and soft rubber gasket thus making the joints air tight . All screws used for panel fixing shall be covered with PVC caps.

Special hollow gaskets and seals shall be used on inspection doors and to create separation between the airstreams to ensure negligible air leakage and mixing
The entire casing shall be mounted on galvanized channel. Condensate drain pan shall be fabricated from 18 g GSS/SS construction.

OUTDOOR VERSION

For Outdoor Installation units have factory installed galvanized sheet metal roof. Exhaust air hood with bird screen will be provided for exhaust air & intake louvers will be provided for intake sections

Exhaust Air hood & roof shall be shipped separately due to shipping restrictions.

5 SUPPLY AIR SECTION

The supply air section shall comprise of the following:

5.1 **FAN SECTION** (Recommended –standard AHU Fan specifications)

The fan shall be backward curved plenum type. Fan performance shall be based on test accordance with AMCA standard. The Plenum fans use backward curved blade wheel, made of cold rolled steel sheet, protected with polyester powder coating finish. Inlet cones are die-formed from galvanized steel sheet. These cones provide smooth airflow into the wheel for even loading.

Structural components of the plenum fans are made of galvanized steel sheet and sections, electrically welded, with the exception of the larger sized models, which use hot rolled steel sections protected with polyester powder coating finish.

5.2 **MOTOR AND DRIVE** (Recommended –standard AHU motor and drive specifications)

Fan motor shall be energy efficient and suitable for 415□10% volts, 50 cycles, 3 phase squirrel cage, totally enclosed fan cooled with IP – 55 protection. Motor shall be designed for for quiet operation . Drive shall be direct driven and suitable for VFD.

5.3. **FILTER SECTION** (Recommended –standard AHU Filter specifications)

The filter section shall be normally designed for deep folded disposable synthetic prefilters (Panel Type) for Class EU3.The filter elements shall be mounted on rails and shall be easily pulled out for replacement. The rails shall be provided with efficient gaskets to minimize the risk of leakage

5.4. **FINE FILTER SECTION** (If Specified in BOQ) (Recommended – standard AHU fine filter specifications)

The Fine filter section shall be normally designed for washable synthetic non-woven media Fine filters (Bag Type) for Class F7.The filter elements shall be mounted on rails and shall be easily pulled out for replacement. The rails shall be provided with efficient gaskets to minimize the risk of leakage

5.5 **MIXING SECTION** (If Specified in BOQ) (Recommended –standard AHU mixing box specifications)
The casing for mixing shall be as described in 4.0. The mixing section shall have built in dampers made up of aluminium profiles with leakage Class III. The damper blades shall be controlled with plastic gear wheels and silicone gaskets shall be provided between the blades. Inspection hatch shall be provided.

5.6 **COOLING COIL SECTION** (If Specified in BOQ) (Recommended –standard AHU cooling coil specifications)

Cooling coil section shall be provided with cooling coil. Coil shall be capable desired dew point. Coil shall be chilled water type or direct expansion depending on the desired dew point

Coil shall be rated in ARI Certified. Coil shall be mounted in powder coated holding racks Water coil supply and return connection shall be extended to the unit exterior. Cooling coil shall be mounted on a insulated SS drain pan.

5.7 **DAMPER SECTION**

Damper section shall contain a built in damper of aluminium profile with leakage class III . The damper blades shall be connected with plastic gear wheels with a gasket of silicon rubber to produce tightness between the blades. The Dampers shall have provision for damper actuator mounting.

6 **RETURN AIR SECTION**

The return air section shall comprise of above sections. The specification for this section shall remain same as defined in 5.1, 5.2 & 5.3

7 **HEAT RECOVERY SECTION**

The Heat Recovery section shall include enthalpy wheels and shall have minimum recovery of 75 % of total heat, i.e both sensible and latent (each being 75 %). Necessary computerized selection of the wheel should be provided along with the bid to justify the same. The wheel shall be made of pure aluminium foil coated with molecular sieve desiccant with pore diameter of 3^{o}A.The cross contamination between the two air streams shall be nil and leakage less than 0.04%. The vertical and radial run of the wheel shall be less than 1 mm per meter of diameter. The wheels shall have non contact labyrinth seals for effective sealing between the two air streams.
Detailed specification for the wheel shall be as per 8.0 i.e. “HEAT RECOVERY WHEEL”

8 **Heat Recovery Wheel specifications:**

Rotor/wheel matrix shall have following Matrix —

The substrate: The substrate or wheel matrix should be made of pure aluminum foil so as to allow.

a) quick and efficient uptake of thermal energy.

b) sufficient mass for optimum heat transfer

c) maximum sensible heat recovery at a relatively low rotational speed of 20 to 25 rpm.

d) The heat recovery unit shall be designed for ambient temperature of DBT=110 °F & WBT = 78 °F and return air temperature of DBT=77F & RH=60% for Summer conditions & DBT=90 °F & WBT = 83 °F and return air temperature of DBT=77 F & RH=60% for Monsoon conditions.

The substrate shall not be made from any material which is combustible or supports combustion like synthetic fibrous media.

The wheel shall have minimum 75% both Sensible and Latent Balanced Effectiveness as per AHRI 1060.

The wheel has to be certified as per DIN EN ISO 846 with 0% fungal and bacterial growth at 95% Relative humidity and above.

Fire rating: NFPA - 90A certification with 0% for Flame spread classification should be confirmed by manufacturer.

The Wheel shall be AHRI certified in accordance with standard 1060 and carry the AHRI certification stamp.

The product shall be produced in an ISO certified facility

NECESSARY SOFTWARE SELECTION OF THE WHEEL HAS TO BE ENCLOSED TO JUSTIFY THE PRESSURE DROP AND EFFICIENCY CALCULATIONS. THE SELECTION SOFTWARE SHALL SHOW HRW PERFORMANCE IN SUMMER, MONSOON & WINTER.

The Desiccant: The desiccant should be water molecule selective and non-migratory.

The desiccant should be molecular sieve 3Å, (certified by a third party lab to have an internal pore diameter of 3Å), so as to keep the cross contamination to absolute minimum and also ensure the exclusion of contaminants from the air streams, while transferring the water vapour molecules.

The desiccant, of sufficient mass which should not be less than 5 kg per 1000 cfm of air, should be coated with non masking porous binder adhesive on the aluminum substrate so as to allow quick and easy uptake and release of water vapour. A confirmation has to be provided by manufacturer of wheel to this effect. A matrix with desiccants impregnated in non metallic substrates, such as synthetic fibre, glass fibre, etc. will not be accepted.

The rotor/wheel matrix shall have equal sensible and latent recovery.

The weight of desiccant coating and the mass of aluminum foil shall be in a ratio so as to ensure equal recovery of both sensible and latent heat over the operating range. Accordingly, a rotor matrix which has an etched or oxidised surface to make a desiccant on a metal foil and results in insufficient latent recovery and hence unequal recovery, or a rotor matrix made from desiccant integrated in a synthetic fibre matrix which result in insufficient sensible recovery, high rotation speed, and unequal recovery, will not be accepted.

Rotor : With optimum heat and mass through matrix formed by desiccant, of sufficient mass, coated on an aluminum foil, the rotor should rotate at lower than 20 to 25 RPM, thereby also ensuring long life of belts and reduced wear and tear of seals.

The rotor shall be made of alternate flat and corrugated aluminum foil of uniform width.

The rotor honeycomb matrix foil should be so wound and adhered (full node line adhesive to be provided) so as to make a structurally very strong and rigid media which shall not get cracked, deformed etc. due to change of temperature or humidity.

The rotor having a diameter upto 2400 mm shall have spokes to reinforce the matrix. The internal threaded rod type spokes shall not be acceptable as it weakens the wheel

structural strength thereby reducing the service life. From 2000 mm diameter upwards, the option of a special wing structure, to prevent the rotors from wobbling or deforming due to the successive pressure differentials, will be available.

Sectioned wheels, with pie segments, capable of being assembled in the field, shall be available as an option, above 2600 mm in diameter.

Wheels above 3400 mm in diameter shall be segmented and provided with wing structures spokes and flanged rim. The segmented wheels shall be provided with field rotation adjustment mechanism.

The HRW hub shall be fabricated out of heavy duty steel in order to have high mechanical strength. Light duty Aluminum hub shall not be accepted.

The surface of the wheel/rotor should be highly polished (FACED) to ensure that the vertical run out does not exceed ± 1 mm for every 1 metre diameter, thereby ensuring, negligible leakage, if labyrinth non contact seals are provided, and minimal drag, if contact wiper seals are provided.

The radial run out also shall not exceed ± 1 mm for every 1 meter diameter, thereby minimising the leakage/drag on the radial seals, and minimise the fluctuation in the tension of the drive belt.

The number of wraps (of alternative corrugated and flat foil) for every inch of rotor radii shall be very consistent so as to ensure uniform air flow and performance over the entire face in the air stream. Flute height and pitch will be consistent to a very tight tolerance to ensure uniform pressure drop and uniform airflows across the rotor face.

The rotor shall be a non clogging aluminum media, having a multitude of narrow aluminum foil channels, thus ensuring a laminar flow, and will allow particles upto 800 microns to pass through it.

The media shall be cleanable with compressed air, or low pressure steam or light detergent, without degrading the latent recovery.

The Cassette / casing

The recovery wheel cassette/casing shall be manufactured from tubular / sheet metal structure to provide a self supporting rigid structure, complete with access panels, purge sector, rotor, bearings, seals, drive mechanism complete with belt. The sheet metal should be coated with a special corrosion inhibitor coating and a certificate for the same should be provided.

The rotor/wheel should have a field adjustable purge mechanism to provide definite separation of airflow minimising the carryover of bacteria, dust and other pollutants, from the exhaust air to the supply air. It shall be possible, with proper adjustment, to limit cross contamination to less than 0.04% of that of the exhaust air concentration.

The face and radial seals shall be four (4) pass non contact labyrinth seals / brush seals for effective sealing between the two air streams, and also for a minimum wear and tear ensuring long life of the seals.

PERFORMANCE TESTING

The HRW manufacturer shall have in-house test facilities for performance testing of HRWs. If required the manufacturer shall be able to offer type testing of HRWs at their works and submit a type test report.

The manufacturer shall have test facilities for carry over testing at the same facilities where HRWs are manufactured..

A I R S I D E E Q U I P M E N T & A S S O C I A T E D W O R K S

L–2
AIR HANDLING UNIT

PART 1 GENERAL

2 **Related Work**

2.1.1 AHU Construction

2.1.2 Motors

2.1.3 Vibration Insulation

2.1.4 Filters and Dampers of AHU

2.1.5 HVAC Air Test and Balancing

2.2 **Submittals**

Submit product data including dimensions as shown in the tender drawings, ratings as mentioned in the tender document and performance data for review

2.3 **Performance**

2.3.1 Select unit components, in accordance with the specifications

2.3.2 Select coils in accordance with ARI standard 410 . Substantiate performance

All AHU's shall be Euro vent certified.

PART 2 PRODUCTS

2.4 **Acceptable Manufacturers**

As per approved list of manufacturers in the annexure

2.5 **General**

Fabricate draw through / Blow through type air handling units as specified in the BOQ, suitable for the scheduled air pressure operations.

The air handling units shall be double skin construction, draw–thru / Blow through type comprising of various sections such as filter section, chilled water coil section, fan section mixing box, thermal break profile, and a weather proof canopy, as per details given in Drawings and Schedule of Quantity. All dampers on the weather exposed Air handlers shall be of Aluminum construction and having an aerofoil profile.

2.6 **Basic Relevant Design Parameters for Air Handlers**

#	Parameter	Outer Limit
1	Maximum face velocity across pre-filters.	150 M/Min

2	Maximum face velocity across cooling/Heating coil.	152 M/Min
3	Maximum fan outlet velocity.	550 M/Min
4	Maximum fan speed (Above 300 mm dia)	1000 RPM
5	Fans up to 300 mm dia	1440 RPM
6	Maximum fan motor speed	1440 RPM

2.7 **Centrifugal Fans**

Maximum fan outlet velocity for fans upto 450 mm dia : 550 M / Min.

Maximum fan outlet velocity for fans above 450 mm dia : 700 M / Min.

Maximum fan speed for fans upto 450 mm dia : 1450 RPM

Maximum fan speed for fans above 450 mm dia : 1000 RPM

Provide vibration isolators, duly selected for deflection and operating weight.

2.8 **Capacity**

The air handling capacities, maximum motor H. P., static pressure shall be as shown on Drawing and in Schedule of Quantity

2.9 **Housing and Casing**

2.9.1 **Housing/Casing-Incase of Double Skin Construction**

2.9.1.2 The housing/casing of the air-handling unit shall be of double skin construction. The Framework shall be of Extruded Aluminum hollow sections. All the frame shall be assembled using pressure die cast aluminum joints to make a sturdy, strong & self-supporting framework for various sections.

2.9.1.2 23+/-1 mm thick Double Skin Panels shall be made of 0.80mm Pre-painted GSS / Pre-plastified / pre-painted GSS on outside and 0.80mm Galvanised sheet inside with P.U. insulation injected in between. These panels shall be screwed on to the frame work with soft rubber gasket fixed in built-in groove of aluminium frame in between to make the joints air tight. **Each air handler shall have a leak proof viewing window and an inspection light. The inspection light switch shall be located outside the AHU.**

2.9.1.3 Frame work for each section shall be jointed together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on Rolled Formed GSS channel frame work having pressure die cast aluminum jointers.

2.9.1.4 Insulation Drain Pan shall be constructed of 1.0mm SS (non welded) with necessary slope to facilitate fast removal of condensate. Necessary arrangement will be provided to slide the coil in the drain pan.

2.9.1.5 Air handlers suitable for out-door application shall have 40-43mm thick insulation of specified type in between the double skin panels. The metallic contacts shall have a thermal break profile of slide on type construction. Similar type of thermal break profiles shall be used for AHUs which have a mixing box but are not exposed to atmosphere and the recommended thickness of insulation shall be 25 mm thick.

2.9.2 **Housing/Casing-Incase of Single Skin Construction**

2.9.2.1 The housing/casing of the air handling unit shall be of single skin construction. The Frame work shall be of Extruded Aluminium hollow sections. All the frame shall be assembled using pressure die cast aluminium joints to make a sturdy, strong & self supporting frame work for various sections

2.9.2.2 Panels shall be made of 1.3 mm Pre-painted GSS / Pre-plastified / pre-painted GSS. These panels shall be screwed on to the frame work with soft rubber gasket fixed in built-in groove of aluminium frame in between to make the joints air tight.

2.9.2.3 Frame work for each section shall be jointed together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on Rolled Formed GSS channel frame work having pressure die cast aluminum jointers.

2.9.2.4 Drain Pan shall be constructed of 1.00 mm SS with necessary slope to facilitate fast removal of condensate. Necessary arrangement will be provided to slide the coil in the drain pan.

2.9.2.5 The blower and coil sections (including the sandwithched drain pan section)shall be thermally insulated with cross linked polyethylene foam / nitrile foam of 18 mm thickness.

2.10 **Motor and Drive**

Fan motors shall be 415 for 10% volts, 50 cycles, 3 phase, squirrel- cage, totally enclosed fan cooled with IP–55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement or **direct driven/Plug** fan. If belt driven than Belts shall be of the oil-resistant type.

2.11 **Fan**

The fan shall be backward/forward in curved, Plug/double inlet double width type. The wheel & housing shall be fabricated from heavy gauge galvanised steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame & pillow block heavy-duty ball bearings. The fan shall be selected for a noise level less than 70-80 db (A). The impeller & fan shaft shall be statically and dynamically balanced. The Fan outlet velocity shall not be more than 550 M/Min. Fan housing with motor shall be mounted on a common extruded aluminum base mounted in side the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric acting as a flexible connection for anti-vibration.

THE FAN WILL HAVE INLET GUIDE VANES WHEREVER VFD IS SPECIFIED TO BE INSTALLED

2.12 **Cooling / Heating Coils**

Chilled/hot water coil shall have 12.5 mm to 15 mm dia tubes minimum 27 G thick with aluminum fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face & surface areas shall be such as to ensure rated capacity from each unit & such that air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg per Sq. air pressure under water. Tube shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 11 to 13 fins per inch (4 to 5 fins per cm).

2.13 **Filters**

Each unit shall be provided with a factory assembled filter section containing washable expanded viscous metal air filters having extruded aluminum frame. The media shall be supported with aluminum mesh on both sides. Filters face velocity shall not exceed 150 meters per minute. Filter shall fit so as to prevent by pass. Holding frames shall be provided for installing a number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels.In TFA Filter section with fine & ESP/EAC filter.

Nano Filter

Nanotechnology filter that is Nano clean filter having life of 4 year is entirely inseparable filter media and the material should be Nano-technology filter media in which Fibers should be water insoluble. Filter technology should be acknowledged by government of India. Also should have test report from NABL/ ILAC accredited or central government lab or international certificate from ASTM to prove conformity of products to the specification to the buyer at the time of supply. The product should be made in India.

Micro VEE Filter : (In AHU)

Filter Media: Non Woven Synthatic(Deep Pleated Panel/Pocket type)/Fire retardant Media

Media Support: Al./GI Mesh

Frame Material: Al./SS

Max. Op. temp.: 80°C

Sealent: Epoxy Resin/PU

Gasket: Syn. Rubber/PE Foam/Silicon/Neoprene

Pressure Drop: Intial 5.5 mm and final/drop conditions is 20 mm

Direction Of Air Flow: Flange to cassette/cassette to flange (Flange width 30mm)

Average Efficiency: 40 to 50% (Approx. micron n 99% at 5 microns)

Test Methods of Efficiency : As per ASHRAE 52.1/EN 779

Cleanable/Washable: Cleaned by compressed air(Pressure Max. 5 Kg/cm2) or Dip washed by any mild liquid detergent (Ensure Full Removal of detergent by repeated clean water wash, do not use any brush. Refix filters only when properly dried.)

Air Purifier (UVGI):

The specified products will be packaged with a plan and drawing for the installation of the
lamp assemblies as supplied by the manufacturer‘s installation manual, indicating the
orientation (upstream, downstream, or both sides of the coil) of the installation. The UVGI
should be UL-2043 & UL-1995 listed. The computer simulation provided by the manufacturer will state the irradiation of the specified organism.
Each UV-C lamp will be attached to a parabolic reflector that will reflect the UV-C energy
in order to effectively irradiate the HVAC coil surface and drain pan. The reflector will be
built from an high UV reflectivity material – Aluminum capable of withstanding air

velocities of up to 2000 ft/min. without excessive noise, wobble, or vibration The electronic
power supply will be mounted on a rigid surface outside of the AHU in an adequate enclosure protecting it from moisture and humidity.

UV LAMP & PERFORMANCE

The UV-C lamp will be a low-pressure mercury type, internally coated to reduce solarization and of such intensity as to provide minimum performance as listed below. The
UV-C lamp will produce only Germicidal UV (by definition this means 99.99% UV-C energy). Net output will be at least 300 microwatts/cm2 per inch of lamp at 1 meter of UV-
C energy (after Burn-In) in the 245 nm to 266 nm. band while operating at nominal temperature in an air stream moving at 400 fpm. The lamp shall be hot cathode type T5
lamps. The lamp performance shall be submitted for each coil considering the intensity at
the end of the useful lamp life ie 12,000 hours.

CONTROL, INSTALLATION & MAINTENANCE

Each fixture will be self-supporting when attached to the AHU coil or wall(s). The fixtures
shall be non-corrosive hardware so that the fixture does not vibrate or loosen. Safety interlock switches are to be installed on all access doors where UV intensity may be present. The system shall have the option of UV Radiometer with data logging capabilities including one (1) UV-C sensor to monitor the UV intensity and report via the
BMS, the lamp intensity, days of operation in real time. The radiometer shall be capable of
actual intensity display on basis of actual measurement & not relative intensity. The radiometer shall have programmed baseline reset facility. The power source will be an
electronic type, program start with a power factor greater than 0.95 and an energy conversion of at least 75%. It shall be a universal 120-277 VAC, 50-60 Hz, unit and be
operationally reliable in indoor environments ranging from 45°F (8°C) lo 170°F (86°C)
temperature, with relative humidity up to 100%.

The system shall be a provided by a visible indicator and audible alarm on each control
panel & signal which indicates if lamp is functioning or if a lamp has failed, lamp is due for
replacement. LED notification on the Control Panel shall be with Audible alarm at the Control Panel & BMS through a dry contact. The system shall have BMS compatibility
with NO-C-NC.

As it is a critical system hence it shall be supplied and installed by either OEM directly or by authorised system integrator only. In case of authorised system integrator no case specific authorisation letter shall be acceptable.

2.14 **Safety Features**

Each Air Handling Unit must have safety features as under:

The Fan Access Door shall be equipped with micro–switch inter locked with fan motor to enable switching of the fan motor automatically in the event of door opening.

The Access Door shall further have wire mesh screen as an added safety feature bolted on to the unit frame.

Fan and motor base shall be properly earthed

All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

2.15 **Performance Data**

Air handling units shall be selected for the lowest operating noise level (Not more than 70 dBA at 1 M from the AHU at a non-ducted condition) of the equipment. Fan performance rating and power consumption data, with operating points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

2.16 **Testing**

Cooling/heating capacity of various air handling unit models shall be computed from the measurements of air–flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury in glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

2.17 **Installation**

2.17.1 Rigidly install Air handlers and base rails on a concrete curb , pedestals of sufficient height to install proper size condensate drain pipe. **All ceiling suspended air handlers shall have additional vibration isolators (In addition to the fan isolator in the AHU casing), on the suspenders.**

2.17.2 Provide clearance at each unit for routine service and Coil removal, changing of filters, bearing greasing, opening of access doors , pulling of blower shaft , and removal of motors.

2.17.3 Duct Work connection: Duct connectors to each unit to allow for straight and smooth air flow . Do not install turns at the fan discharge which are in the opposite direction to the fan wheel rotation.

2.17.4 Piping: Support piping independently of coils and with adequate flexibility to prevent undue stress at coil header connections. Install service valves on both supply and return pipes to coils so as to shut off the water supply , remove a small portion of pipe and enable the coil to be slid out easily.

2.18 **REFER ACOUSTICS AND VIBRATION CONTROL CHAPTER IN THIS BOOK FOR INSTALLATION PRACTICES.**

2.19 **Accessories**

The following accessories, although some of these mentioned separately in the BOQ are to form the part of the air handlers and the scope of supply , install, test and commission.

Pre,Nano,ESP/EAC filters & Fine filters	Built in the cost of AHU
Door limit switch	Built in the cost of AHU
2/3 way diverting motorized valves	Separately itemized in the BOQ
Pressure gauges	Separately itemized in the BOQ
Viewing window with inspection light and switch (switch to be mounted outside the AHU)	Built in the cost of AHU
Industrial thermometers	Separately itemized in the BOQ

L- 3
FAN COIL UNITS

PART 1 GENERAL

3.1 **Related Work**

3.1.1 FCU & Motors

3.1.2 Vibration Insulation

3.1.3 Filters

3.1.4 HVAC Air Test and Balancing

3.2 **Submittals**

Submit product data including dimensions as shown in the tender drawings, ratings as mentioned in the tender document and performance data for review.

3.3 **Performance**

3. 3.1 Certify unit components, in accordance with the specifications

3. 3.2 Certify coils in accordance with ARI standard 410. Substantiate performance

PART 2 PRODUCTS

3.4 **Acceptable Manufacturers**

As per approved list of manufacturers in the annexure

3.5 **Scope**

The scope of this section comprises the supply, erection, testing and commissioning of fan coil units conforming to these specifications and in accordance with the requirements of the Drawings and Schedule of Quantities.

3.6 **Type**

The fan coil units shall be vertical type of floor mounting, horizontal type of ceiling suspension, or bare units for completely recessed installation. Floor mounted vertical units shall discharge into a supply air plenum fitted with adjustable discharge grille supplying horizontally; ceiling suspended units shall have horizontal discharge, and horizontal units mounted within ceiling space shall have horizontal discharge. All units shall be complete with chilled water coil, one or more centrifugal fans and motor. Cleanable expanded viscous metal, double wall insulated condensate drain pan. Horizontal fan coil units shall be provided with auxiliary secondary condensate drain pan, irrespective of the schedule of quantities or the tender drawings.

3.7 **Capacity**

The air moving and coil capacities shall be shown on Drawings and indicated in Schedule of Quantities.

3.8 **Cabinets**

Cabinets shall be constructed of 1.25 mm thick die-formed CRCA sheet steel, bonderized and powder coated. Corners shall be rounded without break lines. the

cabinet shall be of sufficient size to enclose all piping and control valves and shall have access doors to piping and controls. Access panel shall have positive locking fasteners for easy removal. Cabinets shall be provided with all floor mounted vertical units and ceiling suspended horizontal units. Horizontal units mounted within ceiling space shall be provided with a cabinet housing coil and fan section with provision to mount filters within the fan section.

3.9 **Interior Chassis**

The interior chassis shall be constructed of not less than 1.2 mm thick cold rolled steel and coated with a rust inhibiting paint. All fan coil units shall be securely mounted from the building structure with top panel set dead level in both directions. The fan deck shall be easily removable from FCU without disturbing the other installations.

3.10 **Drain Pan**

Primary drain pan shall be fabricated from 0.80 mm thick Stainless Steel with all corners welded and an additional inner bottom panel of 1.25 mm thick cold rolled galvanised sheet steel shall be provided to prevent damage to, and floatation of the bottom panel insulation. The pan shall be insulated with not less than 15mm thick expanded polyethylene insulation sandwiched between top and bottom panels to effectively prevent condensation. The pan shall be of sufficient size to catch all dripage of condensation from any part of the unit. In all cases pan shall be large enough to cover cooling coil supply and return water headers and bends, and control valves. An extension condensate pan similar to primary drain pan shall be provided by the manufacturer of those units where coil connections are to be made on both ends of the coil.

3.11 **Auxiliary Condensate Drain Pan**

As shown on drawings/Schedule of Quantities horizontal fan coil units mounted within false ceiling space may be provided with an auxiliary condensate drain pan similar to primary drain pan in construction and sized larger than primary drain pan to catch all overflow in case primary drain pan outlet gets choked. Drain from auxiliary condensate drain pan shall be connected to the drain from primary drain pan through a tee connection and piped to the vertical risers.

3.12 **Cooling Coil**

All cooling coils shall be standard three-row staggered seamless copper tube with aluminum sine wave fins. Tubes shall be hydraulically expanded for mechanical bondage with fins mechanically. Tubes shall be minimum 10mm($3/8^{th}$ Inch) OD and wall thickness shall be minimum 0.5 mm. All bends and joints shall be enclosed within insulated end sections of the base unit for protection against sweating. Each coil shall be provided with an air vent. All coils shall be factory tested at 21 KG per sq. cm. (300 psig) air pressure while submerged in water. Fin spacing shall be 4 to 5 fins per cm. Tubes shall be mechanically/hydraulically expanded for minimum thermal contact resistance with fins. Air vent shall be provided in headers at a level higher than coils. The cooling coil shall be easily removable from backside of FCU without disturbing the other installations.

3.13 **Fan**

Fans shall be centrifugal forward curve DIDW type, direct driven by a shaded pole motor.

3.14 **Motor**

Motor shall be a 220±6% volt. 50 cycles single phase, six pole, shaded pole type, speed not exceeding 1000 rpm at maximum airflow. Motors shall have three speed windings and shall be factory wired to a terminal block mounted within the fan section. Motors shall have extended shaft on both sides.

3.15 **Mixing Box**

Where ever specified in the BOQ. This section, whenever asked for, shall effect into following:

3.15.1 Totally insulated FCU down stream of coil, with 18mm NITRILE FOAM / CROSS LINKED POLYETHYLENE FOAM.

3.15.2 Thermal break profile to avoid condensation

3.15.3 Mixing box (insulated) with thermal break profile for inhibition of condensation .

3.16 **Installation**

Ceiling suspended horizontal units and units mounted within the ceiling space shall be hung through Dunlop/Emerald make rubber-in-shear vibration isolator suspenders. (Refer the acoustics and vibration control chapter for this).

3.20 **Accessories**

3.20.1 All fan coil units shall be equipped with copper piping connections and manual air vent at the cooling coil. In addition, the following accessories may be required at fan coil units; their detailed specifications are given in individual sections and quantities separately in Schedule of Quantities.

3.20.2 Wall mounted thermostat for individual unit, containing three speed **ON** and **OFF** control for fan speed and temperature control for summer/winter air conditioning.

3.20.3 Motorized two/Three-way valve in water lines for individual unit, or for a group of fan coil units, as mentioned in the drawings.

3.20.4 'Y' strainer, globe valve as shown on drawings/Schedule of Quantities.

HIGH STATIC FAN COIL UNITS SHALL HAVE SUFFICIENT EXTERNAL STATIC PRESSURE TO ALLOW FOR A MINIMUM OF 15 M (Equivalent) DUCT LENGTH.

L- 4

AIR REGISTERS

SHEET METAL ACCESSORIES

PART 1 **GENERAL**

4.1 **Work Included**

4.1.1 Air Distribution Registers, grilles, diffusers .

4.1.2 Fire / Smoke Dampers

4.1.3 Access Doors

4.1.4 Outside Air Louvres

4.1.5 Flexible Ducts

4.2 **Related Works**

4.2.1 Ordinary Duct Work : GSS / Aluminum

4.2.2 Special Duct Work : For Kitchen / Exhaust

4.3 **Quality Control**

4.3.1 Air Diffusers/Grilles: As per ratings by Air Diffusion Council / As per approved manufacturer.

4.3.2 Fire / Smoke / Combination dampers : UL , NFPA 90A / 90 B.

4.4 **Submittals**

Submit manufacturer's product data for review

PART 2 **PRODUCTS**

4.5 **Grills / Diffusers / Fire-Smoke Dampers**

4.5.1 Acceptable manufacturer : As per approved list.

4.5.2 Ceiling diffuser/Grilles shall be of Extruded aluminum construction as per the specifications detailed hereunder.

Jet nozzle diffusers are most suitable when large spaces need to be treated or when the ceiling is relatively high. They are often used in concert halls, museums, theatres, shopping centers, airports etc. The up to 45 degrees possible inclination of the jet helps directing the air to the right places. The diffusers are very efficient for both hot and cold air and they can be directed down or up accordingly to the supplied air temperature. Throws of more then 20 meters can be achieved.

4.5.3 **Air Register**

The scope of this section includes supplying, installation, testing, balancing and commissioning of various air distribution products as specified here under. All air distribution products shall have guaranteed performance rating as regards to air quantity, throw, noise level and pressure drop etc. Contractor has to provide selection curves at the time of supply.

4.5.4 **Supply and Return Registers and Ceiling Terminals**

Supply and return air registers and ceiling terminals shall be made of extruded aluminium section as specified in BOQ. The registers/terminals shall be either anodised or powder coated in finish as given in BOQ. Supply air registers/terminals shall be provided with screw operated opposed blade volume control device of extruded aluminium in mill finish. The registers shall be suitable for fixing arrangement concealed or visible screw as approved by architect/consultant.

All registers shall be selected as per selection curves and in consultation with architect/consultant. All registers shall have soft continuous rubber/ foam gasket between the periphery of the registers/terminals and the surface on which it has to be mounted.

4.5.5 **Linear Registers**

Linear continuous supply or return air register shall be extruded aluminium construction with fixed horizontal bars at 0 ° or 15 ° inclination with one way or two way deflection and flanges on both sides. The thickness of fixed bar louvers shall be 5 mm in front and the flange shall be 20 mm wide with round edges. The register shall be suitable for concealed fixing and horizontal bars of the register shall be mechanically crimped from the back to hold them.

Volume control device of extruded aluminium construction in mill finish shall be provided in S.A. duct collars.

4.5.6 **Single Individual Adjustable Louvered Supply or Return Air Register**

Single individual adjustable horizontal /vertical supply or return air register shall be made of extruded aluminium construction. The louvers shall hold deflection settings under all conditions of velocity and pressure since mounted on Nylon bushes. The register shall have 20 mm wide flange all around with front screw fixing.

Volume control device of extruded aluminium / GI construction in mill finish shall be provided in S.A. duct collars.

4.5.7 **Double Adjustable Louvered Supply/Return Air Register with Horizontal / Vertical or Vertical/Horizontal Louver Arrangement**

The register hall be adjustable as each louver shall be pivoted to provide pattern with 0° to plus or minus 15° arc up to 30° deflection down towards. The louver shall hold deflection settings under all conditions of velocity and pressure. The Rear louver of the register shall be in black shade.

Volume control device of extruded aluminium construction with mill finish shall be provided in S.A. duct collars.

4.5.8 **Rectangular Fixed Bar Register**

Supply/Return air all side flange air register shall be extruded aluminium construction with fixed horizontal bars at 0° or 15° inclination with one way or two way deflection and flanges on both sides. The thickness of fixed bar louvers shall be 5 mm in front and the flange shall be 20 mm wide with roundedges. The register shall be suitable for concealed fixing and horizontal bars of the register shall be mechanically crimped from the back to hold them.

4.5.9 **Exhaust Air Register**

Exhaust air register shall be made of extruded aluminium with fixed horizontal louvers at 40° angle setting on a 20 mm louver pitch. The register shall have 20 mm wide flange with round edges all around. The register shall be suitable for front screw fixing.

Volume control device of extruded aluminium construction in mill finish shall be provided in S.A. duct collars.

4.5.10 **Square Ceiling Air Terminals**

Square/Rectangular ceiling air terminals shall be made of extruded aluminium construction with flush fixed pattern. The terminals shall have Anti-Smudge ring and spring loaded removable central core in various pattern for air flow direction. The terminal shall be mounted by concealed screw fixing arrangement. The supply air terminal to be supplied with Volume control device of extruded aluminium construction in mill finish. Laminar Air Flow Pattern Diffuser used in OT's.

4.5.11 **Curved Blade Ceiling Terminals**

Square /rectangular curved blade ceiling terminals shall be made of extruded aluminium. The terminals shall have individual adjustable blades mounted on nylon bushes which facilitate to adjust the direction of air as per site conditions. The terminals shall have 20 mm wide flanges all around and concealed screw fixing arrangement. The supply air register to be supplied with Volume control device of extruded aluminium construction in mill finish.

4.5.12 **Volume Control Device**

Opposed blade volume control device shall be made of all extruded aluminium construction in mill finish. Opposed blades shall be pivoted to extruded aluminium frame with Nylon bushes . Specially designed blade have an overlapping lip which ensure a tight closure.

4.5.13 **Ventilation Air Intake Louvers**

Ventilation air intake louvers 50 mm deep wherever required as per shop drawing will be made of extruded aluminium construction duly Anodised or Powder coated. Bird/insect screen will be provided with the intake louvers. The blades are inclined at 45 °on a 40 mm blade pitch to minimise water ingress. The lowest blade of the assembly shall extended out slightly to facilitate disposal of rain water without falling in door/wall on which it is mounted.

Wherever specified, the intake louvers shall be provided with factory fitted all aluminium construction volume control dampers in mill finish.

4.5.14 **Storm Proof Louvers**

80mm deep wherever required as per shop drawing will be made of extruded aluminium construction. The blades are inclined at 45 degree on 75 mm blade pitch to minimise water ingress. The lowest blade of the assembly shall extended out slightly to facilitate disposal of rain water without falling in door / wall on which it is mounted.

4.5.15 **Air Transfer Door Register**

Extruded aluminium construction air transfer door register will be provided as per approved shop drawings. The register will be complete with single /double register frame to be mounted on door panel from both sides. The central core shall be NO-SEE-THRU type. The register shall be anodised or powder coated as per Architect's requirement. The register shall be provided with insect screen to prevent movement of insects from inside to outside or vice versa.

4.6 **Fire and Smoke Damper**

4.6.1 ACCEPTABLE MANUFACTURER : As per approved list in annexures.

4.6.2 DAMPER FIRE RATINGS: Minimum 120 minutes.

4.6.3 SMOKE DAMPER : Operator : Electric

4.6.4 COMBINATION FIRE AND SMOKE DAMPER : Operator : Electric

4.6.5 **Motorised Combined Smoke & Fire Dampers - Spring Return**

All Supply and Return Air Ducts at AHU room crossings and at all floor crossings shall be provided with approved make fire and smoke dampers of atleast 120 minutes fire rating certified by CBRI Roorkee as per UL 555:1973.

4.6.8 Fire Damper blades & outer frame shall be formed of 1.6MM galvanised sheet steel. The damper blade shall be in pivoted on both ends using chrome plated spindles in self lubricated bronze bushes. Stop seals will be provided on top and bottom of the damper housing made of 16 G galvanised sheet steel. For preventing smoke leakage side seals will be provided.

4.6.7 In normal position damper blade shall be held in open position with the help of a 24V operated electric actuators thereby providing maximum air passage without creating any noise or chatter.

4.6.8 The damper shall be actuated through electric actuator. The actuator shall be energised with the help of a signal from smoke detector (supplied by others) installed in AHU Room/R.A.Duct/Damper. The Fire Damper shall also close due to Temp.rise in S.A. Ducts thru the Electric Temp.sensor factory set at 165° F micro switches with bakelite base will be provided to stop fan motor and give open & close signal at remote panel in case of motorised actuator.

4.6.9 Each Dampers in case of motorised Smoke-cum-Fire Damper shall have its own panel which will incorporate necessary circuit required to step down voltage available from UPS or Emergency Power Supply to shown status of the damper (open or close), to allow remote testing of damper & indication in event of damper closure due to signal from smoke sensor/Temp.sensor & reset button. Additional Terminal will be provided to have signal (sound beep or visual) in Central Control Room.

4.6.10 Damper Actuator shall be spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored.

4.6.11 The Fire Dampers shall be mounted in fire rated wall with a duct sleeve 400MM long. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be Slip on type. Minimum thickness of G1 Sheet shall be 18 G.

4.6.12 The damper shall be installed in accordance with the installation method recommended by the manufacturer.

4.6.13 After installation of Fire Dampers, contractor will co–ordinate with the civil contractor on site and get the extra openings sealed, and then finally finish the installation by sealing the area, using approved make of mastic fire sealant.

4.7 **Flexible Ducts**

4.7.1 Insulated with 25 mm thick fibre glass insulation.

4.7.2 Seal off the insulation jacket at its ends and at joints with mastic, hard cast or similar material.

4.7.3 Complete insulation coverage up to the Terminal Air Unit.

4.7.4 No bends shall be made in flexible ducts with the centre line radius less than one and a half duct diameter, and only one bend shall occur per three feet length of duct.

AIR SIDE EQUIPMENT & ASSOCIATED WORKS

L- 5

VENTILATION FANS

PART 1 **GENERAL**

5.1 Related Work

5.1.1 Motors

5.1.2 Vibration Insulation

5.2 Submittals

5.2.1 Submit product data including dimensions as shown in the tender drawings , ratings as mentioned in the tender document , and performance data for review

PART 2 **PRODUCTS**

5.3 Acceptable Manufacturer's
As per list of approved manufacturers in annexures.

5.3.1 General
The contractor shall supply install, test and commission ventilation fans wherever shown on the drawings and as scheduled. The system shall be complete in all respects and comply with the specification given

5.3.2 Fans shall be of the type, size, arrangement and capacity as indicated in the schedule and/or as shown on the drawings

5.3.3 Unless specified, fans performance rating data shall be tested accordance with AMCA Standard 210-85 (Air Moving and Conditioning Association), ANSI/ASHRAE Standard 51-1985 "Laboratory Methods of Testing Fans for Rating". Sound ratings shall conform to AMCA Standard 300-85, "Reverberant Room Method for Sound Testing of Fans"

5.3.4 A computer printout of fan performance rating corresponding to the AMCA licensed data, with corrected ratings for altitude and temperature, fan operating speed, bearing life, etc. shall be submitted for approval.

5.3.5 All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly. A computer printout with the vibration spectrum analysis shall be attached to the fans.

5.3.6 Fan motors shall comply in all respects with continuous rating in accordance with IEC34 or equivalent. Motor bearings shall be of ball or roller type, grease or lubricant sealed for life. Fan and drive shall be earthed to prevent accumulation of static charge.

5.3.7 KITCHEN EXHAUST FAN SHALL BE OF BIFURCATED AXIAL OR SISW CENTRIFUGAL DIRECT OR BELT DRIVEN TYPE. DIDW CENTRIFUGAL AND DIRECT DRIVE AXIAL FLOW FAN WHERE BELTS OR MOTOR ARE IN THE AIR STREAM ARE NOT ACCEPTABLE.

5.3.8 FANS FOR ELEVATED TEMPERATURE (SMOKE SPILL DUTY) WITH COMPONENTS RATED FOR HIGH TEMPERATURE (250 DEG C, 2.0 HRS DUTY) SERVICE SHALL BE PROVIDED.

5.4 **Capacity**
The air handling capacities, maximum motor H. P, static pressure shall be as shown on Drawing and in Schedule of Quantity.

5.5 **Type**:
Axial Flow Fans (Direct Drive)

5.5.1 Inline fans shall be of the direct drive vane / tube axial type with cast Aluminum airfoil / extruded Aluminum propellers.

5.5.2

5.5.3 The casing shall be constructed of continuously welded galvanized steel or Mild steel and should include integral punched inlet and outlet flanges to prevent air leakage. If the manufacturer is using GSS, the sheet should be of minimum 220gms coating. All the mild steel fans should either be hot dip galvanized or to be primer coated and finished with powder coating.

4.5.4 The motor shall either be foot mounted or flange mounted supported through a motor mounting plate of suitable size as per manufacturer design.

5.5.5

5.5.6 Blades shall be of airfoil design and the entire rotor shall be made out of cast or fabricated Aluminum. All rotors shall be statically and dynamically balanced as per AMCA 204-05 standard to a minimum of BV-3 level.

5.6 **Centrifugal Fans**

5.6.1 Fans, forward or **backward** curved, SISW or DIDW, shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal.

The test standard used shall be ANSI/AMCA 210-85, ANSI/ASHRAE Standard 51-1985 “Laboratory Method of Testing Fans for Rating” and AMCA 300 “Reverberant Room Method for Sound Testing of fans”.

5.6.2 All fans shall be dynamically trim-balanced to ISO1940 and AMCA 204/3 - G2.5 quality grade after assembly.

5.6.3 Fans shall be oven-baked with polyester coating for minimum thickness of 60 microns, unless the housing scroll and side frame is constructed from galvanized steel sheet (G.I.), Stainless Steel, Aluminum and etc.

5.6.4 Fans must be physically capable of operating safely at every point of rating at or below the “minimum performance” limit for that class as defined in AMCA standard 99-2408-69 “Performance Class of Operating Limits for Centrifugal Fans”.

5.6.5 Shafts shall be made of carbon steel (C45) machined and polished to tolerance of standard ISO 286–2–grade g6. Protective coat of anti-rusting shall be applied to all bare surfaces of the shafts at the factory.

5.6.6 Bearings shall be of self-alignment (concentric) type with adaptor sleeve bearing. Bearings of eccentric locking collar with grub screw type are not acceptable. Bearing shall be maintenance free with permanently lubricated sealed ball bearing type. Bearing life shall be at least 75,000 hours based on basic rating life, L10 of ISO 281 standard. Calculation sheet of Bearing Life shall be submitted for approval.

5.6.7 Motor installed shall be of a minimum 130% of the fan power absorbed (Brake horsepower) and shall have sufficient torque available for starting and continuous operation.

5.6.8 Belts and pulleys shall be sized for a minimum 150% of the installed motor horsepower. The belt speed shall not exceed 30m/s. The pulley shall be of Taper Lock SPZ, SPA, SPB or SPC type. Conventional type of pulley is not acceptable. Both fan and motor pulley shall be balanced to the quality grade G.2.5.

5.7 **In-Line Centrifugal Duct Fan**

5.7.1 Fan shall be of SISW, **backward** curved centrifugal, direct driven type.

5.7.2 Casing shall be of Galvanized steel with Oven-baked epoxy coating. Impeller material shall be either Galvanized Steel or Glass Reinforced Polypropylene

5.7.3 Motor shall be external rotor type for power supply 220~240V/50Hz/Single Phase.

5.8 **Propeller Fan**

5.8.1 Fans shall be of the ring-mounted type and the blades constructed from heavy gauge metal. An aerodynamically designed bell mouth constructed from heavy gauge metal shall be provided. The fan speed shall not exceed 1400RPM at 50Hz operation.

5.8.2 Propeller fans shall be direct driven type, the motor either a single-phase capacitor start-run or a three-phase squirrel cage induction type. The motor shall have inbuilt inherent protection against overloading. Motor with shaded pole or centrifugal switch type is not acceptable

5.8.3 Bearings shall be maintenance free permanently lubricated type. Fans shall be complete with wire guards. External grilles, fan chambers and volume control damper shall be provided where indicated in the specification drawings.

5.9 **Ventilation Units (Fan Sections)**

5.9.1 The scope of this section, comprises the supply, erection, testing and commissioning of double / single skin construction Ventilation units, conforming of these specifications and in accordance with requirements of Drawings & of the Schedule of Quantities.

5.9.2 The Ventilation units shall be double /single skin construction, draw–thru type comprising of various sections such as plenum chamber (wherever the Exhaust Air is ducted) filter section and filter, fan section as per details given in Drawings and Schedule of Quantity.

5.10 **Capacity**

The air handling capacities, maximum motor H. P., static pressure shall be as shown on Drawing and in Schedule of Quantity

511 **Housing / Casing (Single Skin)**

The housing/casing of the air handling unit shall be of Single skin construction. The Frame work shall be of Extruded Aluminum hollow sections.

Frame work for each section shall be jointed together with soft rubber gasket in between to make the joints air tight. Suitable air tight access doors/panels with Nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on Rolled Formed GSS channel frame work .

5.12 **Motor and Drive**

Fan motors shall be 415 for 10% volts, 50 cycles, 3 phase, squirrel- cage, totally enclosed fan cooled with IP - 55 protection. Motor shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type.

5.13 **Fan**

The fan shall be **backward** curved, double inlet double width type. The wheel & housing shall be fabricated from heavy gauge galvanised steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame & pillow block heavy duty ball bearings.

The fan shall be selected for a noise level less than 80 db (A). The impeller & fan shaft shall be statically and dynamically balanced. The Fan outlet velocity shall not be more than 10.0 M/SEC. Fan housing with motor shall be mounted on a common base mounted in side the air handling housing on anti-vibration mounts. The fan outlet shall be connected to casing with the help of fire retardant fabric acting as a flexible connection for anti-vibration.

5.14 **Filters**

Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having extruded aluminium frame as specified in BOQ. The media shall be supported with HDP mesh on one side and aluminium mesh on other side. Filters face velocity shall not exceed 150 meters per minute. Filter shall fit so as to prevent by pass. Whenever fine filter are required to be installed, unit shall be provided with factory fabricated plenum chamber in double skin construction as described above for casing specification. The fine filter shall incorporate pocket filters which will have an efficiency of not less than 95% by ASHRAE standard corresponding to Eurovent standard EU-5.

5.15 **Safety Features**

Each Ventilation Unit must have safety features as under:

5.15.1 The Fan Access Door shall be equipped with micro-switch inter locked with fan motor to enable switching of the fan motor automatically in the event of door opening.

5.15.2 The Access Door shall further have wire mesh screen as an added safety feature bolted on to the unit frame.

5.15.3 Fan and motor base shall be properly earthed from the factory

5.15.4 All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

5.16 **Performance Data**

Ventilation units shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data, with operating points clearly indicating shall be submitted and verified at the time of testing commissioning of the installation.

5.17 **Testing**

Air-flow measurements shall be made by an anemometer and computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

L- 6

AIR WASHER–PACKAGED TYPE

PART 1 GENERAL

6.1 **RELATED WORK**

6.1.1 Supply, install, test and commission packaged type air washer as per specifications.

6.1.2 Associated equipment and material.

6.1.3 Mechanical System Installation and TAB.

6.2 **WARRANTY**

Manufacturer shall warrant equipment for a period of 18 months form date of shipment or One year form date of beneficial use by Owner

6.3 **SUBMITTALS**

6.3.1 Submit manufacturer' product date for review

6.3.2 Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable

PART 2 PRODUCTS

6.4 **ACCEPTABLE MANUFACTURERS**

6.4.1 As per approved list of manufacturers in the annexure

6.4.2 **GENERAL REQUIREMENTS**

6.4.2.1 Statically and dynamically balance rotating parts

6.4.2.2 Construction to permit complete servicing without breaking any connections

6.4.2.3 Provide flanged pump connections

6.4.2.4 Provide mono–block pumps and strainers of adequate capacity.

6.5 **GENERAL**

The Evaporative Cooling Machine will be self contained and will consist of the following component parts listed in the following paragraphs. The entire unit shall be **WEATHER PROOFED** and **CORROSION PROTECTED with 18 Ga SS 304 with FRP lining shall be provided to all the sections.** as hereinafter specified. The unit shall have a horizontal monoblock self priming pump assembly to provide recirculated tank water and a pressurized flow via a piping system for proper pad and media water distribution. The unit shall be factory fabricated and will include

6.5.1 **BLOWER SECTION**

The blower section shall include **Centrifugal Forward/backward Curved DIDW fan wheel of totally GI Construction with Inlet Cones** and shall be complete with

individual motor and drive and shall be mounted **C Channel frame and Cushy Foot Mounts**. The fan shall have a capacity not less than the one specified in the catalogues and shall be constructed and rated based on delivery against the rated static pressure with the media and filters in place. The fan will be of riveted construction and made with GI sheet of required thickness. The fan wheel will be of the multiblade type and mounted on two self aligning pillow block bearings of the requisite size. The fan shall be run with the help of "V" Groove drives as per the recommendation of the drive supplier. The blower housing will of the pittsburg joint construction and the drive will be provided by a motor of adequate capacity. The motor plate will be constructed out of 12 Ga MS or heavier metal with slotted holes which permit belt adjustment in both the directions. The material used will be 16 Ga GI. **The outlet velocity of the blowers will be kept low**.

6.5.2 **EVAPORATIVE SECTION**

The wet section will have 16 Ga GI Tank with folded construction with the bolted openable sides in 16 Ga GI sheet. The section will be of welded construction. 200 mm thick Cooling pads will be provided designed @ 2.5 m/s to give 90% adiabatic efficiency. 2mm thick FRP specially fabricated header will be provided for the water distribution using 20 mm PVC perforated piping. **All wet sections will include 5 layer 30 micron Aluminum Wire mesh filters of 50 mm thickness including the mounting channels for the same**. 15 mm Brass Bleed off cock, 20 mm heavy duty Brass Float. PVC drain/overflow and bleed off outlet are standard on all wet sections.

18 Ga SS 304 with FRP lining shall be provided to all the sections.

6.5.3 Double skin construction similar to air handlers (except for internal sheet which shall be SS 304 with FRP lining) shall be provided. Panel will be 43 mm thick. Wherever exposed to atmosphere., otherwise the panel thickness shall be 23mm thick.

AIR SIDE EQUIPMENT & ASSOCIATED WORKS

L- 7

AIR SCRUBBER DRY TYPE KITCHEN SCRUBBER

7.1 Scope of Work

The specification for package type dry scrubber for kitchen exhaust covers the design requirement, constructional feature, supply, installation, testing & commissioning. It shall have electrostatic air cleaner, Activated Carbon Filter Bank Unit as Odor Absorber Section, Automatic Wash Unit & Detergent Tank as specified in the BOQ. Odor Absorber Section.

7.2 Type

The unit shall be modular in construction and shall have individual sections of inlet, pre-filter, Dust collector section. Unit shall be supplied with control panel and one point wiring.

7.3 Principle Of Operation

The pre-filter shall remove of large grease particles. The electronic filter shall remove the smaller grease and smoke particles. The principle of operation shall be based on electrostatic deposition. The particle shall pass by an ionizing wire, which will induce a positive charge on the particle. The particle then shall pass between closely spaced aluminum plates, which are held at a positive charge and a ground. As the charged particle travels between the two aluminum plates it shall be forced away from the plate held at the identical polarity and drawn towards the grounded plate. Once attached the particle shall remain on the plate until cleaned off during washing.

7.4 Equipment Specification

The air filtration system shall be a modular system. Multiple units can be joined together for increased volume. The system shall be a single pass. Particulate filtration efficiency shall be evaluated on the basis of ASHRAE 52-72 & DOP Test Method. The specified unit shall have demonstrated a removal efficiency of at least 95% and above. Ozone Generation concentration shall not exceed 0.05 PPM.

7.5 Housing

Housing shall be 16 gauge (1.6mm) Electro galvanized steel with powder coat / PU paint finish construction. Each section shall include single door access, located on one side of the unit. The access door shall be mounted on hinges and secured with appropriate arrangement allowing for component access and removal. All doors shall be gasketed to prevent air and water leakage. High voltage contacts on the housing shall be made of appropriate material like phosphor/bronze etc. Enclosure for electrical components shall be included to prevent leaks to the power supply. Unit shall have flanges / collar on the inlet and outlet for connecting ductwork. Unit shall be provided with appropriate drainage arrangement. Electrical contacts shall be in the door for ease of maintenance. Each unit shall have track guides for proper alignment

of cell, making it possible tochange the direction of airflow by reversing the orientation of electronic collector cell(s).

7.6 Finish

The external casing finish shall be a durable industrial grade semi gloss Baked on epoxy ester / PVC / Nylon, not less than 3-mil minimum thickness or PU paint finish with same thickness. The pre-filter shall be Washable type Honeycomb filters of Aluminum mesh are used to optimally remove larger particles of grease and dust before the main filter and shall be secured in stainless steel frame. Face of each prefilter shall be min 2.75 square feet.

7.7 Pre-filter

Access to the prefilter shall be from the side through the same hinged door to gain access to the electronic cells. Separator section shall be designed for an equal airflow across the entire Air cleaning unit.

7.8 Electronic Cells

Electronic cells described in this section refer to a full size cell. Half size shall not be acceptable. Ionizing-Collecting cell shall be of one-piece construction min 254 mm deep in direction of airflow. Face area of each cell shall be min
0.24 square meters and the effective collecting area min 44 square feet (4.1 square meters). Frame- All support framing, end plates and ionizer ground
electrodes shall be 0.080-inch (2.03-mm) thick stainless steel 316 and the distance between each plate should not be more than 7 mm. Handle shall be
located on the side of the cell for removal of the cell from the air cleaner. The handle shall be grounded to the frame of the cell. Contacts shall be made of any suitable material like phosphor bronze or eq. on the front of the cell. They shall make contact with the ionizing, collector and ground sections of the cell.

7.8.1 Ionizer Section

Ionizing wires shall be minimum of 8 per electronic cell, with a length of min15.35 inches (390 mm) each. Ionizing wires shall be constructed of 0.010 inches diameter (0.25 mm) Tungsten for prevention of corroding or breaking. Wires shall be fixed at one end and spring mounted on the other for ease of maintenance. There shall be min7 grounding plates between the wires stabilize the ionization field for better performance. Grounding plates shall be no greater then 1.89 inches (48 mm) apart, and 0.07 inches (1.8 mm) thick. Insulators for the Ionizer shall be made of Teflon.

7.8.2 Collector Section

Grounding plates shall be a minimum of 0.02 inches (0.5 mm) thick aluminum. The plates shall be 9.65 inches (245 mm) deep in the direction of airflow.
Grounding plates shall be a minimum of 23 quantities per cell. Spacing between grounding plates shall be at 0.67 inches (17 mm). Spacing between the grounding

plates and the charged plates shall be at not more than 7 mm. Charged plates shall be a minimum of 0.02 inches (0.5 mm) thick of Stainless Steel 316. The plates shall be 7.68 inches (195 mm) deep in the direction of airflow. Separator rods shall be made of Stainless Steel 316with notches to hold the ground and charged plates apart at given lengths. Rods shall be 0.47 inches (12 mm) in diameter. The separator rods shall run the length of the cell to the frame of the cell. There shall be at least 12 rods total per cell. Insulators for the collector shall be made of PTFE (Teflon). Markings shall be on the cell to inform indicating direction of the airflow.

7.8.3 Power Supply

Power supply shall be of a 100% solid state type. Power supply shall be mounted within the air cleaner out of the air stream. Input voltage shall be 220 Volt, 50 HZ, 1 phase. Output High frequency with built in short circuit and arc protection, providing a dual high voltage output of (+)12 KVDC for the ionizer
and(+) 6 KVDC for the collector. The Power Supply shall be of capable of min120 watts and 10 mA. The power supply shall operate over a temperature range of –20 to 140 degrees F (-38 to 85 degrees C).

7.9 Fan

The blower shall be Centrifugal Backward Curved DIDW fan wheel of totally GI Construction with Inlet Cones and shall be complete with individual motor and drive and shall be mounted on C Channel frame and Cushy Foot or Spring Mounts. Each Scrubber shall comprise of one / two no. fans to handle air quantities as stipulated in BOQ. Each fan shall be driven by suitable HP TEFC motor. The fan wheel will be of the multiblade type and mounted on two self-aligning pillow block bearings of the requisite size. The fan shall be run with the help of “V” Groove drives as per the recommendation of the drive supplier.

7.10 Motor

The TEFC motor shall be suitable for 415 ± 10% volts, 3 phase, 50 Hz ± 5%, A.C supply. The motor shall be with class B/E insulation confirming to IS 325. The motor speed shall be 1440 RPM maximum designed and guaranteed for continuous operation at the nameplate rating. It should confirm to IP 55.

7.11 Installation

The fans, scrubber etc. shall be provided with necessary vibration isolation cushy foot mounts. All necessary accessories such as nut bolts etc. shall be arranged by the contractor. The contractor shall arrange his own labour with material for completion of assembly.
The contractor, if specifically specified in bill of quantities, shall cast the RCC foundations for equipments. Anti-vibration pads of adequate efficiency shall be provided.

7.12 Transit Damage

The contractor at his own cost shall restore the unit to original conditions in case of any damages.

7.13 Testing

The AC contractor shall compute the unit air quantity with the help of velocity meter. The computed results shall be tallied with specified capacities and power consumption shall be tallied with the indicated figures in the technical data furnished with the bid by the contractor.

All necessary instruments of proper accuracy and services needed for the tests required for the computation of capacities and power consumption as required by the Consultant shall be provided by the contractor at his own cost.

It shall also be the responsibility of the Contractor to supply the motors and starters to satisfy the local regulations pertaining to the limitation of starting current and indemnify the Department from all liabilities arising out of any objections raised by the local authorities in this regard.

L–8
AIR DISTRIBUTION

PART 1 **GENERAL**

8.1 Sheet Metal Duct Works shall be carried out in accordance with either SMACNA or B.I.S. (IS 655) guidelines, as asked for in BOQ. SMACNA guidelines (upward modified in this specification) shall be adopted for factory fabricated ducts, and BIS Codes shall be adopted for site fabricated ducts.

8.2 Duct works material shall be as follows:

8.2.1 **G.S.S.** (Class VIII, 120 GSM of light coating zinc) minimum gage to be used is 24

8.2.2 **Aluminum** Minimum gage to be used is 22

8.3 Contractor shall prepare shop drawings, coordinated with the working drawings and the ceiling plans made by Architect.

8.4 Contractor shall fabricate, supply, install, test and balance air system and establish the air balance schedule.

8.5 Contractor shall include in his costing all supporting, suspension and air balancing devices.

8.6 Contractor shall follow the preamble to measurement mode appended to this document.

8.7 **DUCT DESIGN PARAMETERS (Rectangular / Square)**

8.7.1	**Maximum Flow Velocity**	1500 FPM	450 MPM
8.7.2	**Maximum Friction**	0.08 WG/100 FT Run	5MM WG/100 M Run
8.7.3	**Maximum Velocity at SA outlet**	500 FPM	150 MPM
8.7.4	**Maximum flow velocity in exhaust duct**	1800 FPM	550 MPM

8.8 **GAUGES, BRACING BY SIZE OF DUCTS**

All ducts shall be fabricated from galvanized steel / aluminum of the thickness, as indicated in relevant tables. Using the bracings, flanges and duct supports as specified in the said Tables.

8.9 **DUCT FABRICATION SPECIFICATION**

8.9.1 For Ducts with External SP upto 250 Pa

Table–1

Rectangular Ducts G.S.	**Pressure 250 Pa Duct Section Length 1.2 m (4ft.)**

Minimum Duct Size	Gauge	Joint Type	Bracing Spacing (mm)
1–750 mm	24	4 Bolt Transverse Duct Connector–E (TDC) with built in sealant	NIL
751–1000 mm	24	4 Bolt Transverse Duct Connector–E	NIL
1001–1200mm	24	4 Bolt TDC–E	NIL
1201–1500mm	24	4 Bolt TDC–H	NIL
1501–1800mm	22	4 Bolt TDC–H	NIL
1801–2100mm	20	4 Bolt TDC–J	NIL
2101–2700mm	18	4 Bolt TDC–J	600

8.9.2 For Ducts with External SP more than 250 Pa and up to 500 Pa **Table–2**

Rectangular Ducts G.S.	Pressure 500 Pa Duct Section Length 1.2 m (4ft.)		
Minimum Duct Size	**Gauge**	**Joint Type**	**Bracing Spacing (mm)**
1–600 mm	24	4 Bolt Transverse Duct Connector–E (TDC) with built in sealant	NIL
601–750 mm	24	4 Bolt Transverse Duct Connector–E (TDC) with built in sealant	NIL
751–1000 mm	24	4 Bolt Transverse Duct Connector–E	NIL
1001–1200mm	22	4 Bolt TDC–E	NIL
1201–1300mm	20	4 Bolt TDC–H	NIL
1301–1500mm	18	4 Bolt TDC–J	NIL
1501–1800mm	18	4 Bolt TDC–J	NIL
1801–2100mm	18	4 Bolt TDC–J	NIL
2101–2250mm	18	4 Bolt TDC–J	600
2251–2400mm	18	4 Bolt TDC–J	600
2401–2700mm	18	4 Bolt TDC–J	600

8.10 **TRANSVERSE CONNECTORS**

8.10.1 All transverse connectors shall be 4–bolt flanged system, with built–in sealant.

8.10.2 For site fabricated (to suit) ducts and all dampers shall have uniform type of flanges. To ensure this the Contractor shall deploy fabricated flanges on hand made ducts, using pop rivets / approved alternate.

8.11 **DUCT CONSTRUCTION / INSTALLATION**

8.11.1 All ducts shall be fabricated and installed in workmanlike manner, conforming to relevant SMACNA codes.

8.11.2 Coil (Sheet Metal in Roll Form) lines to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.

8.11.3 Ducts shall be straight, smooth on the inside with longitudinal seams shall be airtight, and at corners, only which shall be either Pittsburgh or snap button as per SMACNA practice, to ensure air tightness.

8.11.4 All ducts shall have flanged / transverse joints as mentioned in Table 1 & 2. Ducts and accessories including insulation within ceiling spaces, visible from air-conditioned area shall be provided with two coats of mat black finish paint.

8.11.5 Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Air-turns (vanes) shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

8.11.6 Ducts shall be fabricated as per details shown in Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

8.11.7 All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans, shall be constructed of 18 gauge GSS/16 gauge aluminum, thoroughly stiffened with 25 mm x 25 mm x 3 mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Access doors shall be not less than 45 cm x 45 cm in size.

8.11.8 Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside.

8.11.9 Self adhesive Neoprene rubber / UV resistant PVC foam lining 5 mm nominal thickness instead of felt, shall be used between duct flanges and between duct supports in all ducting installation.

8.11.10 Where duct lines pass through any masonry opening, the contractor shall provide an isolation barrier of expanded Polystyrene 25mm thick of TF quality.

8.11.11 Toilet exhaust ducts in case of guest rooms (hotels)/in–patient rooms (hospital Bed towers) shall have a “goose neck” collars to avoid/minimize cross talks etc.

8.12 **ROUND DUCT CONSTRUCTION**

8.12.1 Duct Fabrication:

8.12.1.1 Conference to SMACNA Guidelines

8.12.1.2 Provide spiral duct (factory fabricated)

8.12.1.3 Construction shall be as per ASTM A 527 and G.S.S. Grade VII shall be used for either insulated or non–insulated spiral ducts.

8.12.1.4 Locking arrangement of spiral lock seams shall be used for all duct sizes up to 1000mm diameter.

8.12.1.5 For any duct size beyond 1000mm dia, use welded longitudinal or spiral seam.

8.12.1.6 For duct line jointing, provide gasket joints (if asked for), or generally provide beaded sleeve joints.

8.12.1.7 For fitting, such as elbows / T–joints, use welded long radius elbows and welded, conical Tees.

8.12.1.8 Use Clevis hangers / universal supports for supporting arrangement. (Subjected to site approval).

8.13 SITE FABRICATED DUCT

8.13.1 Duct Materials

Ducting Material : GSS

All ducts shall be fabricated from galvanized steel sheets of the following thickness as indicated in Schedule of Quantities.

	GSS
• Rectangular ducts upto 75cm	0.63mm
• Rectangular ducts 76 to 150cm and all round ducts	0.80mm
• Rectangular ducts 151 to 225cm	1.00mm
• Rectangular ducts greater than 225cm	1.25mm

Table–3

8.13.2

Duct Size	Sheet Thickness		Type of Joint *	Bracing / flange size (mm)	Suspension rods size for Hangers (mm)	Supports MS (mm)	Distance between supports
	GSS	AL					
00–450	0.63	1.00	Factory Fabricated Flange	—	8	25x25x3	2.5M
451–600	0.63	1.00		—	8	25x25x3	2.5M
601–750	0.63	1.00		25x25x3	8	25x25x3	2.5M
751–1000	0.80	1.00		25x25x3	8	30x30x3	2.5M
1001–1500	0.80	1.00		30x30x3	8	40x40x3	2.5M
1501–1800	1.00	1.25		40x40x3	10	40x40x3	2.5M
1801–2250	1.00	1.25		50x50x3	10	50x50x6	2.5M

	2250>above	1.25	1.80		50x50x5	10	MS Channel	2.5M

Table–4

8.13.3

Duct Size	Sheet Thickness		Type of Joint *	Bracing / flange size (mm)	Suspension rods size for Hangers (mm)	Supports MS (mm)	Distance between supports
	GSS	MS					
00–450	0.63	0.80	Factory Fabricated Flange	—	8	25x25x3	2.5M
451–600	0.63	0.80		—	8	25x25x3	2.5M
601–750	0.63	0.80		25x25x3	8	25x25x3	2.5M
751–1000	0.80	1.00		25x25x3	8	30x30x3	2.5M
1001–1500	0.80	1.00		30x30x3	8	40x40x3	2.5M
1501–1800	1.00	1.25		40x40x3	10	40x40x3	2.5M
1801–2250	1.00	1.25		50x50x3	10	50x50x6	2.5M
2250>above	1.25	1.80		50x50x5	10	MS Channel	2.5M

*** FACTORY FABRICATED FLANGES SUITABLE TO THE FLANGES SUPPLIED BY MANUFACTURER FOR SMACNA SPECIFICATION DUCT**

8.13.4 Aluminum ducting shall have flanges/bracing of Al extrusions.

8.13.5 Manufactures specification shall be submitted for approval for factory-fabricated ducts.

8.13.6 There shall be no metal-to-metal contact between ducts and its supports. Soft neoprene / foam gaskets of minimum 4mm thickness shall be provided between flanges and duct supports. The width of the gasket shall be the same as the flange size.

8.13.7 If any material as indicated above is not available then the next higher size shall be used after necessary approval from the consultant.

8.13.8 MS/ Al pop rivets with round heads inside shall be used.

8.13.9 GI hexagonal nuts and bolts with washers shall be used for flanged joints.

8.13.10 All materials including anchor fasteners shall be approved by the consultant / architect / client prior to use.

8.14 Sheet metal ducts shall be fabricated out of galvanized steel sheets / Aluminum conforming to relevant BIS Codes Sheets used shall be produced by Hot Dip Process and galvanizing shall be Class VIII Light Coating of zinc. Nominal 120 gm/M^2 of surface area.

8.15 All GI/Aluminum sheets shall be checked before dispatch for hardness/flexibility & water–marks. After fabrication if duct is found cracked or having water marks it shall be rejected.

8.16 All ducts shall be fabricated and installed in workmanlike manner, generally conforming to relevant BIS Codes. Round exposed ducts shall be die-formed for achieving perfect circle configuration.

8.16.1 Ducts so identified on the Drawings shall be acoustically lined with thermal insulation as described in the section “Insulation” and as indicated in Schedule of Quantities Duct dimensions shown on Drawings are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in Schedule of Quantities.

8.16.2 Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made air right.

8.16.3 All exposed ducts upto 60cm width within conditioned spaces shall halves slip joints no flanged joints. The internal ends of slip joints shall be in the direction of airflow. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint.

8.16.4 Changes in dimensions and shape of ducts shall be gradual. Air-turns shall be installed in all vanes arranged to permit the air to make the turn without appreciable turbulence.

8.16.5 Ducts shall be fabricated as per details shown on Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

8.16.6 All sheets metal connection, partitions and plenums required to confine the flow of air to and through the filters and fans shall be constructed of 18 gage GSS thoroughly stiffened with 25mmx25mmx3mm angle iron braces and fitted with all necessary inspection doors as required to give access to all parts of the apparatus. Doors shall be not less than 45cmx45cm in size.

8.16.7 Rubber gasket 4mm thick shall be used between duct flanges instead of soft rubber in all ducting installation for complete sealing.

8.17 All ducts shall be installed generally as per tender. Drawings and in strict accordance with approved shop drawings to be prepared by the Contractor.

8.17.1 The Contractor shall provide and nearly erect all sheet metal work as may be required to carry out the intent of these Specifications and Drawings. The work shall meet with the approval of Owner’s site representative in all its parts and details.

8.17.2 All necessary allowances and provisions shall be made by the Contractor for beams, pipes or other obstructions in the building, whether or not the same are shown on the Drawings. Where necessary to avoid beams or to other structural work, plumbing or other pipes and / or conduits, the ducts shall be transformed divided or curved to one side, (the required area being maintained) all as per the site requirements.

8.17.3 If a duct cannot be run as shown on the Drawings, the Contractor shall install the duct between the required points by any path available, in accordance with other services and as per approval of Owner’s site representatives.

8.17.4 All ductwork shall be provided with adequate hangers or supports to ensure rigid support and to prevent vibration. Spacing of duct supports shall not exceed 2.4m centers.

8.17.5 Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Owner's site representative. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion on delay to other Contractor's work on the building.

8.17.6 Where ducts pass thorough brick or partition wall within the opening and crossing ducts provided with heavy flanged collars on each side of angle iron frame–work. So that duct crossing is made leak-proof.

8.17.7 All ducts shall be totally free from vibration under all conditions of operation whether duct work is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with two flexible connections, located close to the unit, in mutually perpendicular directions. Flexible connections shall be constructed of fire retarding flexible duct at least 10 cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supporters on both hands. The flexible connection shall be suitable for pressure at the point of installation.

8.18 **DAMPERS**

8.18.1 All dampers shall be louver dampers of robust construction and tight fitting. The design, method of handling and control shall be suitable for the location and service required.

8.18.2 Dampers shall be provided with suitable links levers and quadrants as required for their proper operation. Control or setting devices shall be made robust, easily operable and accessible through suitable access doors in the duct. Every damper shall have an indicating device clearly showing the damper position at all times.

8.18.3 Dampers shall be placed in ducts at every branch supply or return air duct connection, whether or not indicated on the Drawings for the proper volume control and balancing of the system.

8.19 **ACCESS DOORS**

8.19.1 All main work shall be accessible throughout using tight fitted hinged access doors. Doors shall be provided with neoprene rubber gaskets. Angle joints shall be provided with neoprene rubber gaskets for leak-tightness of the joints.

8.19.2 Access door / panels shall be provided at following places.

8.19.3 Any other places specifically mentioned in the drawing or if envisaged by the owner / consultants during execution stage.

8.19.4 In case access doors are to be installed in the insulated ducts, the access door panel shall be double skin construction with insulation filled in such that it can be operated without damaging the duct insulation.

8.20 **SPECIAL NOTES**

DUCT DIMENSIONS SHOWN ARE BARE DUCT SIZES, FOR ANY ACOUSTIC LINING / OR FOR THERMAL INSULATION TO PROVIDE CLEAR GAP BETWEEN DUCT AND FALSE CEILING, MAKE SUITABLE ALLOWANCES ACCORDINGLY.

8.21 **LEAKAGE TEST**

Test duct for leakage by using test kits containing test blowers, two U tube manometers, and calibrated curve attached to the orifice tube assembly.

The above mentioned test would be a pilot test, and subsequently, if the construction manager / consultant asked for then Halogen / Metal Halide damp test / smoke test could be carried out, prior to branch / collar works.

8.22 **AIR TEST AND BALANCE**

8.22.1 Prepare a format for the testing and balancing of air and correct the deficiencies found by the TAB agency (If involved).

8.22.2 Prepare a format for the testing and balancing of air and correct the deficiencies found by the TAB agency (If involved).

8.22.3 Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5% in excess of those specified and quoted. Branch dust adjustments shall be permanently marked after air balancing is complete so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval and four copies of the approved balance report shall be provided with complete documents.

8.23 **MECHANICAL NOISE AND VIBRATION CONTROL**

8.23.1 Flexible connections shall be provided on all duct work connections to fans, rotating plant and equipment isolated from structure and anti-vibration materials or mountings. Pipe work and duct work crossing building movement or construction joints shall be installed with flexible connections.

8.23.2 Flexible connection on duct work to fans etc. Shall be a minimum/ maximum free length of **100mm** / **200mm** respectively to minimize noise transmission and noise break out. They shall be completely free from stress and shall not be required to accept any weight.

8.23.3 Thickness and strength of flexible connection materials shall be suitable to withstand the positive and negative fan pressure to which they swill be subjected to and shall not allow perceptible leakage. The materials shall be durable, non flammable having food acoustical quality.

8.24 **SILENCERS**

8.24.1 Duct sound attenuators / silencers of the following specifications would be installed wherever asked for in the drawings and the BOQ.

8.24.2 All plant attenuators shall be selected to maintain noise criteria given in this specification.

8.24.3 The outer casing shall be out of min. 22G galvanised steel in accordance with ASHRE (ISI) recommendations for high pressure rectangular duct work. Seams shall be lock formed on pittsburg lock machine.

8.24.4 Interior elements of silencers shall be out of min. 22 G galvanised perforated steel.

8.24.5 Acoustic fill shall be Fibre glass of density not less than 48 kg/m3 sufficient to obtain specified acoustic performance and shall be packed under 10% compression to eliminate voids due to vibration and setting. Material shall be inert, vermin and moisture proof. All material of construction and acoustic fill shall be incombustible as per IS 3144.

8.24.6 All silencer shall be selected against a maximum allowable air pressure drop of **10mm**. Air tight construction shall be provided by use of duct sealing compound at site by the air conditioning contractor.

8.24.7 Acoustic Performance Silencer acoustic ratings shall include insertion loss and self-noise

power levels and shall meet or exceed minimum performance. Contractor shall provide computer selection for the silencer supplied at site which will indicate db reduction at different octave band frequency.

8.24.8 Aerodynamic Performance Static pressure drop through silencers shall not exceed those listed in the silencer schedule at the indicated airflows.

8.24.9 Transitions Where transitions are required to adapt silencer dimensions to connecting duct work, they would be supplied by the installing contractor.

VAV DIFFUSER

Variable VAV diffuser will be four way type complete with Back pan in 1.2mm thick steel construction painted in white color shade.. The Back pan shall be designed with round inlet of size to suit the maximum air flow. The back pan design should ensure delivery of 360 degree air pattern in conjunction with formed edges of Face panel with minimum noise and pressure drop over full range of Air volume from 25-100%. The air flow variation from VAV diffuser is achieved by linear motion of control disc. The position of the control disc will be varied by a linear actuator mounted on the control disc.
Each VAV diffuser or a group of VAV diffusers will be connected to a single Power module using power cable as supplied by manufacturer only. Each Master diffuser shall be connected to wall mounted controller /Thermostat using cable supplied by manufacturer. Subsequent slave (drone) diffusers(up to 14nos. maximum) will be connected to Master diffuser using control cable supplied by manufacturer.
Master controller shall be suitable for 24V AC. The controller shall have LCD screen to display (If Specified in BOQ)
1. Room and supply air Temp.
2. Up and down adjustment of the room temperature to suit individual comfort
3.Supply air Volume.
4. Cooling and Heating Mode.
5. Occupancy sensors
It will also allow over ride function to fully open or close the damper.
Each power Module shall be equipped with Step down Transformer 220V/24V along with protection device to supply power to a group of VAV diffusers (up to maximum 15 nos. without electric heaters).
Neck mounted Electric Heaters will be supplied if required and specified in BOQ. The Electric Heaters will be equipped with Automatic reset Thermal cut out and Manual reset as a secondary protection.
Neck mounted Relief Rings will be supplied with VAV diffuser to allow by-pass of supply air in ceiling plenum at turned down flow. The HVAC contractor shall select the diffuser with neck size higher by 50mm whenever specifications calls for installation of Relief ring.
HVAC contractor shall ensure installation of VAV diffusers as per Manufacturer Instructions and guidelines. Every batch of 15 diffusers shall be commissioned using a computer loaded with Manufacturer,s software and a USB module. Finally as per boq.

Steel Wire Rope Hangers& Supports:

Wire Hangers shall be used to suspend all static HVAC & Mechanical services.

Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10,M12) stud/eye bolt, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturers recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a Hanger self-locking grip (double channel wedge type lock) at the other end. Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key and should not be an integral part of the self-locking grip. Only wire and/or supports supplied and/or approved, shall be used with the system.

a. Wire Hangers should have been independently tested by Lloyds Register. APAVE, TUV, CSA, ADCAS, Intertek , ECA, and SMACNA, approved by CSA and comply with the requirements of DW/144 and BSRIA – wire Rope Suspension systems.Wire rope should be manufactured to BSEN 12385: 2002.

b. Wire Hangers shall be independently tested by reputed third party testing organization to sustain safe working load for 120min at elevated temperature of 175 deg. C or above.

c. The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).

The correct specification of wire hanger required is determined using the following formula.

Weight per meter of object suspended (kg) X distance between suspension points (m) = weight loading per Hanger suspension point (kg).

Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations give in the manufacturer's handbook.

The contractor shall select the correct length of wire rope required to support the service. Lengths from 1-10m lengths. Specials can be made, check with manufacturer. No in–line joints should be made in the rope.

Table. 1

Wire Hanger Safe Working Loads	
size	**working load limit (kg/lbs)**
No. 1	0-10 kg / 0-22 lbs
No. 2	10-45 kg / 23-100 lbs
No. 3	45-90 kg / 101-200 lbs
No. 4	90-225 kg / 210-495 lbs
No. 5	225-325 kg / 496-715 lbs
No. 6	325-500 kg / 715-1100 lbs

The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless steel wire rope as per the application, the minimum specification is as above and should be manufactured to BS 302 (1987), BSEN12385. **Comply with manufacturer's load**

ratings and recommended installation procedures. The testing shall be done to the minimum breaking load of the wire thus giving a minimum safety factor of 5:1.

4.1 Mechanical Supports – Steel wire ropes/ Hanger Supports are suitable for: Ducts,Water Pipes, Drainage Pipes, Gas Pipes, Refrigeration Pipes, Condensation Water Pipes, Chill Beams, Heater, Ceiling Grid, Suspended Ceiling and Acoustic Baffle.

4.1.1 Duct/Piping Supports: Rigid supports may be used in conjunction with steel wire hangers to assist with alignment of services as per the Schedule. These can be at 30m intervals or so depending on the run of the service. Rigid support must also be used in conjunction with Steel wire rope hangers with pipe/Duct work as per support GFC/design drawings. For insulated pipe, provide protective sleeve to protect the entire circumference of the pipe insulation. Stainless Steel Supports should be available for food, chemical and High Corrosion areas near coastlines.

4.1.2 Any other Steel wire rope solution can be used based on manufacturer's recommendation on site conditions after prior approval. Support piping in accordance with Schedule at the end of this Section.

4.1.3 For insulated pipe, provide protective sleeve to protect the entire circumference of the pipe insulation. Stainless Steel Supports should be available for food, chemical and High Corrosion areas near coastlines.

Refer to manufacturers catalogue and installation guide for further technical information.**Comply with manufacturer's load ratings and recommended installation procedures. All supporting system to be provided by same manufacturer.**

Pipe Hanger Schedule I:

Pipe Size	Weight of pipe + fluid (inclu. Fos)	Spacings (pipe + fluid+insulation)	Total Weight of pipe + fluid	Hanger No.
(mm)	with insulation (kgs/rmts)	between supports (mts)	with insulation (kgs/rmts)	with insulation (kgs/rmts)
12-50	15.36	2	31	2
65-80	29.35	2.5	73	3
100-150	80.93	2.5	202	4
200	112.57	2.5	281	5
250 and above	Rigid supports to be used as per Pipe Hanger Schedule II			

Pipe Hanger Schedule II:

Rigid Supports for Ducts/pipes to be used in conjunction with wire supports:

Rigid supports if required in conjunction with wire hangers shall be of steel, adjustable for height and Zinc chromate primer coated and finish coated black, Galvanized Modular Strut support system of required strength and profile can also be used. Where supports and clamps are of dissimilar materials, a gasket shall be provided in between.

PIPE SIZE (mm)	PIPE SUPPORT
UP TO 50 Ø	Modular Strut System as per load bearing capacity
80Ø TO 100Ø	Modular Strut System as per load bearing capacity

PIPE SIZE (mm)	HORIZONTAL SUPPORT	VERTICAL SUPPORT
125Ø TO 200Ø	Modular Strut System as per load bearing capacity	Modular Strut System as per load bearing capacity
250Ø TO 300Ø	100×50 ISMC	75×40 ISMC
300Ø TO 400Ø	150×75 ISMC	100×50 ISMC
450Ø TO 600Ø	200×75 ISMC	200×75 ISMC

L-9

HVAC SYSTEMS
TESTING ADJUSTING AND BALANCING (TAB)

9.1 **Scope**

9.1.1 Testing, adjusting and balancing of heating, ventilating and air-conditioning systems

9.1.2 Testing, adjusting and balancing of HVAC Hydronic systems.

9.2 **Comply with**

9.2.1 ASHRAE : 1995 HVAC Application

9.2.2 SMACNA : Manual for the Balancing and Adjustment of air distribution system

9.3 **Performance**

9.3.1 Verify design conformity.

9.3.2 Establish fluid flow rates, volumes and operating pressures.

9.3.3 Take electrical power readings for each motor.

9.3.4 Establish operating sound and vibration levels.

9.3.5 Adjust and balance to design parameters.

9.3.6 Record and report results as per the formats specified.

9.4 **Definitions**

9.4.1 **Test:** To determine quantitative performance of equipment.

9.4.2 **Adjust:** To regulate for specified fluid flow rates and air patterns at terminal equipment (e.g. reduce fan speed throttling etc).

9.4.3 **Balance:** To proportion within distribution system (sub-mains, branches and terminals) in accordance with design quantities.

9.5 The following procedures shall be directly followed in TESTING, ADJUSTING, AND BALANCING (TAB) of the total system.

9.5.1 Before commencement of each one of the TAB procedure explained hereunder, the contractor should intimate the HVAC consultant about his readiness to conduct the TAB procedures in the format prescribed by them.

9.5.2 To obtain accurate TAB results, it is essential that contractor shall at his own cost use the TAB instruments recommended in this specification.

9.6 **Description of Systems and Requirements**

9.6.1 Adjust and balance the following system to provide most energy efficient operation compatible with Owner's selected operating conditions.

9.6.2 All supply, return and outside air systems.

9.6.3 All exhaust air systems.

9.6.4 All chilled water systems.

9.6.5 All cooling tower (condenser) water systems.

9.6.6 Emergency purge systems.

9.7 **Air Systems**

9.7.1 Air Handling Performance

The TAB procedure shall establish the right selection and performance of the AHUS with the following results.

9.7.1.1 Air-IN D.B and W.B temperature.

9.7.1.2 Air-OUT D.B and W.B temperature.

9.7.1.3 Dew Point air leaving.

9.7.1.4 Sensible heat flow.

9.7.1.5 Latent heat flow.

9.7.1.6 Sensible Heat factor.

9.7.1.7 Fan air volume.

9.7.1.8 Fan air out-let velocity.

9.7.1.9 Fan static pressure.

9.7.1.10 Fan power consumption.

9.7.1.11 Fan speed.

9.7.2 **Air Distribution**

9.7.2.1 Both supply and return air distribution for each AHU and for areas served by this AHU shall be determined and adjusted as necessary to provide design air quantities.

9.7.2.2 The above shall cover balancing of air through main and branch ducts utilizing telescoping probes of the TSI instruments, as specified; Electronic Rotating Vane Anemometers and Accubalance for grilles and diffusers, also from TSI and as specified.

9.7.3 **The Preparatory Work**

To conduct the above test, following preparatory works are required to be carried Out including the availability of consultants approved ducting layout drawings and submittals:

9.7.3.1 All outside air intake, return air and exhaust air dampers are in proper position.

9.7.3.2 All system volume dampers and fire dampers are in full open position.

9.7.3.3 All access doors are there & are airtight.

9.7.3.4 Grilles are installed and dampers are fully open.

9.7.3.5 Provision and accessibility of usage of TAB instruments for traverse measurements are available.

9.7.3.6 All windows, doors are in position.

9.7.3.7 Duct system are of proper construction, are equipped with turning vanes, joints are sealed etc.

9.8 **Hydronic System Balancing**

9.8.1 The Hydronic system involves the checking and balancing of all water pumps, piping net-work (mains & branches), the heat exchange equipment like cooling and heating coils, condensers and chillers, cooling towers etc. in order to provide design water flows.

9.8.2 **Preparation**

The essential preparation work, as under, must be done by the HVAC contractor prior to actual testing, adjusting and balancing of HVAC system

9.8.3 **Ensure**

9.8.3.1 Availability of coordinated drawings and approved submittals and system sketch with design water flows specified thereon

9.8.3.2 Hydronic system is free of leaks, is hydrostatically tested, is thoroughly cleaned, flushed and refilled.

9.8.3.3 Hydronic system is vented.

9.9 **Basic Procedure**

9.9.1 The contractor or his nominate TAB (Testing, Adjusting and Balancing) agency Should confirm completion of the basic procedures and prepare checklists for readiness of system balance. Briefly:

9.9.2 Check pumps operation for proper rotation and motor current drawn etc.

9.9.3 Confirm that provisions for TAB measurements (Temperature, pressure and flow measurements) have been made.

9.9.4 Open all shut-off valves and automatic control valves to provide full flow through coils. Set all balancing valves in the preset position, if these valves are known. If not, shut all riser-balancing valves except the one intended to balance first.

9.9.5 Balancing work for both Chilled Water system and Condenser Water System to be carried out in a professional manner and test reports as enclosed, prepared and presented to the consultants for approval.

9.10 **Readiness for Commencement of T.A.B.**

Before starting of any of the tests, the readiness to do so should recorded as per the prescribed checklist.

9.11 **TAB Instruments**

9.11.1 Air measuring instruments

9.11.2 Microprocessor based.

9.11.3 VelociCalc Plus Meter, Model 8386, with capability to measuring dB and WB temperature, RH and Dew point. It has print out-put and data logging/downloading

facility. This instrument also calculate the sensible, Latent & total hat flows and sensible heat factor.

9.11.4 TSI, VelociCalc meter model 8345 for velocity, dB temperature and Air Volume. Has instant printout capability of Air volume readings taken.

9.11.5 Pitot Tube.

9.11.6 TSI Electronic Rotary Vane Anemometer.

9.11.7 TSI Accubalance Flow Measuring Hood.

9.11.8 (All above items to have NIST (US Institute of Science and Technology) Calibration certificate).

9.11.9 Hydronic Measuring Instrument:

9.11.10 Measuring Instrument, for measurement of water flow, differential pressure and temperature. The instrument has a pressure gauge, a temperature gauge and a microcomputer.

9.11.11 U-Tube manometer.

9.11.12 Pressure gauge.

9.11.13 Differential pressure gauge.

9.11.14 Rotation Measuring Instrument:

Electronic Digital Tachometer.

9.11.15 Temperature and RH Measuring Instrument:

9.11.16 Electrical Measuring Devices:

9.11.16.1 Voltammeter.

9.11.16.2 Continuity Meter.

9.12 Vibration and Noise Levels

9.12.1 Vibration and alignment field measurements shall be taken for each circulating water pump water-chilling unit, and fan driven by a motor over 10 HP. Readings shall include shaft alignment, equipment vibration, bearing housing vibration, and other test as directed by the Project Manger. Readings will be made using portable IRD (or approved equal) equipment capable of filtering out various unwanted frequencies and standard report forms.

9.12.2 The water chilling unit refrigeration system shall be tested for refrigerant and air leaks at least two times approximately six (6) months after start up and at the end of warranty period. The contractor shall certify the condition of the refrigeration system in writing after test. Any leaks detected shall be properly sealed and the above test period repeated. Soapsuds and Halide torch or electronic refrigerant detector shall be used for leak detection. Replace refrigerant and oil lost during warranty period at no cost to the Owner.

9.12.3 Sound level readings shall be taken at ten (10) locations in the building as selected by the Project Manger. The readings shall be taken on an Octave Band Analyzer in a manner acceptable to him. The Contractor shall submit test equipment data and

reporting forms to the Project Manager for review. In order to reduce the ambient noise level the readings shall be taken at night. All test shall be performed in the presence of the Project Manger.

WATER SIDE EQUIPMENT & ASSOCIATED WORKS

L- 1
PUMPS

PART 1 GENERAL

1.1 Related Work

1.1.1 Basic Material and Methods and mechanical requirements as discussed earlier.

1.1.2 Piping and fittings

1.1.3 Valves

1.1.4 Mechanical System Installation and TAB.

1.2 Warranty

Manufacturer shall warrant equipment for a period of 18 months form date of shipment or One year form date of beneficial use by Owner

1.3 Submittals

1.3.1 Submit manufacturer' product date for review

1.3.2 Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable

PART 2 PRODUCTS

1.4 Acceptable Manufacturers

As per approved list of manufacturers in the annexure

1.5 General Requirements

1.5.1 Statically and dynamically balance rotating parts

1.5.2 Construction to permit complete servicing without breaking piping connections

1.5.3 Provide flanged pump connections

1.5.4 Construct pumps of bronze fitted construction with **bronze impeller** and carbon steel shafts. Ensure shaft deflection does not exceed 0.002" at sealing faces at maximum load

1.5.5 Hydrostatic test pump casing at one and one–half times the design working pressure

1.5.6 Construct pump casings of cast iron with replaceable bronze wearing rings and rated for 150 psig working pressure

1.5.7 Impeller diameter not to exceed 90% (ninety percent) of the maximum diameter for which pump curves are published

1.5.8 Coupling and Base Plate

1.5.8.1 Mount pump and motor on common steel base plate furnished by pump manufacturer (If specified in BOQ).

1.5.8.2 Manufacturer to furnish and mount steel flexible coupling fasten metal coupling guard to pump base plate

1.5.9 Name Plate

1.5.9.1 Stainless steel on pump and motor securely fastened to casings

1.6 Scope

The scope of this selection comprises the supply, erection, testing and commissioning of water pumps conforming to these Specifications and in accordance with requirements of schedule of Quantities

1.7 Capacity

Water flow rates and head of the pumps shall be in accordance with the requirements of schedule of Quantities.

1.8 Type

The type and the size of all chilled water , condensing water, chilled water and condensate drain pumps for air conditioning applications shall be in accordance with requirements of Drawing and Schedule of Quantities.

1.9 **Split Casing Pumps:**

1.9.1 Pump casing shall be close - grained cast iron of heavy section, Vertical Inline making possible complete servicing of rotating parts without breaking piping or motors connections. Motor to pump connection shall be of the flexible coupling type. Suction passages shall be volute in form, promoting smooth entry to impeller and increased efficiency. Impeller shall be of **bronze construction**, enclosed type, hydraulically balanced and passages smooth-finished for minimum friction and maximum efficiency **(Not less than 65%)**. Shaft shall be steel, protected by gunmetal sleeves. grease lubricated, contained in easily removable housing. Pumps shall be fitted with an air valve, two grease lubricators, drain plug and water seal connections Mechanical seals (Outside fitted) are necessary

1.9.2 Motors shall be energy efficient, totally enclosed, fan-cooled, class-F insulation. Motor shall be specially designed for quiet operation and its speed not exceed 1440 rpm. The motor rating shall be such as to ensure non overloading of the motor throughout its capacity range. Motor shall be suitable for 415 +/-10% volts, 3 phase, 50 cycle AC, power supply.

1.9.3 Base shall be of a size suitable for the pump, motor and shaft and shall be constructed of cast iron or welded steel . Flexible coupling shall be protected by a guard mounted on the common base (If specified in BOQ) .

1.9.4 Installation: The pump shall be installed on a concrete foundation as shown in Approved–for construction shop drawings. **(Refer acoustics and vibration control topic in this report for this)**

1.9.5 Lubrication: Upon installation of the complete system and before testing , the pump shall be lubricated in strict accordance with the manufacturer's instructions.

1.9.6 Pump Alignment

1.9.7 Vertical inline pumps, prior to testing shall be aligned with a dial indicator within 0.05mm deflection (radial), or as per manufacturer's recommendation.

1.10 **Monobloc Pumps**

1.10.1 Monobloc end-suction design directly connected to motor shall be supplied when asked for. The pump casing shall be of cast iron construction and the Impeller shall be of bronze construction, hydraulically balanced and keyed to shaft. Stuffing boxes

shall be integral with casing and water sealed. Shaft sleeve shall be of gun metal extending through stuffing boxes.

1.10.2 Motor shall be drip and splash proof, designed as integral part of pump. Motor shall be suitable for 415 ± 6% volts, 3 phase, 50 cycles AC power supply.

1.10.3 Painting: All pumps ,motors and bases shall be supplied with approved finish . Shop coat of paint that have become marred during shipment or erection shall be cleaned off with mineral sprits, wire brushed and spot primed over the effected areas, then coated with enamel paint to match the adjoining areas

1.10.4 Performance Data: Pump performance curves and power consumption with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation

1.10.5 Testing adjusting and balancing: Pump performance shall be computed from the pump curves provided by manufacturer.

1.11 **Inertia Bases for Pumps**

1.11.1 The inertia base shall be an all welded mild steel channel frame the minimum depth of which shall be **1/12** of the longest span between isolator but not less than **150 mm** filled with concrete the density of which shall **2300 kg/m3**.

1.11.2 The inertia base shall be sufficiently large to provide support for all parts of the equipments, including any component which overhands the equipment base, such as suction and discharge elbows on centrifugal pumps.

1.11.3 The frame shall include pre-located equipment anchor bolts fixed into position and housed in a steel sleeve allowing minor bolts location adjustment.

1.11.4 Isolator support brackets shall be provided at **200 mm** centers to ensure the concrete and frame is adequately stiffened against distortion.

L- 2

VARIABLE SPEED PUMPING SYSTEM (IF SPECIFIED)

2.1 SECTION INCLUDES

2.1.1 Variable Speed Pumping Package

2.1.2 Individual Components

2.1.3 Pump Control Panel

2.1.4 Adjustable Frequency Drive

2.1.5 Sensor Transmitters

2.1.6 Sequence of Operation

2.2 REFERENCES

2.2.1 Hydraulic Institute

2.2.2 ANSI - American National Standards Institute

2.2.3 NEMA - National Electrical Manufacturers Association

2.2.4 UL - Underwriters Laboratories. Inc.

2.2.5 ETL - Electrical Testing Laboratories

2.2.6 CSA - Canadian Standards Association

2.2.7 NEC - National Electrical Code

2.2.8 ISO - International Standards Organization

2.2.9 IEC - International Electro technical Commission

2.3 SUBMITTALS

Submittals shall include the following:

2.3.1 System summary sheet

2.3.2 Sequence of operation

2.3.3 Shop drawing indicating dimensions, required clearances and location and size of each field connection

2.3.4 Power and control wiring diagrams

2.3.5 System profile analysis including variable speed pump Curves and system curve. The analysis shall also include pump, motor and AFD efficiencies, job specific load profile, staging points, horsepower and kilowatt/hour consumption.

2.3.6 Pump data sheets

2.4 QUALITY ASSURANCE

2.4.1 The local supplier of Chilled Water Variable Speed Pumping System (VSPS) Must have relevant expertise in all aspects of design, application engineering, Installation, programming, interfacing, commissioning and after sales service.

2.4.2 Manufacturer shall be listed by Underwriter's Laboratories as a manufacturer of packaged pumping systems

2.4.3 Bidders shall comply with all sections of this specification relating to packaged pumping systems. Any deviations from this specification shall be bid as a voluntary alternate clearly defined in writing. If no exceptions are noted, the supplier or contractor shall be bound by these specifications

2.4.4 The bidder shall ensure the performance based upon the results of the approved soft wares (w.i.z. ITT Bell and Gossett/Armstrong/ Grundfoss)

2.5 ACCEPTABLE MANUFACTURERS

2.5.1 Subject to compliance with the specifications, the following manufacturers shall be acceptable:

ITT industries

Armstrong

Grundfoss

2.5.2 Responsibilities and Obligations of Contract

2.5.2.1 Furnish and install as shown on the plans an efficient secondary chilled water Pumping System

2.5.2.2 The control system shall include as, a minimum, the programmable logic pump controller, adjustable frequency drive(s) and remote sensor/transmitters as indicated on the plans. Provide additional items as specified or as required to properly execute the sequence of operation

2.5.2.3 The variable speed pump logic controller, adjustable frequency drive(s), AFD bypass (MUST!!!) and remote sensor / transmitter(s) shall ship as individual components to the job site.

2.5.2.4 Pump logic controller, adjustable frequency drives, sensor/transmitters and related equipment shall be installed by the mechanical contractor as shown on the plans

2.5.2.5 Line voltage power wiring shall be installed by the electrical contractor as shown on the field connection drawings and wiring diagrams supplied with the pumping package

2.5.2.6 Low voltage (24 VDC and 115 VAC) wiring shall be installed by the controls contractor as shown on the field connection drawings and wiring diagrams supplied with the pumping package

2.6 COMPONENTS

2.6.1 Pump Logic Controller

2.6.1.1 The Technologic pump logic controller assembly shall be listed by and bear the label of Underwriter's Laboratory, Inc. (UL) and Canadian Underwriter’s Laboratory (CUL). The controller shall be specifically designed for variable speed pumping applications

2.6.1.2 The controller shall function to a proven program (As mentioned earlier) that safeguards against damaging hydraulic conditions including:

Pump low surges
Hunting
End of curve
System over pressure

2.6.1.3 The pump logic controller shall be capable of receiving up to two discrete analog inputs from zone sensor/transmitter as indicated on the plans. It will then select the analogue signal that has deviated the greatest amount from its set point. This selected signal will be used as the command feedback input for a hydraulic stabilization function to minimize hunting. Each input signal shall be capable of maintaining a different set point value. Controller shall be capable of controlling up to three pumps in parallel.

2.6.1.4 The pump logic controller shall be capable of accepting an additional analog input for a flow sensor. This input shall serve as the criteria for the end of curve protection algorithm.

2.6.1.5 The hydraulic stabilization program shall utilize a proportional-integral-derivative control function. The proportional, integral and derivative values shall be user adjustable over an infinite range.

2.6.2 The pump logic controller shall be self prompting. All messages shall be displayed in plain English. The operator interface shall have the following features

2.6.2.1 Multi-fault memory and recall last 10 faults and related operational data

2.6.2.2 Red fault light, Yellow warning light, and Green power on light

2.6.2.3 Soft-touch membrane keypad switches.

2.7 The display shall have four lines, with 20 characters on three lines and eight large characters on one line. Actual pump information shall be displayed indicating pump status.

2.8 Controller shall be capable of performing the following pressure booster function:

Low suction pressure cut-out to protect the pumps against operating with insufficient suction pressure.

High system pressure cut-out to protect the piping system against high pressure conditions.

No Flow Shut down to turn the pumps off automatically when system demand is low enough to be supplied by hydropneumatic tank. No flow shutdown shall require any external flow meters, flow switches, nor pressure switches to determine when a No Flow condition exists

2.9 <u>The following communication features shall be provided to the BAS:</u>

Remote system start / stop non-powered digital input

Failure of any system component. Output closes to indicate alarm condition

One 4-20 mA output with selectable output of

2.9.1 Frequency

2.9.2 Process variable

2.9.3 Output current

2.9.4 Output Power

2.10 The following communication features shall be provided to the Building automation System via an RS-485 port utilizing any open ended protocol (BACNET etc):

2.10.1 Individual Analog Input

2.10.2 Individual Zone Set points

2.10.3 Individual Pump/AFD on/off status

2.10.4 System percent speed

2.10.5 System Start/stop command

2.10.6 System operation mode

2.10.7 Individual KW signals

2.10.8 System flow, when optional flow sensor is provided

2.11 The Pump logic controller shall be a approved NEMA 1 Enclosure.

2.12 Adjustable Frequency Drive

2.12.1 The adjustable frequency drive(s) shall be pulse width modulation (PWM) type, microprocessor controlled design. Unit shall be the VLT 6000 series manufactured by Graham company

2.12.2 The AFD, including all factory installed options, be tested to UL standard 508. The AFD shall also meet C-UL and be CE marked and built to ISO 9001 standards

2.12.3 The AFD shall be with IP 54/55 protection. AFF with plastic enclosure shall not be acceptable.

2.12.4 The AFD shall employ an advanced sine wave approximation and voltage vector control to allow operation at rated motor shaft output speed with no de-rating. This voltage vector control shall minimize harmonics to the motor to increase motor efficiency and life. Power factor shall be near unity regardless of speed or load.

2.12.5 The VFD shall have balanced DC link reactors to minimize power line harmonics. VFDs without a DC link reactor shall provide a 3% impedance line reactor.

2.12.6 Input and output power circuit switching can be done without interlocks or damage to the VFD.

2.12.7 The following customer modifiable adjustments shall be provided:

Accel time

Decel time

Minimum frequency

Maximum frequency

2.13 RS-485 communication for Johnson Controls N2 shall be available and provided as an option.

2.13.1 An automatic energy optimization selection feature shall be provided. This feature shall reduce voltages when lightly loaded and provide a 3% to 10% additional energy savings.

2.13.2 The AFD shall be suitable for elevations to 3300 feet above sea level without de-rating. Maximum operating ambient temperature shall not less than 104 degrees F. AFD shall be suitable for operation in environment up to 95% non-condensing humidity.

2.13.3 The AFD shall be capable of displaying the following information in plain English via an alphanumeric display:

Frequency

Voltage

Current

Kilowatts per hour

Fault identification

Percent torque

Percent Power

RPM

2.14 Sensor / Transmitters

Provide field mounted differential pressure sensor transmitter(s) as indicated in BOQ or on the plans. Unit shall transmit an isolated 4-20mA dc signal indicative of process variable to the pump logic controller via standard two wire 24 DC system. Unit shall have a corrosion resistant steel body with 1/8" NPT process connection

It shall have a NEMA 1 electrical enclosure capable of withstanding 450 PSI static pressure. Accuracy shall be within 0.5% of full span

2.15 Sequence of Operation

2.15.1 The system shall consist of a Technologic pump logic controller, multiple pump/AFD sets, with manual and automatic alternation and pump staging [wherever applicable].

2.15.2 The pumping system shall start upon the closure of customer's contact when the pump logic controller Mode of Operation selector switch is in the REMOTE position

2.15.3 When the pump logic controller selector switch is in the LOCAL position, and start command on Tech 500 is given via operator interface, the pumping system shall operate automatically.

2.15.4 Sensor/transmitters shall be provided as indicated on the plans.

2.15.5 Each sensor/transmitter shall send a 4-20mA signal to the pump logic controller, indicative of process variable condition.

2.15.6 The pump logic controller shall compare each signal to the independent, engineer/user determined set points.

2.15.7 When all set points are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.

2.15.8 The pump logic controller shall continuously scan and compare each process variable to its individual set point and control to the least satisfied zone.

2.15.9 If the set point cannot be satisfied by the designated lead pump, the pump logic controller shall initiate a timed sequence of operation to stage a lag pump [wherever applicable].

2.15.10 The lag pump shall accelerate resulting in the lead pump(s) decelerating until they equalize in speed[wherever applicable]

2.15.11 Further change in process variable shall cause the pumps to change speed together [wherever applicable]

2.15.12 When the set point criteria can be safely satisfied with fewer pumps, the Technologic pump logic controller shall initiate a timed de-stage sequence and continue variable speed operation [wherever applicable].

2.15.13 As the worst case zone deviates from set point, the pump logic controller shall send the appropriate analog signal to the AFD to speed up or slow down the pump/motor.

2.15.14 In the event of a AFD fault, the pump logic controller automatically initiates a times sequence of events to start the redundant pump/AFD set in the variable speed mode. The redundant variable speed system shall be started through the pump logic controller.

2.15.15 Upon AFD fault(s), the pump controller shall display an alarm condition through a plain English message.

2.15.16 AFD fault indication shall be continuously displayed on the operator interface of the pump until the fault has been corrected and the controller has been manually reset.

2.15.17 In the event of the failure of a zone sensor/transmitter, its process variable signal shall be removed from the scan/compare program. Alternative zone sensor/transmitters, if available, shall remain in the scan/compare program for control.

2.15.18 Upon sensor failure a plain English warning message shall be displayed on the operator interface of the pump logic controller.

2.15.19 In the event of failure to receive all zone process variable signals, a user selectable number of AFDs shall maintain a user adjustable speed, reset shall be automatic upon correction of the zone failure.

WATER SIDE EQUIPMENT & ASSOCIATED WORKS

L- 3
PIPING

PART 1 **PIPING AND FITTINGS (CHILLED/CONDENSER WATER/CONDENSATE DRAIN PIPING)**

3.1 **Scope** Supply, laying of pipes, rectifier welding (refer item No. 7), including pipe fittings, valves and all necessary supporting and securing.

3.2 **Standard** B.I.S.

3.3 **Design Parameters** ***Table–1***

Maximum flow velocity		Maximum friction	
FPS	**MKS**	**FPS**	**MKS**
8 FT/SEC	2.5M/SEC.	5 FT / 100ft Water Run	1M/ 30 M Water Run

3.4 **Installation**

3.4.1 Clean inside of pipe before installing it. Keep installed pipe clean and protect ends from foreign material by plugging or capping them.

3.4.2 Install pipe so that it does not interfere with openings of doors or apparatus, access to the equipment or to electrical equipment.

3.4.3 Do not install pipes in such a way that they will apply torque to pumps. After the pumps have been installed and the pumps have been operated, recheck and align pumps if required.

3.4.4 Run pipes in straight lines and square with the building. Install risers plumb. Make offsets only where indicated and where necessary.

3.4.5 Do not install water pipes in electric rooms, telephone rooms, transformer rooms, or elevator equipment room.

3.4.6 Insofar as possible, drainage piping shall not be installed overhead, whether exposed or above false ceiling in (any critical / sensitive areas), such as, delivery rooms, operating rooms, nurseries, food preparation centers, food servicing centers, electrical rooms, (wherever applicable), switch rooms, UPS rooms.

3.4.7 Provide flanged unions through out the pipe systems at all equipments. Make provisions for servicing and removal of equipment without dismantling the piping.

3.5 **Grading Pipes for drainage:**

Slope will not be less than ¼" per 10' for any drain pertaining to HVAC system. All condensate drain pipes will be installed with care for ease of maintenance and operations.

3.6 **Piping Expansion**

3.6.1 Install piping to allow thermal expansion and contraction without injury to piping, equipment or structure.

3.6.2 Use loops or expansion joints where necessary and as where shown in drawings.

3.6.3 Provide pipe guides.

3.6.4 Where screwed piping is used, used caulked joints or expansion joints at intervals to allow expansion movement.

3.7 **Pipe Jointing**

3.7.1 Welded Pipes

3.7.1.1 Preparing Pipe ends (Reaming, Grinding to mill finish)

3.7.1.1.1 Machine cut pipe ends square.

3.7.1.1.2 **Ream pipe ends, after cutting to full diameter, use rectifier for all welded joints as per B.I.S.**

3.8 **Line welds, single V Butts type:**

3.8.2 Mill or machine bevel pipe at 37½° to within 1/16" of inside of inside wall, except that in field limited amount of pipe may be flame welded.

3.8.3 Pipe with a wall thickness of 3/16" or less need not be bevelled but may be welded by melting down into building up over abutting ends.

3.8.4 Separate abutting ends of joints before welding to permit complete fusion to bottom without overlapping.

3.8.5 Tack in two or more points before welding to maintain alignment and fusion weld.

3.8.6 Make all welds of sound metal, thoroughly fused into ends of pipe an to bottom of vee.

3.8.7 Build in excess of pipe wall to give reinforcement to one fourth pipe wall thickness.

3.8.8 Weld metal shall present a gradual increase in thickness from surface of pipe to center of weld.

3.8.9 Minimum weld width: Two and a half times the thickness of the pipe wall.

3.8.10 Use welding ells at turns in welded lines.

3.8.11 Do not weld pipe couplings in place of welded fittings for any branch connection.

3.9 **Threaded GI Pipes:**

3.9.1 Where pipe is to be threaded, die cut right hand, pipe stand, clean cut full depth, taper threads. Make threaded joints so that they will be leak-proof without caulking.

3.9.2 Apply a thin coat of lubricant to male threads only.

3.9.3 All pipes and valves shall be designed for 10kG/ sq.cm test pressure. The pipe thickness shall conform to BIS standards and shall be 6mm thick.

3.9.4 **Where welded steel piping is recommended, make the welds by rectifier (not using transformer welding) in accordance with the laid standards of BIS.**

3.10 **Weld-o-lets and thread-o-lets:**

3.10.1 Scribe and cut openings in main pipes for welded branches accurately taking care to remove all plugs and cuttings from main pipe.

3.10.2 Full weld fillet welds for full depth of fillet, with additional beads to form well rounded connection as recommended by weld-o-let manufacturer.

3.10.3 Cut openings into pipes for welded connections accurately to give matched intersections.

3.10.4 Make welded fittings of same material with same pressure and temperature ratings as pipe with which they are used.

3.10.5 Make flanged connections to control valves, pump suction and specialties with BIS standard welding neck flanges. All other flange connections may be made with slip-on flanges provided they are seal welded on inside.

3.10.6 Fuse all fillet welds for flanges or fittings into pipe and plate for minimum distance of 1½ times pipe wall thickness and depth weld on 11/4 times pipe wall thickness.

3.11 **Soldered and Brazed Joints**

Make soft copper pipe joints with suitable flux and 95/5, lead free solder.

3.12 **Piping Installation Specification**

3.12.1 The drawings indicate schematically the size and location of pipes. Pipes runs and sizes may, however, be changed to meet the site conditions. The Contractor on award of the work, shall prepare detailed working drawings showing the cross section, longitudinal section, detail of fittings, locations of isolating drain and air valves etc. They must keep in view the specific openings in buildings and other structures through which the pipes are designed to pass.

3.12.2 Piping shall be properly supported on or suspended from stands, clamps hangers etc. as specified and as required. The tenderer shall adequately design all the brackets, saddles, clamps, hangers etc. and be responsible for their structural integrity.

3.12.3 Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamp are of dissimilar material, a gasket shall be provided in between.

3.13 **Spacing of pipe supports shall not exceed the following:**

Table–2

3.13.1

Hanger Spacing (M)		
Pipe size O.D.(mm)	**Standard Steel pipe Duty :Water**	**Rod Size (mm)**
20	1.5	6
25	1.5	6
40	2.4	10
50	3.0	10

65	3.0	10
80	3.0	10
100	3.0	12
150	3.0	12
200	3.0	16 / Angle Iron Support
250	3.0	16 / Angle Iron Support
300	3.0	16 / Angle Iron Support
350	3.0	Floor Support
400	3.0	Floor Support
450	3.0	Floor Support
500	5.0	Floor Support

Table–3

3.13.2

MS Flanges Table D					
Pipe Size	**Dia of Flanges**	**Thickness of Flanges**	**Dia of Bolt Circle**	**No. of Bolts of Flanges**	**Dia of Bolts**
½”	3¾	3/16	2⅝	4	½
¾”	4	3/16	2⅞	4	½
1”	4½	3/16	3¼	4	½
1¼”	4¾	¼	3 7/16	4	½
1½”	5¼	¼	3⅞	4	½
2”	6	5/16	4½	4	⅝
2½”	6½	5/16	5	4	⅝
3”	7¼	⅜	5¾	4	⅝
4”	8½	⅜	7	4	⅝
5”	10	½	8¼	8	⅝
6”	11	½	9¼	8	⅝
8”	13¼	½	11½	8	⅝
9”	14½	⅝	12¾	8	⅝
10”	16	⅝	14	8	¾
12”	18	¾	16	12	¾
14”	20¾	⅞	18½	12	⅞
16”	22¾	⅞	20½	12	⅞

Table–4

3.13.3

MS Flanges Table E					
Pipe Size	**Dia of Flanges**	**Thickness of Flanges**	**Dia of Bolt Circle**	**No. of Bolts of Flanges**	**Dia of Bolts**
½	3¾	¼	2⅝	4	½
¾	4	¼	2⅞	4	½
1	4½	9/32	3¼	4	½
1¼	4¾	5/16	3 7/16	4	½
1½	5¼	11/32	3⅞	4	½
2	6	3/8	4½	4	⅝
2½	6½	13/32	5	4	⅝

3	7¼	7/16	5¾	4	⅝
4”	8½	½	7	4	⅝
5”	10	9/16	8¼	8	⅝
6”	11	11/16	9¼	8	¾
8”	13¼	¾	11½	8	¾
9”	14½	13/16	12¾	8	¾
10”	16	⅞	14	8	¾
12”	18	1	16	12	⅞
14”	20¾	1 ⅛	18½	12	⅞
16”	22¾	1¼	20½	12	⅞

Table–5

3.13.4

MS Flanges Table F					
Pipe Size	**Dia of Flanges**	**Thickness of Flanges**	**Dia of Bolt Circle**	**No. of Bolts of Flanges**	**Dia of Bolts**
½	3¾	⅜	2⅝	4	½
¾	4	⅜	2⅞	4	½
1	4¾	⅜	3 7/16	4	⅝
1¼	5¼	½	3⅞	4	⅝
1½	5½	½	4⅛	4	⅝
2	6½	⅝	5	4	⅝
2½	7¼	⅝	5¾	8	⅝
3	8	⅝	6½	8	⅝
4”	9	¾	7½	8	⅝
5”	11	⅞	9¼	8	¾
6”	12	⅞	10¼	12	¾
8”	14¼	1	12¾	12	¾
9”	16	1⅛	14	12	⅞
10”	17	1⅛	15	12	⅞
12”	19¼	1¼	17¼	16	⅞
14”	21¾	1⅜	19½	16	1

Table–6

3.13.5

MS Flanges Table H					
Pipe Size	**Dia of Flanges**	**Thickness of Flanges**	**Dia of Bolt Circle**	**No. of Bolts of Flanges**	**Dia of Bolts**
½	4½	½	3¼	4	⅝
¾	4½	½	3¼	4	⅝
1	4¾	9/16	3 7/16	4	⅝
1¼	5¼	11/16	3⅞	4	⅝
1½	5½	11/16	4⅛	4	⅝
2	6½	¾	5	4	⅝
2½	7¼	¾	5¾	8	⅝
3	8	⅞	6½	8	⅝
4”	9	1	7½	8	⅝
5”	11	1⅛	9¼	8	¾

6”	12	1⅛	10¼	12	¾
8”	14½	1¼	12¾	12	¾
9”	16	1⅜	14	12	⅞
10”	17	1⅜	15	12	⅞
12”	19¼	1½	17¼	16	⅞
14”	21¾	1⅝	19½	16	1

3.14 Pipe hangers shall be fixed on walls and ceilings by means of metallic rawl plugs.

3.15 Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 12mm thick ribbed rubber pad or any other approved resilient material. Where pipes pass through the terrace. Riser shall also have a suitable concrete pipe support at the lowest point.

3.16 Pipe sleeves of 50mm on larger diameter shall be provided wherever pipes pass through well and the annular space filled with felt and finished with retaining rings having 90 minute fire rating and enough mastic properties to avoid any cracks or leaks at normal duty.

3.17 Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 1.80mm metal sheet shall be provided between insulation and the clamp saddle or roller extending at least 150mm on both sides of the clamp, saddle or roller.

3.18 Piping work shall be carried out with minimum disturbance to the other works being done at the site. A program of work shall be chalked out in consultation with the Engineer.

3.19 Piping layout shall take due care for expansion and contraction in pipes.

3.19.1 All piping work shall be carried out in a workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that laying of pipe supports, pipes and pressure testing for each area shall be carried out in stretch.

3.19.2 Cut-outs in the floor slabs for installing the various pipes are indicated in the Drawings. Contractor shall carefully examine the cut-outs provided and clearly point out where the cell-outs shown on the drawings do not meet with the requirements.

3.19.3 The Contractor shall make sure that the clamps, bracket, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansions joints where required.

3.19.4 All pipes shall be accurately cut to the required size in accordance with relevant BIS Codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used.

3.19.5 Flanged inspection pieces 1.5 meter long, with bolted flanges on both sides, shall be provided no more than 30 meters centres where-ever shown in Approved-For-Construction shop drawings to facilitate future cleaning of all welded pipes.

3.19.6 All buried pipes shall be cleaned and coated with zinc chromate primer and bitumen paint then wrapped with three layers of fibre glass tissue, each layer laid in bitumen.

3.19.7 Insulated buried pipes shall be cleaned, de-rusted then coated with rust resistance primer. Insulation shall be applied as per the section “Insulation”, wrapped with GI wire and covered with polyethylene sheet. Two coats (each 6mm thick) of cement plaster shall be applied over chicken wire mesh lath. Where indicated in Schedule of Quantities, buried insulated pipes shall be water-proofed using coat of Shali bond or approved adhesive, over the plastered surface, wrapping one layer of fiberglass RP tissue and one layer of roofing tar-felt with sufficient overlaps, set and sealed with the adhesive held in position by 16 page GI wire tied at 15 cm intervals.

3.19.8 Purge valves shall be provided at all high points in the piping system for venting. Air valves shall be 15 mm pipe size valves with screwed joints.

3.19.9 Discharge from the air valves shall be piped through an equal sized mild steel or galvanised steel pipe to the nearest drain or sump. These pipes shall be pitched towards drain points.

3.19.10 All piping shall be tested to hydrostatic test pressure of at least two and half times the maximum operating pressure, but less than 10 per kg per sq. cm gage for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified and gotten approved at site.

3.19.11 Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

3.19.12 System may be tested in sections and such sections shall be securely capped, then retested for entire system.

3.20 All pipes using screwed fittings shall be accurately cut to the required size and threaded in accordance with IS:554/1955 and burrs removed before laying. Open ends of the piping shall be blocked to avoid entrance of foreign matter. Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.

3.21 Air valves shall be provided al all high points in the piping system for venting. Valves shall be of the double float type, with G.M./C.I. body, vulcanite balls, rubber seating etc. Air valves shall be of the sizes specified and shall be associated with an equal gate / ball valve with rising spindle.

Mains	**Air Valves**
Upto 100mm dia	25mm dia
100mm to 300mm dia	32mm dia
Over 300mm dia	50mm dia

Discharge from the air valves shall be piped through an equal sizes GI pipe to the nearest drain or floor waste or as shown.

3.22 All buried pipes shall be cleaned and coated with zinc chromate primer and bituminous paint, then wrapped with two layers of RP tissue each layer laid in bitumen.

3.23 Drain shall be provided at all low points in the piping systems and shall be of the following sizes:

Mains	**Air Valves**
Upto 300mm dia	25mm dia

Over 300mm dia	40mm dia

3.24 Drains shall be provided with gate valves of equal size with rising spindle. Drains shall be piped through equal size G.I. pipe to the nearest drain or floor waste or as shown on the drawings. Piping shall be pitched towards drain points.

3.25 All piping laid shall be as follows:

Pipe size	**Material**	**Joints and fittings**	**Sealing**
</= 65mm dia	MS tube	Screwed fitting	Non-hardening
	Heavy class	Unions	Lubricant
	IS:239/1964	Slip on flanges	3mm, 3ply, rubber insertion
>65mm dia / = 150 mm dia	MS tube	Welded fittings	
	Heavy class	Slip on flanges	
	IS:239/1964	Screwed flanges	3mm, 3ply, rubber insertion

3.26 All piping shall be black steel unless otherwise stated. Pipes shall be given one primary casting of pressure ratings suitable for the piping system. Fittings used on welded piping shall be of the weldable type. Flanges shall be new and from standard manufacturers. Supply of flanges shall include bolts, washers gaskets, etc., as required.

3.27 Tee-off connection shall be through reducing tees, wherever possible. Otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be restored to.

3.28 All equipment and valve connections shall be through flanges (Welded or screwed for galvanized steel)

3.29 All welded piping is subject to the approval of the Consulting Engineer and sufficient number of flanges and unions shall be provided.

3.30 **Flexible pipe connectors**

Flexible connections shall be provided at each pump and chiller. These flexible connections shall have neoprene rubber coating resistant to weather, heat & oil to protect the body from atmospheric conditions. Beneath the cover, layer of durable high tensile cord shall be provided for reinforcing the supporting member between tube and cover. The tube shall be leak-proof, abrasion resistant, seamless lining of rubber. The joint of tubes shall not be affected by passing fluid. Metal retaining rings shall be provided for distributing the bolting pressure around the flanges and to prevent the bolts from damaging the rubber flanges when tightened. Control rods shall be provided to prevent damage to expansion joint due to excessive elongation or compression of piping systems. All expansion flanges shall be heavy duty application.

3.31 **Mechanical noise and vibration control**

3.31.1 Flexible connections shall be fitted to all pump suction and discharge connections, chillers and other vibrating equipment and where anti-vibration mounts and inertia basis are fitted.

3.31.2 Flexible connections shall be fitted to all cooler coil chilled water pipe work connections Flexible connections shall allow freedom of movements of plant in all plans.

3.31.3 Making flanges to pipe work flexible connections shall be of the smooth faced weld-nick type.

3.31.4 Rubber Bellows shall be fitted as close to the sources of vibration at practicable. The pipe at the end of the bellows shall be a fixed point.

3.31.5 Rubber bellows shall be single convolution of multiply reinforced **EPDM** rubber with wire reinforced cuffs. Flanges shall be able to swivel and be removable. The date of manufacture shall be molded on the bellows. For tractability membranes shall have an indelible identification showing manufacturer, country of origin, the type and a batch number.

3.31.6 **The bars with rubber top hat washers shall be used on bellows.**

3.31.6.1 For working temperature up to **70** degree Celsius. The rubber bellows shall be tensile synthetic fiber reinforced.

3.31.6.2 For working temperature between **70°** C. and **100°** C. the bellows carcass shall be steel wire mesh reinforced throughout. Steel reinforced bellows shall be manufactured and approved to the Standards.

3.31.6.3 For temperatures above **100°** C. bellows shall be multiply stainless steel with Van Stone ends swivel flanges. The overall length shall not exceed **130 mm**.

3.31.6.4 Flexible connections with screwed connections shall be reinforced **EPDM** rubber hoses and shall have at least one full union to avoid torturing on installation.

3.31.6.5 Flexible pipe connections on chilled water systems shall be suitable for a working pressure of **10** bar and test pressure of **17** bar.

OR

Technical Specification of Pre-Insulated Pipe

PIPE

The pipe shall be MS ERW as specified in the Piping Section.

INSULATION

The pipe insulation shall be polyurethane foam with 36 kg/cu m minimum density, 90% minimum closed cell content, minimum compressive strength of 40 psi and initial thermal conductivity of 0.0154 Btu/hr.ft.^{0}F. The insulation shall completely fill the annular space between the service pipe and jacket and shall be bonded to both, the service pipe & jacket.

The insulation (PUF) shall be provided to the minimum thickness with cladding of minimum thickness as specified below:

S.No.	MS Pipe dia. / (mm)	PUF Thickness / (mm)	**OPTION-A** Thickness of G.I. (spirally wounded) Cladding / (Gauge)	**OPTION-B** Thickness of AL. (spirally wounded) Cladding / (Gauge)
1.	20 mm	33	26g	24g
2.	25 mm	32	26g	24g
3.	32 mm	33	26g	24g
4.	40 mm	30	26g	24g
5.	50 mm	31	26g	24g
6.	65 mm	36	26g	24g
7.	80 mm	42	26g	24g
8.	100 mm	42	26g	24g
9.	125mm	41	26g	24g
10.	150 mm	41	26g	24g
11.	200 mm	52	26g	24g
12.	250 mm	62	26g	24g
13.	300 mm	51	26g	24g
14.	350 mm	46	26g	24g
15.	400 mm	46	26g	24g
16.	450mm	45	26g	24g
17.	500mm	57	24g	22g
18.	550mm	57	24g	22g
19.	600mm	57	24g	22g
20.	650mm	56	24g	22g
21.	700mm	56	24g	22g
22.	750mm	55	24g	22g
23.	800mm	55	24g	22g

UNDER GROUND PIPING & INSULATION EXECUTION:

Underground systems shall be buried in a trench of not less than 600 mm deeper than the top of the pipe & not less than 450mm wider than the combined OD of all piping systems. A minimum thickness of 600mm of compacted backfill over the top of the pipe is desirable.

Trench bottom shall have a minimum of 150mm of sand, pea gravel or specified backfill material, consolidated to suit operating weight & to act as a cushion for the piping.

Buried piping:

The outer protective insulation jacket shall be seamless, extruded, black, uv resistant, high-density polyethylene **(HDPE).** The minimum thickness of the **HDPE** jacket and PUF shall be as follows:

S.No.	MS Pipe dia. (mm)	PUF Thickness (mm)	Thickness of HDPE Cladding (mm)
1.	20 mm	29	2.5

2.	25 mm	36	2.5
3.	32 mm	31	2.5
4.	40 mm	36	2.5
5.	50 mm	37	3.0
6.	65 mm	39	3.0
7.	80 mm	43	3.0
8.	100 mm	40	3.2
9.	125mm	39	3.5
10.	150 mm	53	4.4
11.	200 mm	63	5.0
12.	250 mm	57	6.3
13.	300 mm	58	7.0
14.	350 mm	64	7.8
15.	400 mm	68	8.8
16.	450mm	77	9.8
17.	500mm	50	11.1
18.	550mm	65	11.1
19.	600mm	83	12.5
20.	650mm	58	12.5
21.	700mm	82	13.0
22.	750mm	104	15.0
23	800mm	79	15.0

However the exact thickness could vary marginally for underground piping based on the exact sizes of **HDPE** pipes available as per the chart given below:

FITINGS

Fitting can be fabricated at site over the carrier pipe and correct quantity of PUF shall be poured manually.

FIELD JOINTS INSULATION:

Field joints insulation shall consist of **PUF** poured manually in a site-fabricated GI cladding fixed around the joint.

L- 4
VALVES & ACCESSORIES

PART 1: Balancing Valve (Manual–Double Regulating Type)

4.1	Duty	Chilled Water / HOT Water / Condenser Water
4.2	Pressure Rating	PN–10/PN–16 (As specified in B.O.Q.)
4.3	pH Value	Between 4 and 10

4.4 Material Specification

4.4.1	Hand Wheel	– CI-220
4.4.2	Body / Bonnet	– C.A.F. (CI 260 GG 25)
4.4.3	Body / Bonnet Bolts	– A 307, GR.B
4.4.4	Gland Packing	– Graphite asbestos
4.4.5	Stem Seal	– EPDM
4.4.6	Stem	– SS 410
4.4.7	Upper Disc.	– SS 410
4.4.8	Seat Seal	– EPDM (Site replaceable)
4.9	Lower Disc.	– SS 410
4.4.10	Dimensions as per Table	– Table –1 of this chapter
4.4.11	Tight Shut Off Type	
4.4.12	Flanges drilled to IS 6392 (PN 16) Standards	

4.5 General Description

4.5.1 Body and Bonnet shall be constructed of cast iron as per IS 210 Gr.260

4.5.2 Seat shall be erosion resistant stainless steel, with EPDM Seal, rendering it TIGHT SHUT OFF, and suitable for site replace ability.

4.5.3 The spindle shall be non–rising type, and its movement should be lockable/tamper proof type.

4.5.4 Micro–meter scale in the wheel should allow fine settings upto $1/10^{th}$ of a hand wheel turn. The spindle should be lockable with a lock screw, allowing the limiting maximum opening of valve, to pre–determined position, while still allowing to use as shut–off valve.

4.6 **T.A.B. (Testing, Adjusting and Balancing)**

4.6.1 Measurement of pressure drops and flow rate should be possible using the body taps and quarter turn cocks.

4.6.2 Digital measurements compatibility is a pre–requisite.

4.6.3 Published 'K' factor of valve for different hand wheel turns should be available.

(All dimensions in mm)

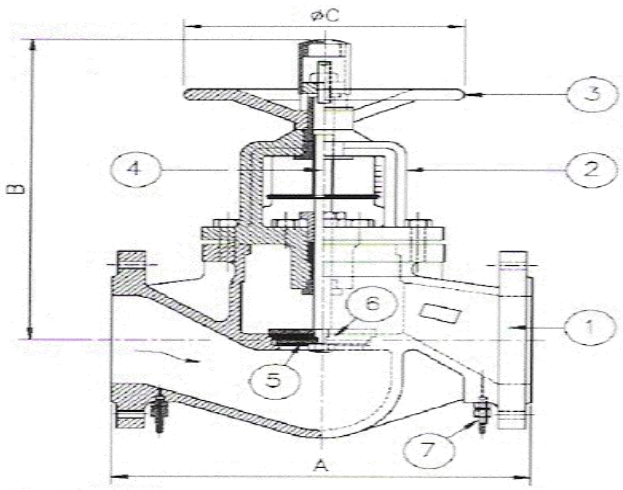


TABLE – 1

Nominal Size	**DN mm (Inch)**	**080 (3")**	**100 (4")**	**125 (5")**	**150 (6")**	**200 (8")**	**250 (10")**	**300 (12")**
L	mm	310	350	400	480	600	730	850
ØD	mm	200	220	250	285	340	405	460
H	mm	290	410	450	490	590	760	820
ØC	mm	175	225	225	300	400	480	480
Stroke	mm	32	40	49	57	69	80	96
Hand wheel Turns		8	10	12.25	14.25	11.25	10	12
Weight	Kg.	22.5	38	55	76	119	220	315

PART 2: BUTTERFLY VALVE

4.7	Duty	Chilled Water / HOT Water / Condenser Water
4.7.1	Pressure Rating	Confirm to BS:5155 PN–10/PN–16 & API–609
4.7.2	pH Value	Between 4 and 10

4.8 **Material Specification**

4.8.1 Single piece construction

4.8.2 Body liner to be integrally molded. Tight shut–off designed

4.8.3 Stem to be designed for best flow efficiency and structural stability

4.8.4 Material of construction of stem to be S.S. (AISI 410) High tensile grade

4.8.5 Stem sealing arrangement should not have gland packing

4.8.6 For sizes between 50mm to 600mm – used standard wafer valves

4.8.7 Provide Hand Lever operated valves with locking arrangement for every 10° turn for valves up to NB200mm

4.8.8 Gear operated (Manual) valves for sized NB250mm and more.

4.8.9 Refer TABLE for physical dimension detail

4.9 **General Description: Valve shall confirm to following intent:**

4.9.1 Single body caste

4.9.2 Body construction material should be graded cast iron

4.9.3 Disc. Construction material should be Stainless steel.

4.9.4 Disc. Seat should be an integral liner made of EDPM / Nitrite rubber, tight shut–off design

4.9.5 Valves more than NB 350 mm shall allow for seat replacement at site.

4.10 **General Description: Valve Installation Dimension**

Installation Dimensions

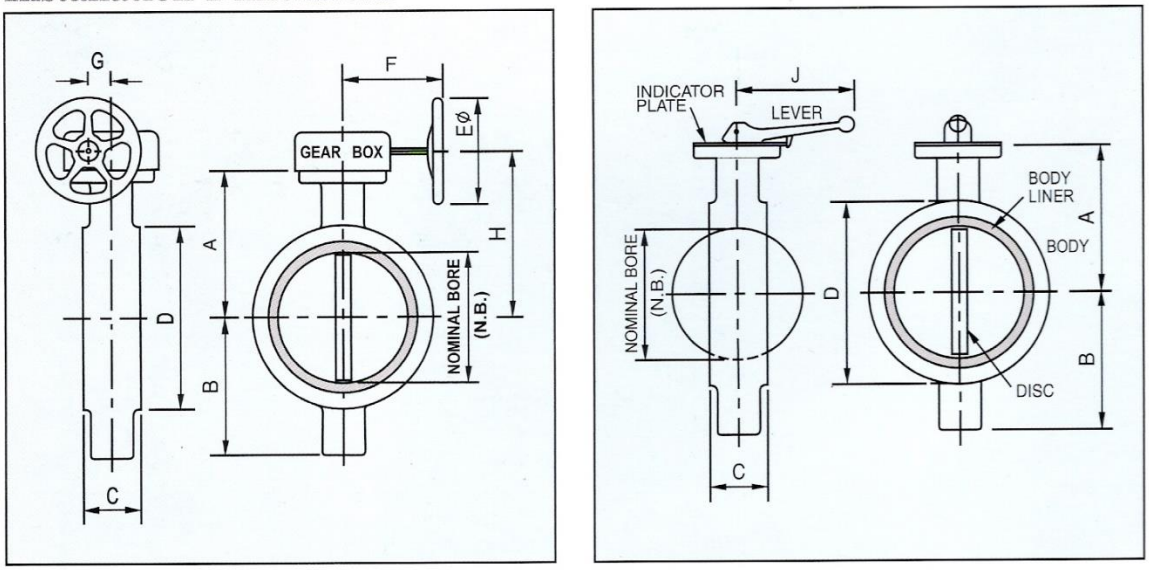


TABLE – 2

(All Dimensions in mm)

Valve I.	Valve NB	A	B	C	D	E	F	G	H	I	Approx. Gr. Wt. Kg.
50	(2")	113	68	43	97	-	-	-	-	237	3.5
65	(2.5")	121	74	46	110	-	-	-	-	237	4.0
80	(3")	128	81	46	129	-	-	-	-	237	4.5
100	(4")	146	96	52	161	-	-	-	-	237	6.2
125	(5")	158	114	56	188	-	-	-	-	237	7.7
150	(6")	174	132	56	212	-	-	-	-	300/350	9.0
200	(8")	198	165	60	269	-	-	-	-	400/500	14.0
250	(10")	245	215	68	320	300	175	61	283	-	30.0
300	(12")	275	240	78	370	300	175	61	313	-	44.0
350	(14")	305	265	92/78*	436	300	175	61	343	-	50.0
400	(16")	335	295	102	487	450	265	117	408	-	72.0
450	(18")	386	325	114	539	450	265	117	459	-	95.0
500	(20")	416	360	127	592	450	265	117	489	-	120.0
600	(24")	506	435	154	695	450	265	117	579	-	210.0

PART 3: DUAL PLATE CHECK VALVE

4.11.1 Duty Chilled Water / HOT Water / Condenser Water

4.11.2 Pressure Rating Confirm to BS:5155 PN–10/PN–16 & API–609

4.11.2 pH Value Between 4 and 10

4.12 **Material Specification**

4.12.1 Dual plate with independent springs in a central hinge pin, to allow for reduced hammer and non-slam

4.12.2 Value design should confirm to APS–594 and API–6D

4.12.3 One piece body, cast cut of graded C.I.

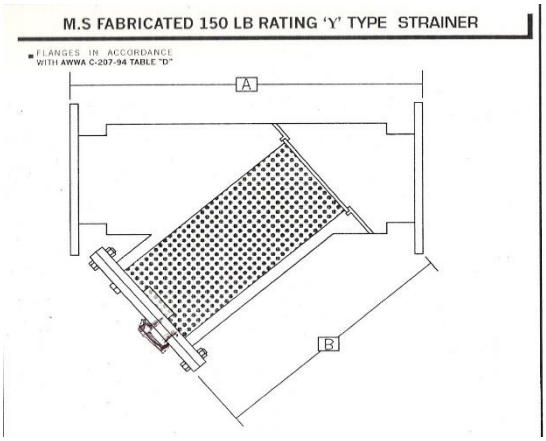
4.12.4 Disc. Shall be stainless steel

4.12.5 Seat to be made of Nitrite rubber

PART 4: STRAINERS (POT / Y / SUCTION DIFFUSERS)

4.13 **Pot Strainer**

4.13.1 Body C.I/MS (IS:2062) 'refer Table–3'



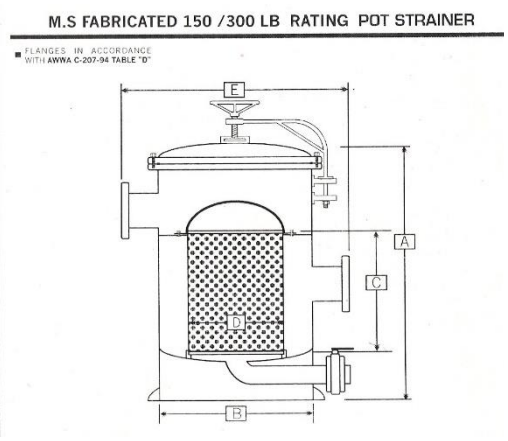


TABLE – 3 **Stainless steel (304) material, 1mm thick**

4.13.2

Plate Thickness (mm)	Pipe Size (mm)	Pot Size (mm)	Pot HT (mm)	Basket Dia (mm)	Basket HT (mm)
8	50	300	400	200	240
8	80	350	450	250	250
8	100	450	500	300	280
12	125	500	600	330	340
12	150	540	700	360	390

12	200	610	815	400	470
12	250	800	955	550	510
12	300	1000	1105	750	580
12	350	1190	1300	895	678
12	400	1350	1500	1020	785
12	450	1518	1700	1060	890
12	500	1690	1800	1100	900

TABLE – 4 **M.S. Fabricated 150 LB Rating 'Y' Type Strainer**

4.13.3

Line Size (NB)	25	50	65	80	100	125	150	200	250	300
"A" Strainer body length	225	260	375	380	425	525	600	750	800	850
"B" Basket length	150	180	230	230	300	340	380	475	525	575

TABLE – 5 **M.S. Fabricated 150 / 300 LB Rating Pot Strainer**

4.13.4

Line Size (NB)	50	80	100	150	200	250	300	350	400	450	500	500
"A"	400	450	500	700	815	955	1105	1300	1500	1700	1800	2200
"B"	300	350	450	540	610	800	1000	190	1350	1520	1690	2000
"C"	240	250	280	390	470	510	580	680	785	890	900	1160
"D"	20	250	300	360	400	550	750	895	1020	1060	1100	1500
"E"	500	500	700	800	900	1200	1500	1590	1850	2090	2290	2600

4.14 **Pressure Rating** Test pressure of PN 14 / PN 16 / as specified for valves etc. in the BOQ.

4.15 **Screen** Stainless steel (SS 304) (non magnetic), 1mm thick with 3mm perforation

4.16 **Filtration Area** NOT Less than 75%

4.17 **Filtration bucket** Brass ring on tap, rested on disc welded to the main body

4.18 Powerful magnet at bottom, to attract weld burrs in the piping network to be located at the bottom of the body, and shall have a clean out provision.

4.19 Flush down arrangement, with a butterfly / gate valve shall be provided.

4.20 Clearance of almost 300mm from the ground should be maintained by using ISMC 100x50.

4.21 Auto Air Vent with a ball valve isolator shall be provided, to purge accidental air entrapment.

4.22 Top lid shall be provided with a swivel arrangement, having a stainless steel screw and a wheel of C.I.–260, along with a hub and bearing arrangement. The lid shall be comply to M.S.–IS 2062 construction, with a lip and gasket ting arrangement.

PART 4: ACCESSORIES

4.23 **Closed Expansion Tank**

4.23.1 Closed vessel expansion tank where-ever specified will be of M. S. construction with interchangeable EPDM – BUTYL rubber membrane. The expansion tank shall be complete with safety relief valve, pressure reducing valve and pressure gauge

4.23.2 The tank will be of pressure rating to suit the system pressure and will be sized to adequately compensate for water expansion due to operating temperature variations.

4.23.3 For chilled water application, it will insulated with 75-mm thick insulating material of expanded polysterene and cladded with 26G-alluminium sheet.

4.24 **Air Separators**

4.24.1 The centrifugal air-separator will of M.S. construction with flanged connections. The air separator will be adequately sized to achieve maximum air-seperation. It will be provided with an automatic air-vent at the top.

4.24.2 For chilled water application, it will insulated with 50-mm thick insulation to the specifications and clad with 26G-alluminium cladding.

4.24.3 **The equipment shall be complete with a make-up pump of suitable rating and all other accessories and interconnecting piping, electrical cabling / panel (if required to operate the pump).**

4.25 **Binder Test Point**

4.25.1 Binder test point shall be installed at the inlet and outlet of each pump, balancing valve and heat exchange equipment like Chiller, Condenser, Cooling Tower, Water Cooling Coil, Boiler. Test Points shall also be provided at different locations in the water pipe line to facilitate pressure measurement.

4.25.2 Test Point shall be of brass construction, 1/4" BSP with NEOPRENE sealing bushes and shall be provided with screwed cover

4.26 **Suction Diffuser**

4.26.1 Suction diffuser shall be installed at the inlet of each pump. Suction Guide shall have cast iron body, outlet guide vanes, removable SS. Strainer and fine mesh brass S..S. start-up filter. The specifications for the Y-strainers shall be read in conjunction with this chapter (Refer table 4 for strainer body length etc.

4.26.2 The Contractor shall inspect the strainer prior to start-up of the pump and shall remove the fine mesh brass filter after short running period. Space shall be provided for removal of strainer and for connection of blow down valve.

4.27 **Gate valves**

Gate valves shall conform to IS : 780/1969, flanges to IS : 1536 or as required. Valves shall have non-rising spindles unless otherwise specified and shall be suitable for 21 Kg/Sq.cm test pressure. Tail pieces shall be used where required.

4.28 **Pressure Gauges (where-ever asked for)**

4.28.1 Pressure guage shall be not less than 100mm dia. dial, and of appropriate range and be complete with shut off gauge cocks, isolating valves etc. duly calibrated before installation.

4.28.2 Supply and return of chillers and condensers

4.28.3 Suction and discharge of heat exchangers

4.28.4 Inlet and outlet of heat exchangers.

4.28 Care shall be taken to protect pressure guage during pressure testing.

4.29 **Thermometers (where-ever asked for)**

4.29.1 Thermometers shall be either 100mm dia dial or direct reading industrial type of appropriate range duly calibrated before installation.

4.29.2 Thermometers shall be installed in separable wells.

4.29.3 Thermometers shall be provided at the following locations and as indicated on the drawings

4.29.3.1 Stem type thermometer on supply and return of chillers and condensers.

4.29.3.2 Direct reading industrial type thermometers on supply and return at air handling units.

High rangeability control valve/ pressure independent dynamic balancing cum control for Air handling Units

The scope of this section comprises the supply, erection, testing and commissioning of automatic control Valve of High range ability with flow limit by Delta temperature control and conforming to these Specifications and in accordance with the requirements of Drawings and Schedule of Quantities.

a. **Control Valves for AHU's**

Two way modulating control valve for each air handling units shall be provided in chilled water line at each air handling unit as shown on the Drawings and included in Schedule of Quantities. The valve shall be balanced ,high rangeability , globe type of cast iron construction, of PN 16 rating with flanged connections .The valve shall have a minimum stroke of 15 mm and rangeability of 300.
The valve actuator shall be electronic, motorized, modulating type with linear stroke of minimum 15 mm stroke, operating on 24Vac and 0-10 Vdc or 4-20 mA control signal.The actuator shall have provision for 0-10v dc position feedback signal and

manual operation mode also.It shall be possible to operate the valve manually and the actuator shall switch back to auto mode when the power is restored.The valve actuator housing shall have IP 54 protection.
The actuator should be suitable for a valve close–up pressure of 1.5 times the pump head or a minimum of 4 bars.
Each valve shall be controlled by a space temperature sensor with a provision to limit the flow through the control valve based on temperature difference across the coil.

b. Electronic temperature Controller for AHU's

The temperature controller shall be electronic,microprocessor based with LCD display working on 24 V AC with 0-10V dc output.It shall be capable of accepting inputs from three NTC temperature sensors.One temperature sensor for space temperature measurement and the other two temperature sensors for coil inlet and outlet water temperature for flow limit by delta T control.The controller shall be capable of comparing the signals and selecting the lower output to prevent excessive water flow through coil.
In case of BMS,controller shall accept 0-10 v dc signal from BMS

3. Components
3.2 Active Slab

3.2.1 PE-RT 10 x 1,3 mm

The pipes are made from environmentally friendly PE-RT with a diameter of 10 x 1.3 mm. Pipes are produced in rolls of 80, 240 and 480 m. The length of circuits depends of project case. Active Slab principle of the same lengths (35 m, 50 m) or variable lengths are possible (depends on manifold and system design). Maximal circuit length for heating system is 80 m, in case of cooling or combined system it's maximum of 60 m.

The pipes are controlled before shipping from the manufacturer to our company's warehouse. The pipes are certified for operating conditions up to 6 bar; the maximum operating temperature is +80 °C. Installation of the pipes should be made from +5 °C.

Temperature limits of the pipe material: -20 till +95 °C

Recommended operating conditions of the pipes: +5 till +60 °C

3.4 Plastic POM manifold

3.4.1 Body of the POM Manifold

The body of the manifold is made of a plastic profile machined on CNC machines. The profile's material is POM (polyoxymethylene). The material is low-absorbent, with a low coefficient of friction and high thermal stability.

Operating temperatures (long-term): -50 to +100°C.

Operating temperature (short-term): +140°C

The body of the manifold is made of a plastic profile machined on CNC machines. The profile's material is POM (polyoxymethylene). The material is low-absorbent, with a low coefficient of friction and high thermal stability.

Operating temperatures (long-term): -50 to +100°C.

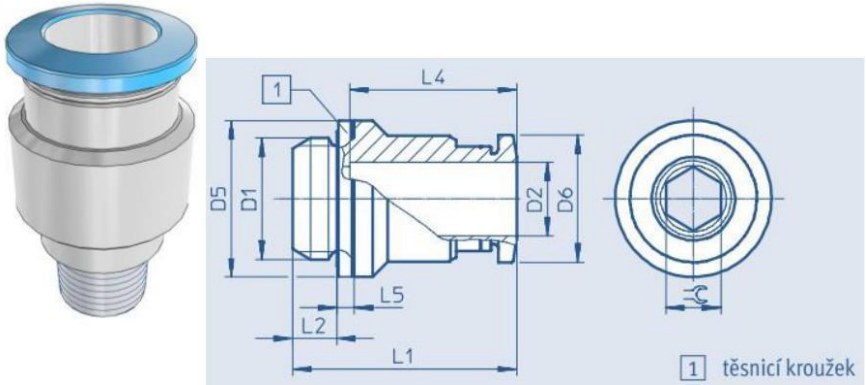
Operating temperature (short-term): +140°C

Pic. 11 – Plastic POM manifold

3.4.2 Push-in Connector

Push-in connectors are used to connect the hoses to the manifold body. They also allow re-dismantling and installation, if service is required. The connector has a 1/8” external thread used to connect it to the manifold body. The dimension of the hose connection is 100 mm. The bolted joint on the manifold body is sealed with an O-ring integrated in the pad. The connector body is made of nickel-plated brass; plastic connectors can also be used.

The used connectors are made by the producer FESTO, model range QS, type QS-G-1-8-10, no. 133000.



Pic. 12 - Festo push-in connector

3.4.3 Air Release Valve of the Plastic Manifold

The air release valve of the plastic manifold is used in a size of 1/8” and put on the input in the upper area of the manifold. If necessary, a 1/2” relief valve can be put on the end of the manifold using a nickel-plated brass reducer of 1” x ½”.

Pic. 13 - *Air release valve 1/8" 1" x ½"*

Pic. 14 - *Air release valve ½" with brass nickel-plated reducer*

3.4.4 Plug for Manifold Outlets

A plug made of nickel-plated brass is used to seal the unused 1/8" outlets. The connecting thread is G1/8"; an O-ring is used for the sealing.

Pic. 15 *– Plug of plastic manifolds, Aignep 3015, cat. no. 030150001*

3.4.5 Drain Valve of the Manifold

To drain the manifold during maintenance, a drain valve on the end of the manifold's body is used (optional). The drain valve has an external 1/2" valve; the cap is opened with a square key integrated in the valve plug. The body of the valve is made of nickel-plated brass. Is it connected through a nickel-plated brass reduction 1" x ½". The threads are sealed with O-rings.

Pic. 16 - *Drain valve of the manifold with connecting reducer*

3.5 Manifold Holder

A DN25 nickel-plated steal bracket with a pitch of 200 mm for the manifold is used to attach manifolds in boxes, niches or to the wall. The product model is IVAR.AC 610, ord. no. 501098.

3.6 Connection of Manifolds

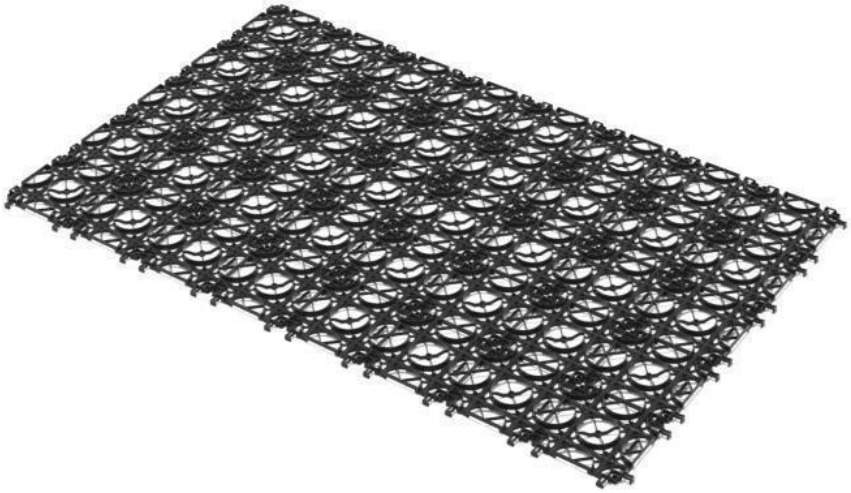
(screw fitting, ball valves etc.)

3.7 SpeeTile System Plate

The SpeeTile system plate is a mounting grid for the pipes of the Active Slab system. It is used mostly in applications in layers of 15-20 mm (low layers). It allows the pipes to be installed on walls and ceilings but also on floors where gluing can't be used. The grid is mounted to the building structure with wall plugs. The pipes are simply clicked into the grooves of the grid that are ready for pipes with an external diameter of 10 mm. Afterwards, the grid is covered with a plaster or a levelling screed (depending on the use). The pitch of the pipes in the grid can be 75 or 150 mm, and eventually multiples of 75 m.

Length x width	1.20 x 0.75 m
Area of 1 plate	0.9 m^2
Thickness	12.75 mm
Laying pitch	75, 150, 225, 300 mm
Material	PP
Diameter of the mounted pipes	10 mm
Diameter of the drill for grid mounting	6.0 mm
Diameter of the screw	7.0 mm
Size of 1 SpeeTile component	150 x 150 mm

Tab. 1 - *Technical parameters of SpeeTile system plate*



Pic. 17 *SpeeTile system plate*

3.8 Circulator Pump

For the circulation of hot water, we use circulator pumps designed for heating systems. An important aspect of the pump we use is its material. Since the ACTIVE SLAB system's hot water may contain more oxygen than a common heating system, we are careful to use non-corrosive materials. Impellers of the heating system pumps are usually made of composite materials combined with parts of stainless steel. Furthermore, the pump's body material is important. Suitable materials are composites, cataphoretically painted cast iron, bronze or stainless steel.

Circulator pumps most often used in ACTIVE SLAB systems:

3.9 Safety Valve

A standard safety valve for heating systems is used; safety pressure is usually 2.5 bar. The safety pressure can be set according to the system's needs. However, it needs to be included in the design of the expansion tank's size. In systems with higher hydrostatic pressure, hoses need to be secured according to Article 3.3.4.

3.10 Expansion Tank

For ACTIVE SLAB systems, we use expansion tanks where water is not in contact with the metal coating. Such tanks are usually certified for drinking water application.

We use standard GWS tanks. These tanks are constructed so that the water is separated from the air inside with a high-quality butyl membrane instead of a bag. The internal metal coating of the pressure tank is treated with plastics (non-toxic polypropylene), which eliminates the risk of corrosion altogether.

3.11 Cartridge Filter

We use an cartridge filter to filter mechanical impurities in the heating system's water. The filter has three parts. Material: body and head – PP, brass coating. Flow rate: 2.7 – 10.5 m^3/hour and max. pressure 6 bar. The filter is made in accordance with the EN ISO 9001:2008 norm and can be also used to filter mechanical impurities from drinking water. The cartridge is interchangeable and several cartridge types can be applied. The cartridges have different filtration grades. In the Active Slab system, we apply a cartridge made of cotton fiber with porosity of 20 µm.

Pic. 23 - Cartridge filter

4 Control and BMS

The system's regulation is an important part of convenient and energy-efficient operation of the ACTIVE SLAB heating system.

4.1 Factors Affecting the System's Operation

The operation of ACTIVE SLAB radiant heating is affected by the following parameters:

- Room thermostat and its settings
- Equitherm curve setting (with equitherm regulation = acc. outside temperature)
- Self-regulatory effect
- Method of operation
- Thermal-technical floor characteristics

4.1.1 Room Thermostat and Its Settings

A room thermostat is usually used to control the heat source or actuator of a zone three-way valve. For the smooth operation of the ACTIVE SLAB system, we use room thermostats with the hysteresis H ≤ 0.2 K. The low hysteresis secures continuous heating and simple temperature maintenance with a minimum range.

For ACTIVE SLAB systems that serve for both heating and active cooling, a thermostat that allows switching between operation regimes of heating/cooling must be used.

It is recommended to set the room thermostat at the requested temperature, e.g. ti = 21 °C, and keep it constant during the whole heating season (if the space is permanently occupied). We don't recommend that you turn down the heat at night and use day regimes because of higher operation costs for heating. See more in part 5.1.4.

Example of used room thermostats with requested hysteresis H ≤ 0,2 K. Attention: In some types, the hysteresis value needs to be set! Always read the installation and user manual of the installed room thermostat carefully.

Radiant Materials

10 mm PE-RT ree Multipert-5 pipe with an oxygen barrier layer accordance with DIN 4726. Max design/operating temperature: 90°C, Malfunction temperature: 100°C, Operating pressure at 90°C: 6 Bar as per ISO 10508, with surface roughness not more than 40nm. Pipe shall be placed at a spacing of 80-150MM over the XPS insulation boards. Pipe to be stapled to the XPS boards using tacker needle clips. Pipes must be Made in Europe with 10 years manufacturing warranty: 10mm x 1,3 mm thick (as per Manufacturer Software selection) - 10mm (OD) X 1,3mm .

Manifold Box with accessories:
For heating & cooling THM Manifold 2xP10-12 made of Polyamid PA6,6 30% fiber glass consisting of a supply and a return bar and a mount with a sound-absorbing element.

Supply bar:

Plastic segment manifold is equipped on the return point with visual adjustable flow meters with range 0.6-2,4 /min. on return point. Manifold bodies are equipped with loading and

emptying valve, deaerating valve 1/2", and required amount of consoles is a part of the package. Manifold connection: 6/4 “external screw. Circuit connection due to quick couplings PUSH for pipes of d10x1,3mm. Maximal operational safe temperature 70 °
Two 1" flat seals as well as one set of labels for marking the supply and return part are sent together
with the manifold.
10 loop manifolds with isolation valveAnd suitable for 10 Loops

Manifold Cabinet:
THM Manifold cabinets under plaster 9-12 circ 830 mm distribution cabinet made of steel with removable door, also made of steel.
Fastening bar installed on the rear wall. Powder coated RAL 9016.
Height-adjustable cabinet feet 0 - 180mm.
• Depth: 110 - 140mm
• Height: 716 - 896mm
Cabinet shall be with lock for distribution cabinet - Cabinet for manifold

Texture Foil/ Pipe Track:
PE texture track to be laid on EPS/XPS insulation used for guiding the PE-RT ree Multipert-5 pipe /PEXa pipes to be fixed on the insulation with the help of fixing clips with a pitch distance of 100/120mm. Woven PE fabric with printed installation grid as cutting orientation and for the exact alignment of the pipes, grid spacing 5cm. The woven fabric moreover serves as moisture barrier with unilateral foil protrusion to cover the insulating layer according to DIN 18560. Use as separating foil between dry construction element and insulation panel.

Loop Actuator:
230 V NC type actuator to be fixed on return manifold loop. Small and compact structural shape, first open function, water protection according to protection type IP54. Also appropriate for overhead mounting. All around function indicator, valve adapter concept, snapon installation, adaptation check on valve. 230V, wing nut M30 x 1,5mm, free cable head with cable and sleevers, length = 1m. Actuator is closed de-energized 230V AC 2W, power stroke 4mm.

Pipe bend support:
90 Degree pipe bend support for 10mm PE-RT ree Multipert-5 pipe /PEXa pipe. Non-halogen and not flame-protected pipe guide bend made of PE, catering for special resistances to alcohols, fats, petroleums and petrols. It has no resistance to concentrated, strongly oxidising acids.

Controller:
Digital controller for heating / cooling: Room control thermostat suitable for common switch ranges for flush mounting. Suitable for the
control of central cold / warm water underfloor cooling / heating in connection with thermal actuators.
• Target temperature adjustable in 0,5k increments
• Easy and intuitive navigation with a rotary-push mechanism
• Adjustable temperature reduction
• Internal weekly time switch
• Frost and valve protection function
• Smart Start / Smart Stop function

Terminal strip:

Terminal strip for professional connection of temperature controllers and electro-thermal actuators in connection with warm water underfloor heating circuits.
• Easy, intuitive installation with a screwless clamping method.
• Input for temperature limiter / dew point sensor
• Pump control
Maximum amount of actuators that can be connected:
• 6 zones: 15 actuators
• 10 zones: 18 actuators
Connections for terminal strips 230 V

Access point:
The Multi I/O box can be connected with the acces point which establishes the connection with a cloud server in the internet. The data transmission is done with a safe AES 128 bit encryption.

Water temperature sensor:
Water temperature sensors in return or supply line or surface temperature sensor. Sensor shall be 1" long and shall be installed in thermo well.

Central Controller which shall be suitable to operate at 24 V+/-10 and ambient temperature range 0 to 50 C. The single zone room controller for heating and cooling with temperature and humidity sensor included, in combination with delivery temperature probe, allows the ambient temperature and humidity regulation combined with mixing valve to manage and control the delivery temperature.
Radiant Room thermostat. The thermostat shall be suitable to operate in temperature range of 0 to 50 C with LCD display. Thermostat should have Temperature & Humidity sensor to calculate dew Point. The thermostat communicates to the regulation unit of the manifolds according to the values of temperature and relative humidity of the room in which it is installed. Viewing and setting the temperature measured and desired can be done directly from the display of the thermostat.

INSTALLATION MANUAL FOR RADIANT SYSTEM

1. Principle

The principle at work behind the “Under floor Heating System (UFH)” is based on the thermal storage capacity of parts of a building. The “Active” element of a combined cooling and heating system is achieved by embedding pipes in the screed of the building.

UFH operate at temperatures close to ambient which facilitates the integration of renewable energy and heating sources that are free of cost. Furthermore, UFH has been a mature and well-proven technology for decades.

Under floor heating of building structures is an ingenious technology that not only provides comfortable indoor climate but also helps protect the environment and save costs.

In UFH system, heating is achieved by circulating hot water as per design parameters. Compared to other forms of heating, this system creates no air turbulence due to the very low convection rate in heat transmission.

UFH system reduces the air change rate to the basic level necessary for proper room hygiene (1x to 2x convection rate). It is thus possible to install a smaller ventilation system

.

2 System Description

UFH System with pipes embedded in the main building construction elements (in screed) in base buildings. It is Suitable primarily for sensible heating and secondarily for base heating. UFH System is not any air-conditioning and does not substitute any ventilation system.

This is the UFH system to improve comfort, work motivation and working conditions in various facilities.
UFH system is energy efficient, noise free and draught less cooling system for different types of facility. In this system PE-RT ree Multipert-5 pipe /PE-Xa pipe installed to distribute heating/cooling energy into the room by conduction and radiation.
In this system, the building mass screed is heated, which forms a source to release energy for the higher level. The human bodies and all other objects in the premise become a sink of heat with lower energy level. Thus the heat is automatically transferred from the hot objects to the colder surrounding, making the human bodies comfortable & also increasing the temperature of all objects in the premise. Eventually the air temperature also increases due to conduction & natural convection.

3 Pre-Installation

1. Prior to installation the workers to be briefed with basic knowledge of the technology and proper communication to be ensured to understand the installation instructions.
2. Instructions to be given about all accessories to handle them in a proper and safe way.
3. The workers to be trained at least for 4-6 hours before they start installation.
4. Basic training on the safety and health aspects of their jobs.
5. Site Safety Standard was discussed to avoid accidents and injuries.

4 Installation procedure

1. Manifold locations should be marked in exact position as per the drawing with a temporary support (with wood or iron rods).
2. Isolate the walls of rooms/area by using edging strip so that energy from one area should not transfer to other area.
3. Isolate the slab by using insulation over slab so that the energy cannot transfer at slab level.
4. Seal the insulation joints by using tape.
5. Lay PE texture foil over insulation to avoid physical contact of screed with insulation & also pattern is imprinted on texture foil to maintain spacing between pipes supply and return line.
6. Fix the manifold to the temporary support, In the way of supply should be on top and return in bottom.
7. Mark all four sides maintaining 100-200mm distance from the walls and beams to lay the pipe as loops.
8. Place the pipe on the decoiler for easy pipe pulling.
9. Stretch the flexible pipe to their full length to place the pipe on the texture foil
10. Fix the pipe the manifold on supply according to the module drawings maintaining the space of 100mm x 100mm pipe to pipe.
11. By using pipes clips securing pipe onto insulation 2-3 clips per 1mtr of pipe length.
12. After completing the loop laying, get the pipe up to the manifold and fix the end to the return to complete the loop.
13. Follow the same process for all loops and other manifolds also.

14. Please cove the manifold ends (for both supply and return) with some packing tape to avoid the dust entering in to the manifold.
15. Ones the manifolds fixing and looping of pipe is done, then it is ready for the pressure test.
16. To make a pressure test for manifold, fill the manifold all loops with water first.

5 Water filling

Water filling helps us to removes the air inside the pipes.

1. Fix one pressure gauge and one ball valve to the return side manifold and one ball valve to the supply.
2. Make sure all the supply and return valves are closed.
3. Potable water is introduced into the supply line through a temporary connection.
4. Now open the first loop supply and let water passes through the loop and after a few seconds open the return valve to flush the water from return side.
5. Hold it for few minutes and close the return first and then supply completely to avoid air gaps.
6. If the water entered in to the supply and not coming from the return, then there is some loop interchange while installation (if that happens please recheck all loops and make necessary changes).
7. After flushing the first loop, then open the second loop supply line and let potable water enters in that loop and hold it for few seconds to fill that entire loop and open the return valve to flush.
8. While flushing, please do it for few minutes until the complete air in the loop exhausted and you get a constant flow of water without any air gaps.
9. Fill the water for all loops of manifold in the same procedure.
10. After filling the water in all loops then the manifold is ready for pressure test.

6 Water Pressure Testing

The purpose of pressure test is to identify leaks caused by gap in fitting.

Water pressure test:

1. First of all, close all the loops (supply and return) before you start the pressure test.
2. Connect a pressure gauge to the supply side and ball valve at both supply and return ends.
3. Close the ball valve of both supply and return.
4. Loops need to be purged of air in turn by flushing the water through each loop.
5. Connect the water supply to the supply line and open the supply ball valve.
6. Make sure that the water quality is good before you feed water in to the manifold.
7. Now open the first loop supply and wait for few minutes so that water fills up in that circuit.
8. Now open the return valve (blue in colour) slowly and let air in the loop completely exhaust.
9. After few minutes of bleeding, close the return ball valve and continue with water supplying to build up the pressure in the loop.
10. Start giving the pressure with an external pump or with manual pressure equipment following the pressure gauge and build up the pressure up to 6 bar.
11. When the needle of the pressure gauge reaches 6 bar, close the supply ball valve also and let the 6 bar pressure remains in the loop.
12. After that open the second loop supply ball valve, ones the loop is filled with water open the return line to bleed the water.

13. Then close the return and continue with water supplying to build up the pressure in the loop.
14. Start giving the pressure with an external pump or with manual pressure equipment following the pressure gauge and build up the pressure up to 6 bar.
15. Now close the supply ball valve also and let the 6 bar pressure remains in the loop.
16. Follow the same procedure to build up the pressure of 6 bar in other loops and to all manifolds.
17. To ensure all loops has been pressurized open all Supply loop valves and give pressure up to 6bar and close supply ball valve.
18. Maintain that 6 bar pressure up to 5-12 hours as per the instructions.
19. When the 5 hours have elapsed, check that the pressure rating in the same to find the pressure drop.
20. Pressure falls because of pipe expansion usually 0.5 to 1.5 bar depending up on the loop length.
21. If the pressure falls more than 2bar then there is a leak. If in that case leak should be identify and make necessary changes and recheck of joints.
22. Make a note of this test in pressure test document with manifold numbers, number of loops, pressure of 6 bar and test starting time and end time.
23. Ones the pressure tests are completed, after 5 hours the pressure of the manifold should put down to 3bar for screeding.
24. Pressure of 3 bar should be maintain while screeding.

7 Reasons for leakage:

Due to manual errors leakage may occurs. Some of them are shown below.

1. If the Pipe is inserted deeply inside the Q&E fitting after expanding the pipe.
2. If the installer Use the wrong head for the expanding the pipe.
3. After installation, if someone drilled externally

8 Rectification of punctures:

1. Find out area where water leakage is happening.
2. Isolate the loop/manifold of desired area.
3. Open the area wherever pipe got punctured.
4. With use of Q & E rings and pipe connector rectify the damaged point.
5. Pressure test the loop/manifold again to ensure proper jointing.
6. After ensuring joint cover the area with same civil construction material & final finish material.

9 Flushing of riser pipes

1. You must flush out the complete rising pipes before you connect it to the manifolds.
2. Please flush the complete riser loop for 2 or 3 times.
3. First and second time water introduced into the riser line may be normal water but it should be clean and clear.
4. Third time flushing should be done with potable water.
5. Water flushing should be done until the inlet water comes in transparent in colour (not brown in colour).

6. The purpose of flushing is to avoid the dirty water with metal pieces (comes while welding the riser pipe joints) entering in to the manifolds.
7. As this metal pieces might lead to no water circulation in some loops/manifolds.
8. Ones the above process is completed, you can connect the riser pipes to the manifolds and run the radiant cooling system as per designed water temperature.

1.7 DUCT–LINE THERMAL INSULATION

External thermal insulation shall be provided as follow:

- The duct insulation Basic material shall be cross linked closed cell Oxide Acetate Foam/Nitrile rubber. Insulation should be of minimum thickness as mention in the BOQ.
- The duct insulation shall be with Factory pre-laminated Aluminium foil for mechanical protection where the men approach to damages the Oxide Acetate foam surface. Insulation should be of minimum thickness as mention in the BOQ.
- Density of Material shall be between 30 ±3 Kg/m3.
- Thermal conductivity of Oxide Acetate foam shall not exceed 0.029 W/m.K at mean temperature of 0°C and 0.35 W/mk at 27±2 Deg C.
- Insulation material shall be UV resistive, anti-microbial and anti-fungal with zero rating fungal growth as per ASTM –G -21
- Insulation material should not have any effect of acids and alkalis as per IS:9845-1998
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O'.
- Water vapor permeability shall be negligible as per DIN EN ISO : 12572 , i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum 12800.
- The insulation material passes Smoke and Toxicity test as per (IMO Resolution MSC -307 (88) (2010 FTP Code): Annex 1: Part 2
- Material shall be CFC/ HCFC free as per US EPA 5021 A(2014).

1.8 Following installation procedure should be adopted:

The thickness of the cross linked closed cell Oxide Acetate Foam shall be as mentioned below and in the in the schedule of quantity. Following installation procedure should be adopted:

- ✓ Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work.
- ✓ One coat Adhesive must be allowed to tack on the surface of the ducts to dry and then press surface firmly together starting from one end and working towards centre.
- ✓ Measurement of surface dimensions shall be taken properly to cut Oxide Acetate Foam sheets to size with sufficient allowance in dimension.
- ✓ Material shall be fitted under compression and no stretching of material should be allowed.
- ✓ A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface.
- ✓ When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond.
- ✓ All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- ✓ The adhesive shall be strictly as recommended by the manufacturer.
- ✓ The detailed Application specifications are as per the manufacturer's recommendation.

1.9 **RECOMMENDED THICKNESS OF CROSS LINKED CLOSED CELL OXIDE ACETATE FOAM /Nitrile Rubber BASED UPON DUTY CONDITIONS FOR COASTAL AREAS**

Supply air duct (Line temperature : 14 Deg C) : Use 25 mm thickness
Return air duct (Line temperature : 22 Deg C) : Use 9 mm thickness

1.10 **RECOMMENDED THICKNESS OF CROSS LINKED CLOSED CELL OXIDE ACETATE FOAM/NITRILE RUBBER BASED UPON DUTY CONDITIONS FOR NON-COASTAL AREAS**

Supply air duct (Line temperature : 14 Deg C) : Use 19 mm thickness
Return air duct (Line temperature : 22 Deg C) : Use 9 mm thickness
Supply Air Duct in Return Air Path
(Line Temp. 14 Deg.C) : Use 9 mm thickness

1.11 **DUCT LINING**

Acoustic material for Duct Acoustic Lining basic material shall be open cell oxide acetate foam. The Thermal conductivity of Oxide acetate foam for air-conditioning application shall not exceed 0.029 W/m K at 0 deg C mean temperature and 0.35 W/mk at 27±2 Deg C and average Noise Reduction Coefficient (NRC=0.50 for 10mm, NRC =0.65 for 15mm and NRC =0.84 for 25mm thickness at frequency range from125 Hz to 4000Hz) .The density of Acoustic material shall between 30 to 60 kg/m3.

The installation guideline for Acoustic Isolate Foam in Duct Acoustic Lining:

- The inside duct surface should be cleaned with suitable solvents and rendered free from all physical and chemical impurities. Thoroughly clean the entire surface with denatured alcohol. This must be done for new sheet metal in order to remove the oil residue off the entire surface.
- The Use of retaining pins is not required when using Rubber based adhesive.
- Measure all sides of the duct, then adding 5 mm approximately to the measurement to ensure a compression fit, cut isolate foam accordingly.
- Using an adhesive roller or a short, stiff bristle brush, apply a thin, uniform coat of adhesive to both the isolate foam as well as to the metal duct surface. Be certain there is 100% coverage on both surfaces.
- Once the adhesive is tacky (finger nail test) the top piece should be adhered. Start at one edge of the duct & align the outside edge of the Acco foam down to the duct. Continue along, applying pressure to the entire length & press firmly. When approximately 90% adhered, align the opposite edge tightly against the duct & press firmly, then press balance of foam flat.
- This will ensure a tight compressed fit at the edges when all the Acco foam has been applied.
- Be certain to apply full, even pressure along the entire surface with your hands or a weighted roller for best adhesion.

1.12 **EXPOSED DUCT THERMAL INSULATION (Optional)**

Duct insulation shall be applied as follows:

- Apply hot bitumen 85/25 over the surface after cleaning the ducts.
- Rigid extruded polystyrene 50 mm thick insulation material to be fixed tightly to the surface with joints well butted and secured.
- Cover the insulation with 24 gauge x 19 mm GI wire mesh with necessary overlapping.

- Apply 2 layers of 1:3 sand cement plaster mixed with water proofing compound each of 10 mm thickness achieving smooth surface finish.
- Apply 2 coats of synthetic paint of approved shade.

1.13 EXPOSED ROOF THERMAL INSULATION

- The Under Deck insulation basic material shall be cross linked closed cell Oxide Acetate Foam . Insulation should be of minimum thickness as mention in the BOQ.
- The insulation material shall be with Factory pre-laminated Aluminium foil.
- Density of Material shall be between 30 ±3 Kg/m3.
- Thermal conductivity of Oxide Acetate foam shall not exceed 0.029 W/m.K at mean temperature of 0°C and 0.35 W/mk at 27±2 Deg C
- Insulation material shall be UV resistive, anti microbial and anti fungal with zero rating fungal growth as per ASTM –G -21
- Insulation material should not have any effect of acids and alkalis as per IS:9845-1998
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O'.

Water vapour permeability shall be negligible as per DIN EN ISO : 12572 , i.e. Moisture Diffusion Resistance Factor or 'μ' value should be minimum

- The insulation material passes Smoke and Toxicity test as per (IMO Resolution MSC -307 (88) (2010 FTP Code): Annex 1: Part 2
- Material shall be CFC/ HCFC free as per US EPA 5021 A(2014).

Application

Under-deck surface of ceiling shall be cleaned with brush to remove all dirt, cement etc. If the surface is uneven it should be made smooth prior to carry out Insulation work. A layer of rubber based adhesive (Zero flame , UL listed – Pedilite SR 998 or Magic 81-10) should be applied on the ceiling with help of brush so that all the pores are filled & surface becomes smooth & allow it to dry.

Insulation material sheet of specific size (1.5mtr x 2mtr) & ceiling surface shall have all over adhesive coverage.

A thin film of adhesive shall be applied on the ceiling with brush & then on the plain side of the insulating material with brush/small piece of sheet metal having smooth edges.

When adhesive is tack dry, insulating material sheet shall be placed in position, pressed firmly & no gap shall be left.

During installation avoid air bubbles. Always apply pressure while fixing the insulation sheet, this action will ensure maximum bond strength.

Insulation material shall be fixed under compression, no stretching of material shall be permitted.

Once insulation material sticks with ceiling, fastener shall be applied at gap of every 400 to 500 mm distance to provide the permanent fixing of insulation material with ceiling.

To avoid the risk of screw head going right through the insulation material, insulation fixing washer of minimum 60 mm diameter shall be used.

1.14 FIRE BREAKS IN INSULATION

Fire breaks shall be provided in all ducts (for internal lining / External thermal insulation) after a run of 10 M (Centre to Centre) . Fire breaks in insulation simply mean that there will be a discontinuity of the insulating material in form of a MS angle of a minimum of 50mmx50mm x 3mm size. At the interface of the MS

angle and the insulating material , proper care of tucking in of the insulating material shall be taken , so as to prevent erosion.

1.15 **CHILLED WATER PIPING INSULATION THICKNESS**

Pipe line surface temperature: 7 Deg C

Pipe NB (mm)	**Required Thickness (mm)**
25 to 40	32
50 to 150	38
200 to 600	44
Cold Water Tank	44

REFRIGERANT PIPING

Line temperature: 3 Deg C

Pipe NB (mm)	**Required Thickness (mm)**
Up to 50	38
Up to 100	44

CONDENSATE DRAIN PIPING

Pipe surface temperature: 15 Deg C

Pipe NB (mm)	**Required Thickness (mm)**
Up to 50	38

RECOMMENDED THICKNESS OF CROSS LINKED CLOSED CELL OXIDE ACETATE FOAM BASED UPON DUTY CONDITIONS FOR NON-COASTAL AREAS

CHILLED WATER PIPING

Pipe line surface temperature: 7 Deg C

Pipe NB (mm)	**Required Thickness (mm)**
25 to 32	19
upto 600	32
Cold Water Tank	32

H V A C R E L A T E D E L E C T R I C A L I N S T A L L A T I O N

L- 1 **GENERAL**

1.1 **DEFINITION**

1.1.2 **Concealed:** Installed above false ceiling, in walls or chases or trenches.

1.1.3 **Out doors:** Exposed to weather or ambient conditions.

1.1.4 **Underground:** Burried.

1.2.1 **CERTIFICATION / QUALITY ASSURANCE**

As per the specified norms detailed in the length of this section.

Materials shall meet the requirements of BIS / NBC / Local codes.

1.3 **SUBMITTALS**

1.3.1 Submit manufacturer's product data and installation procedures for review.

STANDARD SPECIFICATION ON ELECTRICAL MOTORS AND STARTERS

This section deals with supply, installation, testing and commissioning of all types of motors used for pumps, air handlers, compressors, cooling towers etc. The motor installation, wiring & its control shall be carried out in accordance with the specifications as detailed below.

MOTORS

MAKE OF MOTORS

The make of motors shall be as specified in List of Approved Make.

a) The motor shall be of the following design and should run at all loads without any appreciable noise or hum.

i) Totally enclosed fan cooled Sq. Cage.

ii) Screen protected drip proof wound Sq. Cage motor.

Enclosure and type of motor shall depend upon duty and usage unless otherwise specified.

b) The winding of motors shall be class 'F' insulation and suitable for local conditions. The insulation of motors shall confirm to IS:325/1978.

c) All motors shall comply with IS:12615:2011 or Based on IEC 60034:30 foot mounted motors.

d) The rating of the motor shall be as indicated in the Schedule of Equipment & Bill of Quantities should be as per IE3 Type. The motors shall be selected on the basis of ambient temperatures and allowable maximum temperature rise.

e) Motor above 1HP shall be three phase unless otherwise specified.

f) All motors shall be rated for continuous duty as per IS:325. Motor shall be suitable for operation on 415 volts ± 10% volts, 50 ± 5% Hz AC supply (or 230 ± 10% volts, 50 ± 5% Hz for single phase AC supply).

g) Motors shall be provided with cable box to receive Aluminum conductors, PVC insulated, PVC sheathed and armoured cables auitable rised cable eatery berries with in if required shall be provided for easy-ness of cable termination and adequate space.

h) All motors shall be provided with combination of 'Ball and Roller Bearing'. Suitable grease nipples for regreasing the bearing shall be provided.

i) Motors above 0.25 HP shall be provided with overload protection. Motors above 100 HP shall be provided with thermal protection and thermistor detector in the starter winding.

j) The starter current and the type of starter to be used shall be as follows (unless otherwise specified)

Type of motor Starting	Current Starting method
a) Sq. Cage motor up to 7.5 hp current	600% of full load D.O.L
b) Above 10.0 hp up to 60 hp current	250% of full load Star / Delta
c) 75 HP & above current	200% of full load Closed transition Star / Delta

MOTOR STARTERS

a) All starter shall confirm to IS: 13947. The starter shall be enclosed in sheet metal enclosure, which would be dust vermin proof.

b) All starter should have suitable range of voltage and frequency.
c) All starter shall have integral stop/start push button of international colour code.
d) Contactor shall have number of poles as required for appropriate duty. Contacts should be made of solid silver faced & shall be suitable for at least 40 contacts per hours.
e) In event of power failure, the starter should automatically disconnect.
f) All starters shall be provided with thermal over load relay.
g) All star delta starters shall have adjustable timers.
h) Terminal blocks with integral insulating barrier shall be provided for each starter.
i) All starters shall be provided as specified in Bill of Quantities. All starter shall be compatible to the drive and driven equipment.
j) Extra contact for interlocking purpose shall be provided in the starter.

INSTALLATION OF MOTORS
a) The motor and drive machine shall be fixed on slide rails to facilitate belt and other adjustments.
b) Vibration isolation arrangement shall be provided.
c) The installation of motor shall be carried out as per IS:900.
d) The motor with driving equipment shall be mounted on foundation and connected to each other with flexible coupling with guard in condenser & chilled water pumps.
e) All motor shall be wired as per specifications. Earthing of motor frame shall be done with GI strips as specified in 'Bill of Quantities'.
f) All motors shall be tested at manufacturer's works as per I.S. standard and test certificates shall be furnished.
g) All motors after installation shall be tested at site for vibrations, heating and electrical insulation resistance by AC contractor.

L–2 **TECHNICAL SPECIFICATION FOR MV PANEL BOARDS**

GENERAL

2.1.1 **WORK INCLUDED**

2.1.1 Panel Board Enclosures, Switch Gear and Accessories

2.1.2 Internal wiring, control terminal blocks, name plates / labels and painting

2.1.3 **RELATED WORK AND OBLIGATIONS**

2.1.3.1 The general requirements apply to work specified in this section.

2.1.3.2 Examine all the other sections of the specification for requirements, which may affect work of this section.

2.1.3.3 Co-ordinate works with all other trades affecting, or affected by activities of this section. Co-operate with such other trades to assure the steady progress of all operations under the contract.

2.1.4 **GENERAL REQUIREMENTS**

This specification covers requirements for Supply, Erection, Testing and Commissioning of MV Panel Boards. The equipment offered by the Contractor shall be complete in all respects. Any material and component not specifically stated in this

specification but which is necessary for trouble free operation of the equipment and accessories specifically excluded. All such equipment / accessories shall be supplied without any extra cost. Also, all similar components shall be interchangeable and shall be of the same type and rating for easy maintenance and low spare inventory.

SIZES OF POWER CABLING

The following size of power cabling shall be used only:

HP of Motors	Cable size
a) Up to 5 HP	3c x 4 sq.mm aluminium conductor armoured cable.
b) 5 to 7.5 HP	3c x 6sq.mm aluminium conductor armoured cable.
c) 10 to 15 HP	2no. 3c x 6sq.mm aluminum conductor armoured cable.
d) 20 to 25 HP	2 nos. 3 x 16sq.mm aluminum conductor armoured cable.
e) 30 to 35 HP	2 nos. 3c x 25sq.mm aluminum conductor armoured cable.
f) 40 to 50 HP	2 nos. 3c x 35sq.mm aluminum conductor armoured cable.
g) 60 HP	2 nos. 3c x 35sq.mm aluminum conductor armoured cable.
h) 75 HP 2 nos.	3cx 50sq.mm aluminum conductor armoured cable.
i) 100 HP 2 nos.	3cx 70sq.mm aluminum conductor armoured cable.
j) 125 HP 2 nos.	3cx 95sq.mm aluminum conductor armoured cable.

CAPACITY OF RELAYS AND CONTACTS

The following capacity relays and contacts shall be used for various rating of motors:

Type of Starter Contactor Overload Relay Current Phase	Relay Range
a) 50/60 HP Motor	Star Delta Starter 65 Amp. 30 - 50 Amp.
b) 40 HP Motor	Star Delta Starter 45 Amp. 20-33 Amp.
c) 30 HP Motor	Star Delta Starter 45 Amp. 20-33 Amp.
d) 25 HP Motor	Star Delta Starter 32 Amp. 14-23 Amp.
e) 20 HP Motor	Star Delta Starter 32 Amp. 14-23 Amp.
f) 15 HP Motor	Star Delta Starter 25 Amp. 9-15 Amp.
g) 10 HP Motor	Star Delta Starter 16 Amp. 6-10 Amp.
h) 7.5 HP Motor	D.O.L. Starter 16 Amp. 9-15 Amp.
i) 5 HP Motor	D.O.L. Starter 16 Amp. 6-10 Amp.

EARTHING

The earthing of all equipments shall be carried out by Copper strips / wires as mentioned in Bill of Quantities. All panels / three phase motors shall be earthed with two number distinct and independent Copper strips / wires of the following sizes:

1. Motor upto 5.5 KW	3 sq. mm Copper Wire
2. Motor 7.5 to 12 KW	4 sq. mm Copper Wire
3. Motor 12 to 50 KW	2 5 x 3 mm Copper Strip
4. Motor 51 to 89 KW	32 x 6 mm Copper Strip

The earthing connections shall be connected to main earth station or main earth grid. The earth connections shall be connected to equipments after removal of paint, grease etc.

POTENTIAL FREE CONTACTS

The AC contractor shall provide fire shunt relay contact in his panel wherever necessary either it is specified in the Schedule of Quantities or not free of cost along with auto / manual mode selector switch in the outgoing feeder for AHU Fan, Ventilation & Pressurization fan etc. to take fire input signal (Potential Free Contact).

2.1.5 **CODES AND STANDARDS**

Compliance with all applicable Indian standards, Indian Electricity Act and Indian Electricity rules.

2.1.5.1	IS 5	:	Colors for ready-mixed paints and enamels.
2.1.5.2	IS 375 / 1963	:	Making and arrangement for switchgear, busbars, main connections & auxillary wiring
2.1.5.3	IS 694	:	PVC insulated cables for working voltages up to and including 1100V.

2.1.5.4	IS 13779	:	A.C. Static Electricity Meters.
2.1.5.5	IS 1248	:	Electrical Indicating instruments.
2.1.5.6	IS 1567 / 1960	:	Metal clad switches (Current rating not exceeding 100A)
2.1.5.7	IS 1951 / 1916	:	Polyvinyl chloxide sleeving for electric purposes.
2.1.5.8	IS 2147 / IS 12063	:	Degree of protection provided by enclosures for low voltage switchgear and control gear.
2.1.5.9	IS 2675 / 1966	:	Enclosed distribution fuse boards and conduits for voltage not exceeding 1000 Volts.
2.1.5.10	IS 13947 (Part-2)	:	A.C. Circuit breakers.
2..1.5.11	IS 8828	:	Miniature Circuit breakers.
2.1.5.12	IS 12640	:	Residual Current Operated Circuit breakers.
2.1.5.13	IS 2448 / 1962	:	Adhesive insulating tapes.
2.1.5.14	IS 2551	:	Danger Notice Plates.
2.1.5.15	IS 2705	:	Current Transformers.
2.1.5.16	IS 2208 / 1962	:	HRC Cartridge fuses links up to 650 Volts.
2.1.5.17	IS 13947 (Part-4, Sec-1)	:	Contactors and motors starter for voltages not exceeding 1000 V AC or 1200 V DC.
2.1.5.18	IS 13947 (Part-5, Sec-1)	:	Control Circuit Devices and Switching Elements
2.1.5.19	IS 13947 (Part-1&5)	:	Actuators, Indicators
2.1.5.20	IS 13947 (Part-1&5)	:	Timers
2.1.5.21	IS 13947 (Part-3)	:	Switch Disconnector Fuse, Changeover Swiches
2.1.5.22	IS 3043	:	Code of practice for earthing.
2.1.5.23	IS 3072	:	Installation and Maintenance of switchgear.
2.1.5.24	IS 3202	:	Code of practice for climate proofing of electrical equipment.
2.1.5.25	IS 3231/ IS 8686	:	Electrical relays for power system protection.
2.1.5.26	IS 4237	:	General requirements for switchgear and control gear for voltages not exceeding 1000 V.
2.1.5.27	IS 5082	:	Wrought Aluminum & Al alloy for electrical purposes.
2.1.5.28	IS 6875	:	Switches and push-buttons.
2.1.5.29	IS 8623	:	Specification for factory built assemblies of switchgear & control gear for voltages up to & including 1000 V AC.

2.1.5.30	IS 13703 (Part-2)	:	HRC Cartridge fuses.
2.1.5.30	IS 10118	:	Code of practice for selection, installation and maintenance of switchgear and control gear.
2.1.5.31	IS 11353	:	Guide for uniform system of marking and identification of conductors and apparatus terminals.
2.1.5.32	IS 12021	:	Specification of control transformers

Equipment inline with any other authoritative / internationally recognized standards such as IEC, British, USA and German etc. shall also be considered if it ensures performance equivalent or superior to Indian Standards. Prior approval shall be obtained from Consultant for use of this equipment / material. In such cases the decision of Consultant shall be final and binding.

2.1.6 **QUALITY ASSURANCE**

Manufacturers regularly engaged in manufacture of panel boards and enclosures, of types, sizes and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

Installation shall be carried out by a firm with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for project.

2.1.7 **GUARANTEE**

Manufacturer shall provide guarantee for work under this section. However, such guarantee shall be in addition to and not in lieu of all other liabilities which manufacturer and Contractor may have by other provisions of the contract document.

The Panel Boards shall be guaranteed against trouble free operation, defective workmanship, materials and design for a period of 18 months from the date of supply or 12 months from the date of erection and commissioning, whichever is earlier. Any defects during this period shall be rectified free of cost.

2.1.8 **SUBMITTALS**

2.1.8.1 Contractor to submit general arrangement diagrams with front, side, top and bottom view and inside view.

2.1.8.2 General arrangement diagrams shall include outline and dimensions, voltage, main bus capacity, circuit breaker details and their arrangement / sizes.

2.1.8.3 All drawings shall also indicate location / description of all operating / indicating components mounted on the front / rear of the panel for all feeders / starters.

2.1.8.4 Typical control schematic diagram for each type giving designation to be refereed on Single Line Diagram.

2.1.8.5 Terminal block details for all feeders / starters power and control terminals provided for external as well as internal wiring connections.

2.1.8.6 Panel board foundations with necessary dimensions.

2.1.8.7 Details of shipping sections along with all dimensions.

2.1.8.8 Bill of material giving make / rating / catalogue number of all components of the complete switch board.

2.1.9 **DELIVERY**

All panels shall be carefully packed to avoid damage during transit. Panel boards shall be wrapped in polyethylene sheets for local shipment, whereas for outstation delivery in addition to polyethylene sheet the panels shall be packed in wooden crates to prevent damage to the finish.

LIST OF BUREAU OF INDIAN STANDARDS CODES

IS	:	1239 (Part - I) - 1979	Mild steel tube
IS	:	1239 (Part - II) - 1982	Mild steel Tubulars and other Wrought steel pipe fittings
IS	:	4736 - 1968	Hot-dip zinc coatings on steel tubes
IS	:	823 - 1964	Code of procedure for manual metal arc welding of mild steel
IS	:	780 - 1980	Sluice valves for water works purposes
IS	:	778 - 1980	Copper alloy gate, lobe and checks Valves for water works purposes
IS	:	1536 - 1976	Flanges configuration
IS	:	5312 (Part-I) - 1984	Swing - check type reflux Non Return valves for water works
IS	:	2379 - 1963	Colour code for the identification of pipelines
IS	:	554 - 1975	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS	:	655 - 1963	Metal air ducts
IS	:	277 - 1977	Galvanized steel wire for fencing.
IS	:	4064 - (Part -II) - 1978	Specific requirements for the direct switching of individual motors.
IS	:	3854-1969	Switches for domestic & similar Purpose
IS	:	694-1977	PVC insulated (HD) electric cables For working voltage upto and Including 1100 Volts.
IS	:	9224 (Part II) - 1979	HRC cartridge fuse links upto 650 volts.
IS	:	8544 (Part-I to IV)-1979	Starters
IS	:	732 (Part-III)-1982	Inspection and testing of installation.
IS	:	659-1964	Air Conditioning (Safety Code)

IS	:	660-1963	Mechanical Refrigeration (Safety Code)
IS	:	4894-1987	Test Code for Centrifugal Fan.
IS	:	3103-1975	Code of practice for Industrial Ventilation
IS	:	7240-1981	Application & Finishing of thermal insulation material

In case of any revision in above BIS code. The REVISED one shall only be applicable.

PREAMBLE TO MODE OF MEASUREMENT

IS 655 / SMACNA (AS ASKED FOR IN THE BOQ) SHALL BE ADOPTED FOR THE CONSTRUCTION PROCEDURES/ SPECIFICATIONS IN DUE ESSENCE OF THESE GUIDELINES ALSO.

3.1 All equipment described hereafter, shall be in accordance with the specifications.

3.2 All equipment shall be selected and installed for the lowest Operating noise level.

3.3 Supply of various equipment shall include all expenses for correspondence with manufacturers, submission of shop drawings, documents and their approval by the Consulting Engineer, procurement of equipment, transportation, shipping, payment of all taxes and levies, storage, supply of equipment at the point of installation, furnishing all technical literature required, replacement of defective components, and warranty obligations for the individual equipment.

3.4 Installation of various equipment shall include all material and labor associated with hoisting and lowering of equipment in position, insulation of the components and vibration isolation as required, grouting and anchoring or suspension arrangements and all incidentals associated with the installation as per the specifications and manufacturer's recommendation.

3.5 Vibration isolators as specified or as recommended by the manufacturer shall be installed with each component. Performance ratings, power consumption and power data for each component shall be verified at the time of testing and commissioning of the installation, against the data submitted with the tenders.

3.6 Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirit, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop painted surfaces.

3.7 Testing and commissioning shall include furnishing all labour, materials, equipments, instruments, and incidentals necessary for complete testing of each component as per the specifications and manufacturer's recommendations, submission of test results to the Consulting Engineer and obtaining their approval and submission of necessary documents and completion drawings.

3.8 All ducts shall be fabricated and installed conforming to the relevant Indian standards, approved shop drawings and the specifications.

3.9 Duct installation shall include fabricating and installing the ducts, splitter dampers, turning vanes, and distribution grids within the ducts in position, and providing, installing and making air tight all joints with slips, bonded felt insertions, nuts, bolts and screws as required. In addition multi-louvered manually adjustable dampers shall be provided in various branch ducts as required or shown on drawings for proper balancing of air flows.

3.10 All registers and diffusers shall be provided with a soft continuous rubber gaskets between their periphery and the surface on which these have to be mounted.

3.11 Registers and diffusers shall be given, at the factory, a rust resistant primer coat and enamel paint finish of approved color.

3.12 After completion of the installation, the entire air distribution system shall be tested for air leaks and balanced in accordance with the specifications.

3.13 **Mode of Measurement**

The mode of measurement for the various item, unless otherwise specified, shall be as follows:

3.13.1 **Ducting**

3.13.1.1 Payment for ducting shall be made on the basis of the external surface area of the ducting including all material and labor for installed duct.

3.13.1.2 The rates per sq. ft. of the external surface shall include flanges, gaskets for joints, bolts and nuts, duct supports and hangers, vibration isolation pads or suspenders, flexible connection, inspection doors, dampers, turning vanes, and any other item which will be required to complete the duct installation except external insulation and acoustic lining.

3.13.1.3 The external area shall be calculated by measuring the overall width and depth (including the corner joints) in the center of the duct section and overall length of each duct section from flange face in case of duct lengths with uniform cross section. Total area will be arrived at by adding up the areas of all duct sections.

3.13.1.4 In case of taper pieces average width and depth will be worked out as follows;

W1 = Width of small cross section

W2 = Width of large cross section

D1 = Depth of small cross section

D2 = Depth of large cross section

$$\text{Average width} = \frac{W1 + W2}{2}$$

$$\text{Average Depth} = \frac{D1 + D2}{2}$$

3.13.1.5 Width and depth in the case of taper pieces shall be measured at the edge of the collar of the flange for duct sections fitted with angle iron flanges, otherwise at the bottom of the flange where flanges are of duct sheet.

3.13.1.6 For the circular pieces the diameter of the section mid-way between large and small diameters shall be measured and adopted as the mean diameter for calculating the surface at the taper piece.

3.13.1.7 For the face length of taper piece shall be the mean of the lengths measured face to face from the centre of the width and depth flanges.

3.13.1.8 Duct measurements for calculation of area shall be taken before application of insulation.

3.13.1.9 For the special pieces like bends, branches, and tees etc. same principle of area measurement as for linear lengths shall be adopted except for bends and elbows, the length of which shall be the average of the lengths of inner and outer periphery along with curvature or angle of the piece.

3.13.2 **Duct Insulation**

This item is provided separately for various thickness and shall be paid for on area basis of un–insulated duct. The area of the duct to be insulated shall be measured before application of insulation.

3.13.3 **Un–insulated Piping**

Payment for un–insulated piping shall be made on the basis of linear measurement including all materials and labor for installed pipe. The linear rate per meter / feet for each nominal diameter shall include all pipe fittings, flanges, unions, nominal diameter shall include all pipe fittings, flanges, unions, gaskets for joints, bolts and nuts, pipe supports and hangers, vibration isolation devices or suspenders flexible connections and any other item required to complete the pipe installation except valves of any kind and strainers. The length of the pipe section with flanges shall be from flange face to flange face.

For fitting like bends, elbows, branches and tees, etc. Same principle of linear measurement as for pipe sections shall be adopted except for bends, the length of which shall be the average of the lengths of inner and outer periphery along the curvature.

3.13.4 **Valves / Strainer**

Payment will be made on unit basis.

All quantities indicated in this schedule are for Contractor's guidance only.

TECHNICA DATA

(TO BE FURNISHED BY BIDDER IN METRIC SYSTEM ONLY)

Please mention the make and country of origin of all the equipments.

1. AIRCOOLED DUCTABLE UNITS (If Any)

a) Nominal capacity TR :

b) Actual Capacity of split type air
Cooled duct able split unit at
Operating conditions of air entering
at 32.2 DEG.C :

c) Type of compressor :

d) Make/model of compressor :

e) Number of compressors/ unit :

f) Nominal air quantity CMH :

g) HP of blower motor :

h) Make of motor :

i) External static Pressure of Indoor
Units in MM :

j) Noise level of Indoor unit at 1mt away
From unit in DB :

i) Is programmable micro processor :
Panel Included or not. :

2. COOLING COIL
a) Face area of cooling coil SMT :

b) Fins/cm :

c) No. of rows deep :

d) HP of blower motor :

e) Make of motor :

f) Type of motor :

3. CONDENSOR COIL OUTDOOR UNIT.
a) Face area SMT :

b) No. of fins/cm.

c) Heat rejection kcal/hr :

d) Capacity of each fan CMH

e) Fan HP.

f) Total air quantity discharged/unit CMH

g) Noise level of outdoor unit at 1mt away from unit in DB :

h) Number of fans per outdoor unit
i) Type of Fan
j) RPM of Fan :
k) Type and make of motor

4. Unit dimensions
a) Out door unit in mm LxWxH :

b) Indoor unit in mm LxWxH

5. Air filters no. and size
a) Electric supply, voltage and
Frequency
b) Permissible voltage & frequency
Variations :

6. Bare Weight Kgs. :
a) Outdoor unit
b) Indoor unit
7. Actual Capacity & IKW/ TR at
Operating conditions

2. CONTROLS

Makes

a)	Three way Mixing Valve With Actuator (Part of BMS work)	:
b)	Pressure gauge	:
c)	Thermometers	:

3. PIPES

a)	Make	:
b)	Class	:

4. VALVES

Make

a)	Check Valve	:
b)	Butterfly Valve	:
c)	Balancing Valve	:
d)	Y-Strainer	:

4.1 Material/Gauge/Perforation of basket & Make

i)	Pot Strainer	:

ii) Suction strainer :

5 GRILLS/DIFFUSERS/DAMPERS

Please indicate make/material/gauge of the following:

Make

Material

a) Duct Dampers :
b) Grills/Diffusers :
c) Fire Dampers :
d) Smoke & Temperature Sensor :

6 DUCT INSULATION

a) Manufacturers Name :
b) Material :
c) Density Kg. Per Cmt :
d) Thermal Conductivity Kcal/Hr.Deg.C :

7 DUCT LINING

a) Manufacturers Name :
b) Material :
c) Density Kg. Per Cmt :
d) Thermal Conductivity Kcal/Hr.Deg.C :

8 PIPE INSULATION

a) Manufacturers Name :
b) Material :
c) Density Kg. Per Cmt :
d) Thermal Conductivity Kcal/Hr.Deg.C :

9 ELECTRICAL ACCESSORIES

a) Panel Manufacturer's name

10 DOUBLE SKINNED AIR-HANDLING UNITS

	TAG NO.					
A.						
a)	Make of AHU					
b)	Capacity CMH					
c)	Material/Gauge Casing Drain Pan					
d)	Over all size (LxBxH) mt					
e)	Type of AHU, vertical/ horizontal/Ceiling suspended					
f)	Over all weight in Kg.					
B.	**COOLING COIL**					
a)	Make					
b)	Material of Tube/Fins					
c)	No. of Fins/cm					
d)	No. of Rows deep					
e)	Dia of Tubes (mm)					
f)	Face Area (SMT)					
g)	Cooling Capacity (Kcal/hr.)					
h)	Chilled Water Flow Rates LPM					
i)	Face Velocity MPS					
j)	Test Pressure Kgs./Sq.cm					
C.	**FILTER SECTION**					
a)	Make					
b)	Type of Filters					
c)	No. of Filters					
d)	Size of Filters					
e)	Air Velocity through Filter EPM					
f)	Efficiency of Filter %					

	TAG NO.					
D.	**FAN & FAN MOTOR**					
a)	Make of Fans & Motor					
b)	Type of Fan					
c)	No. of Fan					
d)	Width and dia of fans (mm)					
e)	Type of Blade					
f)	Air Quantity CMH					
g)	Static Pressure in wg					
h)	Fan Discharge Velocity					
i)	Type of Balancing					
j)	Brake Horse Power in HP					
k)	Hose Power of Motor in HP					
l)	Motor RPM					
m)	Fan Speed					
n)	Type of Drive Ball Driven/Direct Driven					

11. TYPE OF WATER PUMP

a) Pump Water Flow LPM :
b) Pump Head M :
c) Pump RPM :
d) Motor Rating KW :
e) Pump RPM :

12. AXIAL FANS / SISW FANS / INLINE FANS

a)	Make	:
b)	Model	:
c)	Type	:
d)	Air Flow	:
e)	Static Pressure	:
f)	BHP	:
g)	Motor KW	:
h)	Speed RPM	:
i)	Noise Level dBA	:
j)	Performance Curve	:
k)	Fan blade Adjustable	:
l)	Motor Non Overloading	:
m)	Local disconnect switch	:
n)	Material of blade	:
o)	Material of casing	:
p)	Type of Starter	:

PROJECT
India International Centre for Buddhist Culture and Heritage

SUBJECT
TENDER FOR PLUMBING WORKS

TECHNICAL CONDITIONS OF CONTRACT

SECTION - I SCOPE OF WORK

1.1 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Plumbing Drawings.

1.2 Without restricting to the generality of the foregoing Sanitary installations shall include the following:

a) Sanitary Fixtures & CP Fittings etc as per the GRIHA requirements.
b) Soil, Waste and Rain Water Pipes.
c) Internal and External Water Supply System i/c BMS enabled Flow metre
d) Domestic water distribution system through hydro-pneumatic system to all wet points.
e) Domestic water transfer to flushing water tank near STP.
f) Recycled water distribution system through hydro-pneumatic system to all wet points.
g) Soft water supply through dedicated hydro-pneumatic system to cooling Tower.
h) Internal water supply system including hot water through geyser.
i) Internal and External Sewerage and Storm water drainage system with excavation of pipe around the buildings.
j) Rain Water Harvesting/ borewell.

END OF THE SECTION – I

SECTION - II SPECIAL CONDITIONS OF CONTRACT

1. GENERAL INSTRUCTIONS

1.1 All works specified in the tender have to be executed in accordance with:

a) The latest guidelines of local bylaws specifications as maximum wherever possible and as per local guidelines.

b) The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.

c) Applicable norms to be laid down by the relevant sections of latest editions of National Building Code (NBC), local bylaws and all relevant codes of Bureau of Indian Standards (B.I.S.) shall be followed as applicable.

d) The codes of the Uniform Plumbing Code of India and relevant British Standards or local standards shall be used as a general guide for good engineering practice, design and workmanship norms.

1.2 All materials used in the works shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified here in after.

1.3 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.

1.4 Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior design drawings issued by the Engineer-in-Charge. Work will be executed only as per approved shop drawings.

1.5 Quantities in the tender document are approximate worked out on the tender drawing issued.

1.6 Contractors are invited to highlight any aspects of the contract document that may need revision or reconsideration before the work is started. He must furnish details of any variations in the specifications or the quantities that may be necessary for him to comply with the Code and statutory requirements. These may be identified and approval of the Project managers taken before the start of the work.

1.7 Contractors shall furnish detailed Shop drawings, hydraulic and other design calculations for approval.

1.8 Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.

1.9 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest local bylaws with latest amendments as applicable in the contract.

1.10 The work shall be carried out strictly as specified in Schedule of Quantities and Technical Specifications. In case of any ambiguity, the details of particular item as given in Schedule of Quantities shall supersede the details in Specifications.

2. LICENSE AND PERMITS

2.1 Contractor must hold a valid Plumbing license issued by the Municipal Authority or other competent authority under whose jurisdiction the work falls.

2.2 Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to water supply, sewerage, storm-water drainage system including rainwater harvesting complete.

2.3 Contractor shall obtain No Objection Certificate before commencement of work, from the local authorities all related to his work as required for the building.

2.4 Contractor shall obtain, from the local authorities all related completion certificates with respect to his work as required for occupation of the building.

2.5 No additional charges other than official payment shall be payable to the contractor on getting NOC / completion certificate/Inspection fees. Unless it is obtained, the final payment of the contractor shall not be released.

3. METRIC CONVERSION

3.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

3.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by local Standards shall be acceptable without any additional cost.

4. REFERENCE POINTS

4.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

4.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

5. DRAWINGS ISSUED TO CONTRACTOR

5.1 Service drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

5.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

5.3 Contractor shall verify all dimensions at site and bring to the notice of the Architects, all discrepancies or deviations noticed. Architects decision shall be final.

5.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small-scale drawings.

5.5 All drawings supplied with the tender shall be returned in good conditions along with the tender.

5.6 All drawings/sketches issued by the Architects/Consultant for the works are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

5.7 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Engineer-In-Charge /Owner.

6. SHOP DRAWINGS

6.1 The Contractor shall submit to the Consultant two copies of Shop Drawings for Plumbing works as an Advance Copy to the Engineer-in-Charge for approval before start of work. Subsequent to the approval of the shop drawings, the Contractor shall submit seven copies of Shop Drawings for execution to the Engineer-in-Charge. The Contractor shall also submit four copies of the Technical Specifications and Catalogues for all items, including pump curves, single line diagrams etc. as relevant.

6.2 All Sanitary Engineering drawings issued to the Contractor shall be studied by them. Contractor shall also obtain the necessary architectural, structural and other services drawings, based on which they shall prepare their shop drawings as per site conditions.

6.3 Shop drawings shall incorporate the following:

- All proposed Structural supports/hanging/laying and jointing details for all types of pipes as required.
- Typical details for Toilets & Fixtures required.
- Plumbing layout plans as required and for any changes in the layout of Plumbing/ Architectural Drawings.

- Equipment & piping layout for Mechanical and Electrical equipments as required, SLDs, mounting details of circuit breakers, location of panels, installation of terminals and faucets etc. w.r.t. finishes, surrounding levels & locations.

- Manufacturer's and Contractor's fabrication drawings

6.4 The Contractor can only commence the work after the approval of above documents by Project Manager/ Consultant.

6.5 Contractors shall ensure that the Shop drawings are approved by the Engineer-In-Charge / Owner / Consultant prior to any execution.

7. COMPLETION DRAWINGS & DOCUMENTS

7.1 On completion of work contractor shall submit one complete set of original tracings and two prints of "As Built" drawings for the Engineer-In-Charge. These drawings shall have the following information.

a) Run of all pipes with diameters and length on all floors and vertical stacks.

b) Ground and Invert levels of all Plumbing services pipes.

c) Location of all valves.

d) Location of all Mechanical equipment with layout and piping connection.

7.2 Contractor shall provide four sets of Test Certificate, Routine Type Test certificates for Motors, Dynamic balancing certificate for Impellers, Calibration certificate for instrument catalogues, Operation and Maintenance Manuals, performance data and list of spare parts supplied together with the name and address of the Manufacturers for all Mechanical and Electrical equipments provided by him in the form of a Book or Manual.

7.3 All "Warranty / Guarantee" cards / certificates in original issued by the manufacturers shall be handed over to the Engineer-In-charge also in the form of a comprehensive record book / documents.

8. MATERIALS (SUPPLIED BY THE CONTRACTOR)

8.1 All materials used in the works shall conform to the tender specifications.

8.2 As far as possible all materials shall be bearing I.S. certification marks as per approval of the Engineer-In-Charge.

8.3 All materials shall bear the necessary certification marks, conforming to the Tender Specifications / BOQ / Drawings requirements.

8.4 Unless otherwise specified and expressly approved in writing by the Engineer-In-Charge, materials of makes and specifications mentioned with tender shall be used.

9. INSPECTION AND TESTING OF MATERIALS

9.1 All materials before being allowed to be brought into the store will be preliminary / visually inspected at the entry gate of the project site before the security personnel. All materials shall be inspected by the Engineer-In-charge / Owner before receiving. This inspection will be conducted with the help of the quality approval format as prepared by the Clients.

9.2 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

9.3 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

a) Theodolite
b) Dumpy level
c) Steel tapes
d) Weighing machine
e) Plumb bobs, Spirit levels, Hammers
f) Micrometers
g) Thermometers, Stoves
h) Hydraulic test machine
i) Smoke test machine

9.4 All such equipment shall be tested for calibration at any approved laboratory, and the test and calibration certificate shall be submitted to the Engineer-In-Charge / Owner.

9.5 All Testing Equipment shall be preferably located in special room meant for the purpose.

10. MATERIALS SUPPLIED BY THE OWNER

10.1 The Contractor shall verify that all materials supplied by the Owner conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Engineer-In-Charge.

10.2 After receipt of materials, it shall be the responsibility of the Contractor for any damage found and he shall be liable to pay the actual cost of the material as per market rate at that time.

11. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS FREE OF COST

If any materials issued to the Contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to the Owner which shall include all freight and transportation, excise duty, sales tax, import duty etc. or the actual cost given by the Owner shall be final and binding on the Contractor.

12. CONTRACTORS RATES

12.1 Rates quoted in this tender shall be inclusive of cost of materials, labor, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, sales tax on works contract and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

12.2 Rates quoted are for all heights and depths required for this work.

12.3 All rates quoted must be for complete items inclusive of all such accessories, Fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.

12.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete of appropriate mix and strength as directed by Engineer-In-Charge. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.

12.5 Rates quoted shall be inclusive of cost incurred in testing, commissioning of works and materials.

12.6 The items not covered in BOQ shall be paid extra after getting the approval from Engineer-In-Charge / Owner. The rate analysis considering Cost Price, Labor, 10% (Ten percent) along with supporting documents / bills etc., shall be submitted to Engineer-In-Charge / Owner for approval.

13. MOCK UP AND TRIAL ASSEMBLY

The installation of Sanitary Fixtures and fittings shall be as per the shop drawings approved by Architect / Consultant.

The Contractor shall have to assemble at least one set of each type of Sanitary Fixtures and Fittings in order to determine precisely the required supply and disposal connections. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes, holding devices etc, which will be required for final installation of all Sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Architect / interior designers.

The Fixtures in the trial assembly can be reused for final installation without any additional payments for fixing or dismantling of the fixtures.

14. EXECUTION OF WORK

14.1 The work shall be carried out in conformity with the Plumbing drawings and within the requirements of Architectural, HVAC, Electrical, Structural / Green Building consultant and other specialized services drawings.

14.2 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction programme.

14.3. On award of the work, Contractor shall submit a programme of construction in the form of a Pert Chart or Bar Chart for approval of the Engineer-In-Charge / Owner. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

14.4 Contractor shall be responsible for co-ordination with other agencies working on the project relating to their scope of work and shall take approval from the Engineer-In-Charge / Owner wherever required.

14.5 Cutting & Making Good

No structural member shall be chased or cut without the written permission of the Engineer-In-Charge.

15. TESTING

15.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

15.2 Tests shall be performed in the presence of the Engineer-In-Charge / Consultant.

15.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

15.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other by-laws in force.

15.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

15.6 Contractor shall afford all the expenses for the offsite testing of material and equipments.

15.7 All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested. The Contractor shall block the ends of waste and ventilation pipes and shall conduct air test.

16. SITE CLEARANCE AND CLEANUP

16.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

16.2 After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

16.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

17. FINAL INSTALLATION

The Contractor shall install all Sanitary fixtures and fittings in their final position in accordance with the approved trial assemblies and as shown on the Drawings. The installation shall be complete with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal / replacement of Sanitary Fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and true to alignment. The outlet of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting and the receiving pipes before making the joint. It shall be ensured that the receiving pipes are clear of obstruction. When Fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

18. PROTECTION AGAINST DAMAGE

The Contractor shall take every precaution to protect all Sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation and handling over. At the time of handling over, the Contractor shall clean, disinfect and polish all the fixtures and fittings. Any Fixtures found damped, cracked, clipped, strained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

19. GUARANTEE / WARRANTY

19.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

19.2 The form of warranty shall be as approved by the Engineer-in-charge.

19.3 The warranty shall be valid for a period of one year from the date of commissioning and handing over.

19.4 The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

19.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

19.6 The contractor shall include in his rates the operation of all mechanical equipment for a period of one month from the date of commissioning. No separate payment will be made on this account.

END OF THE SECTION - II

PROJECT
India International Centre for Buddhist Culture and Heritage

SUBJECT
TENDER FOR PLUMBING WORKS

TECHNICAL SPECIFICATIONS

SECTION - I EXCAVATION FOR PIPE LINE

1. EXCAVATION

The excavation for pipe works shall be open cutting unless the permission of the Engineer-in-charge for the ground to be tunneled is obtained in writing. Where sewers have to be constructed along narrow passages, the Engineer-in-charge may order the excavation to be made partly in tunnel and in such cases the excavated soil shall be stacked sufficiently away from the edge of Trenches & then brought back later on for refilling the trenches or tunnel.

Regarding Items of Archaeological interest such as relics of antiquity, coins, fossils etc. found at the site or obtained during excavation, the Engineer-in-charge shall be informed and items delivered immediately. Any other material obtained in such manner which in the opinion of the Engineer-in-charge is useful, shall be stocked properly as per the direction of the Engineer-in-charge.

1.1 Opening out Trenches

In excavation the trenches, etc. the solid road metalling, pavement, curbing etc. and turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully shifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Engineer-in-charge and the Owners of the roads or other property traversed and the Contractor shall not cut out or break down any live fence of trees in the line of the proposed works but shall tunnel under them, unless the Engineer-in-charge shall order to the contrary.

The Contractor shall clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Engineer-in-charge at his own cost.

1.2 Obstruction of Roads

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Engineer-in-charge in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

1.3 Removal of Filth

All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and removed to a suitable place to be provided by the Contractor.

1.4 Excavation to be Taken to Proper Depths

The trenches shall be excavated to such a depth that the pipes shall rest on concrete or on firm bedding as described in the several clauses relating to these so that the inverts may be at the levels given in the sections. In bad ground, the Engineer-in-charge may order the Contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewers with concrete, broken stone, gravel or other materials. For such extra excavation and concrete, broken stone, gravel or other materials, the Contractor shall be paid extra at rates laid down for such works in the schedule, if the extra work was ordered by the Engineer-in-charge in writing, but if the Contractor should excavate the trench to a greater depth than is required without a specific order to that effect in writing of the Engineer-in-charge the extra depth shall have to be filled up with concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40mm nominal size) at the Contractor's own costs and charges to the requirements and satisfactions of the Engineer-in-charge. The excavated earth shall be beyond 1.5m away from the edges of the excavated Trenches.

1.5 Refilling

After the pipes or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and upto 75 cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 20 mm layers with materials taken from the excavation, each layer being watered to assist in the consolidation unless the Engineer-in-charge shall otherwise direct.

1.6 Contractor to Restore Settlement and Damages

The Contractor shall, at his own costs and charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, beams, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be held responsible for any accidents caused thereby. He shall also, at his own expenses and charges, repair and make good any damage done to buildings and other property. In case if he fails to make good such damages inspite of repeated instructions of the Engineer-in-charge, the Engineer-in-charge will be at liberty to get the damaged work done by any other agency at the risk and cost of the contractor and recover such amount from him from him running payments of the bills or by any other manner according to the law of the land.

1.7 Disposal of Surplus Soil

The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

1.8 Timbering of Sewer and Trenches

(a) The Contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be close, timbered in loose or sandy strata and below the surface of the sub soil water level.

(b) All timbering, sheeting and piling with their waling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

(c) The Contractor shall be held responsible and will be accountable for the efficiency of all timbering, branches, sheeting and piling used as also for all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

1.9 Shoring of Buildings

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident. For which nothing extra will be paid.

1.10 Removal of Water from Sewer, Trench etc.

The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed off by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.

1.11 Width and Depth of Trench

The Engineer-in-charge shall have power by giving an order in writing to the Contractor to increase the maximum width in respect of which payment will be allowed for excavation in trenches for various classes of sewer, manholes, and other works in certain lengths to be specifically laid down by him, where on account of bad ground or other unusual conditions, he considers that such increased widths are necessary in view of the site conditions.

1.12 Maximum width of pipes Trenches at the bottom of the Trench shall be as follows:

Maximum width of Trench = D + X
Where D is Outer dia of pipes

X= 300mm upto Trench depth of 1.50m & above 1.50m depth x is to be taken as 400mm for all diameter of pipes.
The maximum width of the bed concrete for sewers / drains shall also be same as above.

END OF SECTION – I

SECTION - II SANITARY FIXTURES

1. SCOPE OF WORK

1.1 The work in general shall be carried out as per CPWD Specifications-2009 Volume-I to II with up to date correction slips or as per local bylaws.

1.2 The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.

1.3 The codes of the latest National building code, Uniform Plumbing Code of India and relevant British Standards shall be used as a general guide for good engineering practice, design and workmanship norms.

1.4 Work under this section shall consist of furnishing all Material and labour as necessary and required to completely install all Sanitary Fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

1.5 Without restricting to the generally of the foregoing the Sanitary Fixtures shall include all Sanitary Fixtures, C.P. fittings and Accessories etc. necessary and required for the Building.

1.6 Sanitary fixtures and fitting shall be as per the GRIHA requirements.

1.7 Whether specifically mentioned or not all Fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

2. GENERAL REQUIREMENTS

2.1 All Fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, Specifications and Drawings.

2.2 All Fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architectural/ Interior designer's requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.

2.3 Fixing screws shall be half round head Chromium Plated brass with C.P. washers wherever required as per directions of Engineer-in-Charge / Owner.

2.4 All Fittings and Fixtures shall be fixed in a neat workman like manner true to Levels and Heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all Inlet and Outlet Pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractors cost.

2.5 When directed, Contractor shall install Fixtures and accessories in a mock-up room for the approval of the Engineer-in-Charge/Owner. Sample room Fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

3. EUROPEAN W.C.

3.1 European W.C. shall be wash down, single or double siphonic type, wall mounted set, flushed by means of exposed or concealed type flushing cistern, as specified in Schedule of Quantities. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair/bolts as per approval.

3.2 Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

4. URINALS

4.1 Urinals shall be white glazed Vitreous China flat back half stall or lip type as specified in Schedule of Quantities.

4.2 Half stall Urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete and as directed by Engineer-in-Charge/Owner.

4.3 Half stall urinals shall be fixed with C.P. Brass screws and shall be provided with 32 mm dia Domical Waste leading to Urinal trap.

4.4 Urinals shall be flushed by means of automatically sensor operated flushing system as specified in Schedule of Quantities.

5. SINKS

5.1 Sinks shall be of precast Terrazzo marble or White Glazed fire clay or vitreous china or stainless steel or any other material as specified in the Schedule of Quantities.

5.2 Each sink shall be provided with R.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Fixing shall be done as directed by Engineer-in-Charge / Owner.

6. WASH BASIN

6.1 Wash Basins shall be white glazed vitreous chinaware of size, shape and type as specified in the Schedule of Quantities.

6.2 Each Basin shall be provided with R.S. or C.I. brackets duly painted. The clips and the basin securely fixed to wall and have accessories as mentioned in the Schedule of Quantities. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and colour as approved by the Architect/Consultants.

6.3 Each basin shall be provided with 32 mm dia. C.P. waste of standard pattern with pop-up waste or rubber plug and chain as specified in the detailed engineering, PDR and system requirement, 32 mm dia. C.P. brass bottle trap and angle valve with C.P. pipe to wall and flange as given in the Bill of Quantities.

6.4 Each basin shall be provided with auto closing pillar cock or as specified in the Bill of Quantities.

6.5 Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cm or as directed by Architect/Consultants.

7. ACCESSORIES

7.1 Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by Engineer-in-Charge / Owner, and given in the Schedule of Quantities.

7.2 All C.P. Accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with raw plugs or nylon sleeves and shall include cutting and making good as required or directed by Engineer-in-Charge/Owner.

7.3 Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work.

8. URINAL PARTITIONS

8.1 Urinal partitions shall be of granite/chinaware as specified in the Schedule of Quantities.

9. EWC PAN CONNECTOR

The EWC pan connector shall be Flexible, soft and shall be made of single body construction with integral fins. The pan connector must be supplied with factory fitted spring loaded seal guard.

While fixing of the pan connector with the Soil pipe, the pipe must be reasonably clean and smooth on the inner surface; in case the soil piping is in C.I. then supplier supplied bush / adaptor shall be used. The connector socket is pushed fully home onto the pan spigot, thereafter the WC is placed in position gently pushing the fitment to ensure that the connector end fits into the Spigot of the pipe. The pan connector must be pushed in such a easy as to ensure that the seals and fins turn inward to ensure proper sealing.

10. Hand Drier:

10.1 The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.

10.2 The hand drier shall be fully hygienic, rated for continuous repeat use (CRU).

10.3 The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds.

10.4 The hand drier shall be of wall mounting type suitable for 230V, single phase, 50 Hz, AC power supply.

11. Toilets for Disabled:

11.1 Where specified in washroom facilities designed to accommodate physically handicapped, accessories should be provided as directed by the Engineer-in-Charge.

11.2 Stainless steel grab bars of required size suitable for concealed or exposed mounting and non-slip gripping surface shall be provided in all washrooms to be used by physically handicapped as directed by the Engineer-in-Charge.

END OF SECTION - II

SECTION - III SOIL, WASTE & VENT PIPES

1. SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

1.2 Without restricting to the generally of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:

a) Vertical and horizontal Soil, Waste and Vent Pipes, Rainwater Pipes and Fittings, Joints Clamps and connections to Fixtures.

b) Connection of pipes to Gully Traps & Manholes etc.

2. GENERAL REQUIREMENTS

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-Charge / Owner.

2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

2.6 All works shall be executed as directed by Engineer-in-Charge / Owner.

3. CAST IRON PIPES & FITTINGS (IS: 15905)

3.1 Pipes & Fittings

All pipes & fittings shall be straight and smooth and inside free from irregular bore, blowholes, cracks and other manufacturing defects & shall confirm to the specifications as per IS:15905 for Hubless Cast iron soil, waste & ventilating pipes fittings & accessories, complete in all respects & as specified in the relevant item of the bill of quantities.

3.2 Other Fittings

a) Other casted CI Fittings used for drainage pipes shall confirm to the required specifications & as per site conditions & wherever possible to the relevant IS code.

3.3 Fixing

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

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

- Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surface.

3.4 Jointing

CI pipes shall be jointed with EPDM rubber gasket with SS 304 coupling of approved make.

4. UPVC PIPES (I.S. 4985) FOR RAIN WATER

4.1 6 kg/cm2 Class selection shall be as per Bill of Quantities.

All fittings for uPVC pipes up to 200 mm O.D. size shall be injections moulded as per manufacturer, confirming to IS: 4985 and as specified in bill of quantities.

4.2 For Fittings of sizes which are not injection moulded but fabricated (Locally/ Imported) sample of the same shall be submitted for approval.

5. CLAMPS / STRUCTURAL SUPPORTS

5.1 G.I. clamps shall be of standard design and fabricated from M.S. flat 40x3mm thick with required Galvanization.

5.2 Where G.I. clamps are to be fixed on RCC columns or slotted angles, walls or beam they shall be fixed with 40x3mm flat iron "U" type clamps with anchor fasteners of approved design or 6mm nuts and bolts.

5.3 Structural clamps shall be fabricated from G.I. (Galvanized) Structural members e.g. rods, angles, channels flats as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black Enamel paint. Wooden saddles, where required shall be provided free of cost.

5.4 Slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in Schedule of Quantities, angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.

5.5 Wherever G.I. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size) as directed by the Engineer-in-Charge / Owner.

6. TRAPS

6.1 Floor traps shall be of CI, deep seal with an effective seal of 50 mm as given in bill of quantities. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cm of the required depth. Where traps are suspended below ceilings, they shall be provided with proper structural supporting arrangements.

6.2 Urinal Traps

Urinal traps shall be of CI, deep seal with an effective seal of 50 mm as given in bill of quantities. and set in cement concrete block specified in Para above without extra charge.

6.3 Floor Trap Inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type G.I. inlet hopper without or with one, two or three inlet sockets to receive the waste pipe. Hopper shall be connected to trap with at least 50 mm seal (Hopper and traps shall be paid for separately).

6.4 C.P./Stainless Steel Gratings

Floor and Urinal Traps shall be provided with 100-150 mm square or round C.P/Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4-5 mm or as specified in the Schedule of Quantities.

7. CLEANOUT PLUGS

Contractor shall provide brass cleanout plugs as required. Cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a male threaded adaptor.

8. WASTE PIPE FROM APPLIANCES

8.1 Waste pipe from appliances e.g. wash basins, sinks, urinals, water coolers shall be of G.I. heavy duty as given in the Schedule of Quantities or as shown on the drawings.

8.2 All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps at approved spacing.

9. CEMENT CONCRETE

Soil and Waste pipes under floors in sunken slabs and in wall chases (When cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm size) 75 mm in bed and alround. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height and size at intervals as directed by Engineer-in-Charge/Owner.

10. CUTTING AND MAKING GOOD

Pipes shall be fixed and tested as buildings proceeds. Contractor shall provide all necessary holes cutouts and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

11. Slot Drain near drinking water area

Bidder has to provide and installed the drain of polymer concrete with slot at the top matching with the tiling plan as per EN standards complete in all respect as per direction of Engineer in charge.

12. Prefab drain channel

Prefab-fab polymer concrete channels conforming to relevant EN standards with V-shaped profile, tounge and groove jointing arrangement, in-built ductile iron edge rail, with in-built slope along the complete length of the channel, and polymer concrete channels to be made of zero water absorbtion, of density being 2.1 - 2.3gm/cm3, with surface roughness of approx 25 µm, with SS grating at the top complete in all respect including all necessary civil and finishing works as required as per site and the instructions of the engineer - in – charge.

13. INSPECTION & TESTING

13.1 Inspection

Work should be inspected during installation and tests applied on completion, care being taken that, all work which is to be encased for concealed is tested before it is finally enclosed.

Inspection should be carried out to ensure the following:

(a) Work accords with the drawing and specifications.

(b) All pipe brackets, clips etc. are securely fixed.

(c) Fixtures are correctly spaced.

(d) Pipe is protected where necessary by Thermal Insulation.

(e) Embedded pipe work is properly protected before sealing-in

(f) All access covers, caps or plugs.

- Are accessible
- Are so made that the internal faces truly complete in internal bore.

- Cause no obstruction in the pipe bore
- Are well joined.

13.2 Testing

The soil, waste piping system and rain water should be tested after installation as follows:

(a) Water Test

The pipes shall be tested after installation & before the appliances are connected, preferably in sections so as to limit the static head of 4.5m. The pipe shall be filled with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. Then it will be necessary to seal all openings and leaks at joints immediately as observed during the test and all defective pipes shall be rejected and removed from the site. Pipes with minor sweating shall be accepted at the discretion of the Engineer-in-Charge/Owner.

(b) Smoke Test

Alternatively, the Contractor may test all Soil, Waste and Rainwater stacks by smoke testing machine. The smoke test shall be carried out as under:

Smoke shall be pumped into the stack after plugging all inlets and connections at the lowest points from a smoke testing machine which consists of a bellow & burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detected by sight as well as by smell, if there is leak at any points of the pipe. The top end shall however be left open. The stack shall then be observed for leakiness and all defective pipes and fittings removed or repaired as directed by the Engineer-in-Charge / Owner.

13.3 A test register shall be maintained and all entries shall be signed and dated by Contractors and Engineer-in-Charge/Owner.

END OF SECTION – II

SECTION - IV WATER SUPPLY SYSTEM

1. SCOPE OF WORK

1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

a) Internal and External water supply system including hot water supply etc.
b) Pipe protection and painting.
c) Control valves, masonry chambers and other appurtenances.
d) Connections to all toilets, storage tanks and appliances.
e) Excavation and refilling of pipe trenches, wherever required.
f) Trenches for taking pipe lines for these services.

2. GENERAL REQUIREMENTS

2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-Charge / Owner.

2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections. As far as possible all Bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 65mm dia.

2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

2.6 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3. G.I. PIPES & FITTINGS

3.1 All pipes inside the buildings and where specified, outside the building shall be galvanized steel tubes conforming to I.S. 1239-1979 of class specified.

3.2 Fittings shall be malleable iron galvanized fittings, of approved make. All fittings shall have manufacturer's trade mark stamped on it. Fittings for G.I. pipes shall include Couplings, Bends, Tees, Reducers, Nipples, Unions, Bushes, Fittings shall be of I.S:1879 - (part I to X) 1975.

3.3 Pipes and fittings shall be jointed with screwed fittings. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. Genuine red lead with grummet and a few strands of fine hemp shall be applied. All pipes shall be

fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other as shown on drawings.

4. CPVC PIPES AND FITTINGS

4.1 Description

CPVC piping shall be Fire Proof, Corrosion resistance with smooth, friction free interior surfaces and with anti - bacterial growth properties.

4.2 JOINING TUBING & FITTINGS

(a) Cutting

CPVC tubing shall be cut with a wheel-type plastic tubing cutter, a hack saw or other fine toothed hand or power saws. Use of ratchet cutters shall be permitted, provided blades are sharpened regularly. A milter box should be used to ensure a square cut when using a saw.

(b) Deburring/Beveling

Burrs and fillings can prevent proper contact between tube and fitting during assembly, and should be removed from the outside and inside of the tubing. A chamfering tool shall be used for this purpose. A slight bevel on the end of the tubing shall be provided to enable entry of the tubing into the fitting socket and minimize the chances of pushing solvent cement to the bottom of the joint.

(c) Fitting Preparation

The surfaces shall be wiped clean of dirt and moisture from the fitting sockets and tubing end. Check the dry fit of the tubing and fitting. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

(d) Solvent Cement Application

Only approved type Solvent Cement shall used for jointing the CPVC pipes, which shall be procured as per the manufacturer recommendations. Apply an even coat of Cement Solvent on the Pipe end after cleaning of whole pipe and also inside the fittings socket. Old or deteriorated or thickened or Lumpy Solvent Cement shall not be used.

(e) Assembly

Immediately insert the pipe into fitting socket, rotate the pipe ¼ to ½ turn while inserting. This motion ensures an even distribution of cement within the joint. Properly align the fitting. Hold the assembly for approximately 10 seconds, allowing the joint to set-up. An even bead of cement should be evident around the socket edge, it may indicate that sufficient cement was applied. In this case, remake the joint to avoid potential leaks. Wipe excess cement from the tubing and fitting surfaces for an attractive, professional appearance.

(f) Rating & Dimensional Details of CPVC Pipes SDR 11

Nominal Pipe Size		Average Outside Diameter		Wall Thickness		Pressure Rating	
inch	mm	inch	mm	inch	mm	73.4^0 F psi	23^0 C kg/cm^2
½	12.70	0.625	(15.9)	0.068	(1.73)	400	28
¾	19.05	0.875	(22.2)	0.080	(2.03)	400	28
1	25.40	1.125	(28.6)	0.102	(2.59)	400	28
1 ¼	31.75	1.375	(34.9)	0.125	(3.18)	400	28
1 ½	38.10	1.625	(41.3)	0.148	(3.76)	400	28
2	50.80	2.215	(54.0)	0.193	(4.90)	400	28

5. CLAMPS

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Engineer-in-Charge / Owner. Pipe in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural as described in the sub section. Pipes in typical shafts shall be supported on Slotted Angles/Channels as specified elsewhere.

6. UNIONS

Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each Valve, Stop Cocks, or Check Valves and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-Charge / Owner.

7. FLANGES

Flanged connections shall be provided on pipes where shown on the drawings, all equipment connections as necessary and required or as directed by Engineer-in-Charge / Owner. Connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion rubber washer. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Engineer-in-Charge / Owner. Bolt hole dia for flanges shall conform to match the specification for C.I. Sluice Valve to I.S. 780.

8. TRENCHES

The external water supply pipes below ground shall be laid in trenches. The width and depth of the trenches for the different diameters of the pipes shall be as follows:

Dia of Pipe	Width of Trench	Depth of Trench
15mm to 50mm	30 cms	60 cms
65mm to 150mm	45 cms	75 cms

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earthwork in trenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

9. PAINTING

9.1 All surfaces shall be thoroughly cleaned before painting.

9.2 All pipes above ground shall be painted with one coat of Red Lead and two coats of Synthetic Enamel paint of approved shade and quality. Pipes shall be painted to standard color code specified by Engineer-in-Charge/Owner.

9.3 All pipes in chases and below floor shall be provided Anti-corrosive treatment.

10. PIPE PROTECTION

Where specified in the Schedule of Quantities all pipes below ground shall be protected against corrosion by wrapping 100mm wide and 4mm thick layer of material of approved make over the pipe.

11. BALL VALVES

The Ball Valve shall be made from forged brass and tested to 16 Kg/cm^2 pressure. The valve shall be internally threaded to receive pipe connections. The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon. The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm^2 pressure. The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree.

12. BUTTERFLY VALVES

- The Butterfly Valve shall be suitable for waterworks. The Valves conforming to IS : 13095 shall be provided. All valves shall be suitable to withstand the pressure in the system and rating shall be PN 1.6. All valves shall be right handed (i.e. handle or key shall be rotated clock wise to close the valve).

- The direction of opening and closing shall be marked and an open / shut indicator fitted.

- The material of valves shall be as under:-

  Body -Cast iron
  Disc -Ductile Iron
  Seat -EPDM/Nitrile rubber
  Shaft -Stainless Steel

- The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

- Joints for butterfly valves shall be made with suitable tail /socket pieces on the pipe line and flanged joints made with 3mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.

- Butterfly valves shall be provided on all branches as shown in the drawings or as specified.

13. Motorized Butterfly valve at the inlet of tanks:

Contractor has to install the IP 67 (Weather Proof /Aluminium casing with positioner to indicate the valve position with key type manual overdrive) Motorized Butterfly valve for filling of over head water tank complete with high and low level float type sensors to control the valve .The sensors shall be installed in over head tanks. The sensors will close the valve when water level is high in over head tank and open the valve when over head water tank level is low . The system should be complete in all respects with control panel indicating the position of valve i.e open /closed with accessories like wiring /conduiting /flanges , nut bolts etc complete as per approved type and specifications as per instructions of the engineer - in - charge.

14. Fittings and Inspection Chambers

Fittings and chambers shall be provided as required.

14.1 Anchor Block

Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.

14.2 Rubber Joints

Joints between two pipes shall be made by pre-moulded rubber joints with suitable tackles in a manner recommended & approved by the manufacturer. No joints shall be covered until the lines are hydraulically tested.

15. VALVE CHAMBERS

15.1 Contractor shall construct chambers for all full way valves, butterfly valves and other type of valves as specified in the Bill of Quantities. These shall be made, in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) on cement concrete foundations 150mm thick 1:5:10 mix (1 cement: 5 coarse sand: 10 graded stone aggregate 40mm nominal size) 12 mm thick cement plaster 1:3(1 cement : 3 coarse sand) inside finished with a floating coat of neat cement with 8mm thick CI surface box with hinged cover and locking arrangement, 150 mm thick reinforcement cement concrete top slab of 1:2:4 (1 cement : 2 coarse sand: 4 graded stone aggregate 20mm nominal size), as specified and shown in drawings, including excavation, back filling rammed complete or as specified in Bill of Quantities.

15.2 Valve chambers shall be constructed as specified in BOQ but generally shall be of following sizes:

	Length (mm)	Width (mm)	Depth (mm)
For pipes dia. up to 50 mm	300	300	500
For pipes dia. 65 to 80 mm	600	600	1000
For pipes dia. 80 mm and above	750	750	1000

16. TESTING

16.1 All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 7 kg/cm^2 in any case and with the consent of Engineer-in-Charge / Owner.

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. ($\pm$10%). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

16.2 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and Fixtures shall be made good during the defects liability period without any extra cost.

16.3 After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

17. DISINFECTION

17.1 After completion of the work Contractor shall flush clean the entire system with the city's filtered water after connection has been made.

17.2 After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/l of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable.

18. PRE COMMISSIONING

18.1 Ensure that all pipes are free from debris and obstructions.

18.2 Check all valves for effective opening and closing action. Defects should be rectified or valves replaced.

18.3 Ensure that all Connections to Branches have been made.

18.4 Ensure that mains have been connected to the respective pumps, underground and overhead tanks.

18.5 Water supply should be available at main Underground tank.

18.6 All main line Valves should be closed.

19. COMMISSIONING

19.1 Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.

19.2 Start Water Supply Pump and allow water to fill main Underground tank. Water will first fill the fire tank and then overflow to the Raw Water tanks.

19.3 After filling Overhead Reservoir drain the same to its one forth capacity through tank scour valve. (This is to ensure removal of all mud, debris etc. from the tank).

19.4 Fill Overhead tank to full.

19.5 Release water in the main lines by opening Valves in each circuit. Drain out water in the system through scour valves or fire hydrant in lower regions. Ensure clean water is now coming out of the system.

19.6 Open valves for individual clusters. Observe for leakages or malfunctions, check pressure & flow at end of line by opening Hydrants etc. Remove and rectify defects noticed.

19.7 Check all outlet points for proper operation by opening each valve and allowing water to flow for a few minutes. Also check for effective closure of valve.

19.8 The entire water supply system should be disinfected with bleaching powder and system flush cleaned.

19.9 Send four samples of water drawn from four extreme locations for testing for bacteriological test in sterilized bottles obtained from the concerned laboratory. (Laboratory personal may collect the samples themselves).

20. RESPONSIBILITY

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

END OF SECTION – IV

SECTION - V SEWERAGE / DRAINAGE SYSTEM

1. SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all Labour, Materials, Equipments and Appliances necessary and required to completely finish Sewerage/Drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the sewerage system shall include:

- Installation of all sewer lines.
- Installation of all storm water drainage lines
- Construction of all catch basins, chambers, manholes & other related civil works etc. around the buildings

2. GENERAL REQUIREMENTS

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Engineer-in-Charge / Owner.

2.2 Drainage lines shall be laid to the required gradients and profiles.

2.3 All drainage work shall be done in accordance with the local Municipal bye laws.

2.4 Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the Engineer-in-Charge / Owner before the actual execution of work at site.

2.5 All works shall be executed as directed by Engineer-in-Charge / Owner.

3. ALIGNMENT AND GRADE

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Engineer-in-Charge / Owner from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Engineer-in-Charge / Owner.

4. HIGH DENSITY POLYTHENE PIPES FOR SEWERAGE LINE

4.1 HDPE(High density polythene black) pipes conforming IS: 14333, for Sewerage effluents with material grade PE-80 with working pressure 4 Kg / Cm2 or as specified in bill of Qty.

4.2 Laying and Jointing of HDPE Pipes

Laying and jointing of the pipes shall be done as specified in IS: 14333

While laying the pipe in trenches the bed of the trench should be level and free from sharp edged stones. While lying in rocky areas suitable bed of sand or gravel should be provided. The initial back fill about 10 to 15 cm above the pipe should be fine sand or screened excavated material. Where hard rock is met with, bed concrete M-100, 15 cm shall be provided, before putting in the soft sand/gravel.

Jointing of two pipes shall be done through BUTT-Welding. The method of butt-welding shall be as below:

a) The ends of the pipes to be joined are cut vertically at right angles with a fine toothed saw and trimmed with a file to make both ends smooth so that the pipes when pressed together are without leaving any gap.
b) Both the inside and outside surfaces of the ends of the pipes are scraped (up to about ½" from the end) with a sharp scraper to remove the thin oxidized layer.
c) It is necessary to see that there are no extraneous particles of dust, mud, grease, polyethylene powder etc. at the joining portion of the pipes.

An electrical HEAT MIRROR (Hot Plate) is used for heating the ends of the pipes. The pipes are pressed flush against the flat surface of the Heat Mirror, one on each side horizontally, and held in that position under slight pressure. The Heat Mirror is maintained at a steady temperature of 200 deg C. with the help of THERMOSTAT. After a while, a slight rim is formed at the ends of the pipes both inside and outside. When a rim of about 1/10" to 1/8" is formed, the pipes are pulled apart and the Heat Mirror is quickly withdrawn. Then the two ends of the pipes are brought together face to face so that the molten portions come into contact with each other. Then the pipes are drawn back very slightly (without separating the joined molten portion) and then again the pipes are pressed together with a moderate pressure of about (1 to 1.5 kg/cm sq). This ensures that any air bubbles are squeezed out. The pipes are held in that position until the pipe-joint cools off naturally in atmospheric air. When a perfect joint is made, the rims cohere in such a way that there is only a very fine slight depression between the two rims. If the top surface of the rim is too flat, it will be because the pipe is overheated. If there is too much of depression (groove) between the rims, the pipe is under-heated. The rims should not be cut off or erased from the joints. Also, correct alignment of the pipes will help in joining the pipes perfectly, as otherwise there will be reduction in the area of the joining surface rendering the joint weak and imperfect.

5. GULLY TRAPS

5.1 Gully traps shall conform to IS 651. These shall be sound, free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free form crazing. They shall give a sharp clear tone when struck with light hammer. There shall be no broken blisters.

5.2 Gully traps shall be fixed in cement concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40mm nominal size) and a brick masonry chamber 30x30 cms or 45x45 cms inside whatever required in cement mortar 1:3 with grating as per requirements and 30x30 cms or 45x45 cms C.I. sealed cover as per requirements and frame weighting not less than 14 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size.

6. REINFORCED CEMENT CONCRETE PIPES FOR STORM WATER SYSTEM

6.1 All underground storm water drainage pipes where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes of NP-2 class. Pipes shall be true and straight with uniform bore. Throughout cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

6.2 Laying

R.C.C. spun pipes shall be paid on cement concrete bed or cradles as specified and shown on the detailed drawings the cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall than be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. cradles or concrete bed may be omitted, if directed by the Engineer-in-Charge / Owner.

6.3 Jointing

After setting out the pipes the collars shall be centered over the joint and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools all joints shall be finished at an angle of 45 degree to the longitudinal axis of the pipe on both side of the collars neatly.

7. TESTING

All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water. The test pressure shall, however, not exceed 1.5 meter head at any point. The pipes shall be plugged preferably with standard design rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head. The tolerance figure of two liters per centimeter of dia per kilometer may be allowed during a period of ten minutes. Subsidence of the test water may be due to one or more of the following causes:

- Absorption by pipes and joints
- Sweating of pipe or joints
- Leakage at joints or from defective pipes

(a) Trapped Air

Allowance shall be made for (i) by adding water until absorption has ceased after which the test proper should commence. Any leakage will be visible and the defective part of the work should be cut out and made good. A slight amount of sweating which is uniform may be overlooked, but excessive sweating from a particular pipe or joint shall be watched for and taken as indicating a defect to be made good.

(b) Sewer and Drain Pipelines shall be tested for straightness by:

- Inserting a smooth ball 12mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invent of the pipe and emerge at the lower end.

- Means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.

(c) The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Engineer-in-Charge / Owner.

(d) A test register shall be maintained which shall be signed and dated by Contractor, Engineer-in-Charge / Owner and representative of Architects/ Consultants.

8. CEMENT CONCRETE AND MASONRY WORKS FOR MANHOLES AND CHAMBERS ETC.

8.1 Materials

(a) Water

Acidity, Alkalinity and percentage of Solids shall be in accordance with IS: 3025. The Ph value shall generally be not less than 6. In general potable water is considered satisfactory for use.

Sea water shall not be used.

Testing shall be done individually for different source points before the start of the work and there after once in every three months.

(b) Aggregate for Concrete

It shall be strong, durable and free from adherent coatings, sea shell, organic impurities, disintegrated pieces.

If dirty, shall be washed with water before actual use. Flaky and elongated piece shall be avoided. It shall confirm to IS: 383 and IS: 2386.

(c) Sand

It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay bald harmful impurities and shall confirm IS: 23l or pellets an86. It shall not contain more than 8 % of silt as per the field test.
Grading for masonry, plaster and concrete shall be as per IS: 2116, IS: 1542, IS: 383 respectively, Sea sand shall not be used.

Testing for bulkage to be done and allowance be made at the time of use.

(d) Cement

The cement used for all the constructional purposes shall be Portland pozzolana cement confirming to I.S. 1489 OR rapid hardening, Portland cement conforming to I.S. 269.

Different types of Cement shall not be mixed together, shall be stacked and stored separately. Cement Bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received.
The site where it is stored shall be dry, leak proof and as far as possible moisture proof.

Necessary precautions to be taken to avoid dampness through floor and walls. Stacking shall not be more than 10 bags high.

(e) Mild Steel Reinforcement

The mild steel for the reinforcement bars shall be in the form of round/ twisted/deformed bars conforming to all requirements of I.S. 432 (Grade I).

(f) Bricks

Brick shall have uniform color, thoroughly burnt, smooth rectangular faces, with parallel slab, sharp and right angled edges, but not over-burnt.

When struck should give clear ringing sound.

The maximum permissible area of perceptible deposit of efflorescence shall be 50% of the surface area of the Bricks. The affected bricks should not be more than 80% of the lot. There shall be no powdering or flaking of the surface.

The average water absorption shall not exceed 22% by weight after 24 hours immersion in water.

The average minimum compressive strength for bricks of class designation 75 shall not be less than 75 kg / cm2.

(g) Other Materials

Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S. All such materials shall be approved by the Engineer-in-Charge / Owner before use.

8.2 Cement Concrete (Plain or Reinforced)

(a) Cement concrete pipes bedding, cradles, foundations and RCC slabs for all works shall be mixed by a Mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the Engineer-in-Charge / Owner. Rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.

(b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.

(c) All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny Bags at all times. All pipe trenches and foundations shall be kept dry during the curing period.

8.3 Masonry Work

Masonry work for manholes, chambers, brick masonry pipe trench and such other works as required shall be constructed from 1st class bricks as specified in the Schedule of Quantities in cement mortar 1:4 mix (1 cement: 4 coarse sand). All joints shall be properly raked to receive plaster.

8.4 Cement Concrete for Pipe Support

(a) Wherever specified or shown on the drawings, all pipes shall be supported in concrete bed all round or in haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Type of the bedding is as described as follows:

(b) Unless otherwise directed by the Engineer-in-Charge / Owner cement concrete for bed, all round or in haunches shall be laid as follows:-

Description	Upto 3 M depth
All underground Sewerage & drainage pipes around the buildings	All round (1:5:10)

(1=1 =1 cement, 2-3-5 coarse sand, 4-6-10) stone aggregate 20 / 40mm nominal size)

(c) R.C.C. pipes or C.I. pipes ,may be supported on brick masonry or precast R.C.C or Cast insitu cradles. Cradles shall be as shown on the drawings.

(d) Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks as shown on the drawings.

9. MANHOLES AND CHAMBERS

9.1 All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) or as specified in the Schedule of Quantities.

9.2 All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the drawings.

Where not specified, Manholes may be constructed as follows:-

(All dimensions internal clear in cms) (As / BMC Regulation)

Size of Manhole Type	90x80 Rect.	120X90 Rect.	91 dia Circular	122 dia Circular	152 dia Circular
Maximum depth	90	250	167	230	Any depth beyond 230
Average thickness of R.C.C slab	15	15	--	--	--
Size of cover and frame (Internal dia)	61x45.5	560 dia.	56 dia	56 dia	56 dia
Weight of cover and frame not less than	Heavy duty as specified in BOQ	Heavy duty as specified in BOQ	Heavy duty as specified in BOQ	Heavy duty as specified in BOQ	Heavy duty as specified in BOQ
Type of Cover & Frame	C.I. or as specified in BOQ.	C.I. or as specified in BOQ.	SFRC or as specified in BOQ.	SFRC or as specified in BOQ.	SFRC or as specified in BOQ.

9.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have a slope of 10cm towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating cost of neat cement.

9.4 All manholes shall be plastered with 12/15mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster.

9.5 All manholes with depths greater than 1 M. shall be provided with plastic encapsulated 20mm square or 25mm round rods foot rungs set in cement concrete

blocks 30 x 20 x 15cms in 1:3:6 mix 30 cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.

9.6 All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab or SFRC precast concrete covers as per instructions of the Engineer-in-Charge / Owner. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or as given above.

9.7 All catch basins shall be having C.I. grating or SFRC precast Gully Grating as per instructions of Engineer-in-Charge / Owner. The grating along with frame shall be of approved design and quality as per instruction of Engineer-in-Charge/ Owner.

10. MAKING CONNECTIONS

Contractor shall connect the new sewer line to the existing manhole by cutting the, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

11. COMMISSIONING

11.1 After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary pipings, labours, tools and equipments etc. for carrying out testing and commissioning of the entire external sewerage and drainage system complete as per requirement in the presence of Client representative/Consultant, whenever and as may be required. Generally, the following test/inspection has to be carried out:-

(a) For any Leakages/seepages in the external sewerage and drainage pipes.

(b) For checking the functioning of the entire external sewerage and drainage system including rainwater harvesting system and to ensure that the waste water is continuously flowing towards outfall without any intermediate stagnation.

(c) For the functioning of the valves and accessories etc. by putting ON/OFF the controlling valves of the various diversions in the sewerage and drainage and rain water harvesting system.

END OF SECTION – V

SECTION - VI TUBEWELLS/RAINYWELLS

1. Boring of Tubewells

1.1 Type of Tube well

Tubewell will be bored with the help of DTH Machine or as per the details given in IS 2800 or as per the local authority for 400 mm dia bore, 200mm dia. casing consisting of blind and slotted pipes and with gravel packed complete as per instruction of Engineer- in-Charge.

1.2 Requirement

The total yield for each Tubewell is expected to be approximately 10,000-12,000 litres per hour, with a possible continuous operation of tubewell for minimum 8-10 hours per day.

1.3. BORING

1.3.1 Boring shall be 400 mm dia. to a maximum depth of 150M as per requirement. The depth may be increased or decreased as per actual site conditions. Sub-soil water shall not be tapped.

1.3.2 Well Pipes (Plain Casings)

Plain casings pipe shall be 200mm dia. uPVC pipe conforming to I.S:12818 with all fittings. A M.S bail plug shall be provided at the bottom.

1.3.3 Slotted Pipes

Slotted pipe shall be 200mm dia. uPVC pipe with conforming to I.S. 12818 with all fittings and slots as per Strata Conditions including sockets of standard design.

1.4 Quoted Rates

Rates for above items shall include all accessories, threading sockets and labour for extraction of boring casing pipe and lowering tubewell assembly.

1.5 Verticality

Well assembly shall be truly vertical as per latest Indian Standard and verticality certificate shall be furnished by the contractor.

1.6. Gravel Packing

1.6.1 Space between boring and well assembly shall be packed with washed Pea gravel 3 to 6mm size.

1.6.2 Gravel shall be paid as per actual quantity consumed and nothing extra will be paid for left over quantity.

1.7 Development

The well shall be developed by an air compressor for a period of at least 72 hours. This period may however be extended in case the development has not been satisfactory.

1.8. Data

The contractor shall provide necessary data regarding strata, yield and depression. Yield tests shall be conducted by providing a suitable channel and V-notch and reading taken over a period of 48 hours in the intervals of 2-3 hours and in presence of Engineer-in-Charge. The tests shall be conducted as per accepted engineering practice for yield tests. Any test done by filling buckets, drums etc. will not be accepted as the final yield.

1.9. Water Tests

The contractor shall get the water tested for the quality of water by a Laboratory, as specified by Consultant/Engineer-in-Charge. Tests shall be for Bacteriological, Physical and Chemical examinations. (Tests shall be performed after development of the well as per attached Annexure-"A").

1.10 Sanitary Sealing

The space between the bore and the housing pipe shall be grouted with Plain cement concrete 1:2:4 to a depth of 500mm below the ground level. Four 50mm dia G.I. pipes for gravel feeding shall be provided with caps at top.

1.11 Strata Chart

1.11.1 A strata chart shall be maintained at the site to give the following informations:

(a) Description and depth of strata
(b) Spring level
(c) Aquifer opposite which slotted pipes have been placed.
(d) Rate of progress of drilling.
(e) Particulars of discharge test.
(f) Four copies of strata sheets yield and water quality tests shall be handed over on completion of the well.

1.11.2 According to "Strata Chart" the decision will be taken about the pattern of pipe to be lowered. Therefore the Contractor will seek approval, with the proposed sketch before lowering of casing and piping.

-:-

ANNEXURE - A

S.No	SAMPLES	EXPRESSED AS	
(A)	**PHYSICAL**		
1.	Turbidity	JTU	
2.	Colour	Units of Pt-Co-Scale	
3.	Taste and Odour	Qualitative	
(B)	**CHEMICAL**		
4.	pH		
5.	Alkalinity	(mg/l) CaCo3	
6.	Chlorides	(mg/l) Cl	
7.	Hardness	(mg/l) CaCo3	
8.	Iron	(mg/l) Fe	
9.	Manganese	(mg/l) Mn	
	Calcium	(mg/l) Ca	
1.	Sulphates	(mg/l) SO4	
2.	Total Solids		
	Dissolved		
	Suspended		
	Volatile		
3.	Arsenic	(mg/l) As.	
(C)	**BACTERIOLOGICAL**		
1.	Plate Count	Colonies/m	
	20o C		
	35o C		
2.	Coliform Organisms	MPN/100ml	

2. TESTING

2.1 All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times the working pressure and subject to minimum of 10 kg/cm^2 in any case and with the consent of Engineer-in-Charge / Owner.

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. ($\pm$10 %). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

2.2 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings shall be made good during the defects liability period without any extra cost.

2.3 After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

3. DISINFECTION

3.1 After completion of the work Contractor shall flush clean the entire distribution systems with filtered water after connection has been made.

3.2 After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/l of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable.

4. PRE COMMISSIONING

4.1 Ensure that all pipes are free from debris and obstructions.

4.2 Check all valves and garden hydrant for effective opening and closing action. Defects should be rectified or valves replaced.

4.3 Ensure that all Connections to Branches has been made.

4.4 Ensure that mains have been connected to the respective pumps, underground and overhead tanks or as per requirements.

4.5 All main line Valves should be closed.

5. COMMISSIONING

5.1 Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.

5.2 Start Water Supply Tubewell / Municipal flow and allow water to fill main Underground tank. Water will first fill the fire tank and then overflow to the Raw Water tanks.

5.3 Run the Pumps with all water treatment accessories or Bypass.

5.4 Fill the domestic water tanks and run main supply pumps.

5.5 Release water in the main lines by opening Valves in each circuit. Drain out water in the system through scour valves or garden hydrant in lower regions. Ensure clean water is now coming out of the system.

5.6 Open valves for individual clusters. Observe for leakages or malfunctions, check pressure & flow at end of line by opening Hydrants etc. Remove and rectify defects noticed.

5.7 Check all outlet points for proper operation by opening each valve and allowing water to flow for a few minutes. Also check for effective closure of valve.

5.8 The entire water supply system should be disinfected with bleaching powder and system flush cleaned.

5.9 Send four samples of water drawn from four extreme locations for testing for bacteriological test in sterilized bottles obtained from the concerned laboratory. (Laboratory personal may collect the samples themselves).

6. RESPONSIBILITY

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

7 .Ecoloo Toilets

Ecoloo biodegradable toilets will be installed at site which are flushless and saves a lot water wasted in flushing. It makes the fertilizer of the solid waste which can be sell out in market as a fertilizer

PRODUCT	DESCRIPTION 1 year warranty applies on all ECOLOO products supplied	PURPOSE
	INDOOR/OUTDOOR **ECO DELUXE** • Base: FRP, Weight: 50kg • Dimension without box: 835mm (W) x 865mm (L) x 635mm (H) • Dimension with box: 850mm (W) x 880mm (L) x 665mm (H) • Items included: Toilet Seat, Toilet Lid, Dry Flush, Wind Ventilation Fan, Drop Bed.	• Indoor purpose • Inside transportation • Off grid housing (i.e. Ger Tent) • One family per house
	INDOOR/OUTDOOR **ECO BASIC** • Material: FRP, Weight: 90kg • Type: ECO BASIC • Dimension: 1100mm (W) x 750mm (H) x 1350mm (L) • Capacity: o Upper: 450L (Solid) o Bottom: 250L (Liquid) • Items included: Toilet Seat + Lid, Dry Flush, Wind Ventilation Fan, Drop Bed. **(Mechanical Waste Cover is Optional)**	• Outdoor purpose • Schools • Up to 15 visits / hour, 24/7 (200+ visits/day) • Can be used for indoor for bigger toilet room with partitions • Proper housing or structure can be placed around the toilet base for outdoor purpose
	OUTDOOR **ECO CLASSIC** • Type: ECO BASIC + Structure • Total Weight: 160kg, Knock Down (D-I-Y) • Structure: Light Composite 38 mm insulated Panels (normally used for cold rooms and trucks), Door, Roof • Optional: Mechanical Waste Cover, Solar Panel & Lighting, Hand bidet, Hand grab, Toilet Paper Holder, Hand Sanitizer, Fertilizer Pump .. etc. • Dimension: 1100mm (W) x 2200mm (H) x 1350mm (L)	• Outdoor purpose • D-I-Y Structure can be installed within less than 1 hour • Up to 15 visits / hour, 24/7 (200+ visits/day)
	OUTDOOR **ECO TENT** • Type: ECO BASIC + TENT • Total Weight: 150kg, Knock Down (D-I-Y) • Structure: Waterproof, Quality Plastic (double layers), Quality Zipper, Painted Galvanized Pipe Pillars • Dimension: 1100mm (W) x 2200mm (H) x 1350mm (L)	• Outdoor purpose especially for disaster relief and military • D-I-Y Structure can be installed in 10 minutes • Up to 15 visits / hour, 24/7 (200+ visits/day)

END OF SECTION - VI

PROJECT
India International Centre
for Buddhist Culture and Heritage
SUBJECT
TENDER FOR PUMPS, EQUIPMENTS & TREATMENT UNIT

TECHNICAL CONDITIONS PUMPS, EQUIPMENTS & TREATMENT UNIT

SECTION - 1 SCOPE OF WORK

1.1 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Public health engineering Drawings.

This contract is an Item Rate Contract. All payments are made for the actual work executed. Any variation in the quantities will not have any extra cost implication on the quoted rates.

1.2 Without restricting to the generally of the foregoing installations shall include the following:

- Filter Feed/ Raw Water pumps
- Water treatment units consisting of Pressure Sand Filters, Softener, chemical dosing pumps, and related equipment and accessories etc
- Domestic water hydro-pneumatic pump
- Flushing water hydro-pneumatic pump
- Horticulture water hydro-pneumatic pump
- Soft water hydro-pneumatic pump
- Tubewell Submersible pump
- Sump pumps for disposal of Drainage from pump room
- PLC based Controller & Indication System for Tanks & Pumps
- Electrical panels, cables, trays and related accessories
- BMS enabled Flow metre at the Inlet and outlet water supply lines.
- Butterfly motorized valve at the inlet line.
- Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work

1.3 Services rendered under sub-section 1.4 shall be done without any extra charge.

1.4 The Contractor must get acquainted with the proposed site for the works and study Specifications and Conditions carefully before tendering. The work shall be executed as per programme approved by the Engineer-In-Charge / Owner. If part of site is not available for any reason, the programme of construction shall be modified accordingly and the Contractor shall have no claim for any extras or compensation on this account.

1.5 Works area shall be the area shown in the plan.

END OF THE SECTION - I

SECTION - 2 TECHNICAL CONDITIONS

2.1. LICENSE AND PERMITS

2.1.1 Contractor must hold a valid Plumbing license issued by the Municipal Authority or other competent authority under whose jurisdiction the work falls.

2.1.2 Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to water supply, sewerage, storm-water drainage system.

2.1.3 Contractor shall obtain No Objection Certificate before commencement of work, from the local authorities all related to his work as required for the building.

2.1.4 Contractor shall obtain, from the local authorities all related completion certificates with respect to his work as required for occupation of the building.

2.1.5 Statuatory fees if any shall be paid by department for getting NOC. However it will be responsibility of contractor to obtain the NOC .Unless it is obtained, the final payment of the contractor shall not be released.

2.2 METRIC CONVERSION

2.2.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

2.2.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

2.3. REFERENCE POINTS

2.3.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

2.3.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

2.4 GENERAL INSTRUCTIONS

2.4.1 All works specified in the tender have to be executed in accordance with:

a) The rules and regulations of Local Authority Having Jurisdiction, and as per the statutory regulations applicable.

b) Applicable norms laid down by the relevant sections of latest editions of National Building Code (NBC) and all relevant codes of Bureau of Indian Standards (B.I.S.) shall be followed as applicable.

c) The codes of the Uniform Plumbing Code of India and relevant British Standards shall be used as a general guide for good engineering practice, design and

workmanship norms.

2.4.2 All materials used in the works shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified hereinafter.

2.4.3 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.

2.4.4 Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior Layout design drawings issued by the Engineer-in-Charge. Work will be executed only as per approved shop drawings and as per the general conditions of contract. Contractors shall furnish detailed Shop drawings, hydraulic and other design calculations for approval.

2.4.5 Quantities in the tender document are approximate worked out on the tender drawing issued.

2.4.6 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with latest amendments as applicable in the contract. Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender

2.4.7 The work shall be carried out strictly as specified in Schedule of Quantities and Technical Specifications. In the case of discrepancy between the schedule of Quantities, the Specifications and/ or the Drawings, the following order of preference shall be observed:-

(i) Description of Schedule of Quantities.
(ii) Particular Specification and Special Condition, if any.
(iii) Drawings.
(iv) CPWD Specifications.
(v) Indian Standard Specifications of B.I.S.

2.5 DRAWINGS ISSUED TO CONTRACTOR

2.5.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

2.5.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

2.5.3 Contractor shall verify all dimensions at site and bring to the notice of the Engineer –in - charge, all discrepancies or deviations noticed. Engineer –in - charge decision shall be final.

2.5.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small-scale drawings.

2.5.5 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Engineer-In-Charge.

2.6 SHOP DRAWINGS

2.6.1 The Contractor shall submit to the Engineer–in–charge two copies of Shop Drawings for Plumbing works as an Advance Copy to the Engineer-in-Charge for approval before start of work. Subsequent to the approval of the shop drawings, the Contractor shall submit seven copies of Shop Drawings for execution to the Engineer-in-Charge. The Contractor shall also submit four copies of the Technical Specifications and Catalogues for all items, including pump curves, single line diagrams etc. as relevant.

2.6.2 All Sanitary Engineering drawings issued to the Contractor shall be studied by them. Contractor shall also obtain the necessary architectural, structural and other services drawings, based on which they shall prepare their shop drawings as per site conditions.

2.6.3 Shop drawings shall incorporate the following:

- All proposed RCC & Structural supports/hanging/laying and jointing details for types of pipes as required.
- Typical details for Manholes, Catch Basins & Valve chambers as required.
- Plumbing layout plans as required and for any changes in the layout of Plumbing/ Architectural Drawings.
- Equipment & piping layout for Mechanical and Electrical equipments as required, SLDs, mounting details of circuit breakers, location of panels, installation of terminals and faucets etc. w.r.t. finishes, surrounding levels & locations.
- Manufacturer's and Contractor's fabrication drawings

2.6.4 The Contractor Shall only commence the work after the approval of above documents by Engineer-in-charge/ Consultant.

2.6.5 Contractors shall ensure that the Shop drawings are approved by the Engineer-In-Charge / Owner / Consultant prior to any execution.

2.7 COMPLETION DRAWINGS & DOCUMENTS

2.7.1 On completion of work contractor shall submit one complete set of original tracings and two prints of "As Built" drawings for the Engineer-In-Charge. These drawings shall have the following information.

a) Run of all pipes with diameters and length on all floors and vertical stacks.

b) Ground and Invert levels of all Plumbing services pipes.

c) Location of all valves.

d) Location of all Mechanical equipment with layout and piping connection.

2.7.2 Contractor shall provide four sets of Test Certificate, Routine Type Test certificates for Motors, Dynamic balancing certificate for Impellers, Calibration certificate for instrument catalogues, Operation and Maintenance Manuals, performance data and list of spare parts supplied together with the name and address of the Manufacturers for all Mechanical and Electrical equipments provided by him in the form of a Book or Manual.

2.7.3 All "Warranty / Guarantee" cards / certificates in original issued by the manufacturers shall be handed over to the Engineer-In-charge also in the form of a comprehensive record book / documents.

2.8 MATERIALS (SUPPLIED BY THE CONTRACTOR)

2.8.1 All materials used in the works shall conform to the tender specifications.

2.8.2 As far as possible all materials shall be bearing I.S. certification marks as per approval of the Engineer-In-Charge.

2.8.3 All materials shall bear the necessary certification marks, conforming to the Tender Specifications / BOQ / Drawings requirements.

2.8.4 Unless otherwise specified and expressly approved in writing by the Engineer-In-Charge, materials of makes and specifications mentioned with tender shall be used.

2.9 INSPECTION AND TESTING OF MATERIALS

2.9.1 All materials before being allowed to be brought into the store will be preliminary / visually inspected at the entry gate of the project site before the security personnel. All materials shall be inspected by the Engineer-In-charge before receiving. This inspection will be conducted with the help of the quality approval format as prepared by the Clients.

2.9.2 Contractor shall be required to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

2.9.3 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

a) Theodolite
b) Dumpy level
c) Steel tapes
d) Weighing machine
e) Plumb bobs, Spirit levels, Hammers
f) Micrometers
g) Thermometers, Stoves
h) Hydraulic test machine
i) Smoke test machine

2.9.4 All such equipment shall be tested for calibration at any approved laboratory, and the test and calibration certificate shall be submitted to the Engineer-In-Charge / Owner.

2.9.5 All Testing Equipment shall be preferably located in the plant room meant for the purpose.

2.10 CONTRACTORS RATES

2.10.1 Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, sales tax on works contract and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition. Nothing extra shall be paid on this account at later stage.

2.10.2 Rates quoted are for all heights and depths required for this work.

2.10.3 All rates quoted must be for complete items inclusive of all such accessories, Fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.

2.10.4 All rates quoted are inclusive of cutting holes and chases and making good the same with cement mortar/concrete of appropriate mix and strength as directed by Engineer-In-Charge.

2.10.5 Rates quoted shall be inclusive of cost incurred in testing, commissioning of works and materials.

2.10.6 Any required items not covered in BOQ, Specifications or Drawings, shall be paid extra only after getting the approval from Engineer-In-Charge / Owner. The rate analysis considering Cost Price, Labour, along with supporting documents / bills etc., shall be submitted to Engineer-In-Charge / Owner for approval .for detail refer clause 12 of GCC of CPWD.

2.11 MOCK UP AND TRIAL ASSEMBLY

The Contractor shall have to assemble a Mock up as instructed by the Engineer-In-Charge in order to determine precisely the required dimensions. Relevant instructions from manufacturers shall also be followed as applicable.

The Material can be reused for final installation without any additional payments for fixing or dismantling of these.

2.12 EXECUTION OF WORK

2.12.1 The work shall be carried out in conformity with the PHE drawings and within the requirements of Architectural, HVAC, Electrical, Structural consultant and other specialized services drawings.

2.12.2 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other

requirements well in advance to prevent hold up of progress of the construction programme.

2.12.3 On award of the work, Contractor shall submit a programme of construction in the form of a Pert Chart or Bar Chart for approval of the Engineer-In-Charge / Owner. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

2.12.4 Cutting & Making Good

No structural member shall be chased or cut without the written permission of the Engineer-In-Charge.

2.13 TESTING

2.13.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

2.13.2 Tests shall be performed in the presence of the Engineer-In-Charge / Consultant.

2.13.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

2.13.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other by-laws in force.

2.13.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

2.13.6 Contractor shall afford all the expenses for the offsite testing of material and equipments.

2.13.7 All Material and Equipment shall be checked before installation and tested after installation.

2.14 SITE CLEARANCE AND CLEANUP

2.14.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

2.14.2 After the Materials, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

2.14.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

2.15 FINAL INSTALLATION

The Contractor shall install all Material and Equipments in their final position in accordance with the approved trial assemblies and as shown on the Drawings.

The installation of equipment shall be complete with all supply and waste connections.

Pipes shall be mounted rigid, plumb and true to alignment as per Drawings and Design requirements.

2.16 PROTECTION AGAINST DAMAGE

The Contractor shall take every precaution to protect all installed material and equipment against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation and handling over.

2.17 GUARANTEE / WARRANTY

2.17.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

2.17.2 The form of warranty shall be as approved by the Engineer-in-charge.

2.17.3 The warranty shall be valid for a period of one year from the date of commissioning and handing over.

2.17.4 The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

2.17.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

2.17.6 The contractor shall include in his rates the operation of all mechanical equipment for a period of one month from the date of commissioning. No separate payment will be made on this account. for detail refer clause 17 of GCC of CPWD.

END OF SECTION - II

PROJECT
India International Centre for Buddhist Culture and Heritage

SUBJECT
TENDER FOR PUMPS, EQUIPMENTS & TREATMENT UNIT

TECHNICAL SPECIFICATIONS - PUMPS, EQUIPMENTS & TREATMENT UNIT

SECTION - I WATER SUPPLY PUMPS, EQUIPMENTS, WATER TREATMENT UNITS

SCOPE

Pumps & Water Treatment Equipment

Work under this sub-head consists of furnishing all labour, with appropriate T&P scaffolding & staging as required to completely install pumping system for various water supply services and water treatment as per drawings, specified hereinafter and given in the Bill of Quantities.

Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:

- Filter Feed/ Raw Water pumps
- Water treatment units consisting of Pressure Sand Filters, Softener, chemical dosing pumps, and related equipment and accessories etc
- Domestic water hydro-pneumatic pump
- Flushing water hydro-pneumatic pump
- Horticulture water hydro-pneumatic pump
- Soft water hydro-pneumatic pump
- Tubewell Submersible pump
- Sump pumps for disposal of Drainage from pump room
- PLC based Controller & Indication System for Tanks & Pumps
- Electrical panels, cables, trays and related accessories
- BMS enabled Flow metre at the Inlet and outlet water supply lines.
- Butterfly motorized valve at the inlet line.
- Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work

Successful Bidder should submit water test quality report before designing the WTP shall accommodate without any price implication.

Successful Bidder shall submit warrantee & guarantee certificates of WTP Electro – mechanical equipments.

1. MATERIAL

1.1 Clear water pump

1.1.1 Water supply pumps shall be suitable for clean water. Pumps shall be multistage, Inline vertical, centrifugal pumps with SS casing, stainless steel impeller, stainless steel shaft, CI base with CED coating and directly coupled with TEFC induction motor of class "F" insulation & efficiency class IE-3, 2900 RPM, IP 55 enclosure, suitable for operation on 415 volts ±10%, 3 phase, 50 Hz, A.C. supply. Each pump should operate at specific duty point of max. efficiency. Tenderers shall select their drivers within 10% to 15% in excess of the maximum B.H.P of the pump plus transmission losses if any.

1.1.2 Pump and motor shall be mounted on a common M.S. structural or C.I. base plate or as required as per site conditions.

1.1.3 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal “Burden” type pressure gauge with gunmetal isolation cock and connecting piping.

1.1.4 Provide vibration-eliminating pads appropriate for each pump.

1.1.5 Provide vibration eliminators/expansion joints on suction and Discharge side of the Pump and wherever required.

1.1.6 Provide rate of flow measuring meter with bypass arrangement with every set of pumps as shown on the drawings and given in the bill of quantities.

1.1.7 All water supply pumps shall be provided with mechanical seals of required specifications.

2 HYDRO-PNEUMATIC SYSTEMS

2.1 Hydro pneumatic systems (With Variable Frequency Drive)

2.1.1 The scope of this section covers supply, installation, testing and commissioning of compact packaged type skid mounted, self-contained variable frequency drive hydro pneumatic system. The skid mounted, factory assembled hydro-pneumatic system shall be provided with pressure transmitters, frequency convertor for noiseless operation of the pump at varying duty point. The convertor shall be provided with short circuit safety, earthing, over current, under voltage protection. The pump shall be complete with suction and delivery pipe. The system shall comprise of multiple pumps working and one stand-by to meet the system discharge requirements.

2.1.2 It shall conform to the following specifications:

(a) Pumps shall be vertical, inline multistage centrifugal and fulfills all specifications as specified in the Clear water pump section.

(b) Pressure vessel shall be of non corrosive FRP composite construction lined with NSF and /or FDA listed material, like high density polyethylene with fully

replaceable polyurethane. Air cell burst pressure of minimum of five times the vessel operating pressure and cycle tested for 80,000 cycles with charging connections to discharge pipe line with necessary flanges, gaskets, isolating valve, nuts/ bolts etc. with suitable foundation bolts & other accessories, complete. Capacity provided shall be as per manufacture specifications.

(c) Panel mounted microprocessor multi pump controller with large graphical display and variable frequency drive (VFD) mounted inside a panel complete with pressure sensor transmitter. The graphical display is capable to show number of pumps running & also communicate with other controllers following with open protocol through RS485 port. System should be capable to compensate for frictional losses at lower flows. All alarms should be displayed in the controller. The panel should also have provision for manual / automatic alternate (cyclic) operation of pumps, ON/OFF switch, dry run protection, inter connecting power and control cabling etc complete.

2.1.3 CONTROL PANEL (FOR HYDRO-PNEUMATIC SYSTEMS)

The control panel shall have terminals for:

- Remote monitoring.
- Pump fault.
- Analog output signal for frequency convertor
  (In case of VFD operated Hydro-pneumatic systems).
- Pressure sensor / Pressure switches as per system requirement.

2.1.4 GENERAL

The hydro pneumatic system shall be capable of maintaining a constant pressure at varied consumption. The hydro pneumatic system shall be complete with pressure sensor and microprocessor based controller for flow control by means of frequency variation (in case of VFD operated system). The controller should have time control switch to adapt pump operation to actual requirement in peak load situation. The control panel should also have manual operation.

The pumping system shall perform the following functions:

- Shut off the pump at zero demand.
- Shut off the pump at zero suction(Dry Run protection)
- Protect the pump from overvoltage, under voltage, overload & earth fault.
- Vary the time of pump speed acceleration and deceleration
  (For VFD operated Hydro pneumatic system).
- Compensate for higher friction losses at high flow rates.
- Send out a signal for remote monitoring of flow as well as pressure.
- Conduct automatic test run of pumps at set times.
- Keep track of run time for pumps.
- Perform run time equalization of all pumps in system.

2.1.5 INSTALLATION

Hydro pneumatic systems shall be mounted on a common base frame & installed as per manufacturer's recommendations. Pump sets shall be mounted on

machinery isolation cork or any other equivalent vibration isolation fitting. The vibration isolation pads, foundation bolts etc. shall be supplied by the Contractor. Contractor shall ensure that the foundation bolts are correctly embedded.

Pump-sets shall be factory aligned, wherever necessary, site alignment shall be done by competent persons. The entire system along with pumps & control panel must be sourced from single manufacturer only for unit responsibility.

3 Pressure sand Filters

3.1 Water filter shall be of dual media pressure filter (comprising of minimum 300mm bed depth of Anthracite and support media and minimum Height on Straight 1500mm) of downward or upward flow type suitable for a rate of filtration given in Schedule of quantities.

3.2 Filter shall be vertical type of required diameter. The shell shall be FRP prefabricated suitable to withstand a working pressure of 3 Kg/cm^2. The filter shall have at least one pressure tight manhole cover.

3.3 Accessories

Each filter shall be provided with following accessories:-

a) Air release valve with connecting piping.
b) 80mm dia dial burden type gunmetal pressure gauges with gunmetal isolation cock and connecting piping on inlet and outlet.
c) SS Sampling cocks on raw water inlet and filtered water outlet.
d) Individual drain connection with gunmetal full way valve should be piped through a properly sized G.I. pipe to nearest drain point.

4. Water Softener for WTP

4.1 Softener shall be designed to give zero commercial hardness. Softener shall be with "cation" ION exchange resins.

4.2 Softener vessel shall be of FRP prefabricated with dished ends and self supporting arrangement. Vessel shall be suitable for a minimum working pressure of 3 Kg/ Sq. cm. The vessel shall be tested at 1.5 times the working pressure. The vessel shall be designed to allow a minimum free board space at 50% of the mineral bed depth for adequate expansion during back washing.

4.3 The vessel shall have an internal collecting and distribution system of manufacturer's design.

4.4 The softener shall have a set of interconnecting face piping consisting of inlet, outlet and brine injection system with valves and accessories complete as per requirement. Piping shall be G.I heavy duty, as per I.S: 1239 and valves shall be cast iron double flanged sluice valves with C.I. body and Neoprene rubber diaphragm. Individual drain connection with gunmetal full way valve should be piped through a properly sized G.I. pipe to nearest drain point.

4.5 The brine injection system consist of hydraulic ejector with control valve, brine delivery pipes with adjustable indicator.

4.6 One measuring tank (Brine Tank) having a capacity of minimum one regenerations or as specified in bill of quantities.

4.7 One orifice board for indicating wash and rinse rate to be fitted in drain sump.

4.8 One initial charge of supporting gravel, sand and "cation" ION exchange resin in requisite quantity.

4.9 One water testing kit with instructions for testing water samples.

4.10 One rotameter to indicate flow rate.

4.11 Inlet & outlet pressure gauges.

5.0 Plant room drainage Sump Pumps

5.1 Sump pump set shall be compact, mono-block, submersible type with class "F" insulation of suitable capacity & RPM operating on 415volt ± 10%, 3 phase, 50Hz AC supply, with non-clog free flow open CI impellers, CI casing (Pump & Motor) and having solid handling capacity of required size for lifting domestic sewage or muddy water/drainage as specified in schedule of Quantities.

5.2 Pump shall inclusive of all necessary accessories like valves, piping, Control Panel and Cabling, Level Controllers, Test and/or air vent cocks, gland drain etc. as required within the quoted cost. The Contractor has to ensure for smooth and trouble free operation after the commissioning of the entire system. Nothing shall be paid extra on this account. Below are the functions of panel

(1) All the working and standby pumps shall start/stop automatically and alternatively.

(2) Each pump shall start/stop automatically at pre-set levels and work alternatively in cyclic operation.

(3) In case of pump getting overloaded, indication shall come on the panel and hooter will give sound non-operation of pump.

(4) In case of emergency due to high volume flow of incoming sewer all pumps shall start operating simultaneously

6. Chlorinator

Chemical dosing should consist of electronic / electro mechanical metering pump with suction and delivery flexible connections and fittings. The pump shall be mounted on FRP tank of 200 litre capacity. The system should be completed with electrically operated single phase motor driven stirrer having stainless steel shaft. This should be suitable for working against a pressure of 1.5 kg/Sq.cm and

should be capable of ejecting Sodium Hypo-chloride solution / suitable alternate chemicals with a dose of 1 ppm.

PARTS	MATERIAL
Head	CF8M
Suction & Discharge Valve Plug	SS-316
Ball	Ceramic
Ring Seal	PTFE
Diaphragm	Teflon Faced Hypalon
Pressure Relief Valve	SS-316
Anti-syphon Valve	SS-316
Suction Strainer	CF8M Y-Type

7. ELECTRICAL CONTROL PANEL

7.1 Motor Control System

The main switchboard shall be floor mounted, free standing, cubical type, compartmentalized and shall be factory built fabricated by CPRI approved fabricators. The board shall be fabricated from 2mm thick CRCA sheet and powder coated after seven tank process. The board shall be fabricated with IP 54 degree of protection suitable for operation of 415 volt ± 10%, 3 phase, 4 wire, 50Hz, AC supply. The switch board shall have provision for termination of cables from top as well as bottom with suitable knockouts. The layout shall be designed for convenient connections and inter-connections with various switchgears. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming necessary on a defective circuit. A base channel of 75mm x 5mm thick shall be provided at the bottom. A maximum of 200mm space between the floor and bottom most panel of unit shall be provided. The bus bar shall be of aluminium complete with heat shrinkable PVC sleeves. The fabrication of switch board shall be taken up only after the drawings for the fabrication of the same are approved by the Engineer –in – charge.

Control panel shall contain starters and safety protection for different types of pump motors & various feeders along with its controls. It shall also house the switchgears for incoming as well for outgoings supply. Provision of voltmeter (for incomer) & ammeter for incomer as well as for other feeders with selector switch, a set of LED indicating light for incoming phases as well as status indication of each equipment. The voltmeter & indication lamps shall be protected by MCBs.

The feeders for all those motors having more than 7.5 HP capacity shall be provided with fully automatic Star Delta starters with motor duty MCCBs for short circuit protection only (ICS = 100% ICU)& Overload Relays with contactors of suitable range & ratings, for overload protection, while less than or equal to 7.5 HP motor shall have Motor protection circuit breaker(MPCB) with suitable rating contactor. Single phase preventers shall be provided for all 3 phase motors. Single phase preventer shall be in conformity with relevant ISI standards. Single phase preventers shall act when the supply voltage drops down to 90 % of the rated voltage or failure of one or more phases. Single phase preventer shall be voltage operated and of approved make.

Other feeders of the panel which don't require starter shall be housed with:

a) MCCB with Thermal magnetic release & should provide adjustable setting for overload and short circuit protection with ICS = 100% ICU.
b) MCB used for controlling shall be with tripping characteristics of C curve. The miniature circuit breakers shall be 1/2/3/4 pole as per requirement. The breaking capacity of MCBs shall have minimum 10KA.

ON-OFF switches for each motor / equipment should not be provided on the cover of the control panel. But at the same time interlocking shall be provided between switch and the door in such a way that the door of the panel cannot be opened when the supply is ON.

The panel shall be provided all identification tags, danger board etc as per IS standard.

All control panels shall be provided with detailed control circuit diagram indicating the terminal numbers and color coding of the wires used in the panels. This diagram shall be pasted on the inner side of the cover and protected with PVC transparent lamination.

All MCCBs / MPCB's shall be equipped with extended front operated rotary handles on the doors. Rotary handle should have provision for pad lock.

Outgoing from each of the MCCB shall be extended to the cable alley by providing necessary busbar of suitable rating and supports etc. for terminating the outgoing feeders.

The detailed specification of switch gears and other accessories shall follow as described in electrical package of tender specifications.

All dosing tanks and process tanks/sumps shall be provided with level indicators/switches for low and high level alarm as well as for dry run protection, indications of which shall be provided in the main Electrical Control Panel.

8. PUMP MOTOR CONTROLLER CUM WATER LEVEL INDICATING PANEL

The Pressure Transducers shall be used for water level measurement, and it shall be convenient to mount on the water tanks. Hydrostatic pressure level sensors shall be submersible or externally mounted pressure sensors suitable for measuring the level of liquids in deep tanks or water in reservoirs. Level measurement shall be based on the pressure measurement principal, also referred to as hydrostatic tank gauging (HTG). It shall work on the principle that the difference between the two pressures (d/p) is equal to the height of the liquid (h, in inches) multiplied by the specific gravity (SG) of the fluid.

$d/p = h(SG)$

Therefore, the Transducers reading will represent the tank level. These sensors sense increasing pressure with depth and because depth is proportional to Volume for a regular tank, the Volume of Water can be easily calculated using a PLC.

The Centralized PLC control panel shall be front operated, cubicle construction, wall mounted type, fabricated out of 1.6 mm thick CRCA Sheet, with hinged lockable doors, dust and vermin proof, powder coated of approved shade, inter-connections, having, internal wiring, earth terminals, Top / Bottom control cable entry, numberings etc. comprises of touch-screen display board (Minimum Diagonal size 8") along with all accessories for complete Programmable logical controls & indications, having necessary interlocks, Inputs/Outputs, required number of repeater amplifiers, all audio-visual alarms as per the requirements listed below i/c emergency stop push button on the panel etc. The panel shall have BMS compatible with open protocol.

Water level indicators and controllers: The hydrostatic pressure sensor (Water level indicator) is working on hydrostatic pressure measurement principle made of Stainless Steel for installation in storage tanks, and capable of providing 4 to 20 mA analog signal compatible with PLC signal inputs and all control outputs to MCC panel (Plumbing/Water supply),for various water tanks as per the schedule of quantities.

8.1 Power / Control Cabling

Contractor shall provide all power /control cables from the motor control centre to various motors, level controllers and other control devices.

Cables and wires in conduits shall be laid on the metallic trays.

8.2 Earthing

Main Electrical power upto the Electrical panel(s) in Pump Room shall be provided by other agency.

All three phase motors / equipment shall be earthed with two independent earth conductors as per the requirement of Indian Electricity Rules and Regulation - 1956.

8.3 Commissioning

After successful testing of the different items in parts, the Contractor shall provide all facilities including necessary piping, labour, tools and equipments etc. for carrying out final commissioning of the entire water treatment plant complete as per requirement in the presence of Engineer-In-charge or his representative whenever and as may be required. Generally, the following test/inspection has to be carried out:

9. PIPES & JOINTING

Pipes for suction and delivery shall be galvanized steel pipes (heavy duty) confirming to I.S:1239 upto 150mm dia and as per I.S:3589 for dia 200mm and above or as specified in bill of quantities.

9.1 Valves & Accessories

Sluice / Gate Valves
Sluice Valves above 65 mm (inside screw and non raising screw type) shall be of Cast Iron body and Gunmetal seat with double flanged ends and valve wheel.

They shall conform to type PN 1.6 of IS:14846. Sluice valves upto 65mm (outside screw raising spindle type) shall be of Gunmetal Full way Valve with wheel tested to 20 Kg./cm2 class-II as per I.S: 778 with female screwed ends. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and close.

Butterfly Valves

The Butterfly Valve shall be suitable for waterworks. The Valves conforming to IS : 13095 shall be provided. All valves shall be suitable to withstand the pressure in the system and rating shall be PN 1.6. All valves shall be right handed (i.e. handle or key shall be rotated clock wise to close the valve).

The direction of opening and closing shall be marked and an open / shut indicator fitted.

The material of valves shall be as under:-

Body	-	Cast iron
Disc	-	Ductile Iron
Seat	-	EPDM / nitrile rubber
Shaft	-	Stainless Steel

The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

Non-Return Valve

Non-return valves shall be of Cast Iron body and Stainless Steel seat. They shall conform to API 594 and have companion flanges. They shall be Dual Plate Type suitable for both horizontal and vertical installation. An arrow mark in the direction of flow shall be marked on the body of the valve.

Ball Valve

The Ball Valve shall be made from forged brass and tested to 16 Kg/ cm^2 pressure. The valve shall be internally threaded to receive pipe connections.

The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon.

The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm^2 pressure.
The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree.

Strainer

Strainers shall be preferably of the approved type with fabricated steel bodies designed to the test pressure of 16 Kg/cm^2. Strainers shall be fabricated by minimum 1.2 mm thick stainless steel sheet with 3 mm dia. perforation holes. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

Pressure Gauges

Pressure gauges shall be of 150mm dia. dial and of appropriate range and be complete with shut off valve etc. duly calibrated before installation. Care shall be taken to protect pressure gauges during pressure testing.

Flexible Connection for Pumps

All suction and delivery lines shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer's details.

9.2 Jointing

Galvanising shall conform to IS 4736. Pipes and fittings shall be jointed with screwed/flanged joints, flanges either screwed or welded complete and flanged joints with 3mm thick rubber gasket as per requirements complete with nuts, bolts and washers etc.

All Fittings shall be new and from reputed manufacturers, Fittings shall be of malleable iron galvanized of pressure ratings suitable for the piping system. Fitting for G.I. pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes.

9.3 Installation

Piping layout shall take due care for expansion and contraction in pipes.

All pipes using screwed fittings shall be accurately cut to the required sizes. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. Genuine red lead with grumet and a few strands of fine hemp shall be applied and threaded in accordance with IS: 554. Open ends of the piping shall be locked as the pipe is installed to avoid entrance of foreign matter. Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.

Drain shall be provided at all low points in the piping system and shall be of the following sizes:

Mains	Drains
Upto 300mm dia	25mm dia
Over 300mm dia	40mm dia

Drains shall be provided with forged brass ball valve of equal size. Drains shall be piped through equal size G.I. pipe to the nearest drain or floor waste or as shown on the drawings. Piping shall be pitched towards drain points.
Piping installation shall be carried out with vibration elimination fittings wherever required.

10. TESTING

10.1 Pumps & Water Treatment Equipment

Tenderers shall submit the performance curves of the pumps supplied by them. They shall also check the capacity and total head requirements of each pump to match his own piping and equipment layout. On completion of the entire installation, pumps shall be tested, wherever possible, for their discharge, head, flow rate, B.H.P. Where it is not possible at least the discharge, head and B.H.P. (as measured on the input side) shall be field tested. Test results shall correspond to the performance curves.

10.1.1 Painting

After complete installation and testing, pumps accessories and fittings shall be given two coats, three mils each of approved finishing paint.

10.2 Piping

All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 10 kg/cm2 in any case and with the consent of Project-in-Charge.
Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

10.2.1 Painting

After the piping has been installed, tested and run for at least ten days. The piping shall be given two finish coats, 3 mils each of approved color. The direction of flow of fluid in the pipes shall be visibly marked in white arrows or as directed by the Engineer-in-charge.

PROJECT
India International Centre for Buddhist Culture and Heritage

SUBJECT SEWERAGE TREATMENT PLANT

SECTION – I GENERAL DESIGN INSTRUCTIONS

1. DETAILED INFORMATION TO BE SUBMITTED WITH TENDER

1.1 To be submitted with Tender

1.1.1 Contractor shall submit with the Tender a General Arrangement (GA) layout and hydraulic drawing of his plant giving all major dimensions, design parameters, sizes of units and equipment and pipes, H.P. of motors and all other pertinent information for assessment of the tender. A brief writes up, describing the process adopted shall also be enclosed.

1.1.2 Contractor shall submit with the Tender all the detailed specifications of proposed civil works including RCC Concrete work, steelwork, water-proofing, plastering, flooring & ceiling finishes, woodwork, etc.

1.1.3 Submit Annexure – I, II, III complete in all respects for standard format comparison.

1.2 To be submitted on award of work

1.2.1 Contractor shall submit detailed working/shop drawings of all civil works including dimensions, details of foundations, cut-out and openings, load requirements and working drawings necessary and required for the execution of the work.

1.2.2 All structures designed based on information given in this document below ground shall be subject to strict architectural control. The specifications, shape, layout and external finishes shall be as per the prior approval of the Architect/Client/Consultant.

2. INTERPRETATION

2.1 Interpretation of the contract documents shall be done in the following order of decreasing importance:-

a) Tender specifications/drawings
b) Special conditions
c) Contract drawings

d) Specifications/information submitted by Contractor & approved by Architect/Client/Consultants.

e) Indian standards and codes of practice.

f) CPWD specification Vol - I & II – as per latest addition (Civil work) and CPWD general specification for electrical work Part I & II (internal) and Part II (External) latest amended upto date.

3. EXECUTION OF WORK

3.1 The work shall be carried out in conformity with the contract drawings and within the requirements of Architectural, Electrical, Structural and other specialized services drawings.

3.2 The Contractor shall co-operate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up or progress of the construction schedule.

3.3 On award of the work, contractor shall submit a schedule of construction in the form of a PERT chart or BAR chart for approval of the Engineer-in-Charge. All dates and time schedule agreed upon shall be strictly adhered to.

END OF SECTION - I

SECTION-II SPECIFICATIONS FOR PIPING WORK

1. GENERAL

1.1 Work under this section consists of furnishing details of materials, necessary equipment required to provide all piping valves and other appurtenances for the treatment plant & labour.

1.2 Without restricting to the generality of the foregoing the piping work shall consists of:-

a) All gravity pipes between various units.
b) Pressure pipes from pumps to aeration tank, treated effluent disposal.
c) All other pipes, valves and control gates necessary and required.

1.3 All piping shall be of suitable material/make, to be as per the approval of the Engineer-In-Charge.

1.4 G.I. Pipes confirming to I.S:1239 upto 150mm dia and as per I.S:3589 for dia 200mm and above to be used in the Pump room and not in submerged Sewage. Galvanising shall conform to IS 4736. Pipes and fittings shall be jointed with screwed/flanged joints, flanges shall be SS 304 either screwed or welded complete and jointed with 3mm thick rubber gasket as per requirements complete with nuts, bolts and washers etc.

All Fittings shall be new and from reputed manufacturers, Fittings shall be of malleable iron galvanized of pressure ratings suitable for the piping system. Fitting for G.I. pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes.

1.5 uPVC pipe being used for the air lines shall mean unplasticized Polyvinyl chloride pipe, confirming to IS: 4985. It shall have a density of approx. 1.43 g / Cm3

1.6 The Pipes should have high corrosion resistance and should be immune to chemical, electrolytic and galvanic action. These pipes should be long lasting as it would be corrosion resistant.

1.7 Pipes should be kept on an even surface while storing. They should be properly supported and should not be stacked for heights more than 1.5 meters for longer duration.

1.8 For the connection of PVC pipe to metal pipes, a piece of special thick wall PVC connecting tube threaded at one end is used. The other end is connected to the normal PVC pipe by means of glued spigot and socket joint.

1.9 All piping shall be tested to hydrostatic test pressure of minimum 10 kg/cm^2 or 1.5 times the design pressure whichever is higher for a period of not less than 24

hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-charge.

1.10 After the piping has been installed, tested and run for at least ten days. The piping shall be given two finish coats epoxy coated paint with Zinc based primer of 150 micron each, of approved color.

1.11 The direction of flow of all fluids in the pipes shall be visibly marked in white arrows or as directed by the Engineer-in-charge.

1.12 Cast Iron pipes shall be used for raw sewage as per I.S. 3989 / CILA class as per requirements.

1.13 All pipes and fittings, valves etc shall be painted with two or more coats of **"chlorinated rubber paints"** over a coat of corrosion resistant zinc chromate primer. Different pipelines shall be painted with different color code as per standard and direction of flow shall be marked on each and every line irrespective of MS or any other pipe.

2. VALVES

2.1 Sluice / Gate Valves

2.1.1 Sluice Valves above 50 mm (inside screw and non raising screw type) shall be of Cast Iron body and Gunmetal seat with double flanged ends and valve wheel. They shall conform to type PN 1.6 of IS:780. Sluice valves upto 50mm (outside screw raising spindle type) shall be of Gunmetal Full way Valve with wheel tested to 20 Kg/cm2 class-II as per I.S: 778 with female screwed ends. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and close.

2.2 Butterfly Valves

2.2.1 The Butterfly Valve shall be suitable for wastewater / waterworks. The Valves conforming to IS: 13095 shall be provided. All valves shall be suitable to withstand the pressure in the system and rating shall be PN 1.6. All valves shall be right handed (i.e. handle or key shall be rotated clock wise to close the valve).

2.2.2 The direction of opening and closing shall be marked and an open / shut indicator fitted.

2.2.3 The material of valves shall be as under:-

Body	-	Cast Iron
Disc	-	Ductile Iron
Seat	-	EPDM / Nitrile Rubber
Shaft	-	Stainless Steel

2.2.4 The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

2.3 Non-Return Valve

Non-return valves shall be of Cast Iron body ball type and Stainless Steel seat for Sewage water handling up to clarified water tank. They shall conform to IS:5312 and have companion flanges. They shall be Stainless steel Dual Plate Type for Clear water suitable for both horizontal and vertical installation. An arrow mark in the direction of flow shall be marked on the body of the valve.

2.4 Air Release Valve

Air valves shall be provided at all high points in the piping system for air vent of the double float type, with G.M. body, vulcanite balls, rubber sealing, etc. Air valves shall be of the sizes specified and shall be associated with an equal size forged ball valve.

2.5 Ball Valve

2.5.1 The Ball Valve 50 mm dia below shall be made from forged brass and tested to 20 Kg/ cm^2 pressure. The valve shall be internally threaded to receive pipe connections.

2.5.2 The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon.

2.5.3 The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm^2 pressure.

2.5.4 The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree.

2.6 Strainer

Strainers shall be preferably of the approved type with Cast iron body with SS-304 Strainer Basket designed to the test pressure of 10 Kg/ cm^2 . Strainers shall be fabricated by minimum 1.2 mm thick stainless steel sheet with 3 mm dia. perforation holes. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

2.7 Pressure Gauges

Pressure gauges shall be of 150mm dia. dial and of 0 to 20 Kgs / Sq. cm. and be complete with shut off valve & siphon tube etc. duly calibrated before

installation. Care shall be taken to protect pressure gauges during pressure testing.

2.8 Flexible Connection for Pumps

All suction and delivery lines shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure 0 to 20 Kgs / Sq. cm. of each pump. Length of the connector shall be as per manufacturer's details.

SECTION-III SPECIFICATION FOR MECHANICAL EQUIPMENT

1. SUMP PUMPS

1.1 Sump pump set shall be dry motor submersible type with SS304 Guide Rail, & SS304 Chain with level float switches & suitable for auto / manual operation with class "F" insulation of suitable capacity & RPM operating on 415volt ± 10%, 3 phase, 50Hz AC supply, with non-clog free flow open CI impellers, CI casing (Pump & Motor) and having solid handling capacity of minimum 40mm for lifting domestic sewage or muddy water/drainage.

1.2 Pump shall inclusive of all necessary accessories like valves, piping, Control Panel and Cabling, Level Controllers, Test and/or air vent etc. as required within the quoted cost. The Contractor has to ensure for smooth and trouble free operation after the commissioning of the entire system.

1.3 The pump having dry run protection & high level alarm with audio and visual function / indication shall automatically operate with high water level and stop at low water level in the sump by means of "Electronic Level Controller", with necessary control cabling of the approved make upto control panel. The pump shall have the facility to cycle through the total number of pumps provided and in case of High Level shall be capable of cumulative operation.

1.4 The sump pumps shall be complete in all respect and shall be installed on the mentioned locations as shown in the drawing as per manufacturer's recommendations. All accessories shall be In-Built as per manufacturer's specification.

1.5 Contractor shall provide Electrical control panel having all necessary accessories, safety devices, Indication Lamp, Ammeter & voltmeter of approved make & standard specifications and shall be suitable for receiving incomer armored cable to connect complete within the quoted cost. It is mandatory to provide the control panel from the same pump manufacturers. Below are the functions of panel

1. All the working and standby pumps shall start/stop automatically and alternatively.

2. Each pump shall start/stop automatically at pre-set levels and work alternatively in cyclic operation.

3. In case of pump getting overloaded, indication shall come on the panel and hooter will give sound non-operation of pump.

4. In case of emergency due to high volume flow of incoming sewer all pumps shall start operating simultaneously

1.6 The entire system along with pumps & control panel must be sourced from single manufacturer only for unit responsibility.

2. AIR BLOWERS

2.1 The treatment plant shall be provided with rotary positive displacement roots type blowers with a common base and a central electric control panel, belt drive system, drip proof induction type electric motors, necessary valves including a pressure release valve and suitable filter and silencing. All piping and related accessories necessary to connect the blowers to the plant air header shall be provided. Flexible reinforced rubber connecting sleeves shall be provided wherever required. There shall be standby arrangements for blowers to enable cyclic operations.

2.2 The Air blower shall have min. requirements as mentioned below:

Casing	CI
Fluid Handled	Air
Installation	Indoor
Sealing	Lip Seal
Recommended Motor	Suitable H.P. Motor & 1500RPM of efficiency class IE-2, operated on 415 Volts ±10%, 3 phase, 50 Hz A.C. supply.
Drive	V- BELT DRIVEN
Shafts	EN18/19 (BS970:1955)/SG Iron

3. AIR DIFFUSERS

3.1 Each diffuser shall be non-clog type diffuser. Supply pipes shall be of sufficient size to keep pressure loss through the drop-pipe assembly to a minimum. The air diffusion devices shall be designed to distribute air to cover the entire length of the tanks and to have efficiency such that an adequate supply of oxygen is maintained in the tanks to treat the effluent load for which the plant is designed. The aeration grid is provided in the tanks to mix the content of sewer to avoid any septic condition in the tank.

3.2 The membrane diffuser shall be made of: -

- Pipe Aerator in Silicon material of construction & PP Support Tube of minimum 5 mm thickness with threaded type fixing arrangement having air throughput rate as per Approved Technical Annexures.

- Disc Aerator in Silicon material of construction– With air throughput rate as per Approved Technical data sheets.

- Disc type diffuser shall be of 5m3/hr and tube type diffuser shall be of 6 m3/hr.

4. SLUDGE RETURN / RE-LIFT PUMPS

4.1 Sludge return pumps shall be horizontal non-clog centrifugal pumps for the required discharge and head and of required specifications. Pump shall be directly connected to an electric motor by means of a flexible coupling and mounted on a common C.I. or G.I. base plate.

4.2 Each sludge return pump shall have a capacity suitable for re-circulating 100% sludge. The second pump shall be a standby in cyclic operation.

4.3 The Sludge return pumps shall have CI Impeller, Cast Steel Shaft, CI delivery casing, bronze sleeve & Mechanical Seal fitted coupled with suitable motor of efficiency class IE-2 with required HP & RPM operated on 415 Volts ±10%, 3 phase, 50 Hz A.C. supply.

5. SLUDGE LOADING / DISPOSAL PUMPS

5.1 Sludge loading/ disposal pumps shall be horizontal non-clog screw type pumps for the required discharge and head and of required specifications.

5.2 The pump shall have following operating parameters:

- Pump Type :Screw Pump
- Pumping Fluid :Sludge
- Suction Head :Flooded
- Motor :Suitable Motor of required HP & RPM operated on 415 Volts ±10%,3 Phase, 50 Hz A.C. supply.
- Flow :Suction on Gland
- Suction / Delivery Position :Top/End
- Type of drive :O/H Drive, V-Belt Driven
- Mounting :M.S. Fabricated Common Base Plate

6. CLEAR WATER PUMP

6.1 Water supply pumps shall be suitable for clean water. Pumps shall be multistage, Inline vertical, centrifugal pumps with SS casing, stainless steel impeller, stainless steel shaft, CI base with CED coating and directly coupled with TEFC induction motor of class "F" insulation & efficiency class IE-3, 2900 RPM, IP 55 enclosure, suitable for operation on 415 volts ±10%, 3 phase, 50 Hz,

A.C. supply. Each pump should operate at maximum efficiency duty point at specified head. Bidders shall select their drives within 10% to 15% in excess of the maximum B.H.P of the pump plus transmission losses, if any.

6.2 Pump and motor shall be mounted on a common G.I. structural base frame.

6.3 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal "Bourden" type pressure gauge with gunmetal isolation cock and connecting piping.

6.4 Provide Anti vibration mounting pads, Lubrication fittings and seal piping, Test and/or air vent cocks, 25mm GI gland drain appropriate for each pump.

6.5 Provide vibration eliminators/expansion joints on suction and Discharge side of the Pump and wherever required.

6.6 All water supply pumps shall be provided with mechanical seals (cartridge type), of required specifications.

7. PRESSURE FILTERS & ACTIVATED CARBON FILTERS

7.1 Water filter shall be of dual media pressure filter (comprising of minimum 300mm bed depth of Anthracite and support media and minimum Height on Straight 1500mm) of downward or upward flow type suitable for a rate of filtration of 17500 LPH per square meter.

7.2 Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure of 3 Kg/cm^2. The minimum thickness of shell will be 8mm and dished ends shall be 10mm.The quality of Steel shall be as per IS: 2062 Grade B, thickness as per ASME Section 8. The filter shall have at least one pressure tight manhole cover. Filter shall be provided with screwed or flanged connections for inlet, outlet, individual drain connections and all other connections necessary as required. Filter shall be painted inside with two or more coats of coal tar epoxy paint or internally FRP Lined, one coat of red oxide primer outside with two or more coats of synthetic enamel paint of approved shade. The Filter media shall comprise of 0.5 to 1.00 mm fine filtering silica sand for removal of turbidity and suspended matter. The initial charge of filter media as specified in above para's shall be the responsibility of contractor. The pressure filter shall be complete with cleaning cycle controller adjustable to meet application requirement, actuating control valves in required sequence for back wash.

7.3 Under Drain System

Filter shall be provided with an efficient under drain system comprising of collecting pipes, gunmetal/polypropylene nozzles of manufacturer's design. The entire under drain system be provided on cement concrete supports.

7.4 Face Piping

Filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash pipe complete with pipes, valves and accessories, as per requirement. Piping shall be G.I. piping, heavy duty, as per I.S: 1239 and valves shall be cast iron double flanged sluice valves with C.I. body and Neoprene rubber diaphragm.

7.5 Accessories

Each filter shall be provided with following accessories:-

a) Air release valve with connecting piping.
b) 150mm dia dial bourden type gunmetal pressure gauges with gunmetal isolation cock and connecting piping on inlet and outlet.
c) SS Sampling cocks on raw water inlet and filtered water outlet.
d) Individual drain connection with gunmetal fullway valve should be piped through a properly sized G.I. pipe to nearest drain point.

7.6 For Activated carbon filters shall have minimum Height on straight 1500mm comprising of minimum 450mm bed depth of Activated carbon, support media as required, consisting of downward or upward flow type as suitable.

9. DOSING SYSTEM

Chemical dosing should consist of electronic / electro mechanical metering pump with suction and delivery flexible connections and fittings. The pump shall be mounted on FRP tank of required capacity having in-built basket for holding alum blocks and lime blocks. The system should be completed with electrically operated single phase motor driven stirrer having stainless steel shaft. This should be suitable for working against a pressure of 1.5 kg/Sq.cm and should be capable of ejecting Sodium Hypo-chloride solution with a dose of 1 ppm.

10. CENTRIFUGE (SLUDGE HOLDING MECHANISM)

10.1 The Centrifuge shall comprise of a rotating bowl, consisting of a feed pipe, a cylindrical section where the separation of the suspension takes place and a conical section where the scroll removes the dewatered sludge.

10.2 The Centrifuge shall be high efficiency type system for de-watering of sludge. The separation of the solid-liquid sludge suspension shall be accomplished using high bowl speeds and low scroll differential speeds at high scroll torques.

10.3 Provision shall be made for the feed suspension to enter the rotating feed compartment through the feed pipe. There it shall accelerate in the direction of rotation and enter the rotating bowl via feed ports. The settled solids shall be moved by the scroll to and through the conical section, at the end of which shall be discharged through the discharge ports of the bowl as dewatered solids / cake.

10.4 The liquid effluent shall be discharged from the bowl over adjustable weir plates at the feed end.

10.5 The rotating bowl shall be supported by the main bearings, mounted in pillow blocks, pinned to the base frame. The base frame shall be mounted on hollow rubber buffers. Lubrication of the main bearings and the scroll bearing shall be done by grease lubrication.

10.6 The dried sludge from centrifuge shall be made available as a fertilizer for utilizing for horticultural purposes within the site and excess, if any, to be carted away from the site premises by Contractor at his own cost until Operation & Maintenance period end. Output Filtrate from centrifuge may be disposed back into the equalization tank.

10.7 The centrifuge complete with VFD Control panel.

10.8 MATERIAL

Parts in contact with process – product	Stainless Steel
Bowl material	Stainless Steel
Screw conveyor material	Stainless Steel
Housing material	Stainless Steel, Epoxy Painted
Parts not in contact with process-product	Carbon Steel / Cast Steel
Solid and Liquid Chutes	MS (Epoxy Painted) / FRP Construction
Speed of Motor	3000 rpm (3 phase)

11.0 SPECIFICATION OF BIO- MEDIA FOR SECONDARY SETTLING TANK

Specifications for Secondary settling tank Media / Tube settler media:

Distance b/w adjacent tubes	Horizontal 120mm, vertical 44 mm
MOC of media	PVC
Shape of tube	Hexagonal chevron
Tube fitting	Tongue and groove
Thickness	1.1 mm
Maximum continuous working temperature	55 deg celcius
Colour	Black
Plan settling area	11 m2/m3 at 60 degree slope and 13 m2/m3 at 55 degree slope
Height of media	750 mm

12. ULTRA FILTRATION SYSTEM

Module Specification

Parameter	Description / Information
Configuration	Self-encapsulated hollow fiber ultrafiltration

	membrane module (inside-out)
Operating Mode	Dead-end or Cross flow, Back washable
Module mounting	Vertical
Membrane pore size	0.02 micron

Description	Unit	Details
Membrane area	m2 / ft2	45 / 484 or As per Standard Design
Filtrate flow rate minimum	m3/hr/gpm	2.25 / 9.9
Filtrate flow rate maximum	m3/hr/gpm	6.75 / 29.7
Inside diameter	mm / inch	0.8 / 0.03
Outside diameter	mm / inch	1.2 / 0.05
Module Dimensions		
Diameter (A)	mm / inch	225 / 8.85
Length – with end cap (B)	mm / inch	1780.7 / 70.10
Length – feed connections (C)	mm / inch	1666 / 65.59
Distance – width (D)	mm / inch	316 / 12.44
Distance – feed to center (E)	mm / inch	140 / 5.51
Module weight	mm / inch	47.2 / 103.5

Technical Information

Operational Instructions	
Filtrate Flux Range	40 to 150 l/m²h (30 to 90 gfd)
Maximum feed pressure	4.8 bar (70 psi)
Membrane Burst pressure	8.5 to 9.5 bar
Trans-membrane pressure	0.3 to 1.4 bar (5 to 20 psi)
pH range	2 to 12
Maximum instantaneous chlorine tolerance	100 to 200 ppm
Maximum operating temperature	45°C (113°F)
Maximum feed turbidity	0.8 mm ID: 25 NTU 1.2 mm ID: 50 NTU
Backwash flux range	150 to 300 l/m²h (90 to 180 gfd)
Backwash feed pressure	0.7 to 2.1 bar (10 to 30 psi)
Backwash frequency & duration	Every 15 - 45 minutes for 30 - 60 seconds
Chemically Enhanced Backwash (CEB)	
Estimated Frequency	Every 1 to 10 days of operation (depending upon feed water conditions)
Duration	10 to 20 minutes
CEB chemicals	NaOCl (100-200 ppm), NaOH (pH: 11- 12), Acid (pH: 2-3), H2O2, Citric acid.
Module Characteristics	
Membrane material	PVDF
Housing material	UPVC
End cap material	GRP
Nozzles material	2” Victaulic

Note: *The above are for guidance purpose. Technical approval to be obtained before installation.*

END OF SECTION - III

SECTION – IV **SPECIFICATIONS FOR ELECTRICAL WORK**

NOTE: (1) All electrical cable entry should be from the top of panel, electrical cable should be FRLSH outer sheath only

(2) STP vendor will get only single point power supply cable to the stp panel from where his scope starts including termination of incoming cable to the stp panel.

1. Work under this section shall consist of providing detailed designing, labour, materials and equipment necessary and required to provide all electrical equipment for the treatment plant.

1.2 Without restricting to the generality of the foregoing the electrical installation work shall consist of:-

a) Electric motors for all equipment.

b) Cabling to all electrical motors.

c) Wiring for pumping station and control room.

d) Motor control center

e) Instrumentation

f) Internal electrification of all pumps/control rotors.

2. GENERAL

2.1 All electrical motors and other equipment shall be suitable for 400 volts, 3 phase, 50 cycles or 220 volts, single phase, 50 cycles, A.C., Supply motor 1 H.P. or below shall be single phase. All motors installed in open area must have space heaters and the circuits should have provision for automated operation.

2.2 All motors shall be rated 10.5% above the required H.P.

2.3 Each motor shall be provided with weatherproof terminal box and motors in exposed conditions shall be provided with suitable removable PVC covers.

2.4 Connections to all motors shall be made with flexible connections with suitable bushes and terminal lugs.

2.5 All electrical equipment supplied shall conform to relevant Indian or British standards wherever applicable and of reputed makes. All items shall be tested at manufacturer's works and certified copies of such tests shall be supplied to the owners.

2.6 All electrical equipment e.g. motors, switchgears, cables etc. shall be of reputed make. (Refer the list of approved make for details).

2.7 All electrical work shall be executed by authorized and qualified persons competent to undertake such works under the rules and regulations of the local electric supply authority.

3. MOTORS

3.1 Electric motors shall be totally enclosed fan cooled induction type squirrel cage motors conforming to I.S: 325.

3.2 Each motor shall be provided with a starter and stop push button switch suitably mounted near each motor. This shall be in addition to the main switchgear provided in the switchboard cubicle. Not required for sludge/effluent pump).

4 MOTOR CONTROL CENTRE

4.1 Contractor shall supply and install cubicle type motor control center fabricated from 16 gauge M.S. sheet and angle irons. The cubicle shall be stove enamel painted inside and outside. Provision of space for switchgear for future installations shall be made as specified below:-

4.2 The Switchgear shall comprise of:-

a) Incoming switch fuse unit of required rating.

b) Flush panel mounted voltmeter on incoming main with selector switch for reading voltage between each phase 0-500 volts.

c) Bus bar chamber with copper bus bars of required capacity.

d) Isolation S.F. Units one for each motor.

e) Isolation S.F. Unit for yard lighting circuit 60 amps.

f) Isolation S.F. unit for pump house and control room lighting circuit 15 amps.

g) Push button operation DOL starters for motors / pumps upto 7.5 H.P. and automatic star-delta starters for motor 7.5 H.P. and above for all motors.

h) Space for two starters for future installations.

i) One flush mounted Ampere meter for each 3 Phase motor.

j) Three phase indicating lamps on incoming main.

k) On/Off Neon indicating lamps for each motor.

l) All interconnection color-coded wiring from incoming S.F. unit to switches, starters, motors and other accessories. All wiring inside the panel shall be with copper conductors.

m) Provision of remote starting (from plant room)

n) MCC panel shall have the feeder provision for supply to the control panel of UF system and submersible raw sewerage pump.

5. CABLING

5.1 Contractor shall supply install and commission all cables from the M.C.C. panel to each motor. All electrical cable should be FRLSH outer sheath only asper below specifications:

A) **Conductor** - Annealed Plain / Annealed Tinned Copper / Aluminium – IS:8130 / IEC 60228 / BS 6360.

B) **Insulation -** PVC as per IS:1554, BS IEC-60502/BS 6743 OR XLPE as per IS:7098. IEC-60502/BS 5467.

C) **Inner Shealth -** ST1/ST2 PVC, FRLS PVC, IS/IEC.

D) **Armouring** - Unarmoured / Galvanized Steel (***or Aluminium*** for Single Core) Round / Strip Wire Armoured to IS:3975/IEC-60502, BS 6746/5467.

E) Outer Sheath - FRLS PVC ST1 / FRLS PVC ST2, IS/IEC.

F) FRLS Properties- IEC-60332-1 & 3, IEC-60754-1, SS-4241417, IEEE-383. ASTM-D-2863, ASTM-D-2843.

5.2 FRLS cable meet the standard requirements of

(a) IS 10810 Part 62/IS-1554

(b) IS 10810 Part 61/IS-1554

(c) IEC-60332 Part1 & 3

(d) ASTDM-D-2843 & D 2863

5.3 Advantages of FRLSH Cable

- Does not allow fire propagation in single and multi layered or bunched cables.
- Does emit limited smoke in case of fire.
- Does emit limited toxic and halogen gases.
- Does have high temperature index.

6. CABLE TRAYS

6.1 Contractor shall provide M.S slotted cable trays at locations as shown on the drawings and of sizes as given in the bill of quantities.

6.2 Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by anchor fasteners. Cost of MS angle, rods and anchor fasteners etc. shall be included in the rate of the tray and no separate payment shall be made on this account.

6.3 Cost of clips, bolts, nuts, support rods and any other materials required to fix the trays in proper manner shall be included in the rate for trays.

7. EARTHING

7.1 Contractor shall provide two earthing stations independent of each other separated by 3 m from the building.

7.2 Earth plates shall be buried in a pit 1.2 x 1.2 m wide and at a depth of at least 3 m. below ground level. The connection between main bars shall be made by means of three 5mm brass studs fixed at 100mm centres. The pit shall be filled with coke breeze loose soil and salt. A G.I. pipe 20mm dia. with perforations shall be placed vertically on the periphery to reach to ground level. A manhole of brick masonry 30x30x24 Consultant to surround the pipe shall be provided over the pit for inspection.

7.3 All conduit runs metal clad equipment, main switches, plug, boxes metallic fittings shall have effective earthing using appropriate size of G.I. wire and proper clips to comply with the requirements of the rules.

7.4 APPROVAL

7.4.1. Contractor shall comply with the provisions of Govt. Acts, regulations and by-laws of local authorities and any other competent authority to whose supply the proposed installation is to be connected.

7.4.2 Contractor shall obtain all the necessary permits. He shall be responsible for submitting all test reports, application forms payments of fees etc.

END OF SECTION – IV

SECTION – V COMISSIONING OF PLANT, GUARANTEES & DLP

1. COMISSIONING OF THE SYSTEMS

1.1 Contractor shall operate and maintain the entire STP for the period from start-up up to the date of certification of successful commissioning of the systems, as part of the contract and handing over to the client or as the case may be with mutual consent.

1.2 The contractor shall submit the Operation and Maintenance Manual for the plant with complete set of drawings and normal operations instructions at the time of commissioning of the plant.

1.3 Contractor shall submit all required test reports, approvals etc. as per the above sections, as part of the commissioning process.

2. EQUIPMENT GUARANTEE

2.1 All equipment supplied and installed by the contractor under this contract (whether manufactured by him or not) shall be guaranteed for a defect liability period of twelve months from the date of commissioning of the plant against defective workmanship, installation and materials.

2.2 The guarantee shall cover replacement of defective parts with new ones. Replaced parts shall also be covered by a similar guarantee.

2.3 The replaced parts shall be of genuine make and approved by the Project Manager.

3. PERFORMANCE GUARANTEE

3.1 The contractor shall guarantee the performance of the entire process, equipment and plant for a period of one year from the date of commissioning and handover to client.

3.2 The guarantee shall cover the structural stability, performance rating of each individual element of the plant. Performance rating shall include the quality of effluent to meet all requirements as mentioned in above sections, and the norms of the local state government pollution control board.

3.3 In case in the influent characteristics vary from what is specified, the operation schedule should be modified to obtain the final effluent as required in the relevant sections, with consent of the Client.

3.4 Acceptance of the contractor's tender shall automatically make him liable for the above guarantees.

END OF SECTION – V

PROJECT
India International Centre for Buddhist Culture and Heritage

SUBJECT
TENDER FOR FIRE FIGHTING SYSTEM

GENERAL TECHNICAL CONDITIONS

SECTION - I SCOPE OF WORK

1.1 The scope of work covers design & engineering, supply, erection, testing, commissioning, and handing over of complete Fire Protection System envisaged for all the buildings covered under the current phase of the project in line with stipulations of National Building Code – 2016.

Work under this sub-head consists of furnishing all Labour, Material, equipment and accessories necessary and required to completely install the Fire Fighting equipment etc., specified hereinafter. and given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the work of Fire Fighting System shall include the followings:

a) Hydrant Systems consisting of internal hydrant risers, external hydrant ring around the buildings, hydrant stations with all accessories such as hydrant hoses, first aid hose reel, branch pipe etc., including all valves, accessories etc.

b) Pumping system consisting of plant Room, Terrace pumps and related equipments such as valves, strainers, piping, instrumentation and motor starting system.

c) Sprinkler system is provided for the Buildings wherever required depend on height of buildings.

d) Excavation for Pipes, Laying of pipe, Protection for Underground pipes, Painting of pipes, Structural Supports etc. as per requirements.

e) Portable Fire Extinguishers.

1.3 The Bill of Quantities includes the works of Fire Fighting system for budha monestry.

1.4 It will be the decisions of the Client to award the entire work either to one vendor or parts of the work to different vendors. However, the system will be ultimately commissioned in totality and therefore all party concerned shall be responsible for successful commissioning and assisting in getting approval from all concerned authorities.

END OF THE SECTION – I

SECTION - II TECHNICAL CONDITIONS

1. LICENSE, PERMITS & COMPLETION CERTIFICATES

1.1 Contractor shall possess and maintain all necessary licenses and permits as necessary for the execution of the works.

1.2 Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to fire fighting system. He shall also be responsible for co-ordination for getting the approval, with other agencies working on the project relating to their scope of work.

1.3 It is the responsibility of the Contractor to ensure that all the works carried out are as per requirements of the local authorities having jurisdiction and as per the approved sanction drawings.

1.4 Contractor shall obtain, from the local authorities all related completion certificates with respect to his work as required for occupation of the building.

1.5 All inspection fees or submission fees paid by the Contractor shall be reimbursed by the Employer on production of valid official receipts.

2. METRIC CONVERSION

2.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

2.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

3. REFERENCE POINTS

3.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

3.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Fire fighting drawings.

4. GENERAL INSTRUCTIONS

4.1 Fire suppression works specified in the tender have to be executed in accordance with:

- The rules and regulations of Local Fire Authority as per the statutory regulations applicable for obtaining the occupation/No objection certificate from the Local Development / Fire Authority.

- Applicable norms laid down by the relevant sections of latest editions of National Building Code (NBC) and all relevant codes of Bureau of Indian Standards (B.I.S.) shall be followed as applicable.

- The codes of the National Fire Protection Association of USA (N.F.P.A.) shall be used as a general guide for good engineering practice, design and workmanship norms. No certificate of compliance to NFPA codes will be required.

4.2 All materials used in the works shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified hereinafter.

4.3 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.

4.4 Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior design drawings issued by the Engineer-in-Charge. Work will be executed only as per approved shop drawings.

4.5 Quantities in the tender document are approximate and worked out on the tender drawing issued and may vary as per actual requirements.

4.6 Contractors are invited to highlight any aspects of the contract document that may need revision or reconsideration before the work is started. He must furnish details of any variations in the specifications or the quantities that may be necessary for him to comply with the Code and statutory requirements. These may be identified and approval of the Project managers taken before the start of the work.

4.7 Contractors shall furnish detailed Shop drawings, hydraulic and other design calculations for submission and approval of the Local Fire Authority and for Insurance Companies as may be required by the Client.

5. DRAWINGS ISSUED TO CONTRACTOR

The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be approved by the Engineer-in-Charge.

6. SHOP DRAWINGS & TECHNICAL SUBMITTALS

6.1 The Contractor shall submit to the Consultant two copies of Shop Drawings for Fire Fighting works as an Advance Copy to the Engineer-in-Charge for approval before start of work. Subsequent to the approval of the shop drawings, the Contractor shall submit seven copies of Shop Drawings for execution to the Engineer-in-Charge. The Contractor shall also submit four copies of the Technical Specifications and Catalogues for all items, including pump curves, single line diagrams etc. as relevant.

6.2 All Fire Fighting drawings issued to the Contractor shall be studied by them. Contractor shall also obtain the necessary architectural, structural and other services drawings, based on which they shall prepare their shop drawings as per site conditions.

6.3 Shop drawings shall incorporate all proposed Structural supports/hanging/laying and jointing details for all types of pipes as required.

6.4 Contractor shall also submit all details of fabrication items, Single Line Diagrams etc. as per requirements.

6.5 The Contractor can only commence the work after the approval of above documents by Project Manager/ Consultant.

7. COMPLETION DRAWINGS

7.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the Engineer-in-Charge. These drawings shall have the following information:

(a) Run of all piping with diameters on all floors and vertical stacks.

(b) Ground and invert levels of all fire fighting pipes.

(c) Location of Control Valves.

(d) Location of all Mechanical equipment with layout and piping connections.

7.2 Contractor shall provide four sets of catalogues, manuals, performance data and list of spare parts together with the name and address of the manufacturer for all

Electrical and Mechanical equipment provided by him in the form of a book of manuals.

7.3 All "Warranty cards" given by the manufacturers shall be handed over to the Project Manager also in the form of a comprehensive of record book / documents.

8. MATERIALS (SUPPLIED BY THE CONTRACTOR)

8.1 All materials used in the works shall conform to the tender specifications.

8.2 As far as possible materials bearing I.S. certification marks shall be used with the approval of the Engineer-in-Charge.

8.3 Unless otherwise specified and expressly approved in writing by the Engineer-in-Charge, materials of makes and specifications mentioned with tender shall be used.

9. INSPECTION AND TESTING OF MATERIALS

9.1 All material before allowing to bring at the store, will be preliminary / visually inspected at the entry gate of the project site.

This inspection will be conducted with the help of the quality approval format as prepared by the clients.

9.2 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment as necessary.

9.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the Engineer-in-Charge.

9.4 All Testing Equipment shall be preferably located in special room meant for the purpose.

10. MATERIALS SUPPLIED BY THE OWNER

10.1 The Contractor shall verify that all materials supplied by the Employer conform to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Engineer-in-Charge.

10.2 After receipt of materials, it shall be the responsibility of the Contractor for any damage found and he shall be liable to pay the actual cost of the material as per market rate at that time.

11. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS FREE OF COST

If any materials issued to the Contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to Owner which shall include all freight and transportation, excise duty,

sales tax, octroi, import duty etc. or the actual cost given by the Employer shall be final and binding on the Contractor.

12. CONTRACTORS RATES

12.1 Rates quoted in this tender shall be inclusive of cost, unless specified of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, sales tax on works contract and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

12.2 Rates quoted are for all heights and depths required for this work.

12.3 Unless specified, all rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete of appropriate mix and strength as directed by Engineer-in-Charge. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.

12.4 Rates quoted shall be inclusive of cost incurred in testing, commissioning of works and materials.

13. MOCK UP

The Contractor shall install all pipes, clamps and accessories and fixing devices in mock-up shaft and room so constructed as directed by Engineer-in-Charge without any extra cost. The materials used in the mock-up may be reused in the works if found undamaged.

Any tiles or finished surfaces or floors damaged by the Contractor while doing his work shall be made good with new tiles or other finishing material. No payment shall be admissible for such repairs. The Engineer-in-Charge may, at his discretion get the damaged work repaired by other agencies and debit the cost of such repairs to the Contractor.

14. EXECUTION OF WORK

14.1 The work shall be carried out in conformity with the Fire Fighting drawings and within the requirements of Architectural, HVAC, Electrical, Structural / Green Building consultant and other specialized services drawings.

14.2 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction programme.

14.3. On award of the work, Contractor shall submit a programme of construction in the form of a Pert Chart or Bar Chart for approval of the Engineer-In-Charge / Owner. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

14.4 Contractor shall be responsible for co-ordination with other agencies working on the project relating to their scope of work and shall take approval from the Engineer-In-Charge / Owner wherever required.

14.5 No structural member shall be chased or cut without the written permission of the Engineer-in-Charge.

15. TESTING

15.1 All works shall be tested as specified under the relevant clauses of the specifications.

15.2 Tests shall be performed in the presence of the Engineer-in-Charge/ Consultant.

15.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

15.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.

15.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

16. SITE CLEARANCE AND CLEANUP

16.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

16.2 After the pipelines, fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

16.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

16.4 All aforesaid expenditure involved in the site clearance and cleanup are included in the contract price.

17. FINAL INSTALLATION

The Contractor shall install all fire fighting accessories, fixtures and fittings in their final position in accordance with the approved trial assemblies and as shown on the Drawings. The installation shall be complete in all respects. The connection between the piping system and the fixtures shall be through proper flanges to facilitate removal / replacement without disturbing the built in piping system. All flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and true to alignment. It shall be ensured that all pipelines are clear of obstruction. Due attention shall be paid to the

possibility of movement and settlement of fixtures due to pressurization and charging of the systems.

18. PROTECTION AGAINST DAMAGE

The Contractor shall take every precaution to protect all fire fighting fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper covering, wrapping and locking arrangement till the completion of the installation and handling over. At the time of handling over, the Contractor shall clean, and polish all the fixtures and fittings. Any Fixtures found damped, cracked, or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

19. GUARANTEE / WARRANTY

19.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

19.2 The form of warranty shall be as approved by the Engineer-in-charge.

19.3 The warranty shall be valid for a period of one year from the date of commissioning and handing over or as mentioned in the General Conditions of Contract

19.4 The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

19.5 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

19.6 The contractor shall include in his rates the operation of all mechanical equipment for a period of six months from the date of commissioning. No separate payment will be made on this account.

END OF THE SECTION - II

PROJECT
India International Centre for Buddhist Culture and Heritage

SUBJECT
TENDER FOR FIRE FIGHTING SYSTEM

TECHNICAL SPECIFICATIONS

1. GENERAL REQUIREMENTS

1.1 All materials shall be of the best quality conforming to the Specifications and subject to the approval of the Engineer-in-Charge/ Project Manager/ Owner.

1.2 Pipes and Fittings shall be fixed truly Vertical, Horizontal or in slopes as required in a neat workman like manner.

1.3 Pipes shall be fixed in such a manner so as to provide easy accessibility for repair and maintenance and shall not cause any obstruction in Shaft, Passage etc.

1.4 Pipes shall be securely fixed to walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings.

1.5 Valves and other appurtenance shall be suitably located so that they are easily accessible for operation, repairs and maintenance.

2. PIPES

2.1 All pipes within and outside the building in exposed locations and shafts shall be as follows:

a) Pipe 150mm dia and below IS: 1239 heavy class.
The pipes shall be Mild Steel (M.S.) manufactured by electric resistant welded (ERW)/ High Frequency induction welding or hot finished welded process. The sulphur and phosphorus requirements in steel shall not be more than 0.05 percent each. The tubes shall be manufactured from hot rolled steel skelps/ strips conforming to IS: 10748.

The following manufacturing tolerances shall be permitted on the tubes and sockets:

Thickness: shall not be less than 10 percent.

Weight: shall not vary by more than 10 percent either way.

The pipes shall satisfy the following table with regards to diameter, thickness and weight of tube.

Screwed tubes shall be supplied with threads as per IS:554. Each tube shall be

tested for hydrostatic test for leak-tightness as an in-process test at the manufacturer's works. The finished pipe shall be tested for tensile strength, elongation, bend test and flattening test.

b) **Pipe 200 mm dia and above IS 3589 of thickness specified**.

The pipes shall be manufactured by electric resistant welding (ERW)/ High Frequency induction welding or hot finished welded process. The sulphur and phosphorus requirements in steel shall not be more than 0.05 percent each. The tubes shall be manufactured from hot rolled steel skelps/strips conforming to IS: 10748.

The pipes shall conform to the tensile test, hydraulic pressure test and mechanical tests as per IS:3589. The pipe shall also conform to the requirements of as per IS: 3589. The tolerance shall as per IS: 3589. All pipes shall be of minimum 6 mm wall thickness. Pipes shall be supplied with bevel edging.

3. PIPE FITTINGS

3.1 Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. And all such connecting devices that are need to complete the piping work in its totality.

3.2 Fabricated fittings shall not be permitted for MS pipe diameters 50 mm and below only screwed jointing shall be adopted, while for pipes above 50 mm dia welded or flanged connection shall be used. Only electro galvanized nuts/ bolts shall be used.

3.3 When used, they shall be fabricated, welded and inspected in workshops under supervision of Project Managers whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler system. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

3.4 M.S Pipe up to 150 mm dia shall have all fittings as per IS: 1239, part II, (heavy grade) while pipes above 150 mm dia shall be as per IS: 3589 inclusive of IS marking.

3.5 For sprinkler pipes branches, fittings shall be forged type.

4. JOINTING

4.1 Screwed

Joint for black steel pipes and fittings shall be metal-to-metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked. (With screwed M.S. forged fittings)

4.2 Welded

Joints between M.S. and pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Buried pipes will be subject to X Ray test from an approved agency as per the TAC norms at the cost of contractor. (With welded M.S. fittings heavy class with V-Groove). The welding machine shall be 3 Phase of required

current and capacity.

4.3 All welding shall be carried out by a certified welder only. The contractor must produce the welder's certificate.

4.4 All pipe edges shall be bevel finished to a clean edge by a electric grinder. A requisite gap determined by the thickness of the weld electrode shall be given between the joints before start of welding.

Weld electrodes shall be of approved make of grade and type as suitable for the job. This shall be satisfied by the Project Manager before start of work.

4.5 Joints shall be given a first weld in the full width on the full dia of the pipe. Welding shall be carried out vertically from the surface.

After application of first coat the weld shall be cleaned by electric grinder and then another layer of welding shall be done. The weld shall also be cleaned by grinding. Similarly, a third weld shall also be applied.

4.6 All pipe cutting shall be by oxy-acetylene gas flame cutter only. The cut surface shall be cleaned by electric grinder before further welding.

4.7 Flanges

Flanged joints where specified in the bill of quantities shall be follows:

a) Straight runs not exceeding 30 m on pipelines 80 mm dia and above.

b) Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger diameter.

c) For jointing all types of flanged valves, vessels appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.

d) Flanges shall be as per I.S.6392-1971, Table 17/18 with appropriate number of G.I. Washers, Nuts and Bolts, half threaded of GKW make or equivalent with 3 mm insertion neoprene gasket complete.

4.8 Unions

Provide approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges.

5.0 PIPE PROTECTION

5.1 All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer immediately after bringing the pipes to site and shall be painted with one coat of red oxide primer after erection and proper hydraulic testing, and two or more coats of Synthetic Enamel Paint of approved shade on finishing.

5.2 All black steel pipes under floors or below ground shall be provided with protection against corrosion after proper hydraulic testing by application of 100mm wide and 4mm thick layer of anti-corrosive protection tape over the pipe, with overlap of 25mm minimum as per manufacturers specifications.

6. PIPE SUPPORTS

6.1 All pipes shall be adequately supported from ceiling or walls from inserts by Structural clamps fabricated from M.S. Structural works e.g. Rods, Channels, Angles and Flats as per details given in drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint.

6.2 Where inserts are not provided, the Contractor shall provide anchor fasteners. Anchor fastener shall be fixed to walls and ceilings by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners. Load bearing capacity of Anchor Fastener will be checked at site and then approved for implementation.

Hangers/ supports for all the piping shall be approved by the Project Manger before installation. Anchoring fasteners shall be rated to take minimum 0.4 ton load and shall be as per approved make. Additional supports shall be provided at bends etc. Angles for pipe supports shall not be less than 50x50x6mm size. cutting shall be by gas cutter. All cut edges and weld surfaces shall be ground to a smooth finish.

6.3 The supports/ angle pieces shall be cut by oxy-acetylene gas and cleaned by electric grinder. All cutting for bolt inserts shall be by electric drill.

6.4 Hangers for fire hydrant pipes shall be at 30m intervals & for sprinkler pipes shall be as per I.S. 15105.

7. TESTING

7.1 All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure subject to a min of 15 kg/cm^2 including water hammer effects without drop in the pressure for at least 24 hours.

7.2 In case of any detected drop in pressure, leakages are to be rectified and the pipes re-tested as required.

7.3 Complete Flushing out Test of Sprinklers installation shall be carried out to clean the sprinkler pipes for foreign materials before fixing the sprinkler heads to avoid obstruction in the sprinklers

8. ANCHOR BLOCK

Contractor shall provide suitable cement concrete, anchor blocks of adequate dimensions at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes wherever pipes are installed on-

ground/underground/terraces. Anchor blocks shall be of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

9. VALVES

9.1 Butterfly Valves-

a) Butterfly valves of approved quality for pressure rating of PN 16 with locking arrangement and gearbox with handle operated or gearbox with lid shall be provided or as given in the Bill of Quantities.

b) Butterfly valves shall be of specified quality conforming to IS: 13095 or BS: 5155.

c) Joints for butterfly valves shall be made with suitable tail /socket pieces on the pipe line and flanged joints made with 3mm thick insertion rubber gasket with appropriate number of bolts, nuts and washers.

d) Butterfly valves shall be provided on all branches as shown in the drawings or as specified.

9.3 Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS:5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type. An arrow mark in the direction of flow shall be marked on the body of the valve.

9.4 Valves below 50mm size shall have screwed ends while those of 50mm and higher sizes shall have flanged connections.

9.5 Strainers shall be preferably of the approved type with fabricated steel bodies designed to the test pressure of 16 Kg/ cm^2 . Strainers shall be fabricated by minimum 1.2 mm thick stainless steel sheet with 3 mm dia. perforation holes. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

10. EXTERNAL YARD HYDRANTS

10.1 The Contractor shall provide External Fire Hydrant in the Ring or on External Fire Line, as per specifications as specified in Schedule of Quantities and as shown in drawings. The spacing of the hydrants and the distance from the building shall be maintained as per relevant requirements of latest relevant codes, unless specified herewith.

10.2 Each External Fire Hydrant shall be provided with an External Fire Hose Cabinet of M.S or fibre glass, as specified in Schedule of Quantities of size 75 x 60 x 25 cms, as approved by the Architect to equip 2 nos. of 63 mm dia non percolating reinforced rubber line (RRL) hose and accessories as required. The cabinet shall be installed near the Hydrant as per details, approved by the Engineer-in-Charge/Architect. The fire hose cabinet shall have with glass fronted double door with lock and keys and break glass recess for keys, all complete. The glass shall be of minimum 8mm thickness.

The FHC shall be red painted. The words "yard hydrant", "hydrant" etc. shall be painted in white (or red on the glass) in 75mm high letters. The hose box shall be lockable with socket spanner. Top surfaces shall be slopped for water discharge. Vents shall also be located on sides of the Hose Box.

A brick pedestal with brick wall complex with plaster shall also be constructed for supporting the hose box. All surfaces shall be plastered with 1:4 ratio (1 cement: 4 fine sand) mortar.

Yard hydrant valve shall comprise "single headed single outlet stainless steel valve" conforming to type 'A' of IS: 5290-1977. The valve shall be complete with hand wheel, quick coupling connection spring and gun metal blank cap as per IS: 5290. The hydrant shall be fixed on hydrant riser through a 80mm dia tool piece pipe at approx. 1.2 meter from finished floor level. The hydrant shall be IS marked. The hydrant shall be tested to 25 kg/cm2 test pressure. All threaded joint shall be sealed with approved type of sealant such as "holdtite". The lug shall be wing type. Sample shall be approved by Project Manager

11. INTERNAL HYDRANTS

11.1 The Internal Hydrant outlet shall comprise "Single Headed Single Outlet Stainless steel Landing Valve" conforming to type 'A' of IS: 5290-1977. Separate valve on the head shall form part of the landing valve construction.

11.2 A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.

11.3 The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

12. FIRST-AID HOSE REEL EQUIPMENT

12.1 First aid hose reel equipment shall comprise reel, drum which can swing upto 170 degrees, with hose, guide fixing wall bracket, hose tubing, globe valve, stopcock and nozzle. This shall conform to IS: 884 - 1969. The hose tubing shall confirm to IS: 12585 (Thermoplastic). The drum shall be fabricated from GI sheet of minimum 18 gauge thickness or as specified in the bill of quantities.

12.2 The hose tubing shall be 20 mm dia and 36.5m long, or as specified in the bill of quantities. The G.M nozzle 5mm and globe valve shall be of 20 mm size to shut off the water supply to the Hose Reel, or as specified in the bill of quantities.

12.3 The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS: 884 - 1969. The first-aid hose reel shall be connected directly to the M.S. pipe riser through a 25mm dia pipe..

12.4 A MS bracket shall be fixed on the wall to which the first aid hose reel shall be bolted. The bracket shall be of 40x40x5mm thick MS angle to form a square of 400x400 approx. This shall be fixed on the wall. After approval of sample by

Project Manager further units shall be fabricated in factory and all joints shall be finished with grinder and shall be spray painted after single coat of primer.

13. HOSE PIPES, BRANCH PIPES AND NOZZLES

13.1 Hose pipes

a) Two numbers Hose Pipes shall be rubber lined woven jacketed (RRL) and 63mm in dia. 15m long, conforming to type A (Reinforced rubber lined) of IS:636 – 1979, or as specified in the bill of quantities. The hose shall be sufficiently flexible and capable of being rolled.

b) Each run of hose shall be complete with necessary coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS: 903.

13.2 Branch Pipes

Standard short sized Branch pipe shall be of Stainless steel, as per bill of quantities, 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle. The branch pipe shall to be tested to 20 kg/ cm^2 pressure.

13.3 Nozzles

The nozzle shall be of Copper or Gunmetal or as per bill of quantities, 20 mm internal diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.

13.4 End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985.

13.5 Two RRL hoses of 15m length with couplings shall be provided with each External (Yard) & Internal Hydrant. Two RRL hoses of 15m length, as specified, with couplings shall be provided with each Internal Hydrant. One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

14. DOOR FOR INTERNAL HYDRANT

14.1 Providing & fixing angle iron (40mmx 40 mm x 5mm) door frame and M.S Sheet (2 mm. thick) cum glass shutter of size 2.1 mtr.x1.2mtr.(N.S)with 25 mm. x 25 mm x 3 mm. angle frame all around & stiffened in between i/c hinges ,handle, locking arrangement, painting with approved synthetic enamel paint i/c sign writing on glass at internal hydrant including providing & fixing M.S. Sheet 2 mm. thick on remaining portion above door to close opening i/c painting etc.as required. Sample of the fire door shall be approved by Project Manager.

15. FIRE BRIGADE 2-WAY CONNECTIONS

15.1 Fire Brigade Inlet connection shall be provided to the wet riser system as specified and as described in the BOQ, for the following purposes:

i) Fire brigade inlet connection to the wet riser system. Each connection shall be in accordance with similar dia of Control valve and Non return valve.

15.2 The locations of these fire brigade connections shall be suitably decided with the approval of Consultant/ Project Manager and with a view that these are easily accessible to the fire brigade, without any possible hindrance.

16. VALVE CHAMBERS

16.1 Contractor shall provide suitable Brick Masonry Chamber in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick in 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 15 mm thick plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete.

17. PORTABLE FIRE EXTINGUISHER

Portable fire extinguishers shall be provided as per Bill of Quantities and shall conform to IS: 15683-2006.

18. SPRINKLER SYSTEM

18.1 System Design

(a) Sprinkler system shall be designed generally as per I.S. – 15105 with reference to NFPA-13 for general practices.

(b) Automatic sprinkler system shall be provided for all areas as per requirement with permitted exceptions e.g. electrical switch rooms, power transformers and D.G. rooms, Panel rooms, Electrical rooms as identified.

(c) Sprinkler heads shall be provided at approximate spacing to cover 12 m^2 per Sprinkler head or as per specific requirements to meet the approval of the authority having jurisdiction. The spacing shall also be in conformity with the drawings and properly coordinated with Electrical Fixtures, Ventilation Ducts and Grills and other services along the ceiling.

(d) Types of sprinklers to be used shall be as given in specifications, BOQ and approved by the Project Managers

18.2 Sprinkler Heads

(a) Sprinkler heads shall be Chrome finished Brass/Gunmetal with quartz bulb with a temperature rating of 68°C. Sprinkler heads shall be of type and quality approved by the local fire brigade authority. The inlet shall be screwed. Sprinkler heads shall be pendent, recessed or special application side wall Sprinkler types as shown in drawings. All Sprinklers should have the Specifications, as far as maximum possible as per NFPA requirements and shall be UL/FM approved.

(b) Contractor shall supply spare Sprinkler Heads of each type as per requirement and one Spanner neatly installed in a steel box with glass shutters as specified in BOQ and installed at locations approved by the Engineer-in-Charge.

(c) The nominal bore shall be 15 mm dia and colour of liquid shall be red. The below false ceiling shall also be provided with a double plate captive rosette assembly to seal the junction between the pipe and the false ceiling. The sprinkler head shall be of approved make.

18.3 Alarm Valve & Automatic Water Motor Gong Valve

The alarm valve & water motor gong valve is to be provided on all the Sprinkler main delivery pipes or Installation Control Valves as per approval of authority having jurisdiction.

18.4 Inspector Test Valves

The Inspectors Test Valve assembly is to be provided on the Sprinkler System pipes in location as per approval of authority having jurisdiction.

18.5 Flow Switches

The Flow Switches are to be provided on the Sprinkler System pipes for each zone, complete with all necessary wiring upto Zonal Indication Panel.

19.0 **FIRE FIGHTING PUMPS**

19.1.1 Fire, Sprinkler and Jockey Pumps

(a) Pumping sets shall be multi stage horizontal centrifugal single outlet split casing pump with cast iron body and bronze dynamically balanced impellers.

Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.

(b) Pumps shall be connected to the drive by means of spacer type love-joy coupling, which shall be individually balanced dynamically and statically.

(c) The coupling joins the prime mover with the pump shall be provided with a sheet metal guard.

(d) Pumps shall be provided with approved type of mechanical seals.

(e) Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.

(f) The pump shall meet the requirements of the Tariff Advisory Committee (TAC) and unit shall be design proven in fire protection services.

19.1.2 Motors for Electric Driven Pumps

(a) Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps, the motors should be rated not to draw starting current more than 3 times normal running current.

(b) Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.

(c) Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.

(d) Motors shall be suitable for 415 volts, 3 Phase,50 cycles A.C supply and shall be designed for 33° C ambient temperature. Motors shall conform to IS: 325.

(e) Motors shall be designed for two start system.

(f) Motors shall be capable of handling the required starting torque of the pumps.

(g) Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

19.1.3 Air Vessel for Fire Pumps

(a) Provide an air vessel fabricated from 10mm M.S. sheet with dished ends and suitable supporting legs, air vessel shall be provided with a 100mm dia flanged connection from pump, one 50mm dia drain with valve, one gunmetal water level gauge and 25mm sockets for pressure switches. the vessel shall be 450mmx2000mm dia high and tested to 1.5 times of the working pressure or 20 Kg/Cm2, whichever is greater.

(b) The fire pumps shall operate on drop pressure in the mains automatically or manually as specified below:

Operating Conditions for the Service Pumps

Fire Service Pump	Nos.	Cut in Pressure	Cut Out Pressure	Remarks
Jockey pump	Two	Automatic	Automatic	To auto start and auto stop on pressure switch on air vessel to stop.
Main pump (Hydrant)	One	Automatic	Push button manual	To auto start on pressure switch on air vessel and manual off.
Diesel Fire Pump	One	Automatic	Push button manual	To auto start on pressure switch on air vessel and manual off.

Sprinkler Pump	One	Automatic	Push button manual	To auto start on pressure switch on air vessel and manual off.

(The above ratings will be adjusted finally at the time of commissioning as per site requirement and final setting shall be kept as per approval of Engineer-in-Charge/Project Consultant).

19.1.4 Diesel Fire Pump

(a) Scope

This section covers the details of requirements of the standby fire pump, operated by a diesel engine.

(b) General

The diesel pump set shall be suitable for automatic and manual operation complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed plate, fabricated from mild steel channel.

(c) Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500/2900 RPM as specified in bill of quantities.

(d) Fire Pump

(i) The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver the discharge as specified, developing adequate head so as to ensure a minimum pressure of 3.5 Kg./cm^2 at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 13 Kg./cm^2 in any case. The pump may be single stage or multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head.

(ii) The pump casing shall be of cast iron to grade FG 200 to I.S: 210 and parts like impeller shaft sleeve, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gunmetal. The shaft shall be of stainless steel. The pump shall be provided with mechanical seal.

(iii) The pump casing shall be designed to withstand 1.5 times the working pressure.

(iv) Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

19.1.5 Diesel Engine

(a) **Environmental Conditions** - The engine shall be required to operate under the conditions of environment as specified.

(b) **Engine Rating** - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc). The engine shall be multi cylinder/vertical 4 stroke cycle, water cooled diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for the specified environmental conditions as mentioned. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and at least 3000 hours of operation before major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended upto date.

(c) **Engine Accessories** - The engine shall be complete with the following accessories:-

- Flywheel dynamically balanced.
- Direct coupling for pump and coupling guard.
- Radiator with hoses, fan, water pump, drive arrangement and guard.
- Corrosion Resister.
- Air cleaner, oil bath type/dry type.
- Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.
- Pump for lubricating oil and lub. oil filter.
- Elect. starting battery (2x12 v).
- Exhaust silencer with necessary pipe work.
- Governor.
- Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual staring).
- Necessary safety controls.
- Winterization arrangement, where specified.
- Fuel System: The fuel shall be gravity fed from the engine fuel storage tank to the engine driven fuel pump. The engine fuel storage tank shall be mounted either over or adjacent to the engine itself suitably wall / floor mounted with proper support.

  All fuel tubing in the engine shall be with copper and fuel piping from day oil tank to engine shall be MS / Reinforced flexible hose connection. Plastic tubing shall not be permitted.

  The fuel tank shall be welded Steel Construction (4mm Thick) and of 200 Ltrs. capacity or of capacity sufficient to allow the engine to run on full load for at least 4 hours. The tank shall be complete with necessary supports, level indicator (Protected against mechanical injury) inlet, outlet, overflow connection and drain

plug and piping to the engine fuel tank. The outlet shall be so located as to avoid entry of any sediment into the fuel line to the engine.

Tank shall be provided with epoxy coat from inside and outside with one coat of Red oxide primer and two or more Coats of Synthetic enamel paint of approved shade. A semi rotary hand pump for filling the daily service tank together with hose pipe of 5 m long with a foot valve etc shall also form part of scope of supply.

(d) **Starting system** - The starting system shall comprise necessary batteries (2x12 v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the flywheel. By metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The battery capacity shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

(e) **Exhaust system** - The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed to be taken out of the building as per statutory requirement. The Contractors are advised to see the drawing and site to assess the length and size of exhaust pipe required and its cost & installation included with price of pump. The total backpressure shall not exceed the engine manufacturer's recommendation. The exhaust piping shall be suitably lagged.

(f) **Engine shut down mechanism** - This shall be manually operated and shall return automatically to the starting position after use.

(g) **Governing System** - The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

(h) **Engine Instrumentation** - Engine instrumentation shall include the following:-

- Lub. oil pressure gauge.
- Lub. oil temperature gauge
- Water pressure gauge
- Water temperature gauge
- Tachometer
- Hour meter

The instrumentation panel shall be suitably mounted on the engine.

(i) **Engine Protection Devices** – The following engine protection and automatic shut down facilities shall be provided:-

- Low lub. oil pressure
- High cooling water temp
- High lub. oil temperature
- Over speed shut down

(j) **Pipe work** - All pipe lines with fittings and accessories required shall be provided for fuel oil, lub. oil and exhaust systems, copper piping of adequate sizes shall be used for lub. oil and fuel oil. M.S. piping will be permitted for exhaust.

(k) **Anti Vibration Mounting** - Suitable anti-vibration mounting duly approved by Engineer-in-charge shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

(l) **Battery Charger** - Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

19.2 TERRACE FIRE FIGHTING PUMPS

19.2.1 This section covers the general requirement of water pumps for Terrace pump.

CAPACITY: The discharge and head of the pumps shall be as mentioned in Schedule of Quantities.

19.2.2 Type

The pump shall be centrifugal type direct driven with a 3 phase, 415 V ±10%, 50 Hz, A.C. Motor. The pumps may be either of horizontal split casing (HSC) type of suitable rpm, or as specified in the tender documents.

19.2.3 Rating

- The terrace pump shall be suitable for continuous operation in the system. The head and discharge requirements shall be as specified in the Tender documents. The head shall be suitable for the system and shall take into consideration the pressure drops across the various components in the water circuit as well as the frictional losses.

- Pump shall be capable of discharging not less than 150 percent of the rated discharge at a head of not less than 65 percent with the rated head. The shut off head shall not exceed 120 percent of the rated head.

19.2.4 Material and Construction

I. The Centrifugal pumps shall conform to IS 1520.

II. The Pump casing shall be of heavy section close grained cast iron and designed to withstand 1.5 times the working pressure. The casing shall be provided with shaft seal arrangement as well as flanges for suction and delivery pipe connections as required.

III. The impeller shall be of Bronze of Gunmetal. This shall be shrouded type with machined collars. Wear rings, where fitted to the impeller, shall be of the same material as the impeller. The impeller surface shall be smooth finished for minimum frictional loss. The impeller surface shall be smooth finished for minimum frictional loss. The impeller shall be secured to the shaft by a key.

IV. The shaft shall be of stainless steel and shall be accurately machined. The shaft shall be balanced to avoid vibrations at any speed within the operating range of the pump.

V. The shaft sleeve shall be of Bronze or Gunmetal.

VI. The bearings shall be ball or roller type suitable for the duty involved. These shall be grease lubricated and shall be provided with grease nipples/cups. The bearings shall be effectively sealed against leakage of lubricant or entry of dust or water.

VII. The shaft seal shall be mechanical type, so as to allow minimum leakage. A drip well shall be provided beneath the seal.

VIII. The pumps shall be directly coupled with motor /diesel engine shaft through a flexible coupling protected by a coupling guard.

IX. The pump and motor shall be mounted on a common base plate fabricated from mild steel section. The base plate shall have rigid, flat and true surfaces to receive the pump and motor/diesel engine mounting feet. The Pump will be perfectly aligned with motor/engine so as to avoid any vibration during operation.

19.2.5 Accessories

Each pump shall be provided with the following accessories: -

(a) Butterfly valves on suction and discharge

(b) Reducers, as may be required to match the sizes of the connected pipe work.

(c) Non-return valve at the discharge.

(d) Pressure gauge at discharge side between pump and non-return valve.

19.2.6 Installation

(i) The pump assembly shall be mounted and arranged for ease of maintenance and to prevent transmission of vibration and noise to the building structure or

to the pipe work.

(ii) The pump assembly shall be installed on suitable RCC foundation. The Length and Width of the foundation shall be such that 100 mm. space is left all around the base frame. The height of foundation shall be so decided that the total weight of foundation block is 1.5 times the operating weight of the pump assembly. The foundation shall be isolated from the floor by vibration isolating pads. Angle iron frame of size 35 mm x 35 mm x 3 mm shall be provided on the top edges of the foundation.

(iii) More than one pump assembly shall not be installed on a single base or cement concrete block.

(iv) The suction / discharge pipes shall be independently supported and their weight shall not be transferred to the pump. It should be possible to disconnect any pump for repairs without disturbing the connecting pipe line.

19.2.7 AIR VESSEL FOR FIRE PUMPS

Air vessel shall be fabricated out of 8mm thick MS sheet & the end shall be dished and suitable supporting legs, air vessel shall be provided with a 100mm dia flanged connection from pump, one 50mm dia drain with valve, one gunmetal water level gauge and 25mm sockets for pressure switches. The vessel shall be 250mmx1200mm dia high and tested at 6 Kg/cm2 pressure before installation.

The fire pumps shall operate on drop pressure in the mains automatically or manually.

(The ratings will be adjusted finally at the time of commissioning as per site requirement and final setting shall be kept as per approval of Engineer-in-Charge).

20.0 CABLES

20.1 Contractor shall provide all power control cables from the motor control centre to various motors, level controllers and other control devices.

20.2 Cables shall conform to IS: 1554 and carry ISI mark.

20.3 Wiring cables shall conform to IS 694.

20.4 All power and wiring cables shall be aluminium conductor PVC insulated armored and PVC sheathed of 1100 volts grade.

20.5 All control cables shall be copper conductor PVC insulated armored and PVC sheathed 1100 Volt grade.

20.6 All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

20.7 All cables joints shall be made in approved manner as per standard practice.

20.8 The cable jointing shall be Crimping type.

20.9 The cable shall satisfy the following tests as per relevant IS codes:

- Insulation Resistance test sectional and overall.
- Continuity Resistance test.
- Earth continuity test.

  All tests shall be carried out in accordance with relevant standard code of practice and Indian electricity rules. The contractor shall provide necessary instruments, equipments and labour for conducting the above tests and shall bear all expenses of conducting such tests.

21.0 CABLE TRAYS

21.1 Contractor shall provide G.I. perforated cable trays at locations as shown on the drawings and of sizes as given in the bill of quantities, with G.I. sheet thickness of 2.0mm.

21.2 Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by welding support rods with insert plates OR Anchor fasteners.

21.3 Cost of clips, bolts, nuts, support rods and any other materials required to fix the trays in proper manner shall be included in the rate for trays.

21.4 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8 mm dia round headed bolts, nuts and washers.

21.5 Factory fabricated bends, reducers, tee/ cross junctions etc shall be provided as per good engineering practice. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending the largest size of cable to be carried by the cable tray.

22.0 TESTING

22.1 Initial Testing

22.1.1 During laying of pipes, the same shall be subjected to 10 kg/cm2 hydraulic pressure for a period of 24 hours, in sections.

22.1.2 After completion of the work all valves/ fittings shall be installed in position and entire system shall be tested for 24 hours at a pressure of 10 kg/ cm2. The drop of pressure up to 0.5 kg/cm2 shall be accepted.

22.1.2 Final Testing

22.1.2.1 After completion, all operation checks shall be carried out for automatic operation of the systems. For this purpose, landing valves may be opened at different locations. The exercise shall be repeated couple of times to ensure trouble free operation of the system.

22.1.2.2 **Flow Test:-** The design flow of pumps shall be checked. The pump shall be operated after opening a number of landing valves at different locations. All pumps shall be tested one by one. The flow rate shall be not less than as specified while maintaining the design pressure in pump house.

22.2 INSPECTION BY LOCAL FIRE OFFICER

After completion of the work and testing to the entire satisfaction of Engineer-in Charge, the installation shall be offered for inspection by Chief Fire Officer or his representative. Testing as desired by the Fire Officer shall be carried out. The contractor will extend all help including manpower during testing. The observation of Chief Fire Officer which are a part of agreement shall by attended by the contractor. Nothing extra is to be paid for testing as above.

21.0 COMMISSIONING

After successful testing of the different items in parts, the Contractor shall provide all facilities including necessary piping, labour, tools and equipments etc. for carrying out testing and commissioning of the entire fire fighting system complete as per requirement in the presence of Engineer-In-charge or his representative and during the visit of the Fire Officer whenever and as may be required. Generally, the following test/inspection has to be carried out:

- For the automatic operation of the all fire pumps as per the prescribed sequence above.
- For checking the Pressure available at the farthest and highest point in fire wet riser / down comer system.
- For the automatic operation of the Sprinkler System either by a dummy fire below a sprinkler head or by using the Inspection Test Valves. In this case, the annunciation panel indicating the particular zone and mechanical Gong valve should work.
- Flushing the System:- Before commissioning, the entire system shall be flushed to ensure that any earth/ foreign matters which might have entered during installation are taken out. For this, pump may be operated and valves opened at different locations.
- As soon as the work is complete, the system shall be commissioned and made available for use. Requirement of fire fighting installations is equally important during occupation of the building.
- The fire fighting system shall be maintained and manned from the very first day of its commissioning.
- Any defects noticed during the warranty period shall be promptly attended by the contractor and availability of the system at all time is to be ensured.

End of Sections

LIST OF PREFERABLE MAKES

Approved Make List

(Approved make shall fulfill the public procurement policy of Make in India)

1) The contractor shall obtain prior approval from the Consultant Architect before placing order for any specific material or engaging any of the specialized agencies. The contractor shall make a detailed submittal with catalogues and highlighted proposed specifications, as well as full details of the works executed by the specialized agency, as specified.

2) Wherever applicable, the Consultant Architect may approve any material equivalent to that specified in the tender subject to proof being offered by the contractor for equivalence to his satisfaction.

3) Unless otherwise specified, the brand / make of the material as specified in the item nomenclature, in the particular specifications and in the list of preferred materials attached in the tender, shall be used in the work after consulting Consultant Architect.

4) In case the make of any material is not mentioned in this list, the decision of Consultant Architect shall be final and binding.

5) In case of non-availability of the brand specified in the contract the contractor shall be allowed to use alternate equivalent brand of the material subject to submission of documentary evidence of non availability of the specified brand and get it approved by Consultant Architect.

6) Sample of all the materials will be used only after approval of the Consultant Architect.

	MAKE LIST FOR CIVIL	INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE AND HERITAGE
Sr. No.	**MATERIAL**	**MANUFACTURER / BRAND NAME**
1	Cement (Grey/White)	Ultratech/ACC, Gujarat Ambuja/Sree, JK, Birla and Vikram/or Equivelent
2	Flyash	Dadri plant/Ncarest plant or Equivclent
3	Plasticiser / Super plasticiser	FOSROC/T P Builtech or Equivelent
4	Bonding Agent	Nitobond EP Std by Fosroc or Equivelent
5	Reinforcement bars	TATA TISCO SAIL/ RINL Jindal or Equivelent
6	Structural steel	TATA/SAIL/JINDAL or Equivelent
7	Mechanical couplers	G.Tech splices or Equivelent
8	Plaster of Paris	Super fine/ Sakarni or Equivelent
9	Safety Foot Rest for Strong Tanks Manholes	RIF or Equivelent
10	Wooden flooring &skirting	Pergo Vista/ Armstrong or Equivelent
11	MS tube	Tata/Jindal/Prakash or Equivelent
12	Grouting Mortar/ Tile Joint Filler	Laticrete/Bal Adhesives & Grouts/Roff Rainbow Tile mate or Equivelent
13	Silicone Sealants	G.E. Bayer Silicone/ Dow Corning/ Wacker or Equivelent
14	Waterproofing Chemicals	MBT/ FOSROC/SIKA/CICO/ Dr FIXIT or Equivelent
15	Epoxy Flooring and Admixtures	MBT FOSROC/SIKA/CICO or Equivelent
16	Resin Bonded Glass Wool Mincral wool	UP Twiga/Lloyd Insulations, Crown Fibreglass or Equivelent
17	Welding Rods	Ador/Esab lamzon or Equivelent
18	Expanded polyethylene board as Expansion Joint filler during	Armour board from Supreme Industries or Equivelent
19	Expansion Rebar Anchor & Chemical Fasteners	Hilti/Fischer/Canon or Equivelent
20	Anti skid/Ceranmic Tiles	Kajaria /aisan /lomzon Somany or Equivelent
21	Vitrified Tiles/ Imported Tiles	Kajaria / Somanyasian/lamzon or Equivelent
22	Interlocking Paving Tiles	Duracrete/Unistone /Nimco Prefab / Nitco/vyara or Equivelent
23	Aluminium Sections	Jindal / Bhoruka /Hindustan Aluminium or Equivelent
24	Powder Coatinggs	Nerocoat Jenson & Nicholson or Equivelent
25	Stainless Steel Screws, Bolts, Washers & Nuts	Kundan/ Pujal Atul or Equivelent
26	Locks	droma/ozone/Godrej or Equivelent
27	Auto closing Hinges, Drawer slides	Hafele, Hettich, Grass, Blum or Equivelent
28	Adhesive for wood	Fevicol-SH Vamicol or Equivelent
29	Adhesive for stainless steel	Ciba Arocolite/Asian, J&N Deluxe or Equivelent
30	Fire Resistant coating	Viper or Equivelent
31	Paints & Polish	Asian/ Dulux Berger /khadi india prakurtik pintsor Equivelent
32	Texture Paint	Oikos/Spectrum/Unitile/asian or Equivelent
33	Plywood/ Ply Board	Duroboard&Duroply (Green), Greenply Industries (Club), century (architectior eauivelent)
34	Marine Plywood/ Ply Board	Green Ply Sonear National /CPLor Equivelent
35	Gypsum Board	India Gypsum /Saint Gobain Gyproc India Ltd lagyp(lafarge boral gypsum india pvt.ltd.)or equivelent
36	Shuttering Oil	REEBOL (FOSROC) or Equivelent
37	Chicken wire Mesh	Micromesh or Equivelent
38	Skin Door Shutters	Door Kraft/ Space wood/ Orion or Equivelent
39	M.D.F. Board	Nuwud/CPL or Equivelent
40	Flush Door Shutter (Marandi frame & Pine infill with BWP ply)	Durodoors/National/Greenply/ Century merion / ravalson or Equivelent
41	Natural Wood Veneer	Ventura/Donear/cpl or Equivelent
42	Soft board	Sitatex or/cpl Equivelent
43	Laminate	Sunmica /Formica/Merino/National, Century or Equivelent
44	Laminatemetallic	Metlam or Equivelent
45	Glass Processor	Gold plus /Allicd Glass / GSC Toughened Glass/AIS Glass Solutions or Equiv

46	Mincral fibre False Ceiling	Armstrong/Ecophon/AMF, USG. Nittobo or approved cquivalent or Equivelent
47	Acoustic False Ceiling	Ecophon/ Armstrong/Celotex of Hytone or Equivelent
48	Pipe Clamps and hangers	Intellotech' from Chilly/ Camry or Equivelent
49	CI Pipes and fittings	Neco/Kiplans/RIF/BEC or Equivelent
50	GI Pipes	Tata Jindal (Hissar) or Equivelent
51	GI fittings	Unik, 'R/Zoloto M or Equivelent
52	UPVC Pipes & Fittings	Supreme,Kissan. Prince, Finolex, AKG or Equivelent
53	RCC Pipes	Pragatiain. KK, Pranali or Equivelent
54	Aluminium Extrusion	INDO Bhoruka/Hindalco/Jindal / Sapa/ Global or Equivelent
55	Aluminium Ingots	Nalco Balco Hindalco or Equivelent
56	Powder coater Anodizer	Extruders Radiant / Art n Glass/ Micron /National or Equivelent
57	Powders for coating	Akzonobel Juton or Equivelent
58	Masking Tapes	Sun control/ Wonder Polymer or Equivelent
59	SS Screws for Fabrication/ Fixing	LPS/Kundan/ PrabhatJOM / Omni or Equivelent
60	Treatment On MS Brackets	Galvanised Brackets As PerIS 4759-1996 610gms./Sqm. (Microns) 80 -90
61	Anchors/Fasteners	Hilti/Fischer/Wurth/Rawlplug or Equivelent
62	Stainless Steel Bolts, Washers And Nuts	LPS Kundan /Prabhat/ Harsh or Equivelent
63	E.P.D.M. Gaskets	Mona /Hannu / Bohra / Osaka or Equivelent
64	6mm,8mm,10mm&12mm thick clear float colored glass	Saint Gobain/ ASI Glass/ Gaurdian or Equivelent
65	6mm,8mm performance glass	Saint Gobain / ASI Glass/ Gaurdian/ Pilkington or Equivelent
66	Glass processor Toughening frosting ceramic fritting/L	GSC Toughened / Gold Plus 7 Art & Glass/ Allied Glass/ Shiv Shakti or Equiv
67	Standards For Glass Toughening	DIN 1249 Part12 (1990) or Equivelent
68	Weather Structural Silicone	Dow Corning/GE Silicones Wacker or Equivelent
69	PVC Continuous Fillet For Periphery Packing Of Glzgs./ Cu	Anand Rediplex /Roop Polymers Forex Plastic or Equivelent
70	Door Seal Wool Pile Weather Strip	Anand Rediplex/ Beta/ JBL or Equivelent
71	Backer Rod	Supreme/ Paramount Systerain or Equivelent
72	Aluminium Door/Window Hardware	Giesse Alu alpha Lavaal/ Kinlong or Equivelent
73	Stainless Steel Friction Stay	Giesse/ Securi Style Kinlong/ Cotswool or Equivelent
74	S.S. handle, dead lock, floor spring, Spiders, Fin plates	Dorma KinlongOzone / Godrej or Equivelent
75	Double Side adhesive tape	V-2200 series Norton Saint Gobain only or Equivelent
76	Glass wool Rock wool in spandrel	Siderise UP Twiga Rockwool or Equivelent
77	G.I. Sheet	Tata Jindal SAIL or Equivelent
78	Aluminium Composite Panel (FR Grade B1 only)	Alucobond Aludecor Alstrong or Equivelent
79	Zink composite Panels (ZCP)	VMZINK/ ALUZINK Hunter Douglas or Equivelent
80	S. S. Railing fittings (304 Grade)	Jindal Kinlong / Dorma or Equivelent
81	High pressure Laminate (HPL)	Fundermax/ Merino Laminates or Equivelent
82	Fire rated spray sealant at floor	Hilti/3M Or Equivalent or Equivelent
83	Fire rated Glazing	Saint Gobian / Pyroguard or Equivelent
84	Fire rated doors	Sakti Hornmann/ Navair/Tata Parvesh/Ozone or Equivelent
85	Toilet Cubicals /Partitons	Merino Laminate/ Cubix or Equivelent
86	Door Closer	hafele/Dorma/Ozone/ Kinlong/Godrej or Equivelent
87	Stone work	Odyssey or equilevent
88	Preciuos stone work	Jewel craftz
89	Furnitures	Hafele/ HOF / Steel ase / Godrej

LIST OF MAKES ELECTRICAL_India International Centre for Buddhist Culture and Heritage	
Details of Materials/Equipment	**Manufacturer's Name**
HIGH VOLTAGE EQUIPMENT	
HT PANEL : 11 KV	ABB/SIEMENS/ L&T/ Schneider Electric
TRANSFORMER	Voltamp/Kirloskar/ Crompton Greaves
Compact HT Switchgear: 11 KV	ABB/SIEMENS/ Schneider Electric/ Crompton/ Siemens
HT Jointing Kit : 11KV	Raychem 3M (Heat Shrinkable)
Insulated Floor Mats/ISI Marked HT/LT	Premier Polyfilm Ltd.- (Electromat)/ RMG Polyvinyl India Ltd – Safe volt,
XLPE Aluminium Conductor HT Cables	Gloster/KEI/Polycab/ Universal
XLPE Aluminium/Copper Conductor LT Cables	Gloster/KEI/Polycab/ Skytone
Protection Relays Numeric Type	AREVA/ L&T/ Siemens
Potential Transformer	Automatic Electric/ Pragati/ Indcoil/ Matrix
Current Transformer (Cast Resin /Epoxy Coated)	Automatic Electric/ Pragati/ Indcoil/ Matrix,
Static Power Meter ISI & Meters Logger (Trivector)With RS 485 port	Conzerv (Schneider Electric), Larsen & Toubro,Secure Ltd
Electronic Digital Meter (A/V/PF/HZ/KWH) with LED Display -ISI Mark.	Larsen & Toubro/Secure Ltd/Tirnity Ltd
HRC Switches/Fuse and Fuse Fitting	L & T/Siemens/Schneider Electric
Battery Charger	HBLNIFE/KELTRON/ NELCO/ EXIDE
Sealed Maintenance Free Batteries	Exide/ Luminous/Standard
MEDIUM VOLTAGE EQUIPMENT	
LT Panels,Power Distribution Board, , Motor Control Centre, Air Insulated Bus ducts,Meter Boards etc	Advance Panels& Switchgears Pvt Ltd/Shiv Power Technology /balaji power,Chandigarh
Sub Distribution Board	Advance Panels& Switchgears Pvt Ltd/Shiv Power Technology /balaji power,Chandigarh
Air Circuit Breaker (3/4 Pole)	SIEMENS/ABB/SCHNEIDER
Moulded Case Circuit Breaker (MCCB)	SIEMENS/ABB/SCHNEIDER
Motor Protection Circuit Breaker(MPCB)	SIEMENS/ABB/SCHNEIDER
Miniature Circuit Breakers (MCB)	SIEMENS/ABB/SCHNEIDER
Residual Current Circuit Breaker (RCCB)	SIEMENS/ABB/SCHNEIDER
CONTACTOR/TIMER/SINGLE PHASE PREVENTOR &OVER LOAD RELAY	Control & Switch gears/Larsen & Toubro/Schneider Electric(Telemechanique)/Siemens
Numeric Type Relay	Areva/ABB Larsen & Toubro/Siemens
Electromagnetic Type Relay	Areva/Larsen & Toubro/Siemens
Indicating Lamps LED type and Push Button	Larsen & Toubro/Vaishno (ESBEE)/Schneider Electric (MG)/Siemens C&S
Overload relays with built in Single Phase preventer	GE Power Controls/Larsen & Toubro/Schneider Electric(Telemechanique)/Siemens
Electronic Tariff Energy Meter (KW/KWH-MD-ISI) with Display(Prepaid)	L&T /Secure/ELSERV
FRLS PVC Insulated copper conductor Wires up to 1100Vgrade-ISI	Finolex//RR Kable/Polycab
Power Capacitors, & Relay	L&T/Siemens-Epcos/Schneider-Mehar/Matrix
Cable Glands Double Compression with earthing links	Comet/Comax/Dowell
Bimetallic Cable Lug	Comex/Dowell's (Billet India)/Hax Brass (Copper Alloy India)
Lighting fixtures/LED LIGHT(Indoor)	IGUZZINI/LEDLINEAR/REGENT/TARGETTI/FORMA/XAL
Lighting fixtures/LED LIGHT(outdoor)	GMR/ENLIGHTS/NERI/LAM32
Lighting management system	MICROSENS and Equivalent
Ceiling Fan 5star Rating	BAJAJ/crompton /Usha/Havells
Wall Fan	BAJAJ/crompton /Usha/Havells
Exhaust Fan Heavy Duty	BAJAJ/crompton /Usha/Havells
Data cable	Havells/Finolex/KEI/LINK/AMP
Telephone cable	Havells/Finolex/KEI/LINK/AMP
External Lighting Fixture & Octagonal/decorative GI Poles/bollard etc	Bajaj/Philips/CGL/Wipro/LIGMEN
Electronic Ballast for Fluorescent	Bajaj/Philips/Wipro
Selector Switch/Toggle switch	Kaycee/Salzer (Larsen & Toubro)/ESBEE
Timer	HPL (Socomec)/Larsen & Toubro/Legrand/Schneider Electric/Siemens

UPS	Socomec/APC-Schneider/Emerson/Mitsubishi Eiectric/
LIFT	Schneider/Kone/Otis
Cable Trays (Factory Fabricated)/Raceways	Slottco//INDEANA/Super steel
Diesel Generator Set And Other Misc. Works	
Diesel Operated Power Generating Engine	Cummins India/KIrloskar/Catter pillar/Mahendra
Alternator	Stamford/Leroy Somer/Kirloskar
Overload relays with built in Single Phase preventer	ABB/Larsen & Toubro/Schneider Electric/Siemens
PVC Conduit pipe	AKG/BEC/NIC
Hume pipe	As approved by Architect
Fire Sealant	BTHM Engineering Birla /3 M /HILTI
MS Pipe/Angel/Chanel/GI Pipe	Tata Steel /Surya Jindal Hissar /BEC
Vibration Isolators	RESISTOFLEX/KANWAL/as recommended by DG manufacturer
Fiberglass	UP Twiga/Kimmco/Owing Corning
Thermometer	Emeraled H Guru Forbes Marshall
Flexible Pipe Connections	Resistoflex Flexionics (USA)
Level Indicator (Oil)	Forbes Marshall
Welding Rod	Advani
Fastner	Fisher/HILTI
Terminals And Connectors	WAGO/Phoenix/Elemax
INTERNAL ELECTRICAL WORKS :	
MS black enameled/galvanized ERW conduits	BEC/AKG/Rama
Copper conductor PVC insulated wires	Gloster/Polycab/KEI
GI pipes	Tata/Jindal/Prakash
MS Conduit accessories	Sharma/Rama/Noble
Modular switches/socket outlets accessories with moulded cover plate and wiring	Anchor Roma/Legrand/Schneider
Heavy duty metal clad socket outlets with MCB in MS housing	Legrand/Siemens/Mennikes Lexic
Weather proof socket outlets with MCB	Sudhir switchgear/ABB/Mennikies Lexic/Siemens
Miniature Circuit Breaker	LEGRAND Lexic//Havells /siemens
Earth Leakage Circuit Breaker	LEGRAND Lexic//Havells /Siemens
Timers	LEGRAND Lexic//Havells /Siemens
MCB Distribution Boards in sheet steel housing (double door)	LEGRAND Lexic/Havells /Schneider
Moulded case circuit breakers	EGRAND Lexic/Havells/Siemens/ABB
Switch & Socket Modular type	Anchor Roma/Legrand/MK
Fire alarm system	Ravel/Notifire-Honeywell/Agni
CCTV Camera	Panasonic/Honeywell/Bosch
EPBX system	Siemens/Alcatetel/CP-Plus
Solar Photo voltaic System	Jakson/TATA BP/Lanco
Note: All materials and their brands to be used in this project shall have to be mandatorily approved by the consultant Architect.	

India International Centre for Buddhist Heritage and Culture		
S.No.	**Details of Materials/Equipment**	**Manufacturer's Name**
Mechanical		
1	Chiller/ Heatpump	Trane / York / Carrier / I Handle / Energy Machine /Panasonic
2	Air Handling Equipment (DoubleSkin)	Edgetech / Zeco / Waves / VTS / Panasonic
3	Cooling Towers	Advance / Bell / Paharpur / Panasonic
4	Pumps	Armstrong / Xylem / Grundfoss / Wilo / Panasonic
5	Cooling/Heating Coils	Edgetech / Zeco / Waves / VTS / Panasonic
6	Fan Coil Units (Low static)	Edgetech / Zeco / Waves / VTS / Panasonic
7	Cassette Unit	Bhutoria / Zero / Caryaire / Panasonic
8	Ventilation fan sections	Edgetech / Zeco / Waves / VTS / Panasonic
9	Centrifugal Fans for AHUs	Kruger / Nicotra / Airflow / Humidin / Panasonic
10	EC Fans	Kruger / Nicotra / Ziehl Abegg / EBM / Panasonic
11	Inline Fans	Kruger / Nicotra / Osteberg / Systemair / Panasonic
12	Axial fans	Nicotra / Kruger / Humidin / Elta / Panasonic
13	Centrifugal Fans for ventilation units	Kruger / Nicotra / Airflow / Humidin / Panasonic
14	Air Filters (Pre Filter)	AAF / Spectrum / Mechmark / Thermadyne / Panasonic
15	ESP/EAC filter	Humidin / Energeo / Dustech / Panasonic / Eqvt.
16	Hot Water Generator	Rapidcool /Emerald/KEPL / Panasonic
17	Automativ Tube Cleaning System	Trane / York / I Handle / Energy Machine / OEM / Panasonic
18	Pres / Panasonic surization Unit with Deaerator	Anergy / Flamco / Emerald / IMI Hydronics / Panasonic
19	Dirt /AIR Separator	Anergy / Flamco / Emerald / IMI Hydronics / Panasonic
20	Condenser Water Non-Chemical Treatment System	Scale Guard-Aqua Treat/Crystallo-D Borne/Supremo-Hi Tech / Panasonic
21	Side / Panasonic Stream Filtration System	Lakos/PEP Separators/Griswold / Panasonic
22	VRV/VRF System	Daikin / Mitsubishi / Hitachi / Samsung / Panasonic
23	BMS	Siemens / Honeywell / Johnson / Delta / Atoms / Panasonic
24	Expansion Tank	Anergy / Flamco / Emerald / IMI Hydronics / Panasonic
25	PIPING (Chilled/Condenser/Drain Water)	Tata / Sail / Jindal / Surya / Mukut / JCO / Panasonic
26	Pot Strainer	Emerald / Sant / Anergy / Zoloto / Panasonic
27	Y-Strainers	Emerald / Sant / VTM / Zoloto / Panasonic
28	Suction Guide	Emerald / Sant / Anergy / Armstrong / Panasonic
29	Butterfly Valves (Water duty) (Gear Operated beyond 200mm Dia)	Advance / Zoloto / VTM / Castel / Panasonic
30	Check Valves (Water duty)	Advance / Zoloto / VTM / Castel / Panasonic
31	Ball Valves (Water duty)	Advance / Zoloto / RB/ITAP / Castel / Panasonic
32	Balancing Valves (Water duty)	Advance / Zoloto / VTM / Castel / Panasonic
33	Two way motorized Valves (Water duty)	Honeywell / Johnson / Siemens / Belimo / Zoloto / Panasonic
34	High range ability control valve/PIBCV	Advance / Flowcon / VTM / Panasonic / Eqvt.
35	Pressure gauges	H Guru / Waree / Emerald / Panasonic
36	Industrial thermometers	H Guru / Waree / Emerald / Panasonic
37	Two way Valves	Honeywell / Johnson / Siemens / Belimo / Zoloto / Panasonic
38	Actuator	Belimo / Honeywell / Siemens / Johnson / Panasonic
39	Water Flow switch	Danfoss / Johnson / Honeywell / Anergy / Panasonic
40	Modulating Motors	Belimo / Honeywell / Siemens / Johnson / Panasonic
41	Flexible couplings for pipes	Easyflex / Kanwal / Cori / Resistoflex / Panasonic
42	Binder test point	Anergy / Flamco / Emerald / Panasonic / Eqvt.
43	Room thermostat	Honeywell / Johnson / Siemens / Belimo / Panasonic
44	Humidistat & Airstat	Honeywell / Johnson / Siemens / Belimo / Panasonic
45	Safety thermostat for heater	Honeywell / Johnson / Siemens / Belimo / Panasonic
46	Pan Type Humidifier	Rapid cool / Zeco / Edgetech / Panasonic / Eqvt.
47	Auto air vent	Anergy / RC/Flamco / Panasonic
48	Micro processor based controllers	Johnson / Honeywell / Siemens / Delta / Panasonic
49	AIR DISTRIBUTION	Rolastar / Zeco / Dustech / Airflow / Panasonic
50	GSS Sheet	Tata / Sail / Jindal / JSW / Hindalco / Panasonic
51	Extruded Aluminum Grilles/Diffusers	Systemair / Airflow / Caryair / Dustech / Mapro / Panasonic
52	Combined fire/smoke Dampers	Systemair / Airflow / Caryair / Dustech / Mapro / Panasonic
53	Ventilation/Exhaust Air Grilles	Systemair / Airflow / Caryair / Dustech / Mapro / Panasonic
54	Factory fabricated duct	Rolastar / Zeco / Dustech / Ductofab / Panasonic
55	Jet Nozzles	Systemair / Airflow / Caryair / Dustech / Mapro / Panasonic
56	INSULATION	K-Flex / Armacell / A-Flex / Aerofoam / Panasonic
57	Nitrile Rubber Insulation (Open Cell/Closed Cell)	K-Flex / Armacell / A-Flex / Aerofoam / Panasonic
58	XPS Insulation	Supreme / Owens Corning / Panasonic / Eqvt.
59	Fire sealant	3M / Hilti / Flame Bar / Panasonic / Eqvt.
60	VFD/VSD	ABB / Danfoss / Delta / Invent / Panasonic

61	Air Washer/Scrubber	Ambassador / Emerald . Dustech / Zeco / Edgetech/ Panasonic
62	Air Curtains	Mistwah / Euronics / Dolphy / Russell/ Panasonic
63	UV LAMP	Alfa UV / Rucks / Philips / Airpure/ Panasonic
64	VAV/Thermofuser	Johnson / Belimo / Synro / Honeywell/ Panasonic
65	DUCT/PIPE/TRAY SUPPORTS	Hitech / Hilti / Panasonic / Eqvt.
66	Radiant Cooling/Heating	Kamazo / Uponor / L K Pex / Panasonic
67	THM Manifold	Kamazo / Uponor / L K Pex / Panasonic
68	Radiant Cooling/Heating PE-RT ree Multipert Pipe	Kamazo / Uponor / L K Pex / Panasonic
69	Welding Rod	Advani / Essab / Panasonic / Eqvt.
70	Fastner	Hilti / Hitech / Fisher / Panasonic

Note: All materials and their brands to be used in this project shall have to be mandatorily approved by the consultant Architect.

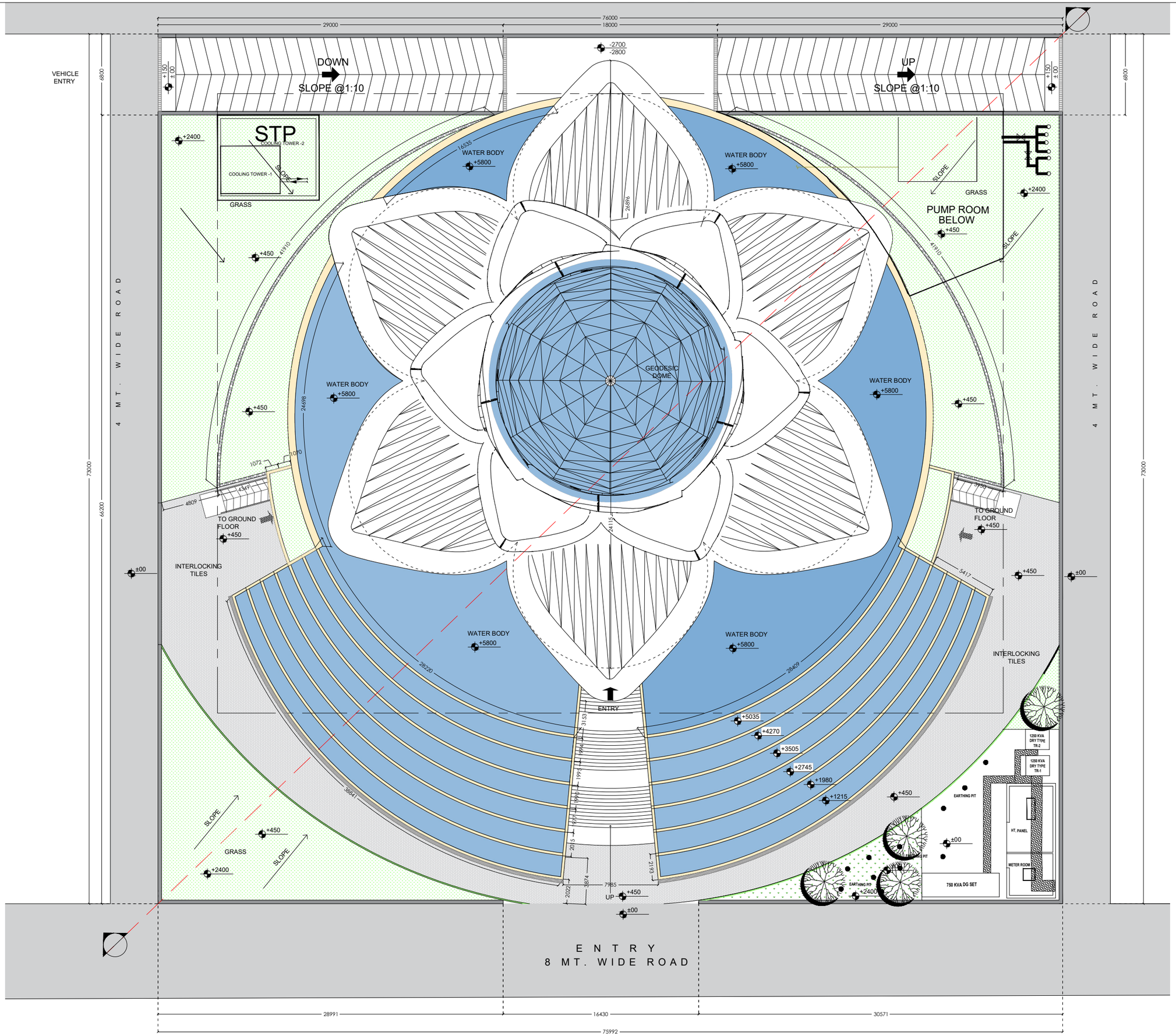
PROJECT India International Centre for Buddhist Culture and Heritage_PHEF		
S. No.	**Material / Item**	**Makes**
SUBJECT:LIST OF MAKES OF MATERIALS FOR WTP & RELATED EQUIPMENTS		
1	Clear water pump	GRUNDFOS / ITT/EBARA/KSB/MACHZEAL
2	Hydro-pneumatic Pumping System	GRUNDFOS / ITT/ EBARA/KSB/MACHZEAL
3	Submersible Sump Pumps	GRUNDFOS / ITT/ EBARA/KSB/MACHZEAL
4	Water Level Control & Indication System Integrators	ADVANCE / HONEY WELL / DANFOSS/MACHZEAL
6	Pressure Gauges	FIEBIG / H. GURU / DANFOSS/MACHZEAL
7	Dosing System	MILTON ROY/ ASIA LMI / GRUNDFOS/MACHZEAL
8	Pump Vibration Pads & Suction & Delivery Flexible Connectors	EASYFLEX / RESISTOFLEX / DUNLOP/MACHZEAL
11	Filter & Softener	Pentair/Thermax/MACHZEAL
12	Electro magnetic flow Meters	IOTA / FORBES MARSHALL/MACHZEAL
17	G.I. pipes	TATA / JINDAL HISSAR / SURYA / VISHAL PIPES - VPL ROSHNI/MACHZEAL
18	G.I. Fittings	UNIK / Zoloto / KS/ NEW/MACHZEAL
19	Ball valve	TIMME/ARCO/SKS/CIM/NEU-G/MACHZEAL
20	Butterfly Valve	KSB/SKS/AUDCO/SANT/ZOLOTO/MACHZEAL
21	C.I double flanged sluice valve	ADVANCE / SANT / CASTLE/MACHZEAL
22	Non return valves	KIRLOSKAR / SANT / SKS/ADVANCE/MACHZEAL
23	Motorized butterfly valve with controller for OHT	LEHRY/CASTLE/AIP/MACHZEAL
25	Strainer	ZOLOTO / SANT / CASTLE/ TIEMME/MACHZEAL
26	Float switch	NOLTA / DANFOSS / HONEY WELL/MACHZEAL
27.	Pre-Fabricated Structural supports and clamps	CHILLY/MUPRO/CAMRY/MASCOT/MACHZEAL
28.	Paints	ASIAN PAINTS/BERGER/SHALIMAR/MACHZEAL
29.	C.I Manholes cover	NECO/KARTAR/RIF/MACHZEAL
30.	SFRC Manhole Cover & Gratings	KK/ABC-ACCURATE BUILDCON/SURABH/MACHZEAL
31.	Plastic Encapsulated Foot Rest	KGM/KK/ABC/MACHZEAL
SUBJECT:LIST OF APPROVED MAKES FOR FIRE FIGHTING SYSTEMS		
32.	M.S Pipes	TATA/JINDALHISSAR /SURYA ROSHNI/VISHAL PIPES -VPL
33.	Forged Steel Fittings	SS/MEC (JAINSONS)/VS /NEW
34.	Butt Welded Fittings	DRP/TRUE FORGE/SS
35.	D.I. Grooved Coupling Fittings	VICTAULIC/VEXOMICA/MEC (JAINSONS)/NEW
38.	Air Release Valve	SANT/ARCO/LEADER/TIMME/SKS/RBM/TIEMME
40.	C.I Double Flanged Non-return valve	KRILOSKAR/SANT/KARTAR
41.	Dual Plate / Wafer Type Non-return valves (upto PN 16)	ADVANCE/KSB/KIRLOSKAR
42.	Fire Extinguishers	MINIMAX/NEWAGE/SUPEREX
43.	First-aid Hose Reel Drum	MINIMAX/NEWAGE/SUPEREX
44.	Rubber Hose Reels for Drums	MINIMAX/NEWAGE/SUPEREX
45.	Thermo Plastic Hose Reels for Drums	MINIMAX/NEWAGE/SUPEREX
46.	R.R.L. Hose &C.P. Hose	MINIMAX/NEWAGE/SUPEREX
47.	Branch Pipe, Nozzle, Coupling etc.	MINIMAX/NEWAGE/SUPEREX
48.	Landing Valves	MINIMAX/NEWAGE/SUPEREX
49.	Fire Brigade Connections	MINIMAX/NEWAGE/SUPEREX
50.	Fire Fighting Equipment not covered else where	MINIMAX/NEWAGE/SUPEREX
51.	Hose Box	Reputed make as per IS: specification subject to approval of Samples/Technical Details.
52.	Sprinklers & Rosette Plates (All Types)	TYCO/VIKING/HD
54.	Fire Pumps	KIRLOSKAR/ WILLO/LUBI/ABB/CROMPTON GREAVES

55.	Diesel Engine	KIRLOSKAR/CUMMINS/MAHINDRA
60.	Y-Type / Pot / Suction Strainer	KIRLOSKAR/LEADER/FIVALCO
61.	Foot valve with Strainer	KIRLOSKAR/LEADER/KARTAR
62.	Pressure Reducing Valves (For Fire Fighting)	WILKINS/OCV/AIP/LEHRY/CASTLE
64.	Flexible Connectors (Drop) for Sprinklers	RESISTOFLEX/VIKING/EASYFLEX
65.	Flow Switches /Monitor Modules	MORLEY IAS/SYSTEM SENSOR/POTTER
66.	Inspector Test Valves	HD FIRE/NEWAGE/CASTLE
67.	Pre-Fabricated Structural supports and clamps	CHILLY/EASYFLEX/CAMRY/MUPRO
69.	Alarm Valve	HD/SUPREX/SAFEGUARD/NEWAGE
70.	Pipe Coat Material (Pipe Protection)	PYPKOTE/MAKPOLYKOTE/ARMAFLEX
71.	Dash fasteners	HILTI/FISHER/CAMRY
72.	Paint / Primers	ASIAN/SHALIMAR/BERGER
73.	Weld. Electrodes	ADVANI/ESSAB
74.	Anti-vibration Pads & suction &delivery flexible connectors	EASYFLEX/RESISTOFLEX/DUNLOP
75.	Nuts/ Bolts	LAKSHMI/UNBRAKO
LIST OF MAKES OF MATERIALS FOR PLUMBING WORKS		
83.	Sanitary Fixtures & fittings	HINDWARE/JAQUAR/PARRYWARE/SERA/BAFIT
84.	Waterless Urinal	HINDWARE/GEBERIT/SERA/BAFIT
86.	G.I. Fittings for Water Supply (Malleable)	UNIK/ZOLOTO/KS/ NEW
87.	Galvanized forged fittings I.S:1239 (Part-II)	VS/DRP/JAINSONS/ NEW
88.	SS Pipes 316	JINDAL STAINLESS/VIEGA/J. PRESS
89.	uPVC pipes	SUPREME/PRINCE/ASTRAL /WAVIN
90.	UPVC pipe Pressure Fittings	CEPEX/ASTRAL/SUPREME /WAVIN
91.	CPVC pipes	SUPREME/PRINCE/ASTRAL /WAVIN
92.	Centrifugal Cast Iron Hubless Pipes & fittings	NECO/HEPCO/RIF
93.	Gully Trap	ANAND/BK CERAMICS INDUSTRY/LOCAL APPROVED AS PER BIS STANDARDS
94.	RCC PIPES	PRAGATI/ OM SPUN PIPE/ LOCAL APPROVED AS PER BIS STANDARDS
95.	HDPE pipe for sewerage system (IS 14333)	SUPREME/JAIN/ORIPLAST /GODAVARI / DURALINE/ASHIRVAD
96.	Insulation For Pipes	CAREFLEX/ARMAFLEX/THERMAFLEX/K-FLEX
97.	HDPE pipe for sewerage system (IS 14333)	CAREFLEX/ARMAFLEX/TWIGA/K-FLEX
98.	Pipe protection For External Water Supply Pipes	PYPKOTE/MAKPOLYKOTE/ARMAFLEX/K-FLEX
99.	Pre-Fabricated Structural supports and clamps	CHILLY/MUPRO/CAMRY/MASCOT
102.	SFRC Manhole Cover & Gratings	KK/ABC-ACCURATE BUILDCON/SURABH
106.	Motorized butterfly valve with controller for OHT	LEHRY/CASTLE/AIP
109.	C.I double flanged sluice valve	KIRLOSKAR/LEADER/SANT
110.	Float valve (gunmetal) upto 40mm	LEADER/SANT/AIP
111.	Float valve (C.I) 50mm and above	LEADER/SARKAR/CSA
112.	Altitude / Equilibrium Float Valve	CSA/HONEYWELL/DANFOSS
113.	C.I Strainer more than 65mm dia.	LEADER/SANT/AIP
115.	Solenoid valve	DANFOSS/HONEYWELL
116.	PVC Water storage tank	SINTEX/SHEETAL/SUPREME/ASHIRVAD
117.	Grating	NEER/MARVELLS/VIJAY METALS

118.	FLUSHLESS TOILETS	ECOLOO
119.	Clean out plug /COP/FCO	NEER/VIJAY METALS/MARVELLS
122.	M.S Forged Steel fittings	VS/DRP/SS/NEW
124.	HDPE Pipes	JAIN PIPES/ORIPLAST/SUPREME/ASHIRVAD / DURALINE
131.	C.I double flanged sluice valve	KIRLOSKAR/LEADER/AIP
132.	C.I Disk Type non return valves (65mm dia and above – Dual plate type)	KIRLOSKAR/LEADER/SKS
133.	PVC Valves	CEPEX/ASTRAL/SUPREME/ASHIRVAD
135.	SFRC Manhole Cover & Gratings	KK/ABC-ACCURATE/SURABH
137.	Clear Water Pumps	GRUNDFOS/ITT INDUSTRIES/LUBI
138.	Submersible Sump Pumps	KSB/GRUNDFOS/ITT INDUTRIES
139.	Pressure Gauges	FIEBIG/H. GURU
141.	Pump Vibration Pads & Suction & Delivery Flexible Connectors	EASYFLEX/RESISTOFLEX/DUNLOP
142.	Electromagnetic flow Meters	FORBES MARSHALL/IOTA/ADEPT
143.	FRP/GRP Vessels	PENTAIR/THERMAX/STRUCTURAL
144.	Air Blowers	EVEREST/BETA/AKASH
145.	Air Diffusors	BOBKAY/REHAU/MM AQUA
146.	Submerged Media	MM AQUA/PP AQUA/COOLDECK
147.	Tubesettler media	MM AQUA/PP AQUA/COOLDECK
148.	Sludge Pumps (Centrifugal)	KIRLOSKAR/JOHNSON/LUBI
149.	Sludge Pumps (Screw)	ROTO/UT PUMPS/RISANSI INDUSTRIES
150.	Testing Meters	ABB/SIEMENS
151.	Filter Press	PHARMATECH/SACHIN
152.	pH Meter	ASTER OR EQUIVALENT
153.	Ultrafiltration membrane	QUA/HYDRONAUTICS/MEMSTAR

Note: All materials and their brands to be used in this project shall have to be mandatorily approved by the consultant Architect.

DRAWINGS



NOTES:

MATERIALS LEGEND:

- LAWN
- STONE
- GRASS
- WATER
- SHRUBS
- ROAD
- TREES

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

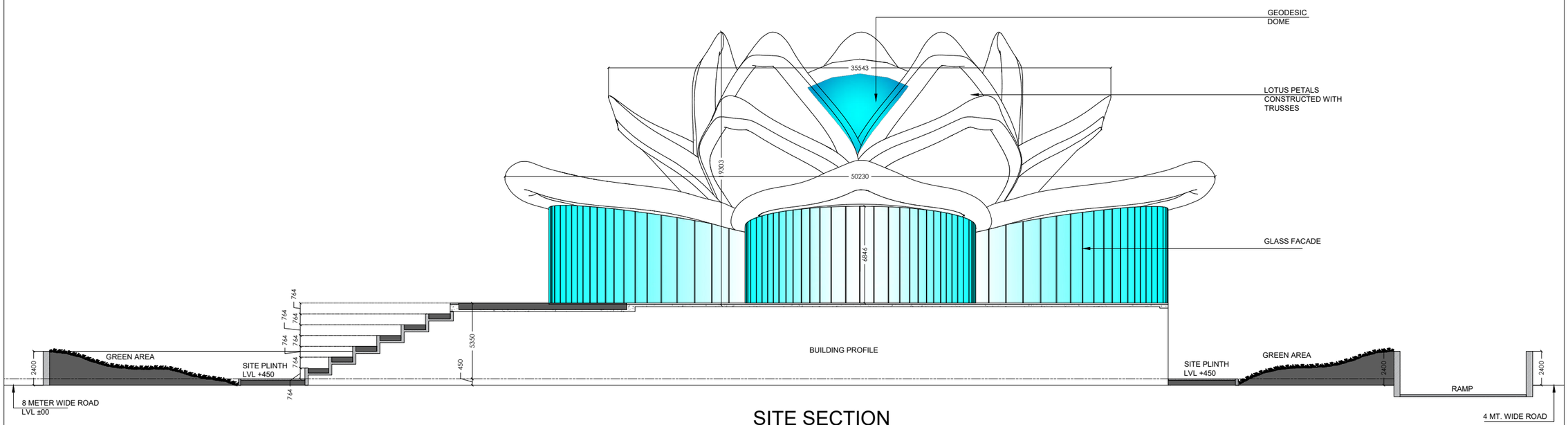
SITE PLAN

Scale	Date	Rev.no.
1: 300	11-05-22	R-00

Drg. no.
LUMB_AR_P_00

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



SITE SECTION

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

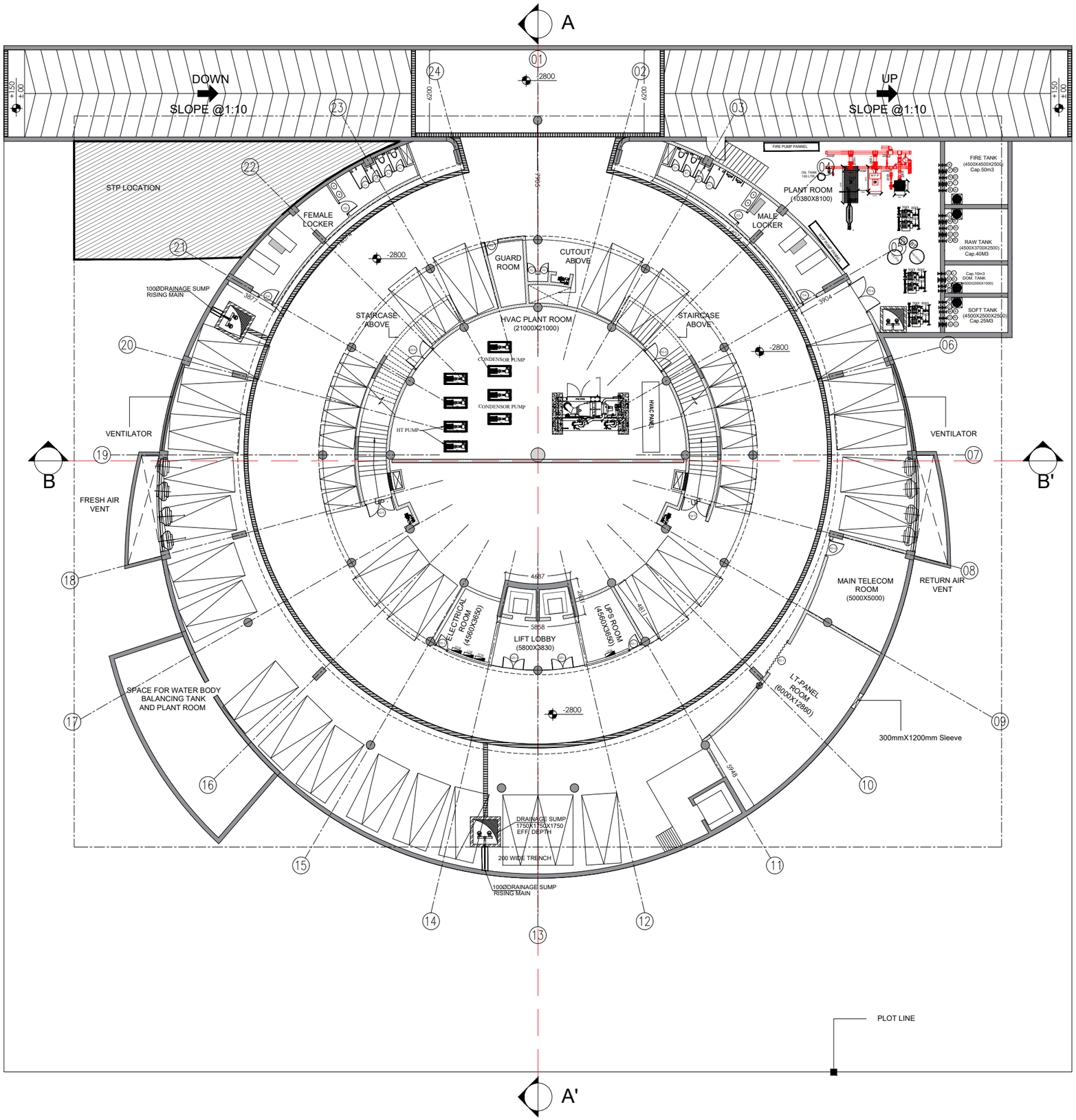
SITE SECTION

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_AR_S_00

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

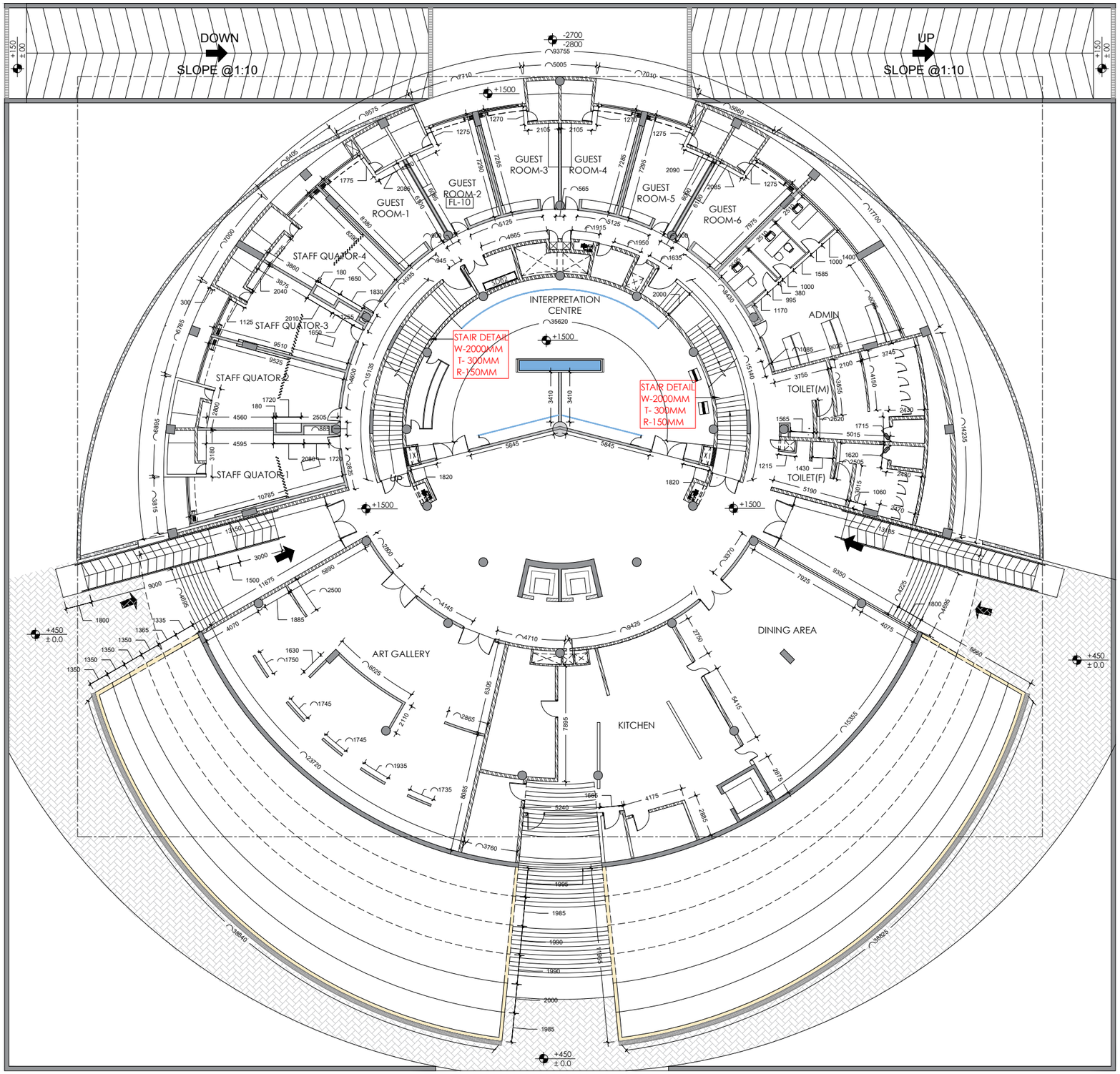
BASEMENT FLOOR PLAN

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_AR_P_01

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



GROUND FLOOR

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

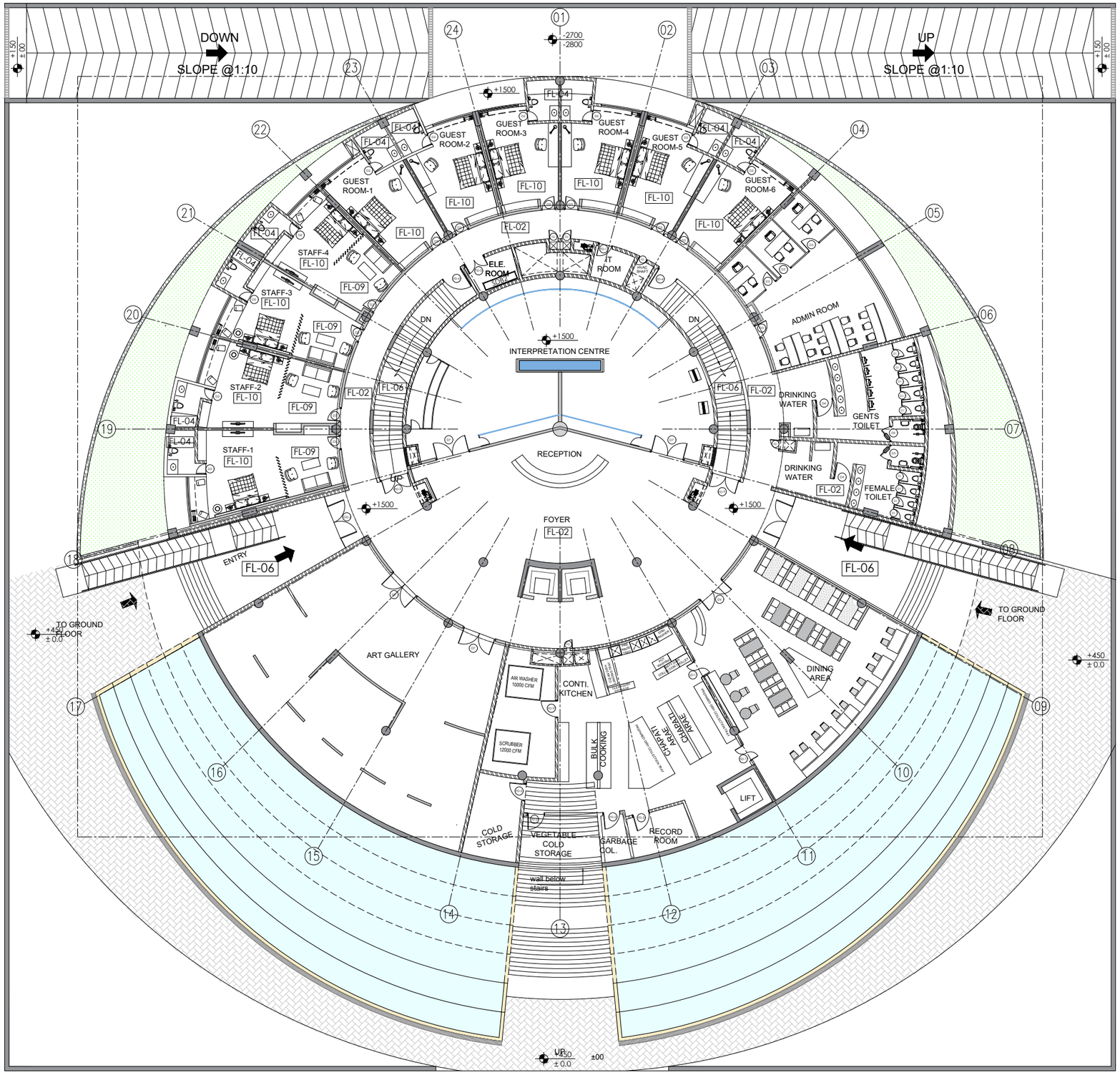
DRG. TITLE :

SITE PLAN

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_AR_P_02

ISSUED FOR:



GROUND FLOOR

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

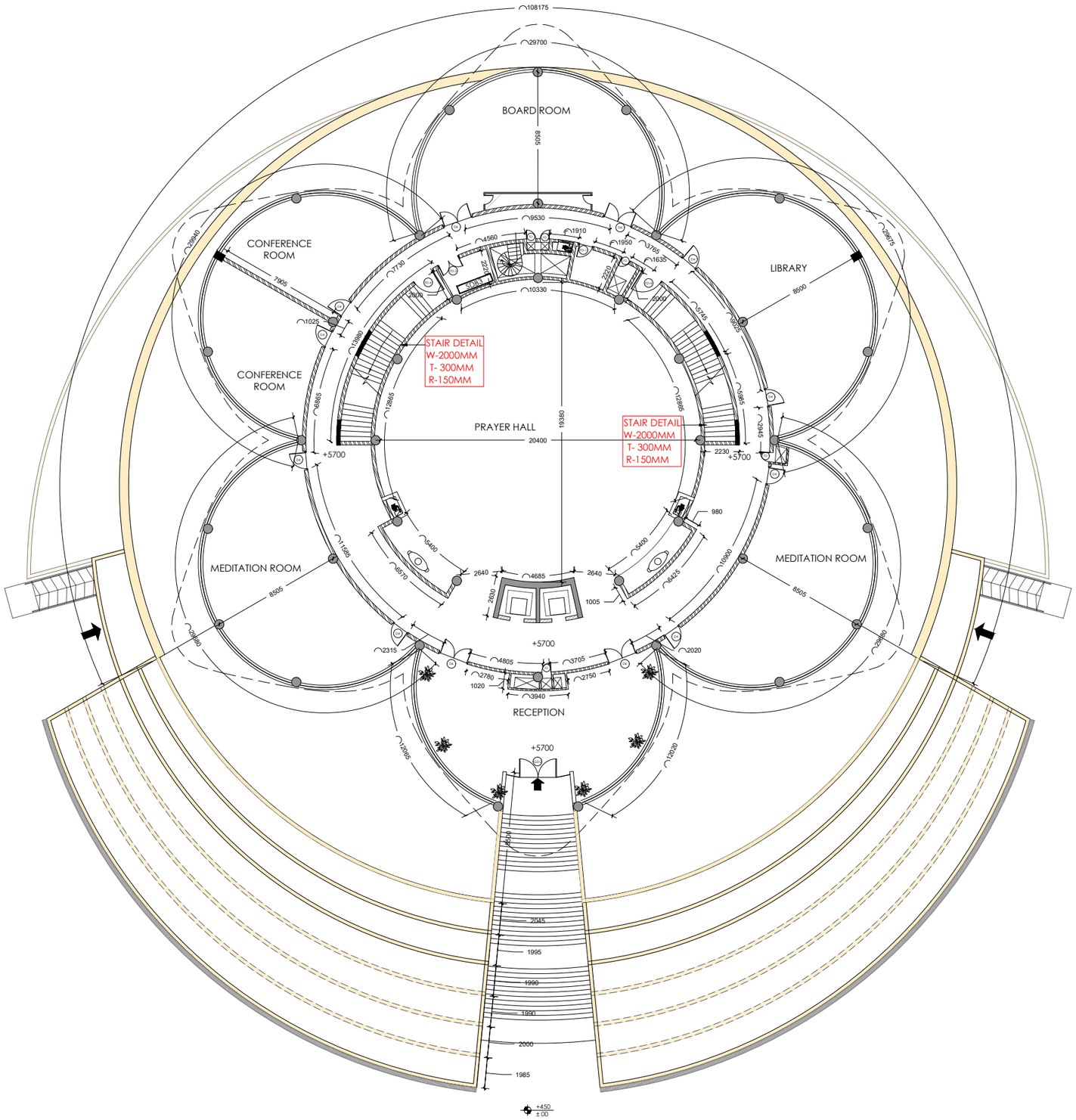
DRG. TITLE :

SITE PLAN

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_AR_FURNITURE_P_02

ISSUED FOR:



NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

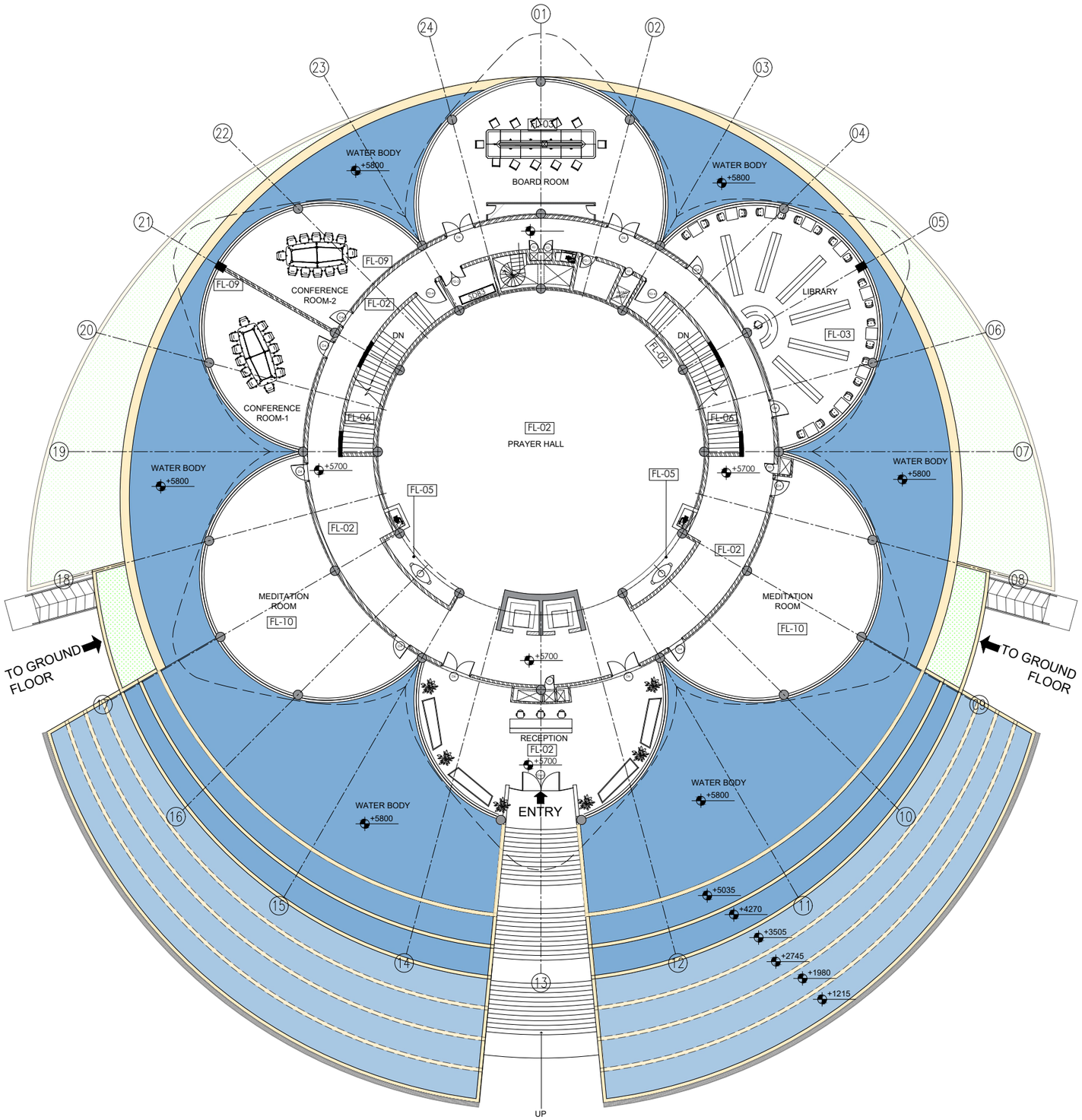
FIRST FLOOR PLAN

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_AR_P_03

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

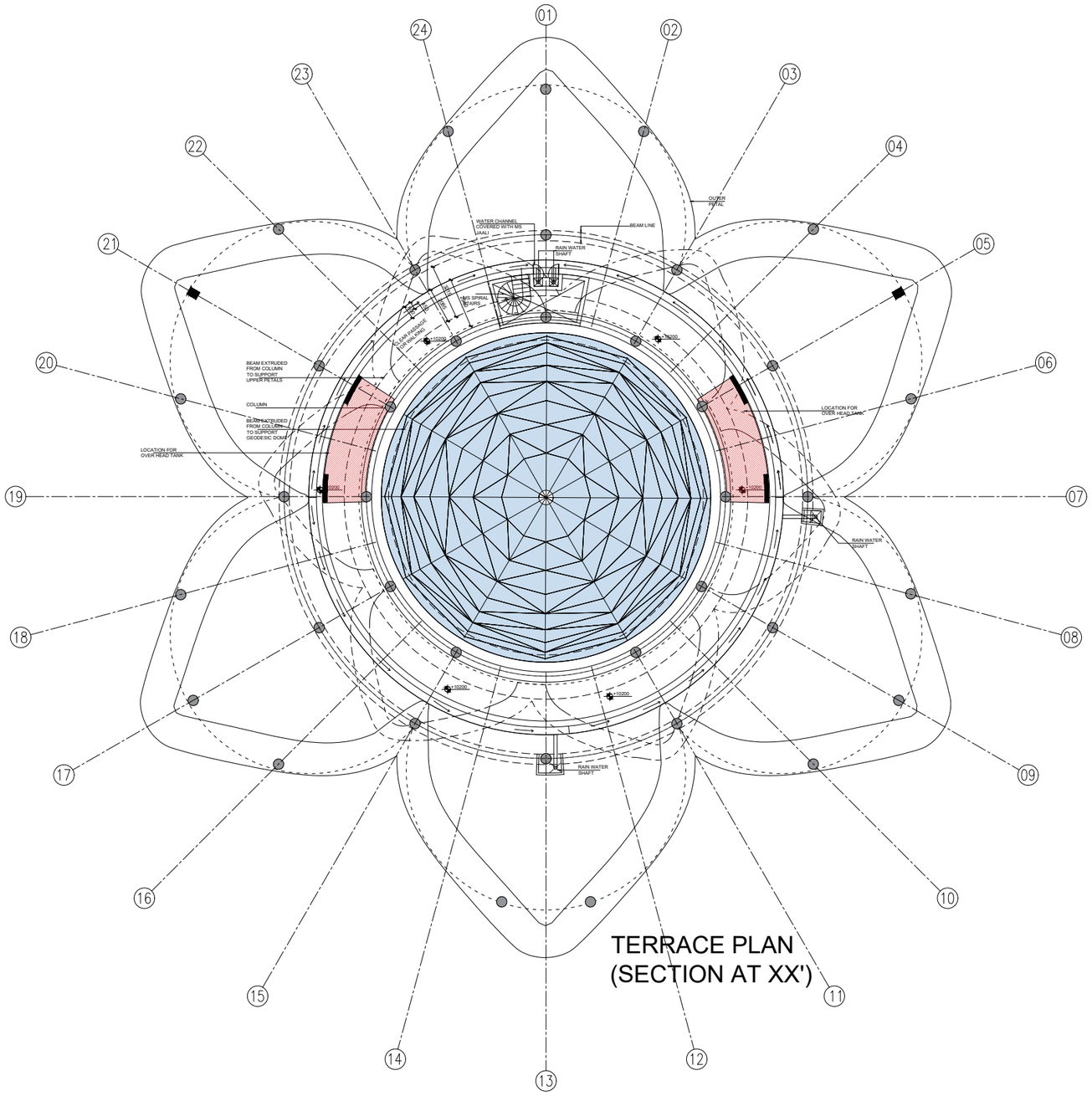
FIRST FLOOR FURNITURE LAYOUT & FLOOR FINISH

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_AR_FURNITURE_P_03

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



TERRACE PLAN
(SECTION AT XX')

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

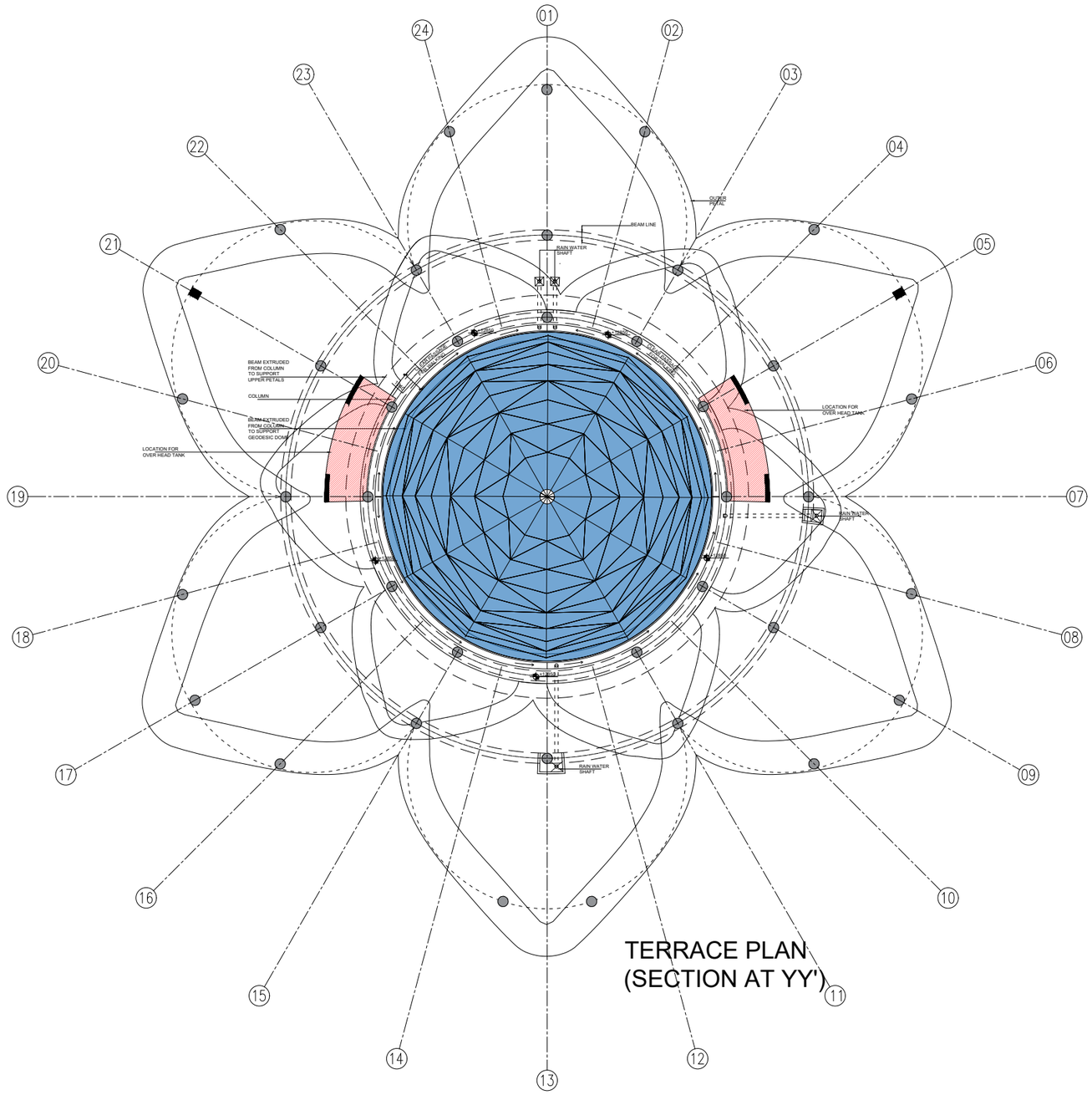
TERRACE PLAN LOWER LEAF LVL.

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_AR_P_04

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



TERRACE PLAN
(SECTION AT YY')

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

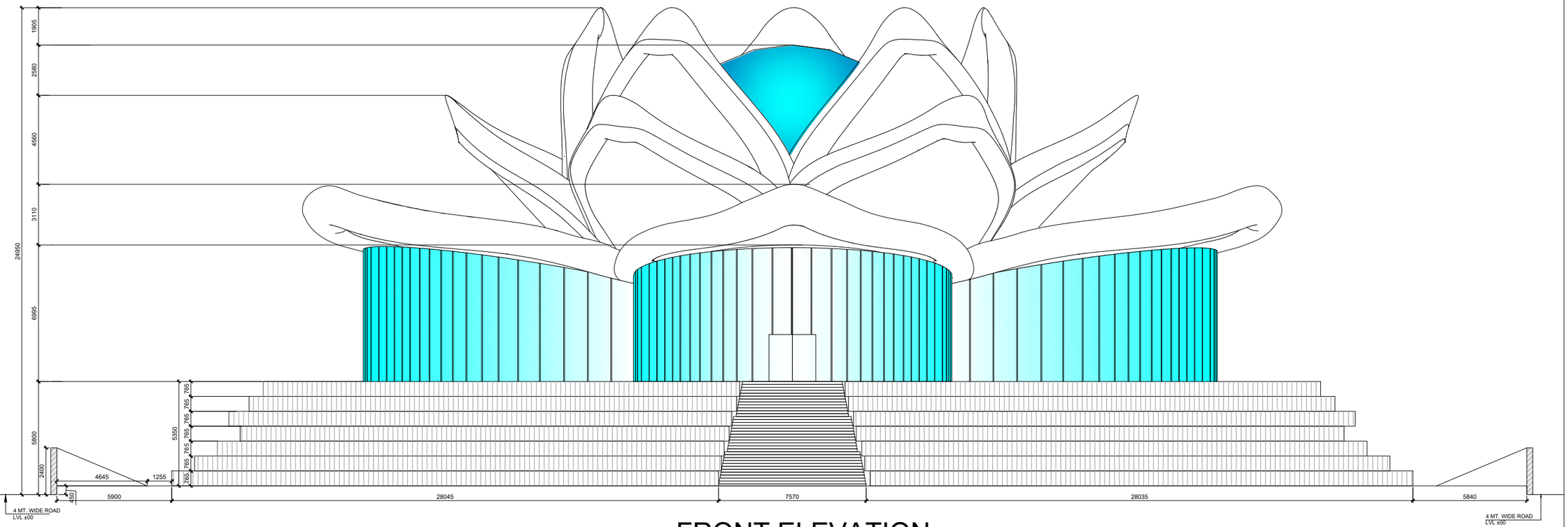
TERRACE PLAN AT UPPER LEAF & DOME LVL.

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_AR_P_05

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



FRONT ELEVATION

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

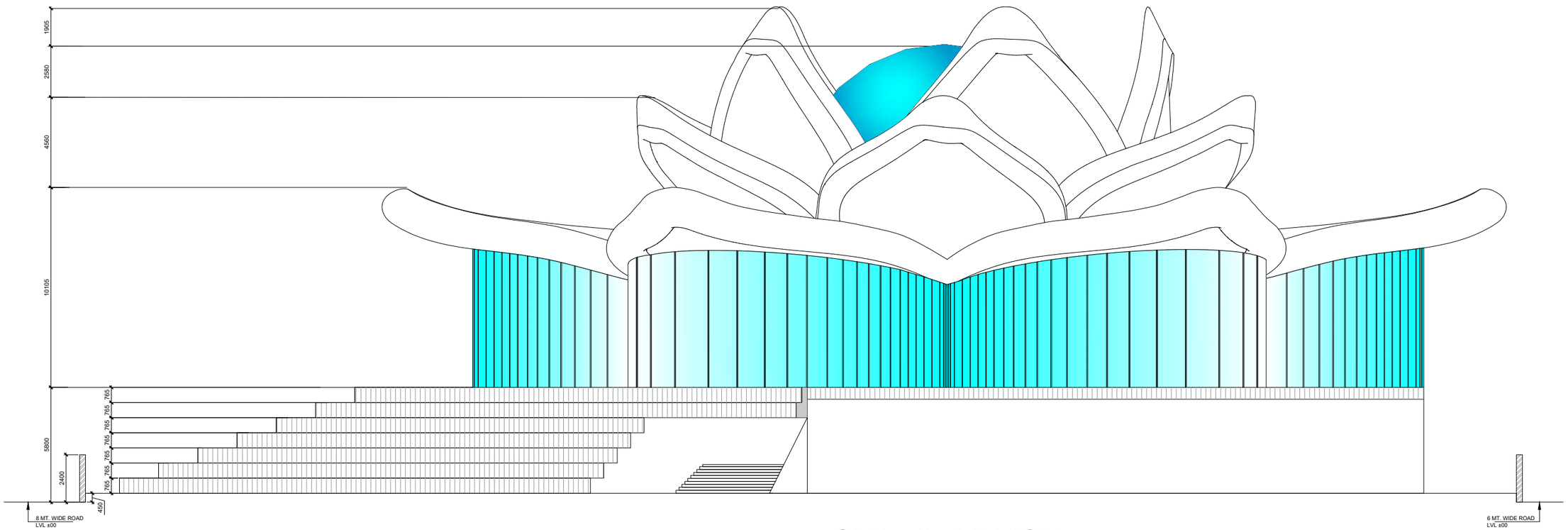
FRONT ELEVATION

Scale	Date	Rev.no.
1: 200	01-05-22	R-00

Drg. no.
LUMB_AR_E_01

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



SIDE ELEVATION

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

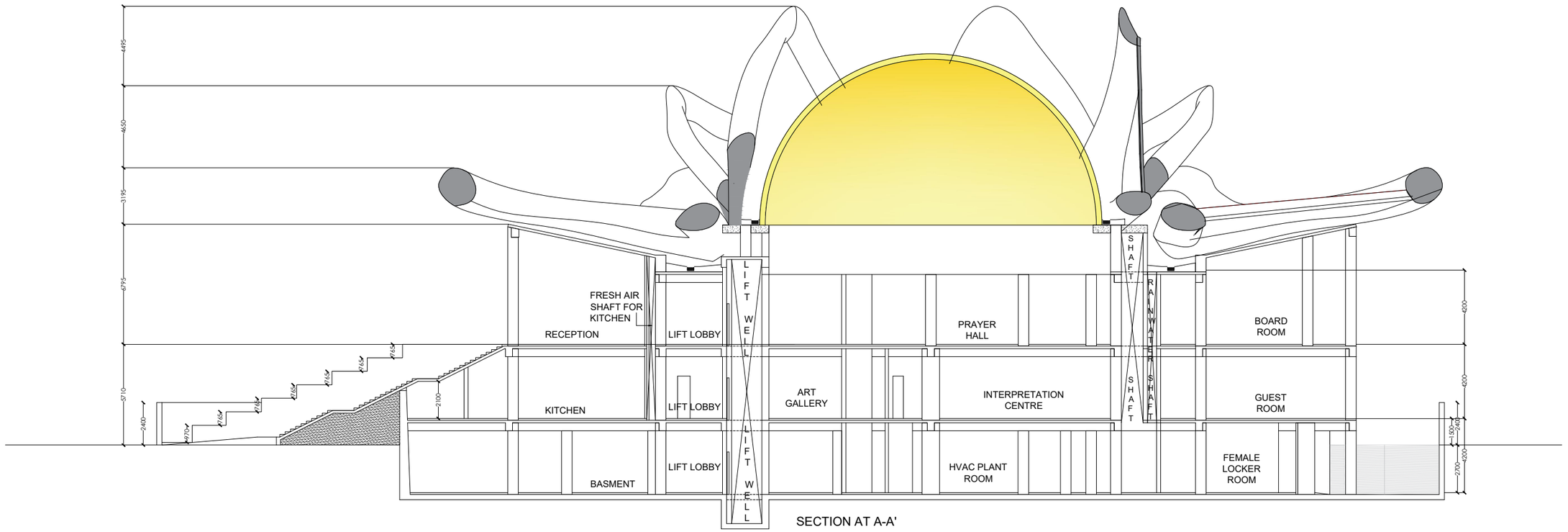
SIDE ELEVATION

Scale	Date	Rev.no.
1: 200	01-05-22	R-00

Drg. no.
LUMB_AR_E_02

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



SECTION AT A-A'

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

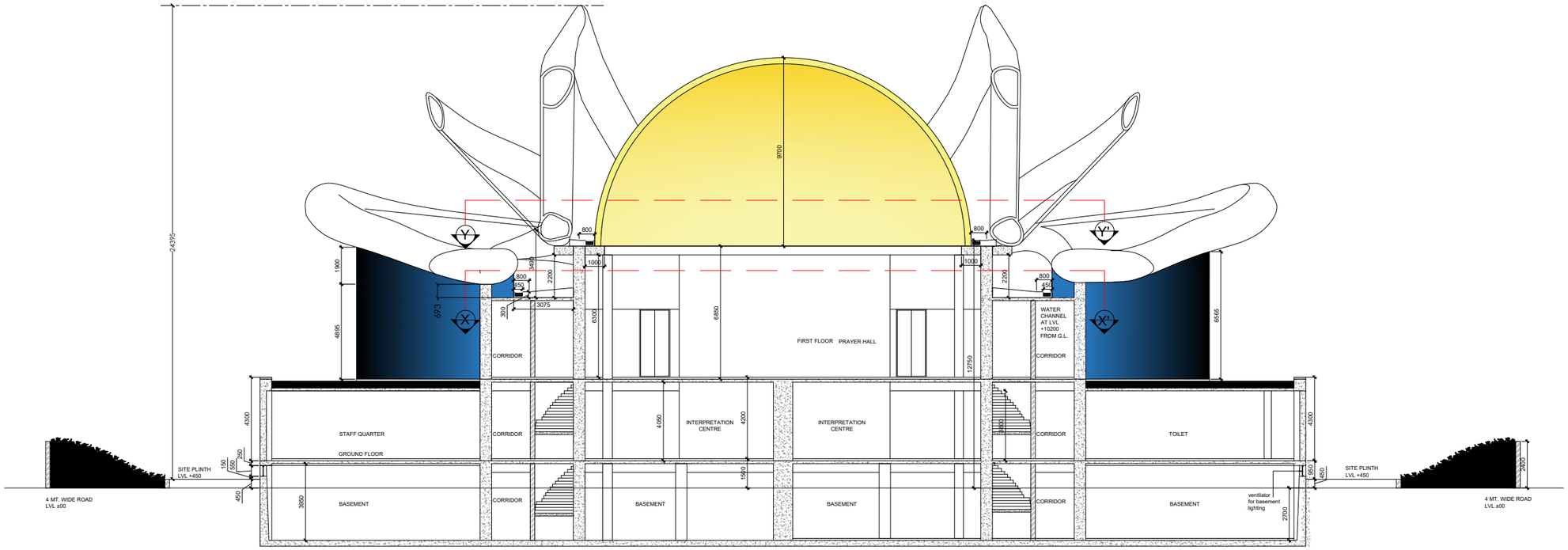
SECTION AT AA'

Scale	Date	Rev.no.
1: 250	01-05-22	R-00

Drg. no.
LUMB_AR_S_01

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



SECTION AT B-B'

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

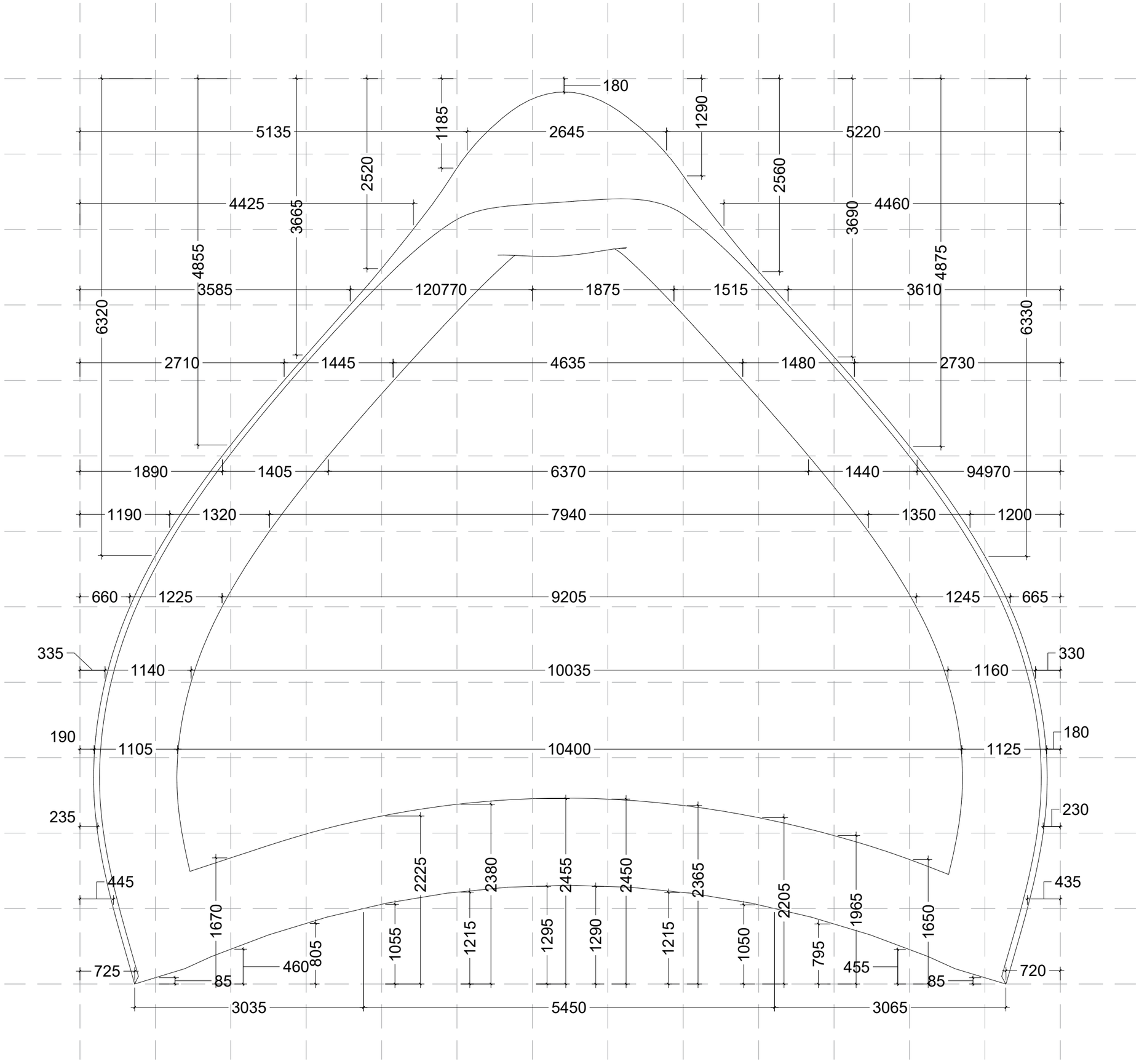
SECTION AT BB'

Scale	Date	Rev.no.
1: 250	01-05-22	R-00

Drg. no.
LUMB_AR_S_02

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

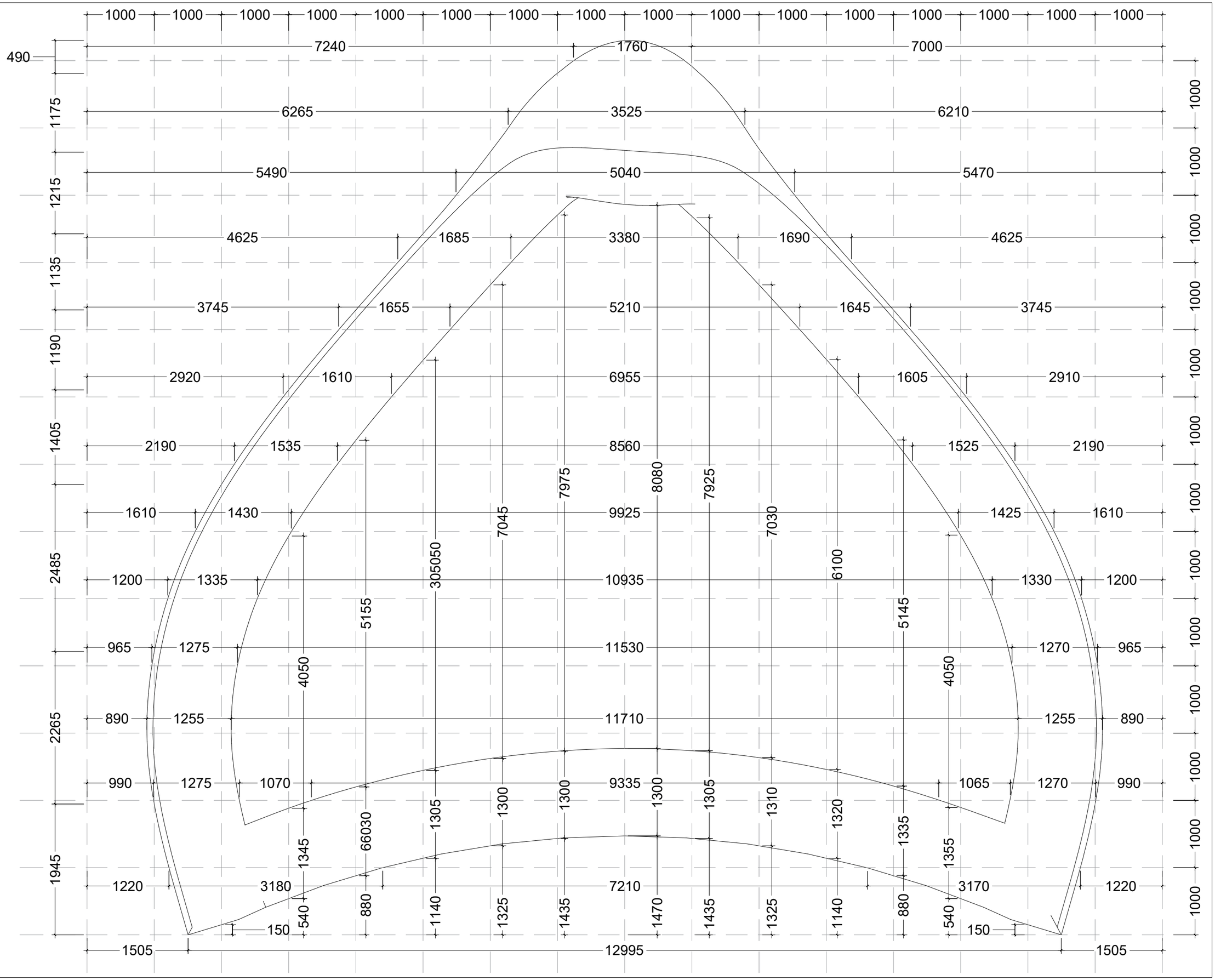
MIDDLE LEAF PLAN

Scale	Date	Rev.no.
1: 50	01-05-22	R-00

Drg. no.
LUMB_AR_P_03

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

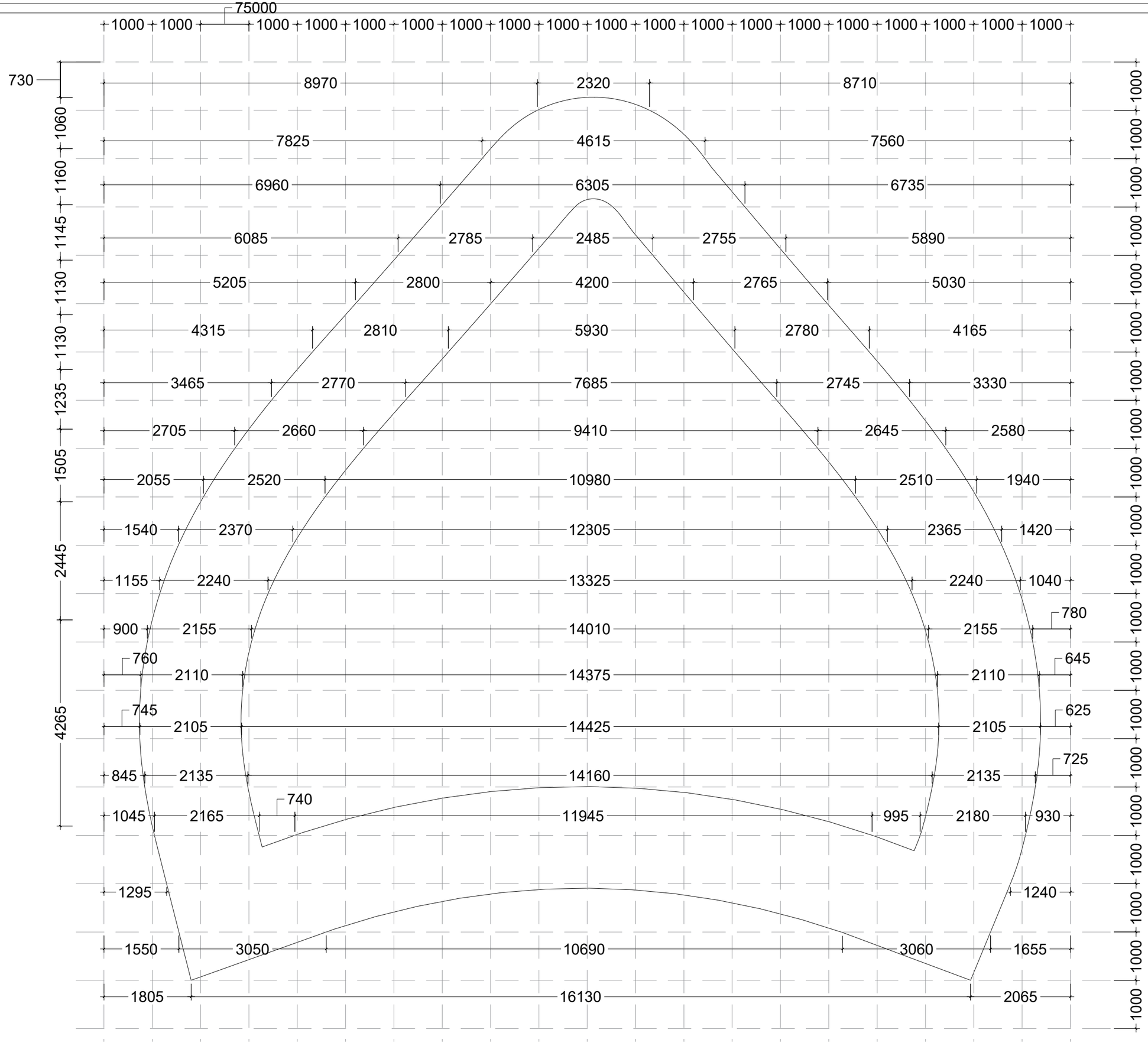
INNER LEAF PLAN

Scale	Date	Rev.no.
1: 50	01-05-22	R-00

Drg. no.
LUMB_AR_P_03

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

OUTER LEAF PLAN

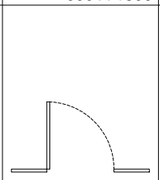
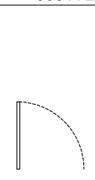
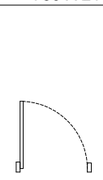
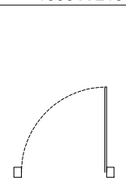
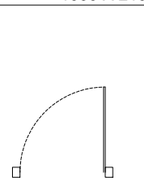
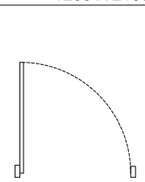
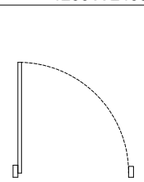
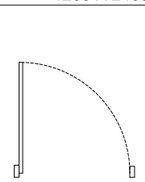
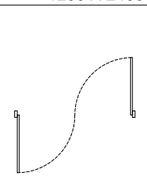
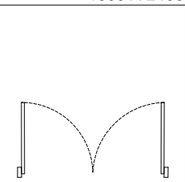
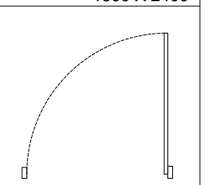
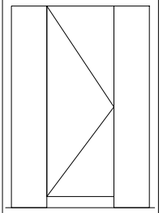
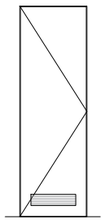
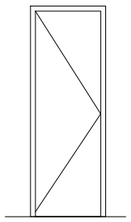
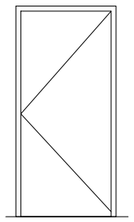
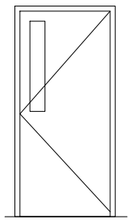
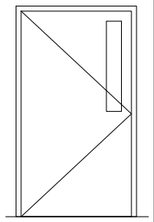
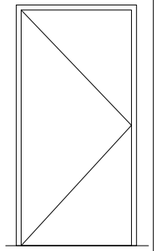
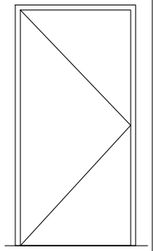
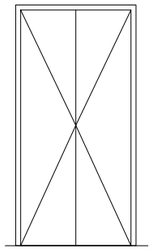
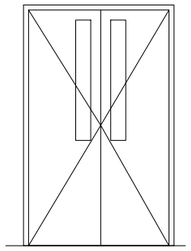
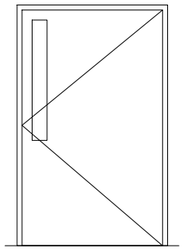
Scale	Date	Rev.no.
1: 300	01-05-22	R-00

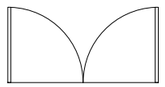
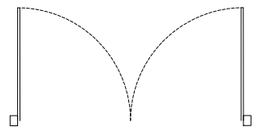
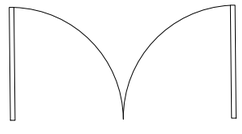
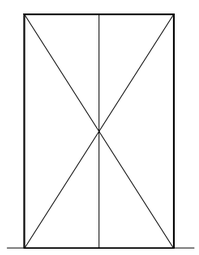
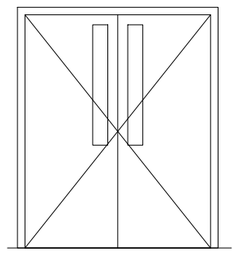
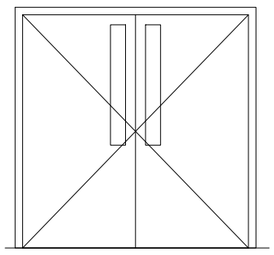
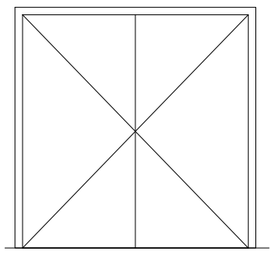
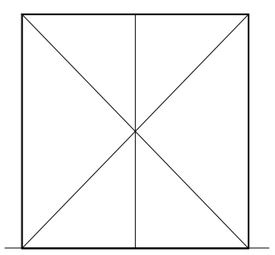
Drg. no.
LUMB_AR_P_03

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE

DOOR WINDOW SCHEDULE

ELEMENT ID	D1	FD	D2	D3	FD1	FD2	D3	D4	SD1	FD3	FD4
TYPE	WOODEN FLUSH DOOR	METAL WITH VENT LOUVERS	WOODEN FLUSH DOOR	WOODEN FLUSH DOOR	WOODEN FLUSH DOOR WITH VISION PANEL	WOODEN FLUSH DOOR	WOODEN FLUSH DOOR	WOODEN FLUSH DOOR	WOODEN FLUSH DOOR	WOODEN FLUSH DOOR WITH VISION PANEL	WOODEN FLUSH DOOR WITH VISION PANEL
QUANTITY	19	10	10	13	4	6	8	2	2	2	4
W X H SIZE	600 X 1800	600 X 2100	750 X 2100	1000 X 2100	1000 X 2100	1200 X 2100	1200 X 2400	1200 X 2400	1200 X 2400	1500 X 2400	1500 X 2400
2D SYMBOL											
FIRE RATING	—	1 HOUR	—	—	2 HOUR	1 HOUR			2 HOUR	2 HOUR	2 HOUR
LOCATION	TOILET CUBICLE	PLUMBING SHAFT	GUEST BATH, STAFF QUARTER BATH	GUEST BEDROOM, STAFF QUARTER BEDROOM, STAFF LOCKER TOILET,GUARD ROOM	IT ROOM, ELECTRICAL ROOM	MAIN TELECOM ROOM	MEDITATION ROOM, CONFERENCE ROOM,LIBRARY	MALE TOILET, FEMALE TOILET	KITCHEN SERVICE ENTRY	ELECTRICAL ROOM	FIRE STAIRCASE
ELEVATION											

ELEMENT ID	GD2	FD5	FD6	D5	GD2
TYPE	FRAME LESS GLASS DOOR WITH PATCH FITTING	WOODEN FLUSH DOOR WITH VISION PANEL	WOODEN FLUSH DOOR WITH VISION PANEL	WOODEN FLUSH DOOR WITH VISION PANEL	FRAME LESS GLASS DOOR WITH PATCH FITTING
QUANTITY	2	6	1	4	3
W X H SIZE	1500 X 2400	2000 X 2400	2400 X 2400	2400 X 2400	2400 X 2400
2D SYMBOL					
FIRE RATING		2 HOUR	2 HOUR	—	—
LOCATION	BASEMENT LIFT LOBBY	FIRE STAIRCASE, HVAC PLANT ROOM	PLANT ROOM	INTERPRETATION CENTRE, ART GALLERY	INTERPRETATION CENTRE, ART GALLERY
ELEVATION					

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

DOOR WINDOW SCHEDULE

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

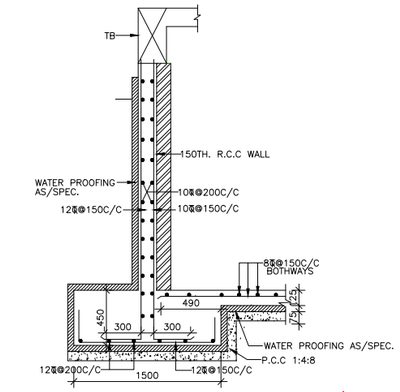
Drg. no.
LUMB_AR_P_03

ISSUED FOR:

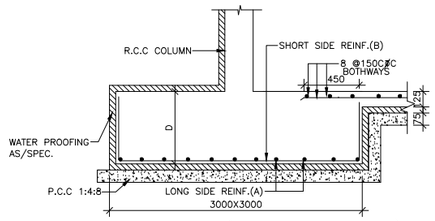
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE

SCHEDULE OF FOOTING			
FOOT MARK	CONC. DIMENSION		
	LONG SIDE (A)	SHORT SIDE (B)	DEPTH (D)
F-1	3000	3000	600
F-2	3000	3000	600
F-3	5000	5000	1000
CF-1	7105	3000	600
CF-2	7810	3000	600
CF-3	8310	4670	1600
CF-4	7810	3000	600
CF-5	5080	5060	1600

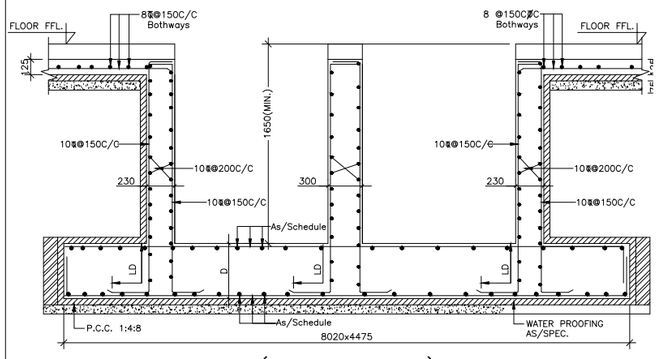
SCHEDULE OF COLUMN	
COLUMN MARK	COLUMN DIMENSION(mm)
C-1	600X600
C-2	1985X450
C-3	1000X400
C-4	600ø
C-5	1600X230
C-6	1000ø



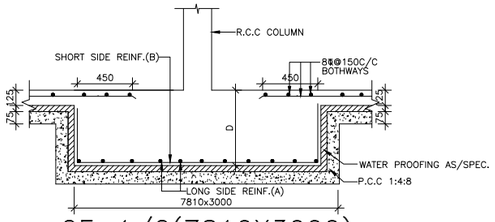
RETAINING WALL–SECTION(A–A')



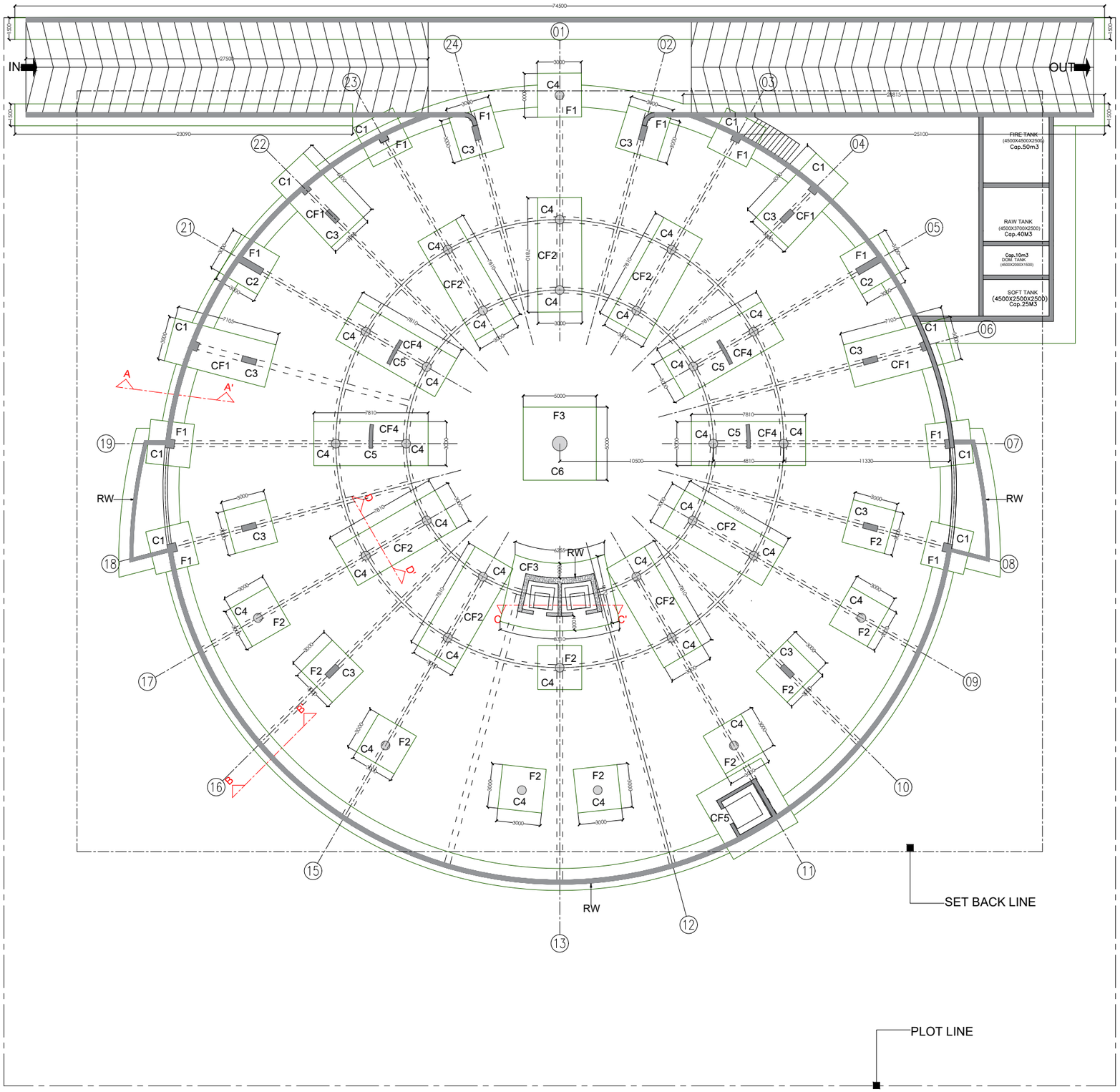
FOOTING–1(3000X3000)
SECTION(B–B')



CF3(8020x4475)
SECTION(C–C')



CF–1/2(7810X3000)
SECTION(D–D')



NOTES:

THIS DRAWING IS THE PROPERTY OF THE ARCHITECTS AND IS NOT TO BE COPIED OR USED WITHOUT THEIR PERMISSION.

ALL DIMENSION ARE IN **mm** AND TO BE CHECKED AND CO RELATED WITH STRUCTURAL AND OTHER CONSULTANTS DRAWINGS AND ANY

SHALL BE IMMEDIATELY BROUGHT TO THE NOTICE OF THE ARCHITECT BEFORE COMMENCEMENT OF THE WORK.

ALL STRUCTURAL MEMBER SIZES AND LOCATIONS ARE TO BE

ACCORDING TO THE STRUCTURAL DRAWINGS.

DO NOT SCALE DRAWINGS. FOLLOW WRITTEN DIMENSIONS ONLY.

ALL DIMENSIONS ARE UNFINISHED DIMENSIONS UNLESS OTHERWISE MENTIONED.

ALL LEVELS ARE FROM THE DATUM LEVEL ± 00 LVL.

ANY DISCREPANCY SHOULD BE BROUGHT TO THE NOTICE OF THE ARCHITECT IMMEDIATELY.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

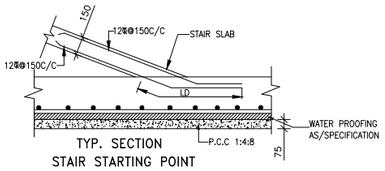
DRG. TITLE :

FOUNDATION PLAN

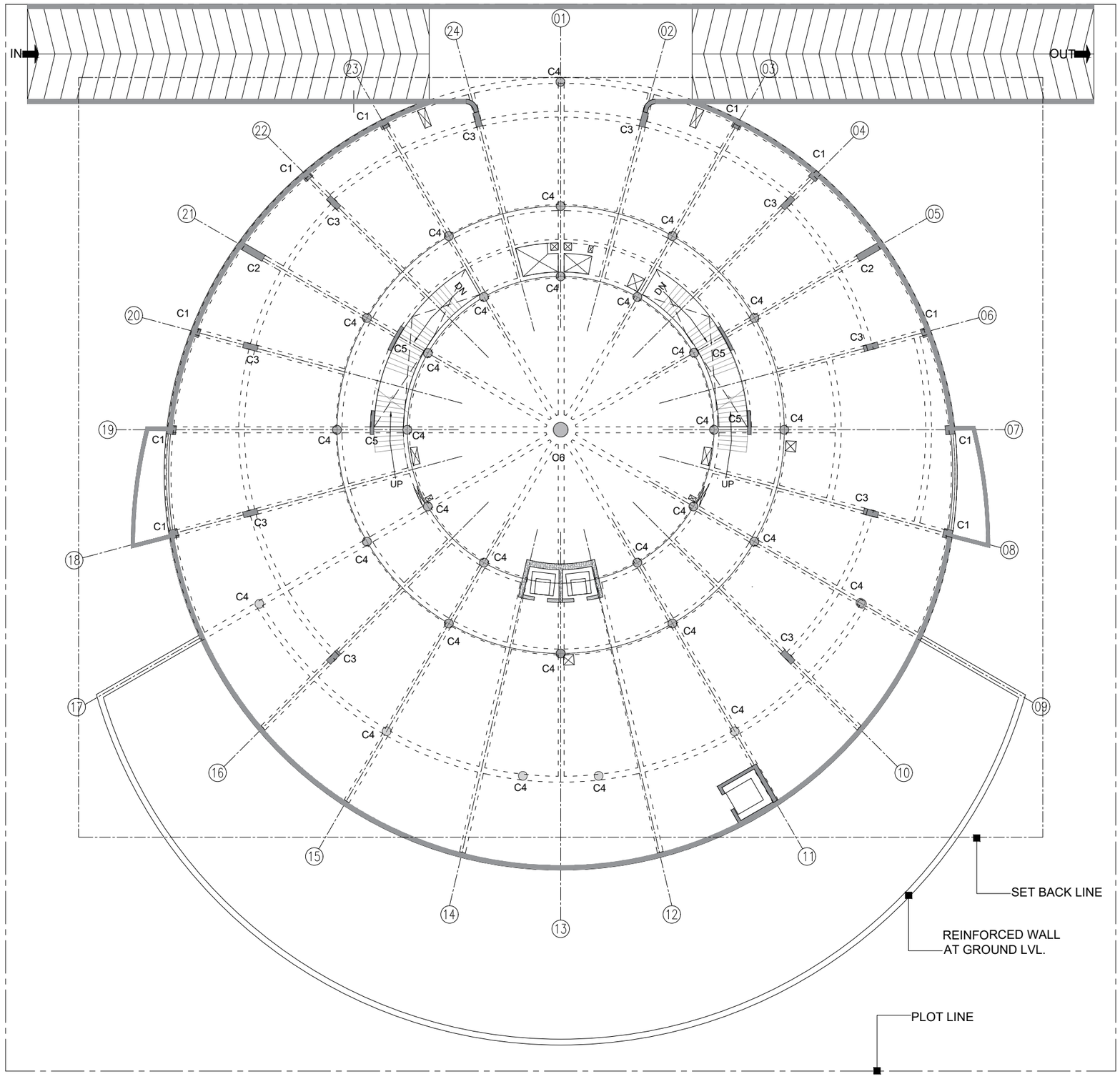
Scale	Date	Rev.no.
1: 300	01-05-22	R-00
	Drg. no.	
	LUMB_ST_P_00	

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



TYP. SECTION
STAIR STARTING POINT



NOTES:

THIS DRAWING IS THE PROPERTY OF THE ARCHITECTS AND IS NOT TO BE COPIED OR USED WITHOUT THEIR PERMISSION.

ALL DIMENSION ARE IN **mm** AND TO BE CHECKED AND CO RELATED WITH STRUCTURAL AND OTHER CONSULTANTS DRAWINGS AND ANY

SHALL BE IMMEDIATELY BROUGHT TO THE NOTICE OF THE ARCHITECT BEFORE COMMENCEMENT OF THE WORK.

ALL STRUCTURAL MEMBER SIZES AND LOCATIONS ARE TO BE

ACCORDING TO THE STRUCTURAL DRAWINGS.

DO NOT SCALE DRAWINGS. FOLLOW WRITTEN DIMENSIONS ONLY.

ALL DIMENSIONS ARE UNFINISHED DIMENSIONS UNLESS OTHERWISE MENTIONED.

ALL LEVELS ARE FROM THE DATUM LEVEL ± 00 LVL.

ANY DISCREPANCY SHOULD BE BROUGHT TO THE NOTICE OF THE ARCHITECT IMMEDIATELY.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

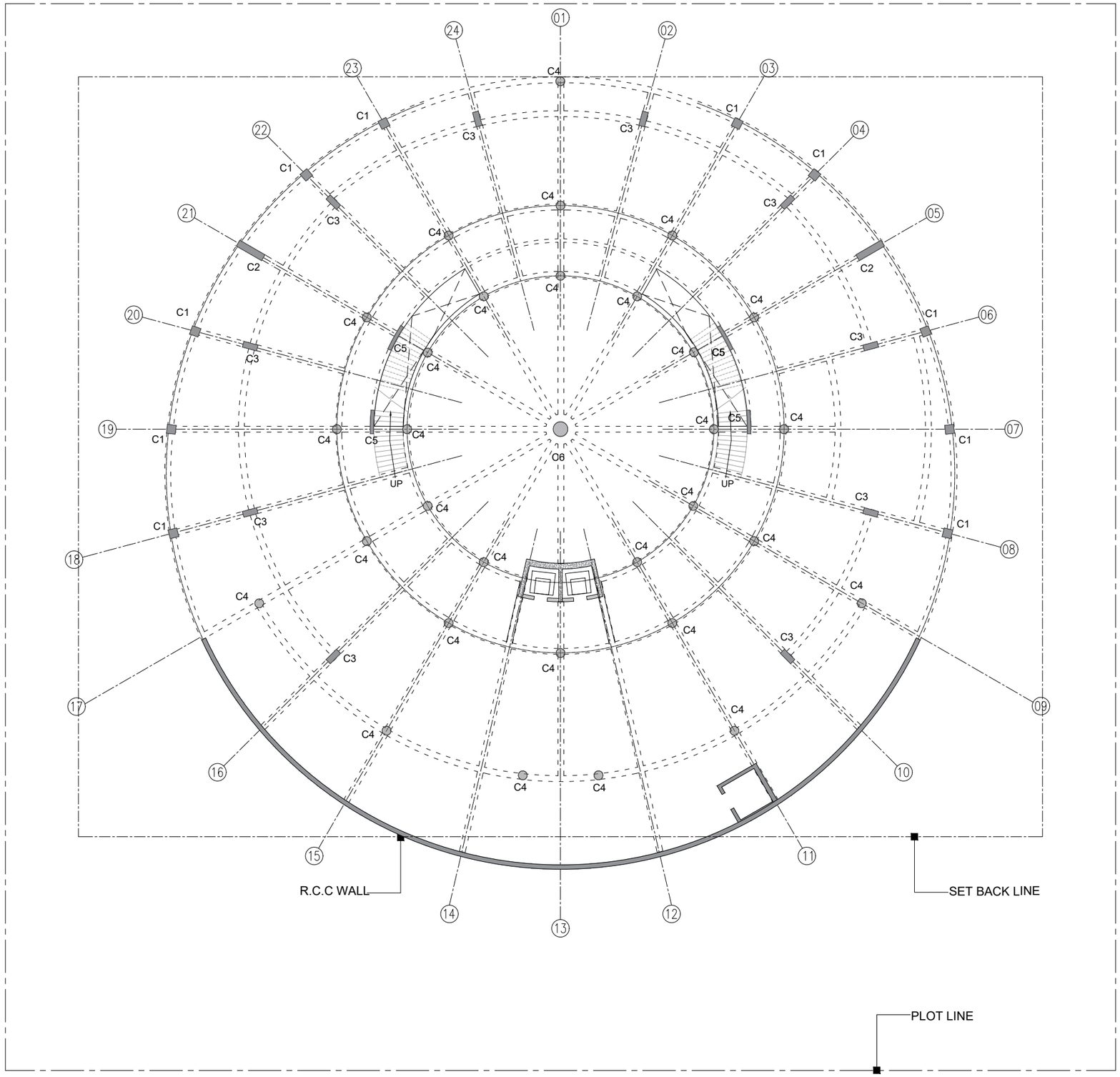
BASEMENT BEAM PLAN

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_ST_P_01

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

THIS DRAWING IS THE PROPERTY OF THE ARCHITECTS AND IS NOT TO BE COPIED OR USED WITHOUT THEIR PERMISSION.

ALL DIMENSION ARE IN **mm** AND TO BE CHECKED AND CO RELATED WITH STRUCTURAL AND OTHER CONSULTANTS DRAWINGS AND ANY

SHALL BE IMMEDIATELY BROUGHT TO THE NOTICE OF THE ARCHITECT BEFORE COMMENCEMENT OF THE WORK.

ALL STRUCTURAL MEMBER SIZES AND LOCATIONS ARE TO BE

ACCORDING TO THE STRUCTURAL DRAWINGS.

DO NOT SCALE DRAWINGS. FOLLOW WRITTEN DIMENSIONS ONLY.

ALL DIMENSIONS ARE UNFINISHED DIMENSIONS UNLESS OTHERWISE MENTIONED.

ALL LEVELS ARE FROM THE DATUM LEVEL ± 00 LVL.

ANY DISCREPANCY SHOULD BE BROUGHT TO THE NOTICE OF THE ARCHITECT IMMEDIATELY.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

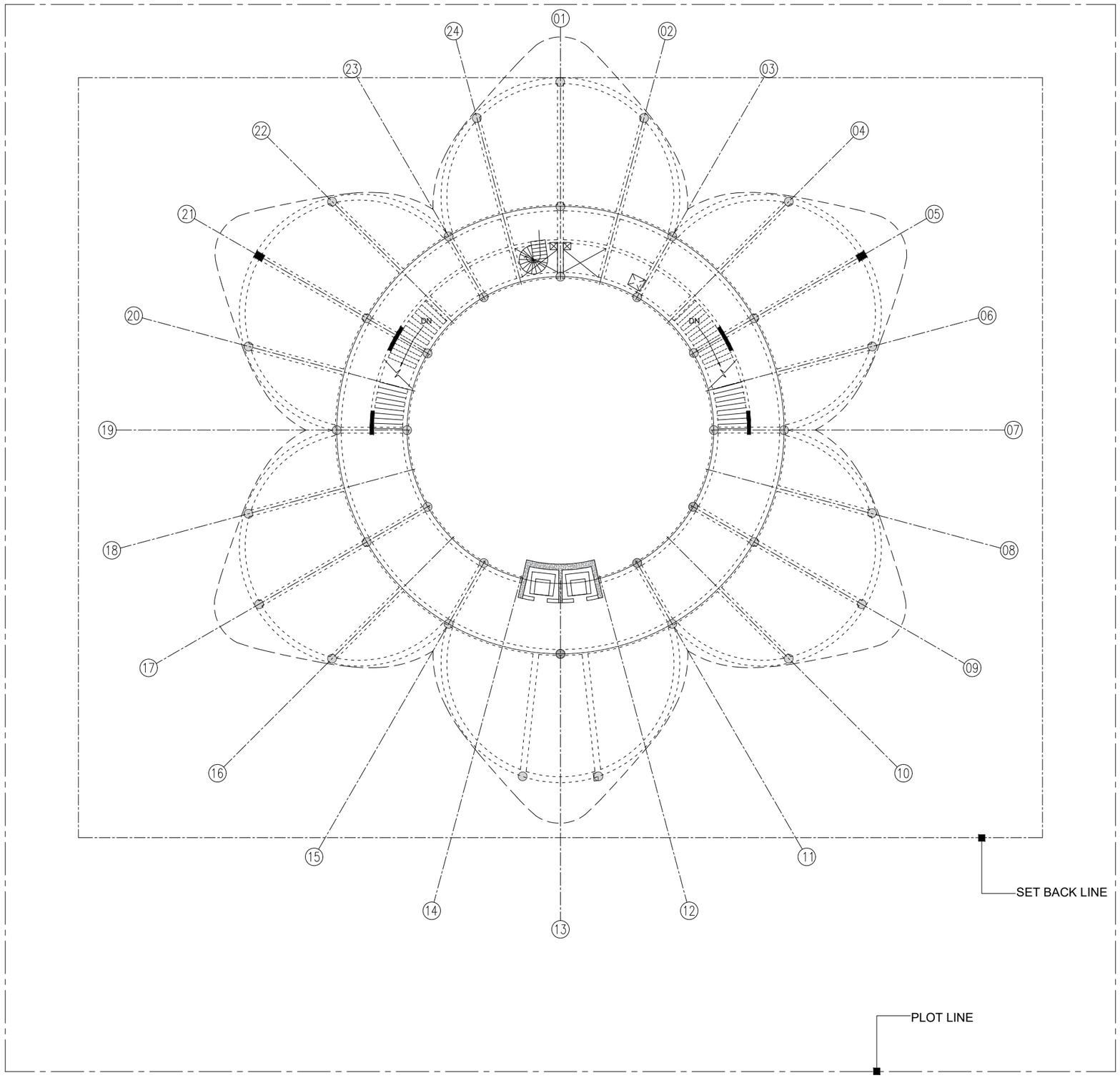
GROUND FLOOR BEAM PLAN

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB_ST_P_02

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

THIS DRAWING IS THE PROPERTY OF THE ARCHITECTS AND IS NOT TO BE COPIED OR USED WITHOUT THEIR PERMISSION.

ALL DIMENSION ARE IN **mm** AND TO BE CHECKED AND CO RELATED WITH STRUCTURAL AND OTHER CONSULTANTS DRAWINGS AND ANY

SHALL BE IMMEDIATELY BROUGHT TO THE NOTICE OF THE ARCHITECT BEFORE COMMENCEMENT OF THE WORK.

ALL STRUCTURAL MEMBER SIZES AND LOCATIONS ARE TO BE

ACCORDING TO THE STRUCTURAL DRAWINGS.

DO NOT SCALE DRAWINGS. FOLLOW WRITTEN DIMENSIONS ONLY.

ALL DIMENSIONS ARE UNFINISHED DIMENSIONS UNLESS OTHERWISE MENTIONED.

ALL LEVELS ARE FROM THE DATUM LEVEL ± 00 LVL.

ANY DISCREPANCY SHOULD BE BROUGHT TO THE NOTICE OF THE ARCHITECT IMMEDIATELY.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

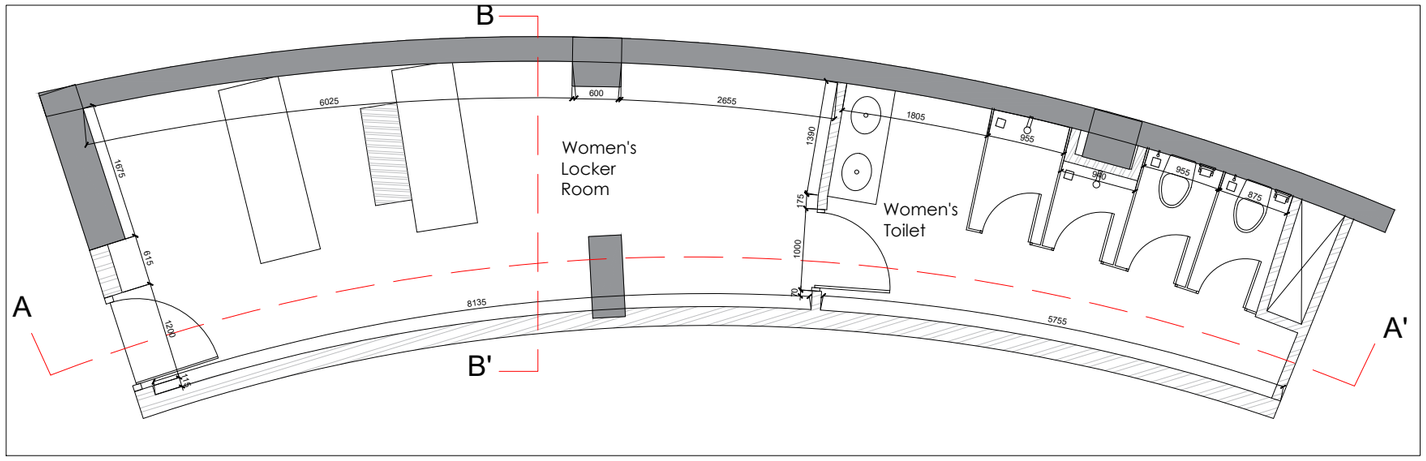
FIRST FLOOR BEAM PLAN

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

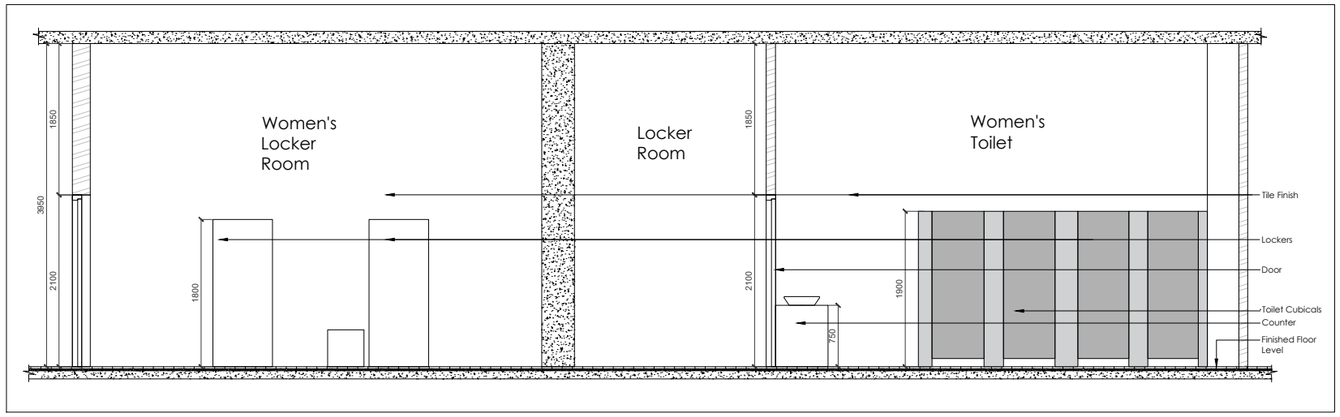
Drg. no.
LUMB_ST_P_03

ISSUED FOR:

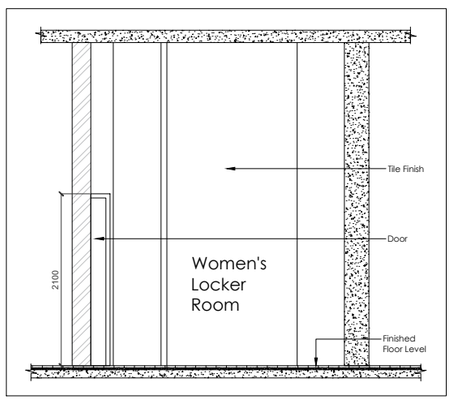
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



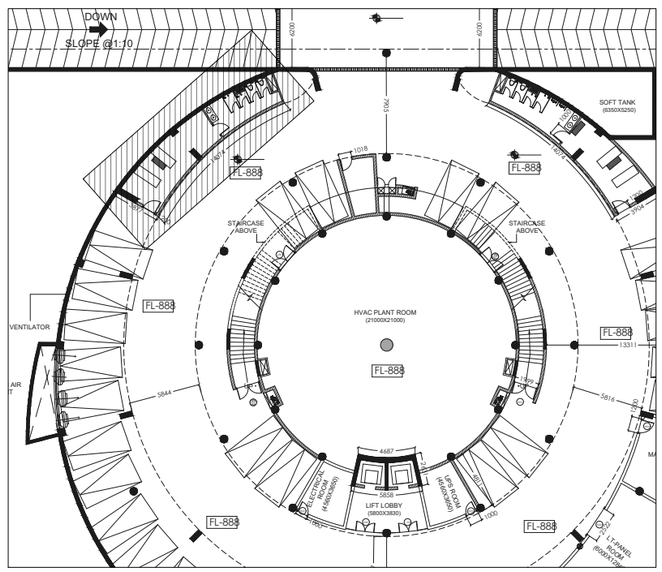
PLAN



SECTION-AA'



SECTION-BB'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

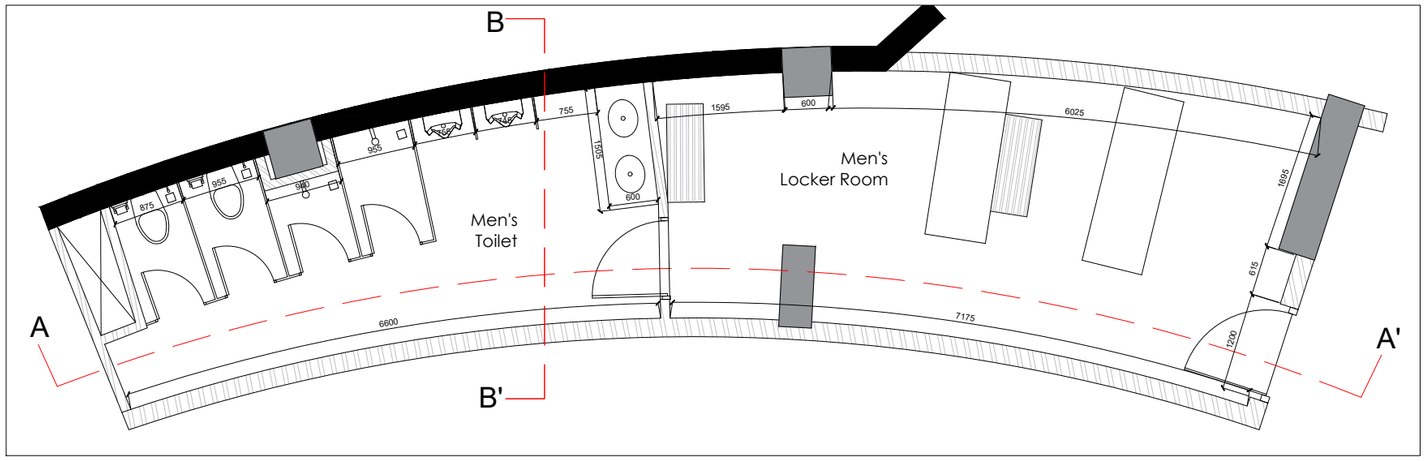
SECTIONS (FEMALE TOILET)-BASEMENT

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

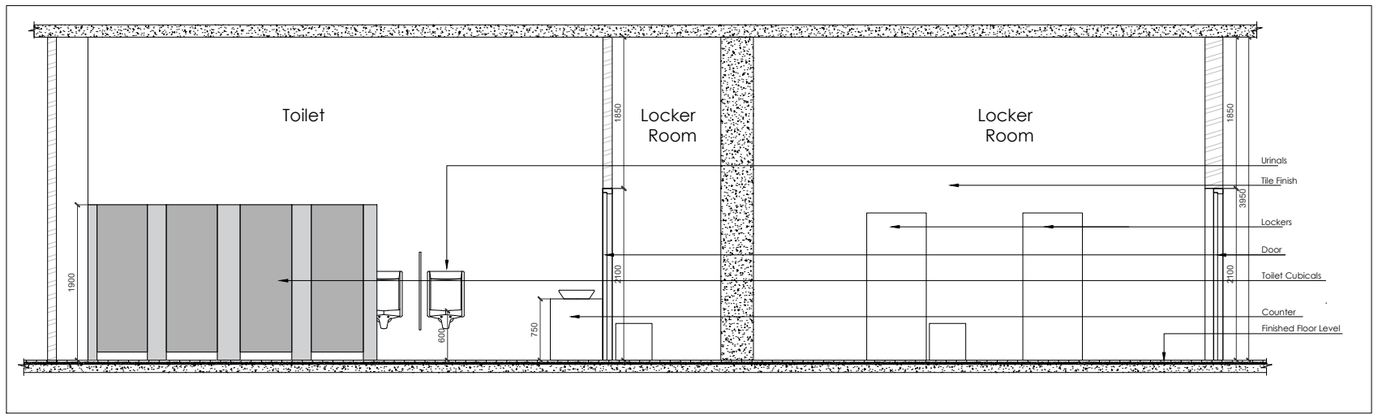
Drg. no.
LUMB-ID-BF-S-01

ISSUED FOR:

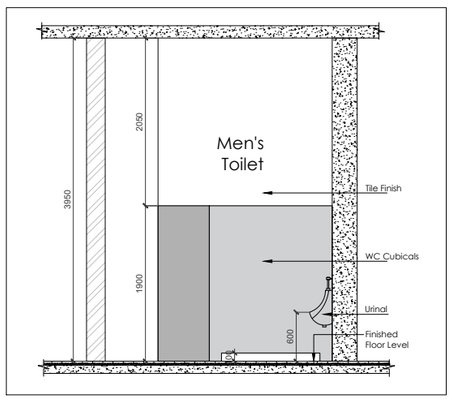
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



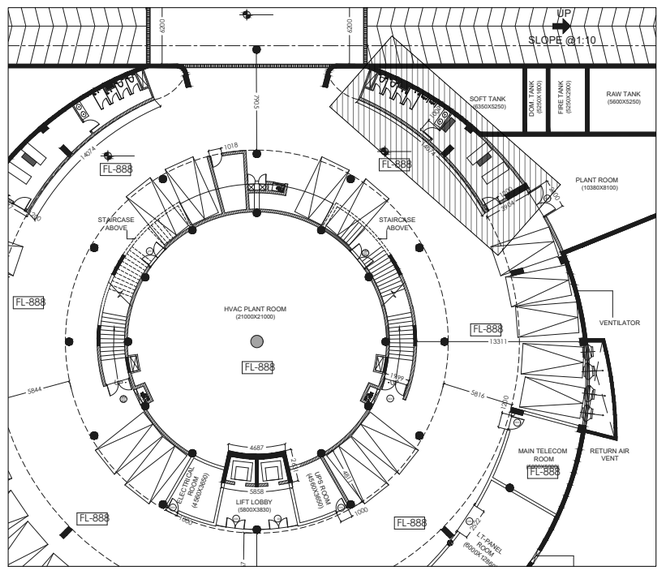
PLAN



SECTION-AA'



SECTION-BB'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

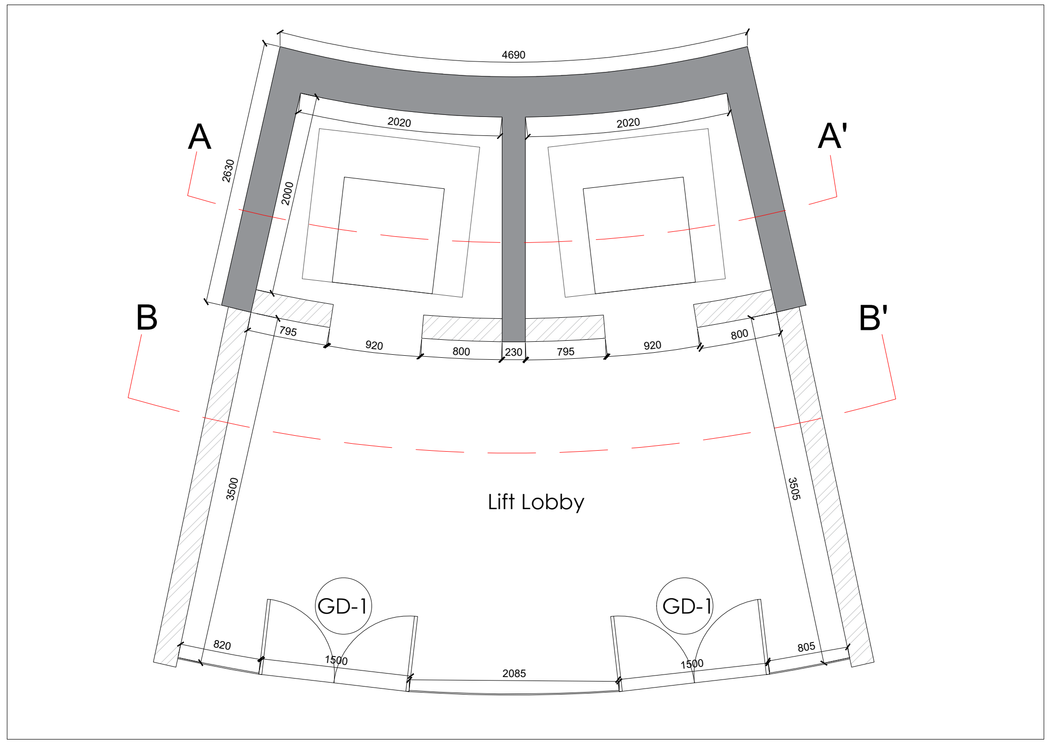
SECTIONS (MALE TOILET)-BASEMENT

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

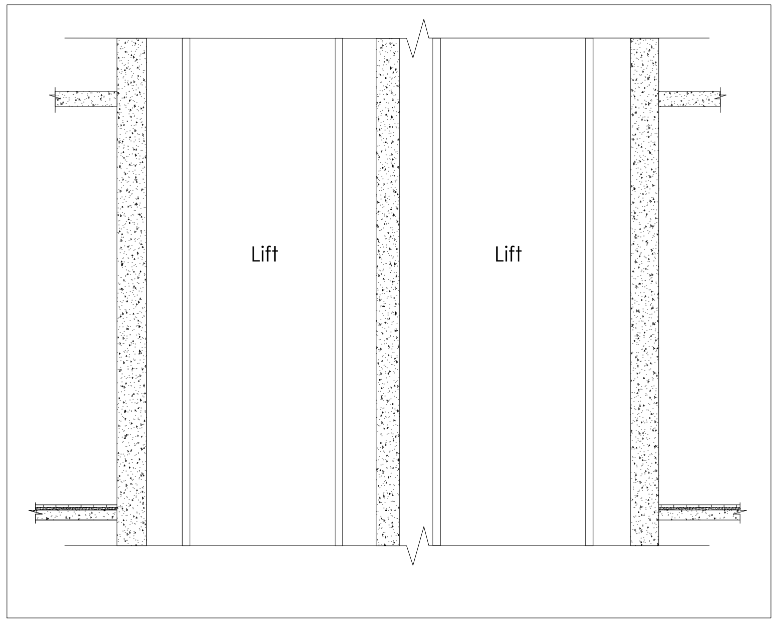
Drg. no.
LUMB-ID-BF-S-02

ISSUED FOR:

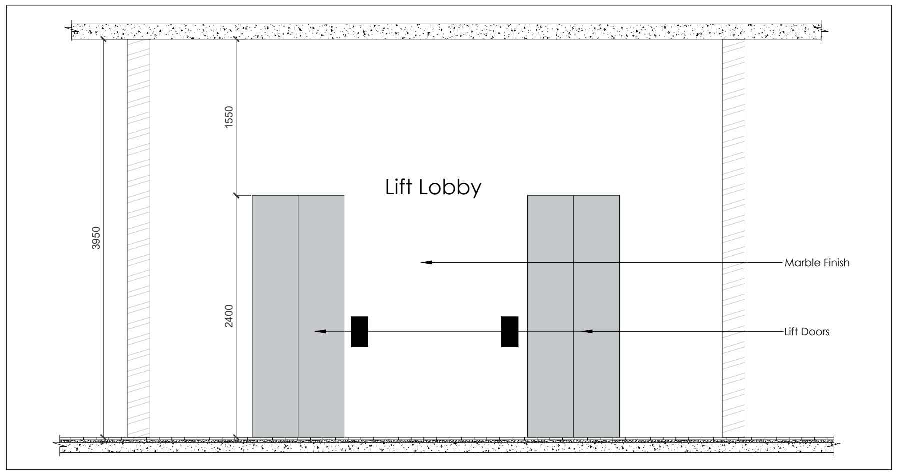
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



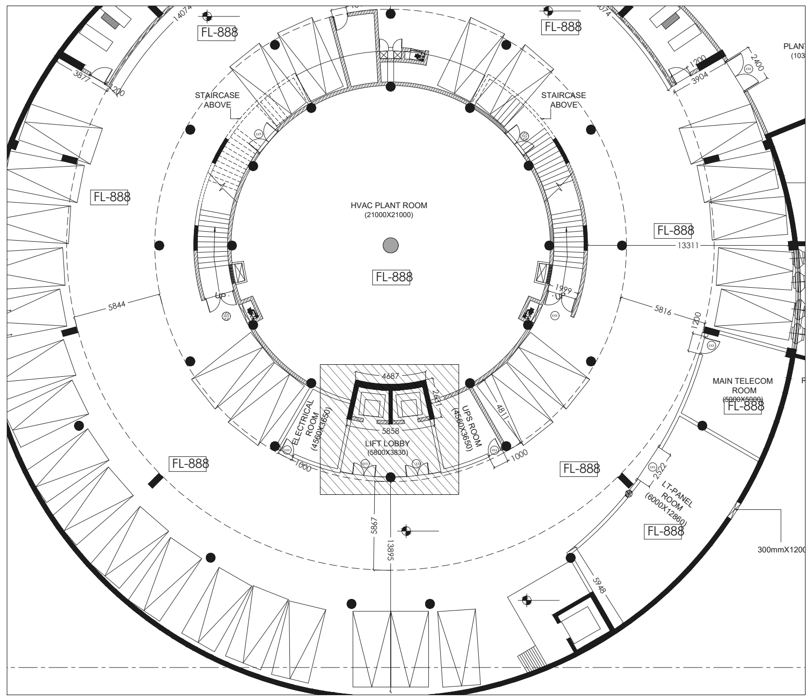
PLAN



SECTION-AA'



SECTION-BB'



key Plan (Not to scale)

NOTES:

R00		
Rev.no.	Date	Description

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

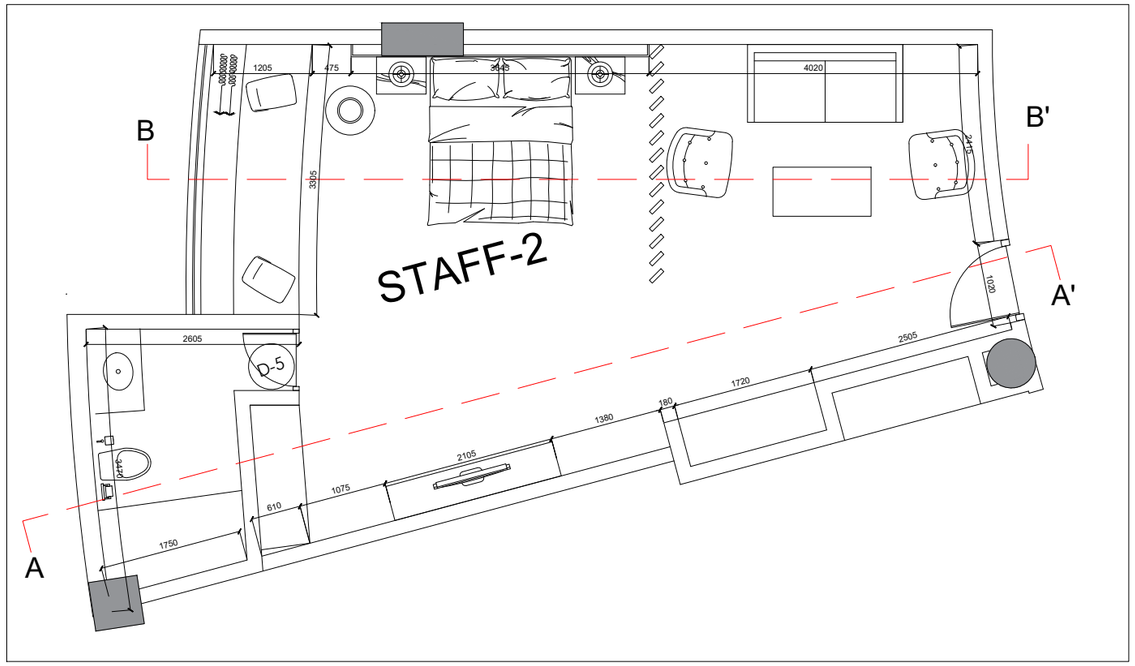
DRG. TITLE :

SECTIONS (LIFT LOBBY)-GROUND FLOOR

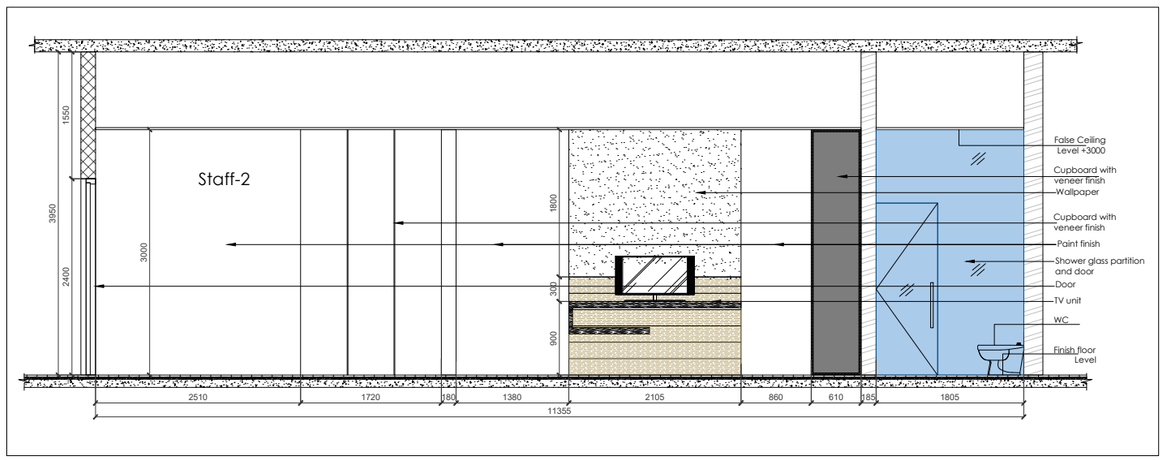
Scale	Date	Rev.no.
1: 75	01-05-22	R-00

Drg. no.
LUMB-ID-BF-S-03

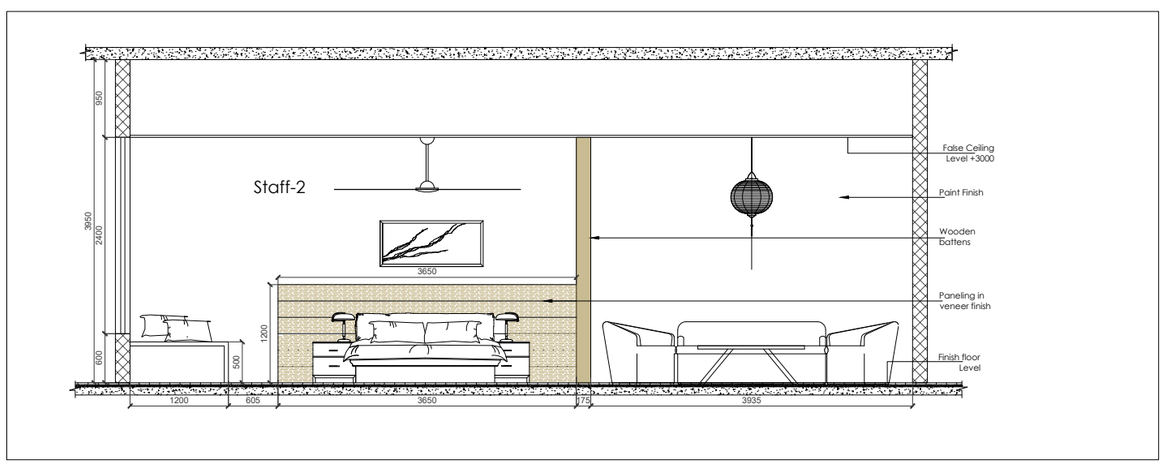
ISSUED FOR:
☐ GFC ☐ APPROVAL
■ TENDER ☐ REFERENCE



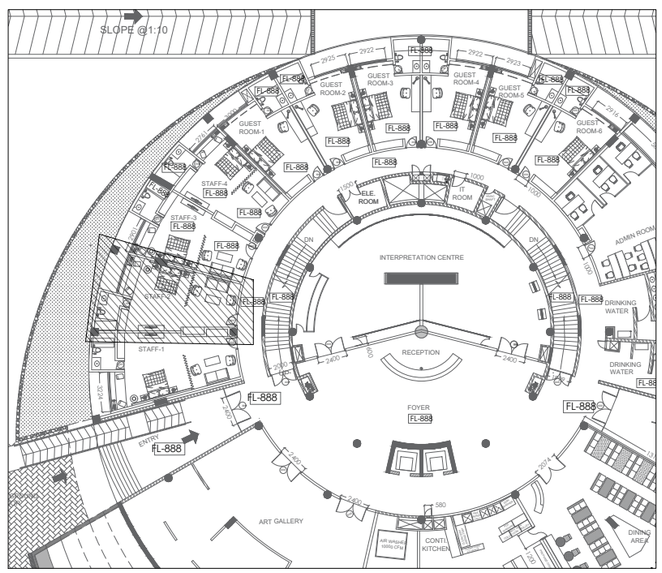
PLAN



SECTION-AA'



SECTION-BB'



key Plan (Not to scale)

NOTES:

R00		
Rev.no.	Date	Description

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

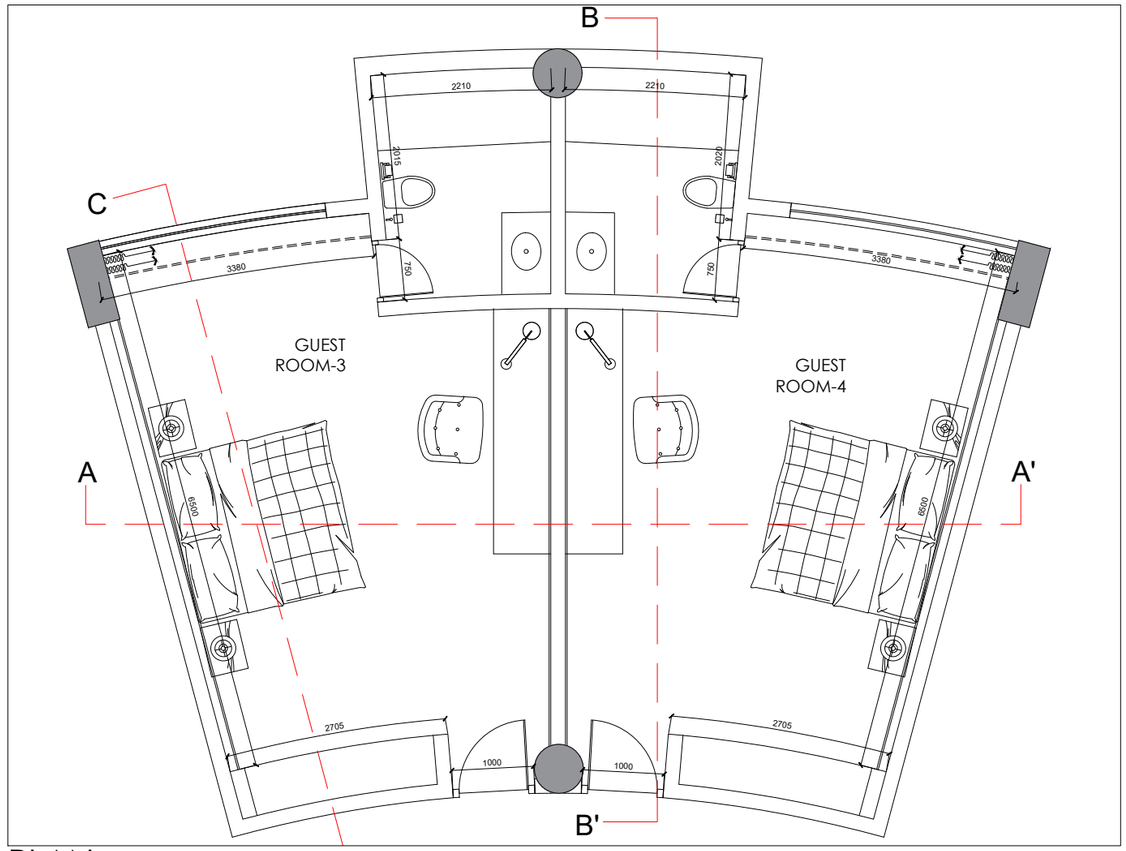
DRG. TITLE :

SECTIONS (STAFF-2)-GROUND FLOOR

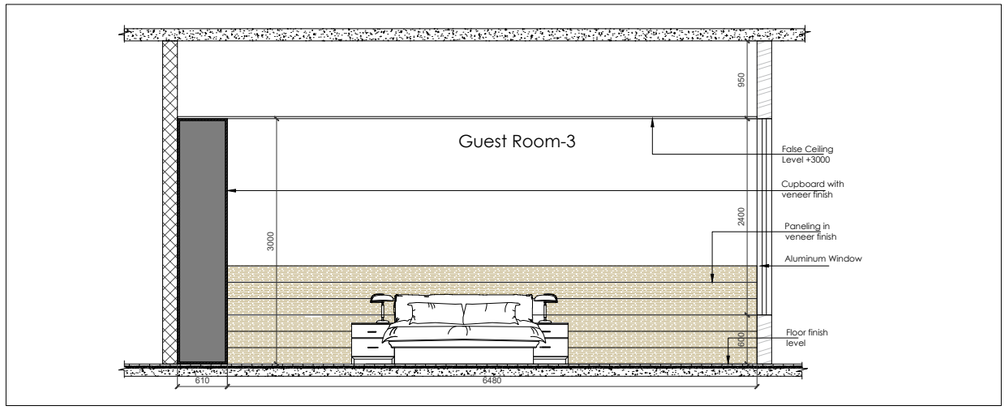
Scale	Date	Rev.no.
1: 75	01-05-22	R-00
	Drg. no.	
	LUMB-ID-GF-S-01	

ISSUED FOR:

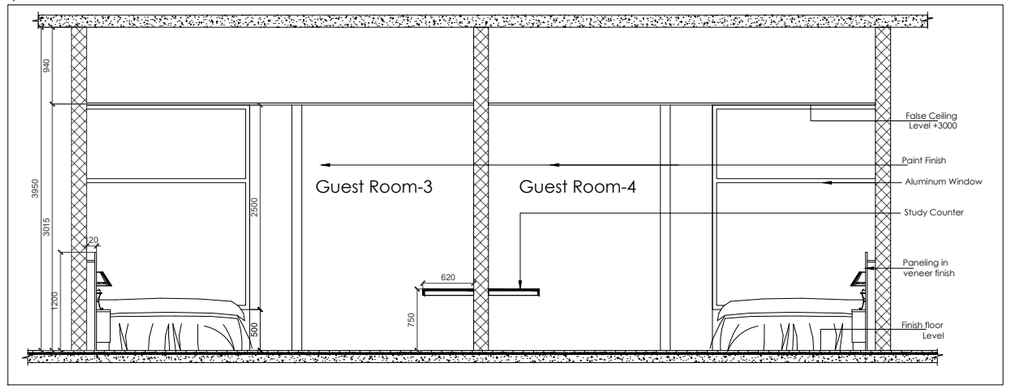
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



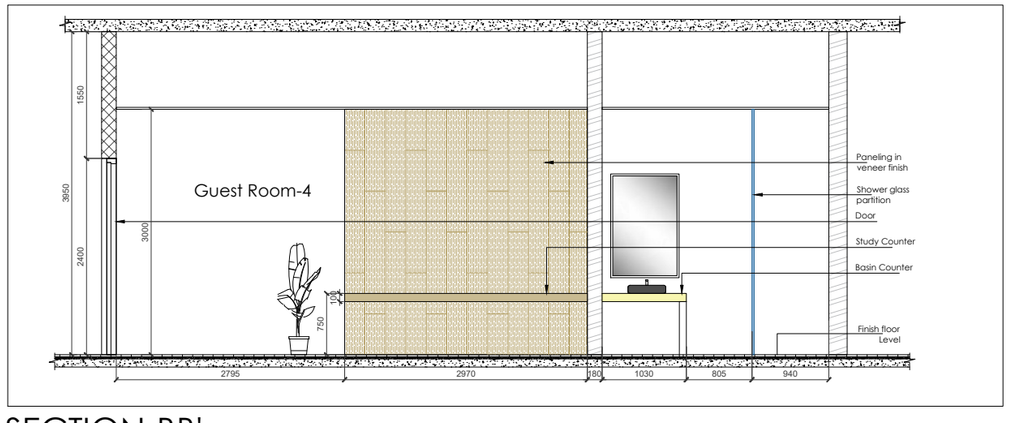
PLAN



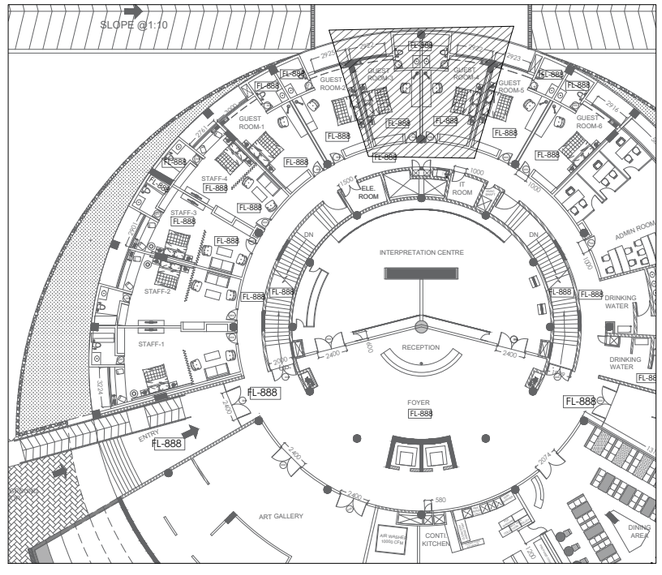
SECTION-CC'



SECTION-AA'



SECTION-BB'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

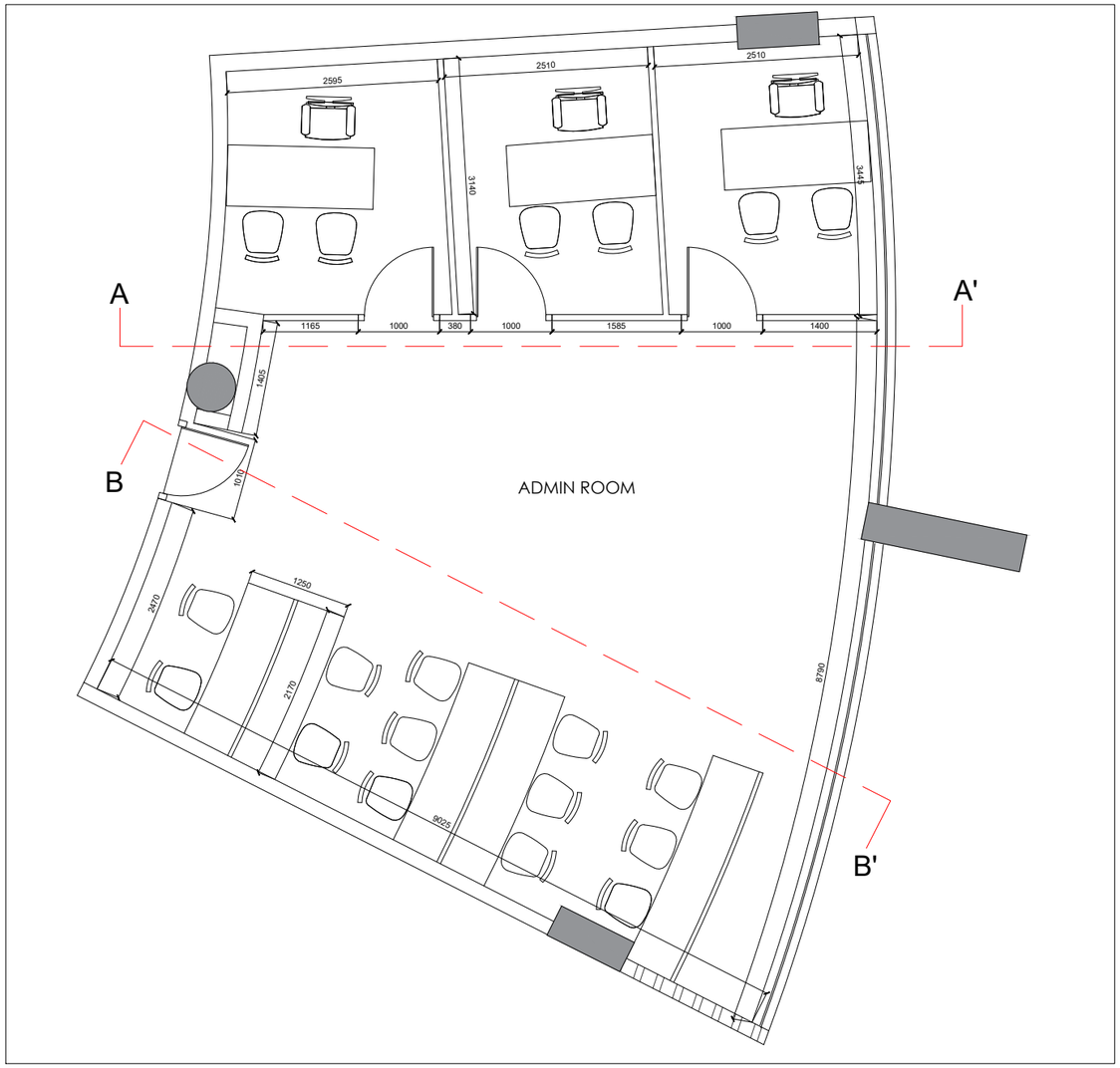
SECTIONS (GUEST ROOM-3&4)-GF

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

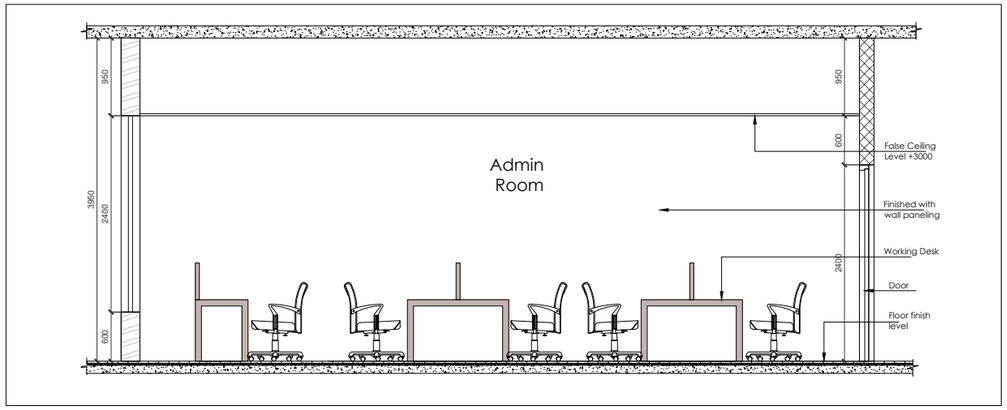
Drg. no.
LUMB-ID-GF-S-02

ISSUED FOR:

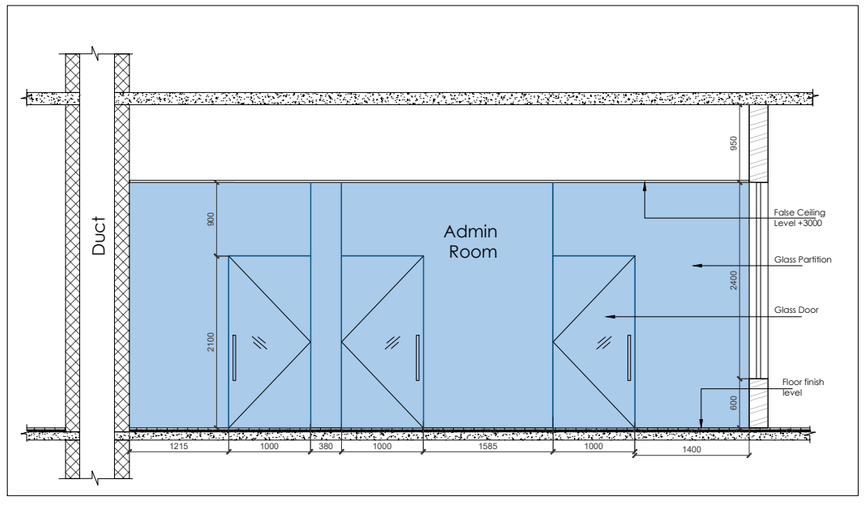
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



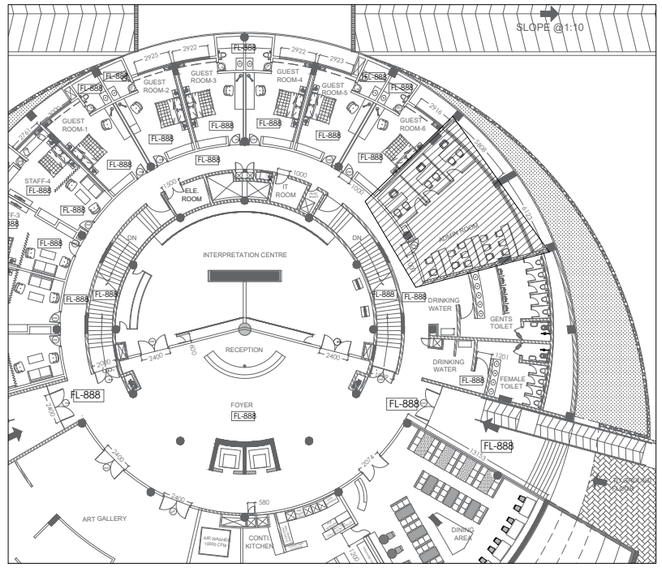
PLAN



SECTION-BB'



SECTION-AA'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

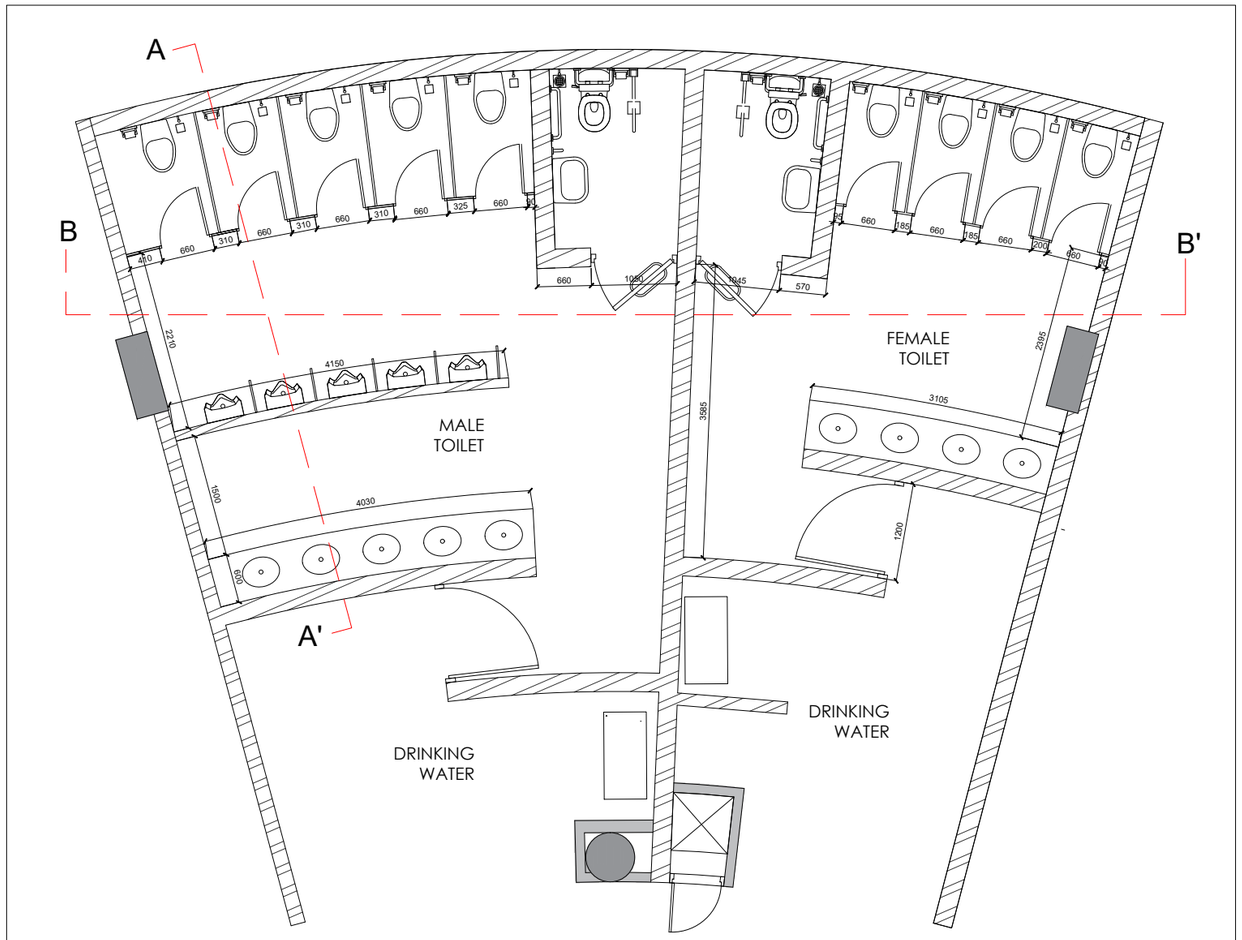
SECTIONS (ADMIN. ROOM)-GROUND FLOOR

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

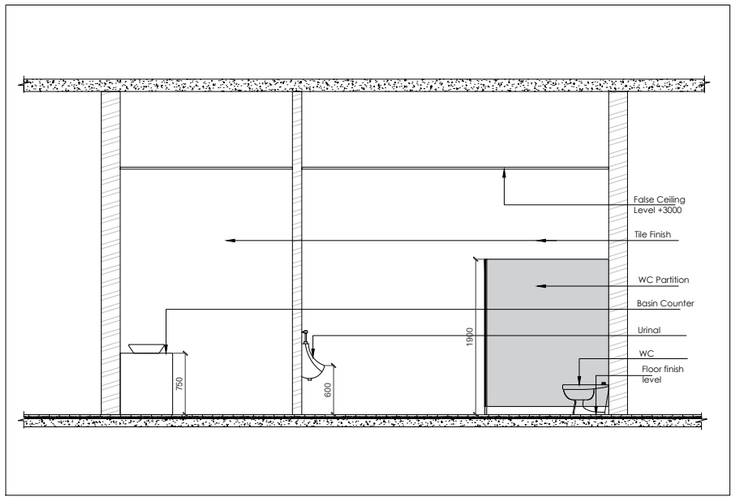
Drg. no.
LUMB-ID-GF-S-03

ISSUED FOR:

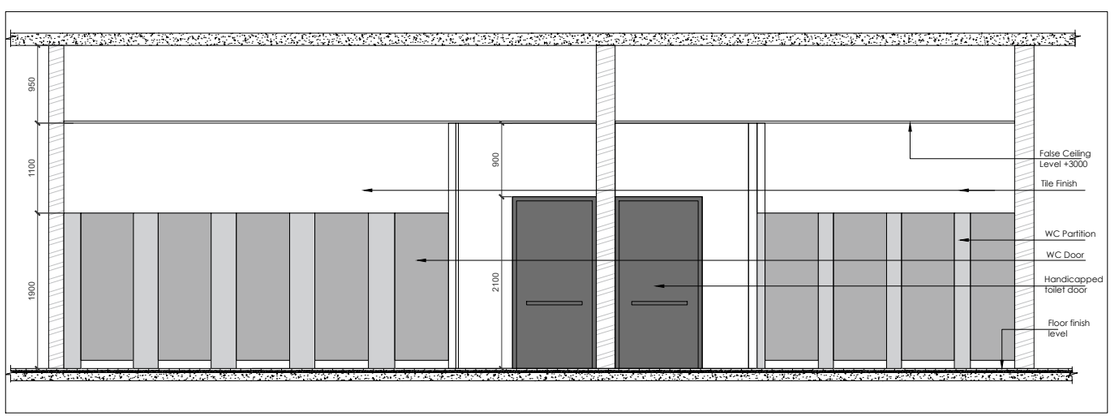
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



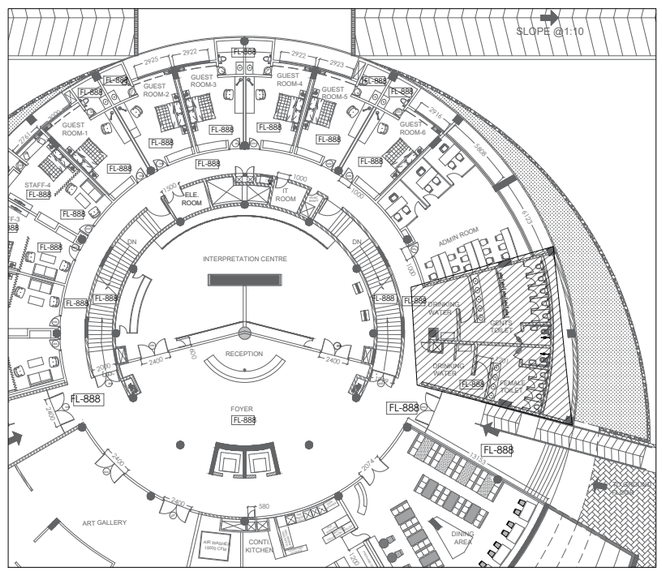
PLAN



SECTION-AA'



SECTION-BB'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

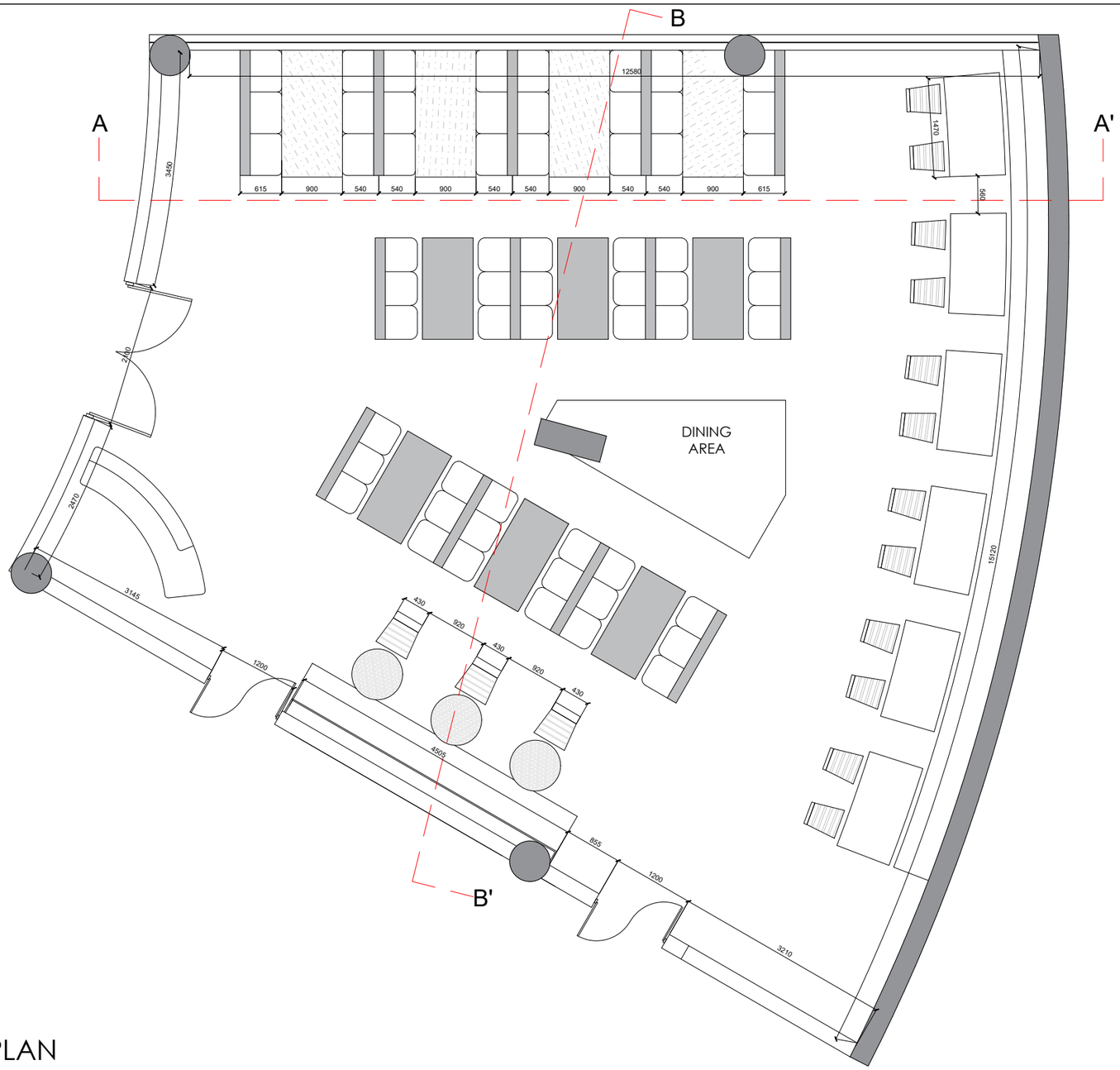
SECTIONS (MALE&FEMALE TOILETS)-GF

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

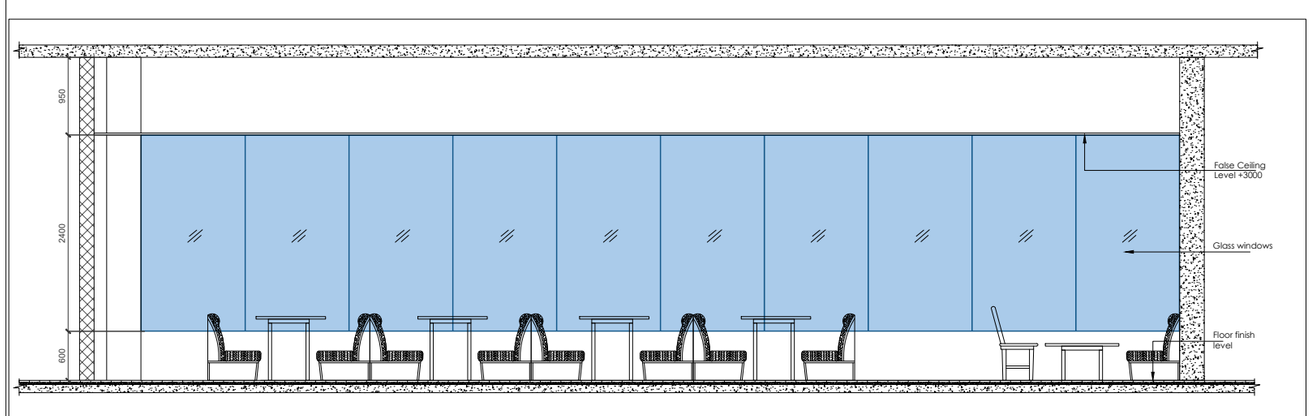
Drg. no.
LUMB-ID-GF-S-04

ISSUED FOR:

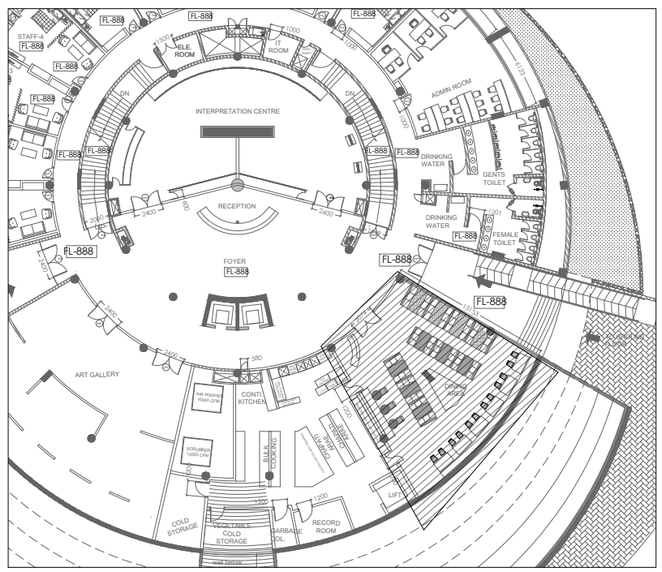
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



PLAN



SECTION-AA'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

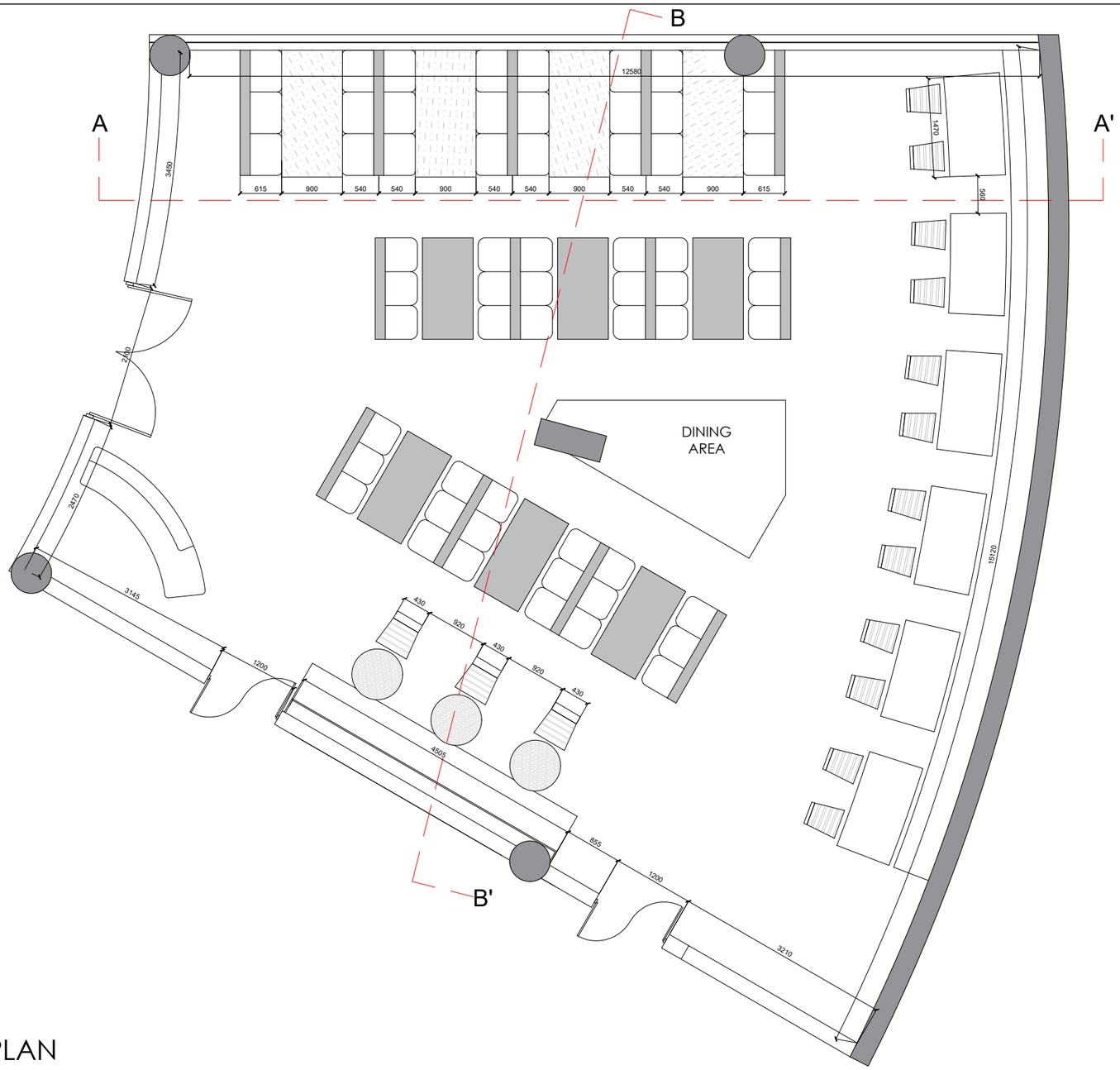
SECTIONS (DINING AREA)-GF

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

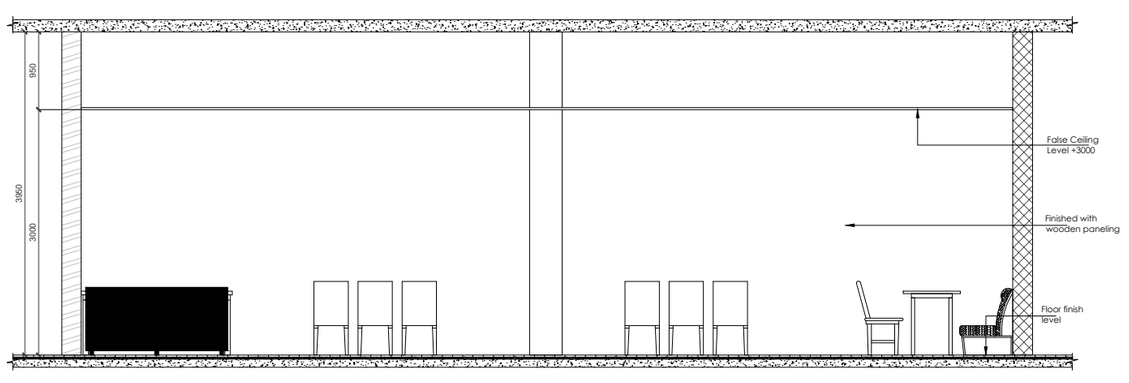
Drg. no.
LUMB-ID-GF-S-05-A

ISSUED FOR:

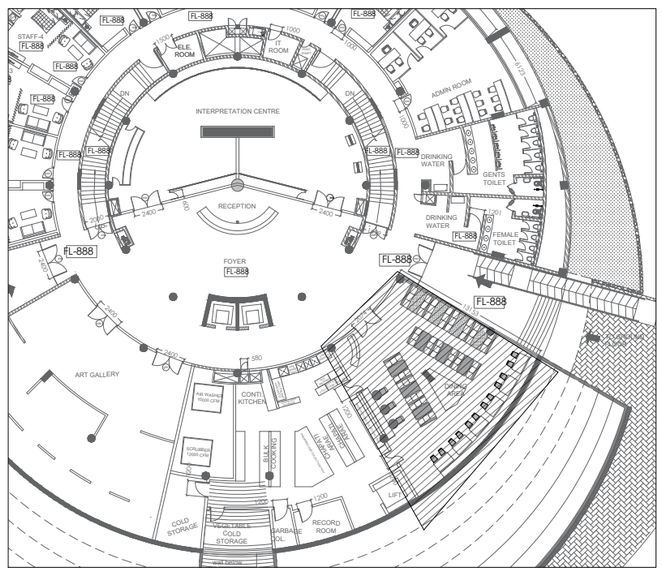
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



PLAN



SECTION-BB'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

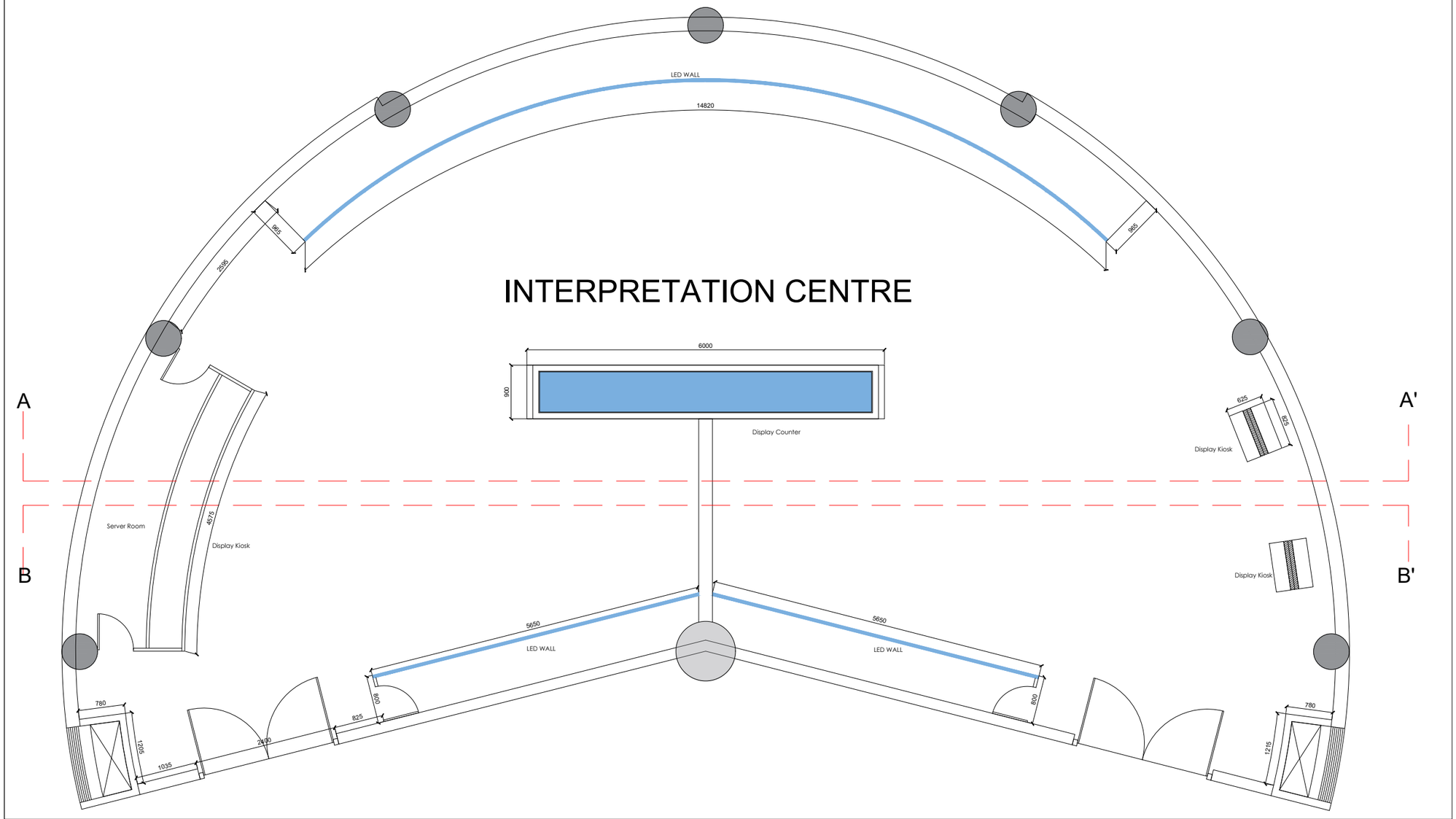
SECTIONS (DINING AREA)-GF

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

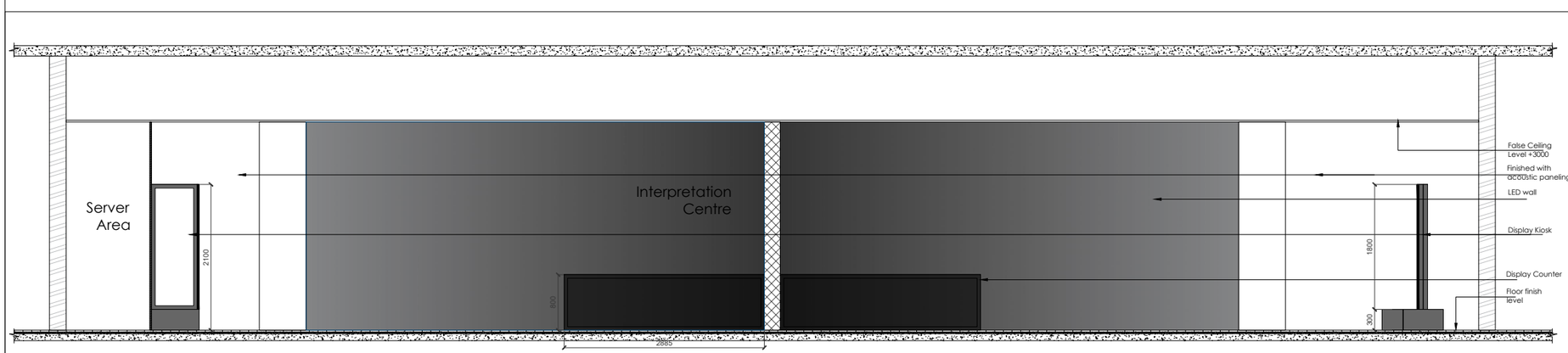
Drg. no.
LUMB-ID-GF-S-05-B

ISSUED FOR:

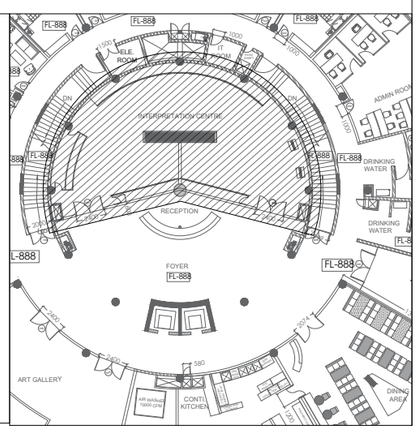
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



PLAN



SECTION-AA'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

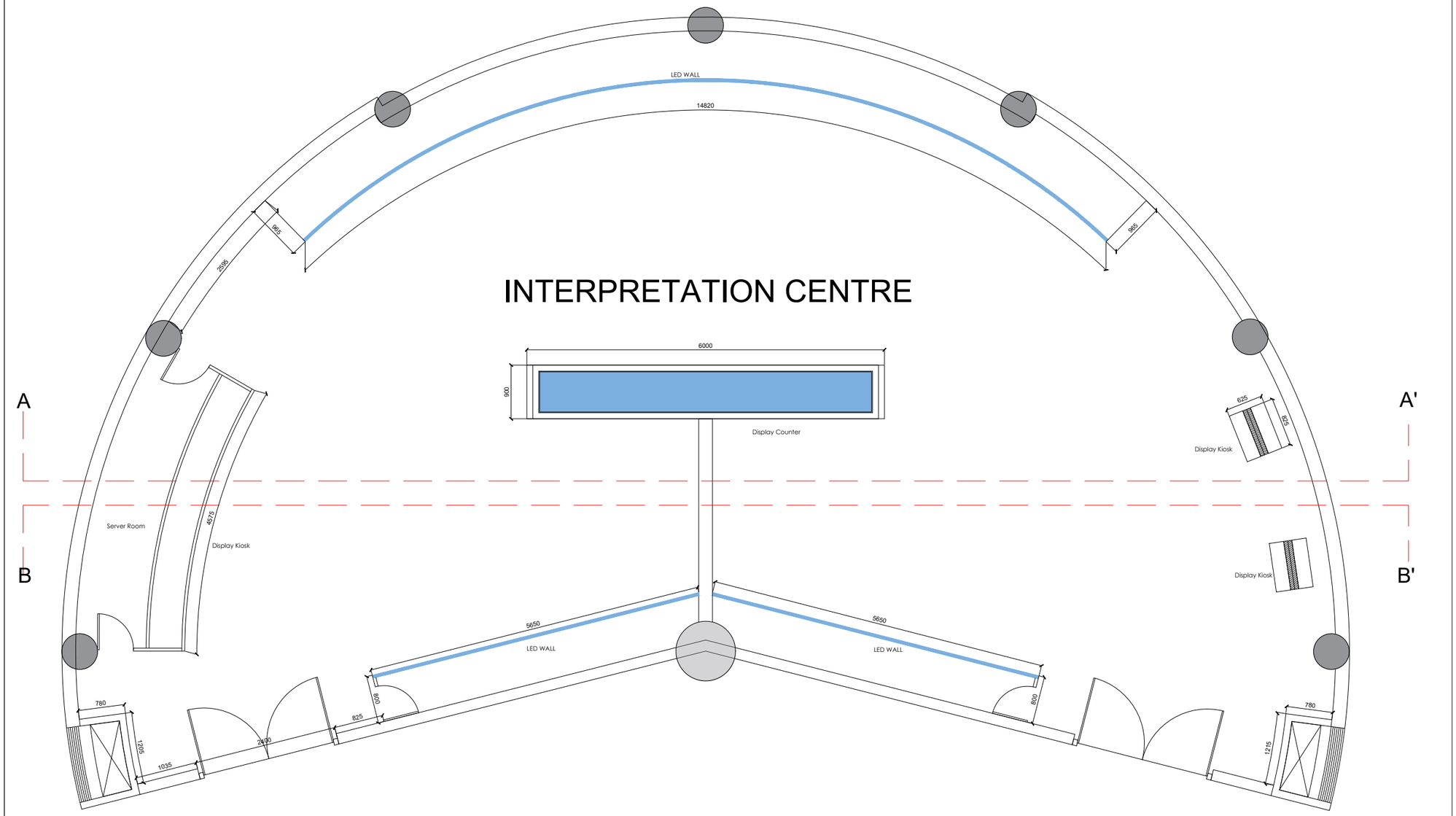
SECTIONS (INTERPRETATION CENTRE)-GF

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

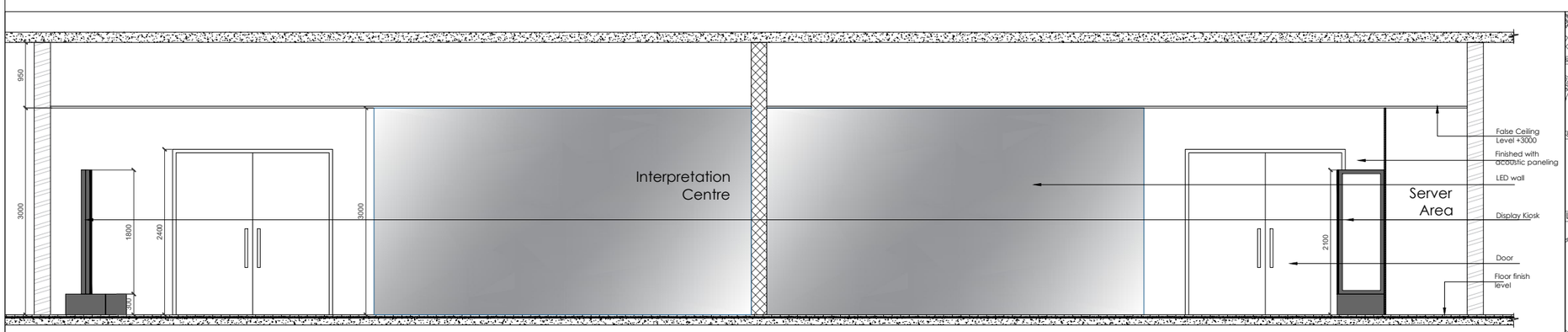
Drg. no.
LUMB-ID-GF-S-06-A

ISSUED FOR:

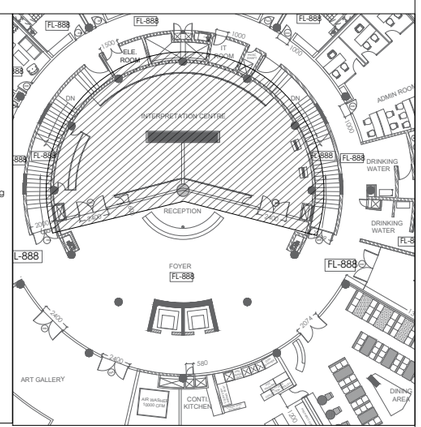
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



PLAN



SECTION-BB'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

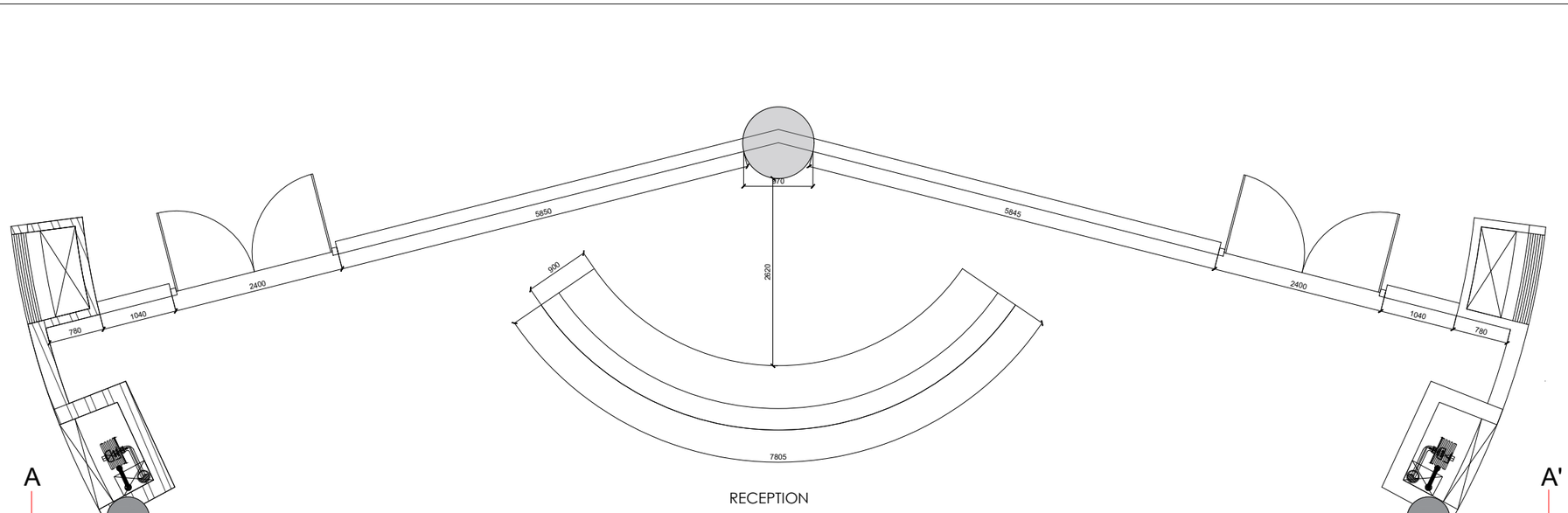
SECTIONS (INTERPRETATION CENTRE)-GF

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

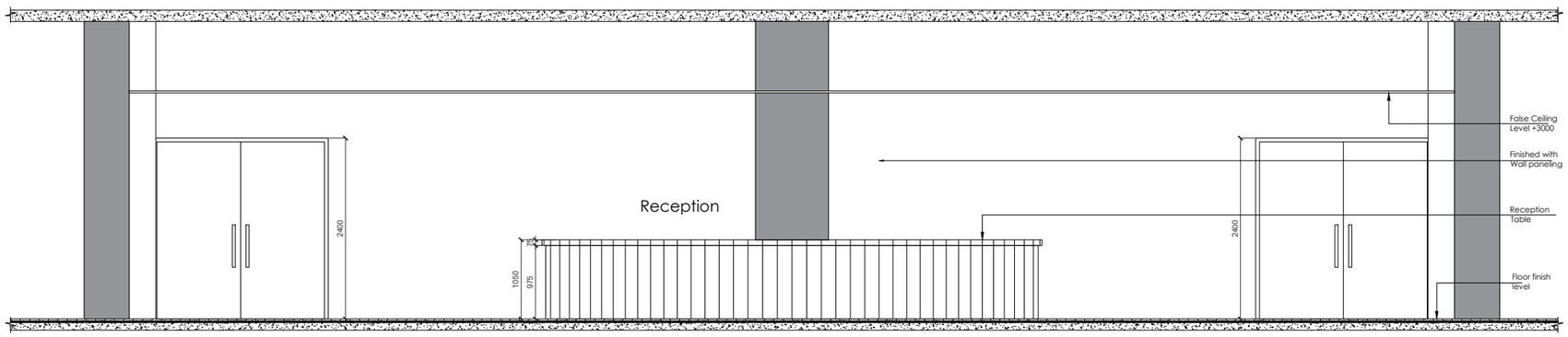
Drg. no.
LUMB-ID-GF-S-06-B

ISSUED FOR:

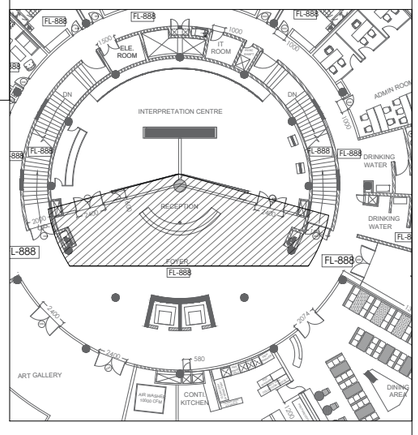
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



PLAN



SECTION-BB'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

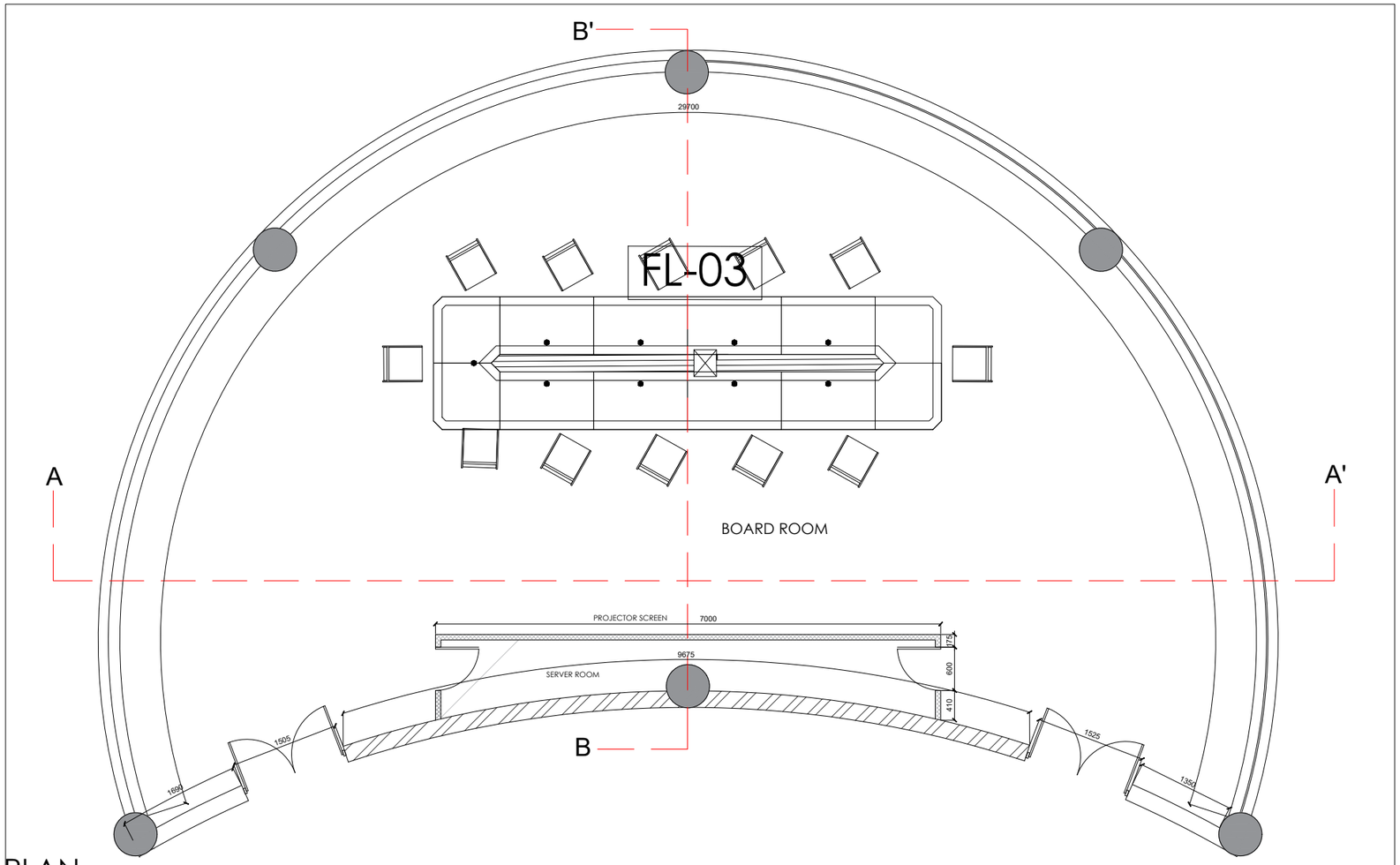
SECTIONS (RECEPTION)-GF

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

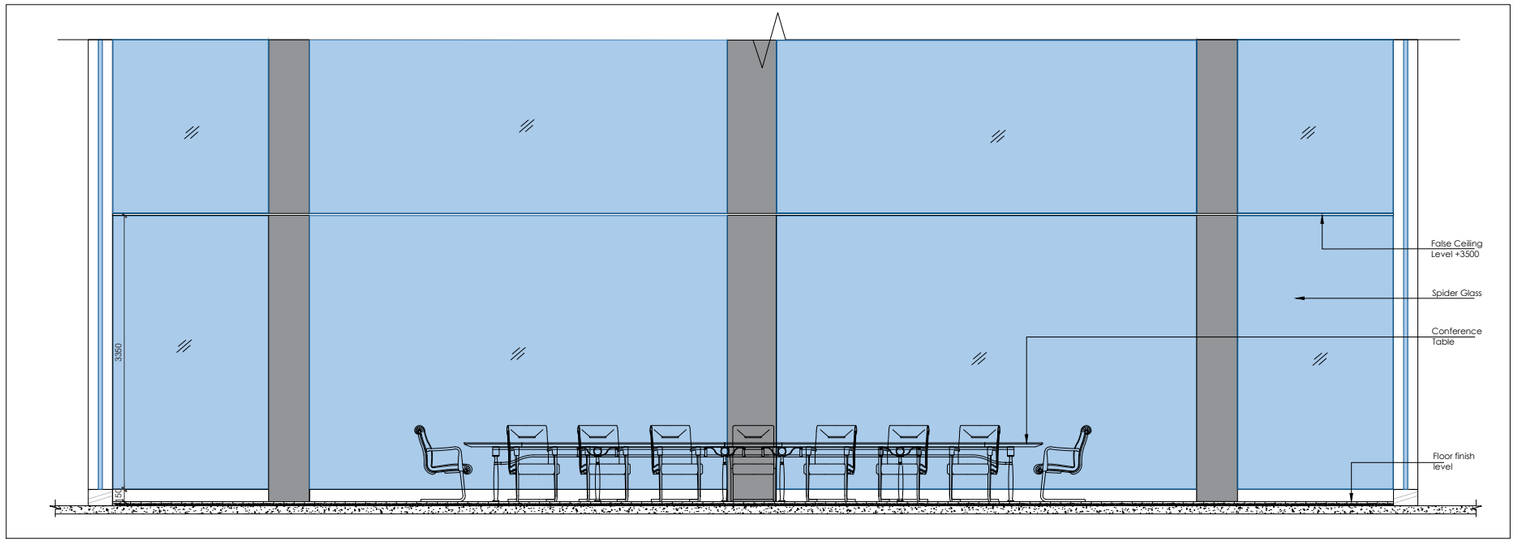
Drg. no.
LUMB-ID-GF-S-07

ISSUED FOR:

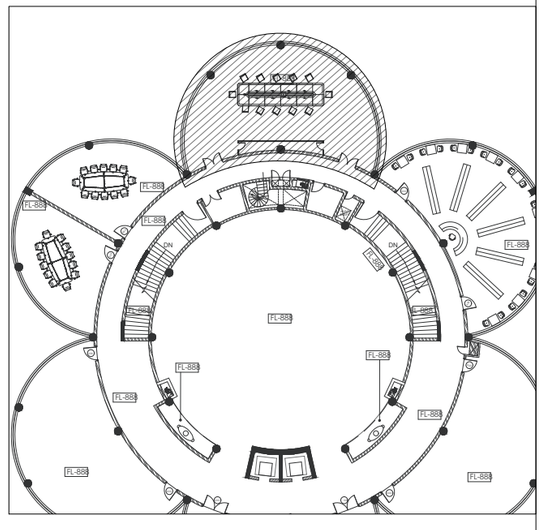
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



PLAN



SECTION-AA'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

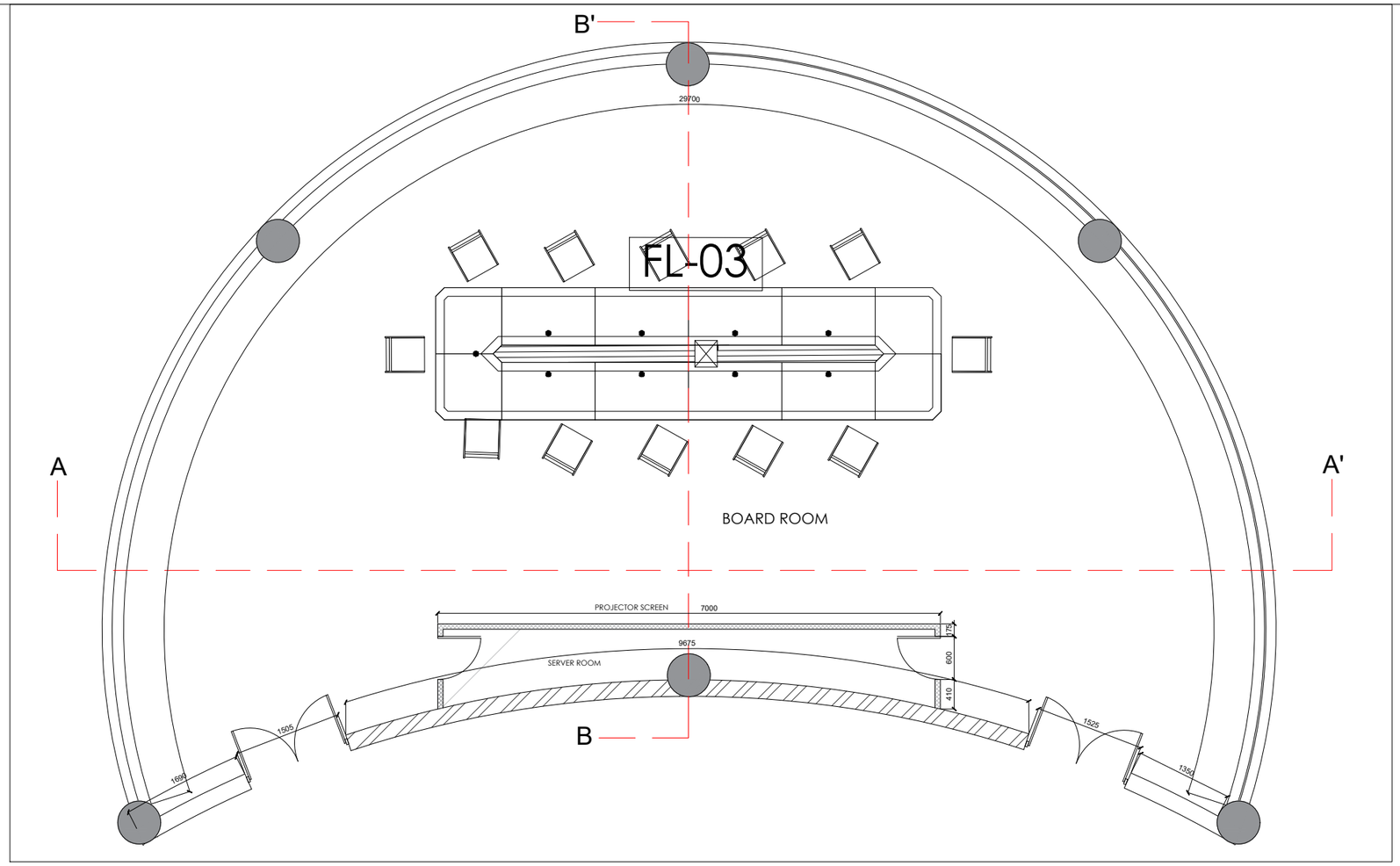
SECTIONS (BOARD ROOM)-FIRST FLOOR

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

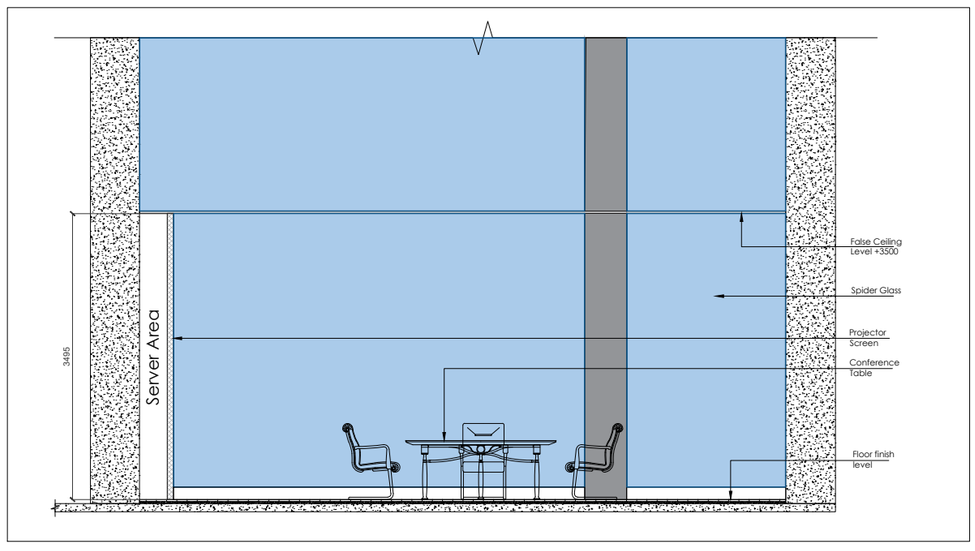
Drg. no.
LUMB-ID-FF-S-01-A

ISSUED FOR:

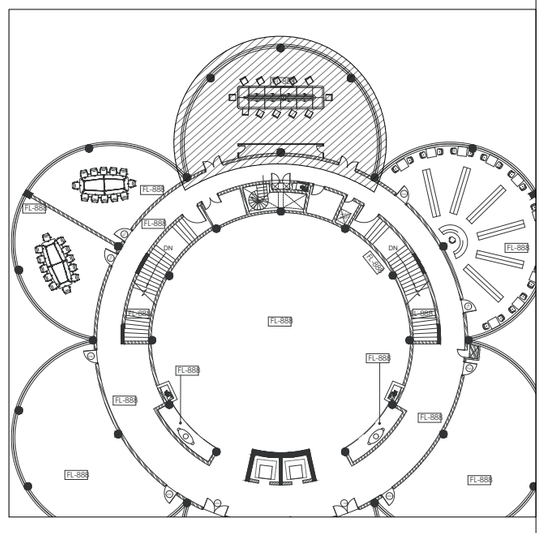
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



PLAN



SECTION-BB'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL

DRG. TITLE :

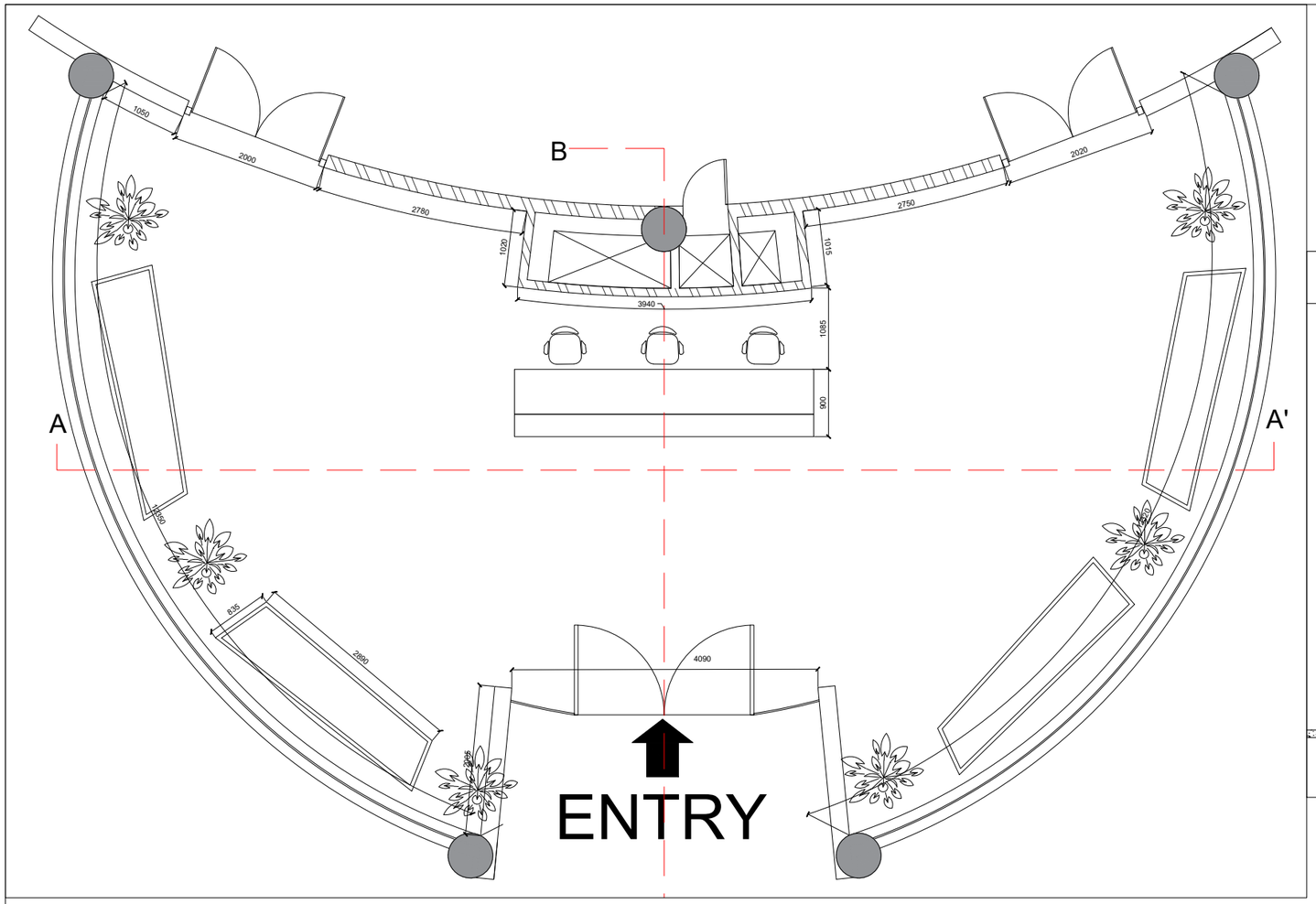
SECTIONS (BOARD ROOM)-FIRST FLOOR

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

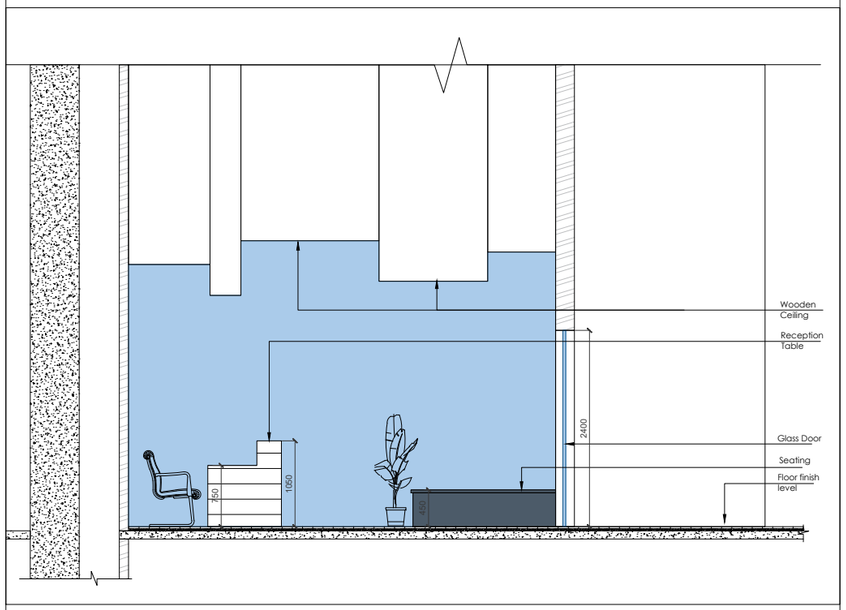
Drg. no.
LUMB-ID-FF-S-01-B

ISSUED FOR:

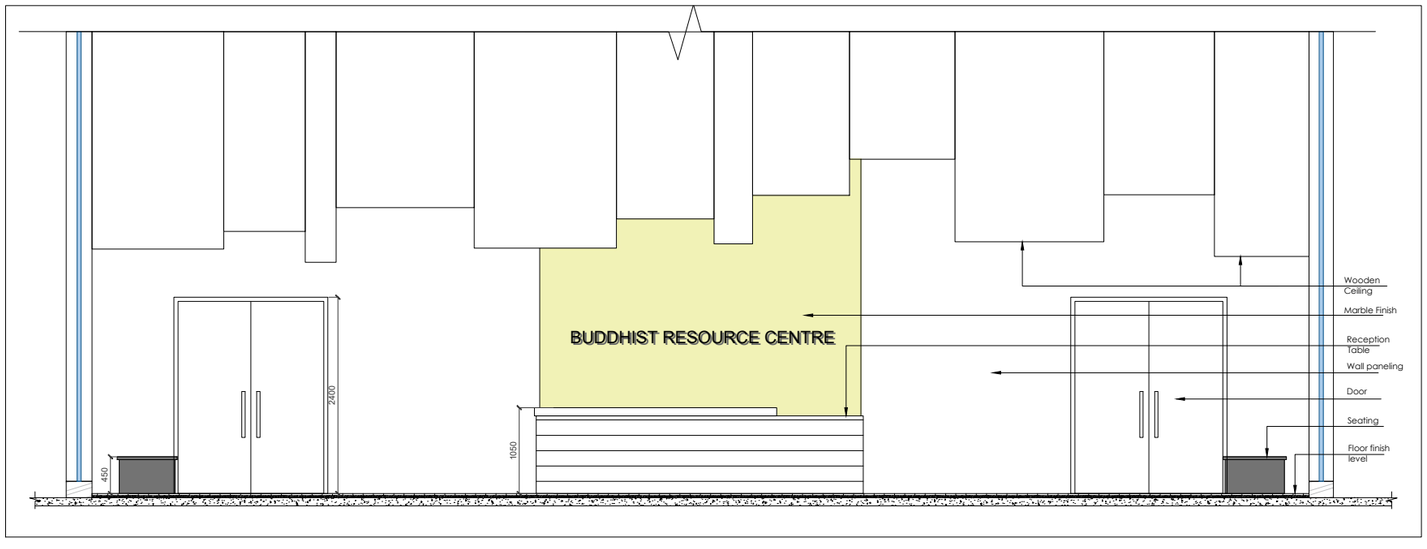
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



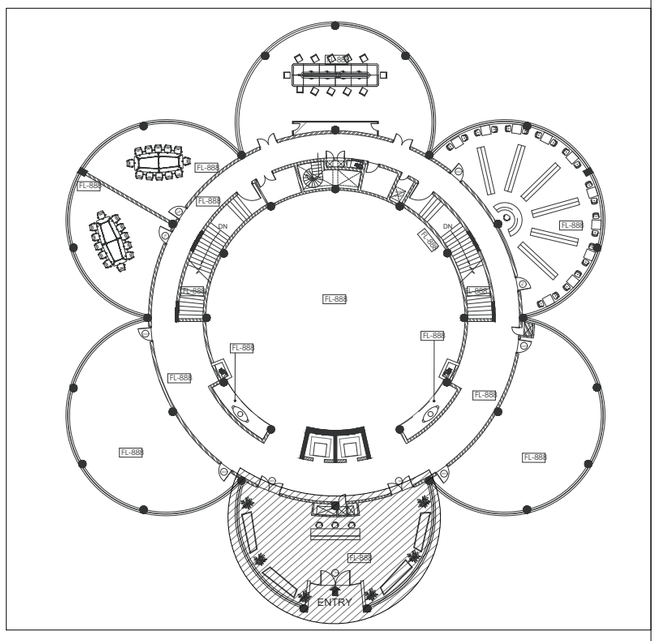
PLAN



SECTION-BB'



SECTION-AA'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

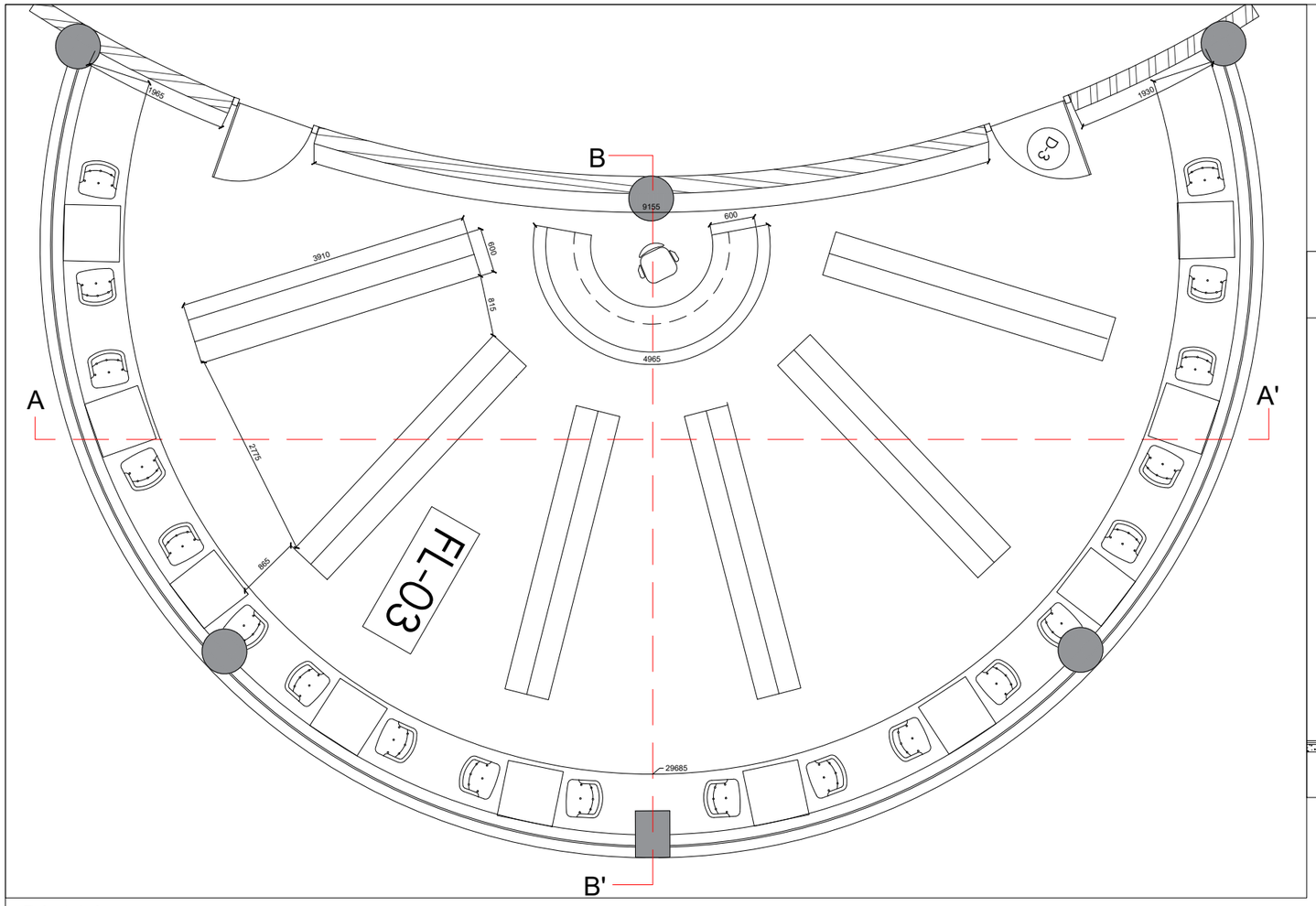
SECTIONS (RECEPTION)-FIRST FLOOR

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

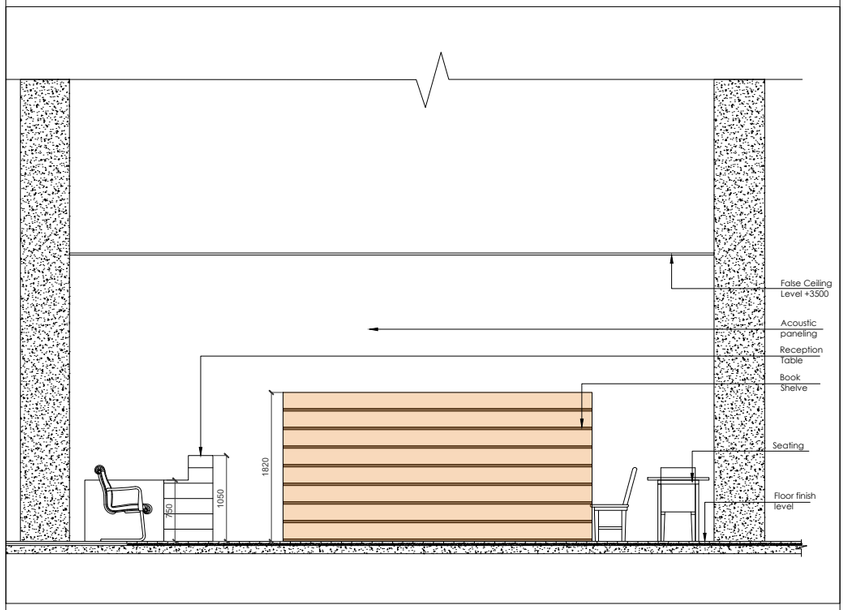
Drg. no.
LUMB-ID-FF-S-02

ISSUED FOR:

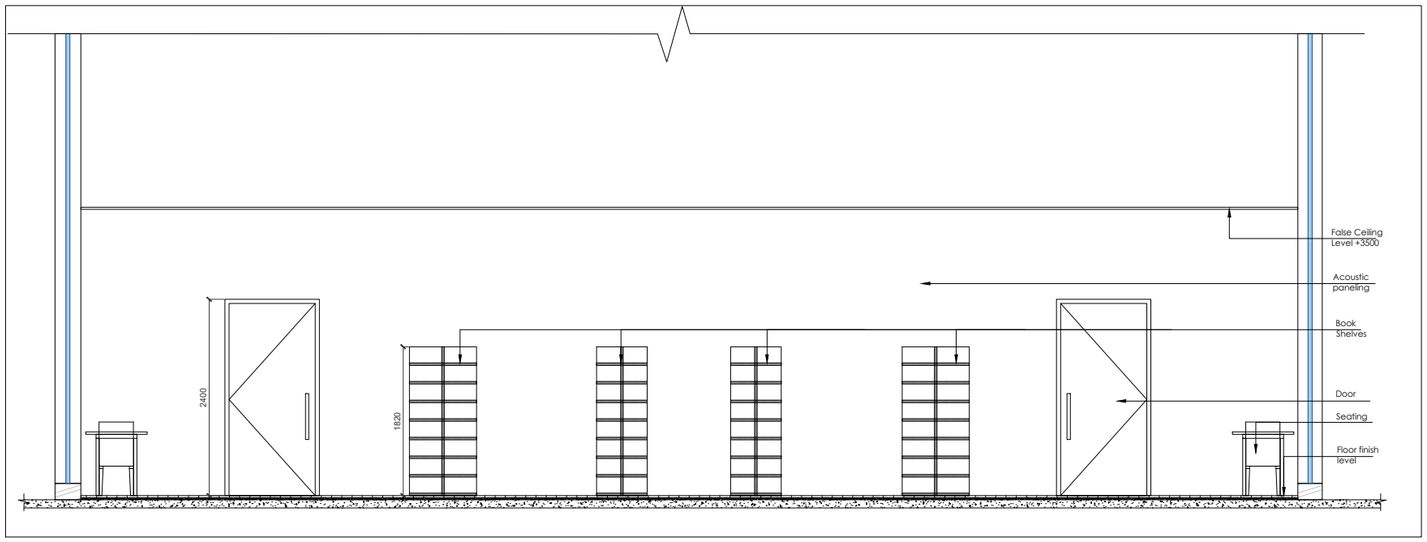
- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



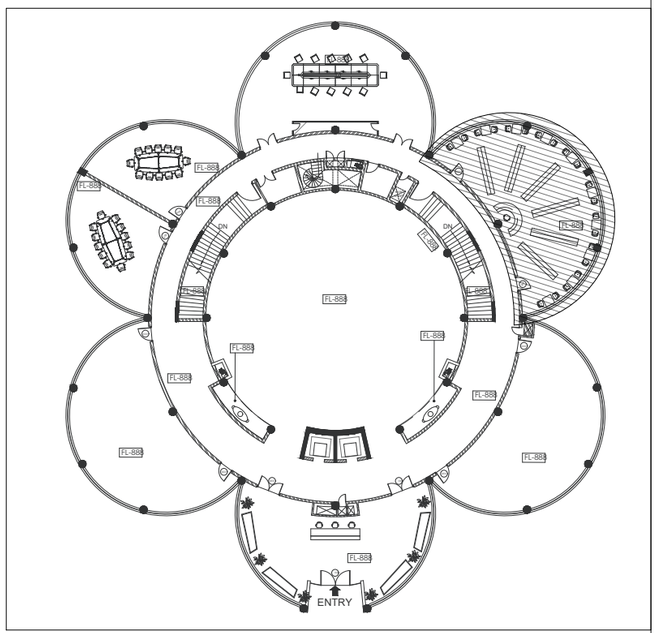
PLAN



SECTION-BB'



SECTION-AA'



key Plan (Not to scale)

NOTES:

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST CULTURE & HERITAGE
LUMBINI, NEPAL.

DRG. TITLE :

SECTIONS (LIBRARY)-FIRST FLOOR

Scale	Date	Rev.no.
1: 75	01-05-22	R-00

Drg. no.
LUMB-ID-FF-S-03

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE

LEGEND	
SYMBOL	DESCRIPTION
	TRANSFORMER
	DIESEL GENERATOR SET
	VACUUM CIRCUIT BREAKER
	AIR CIRCUIT BREAKER
	MOULDED CASE CIRCUIT BREAKER
	MINIATURE CIRCUIT BREAKER (10KA RATING WITH 'C' CHARECTERISTICS
MPCB	MOTOR PROTECTION CIRCUIT BREAKER
3	CURRENT TRANSFORMER
	EARTHING CONNECTION (GI OR Cu.)
MFM	MULTI FUNCTIONAL MODULES
KWH	KILOWATT-HOUR
	CAPACITOR BANK.
V/I	DIGITAL VOLTMETER & AMMETER
M	MOTOR / PUMP
LA	LIGHTNING ARRESTOR (HT PORCELAIN TYPE)
R Y B	PHASE INDICATING LAMP. (LED TYPE)
ON OFF TRIP	INDICATING LAMP. (LED TYPE)
	EMERGENCY STOP PUSH BUTTONS
27	UNDER VOLTAGE RELAY
32	DIRECTIONAL POWER RELAY
47	PHASE SEQUENCE OR PHASE BALANCE VOLTAGE RELAY
50	INSTANTANEOUS OVER CURRENT RELAY
50N	INSTANTANEOUS EARTH FAULT RELAY
51	IDMT PHASE OVER CURRENT FAULT RELAY
51N	IDMT EARTH FAULT RELAY
57	OVER VOLTAGE RELAY
86	HIGH SPEED TRIP RELAY
95	TRIP CIRCUIT SUPERVISION

NOTE : L/R
ALL BREAKERS IN PANEL SHALL BE SUITABLE FOR CLOSING IN LOCAL MODE UNDER TEST POSITION & REMOTE MODE UNDER SERVICE POSITION.

NOTES

1. REDUNDANT 24V DC SUPPLY SHALL BE PROVIDED FOR INDICATIONS & PLC CONTROL THROUGH PLANT BATTERY(24V DC) AND POWER SUPPLY UNIT(230V/24V DC)
2. ALL ENGINE & ALTERNATOR FAULTS SHALL BE WIRED TO THE ANNUNCIATOR & MASTER TRIP RELAYS, ONLY ENGINE & ALTERNATOR FAULT INPUT SHALL BE GIVEN TO PLC FOR NECESSARY TRIPPING.
3. THE BUS COUPLER SHALL BE PROVIDED WITH AUTO CHANGEOVER CONTROL SUPPLY FROM BUSES. A MIMIC (WITH 10mm DIA LED LAMPS) SHALL BE PROVIDED FOR BREAKER STATUS INDICATION.
4. (APP.600mm(W)x500mm(H)) IN PCC INCLUDING DG AND DG BREAKER STATUS
5. ALL BREAKERS WHICH ARE USED FOR INTERLOCKING SHALL BE PROVIDED WITH MINIMUM 4NO+4NC AUX.CONTACTS.
6. IN AC PANEL & AHU STARTER PANEL ALL STARTERS POTENTIAL FREE AUTO/MAN. CONTACT FROM AUTO/MAN. SWITCH, CONTACTOR NO, NC AND TRIP CONTACT SHALL BE WIRED UP TO THE COMMON TERMINAL BLOCKWITH IN THE PANEL AND REMOTE TRIP FACILITY FOR FIRE ANDLIMIT SWITCH NC CONTACTS
7. ALL CAPACITOR CONTACTORS SHALL BE SWITCHED 'ON' ONLY WHEN RESPECTIVE MCCB INCOMER IS SWITCHED 'ON'.
8. ALL CAPACITOR VERTICAL SHALL BE FITTED WITH EXHAUST FAN AT REAR SIDE
9. ALL MCCB'S TO BE WITH ROM, SPREADERS AND PHASE BARRIERS ETC
10. ALL LIVE TERMINAL SHALL BE SHROUDED BY ACRYLIC SHEET/FRP/HYLAM SHEET.
11. THE DG PLC SHALL BE COMPATIBLE TO BMS TO MONITOR DG PARAMETERS
12. ALL KWH, LM, DEM MDC METERS TO BE PROVIDED WITH RS-485 PORT AND PORT TERMINALS SHALL BE LOOPED.
13. ALL INDOOR PANELS SHALL BE OF IP 42 PROTECTION
14. TVSS SHALL BE FULLY ENCAPSULATED TYPE & SHALL BE MOUNTED SEPARATELY. (TO BE SEPARATED FROM CONTROL COMPONENTS)
15. MCCB'S BELOW 200A SHALL BE WITH THERMO MAGNETIC RELEASES FOR OC,SC
15. MCCB'S BELOW 200A SHALL BE WITH THERMO MAGNETIC RELEASES FOR OC,SC
16. MCCB'S & ACB'S 200A&ABOVE SHALL BE WITH MICROPROCESSOR RELEASES FOR OC&SC
17. ALL PANELS WITH IN THE BUILDING SHALL BE PROVIDED WITH TOP ENTRY CABLES.
18. APP.RATING OF MCCB, CONTACTOR, TYPE, RELAY, REACTOR ETC. SHALL BE PROVIDED BASED ON KVAR RATING IN CAPACITOR PANEL.
19. CAPACITOR BANK SHALL BE CONNECTED TO EB POWER SUPPLY ONLY.NECESSARY INTERLOCKS SHALL BE PROVIDED.
20. SURGE DIVERTERS SHALL BE PROVIDED IN MAIN PANELS.
21. THE ENERGY METERS INSTALLED ON BUSWAY SHALL BE WIRED UP FOR RECEIVING SIGNAL FROM GRID & DG POWER. ALSO THE RS485 COMMUNICATION CABLING SHALL BE CARRIED OUT BETWEEN ALL THE METERS AND SHALL BROUGHT UPTO COMMON TERMINAL BLOCK WITH IN THE PANEL FOR BMS, MOINTORING/BILLING.
22. PROVISION OF CONTROL FEATURES FOR AUTO SWITCHING ON/OFF OF PRESSURIZATION/SMOKE EXHAUST FANS SHOULD BE PROVIDED IN CASE OF FIRE.
23. CONTROL CABLES – MINIMUM 1.5SQ.MM SHALL BE USED.
24. ALL BUSBARS ARE OF ALUMINIUM TYPE & 0.8A/SQ.MM, UNLESS OTHERWISE SPECIFIED
25. ALL BREAKERS USED FOR MOTOR APPLICATION SHALL BE OF MOTOR DUTY TYPE
26. ALL OUTDOOR PANELS SHALL BE OF IP 55 PROTECTION
27. THE SELECTION OF MCB"S BREAKER CURVE TO BE DONE TO SUIT THE APPLICATION
28. MPCC – MAXIMUM POWER CONTROLLER : SHOULD CONTROL PEAK LOAD. AT 95% LOADING, IT SHOULD GIVE AN ALARM AND AT 100% LOAD, IT SHOULD TRIP THE BREAKER
29. PROVIDE LOUVERS FOR ALL PANELS
30. ALL LM SHOULD BE OF MAXIMUM DEMAND RECORDING

NOTE FOR AHU STARTER PANEL:

1. POTENTIAL FREE CONTACTS OF MAIN CONTACTOR, A/M SWITCH & TRIP CONTACT SHALL BE WIRED UP TO THE TERMINALS FOR BMS INTEGRATION.
2. ADDITIONAL 2 'NO' CONTACTS SHALL BE PROVIDED FOR AHU STARTERS FOR FIRE DAMPER TRIPPING.
3. ALL STARTER RATINGS ARE TENTATIVE & SUBJECTED TO CHANGE

Rev.no.	Date	Description

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVELOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

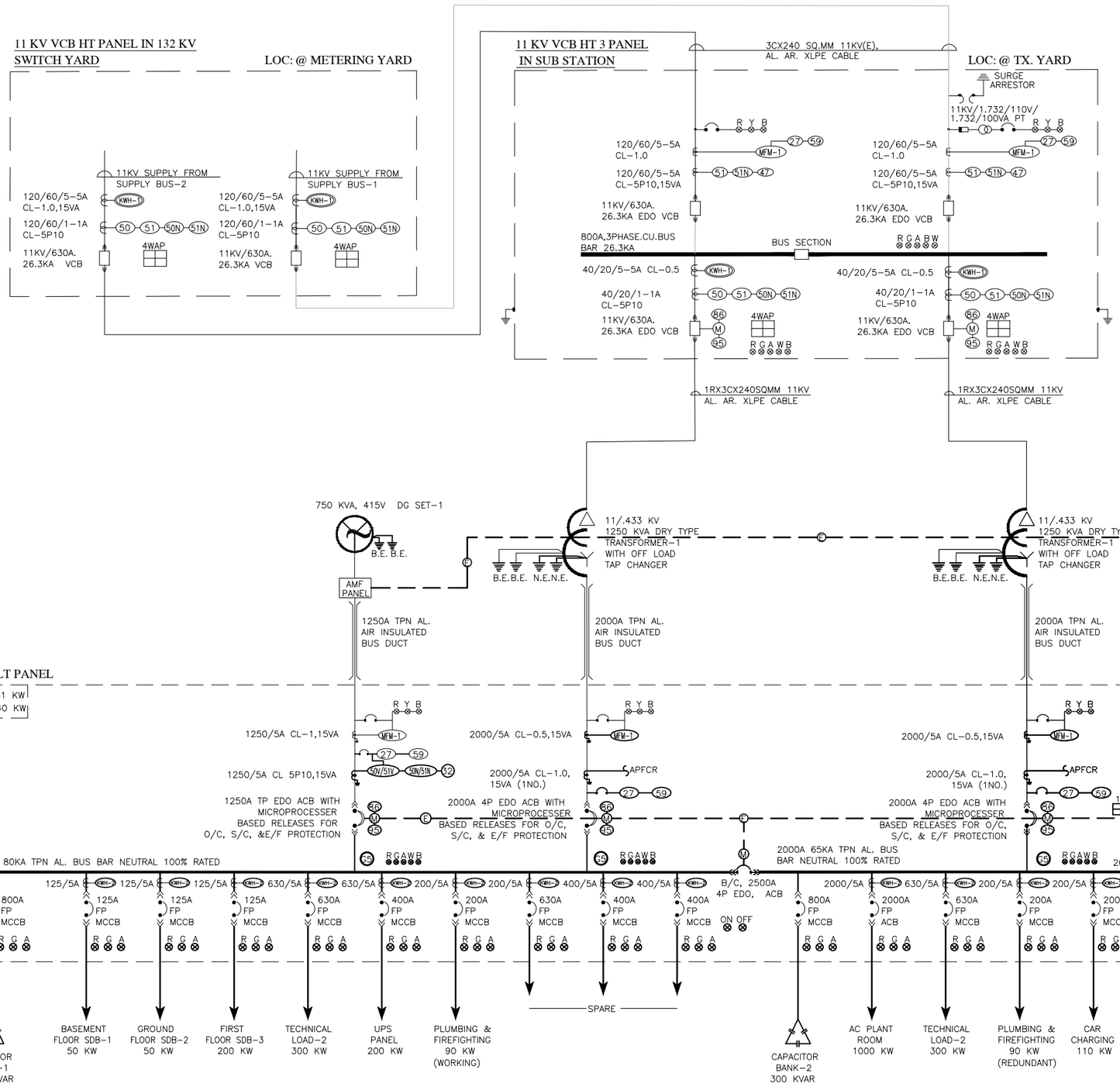
SINGLE LINE DIAGRAM (SHEET-1 OF 3)

Scale	Date	Rev.no.	Sheet Size.
NTS	03-05-22	R-00	A0

Drg. no.
LUMB-ELE-00-SLD-2010

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
	TRANSFORMER
	DIESEL GENERATOR SET
	VACUUM CIRCUIT BREAKER
	AIR CIRCUIT BREAKER
	MOULDED CASE CIRCUIT BREAKER
	MINIATURE CIRCUIT BREAKER (10KA RATING WITH 'C' CHARECTERISTICS
MPCB	MOTOR PROTECTION CIRCUIT BREAKER
3	CURRENT TRANSFORMER
	EARTHING CONNECTION (GI OR Cu.)
MFM	MULTI FUNCTIONAL MODULES
KWH	KILOWATT-HOUR
	CAPACITOR BANK.
V/I	DIGITAL VOLTMETER & AMMETER
M	MOTOR / PUMP
LA	LIGHTNING ARRESTOR (HT PORCELAIN TYPE)
R Y B	PHASE INDICATING LAMP. (LED TYPE)
ON OFF TRIP	INDICATING LAMP. (LED TYPE)
	EMERGENCY STOP PUSH BUTTONS
27	UNDER VOLTAGE RELAY
32	DIRECTIONAL POWER RELAY
47	PHASE SEQUENCE OR PHASE BALANCE VOLTAGE RELAY
50	INSTANTANEOUS OVER CURRENT RELAY
50N	INSTANTANEOUS EARTH FAULT RELAY
51	IDMT PHASE OVER CURRENT FAULT RELAY
51N	IDMT EARTH FAULT RELAY
59	OVER VOLTAGE RELAY
86	HIGH SPEED TRIP RELAY
95	TRIP CIRCUIT SUPERVISION

NOTE : L/R
ALL BREAKERS IN PANEL SHALL BE SUITABLE FOR CLOSING IN LOCAL MODE UNDER TEST POSITION & REMOTE MODE UNDER SERVICE POSITION.

Rev.no.	Date	Description

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVELOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

SINGLE LINE DIAGRAM (SHEET-2 OF 3)

Scale	Date	Rev.no.	Sheet Size.
NTS	03-05-22	R-00	A0

Drg. no.
LUMB-ELE-00-SLD-2010

ISSUED FOR:

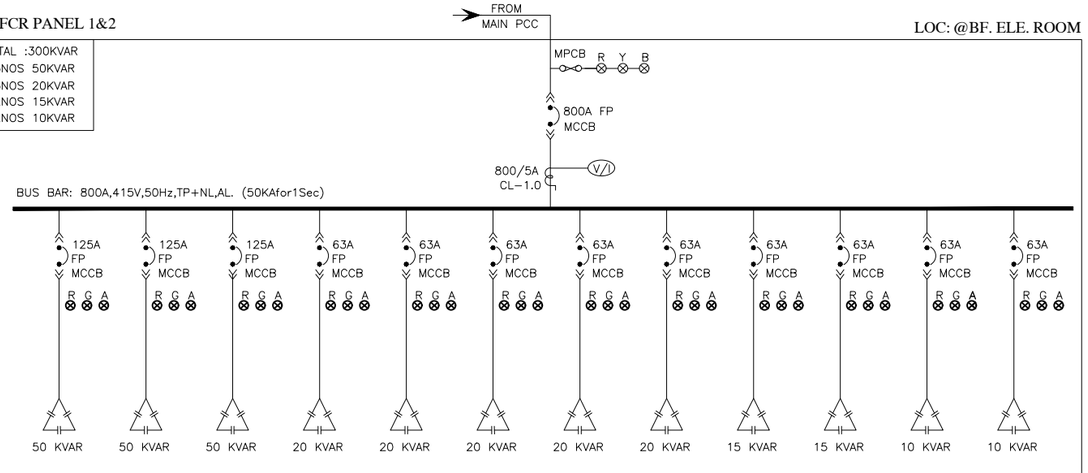
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

APFCR PANEL 1&2

FROM MAIN PCC

LOC: @BF. ELE. ROOM

TOTAL :300KVAR
3NOS 50KVAR
5NOS 20KVAR
2NOS 15KVAR
2NOS 10KVAR

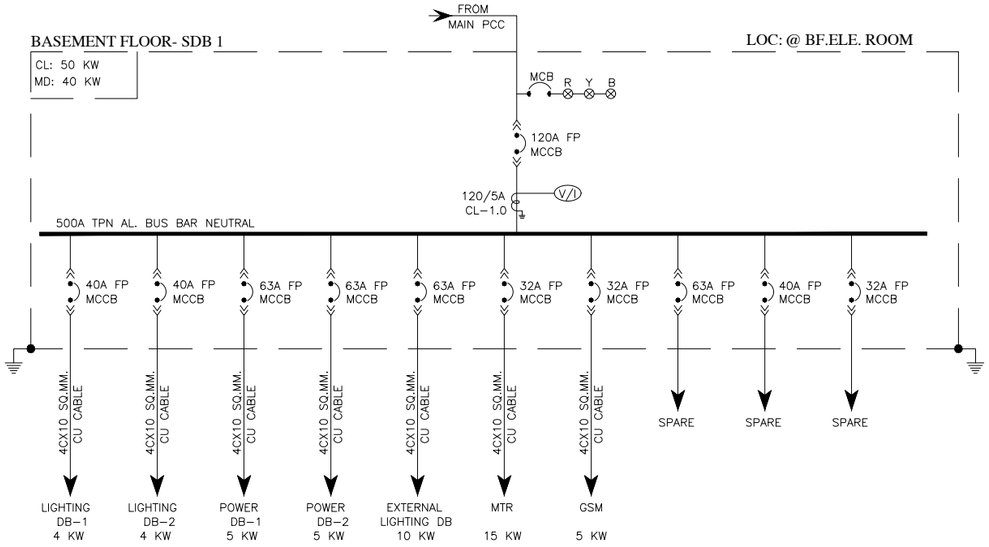


BASEMENT FLOOR- SDB 1

FROM MAIN PCC

LOC: @ BF.ELE. ROOM

CL: 50 KW
MD: 40 KW

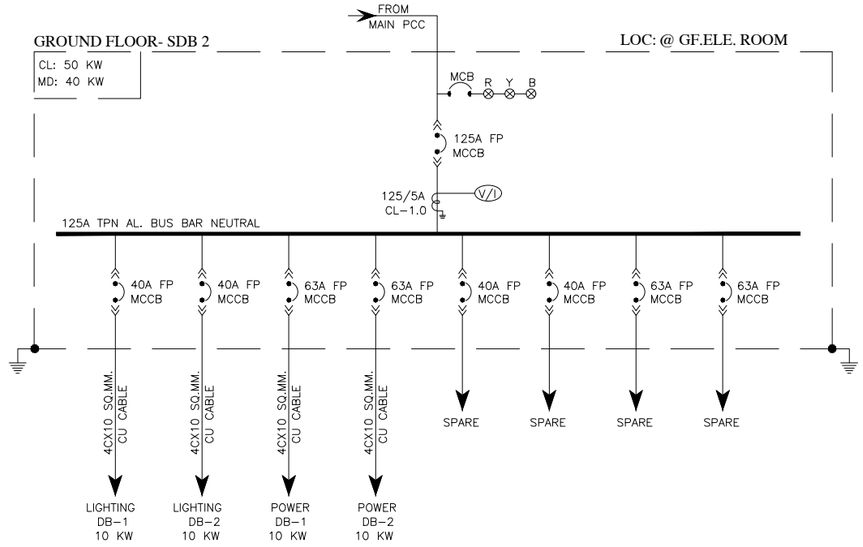


GROUND FLOOR- SDB 2

FROM MAIN PCC

LOC: @ GF.ELE. ROOM

CL: 50 KW
MD: 40 KW

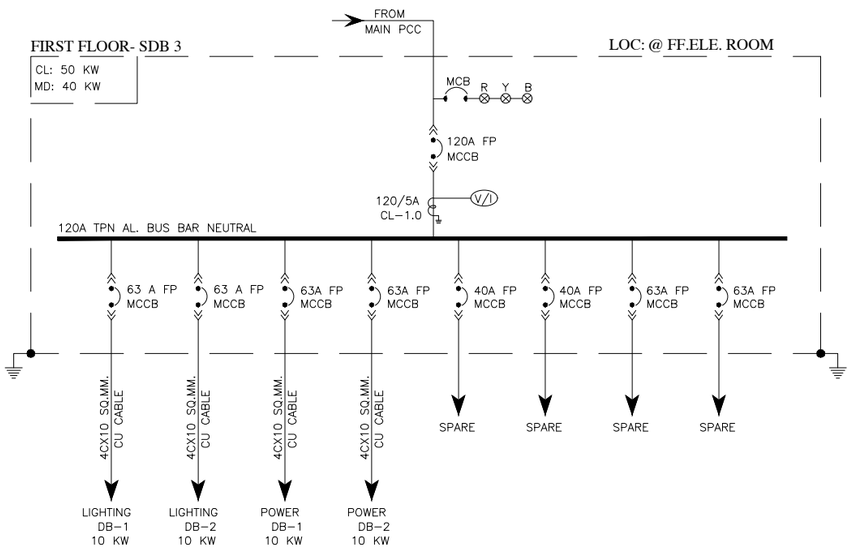


FIRST FLOOR- SDB 3

FROM MAIN PCC

LOC: @ FF.ELE. ROOM

CL: 50 KW
MD: 40 KW

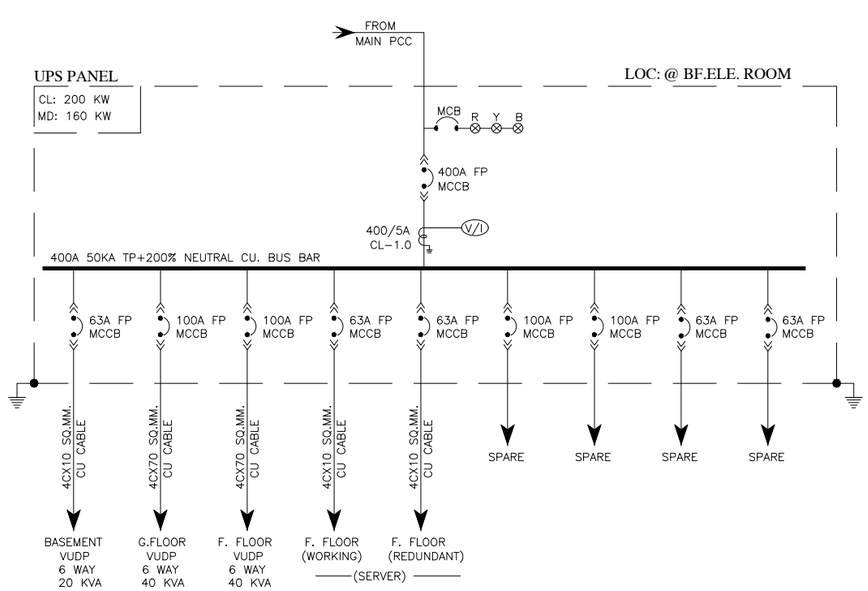


UPS PANEL

FROM MAIN PCC

LOC: @ BF.ELE. ROOM

CL: 200 KW
MD: 160 KW



1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

Rev.no.	Date	Description

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVELOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE

LUMBINI, NEPAL.

DRG. TITLE :

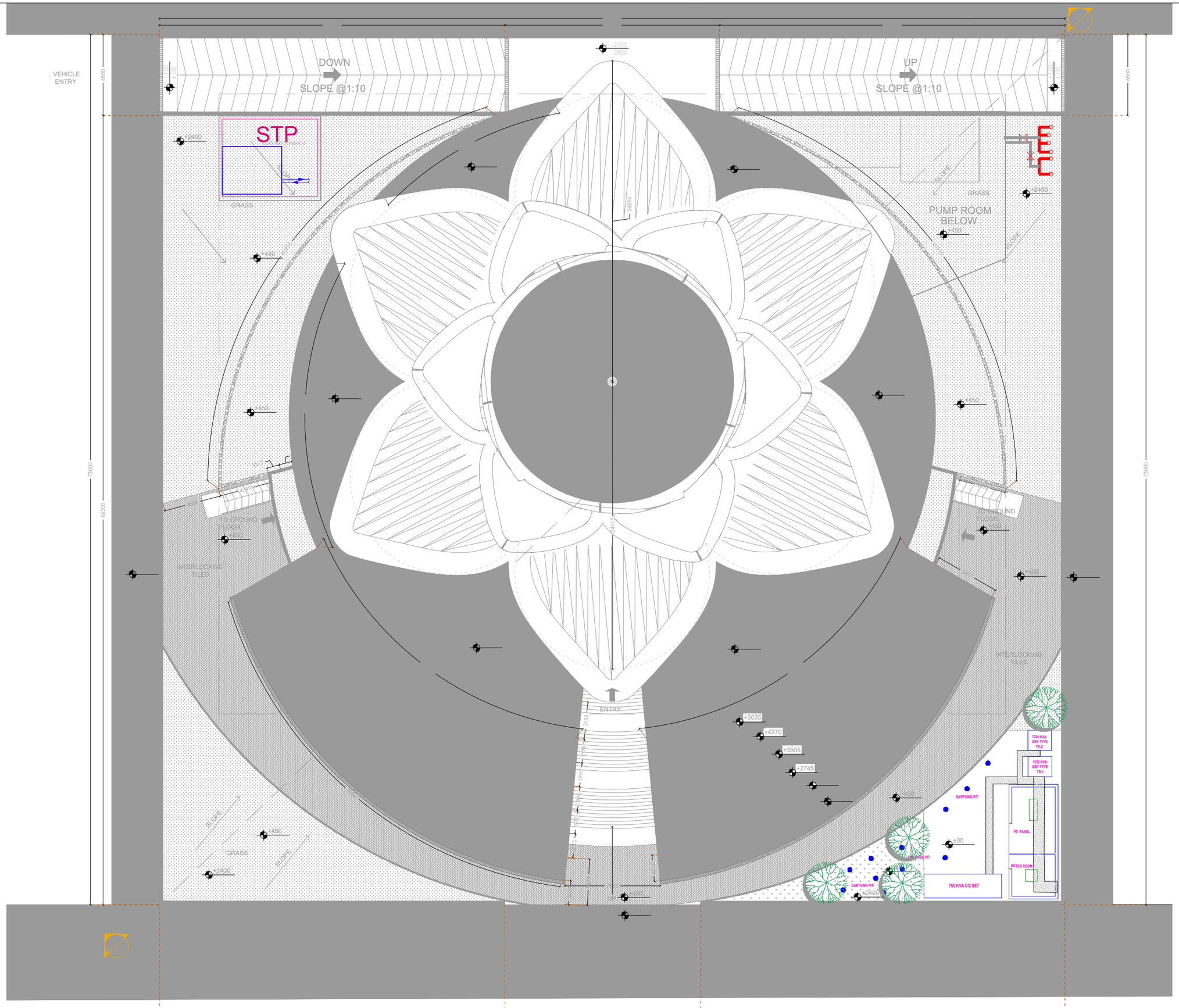
SINGLE LINE DIAGRAM (SHEET-3 OF 3)

Scale	Date	Rev.no.	Sheet Size.
NTS	03-05-22	R-00	A0

Drg. no.
LUMB-ELE-00-SLD-2010

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

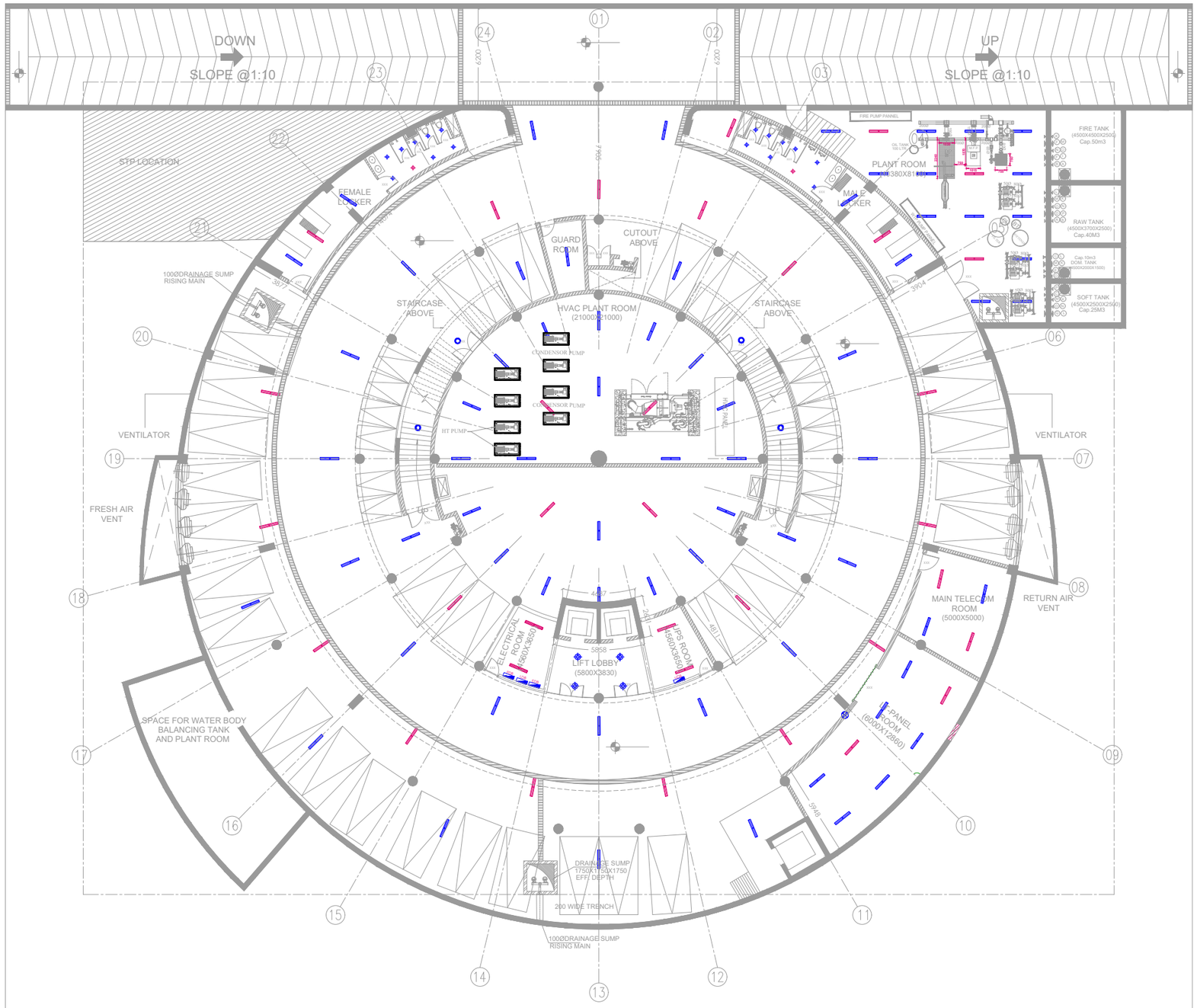
SITE PLAN TRANSFOREMER YARD (INCUDE HT & LT)

Scale	Date	Rev.no.
1: 300	11-05-22	R-00

Drg. no.
LUMB-ELE-00-TY-2020

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

	ELECTRICAL LEGEND	
SYMBOL	DESCRIPTIONS	HEIGHT(MM)
	60W LED DOWN LIGHT	CEILING
	40W LED DOWN LIGHT	CEILING
	22.5W LED DOWN LIGHT	CEILING
	40W LED BATTEN	CEILING
	15W LED DOWN LIGHT	CEILING
	10W MIRROR LED LIGHT	AS PER SITE
	20W LED WALL MOUNTED LIGHT	AS PER SITE
	60W LED DOWN EMERGENCY LIGHT	CEILING
	40W LED DOWN EMERGENCY LIGHT	CEILING
	15W LED DOWN EMERGENCY LIGHT	CEILING
	40W LED BATTEN EMERGENCY LIGHT	CEILING
	CEILING FAN	CEILING
	WALL LIGHT FIXTURE	WALL

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

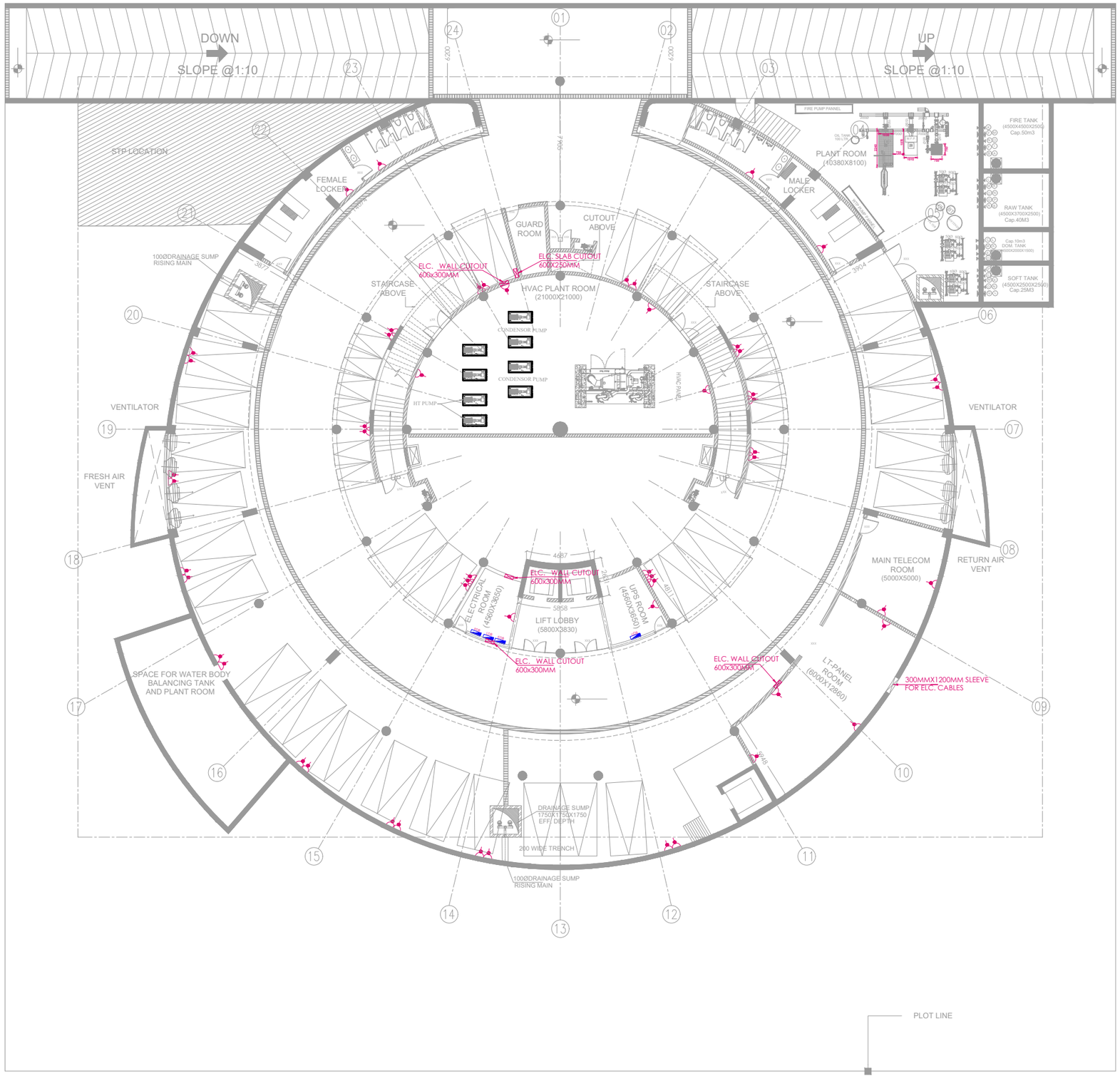
LIGHTING LAYOUT FOR BASEMENT FLOOR

Scale	Date	Rev.no.
1: 300	28.06.2022	R-00

Drg. no.
LUMB-ELE-BF-LL-2025

ISSUED FOR:

- ☐ GFC
- ☐ APPROVAL
- ■ TENDER
- ☐ REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

ELECTRICAL LEGEND

SYMBOL	DESCRIPTIONS	HEIGHT(MM)
	EXHAUST FAN	AS PER SITE
	TELEVISION POINT	900MM@ FFL.
	2X6A SOCKET OUTLET FOR RAW POWER	900MM@ FFL.
	6A SOCKET OUTLET FOR RAW POWER	450MM@ FFL.
	6/16A SOCKET OUTLET FOR RAW POWER	450MM@ FFL.
	20A SOCKET OUTLET FOR RAW POWER	450MM@ FFL.
	32A SOCKET OUTLET FOR RAW POWER	450MM@ FFL.
	2X6A SOCKET OUTLET FOR UPS POWER	450MM@ FFL.
	16A SOCKET OUTLET FOR UPS POWER	450MM@ FFL.
	FLOOR JUNCTION BOX	FLOOR
	DISTRIBUTION BOARD	1500MM FFL.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

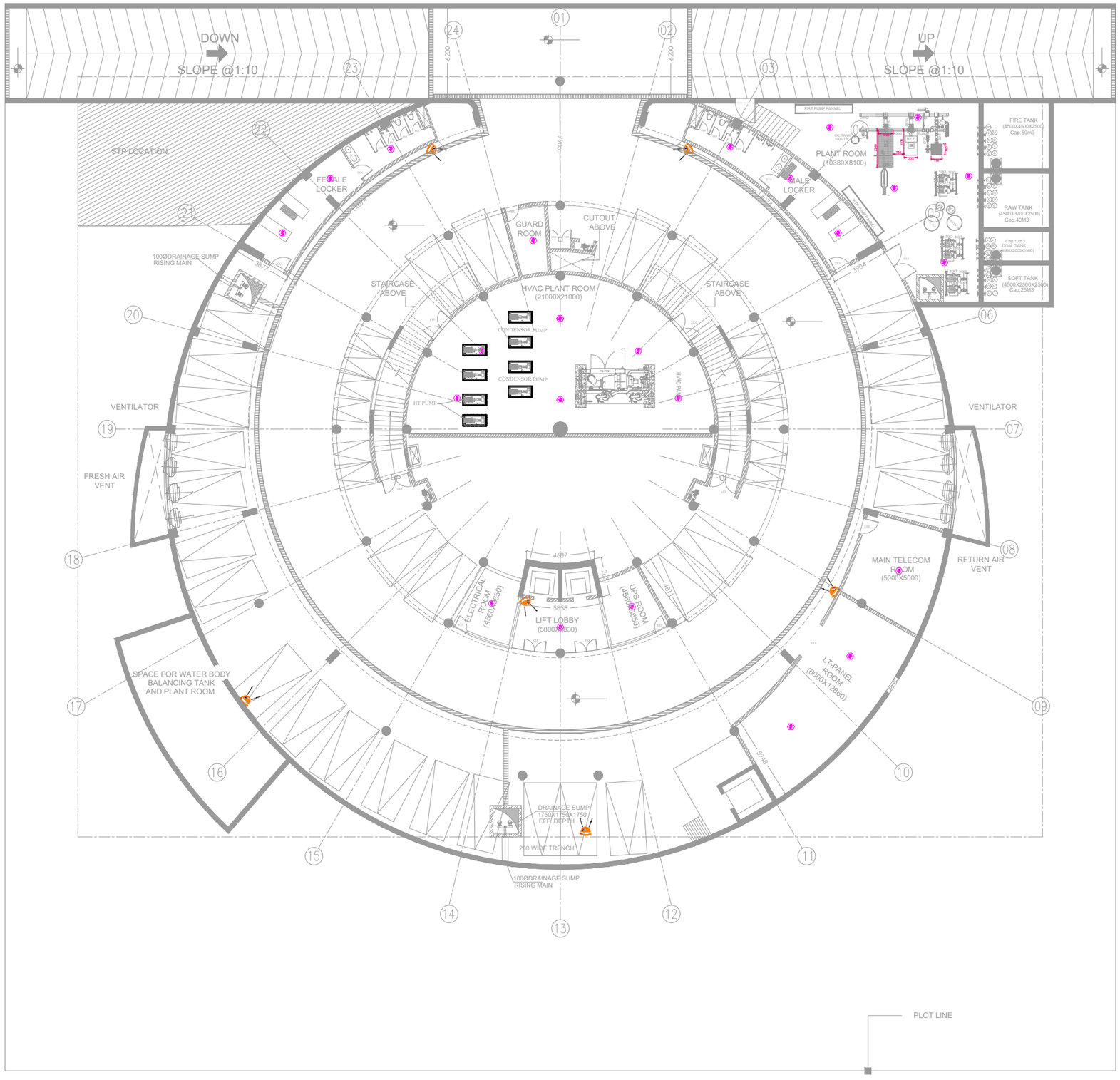
POWER LAYOUT FOR BASEMENT FLOOR

Scale	Date	Rev.no.
1: 300	28.06.2022	R-00

Drg. no.
LUMB-ELE-BF-PL-2030

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

FIRE ALARM LEGEND

SYMBOL	DESCRIPTION	
	OPTICAL SMOKE DETECTOR	CEILING
	MULTI SENSOR	CEILING
	CAMERA	AS PER SITE

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

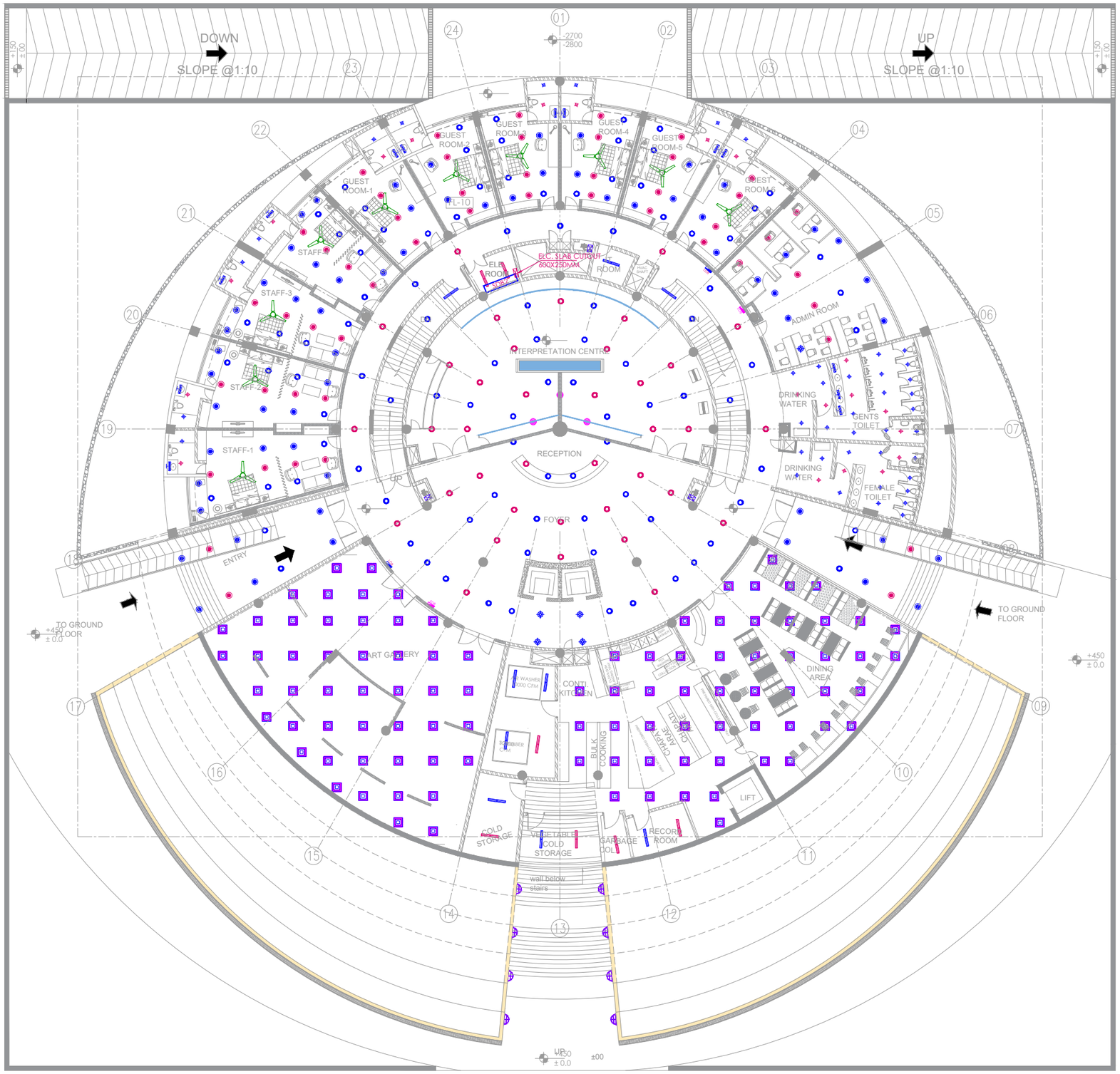
ELV LAYOUT FOR BASEMENT FLOOR

Scale	Date	Rev.no.
1: 300	28.06.2022	R-00

Drg. no.
LUMB-ELE-BF-ELV-2040

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

ELECTRICAL LEGEND

SYMBOL	DESCRIPTIONS	HEIGHT(MM)
	60W LED DOWN LIGHT	CEILING
	40W LED DOWN LIGHT	CEILING
	22.5W LED DOWN LIGHT	CEILING
	40W LED BATTEN	CEILING
	15W LED DOWN LIGHT	CEILING
	10W MIRROR LED LIGHT	AS PER SITE
	20W LED WALL MOUNTED LIGHT	AS PER SITE
	60W LED DOWN EMERGENCY LIGHT	CEILING
	40W LED DOWN EMERGENCY LIGHT	CEILING
	15W LED DOWN EMERGENCY LIGHT	CEILING
	40W LED BATTEN EMERGENCY LIGHT	CEILING
	CEILING FAN	CEILING
	WALL LIGHT FIXTURE	WALL
	36W LED LIGHT FIXTURE	CEILING

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

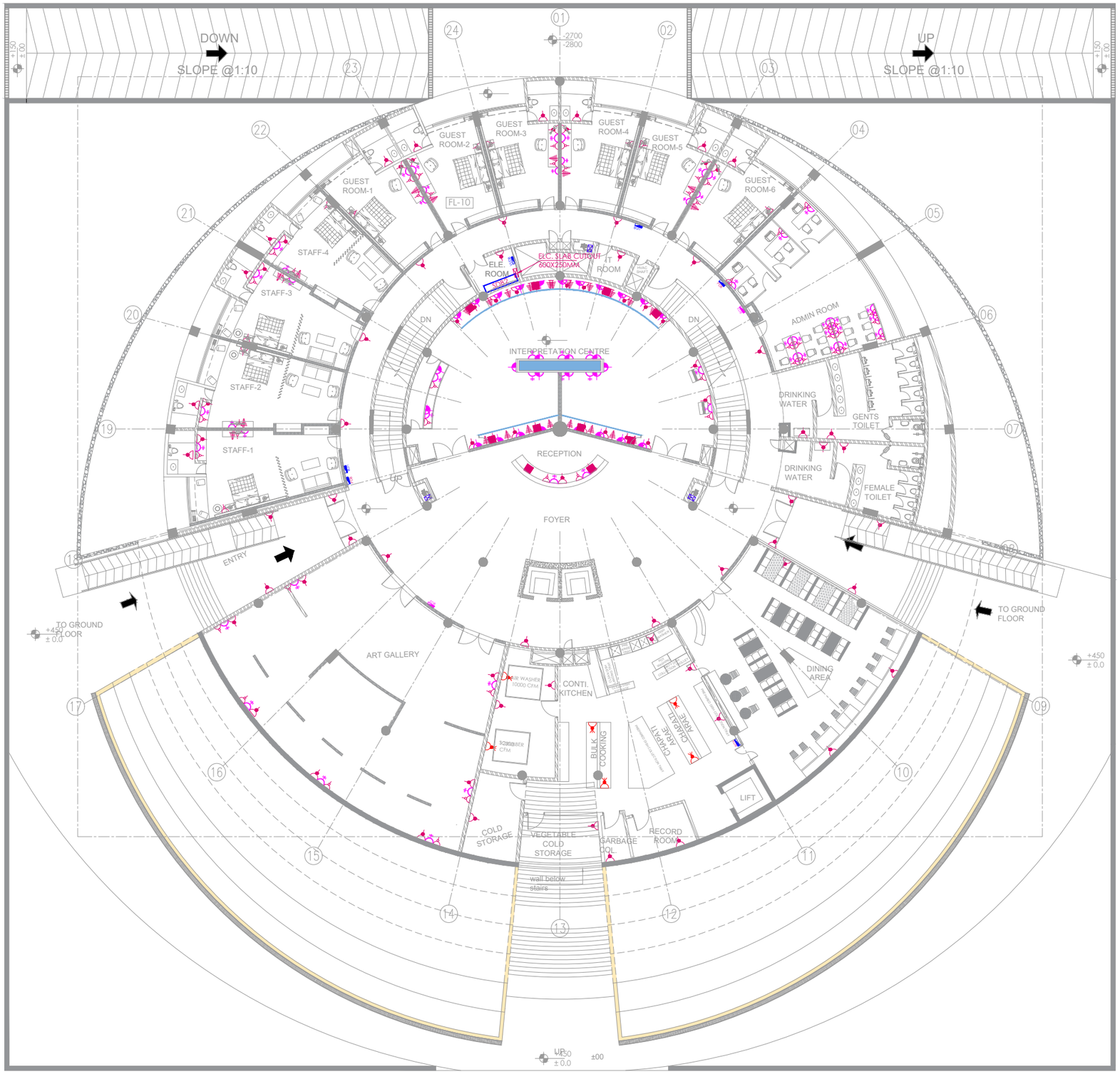
LIGHTING LAYOUT FOR GROUND FLOOR

Scale	Date	Rev.no.
1: 300	28.06.2022	R-00

Drg. no.
LUMB-ELE-GF-LL-2026

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

ELECTRICAL LEGEND

SYMBOL	DESCRIPTIONS	HEIGHT(MM)
	EXHAUST FAN	AS PER SITE
	TELEVISION POINT	900MM@ FFL
	2X6A SOCKET OUTLET FOR RAW POWER	900MM@ FFL
	6A SOCKET OUTLET FOR RAW POWER	450MM@ FFL
	6/16A SOCKET OUTLET FOR RAW POWER	450MM@ FFL
	20A SOCKET OUTLET FOR RAW POWER	450MM@ FFL
	32A SOCKET OUTLET FOR RAW POWER	450MM@ FFL
	2X6A SOCKET OUTLET FOR UPS POWER	450MM@ FFL
	16A SOCKET OUTLET FOR UPS POWER	450MM@ FFL
	FLOOR JUNCTION BOX	FLOOR
	DISTRIBUTION BOARD	1500MM FFL

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

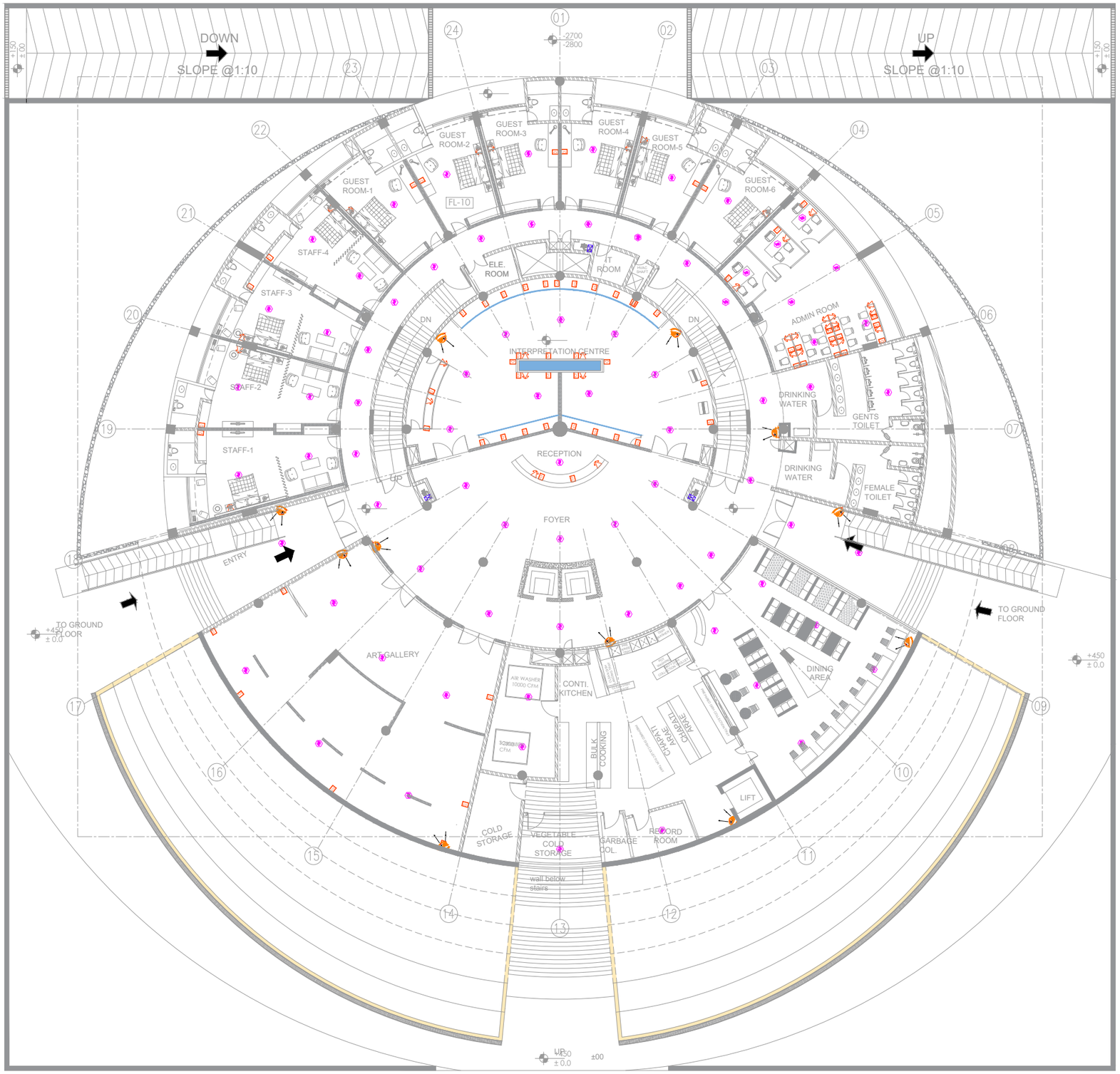
POWER LAYOUT FOR GROUND FLOOR

Scale	Date	Rev.no.
1: 300	28.06.2022	R-00

Drg. no.
LUMB-ELE-GF-PL-2031

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

FIRE ALARM LEGEND

SYMBOL	DESCRIPTION	
	OPTICAL SMOKE DETECTOR	CEILING
	MULTI SENSOR	CEILING
	CAMERA	AS PER SITE
	1NOS. DATA	AS PER SITE
	1NOS VOICE	AS PER SITE

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

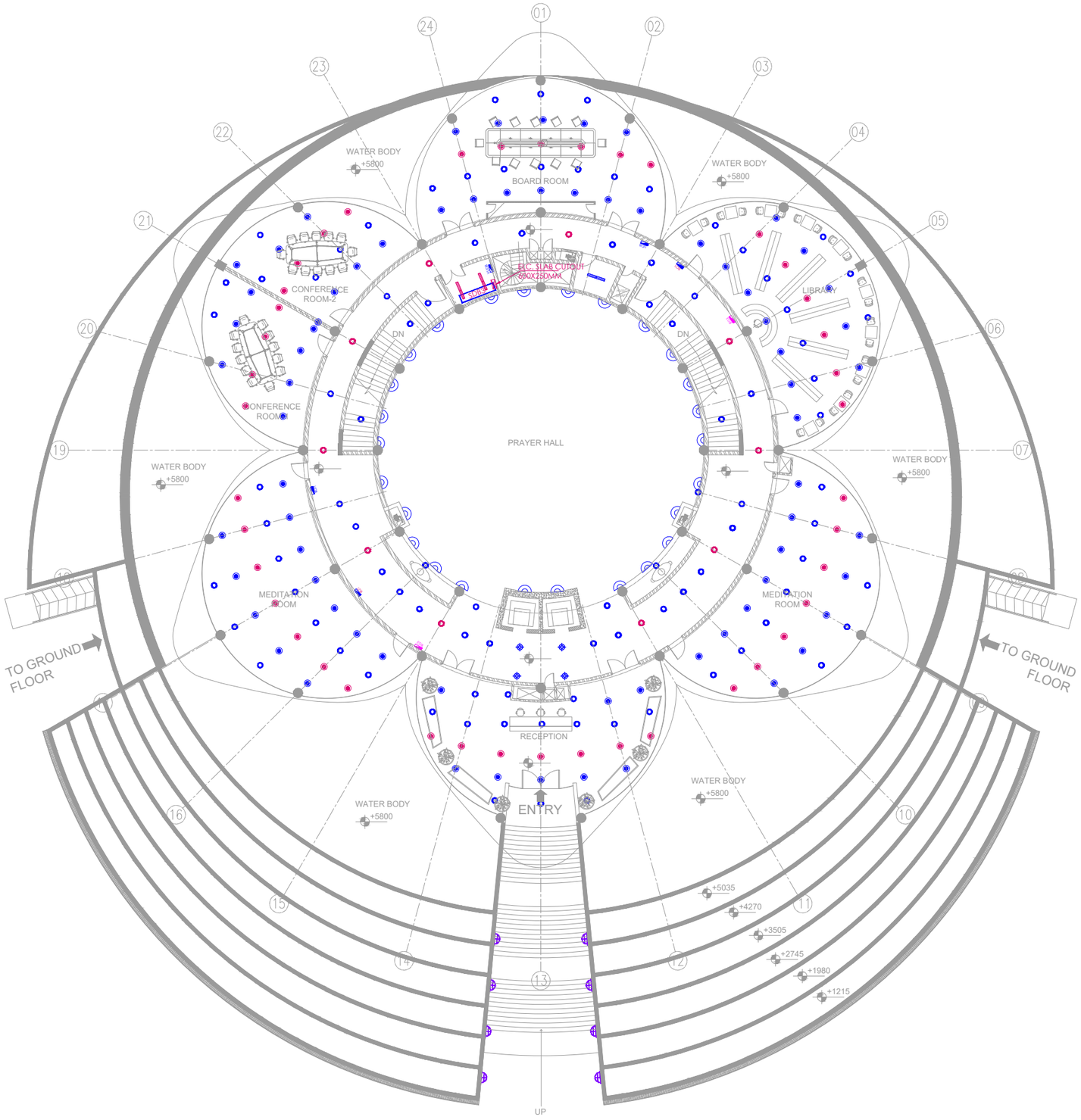
ELV LAYOUT FOR GROUND FLOOR

Scale	Date	Rev.no.
1: 300	28.06.2022	R-00

Drg. no.
LUMB-ELE-GF-ELV-2041

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

ELECTRICAL LEGEND		
SYMBOL	DESCRIPTIONS	HEIGHT(MM)
	60W LED DOWN LIGHT	CEILING
	40W LED DOWN LIGHT	CEILING
	22.5W LED DOWN LIGHT	CEILING
	40W LED BATTEN	CEILING
	15W LED DOWN LIGHT	CEILING
	10W MIRROR LED LIGHT	AS PER SITE
	20W LED WALL MOUNTED LIGHT	AS PER SITE
	60W LED DOWN EMERGENCY LIGHT	CEILING
	40W LED DOWN EMERGENCY LIGHT	CEILING
	15W LED DOWN EMERGENCY LIGHT	CEILING
	40W LED BATTEN EMERGENCY LIGHT	CEILING
	CEILING FAN	CEILING
	WALL LIGHT FIXTURE	WALL
	36W LED LIGHT FIXTURE	CEILING

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

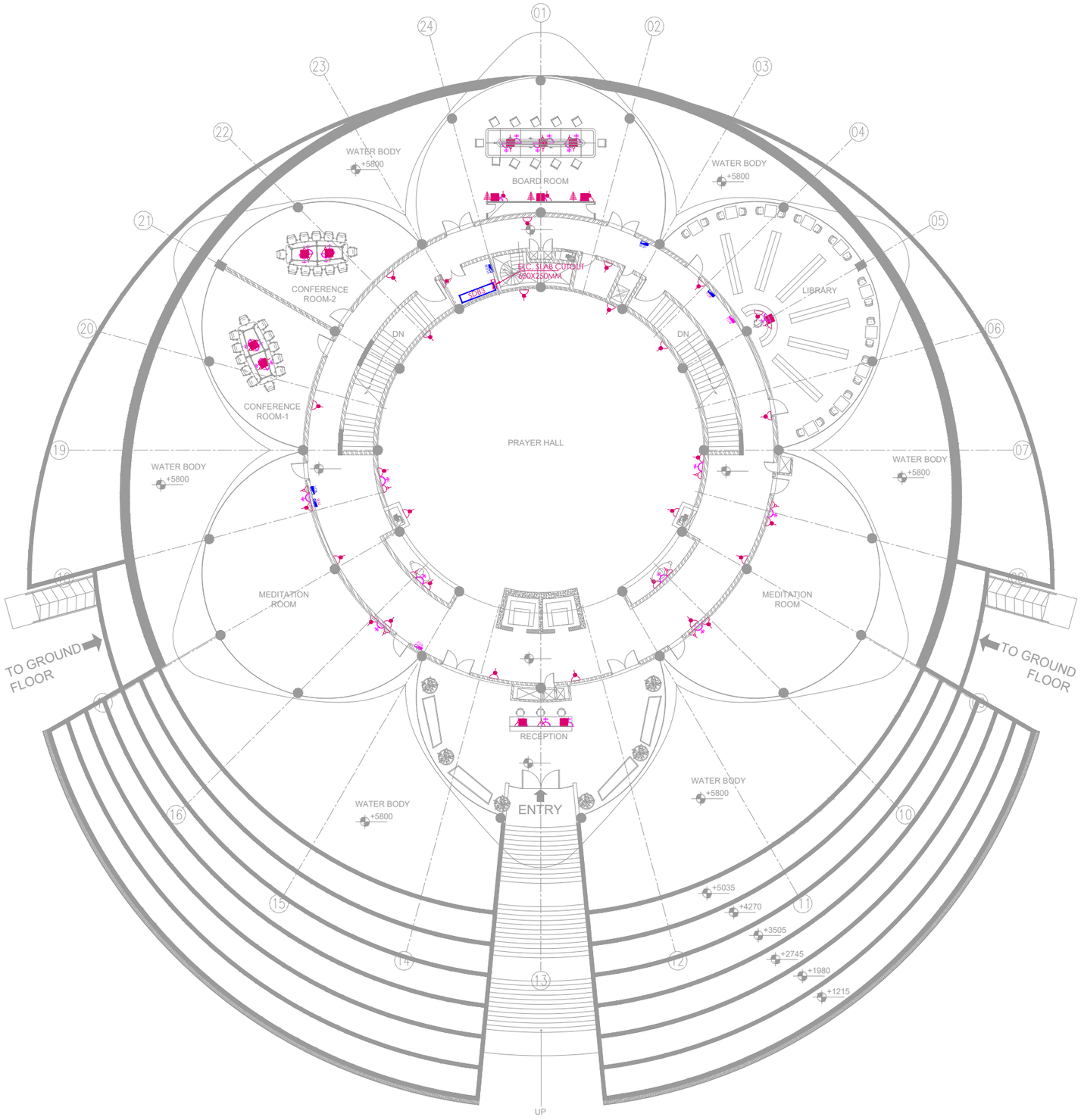
LIGHTING LAYOUT FOR FIRST FLOOR

Scale	Date	Rev.no.
1: 300	28.06.2022	R-00

Drg. no.
LUMB-ELE-FF-LL-2027

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

ELECTRICAL LEGEND		
SYMBOL	DESCRIPTIONS	HEIGHT(MM)
	EXHAUST FAN	AS PER SITE
	TELEVISION POINT	900MM@ FFL
	2X6A SOCKET OUTLET FOR RAW POWER	900MM@ FFL
	6A SOCKET OUTLET FOR RAW POWER	450MM@ FFL
	6/16A SOCKET OUTLET FOR RAW POWER	450MM@ FFL
	20A SOCKET OUTLET FOR RAW POWER	450MM@ FFL
	32A SOCKET OUTLET FOR RAW POWER	450MM@ FFL
	2X6A SOCKET OUTLET FOR UPS POWER	450MM@ FFL
	16A SOCKET OUTLET FOR UPS POWER	450MM@ FFL
	FLOOR JUNCTION BOX	FLOOR
	DISTRIBUTION BOARD	1500MM FFL
	DIRECTION LIGHT	

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

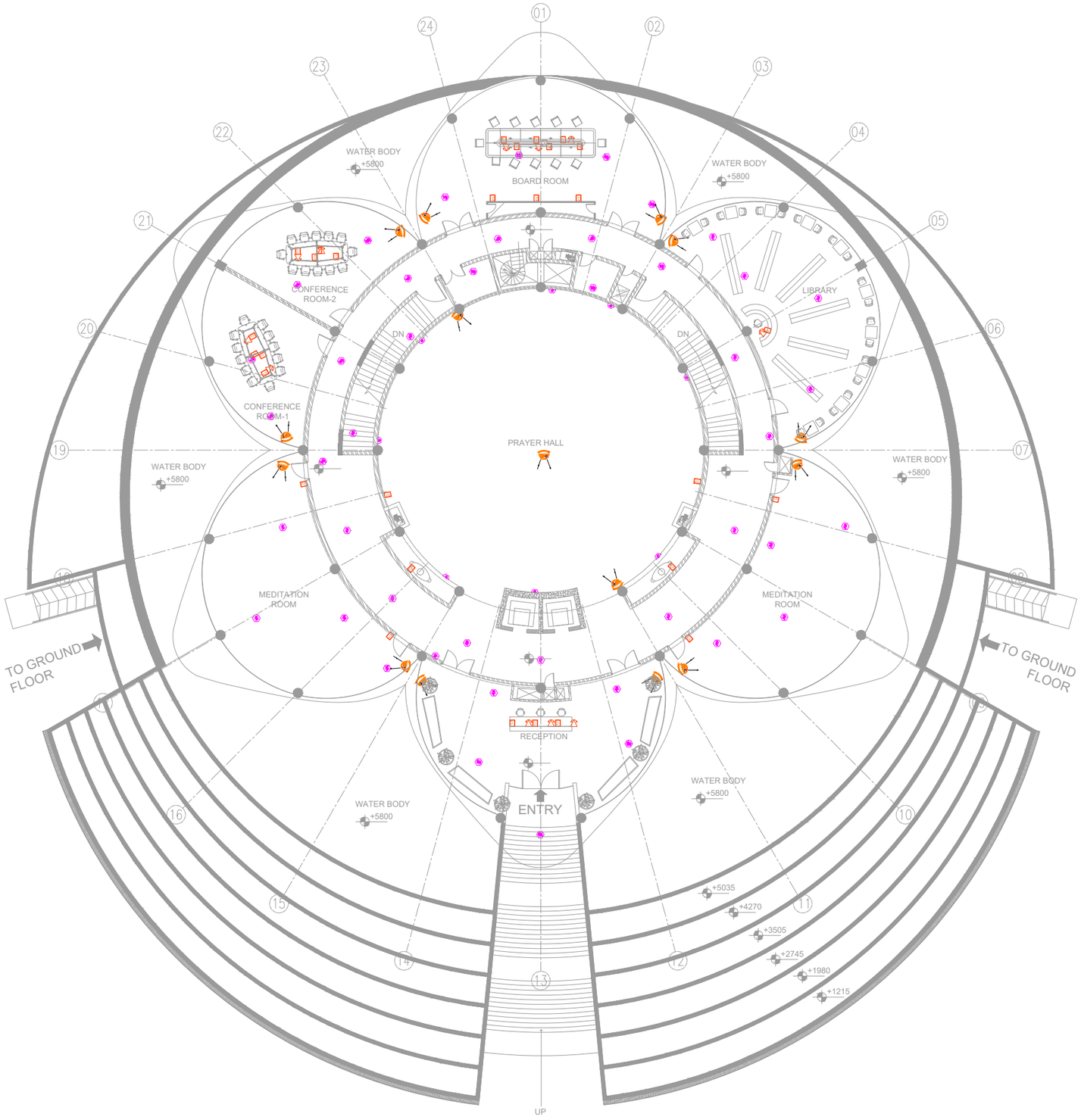
POWER LAYOUT FOR FIRST FLOOR

Scale	Date	Rev.no.
1: 300	28.06.2022	R-00

Drg. no.
LUMB-ELE-FF-PL-2032

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

FIRE ALARM LEGEND

SYMBOL	DESCRIPTION	
	OPTICAL SMOKE DETECTOR	CEILING
	WALL MOUNTED SMOKE DETECTOR	WALL
	MULTI SENSOR	CEILING
	CAMERA	AS PER SITE
	1NOS. DATA	AS PER SITE
	1NOS VOICE	AS PER SITE

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

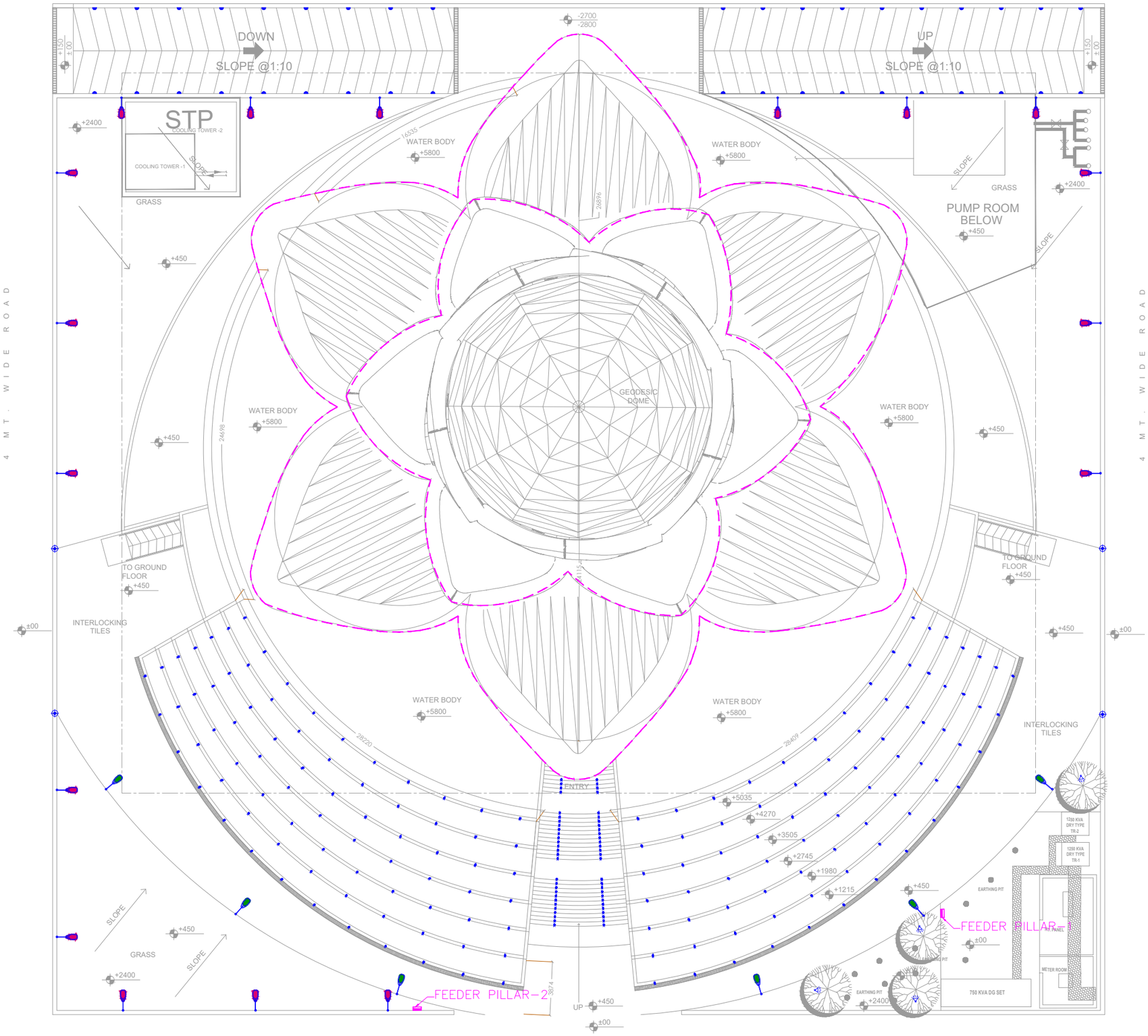
ELV LAYOUT FOR FIRST FLOOR

Scale	Date	Rev.no.
1: 300	28.06.2022	R-00

Drg. no.
LUMB-ELE-FF-ELV-2043

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



S. No.	SYMBOL	DESCRIPTION
1.		GATE LIGHT
2.		LED SPICK LIGHT
3.		STEP LIGHT
4.		6mt. SINGLE POLE LED LIGHT FITTING
5.		3mt. SINGLE POLE LED LIGHT FITTING
6.		BULK HEAD LIGHT
7.		LED STRIP LIGHT

NOTES:

1. THIS DRAWING IS THE COPYRIGHT OF: EGIS, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.
2. ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.
3. ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.
4. THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

LANDSCAPE LIGHTING LAYOUT

Scale	Date	Rev.no.
1: 300	29.06.2022	R-00

Drg. no.
LUMB-ELE-EX-LL-2056

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

ABBREVIATIONS-HVAC

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR
	CASSETTE UNIT
MOV	MOTORISED BUTTERFLY VALVE
	BUTTERFLY VALVE
	2-WAY MODULATING VALVE
	NON RETURN VALVE
	WATER PUMP
P	PRESSURE GAUGE WITH VALVE
	TEMPERATURE GUAGE
	BALANCING VALVE
	'Y' STRAINER
	DRAIN VALVE
	AIR VENT
	FLOW METER
	DP TRANSMITER/SENSOR
TE	TEMPERATURE SENSOR
LS	LEVEL SENSOR
PT	PRESSURE TRANSMITTER
FS	FLOW SWITCH (BY CHILLER MANUFACTURER)

ABBREVIATIONS	DESCRIPTION	ABBREVIATIONS	DESCRIPTION	ABBREVIATIONS	DESCRIPTION
AAV	AUTOMATIC AIR VENT	FAL	FRESH AIR LOUVER	NRV	NON RETURN VALVE
AFCV	AUTOMATIC FLOW CONTROL VALVE	FAHU	FRESH AIR HANDLING UNIT	N.T.S.	NOT TO SCALE
AHU	AIR HANDLING UNIT	F/B	FROM BELOW	ODU	OUT DOOR UNIT
AS	AIR SEPARATOR	F/C	FALSE CEILING	PG	PRESSURE GAUGE
BMS	BUILDING MANAGEMENT SYSTEM	FCU	FAN COIL UNIT	PICV	AUTOMATIC PRESSURE INDEPENDENT CONTROL VALVE
BOD	BOTTOM OF DUCT	FD	FIRE DAMPER	R	REDUCER
BOP	BOTTOM OF PIPE (WITH INSULATION)	FE	FLEXIBLE CONNECTION	RA	RETURN AIR
BOU	BOTTOM OF UNIT	F/F	FALSE FLOOR	RAD	RETURN AIR DUCT
BTP	BINDER TEST POINT	FFL	FINISH FLOOR LEVEL	RAG	RETURN AIR GRILLE
CCU	CLOSE CONTROL UNIT	FM	FLOW METER	RLBG	RETURN LINEAR BAR GRILLE
CDP	CONDENSATE DRAIN PIPE	FODRV	FIXED ORIFICE DOUBLE REGULATING VALVE	RLD	RETURN LINEAR SLOT DIFFUSER
CFM	CUBIC FEET PER MINUTE	FS	FLOW SWITCH	REF.	REFRIGERANT
℄	CENTER LINE	FPM	FEET PER MINUTE	RPM	REVOLUTIONS PER MINUTE
CMH	CUBIC METER PER HOUR	HEX	HEAT EXCHANGER	SA	SUPPLY AIR
CO	CARBON MONO OXIDE SENSOR	HRU	HEAT RECOVERY UNIT	SAT	SOUND ATTENUATOR
CHWPP	CHILLED WATER PRIMARY PUMP	HP	HORSE POWER	SAD	SUPPLY AIR DUCT
CHWSP	CHILLED WATER SECONDARY PUMP	HRW	HEAT RECOVERY WHEEL	SEG	SMOKE EXTRACT GRILLE
CHWR	CHILLED WATER RETURN PIPE	IDU	INDOOR UNIT	SEF	SMOKE EXTRACT FAN
CHWS	CHILLED WATER SUPPLY PIPE	IV	ISOLATING VALVE (BALL/GATE/BUTTERFLY VALVE)	SLBG	SUPPLY LINEAR BAR GRILLE
CYF	CYCLONE FAN	JEF	JET FAN	SLD	SUPPLY LINEAR SLOT DIFFUSER
DC	DRAIN COCK	KW	KILO WATT	SR	SUPPLY REGISTER
DG	DOOR GRILLE	L	LITRE	STL	SAND TRAP LOUVER
DPCV	DIFFERENTIAL PRESSURE CONTROL VALVE	l/s	LITRES PER SECOND	STR	'Y' STRAINER
DRV	DOUBLE REGULATING VALVE	M	METER	T	THERMOSTAT
DPT	DIFFERENTIAL PRESSURE TRANSMITTER	MAD	MAKEUP AIR DUCT	T	THERMOMETER
EA	EXTRACT AIR	MAF	MAKEUP AIR FAN	TAG	TRANSFER AIR GRILLE
EAD	EXTRACT AIR DUCT	MAV	MANUAL AIR VENT	TED	TOILET EXTRACT AIR DUCT
EAF	EXTRACT AIR FAN	MAG	MAKEUP AIR GRILLE	TP	TEST POINT
EAG	EXTRACT AIR GRILLE	MCV	MOTORIZED CONTROL VALVE	TYP.	TYPICAL
EAL	EXTRACT AIR LOUVER	MD	MOTORIZED DAMPER	TR	TON OF REFRIGERATION
ED	EXTRACT AIR DIFFUSER	MFD	MOTORIZED FIRE DAMPER	TT	TEMPERATURE TRANSMITTER
ET	EXPANSION TANK	MFSD	MOTORIZED FIRE & SMOKE DAMPER	VCD	VOLUME CONTROL DAMPER
FA	FRESH AIR	MM	MILLIMETER	VE	VIBRATION ELIMINATOR
F/A	FROM ABOVE	MSD	MOTORIZED SMOKE DAMPER	VFD	VARIABLE FREQUENCY DRIVE
FAD	FRESH AIR DUCT	NC	NORMALLY CLOSED	VIP	VIBRATION ISOLATING PAD
FAF	FRESH AIR FAN	NRD	NON RETURN DAMPER		

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

STANDARD LEGEND - HVAC SERVICE

Scale	Date	Rev.no.
1: 150	01-05-22	R-00

Drg. no.
LUMB-HV-00-D-1001

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

GENERAL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CO-ORDINATION OF ALL SERVICES.
2. ALL DUCT, GRILLE AND PIPE SIZES ARE IN MM UNLESS MENTIONED
3. ALL CONDENSATE DRAINS FROM EACH AHU / FCU WHETHER SHOWN ON DRAWING OR NOT SHALL RUN WITH A FALL TO THE NEAREST WASTE STACK OR FLOOR DRAIN VIA U-TRAPS.
4. ALL DUCT CONNECTIONS TO AC UNITS SHALL BE OF THE FLEXIBLE TYPE DUCT CONNECTION.
5. ACCESS PANELS TO BE PROVIDED WITHIN FALSE CEILING/UNDER FLOOR AT ALL LOCATIONS OF FCU, VALVES, FD, VCD, NRD & SPD. CONTRACTOR SHALL CO-ORDINATE WITH ALL MEP SERVICES & FALSE CEILING LAYOUT TO ENSURE THAT COMMON ACCESS PANELS TO BE PROVIDED FOR MAINTENANCE.
6. FD'S SHALL BE PROVIDED WHERE DUCTS/AIR OPENINGS CROSS FIRE ZONES/ STAIRCASE WALL AS IDENTIFIED BY THE ARCHITECT. ALL FD'S TO HAVE BLADES OUT OF THE AIR STREAM WHETHER SHOWN ON THE LAYOUT OR NOT AND 2 Hr. RATED ALL FD'S TO HAVE INSULATED ACCESS PANEL WITHIN DUCT.
7. SUITABLE FOR RATED APPROVED SLEEVES SHALL BE PROVIDED WHERE BOTH INSULATED AND NON INSULATED DUCTS PASS THROUGH WALLS/FLOORS ETC. ALL GAPS TO BE SEALED WITH SPECIFIED AND APPROVED TYPE MATERIAL.
8. ALL CHILLED WATER VALVES ETC.IN PLANT ROOMS, ROOF, RISER, SHAFTS AND EXTERNAL SHALL BE INSULATED IN APPROVED ACCESSIBLE VALVE BOXES WITH QUICK RELEASE FASTENINGS.
9. CHILLED WATER PIPE SUPPORTS SHALL NOT BE PENETRATED THROUGH INSULATION VAPOUR SEALS.
10. ALL DUCTWORK WITHIN 3.0 M OF FAN COIL UNITS /AHU SHALL BE ACOUSTICALLY LINED.
11. NON RETURN DAMPER (NRD) SHALL BE PROVIDED AFTER EACH DUCTED EXTRACT FAN IF ANY.
12. VCD'S SHALL BE PROVIDED AT ALL A/C DUCT BRANCHES. WHETHER SHOWN ON DRAWINGS OR NOT FOR PROPER AIR BALANCING.
13. POWER FACTOR CAPACITORS SHALL BE PROVIDED TO ALL MECHANICAL EQUIPMENT (PUMPS, A/C UNITS, ...etc)
14. ALL EXPOSED CHILLED WATER PIPES AND DUCTS ON ROOF, BASEMENT AND PLANT ROOM SHALL BE ALUMINIUM CLADDING ON TOP OF THE INSULATION.
15. ALL SUPPLY DIFFUSERS/GRILLES SHALL HAVE BUILT-IN V.C.D FOR FINAL FINE TUNING.
16. TOILET/PANTRY DOORS SHALL HAVE 20mm UNDERCUTS FOR AIR CIRCULATION. DOOR GRILLES SHALL NOT BE USED UNLESS OTHERWISE STATED/INDICATED.
17. AIRTIGHT PARTITIONS SHALL BE PROVIDED WHERE REQUIRED ABOVE FALSE CEILING/BELOW UNDER FLOOR TO SEGREGATE THE RETURN AIR FOR ALL AHU's/FCU's.
18. RETURN AIR OPENING/DUCT OF PROPER SIZE WITH FRAME AND WIRE MESH SHALL BE PROVIDED ABOVE FALSE CEILING WHERE NECESSARY.
19. ALL THERMOSTAT IN PUBLIC & COMMON AREA SHALL BE HOUSED IN LOCKABLE GLASS ENCLOSURE.
20. ALL OPENING FOR RETURN AIR PATH ABOVE FALSE CEILING/BELOW UNDER FLOOR SHALL BE PROVIDED WITH FD, WHERE AC SUPPLY DUCT HAS A FD.
21. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED PRIOR TO FINALIZATION OF CONTRACT. ANY VARIATION DUE TO NOT DOING SO, WILL NOT BE ENTERTAINED.
22. FINAL LOCATION T SHALL BE CO-ORDINATE WITH ARCHITECT'S DURING CONSTRUCTION STAGE.
23. ALL FRESH AIR AND EXTRACT BRANCH OUTLET SHALL BE TERMINATED ADJACENT TO EACH FCU WITH VCD AND, STAINLESS STEEL WIRE MESH.
24. FLEXIBLE CONNECTORS/EXPANSION BELLOWS SHALL BE PROVIDED WHERE A/C DUCTS/CHW PIPE CROSS BUILDING EXPANSION JOINT.
25. ALL EXPOSED ANGLE SUPPORTS FOR DUCTS/CHILLED WATER PIPES SHALL BE PAINTED AS SPECIFIED. COLOUR SUBJECT TO ARCH'S APPROVAL.
26. FINAL LOCATION OF FAL & EAL TO BE CO-ORDINATED WITH ARCH'S AT SITE. COLOUR SUBJECT TO ARCH'S APPROVAL.
27. WHERE MORE THAN ONE SERVICE (ELECTRICAL CABLES,DUCT, CHW PIPES) IS ROUTED THROUGH THE SAME AREA, THEY SHALL BE SUPPORTED BY STRUCTURAL FRAME SUPPORT WITH SERVICES STACKED ONE ABOVE THE OTHER. IF SPACE IS CONSTRAINT.
28. ALL SUPPLY AIR PLENUM SHALL BE INTERNALLY LINED AND PAINTED BLACK INTERNALLY.
29. CONTRACTOR TO ENSURE THAT THE SPECIFIED ROOM NOISE LEVELS (NC) ARE MAINTAINED. CONTRACTOR SHALL INCLUDE ATTENUATERS, ACOUSTIC INSULATION TO DUCTS, FAN ROOMS, FAHU ROOM, ETC TO ACHIEVE THE SPECIFIED NOISE LEVEL.
30. CONTRACTOR SHALL FORWARD ACTUAL PHYSICAL DIMENSIONS, WEIGHTS OF EQUIPMENT AFTER APPROVAL FOR STRUCTURAL ENGINEER.
31. CONTRACTOR TO CO-ORDINATE WITH STRUCTURAL DRAWINGS FOR OPENINGS AND PENETRATIONS. SUBMIT BUILDING WORK SHOP DRAWING FOR STRUCTURAL ENGINEER APPROVAL. ANY OPENING REQUIRED OTHER THAN THAT SHOWN ON STRUCTURAL DRAWING SHALL BE APPROVED BY STRUCTURAL ENGINEER.
32. ALL SLAB SUSPENDED SUPPORT LOCATION SHALL BE SUBMITTED FOR APPROVAL. NO DRILLING OR FIXING OF SUPPORT FROM OR ON SLAB SHALL BE CARRIED OUT WITH OUT THE STRUCTURAL ENGINEER'S APPROVAL.
33. ACOUSTIC MATS SHALL BE PROVIDED ON FALSE CEILING TILES BELOW FAN COIL UNITS IN ORDER TO ACHIEVE THE SPECIFIED NOISE LEVELS.
34. ALL FRESH AIR LOUVER SHALL HAVE SAND TRAP.
35. FINAL LOCATION OF ALL AIR OUTLET SHALL BE CO-ORDINATED WITH FINAL FALSE CEILING LAYOUT APPROVED BY ARCH'S.
36. ALL ELECTRICAL LOADS SHOWN ON ELECTRICAL TENDER DRAWING/ SPECIFICATIONS TO BE CHECKED & CONFIRMED AND THE CONTRACTOR SHALL INCLUDE IN HIS QUOTE ANY UPGRADING AS REQUIRED AT TENDER STAGE.
37. ALL AIR SIDE EQUIPMENTS SHALL BE CONNECTED TO THE FIRE ALARM SYSTEM.
38. SMOKE EXTRACT FANS & COMBINATION FIRE/SMOKE DAMPERS TO BE INTERFACED WITH ALARM PANEL. INCASE OF FIRE, DAMPERS & FIRE FLOOR & FLOORS ABOVE & BELOW SHALL BE OPENED TO EXTRACT SMOKE. ALL REMAINING FLOORS DAMPERS TO BE KEPT CLOSED.
39. THE CONTRACTOR WILL ENSURE THAT PROPER CALCULATION AND SELECTION OF ALL EQUIPMENTS IS CARRIED OUT AND APPROVED BY CLIENT/SITE ENGINEER.
40. CONTRACTOR TO RECHECK AND RECALCULATE THE VELOCITY, FLOW & PRESSURE OF CHW PIPES & AIR DUCTS BEFORE SUBMITTING THE SHOP DRAWINGS, IN CASE OF ANY DISCREPANCY THE CONTRACTOR SHALL MODIFY THE SIZE OF PIPES, DUCTS OR EQUIPMENTS AT NO ADDITIONAL COST.
41. ALL SMOKE EXTRACT DUCTWORK TO BE FIRE RATED.
42. SMOKE EXTRACT FANS & COMBINATION FIRE/SMOKE DAMPERS TO BE INTERFACED
43. ALL TYPES OF AHU'S, FCU'S, FANS, PUMPS TO BE PERFORMANCE TESTED IN THE FACTORY BEFORE SHIPPING TO SITE. TEST TO BE WITNESSED BY THE ENGINEER.
44. REFER TO ARCHITECTS DRAWINGS FOR FIRE COMPARTMENTATION.
45. MAKE AT NO EXTRA COST, ANY CHANGES OR ADDITION MATERIAL, AND/OR EQUIPMENT NECESSARY TO ACCOMMODATE STRUCTURAL CONDITIONS.
46. MEP SHOP DRAWING TO BE BASED ON MEP CONTRACTORS MULTI SERVICE. COORDINATED DRAWINGS.
47. PRESSURE DROP CALCULATIONS FOR ALL AIR SYSTEMS, AHU'S & FCU'S SHALL BE SUBMITTED BY THE MEP CONTRACTOR TO THE ENGINEER FOR REVIEW AND APPROVAL BEFORE PLACING THE ORDER OF EQUIPMENTS.
48. MEP CONTRACTOR TO ENSURE SUFFICIENT ACCESS IS PROVIDED TO ALL PLANT FOR COMMISSIONING, MAINTENANCE & FUTURE REPLACEMENT.
49. ALL CONDENSATE DRAIN PIPES TO BE INSULATED IN ACCORDANCE WITH THE SPECIFICATION AND DRAWINGS.
50. DAMPERS WITH DIFFUSERS/GRILLES SHALL BE PAINTED BLACK.
51. HYDRAULIC PRESSURE DROP CALCULATIONS FOR ALL PUMPS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL BEFORE PLACING THE ORDER OF EQUIPMENTS.
52. INSTALL ALL CEILING MOUNTED COMPONENTS (DIFFUSERS, GRILLES,LIGHT FIXTURES, SPRINKLERS, DETECTORS. etc) IN ACCORDANCE WITH THE REFLECTED CEILING DRAWINGS WHICH TO BE PREPARED BY THE CONTRACTOR AND COORDINATED WITH ALL TRADES. THESE MUST BE SUBMITTED FOR ENGINEER FOR REVIEW AND APPROVAL BEFORE COMMENCEMENT ON SITE.
53. ALL HVAC WORK SHALL BE COMPLIED WITH ASHRAE STANDARD AND ALL DUCT AND ACCESSORIES SHALL COMPLY WITH SMACNA/DW 144.
54. BY PASS LINE WITH ISOLATING VALVE SHALL BE PROVIDED TO ALL FCU'S AHU'S FAHU'S FOR FLUSHING.
55. 55 THE CONTRACTOR TO PROVIDE POWER SUPPLY TO MECHANICAL EQUIPMENTS WHETHER SHOWN ON THE POWER DRAWINGS OR NOT.
56. ALL KED SHALL BE FIRE RATED AS PER SPECIFICATION.
57. BINDER'S MECHANICAL SEALS TO BE PROVIDED AS ALL SIDES OF PUMPS, COILS, STRAINERS & CONTROL VALVES WHETHER SHOWN OR NOT.

NOTES:

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

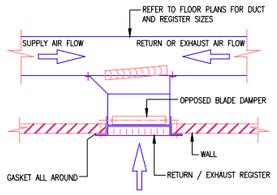
STANDARD NOTES - HVAC SERVICE

Scale	Date	Rev.no.
1: 150	01-05-22	R-00

Drg. no.
LUMB-HV-00-D-1002

ISSUED FOR:

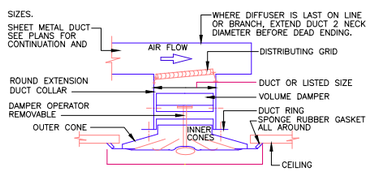
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES

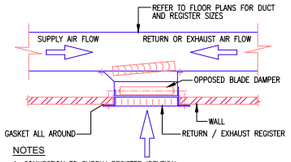
1. CONNECTION TO SUPPLY REGISTER IDENTICAL
2. IN PLASTER FINISHED WALLS, FURNISH AND INSTALL MATCHING PLASTER FRAME FOR REGISTER OR GRILLE.
3. WHERE REGISTER IS LAST ON LINE OR BRANCH, EXTEND DUCT TO NECK DIAMETERS BEFORE ENDING DUCT.

TYPICAL DUCT CONNECTION TO REGISTER



ROUND DIFFUSER WITH ROUND NECK
FLUSH FIXED PATTERN

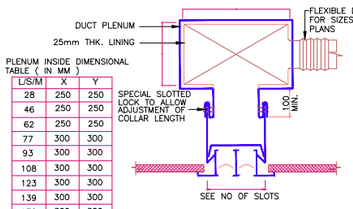
FLUSH MOUNTED DIFFUSER IN DUCT



NOTES

1. CONNECTION TO SUPPLY REGISTER IDENTICAL
2. IN PLASTER FINISHED WALLS, FURNISHED & INSTALL MATCHING PLASTER FRAME FOR REGISTER OR GRILLE.
3. WHERE REGISTER IS LAST ON LINE OR BRANCH EXTEND DUCT TWO NECK DIAMETERS BEFORE ENDING DUCT.

FLUSH MOUNTED REGISTER IN DUCT

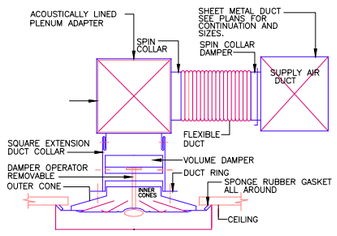


PLENUM INSIDE DIMENSIONAL TABLE (IN MM)

L/S/M	X	Y
28	250	250
46	250	250
62	250	250
77	300	300
93	300	300
108	300	300
123	300	300
139	300	300
170	300	300
186	300	300

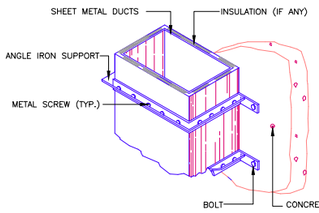
NOTE.
PLENUM LENGTH SHALL BE 25mm LONGER THAN THE LINEAR SLOT DIFFUSER.

LINEAR DIFFUSER PLENUM DETAILS

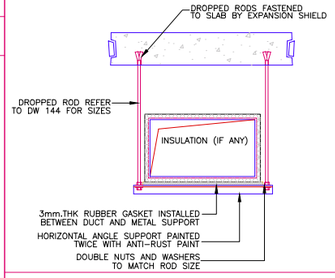


SQUARE DIFFUSER WITH SQUARE NECK FIXED PATTERN
WITH PLENUM BOX ADAPTER FOR FLEXIBLE CONNECTION

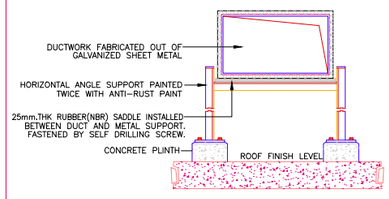
INSTALLATION OF SQUARE CEILING DIFFUSER



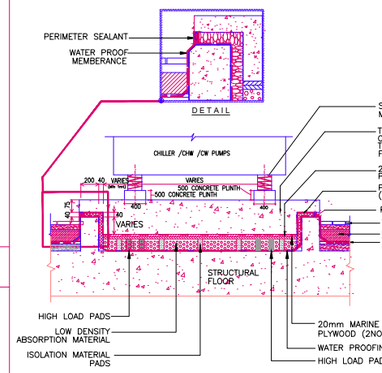
VERTICAL DUCT HANGER DETAIL



HORIZONTAL DUCT SUSPENDED TO CONCRETE SLAB



TYPICAL DUCT SUPPORT AT THE ROOF



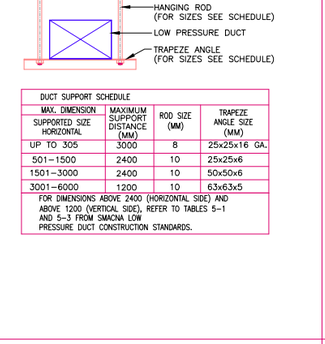
A. SPECIFICATIONS FOR FLOATING FLOORS

1. THE FLOATING FLOOR SYSTEM SHALL CONSIST OF A HEAVY AGGREGATE 150PCF CONCRETE 'FLOATING' SLAB OF 200mmMINIMUM THICKNESS, THE ISOLATION MATERIAL AND THE SUPPORTING FLOOR STRUCTURE.
2. ISOLATION SYSTEM :
   SHALL CONSIST OF 20mm MARINE PLYWOOD (2NOS.) SUPPORTED BY PRECOMPRESSED MOLDED FIBER GLASS NOISE AND VIBRATION ISOLATION PADS, INDIVIDUALLY COATED WITH A FLEXIBLE MOISTURE-IMPERVIOUS MEMBRANE. ISOLATION PADS SHALL BE OF FLAME- ANNEALED GLASS FIBERS AND SHALL HAVE BEEN STABILIZED BY PRE-COMPRESSION. THE ISOLATION PADS SHALL BE SPACED ON 300mm CENTERS EACH WAY. THE THICKNESS AND DENSITY SHALL BE TO SUIT THE WEIGHT AND THE NOISE AND VIBRATION GENERATED BY THE MACHINES. LOW DENSITY FIBER GLASS NOISE ABSORPTION MATERIAL 18kg/m3, NRC.87 50mm THICK, SHALL BE BONDED TO THE ENTIRE AREA BETWEEN THE ISOLATION PADS.
   PADS AND ABSORPTION MATERIAL CAN BE SUPPLIED IN ROLL OUT FROM WITH PLYWOOD APPLIED TO ROLLS AT SITE BY OTHERS. BEARING SURFACE AREA OF EACH PAD SHALL BE DETERMINED BY THE ISOLATION MANUFACTURER ON THE BASIS OF FINAL EVALUATION OF CONCENTRATED AND UNIFORMLY IMPOSED LOADS. BUT IN NO CASE SHALL THE UNIFORM LOAD RANGE BE LESS THAN 978kg/m2 TO MAINTAIN AN ESSENTIALLY CONSTANT NATURAL FREQUENCY OF 15Hz OR LOWER AND UNIFORM DEFLECTION OF THE FLOATING FLOOR.PADS SHALL HAVE A MINIMUM OVERLOAD CAPACITY OF 100% IN ALL HIGH LOAD AREAS.
   THE PLYWOOD SHALL BE ASSEMBLED WITH METAL JUNCTION PLATES DURING INSTALLATION.
3. PERIMETER ISOLATION BOARD SHALL BE 2 LAYERS OF 20mm MOISTURE NON-ABSORBENT CLOSED CELL EXPANDED POLYETHYLENE CONFORMING TO ASTM DESIGNATIONS C-272, D-624, D-1564 AND D-1621.

B. GENERAL :

1. FLOATING FLOOR SHALL BE PROVIDED BY MAIN CONTRACTOR. 50mm RATED SPRING ISOLATORS SHALL BE BY MEP SUB-CONTRACTOR.
2. MAIN CONTRACTOR SHALL ENGAGE A SPECIALIST TO PROVIDE :
   2.1 DETAIL DESIGN FOR FLOATING FLOOR, BASED ON ABOVE INDICATIVE DETAIL AND SPECIFICATIONS.
   2.2 NECESSARY CALCULATIONS AND GUARANTEE THAT NOISE LEVELS IN AREAS BELOW THE CHILLERS AND IN ADJOINING AREAS SHALL NOT EXCEED SPECIFIED NC LEVELS.
   2.3 ALL NECESSARY MATERIALS AND SUPERVISION DURING CONSTRUCTION.
3. EXTENSIONS REQUIRED TO FLOATING FLOOR AREA, IF ANY REQUIRED, TO PREVENT FLANKING NOISE OR ANY OTHER NECESSARY RELATED MEASURES SHALL BE DEEMED TO BE RESPONSIBILITY OF THE CONTRACTOR.
4. ALL ISOLATION MATERIALS AND PADS SHALL BE AS PER SPECIFIED MANUFACTURES.

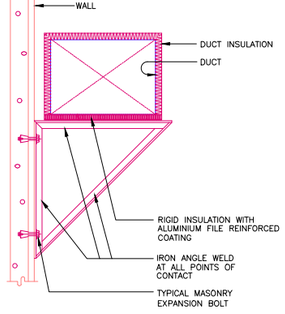
FLOATING FLOOR SYSTEM WITH ISOLATED HOUSEKEEPING PAD



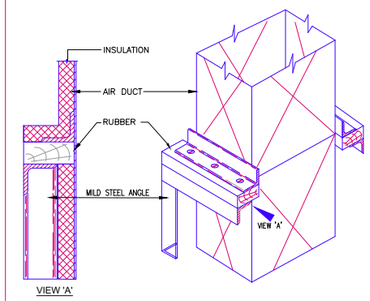
DUCT SUPPORT SCHEDULE			
MAX. DIMENSION SUPPORTED SIZE HORIZONTAL	MAXIMUM SUPPORT DISTANCE (MM)	ROD SIZE (MM)	TRAPEZE ANGLE SIZE (MM)
UP TO 305	3000	8	25x25x16 GA.
501-1500	2400	10	25x25x6
1501-3000	2400	10	50x50x6
3001-6000	1200	10	63x63x5

FOR DIMENSIONS ABOVE 2400 (HORIZONTAL SIDE) AND ABOVE 1200 (VERTICAL SIDE), REFER TO TABLES 5-1 AND 5-3 FROM SMACNA LOW PRESSURE DUCT CONSTRUCTION STANDARDS.

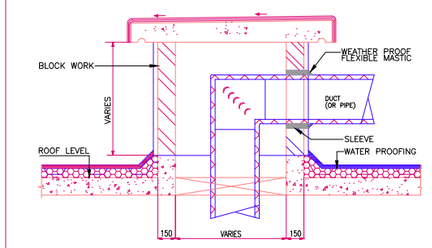
DUCT HANGERS AND SUPPORTS



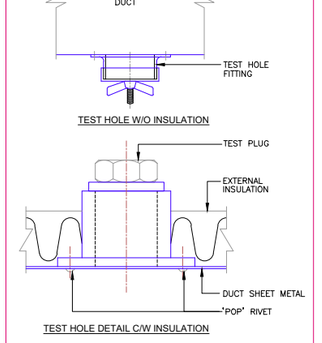
DUCT WORK WALL SUPPORT DETAILS



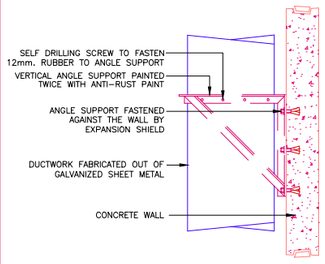
DETAIL OF VERTICAL AIR DUCT SUPPORT



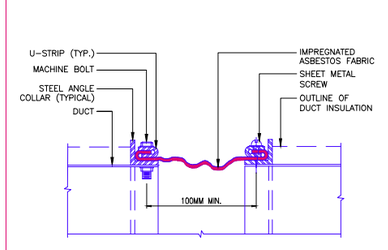
ROOF SLAB HVAC DUCT / PIPE PENETRATION DETAIL



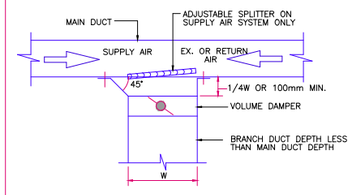
METHOD OF TEST HOLE INSTALLATION



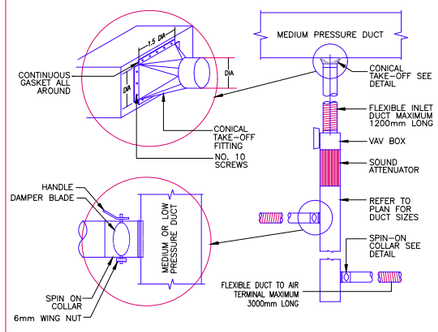
VERTICAL DUCT SUSPENDED AGAINST THE WALL



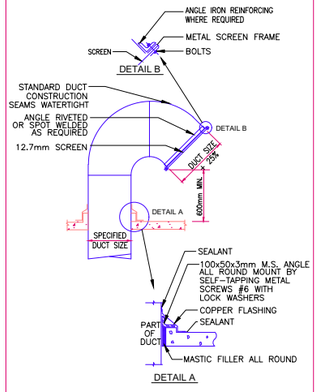
FLEXIBLE DUCT CONNECTOR DETAIL



TYPICAL SPLITTER DAMPER AT TAKE-OFF



DUCTWORK BEND & TAPER DETAILS



GOOSE NECK DETAIL

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR
	CASSETTE UNIT

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

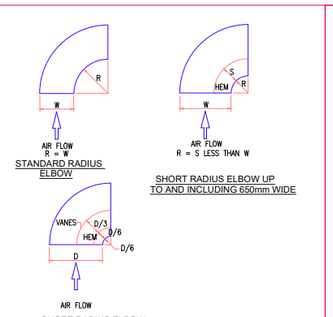
STANDARD DETAIL - HVAC SERVICE (SHEET1 TO 5)

Scale	Date	Rev.no.
NTS	01-05-22	R-00

Drg. no.
LUMB-HV-00-D-1003

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



STANDARD RADIUS ELBOW

SHORT RADIUS ELBOW UP TO AND INCLUDING 650mm WIDE

SHORT RADIUS ELBOW LARGER THAN 650mm WIDE

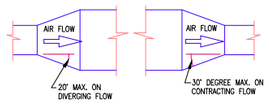
ROUND ELBOW

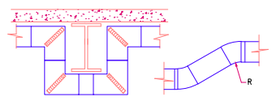
SMALL DOUBLE VANE SQUARE ELBOW

SMALL DOUBLE VANE

LARGE DOUBLE VANE SQUARE ELBOW OVER 900mm WIDTH

SQUARE ELBOW



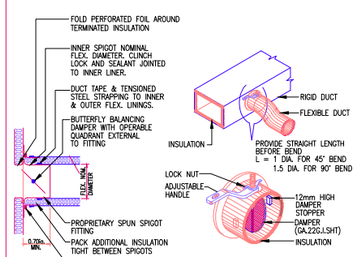


FULL RADIUS WHERE POSSIBLE R = W

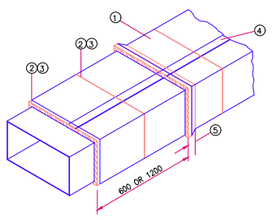
NOTE

ROUND RADIUS ELBOW TO BE USED WHENEVER SPACE PERMITS. OTHERWISE MITERED 90 DEGREE SHALL BE USED.

TAPERS - OFFSETS

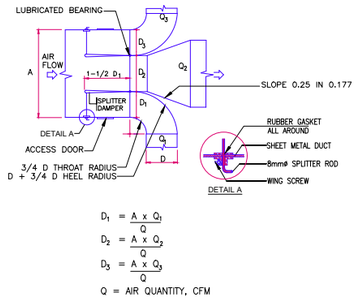


FLEXIBLE DUCT VAPOR SEALED SPIGOT DETAIL



ITEM	DESCRIPTION
1	FIRE WRAP 1.5 DUCT INSULATION, ONE LAYER
2	FILAMENT TAPE (TEMPORARY HOLD)
3	SS BANDING STRAPS (PERMANENT HOLD)
4	75MM MINIMUM LONGITUDINAL OVERLAP
5	75MM MINIMUM OVERLAP

SMOKE DUCT INSULATION



$D_1 = \frac{A \times Q_1}{Q}$

$D_2 = \frac{A \times Q_2}{Q}$

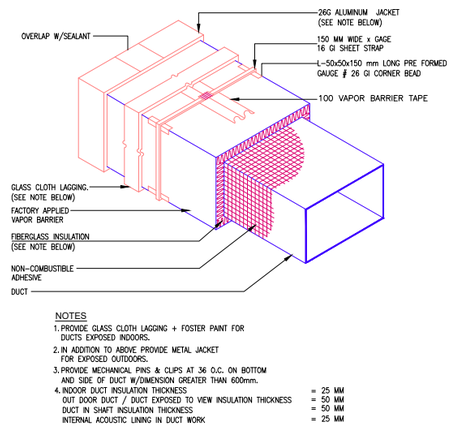
$D_3 = \frac{A \times Q_3}{Q}$

Q = AIR QUANTITY, CFM

NOTE:

1. DAMPER SHALL BE 1 SIZE HEAVIER THAN DUCT.
2. MINIMUM 22 GAUGE, 6 DOUBLE CONSTRUCTION.

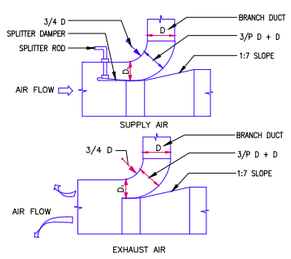
LONG RADIUS ELBOW DUCT TAKE-OFF DETAIL



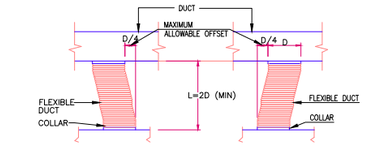
NOTES

1. PROVIDE GLASS CLOTH LAGGING + FOSTER PAINT FOR DUCTS EXPOSED INDOORS.
2. IN ADDITION TO ABOVE PROVIDE METAL JACKET FOR EXPOSED OUTDOORS.
3. PROVIDE MECHANICAL PINS & CLIPS AT 36 O.C. ON BOTTOM AND SIDE OF DUCT W/DIMENSION GREATER THAN 600mm.
4. INDOOR DUCT INSULATION THICKNESS = 25 MM
   OUT DOOR DUCT / DUCT EXPOSED TO VIEW INSULATION THICKNESS = 50 MM
   DUCT IN SHAFT INSULATION THICKNESS = 50 MM
   INTERNAL ACOUSTIC LINING IN DUCT WORK = 25 MM

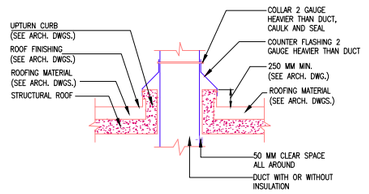
HVAC DUCT INSULATION DETAIL



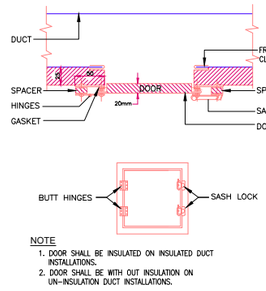
TYPICAL DUCT TAKE OFF DETAIL



FLEXIBLE DUCT CONNECTIONS



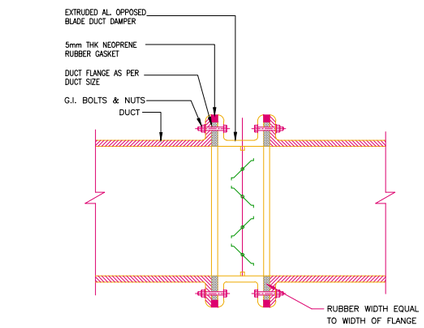
DUCT PENETRATIONS THRU ROOF



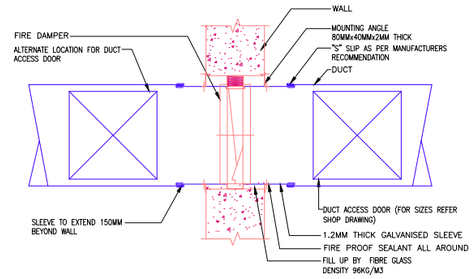
NOTE

1. DOOR SHALL BE INSULATED ON INSULATED DUCT INSTALLATIONS.
2. DOOR SHALL BE WITH OUT INSULATION ON UN-INSULATION DUCT INSTALLATIONS.

ACCESS DOOR IN DUCTS FOR FIRE DAMPER



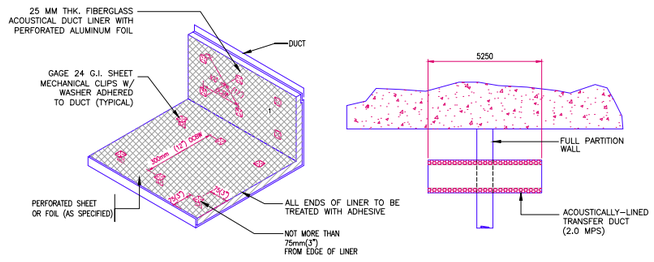
DUCT DAMPER FIXING DETAIL (VD)



NOTES:

1. OPENING IN WALL SHALL BE 6MM LARGER THAN OVERALL SIZE OF FIRE DAMPER.

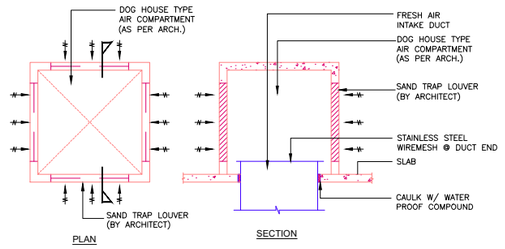
VERTICAL FIRE DAMPER FOR ALL SIZES



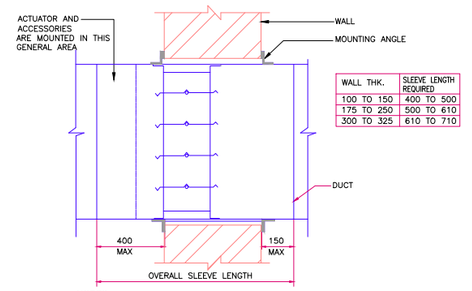
NOTES:

1. INSTALL SURFACE W/ PERFORATED SHEET OR FOIL (AS SPECIFIED) ON AIR STREAM SIDE
2. APPLY ADHESIVE ON 100% OF DUCT SURFACE FOR ATTACHMENT OF THE ACOUSTICAL DUCT LINER

ACOUSTICAL DUCT LINER MOUNTING DETAIL.



DETAIL OF FRESH AIR INTAKE DOG HOUSE



WALL THK.	SLEEVE LENGTH REQUIRED
100 TO 150	400 TO 500
175 TO 250	500 TO 610
300 TO 325	610 TO 710

NOTES

1. OPENING IN WALL SHALL BE 25mm TO 40mm LARGER THAN OVERALL SIZE OF MOTORIZED SMOKE FIRE DAMPER
2. SLEEVE SHALL BE 16 GA. FOR DAMPERS 900mm WIDE AND 14 GA. IF WIDTH EXCEEDS 900mm
3. ACCESS SHALL BE PROVIDED FOR ACTUATOR AND ACCESSORIES
4. CEILING ACCESS PANEL BY GENERAL CONTRACTOR. SEE REFLECTED CEILING PLANS.

MOTORIZED SMOKE FIRE DAMPER INSTALLATION DETAILS

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR
	CASSETTE UNIT

R00		
Rev.no.	Date	Description

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

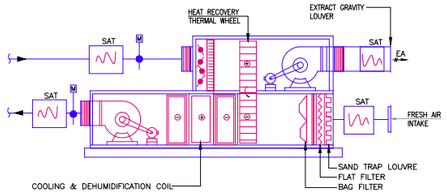
STANDARD DETAIL - HVAC SERVICE (SHEET2 TO 5)

Scale	Date	Rev.no.
NTS	01-05-22	R-00

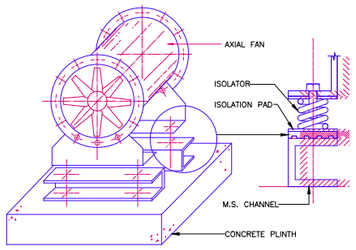
Drg. no.
LUMB-HV-00-D-1004

ISSUED FOR:

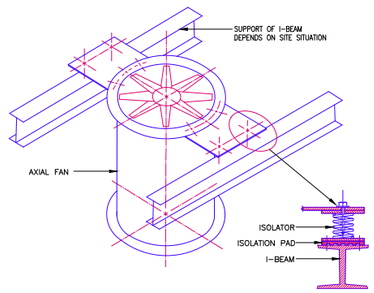
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



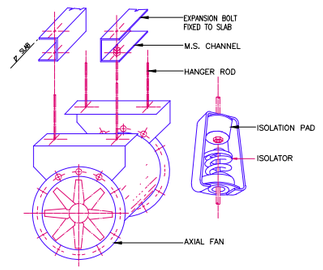
TYPICAL FRESH AIR HANDLING UNIT



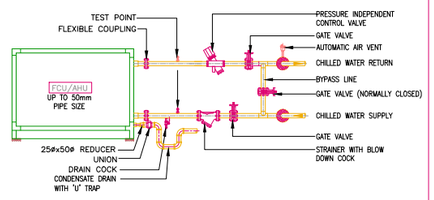
FLOOR MOUNTED AXIAL FAN



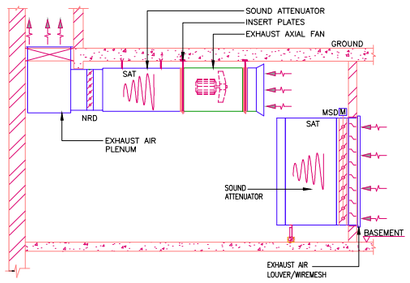
VERTICAL MOUNTED AXIAL FAN



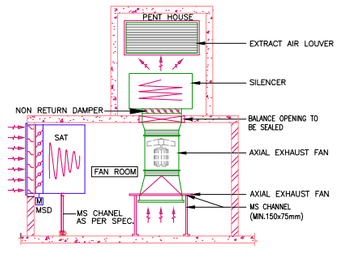
CEILING SUSPENDED AXIAL FAN



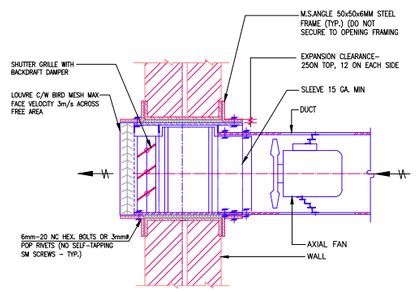
CHILLED WATER PIPE CONNECTION DETAIL UP TO 50Ø PIPE SIZE



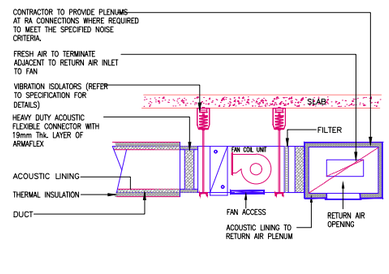
TYPICAL FAN INSTALLATION DETAILS - HORIZONTAL



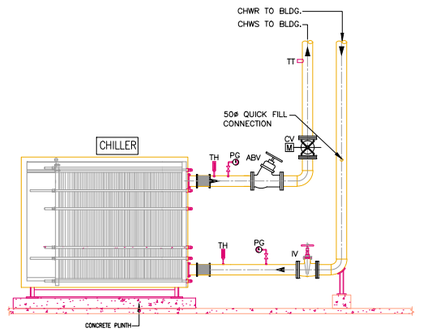
TYPICAL FAN INSTALLATION DETAILS - VERTICAL



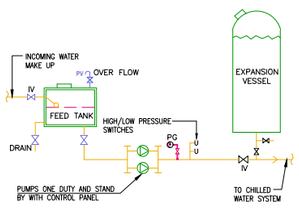
WALL MOUNTED EXHAUST FAN (DUCTED)



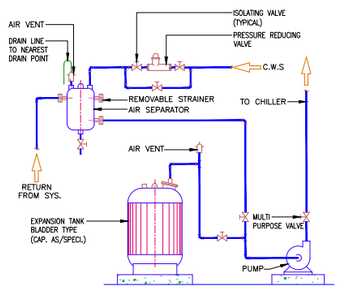
TYPICAL FAN COIL UNIT INSTALLATION



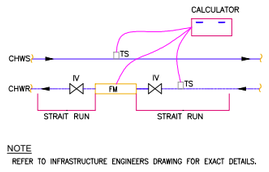
AIR COOLED CHILLER CONNECTION



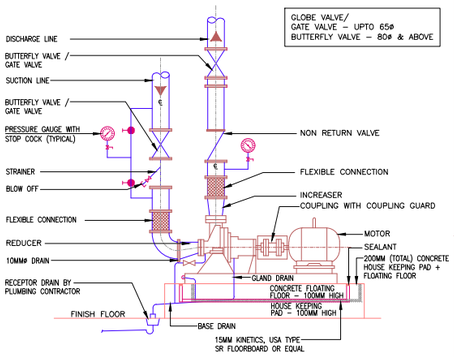
PRESSURIZATION UNIT SCHEMATIC



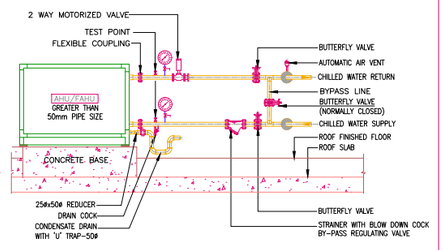
AIR SEPARATOR & EXPANSION DETAIL (VERTICAL FLOOR MOUNTED REPLACEABLE BLADDER)



BTU COOLING METER STATION



END SUCTION PUMP WITH FOUNDATION



AHU / FAHU 2 PORT VALVE ARRANGEMENT

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR
	CASSETTE UNIT

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

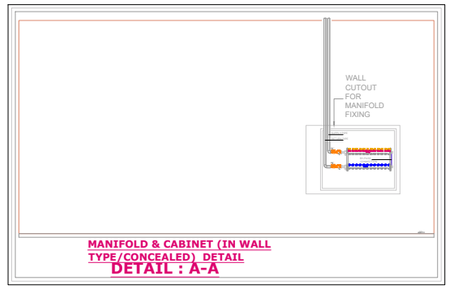
STANDARD DETAIL - HVAC SERVICE (SHEET3 TO 5)

Scale	Date	Rev.no.
NTS	01-05-22	R-00

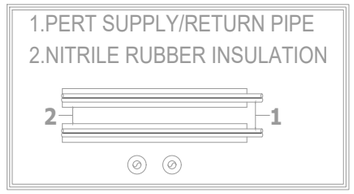
Drg. no.
LUMB-HV-00-D-1005

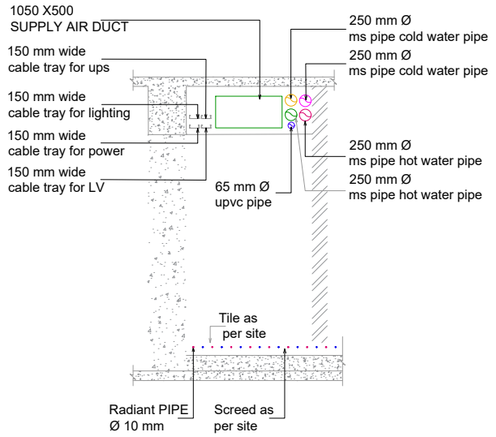
ISSUED FOR:

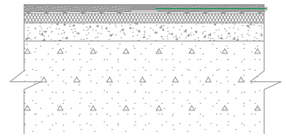
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



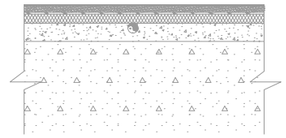
MANIFOLD & CABINET (IN WALL TYPE/CONCEALED) DETAIL
DETAIL : A-A



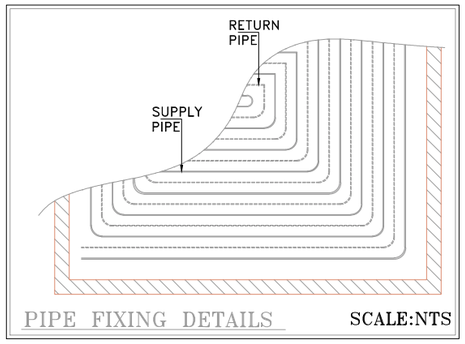




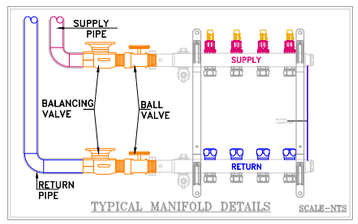
FLOOR COOLING PIPE & ELECTRICAL FLOOR BOX DETAIL



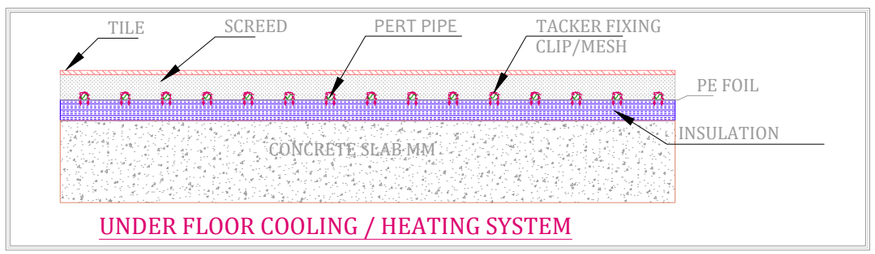
FLOOR COOLING PIPE & DRAINAGE PIPE CROSSING DETAILS



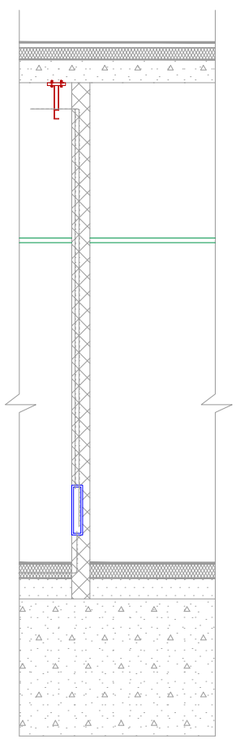
PIPE FIXING DETAILS SCALE:NTS

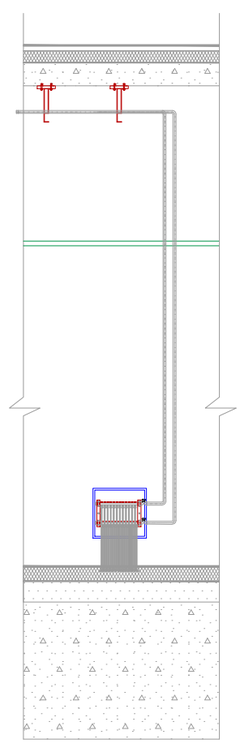


TYPICAL MANIFOLD DETAILS SCALE-NTS



UNDER FLOOR COOLING / HEATING SYSTEM





NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR
	CASSETTE UNIT

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

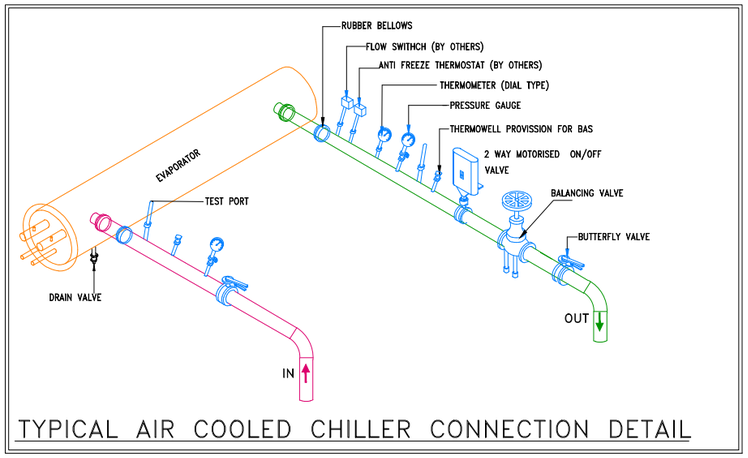
STANDARD DETAIL - HVAC SERVICE (SHEET4 TO 5)

Scale	Date	Rev.no.
NTS	01-05-22	R-00

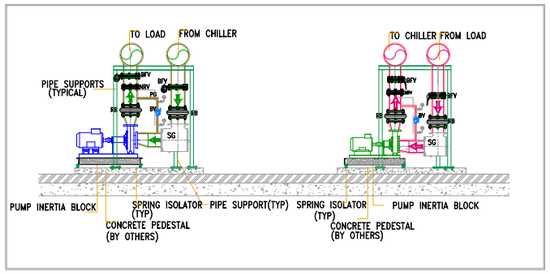
Drg. no.
LUMB-HV-00-D-1006

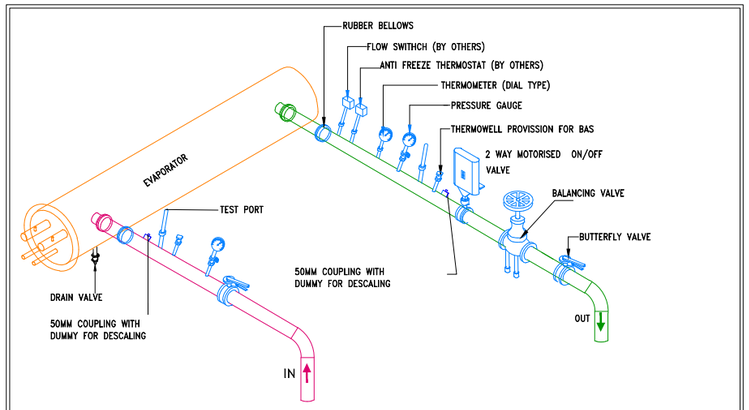
ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

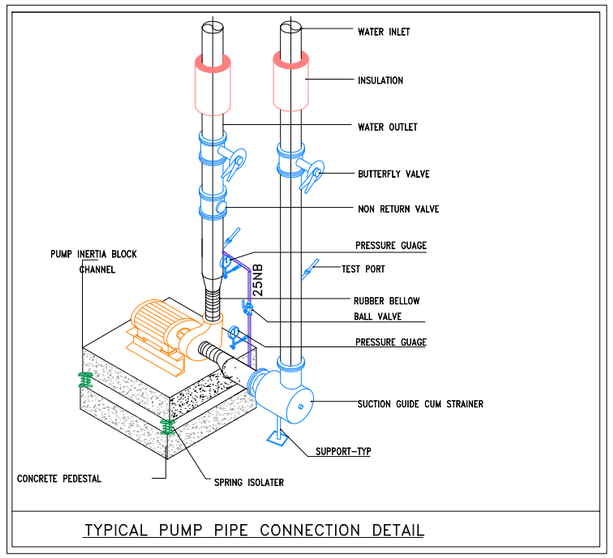


TYPICAL AIR COOLED CHILLER CONNECTION DETAIL

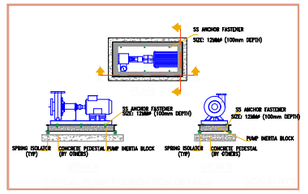


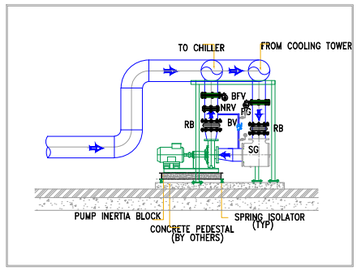


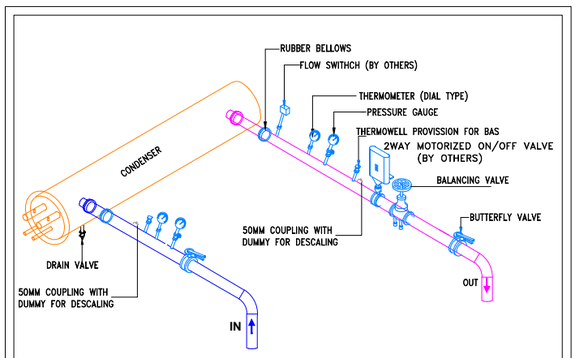
TYPICAL WATER COOLED CHILLER CONNECTION DETAIL



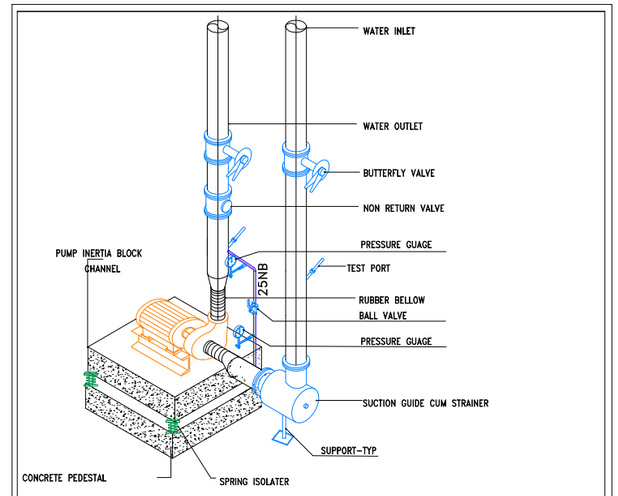
TYPICAL PUMP PIPE CONNECTION DETAIL



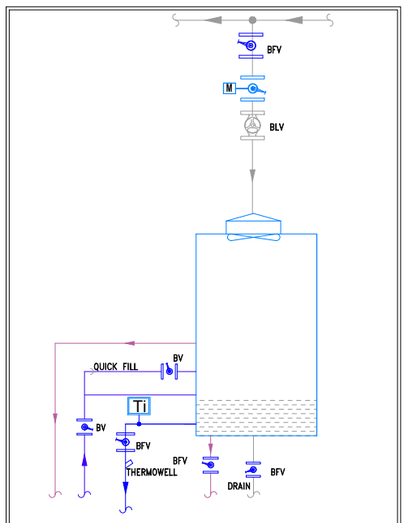




TYPICAL WATER COOLED CONDENSER CONNECTION DETAIL



TYPICAL CONDENSER PUMP PIPE CONNECTION DETAIL



TYPICAL COOLING TOWER CONNECTION DETAIL

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

LEGEND:-

S.NO.	SYMBOL	DESCRIPTION
1	BFV	MOTORISED BUTTERFLY VALVE
2		BUTTERFLY VALVE
3		2-WAY MODULATING VALVE
4		NON RETURN VALVE
5		WATER PUMP
6	P	PRESSURE GAUGE WITH VALVE
7		TEMPERATURE GUAGE
8		BALANCING VALVE
9		'Y' STRAINER
10		DRAIN VALVE
11		AIR VENT
12		FLOW METER
13	TE	TEMPERATURE SENSOR
14	LS	LEVEL SENSOR
15	PT	PRESSURE TRANSMITTER
16	FS	FLOW SWITCH (BY CHILLER MANUFACTURER)
17		DP TRANSMITER/SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

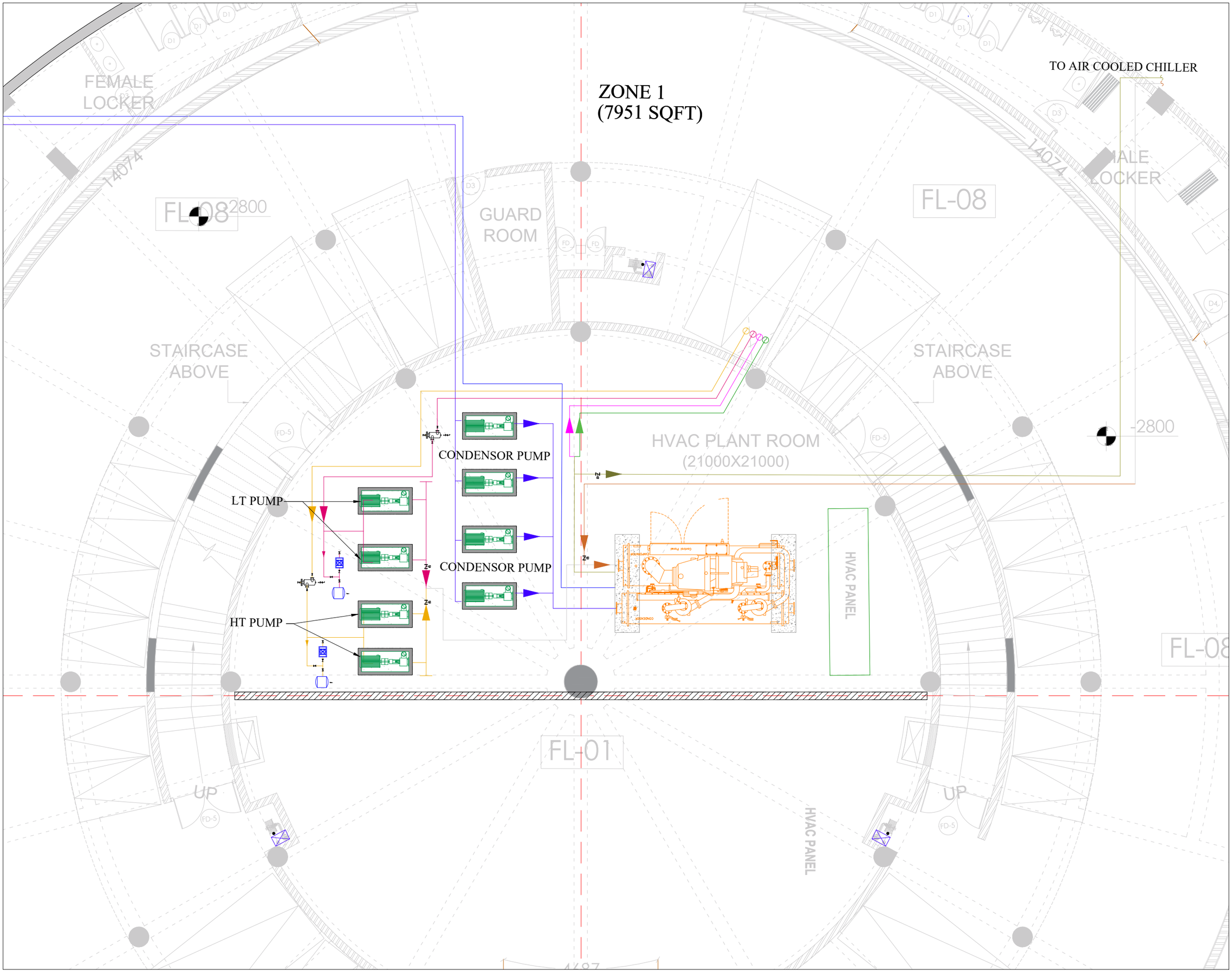
DRG. TITLE :

STANDARD DETAIL - HVAC SERVICE (SHEET5 TO 5)

Scale	Date	Rev.no.
NTS	01-05-22	R-00
	Drg. no.	
	LUMB-HV-00-D-1007	

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS

LEGEND:-

S.NO.	SYMBOL	DESCRIPTION
1	FCV	MOTORISED BUTTERFLY VALVE
2		BUTTERFLY VALVE
3		2-WAY MODULATING VALVE
4		NON RETURN VALVE
5		WATER PUMP
6	P	PRESSURE GAUGE WITH VALVE
7		TEMPERATURE GUAGE
8		BALANCING VALVE
9		'Y' STRAINER
10		DRAIN VALVE
11		AIR VENT
12		FLOW METER
13	TE	TEMPERATURE SENSOR
14	LS	LEVEL SENSOR
15	PT	PRESSURE TRANSMITTER
16	FS	
17		

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

CHILLER PLANT ROOM LAYOUT

Scale	Date	Rev.no.
1: 100	01-05-22	R-00

Drg. no.
LUMB-HV-BF-PR-1010

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

F.F.

G.F.

MANIFOLD-1 MANIFOLD-2 MANIFOLD-3 MANIFOLD-4 MANIFOLD-5 MANIFOLD-6 MANIFOLD-7 MANIFOLD-8 MANIFOLD-9 MANIFOLD-10 MANIFOLD-11 MANIFOLD-12 MANIFOLD-13 MANIFOLD-14 MANIFOLD-15 MANIFOLD-16 MANIFOLD-17 MANIFOLD-18 MANIFOLD-19 MANIFOLD-20 MANIFOLD-21 MANIFOLD-22 MANIFOLD-23 MANIFOLD-24 MANIFOLD-25 MANIFOLD-26 MANIFOLD-27 MANIFOLD-28 MANIFOLD-29 MANIFOLD-30

CSU AHU/TFA-1 CSU AHU/TFA-2 CSU AHU/TFA-3 CSU AHU/TFA-4 CSU AHU/TFA-5 CSU AHU/TFA-6 CSU AHU/TFA-7 CSU AHU/TFA-8 CSU AHU/TFA-9

CSU AHU/TFA-10 CSU AHU/TFA-11 CSU AHU/TFA-12 CSU AHU/TFA-13 CSU AHU/TFA-14 CSU AHU/TFA-15 CSU AHU/TFA-16 CSU AHU/TFA-17

CASSETTE AC-1 CASSETTE AC-2 CASSETTE AC-3 CASSETTE AC-4 CASSETTE AC-5 CASSETTE AC-6

LS1

#1 300TR COOLING TOWERS ON EQUIPMENT TERRRACE

300mm
250 mm 1050 GPM
COOLING TOWER
2+2 Z
Z
Ø150 BS MULSER LINE
250 mm 1050 GPM Ø 80 MAKEUP WATER LINE
400mm
POT STRAINER

MAKE UP WATER CONNECTION (BY OTHERS)
PRESSURISATION UNIT
EXPANSION TANK
PRESSURISATION UNIT
MAKE UP WATER CONNECTION (BY OTHERS)
600mm
400mm
CHEMICAL DOSING POT
CHEMICAL DOSING PUMP
POWER & CONTROL CABLE
200mm 800 GPM
840 GPM PRIMARY VARIABLE PUMP (WORKING)
PLC PRIMARY PUMP PANEL FOR LT CIRCUIT
200mm 840 GPM
988 GPM PRIMARY VARIABLE PUMP (WORKING)
200 mm 988 GPM
300 mm
DPSENSOR
250 mm 988 GPM
1050 GPM CONDENSER PUMP (WORKING)
250 mm 1050 GPM
PANEL FOR MT CIRCUIT
300TR MBC LT/MT/Heat Pump Chiller STAND-BY
300TR MBC MT Chiller (WORKING)

#3 300TR WATER COOLED CHILLERS (2W+1STBY) IN BASEMENT

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

LEGEND:-

S.NO.	SYMBOL	DESCRIPTION
1	MCV	MOTORISED BUTTERFLY VALVE
2		BUTTERFLY VALVE
3		2-WAY MODULATING VALVE
4		NON RETURN VALVE
5		WATER PUMP
6	P	PRESSURE GAUGE WITH VALVE
7		TEMPERATURE GUAGE
8		BALANCING VALVE
9		'Y' STRAINER
10		DRAIN VALVE
11		AIR VENT
12		FLOW METER
13	TE	TEMPERATURE SENSOR
14	LS	LEVEL SENSOR
15	PT	PRESSURE TRANSMITTER
16	FS	FLOW SWITCH (BY CHILLER MANUFACTURER)
17		DP TRANSMITER/SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

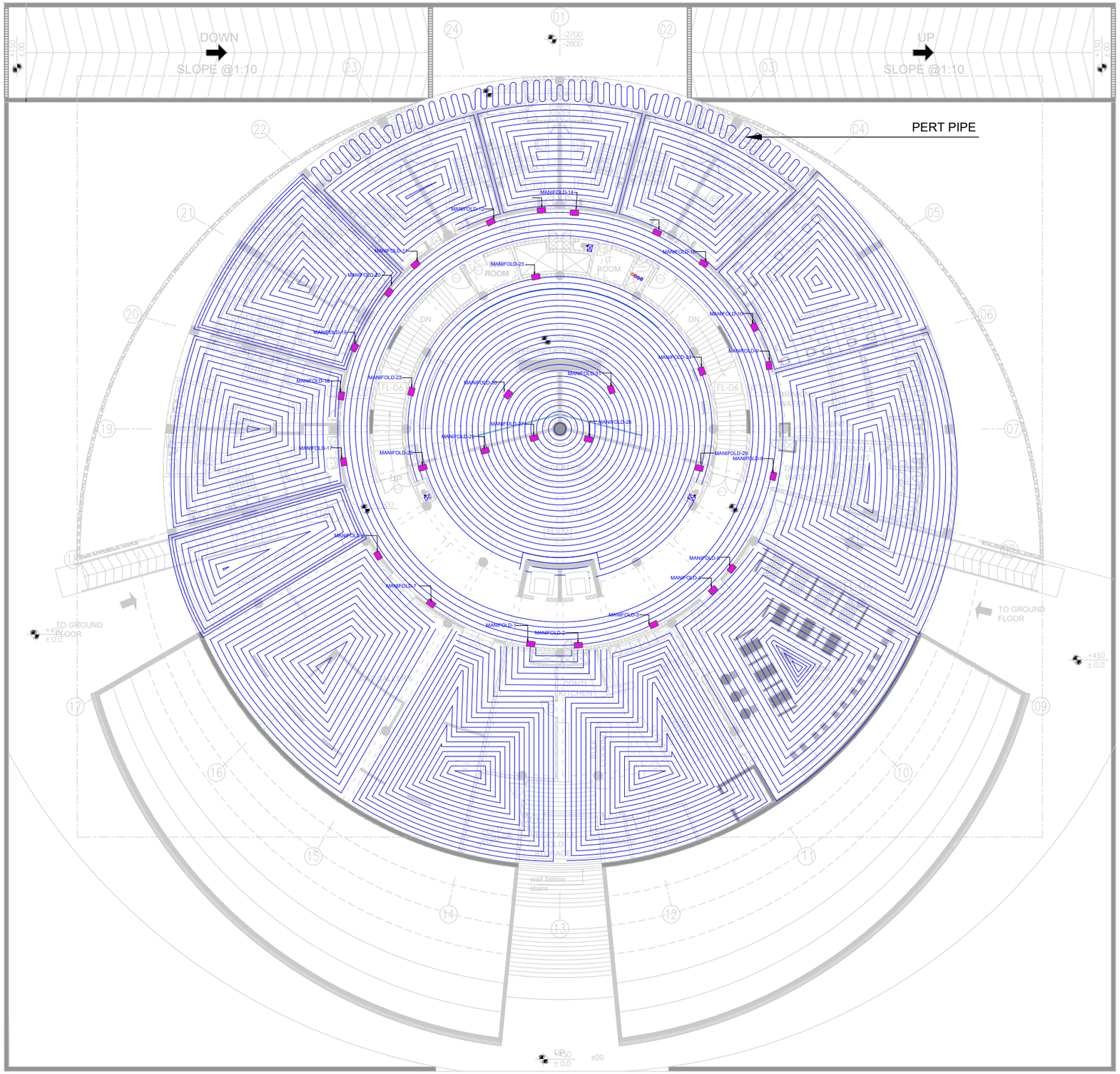
CHILLED PLANT SINGLE LINE DIAGRAM

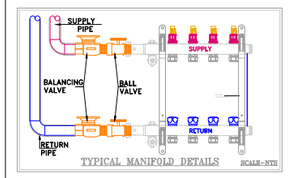
Scale	Date	Rev.no.
NTS	01-05-22	R-00

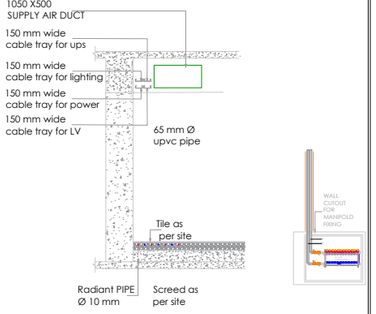
Drg. no.
LUMB-HV-00-SL-1013

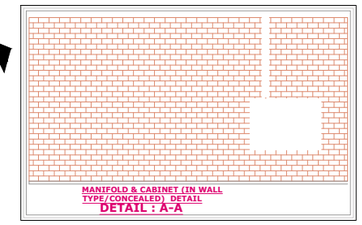
ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

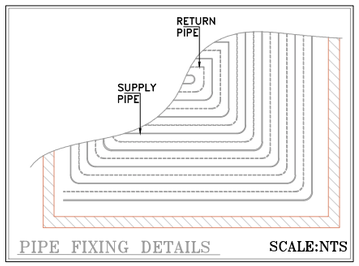


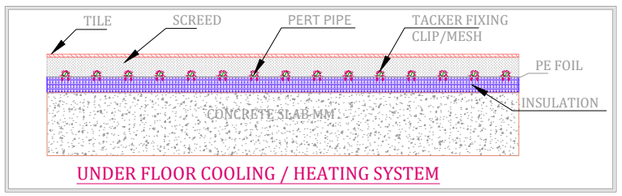






SCALE-1:200





SCALE-1:200

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD., MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

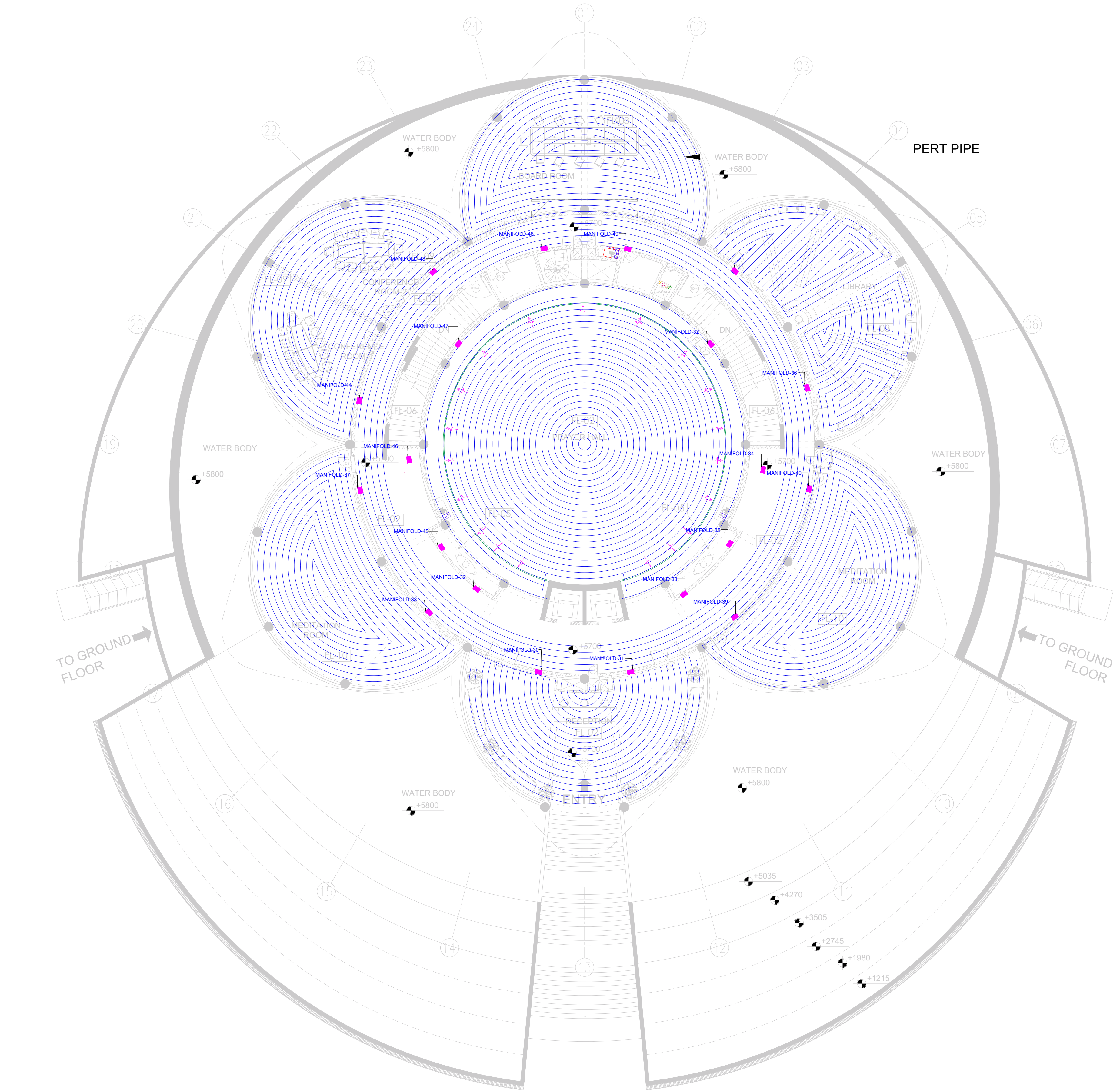
HVAC SYSTEM LAYOUT FOR GROUND FLOOR UNDER FLOOR COOLING

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

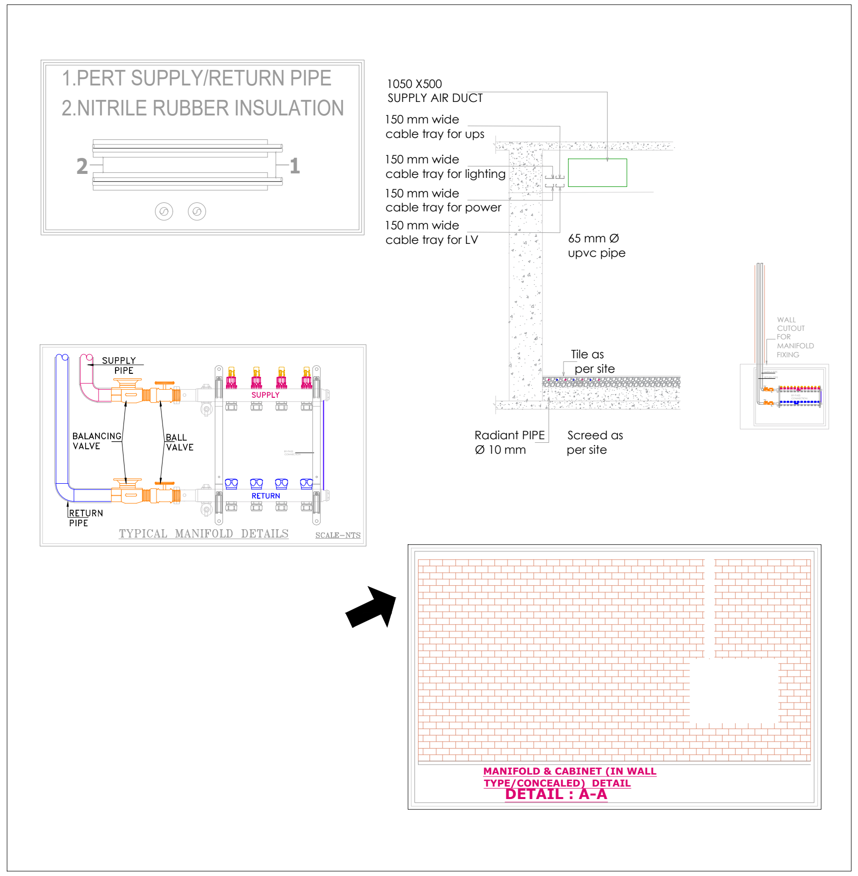
Drg. no.
LUMB-HV-GF-UFC-1016

ISSUED FOR:

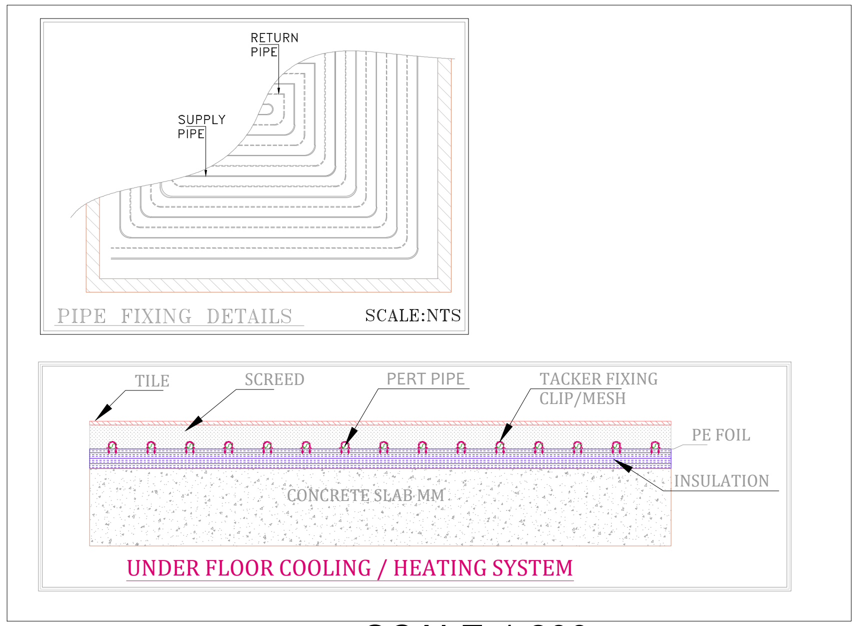
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



FIRST FLOOR PLAN



SCALE-1:200



SCALE-1:200

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :
INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

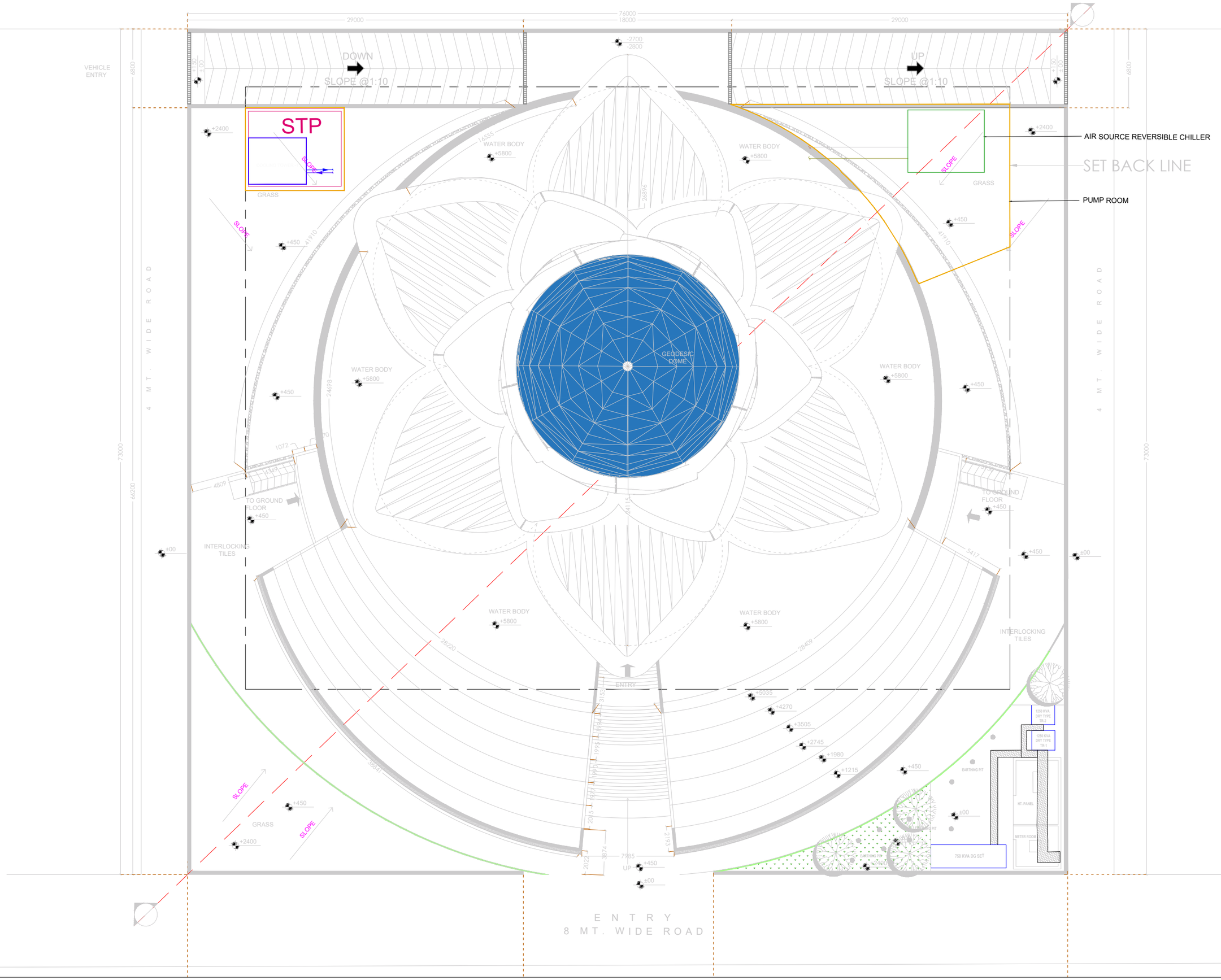
DRG. TITLE :
HVAC SYSTEM LAYOUT FOR FIRST FLOOR UNDER FLOOR COOLING

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-FF-UFC-1017

ISSUED FOR:

GFC	APPROVAL
TENDER (marked)	REFERENCE



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

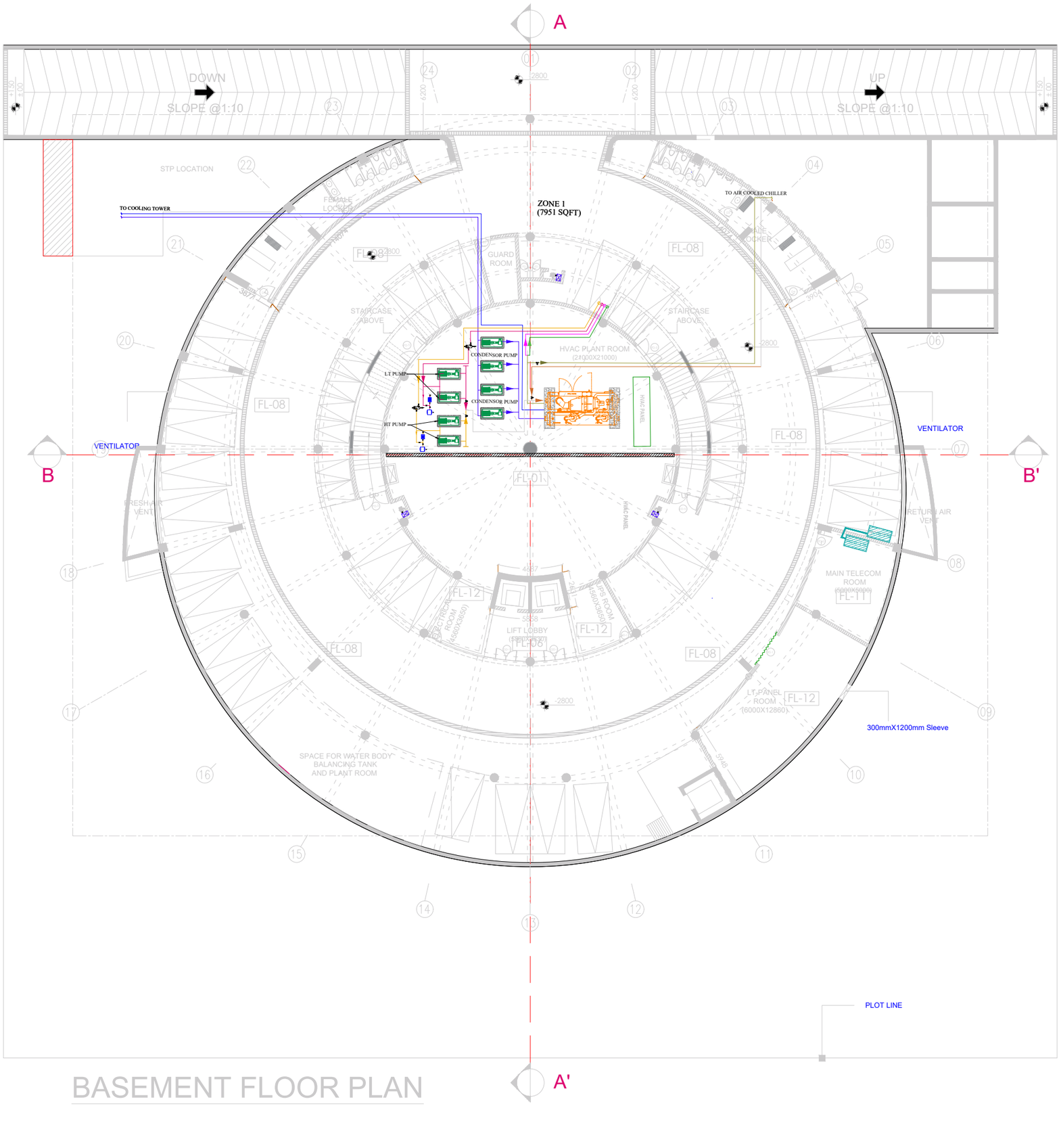
DRG. TITLE :
HVAC SYSTEM LAYOUT FOR EXTERNAL PLAN

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-EX-P-1020

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



BASEMENT FLOOR PLAN

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

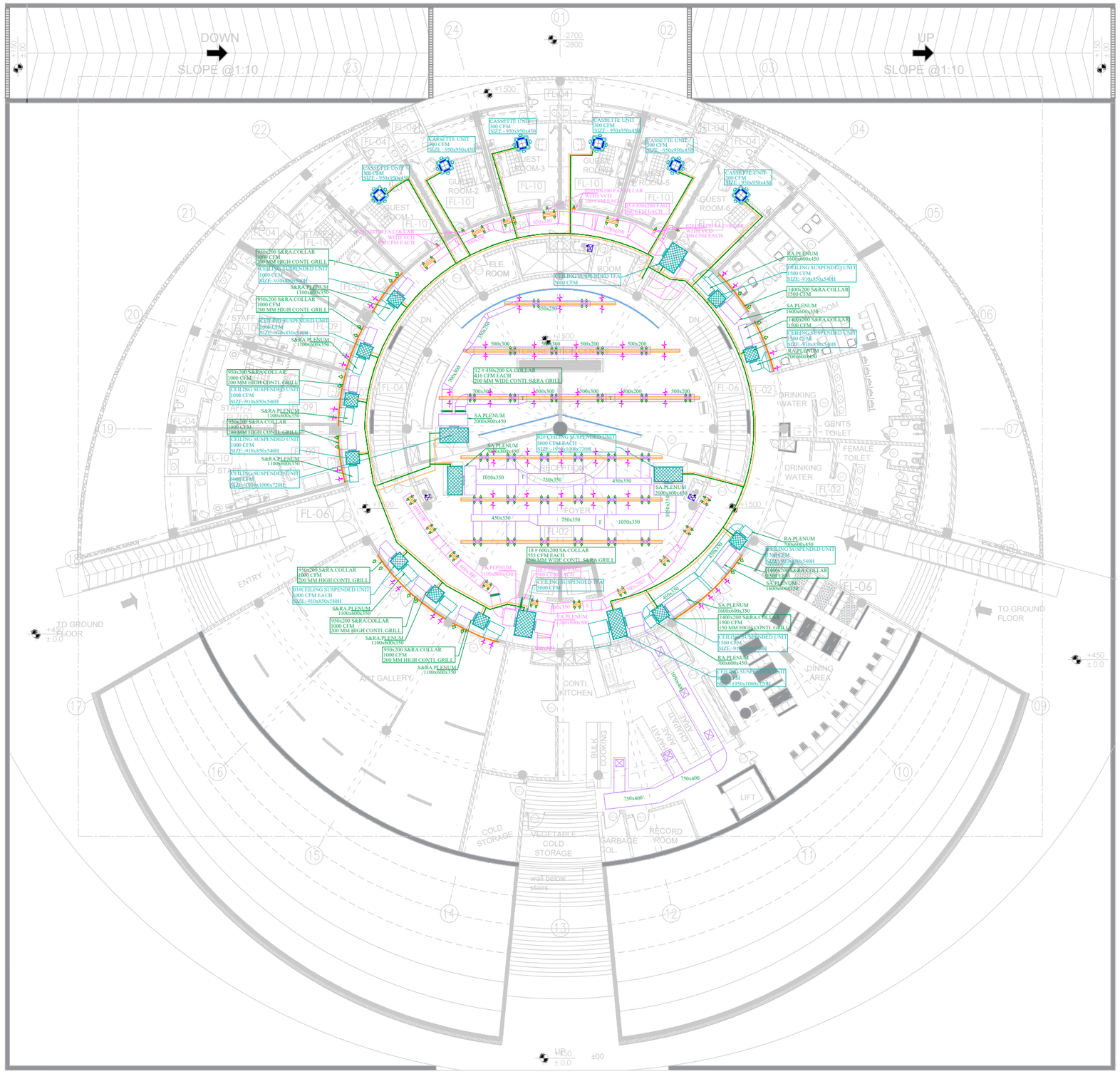
HVAC SYSTEM LAYOUT FOR BASEMENT FLOOR AIR CONDITIONING

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-BF-AC-1021

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



GROUND FLOOR PLAN

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR

R00		
Rev.no.	Date	Description

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

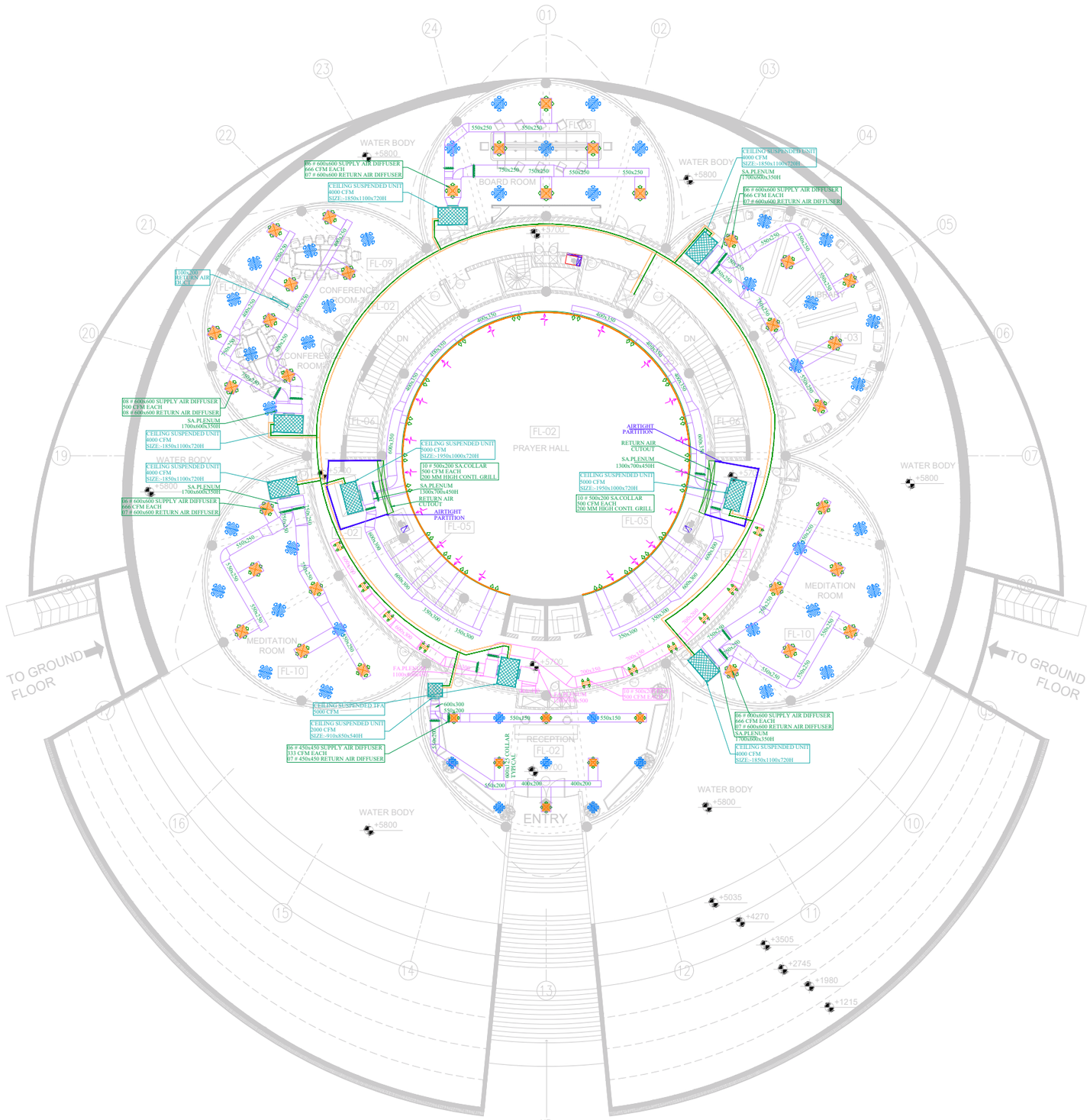
DRG. TITLE :
HVAC SYSTEM LAYOUT FOR GROUND FLOOR AIR CONDITIONING

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-GF-AC-1022

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



FIRST FLOOR PLAN

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

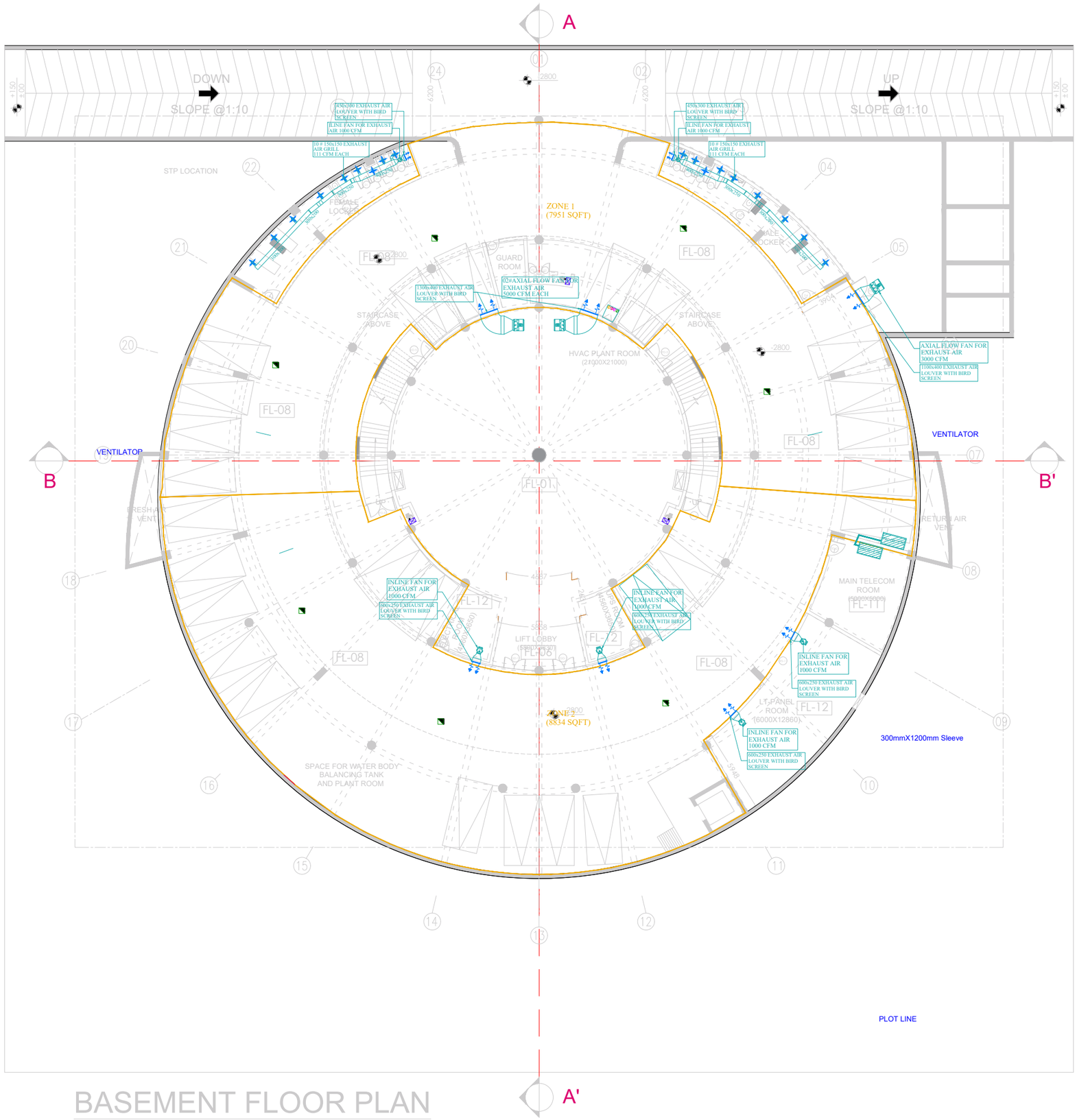
HVAC SYSTEM LAYOUT FOR FIRST FLOOR AIR CONDITIONING

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-FF-AC-1023

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



BASEMENT FLOOR PLAN

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

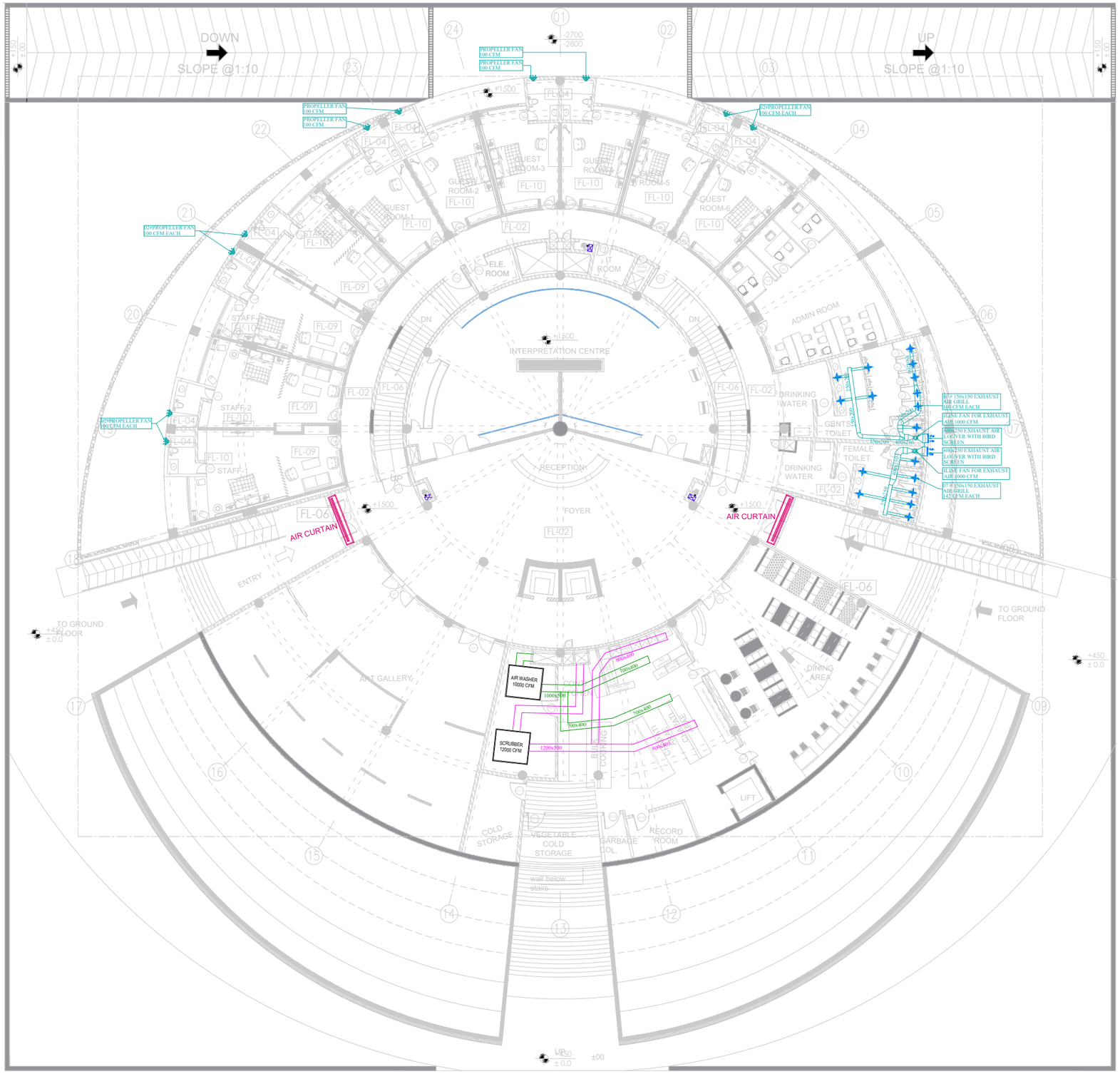
HVAC SYSTEM LAYOUT FOR BASEMENT FLOOR NORMAL VENTILATION

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-BF-NV-1026

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



GROUND FLOOR PLAN

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

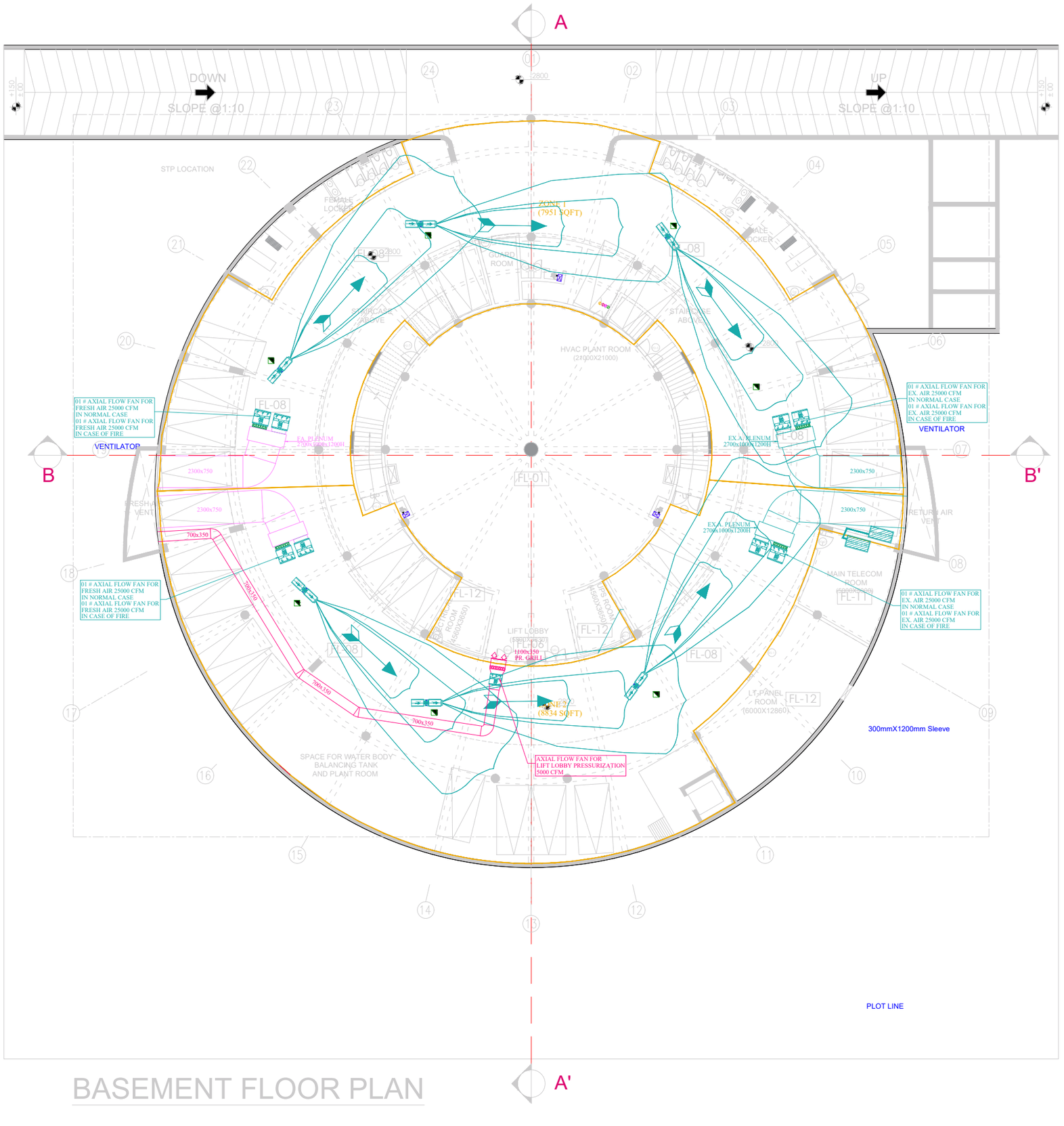
HVAC SYSTEM LAYOUT FOR GROUND FLOOR NORMAL VENTILATION

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-GF-NV-1027

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



BASEMENT FLOOR PLAN

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

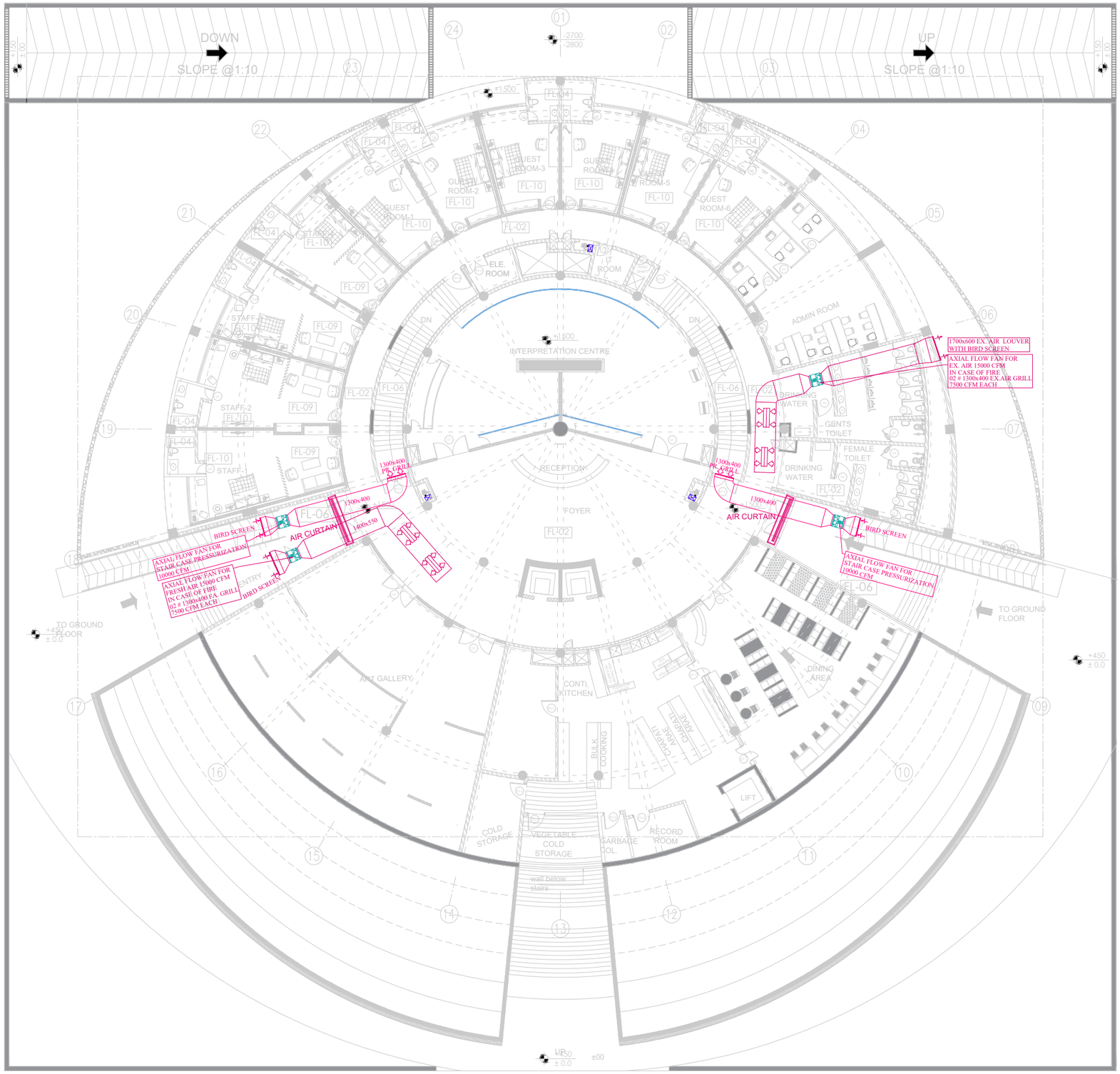
DRG. TITLE :
HVAC SYSTEM LAYOUT FOR BASEMENT FLOOR EMERGENCY VENTILATION

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-BF-EV-1031

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



GROUND FLOOR PLAN

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

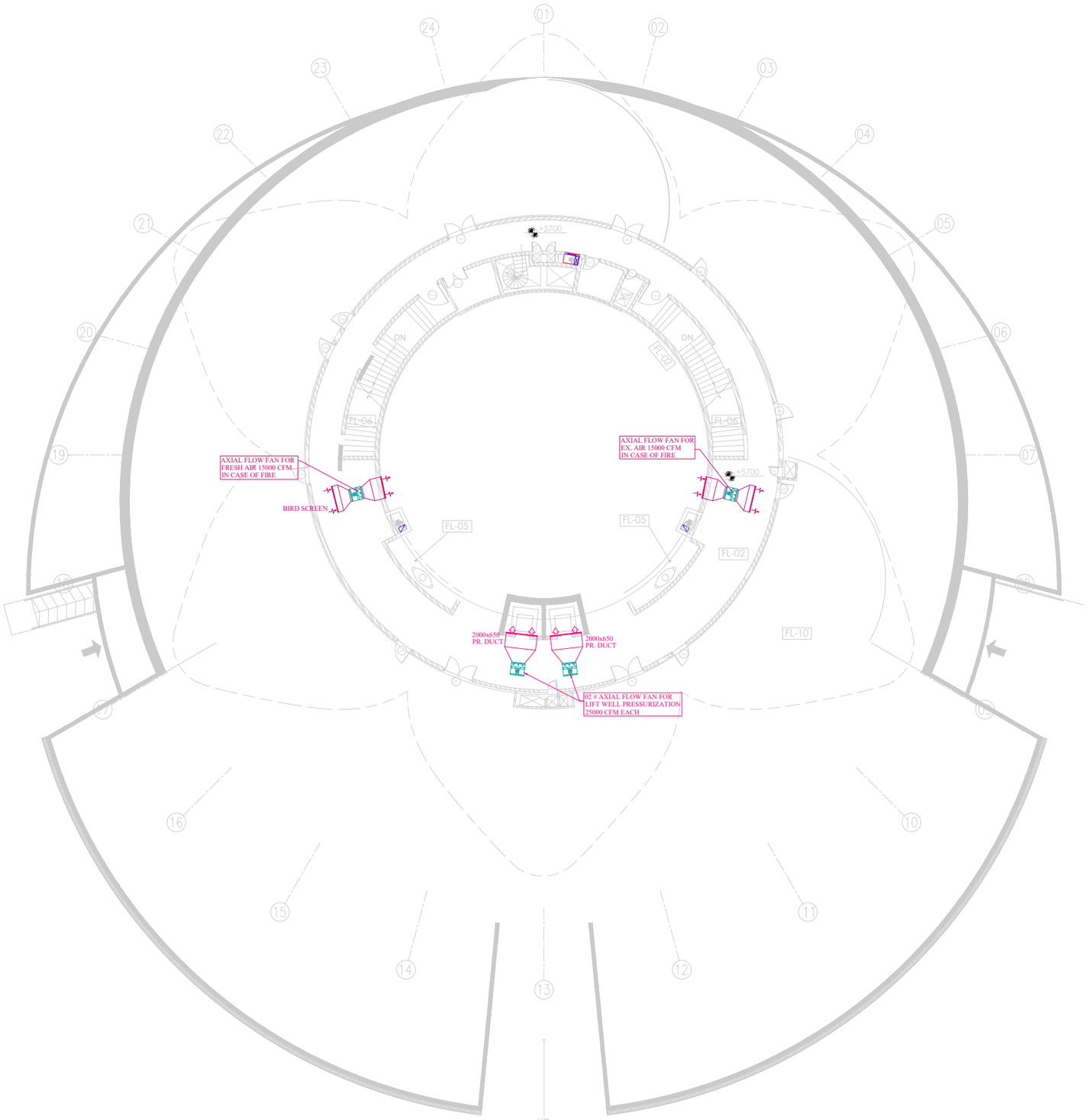
HVAC SYSTEM LAYOUT FOR GROUND FLOOR EMERGENCY VENTILATION

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-GF-EV-1032

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



TERRACE FLOOR PLAN

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

HVAC LEGEND

	MANIFOLD
	RETURN WATER HT
	SUPPLY WATER HT
	LT RETURN
	LT SUPPLY
	RETURN CONDENSOR FROM CT
	SUPPLY CONDENSOR FROM CT
	EXPANSION JOINTS
	FRESH AIR DUCT
	EXHAUST AIR DUCT
	RETURN AIR DUCT
	PRESSURIZATION DUCT
	IN LINE FAN
	RETURN AIR DIFFUSER
	SUPPLY AIR DIFFUSER
	AXIAL FLOW FAN
	SUPPLY&RETURN AIR GRILL
	CEILING SUSPENDED UNIT
	EXHAUST AIR GRILL
	JET FAN
	VOLUME CONTROL DAMPER
	CO SENSOR

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTER FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

HVAC SYSTEM LAYOUT FOR TERRACE FLOOR EMERGENCY VENTILATION

Scale	Date	Rev.no.
1: 300	01-05-22	R-00

Drg. no.
LUMB-HV-TF-EV-1034

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

PARTICULAR NOTES - FIRE PROTECTION

1. THE FIRE FIGHTING CONTRACTOR SHALL BE SPECIALIST AND APPROVED BY THE SAUDI CIVIL DEFENSE.
2. THE ENGINEERING CONSULTANT PRIMARY APPROVAL ON FIRE FIGHTING AND FIRE ALARM DRAWINGS DOES NOT MEAN IN ANY WAY THE FINAL APPROVAL. THE FINAL APPROVAL SHALL BE OBTAINED BY THE FIRE FIGHTING CONTRACTOR ON SHOP DRAWINGS AND INSTALLATION FROM THE SAUDI CIVIL DEFENSE.
3. ALL FIRE FIGHTING WORKS SHALL COMPLY TO THE REQUIREMENTS OF THE SAUDI CIVIL DEFENSE.
4. THE FINAL LOCATION OF THE BREECHING INLET SHALL BE IN AN APPROVED SPACE COORDINATED WITH THE SAUDI CIVIL DEFENSE.
5. THE FIRE FIGHTING PRODUCTS SHALL BE LISTED FOR INTENDED PURPOSE (MINIMUM UL/FM).
6. ALL PIPE SUPPORTS SHALL BE LISTED AND APPROVED TYPE SUPPORT CONFORM TO NFPA 13.
7. ALL FIRE FIGHTING EQUIPMENT TO BE PAINTED RED AND CLEARLY INDICATED BY AN APPROVED SIGNAGE.
8. MONITORING INTERFACE WIRING BETWEEN SPRINKLER/FIRE FIGHTING SYSTEM TO THE FIRE ALARM SYSTEM SHALL BE THE SCOPE OF FIRE ALARM CONTRACTOR.
9. SIGN BOARD SHALL BE PROVIDED FOR ALL GARBAGE ROOM, PUMP ROOM, LIFT ROOM, TOILETS AND OTHER SERVICES.
10. PROVIDE ACCESS LADDER OR MEANS TO ACCESS LIFT MACHINE ROOM FOR LIFT MANUAL OPERATION.
11. ALL FIRE FIGHTING VALVES AND SPECIALTY VALVES SHALL BE PROVIDED WITH IDENTIFICATION TAG AND
12. ALL LIFTS SHALL BE BE PROVIDED WITH EMERGENCY LANDING DEVICE.
13. ALL STAIRCASE EXIT DOOR AND SERVICE DOOR SHALL BE 2 HOURS FIRE RATED.
14. ALL FLATS AND OFFICE DOORS SHALL BE 1 HOUR FIRE RATED AND SMOKE PROOF WITH SELF CLOSING DEVICE.
15. EXIT ROUTES (CORRIDORS) SHALL HAVE 1 HOUR FIRE RATED WALLS.
16. EVERY SHOPS, OFFICES, CORRIDORS, SERVICES SHALL BE FIRE COMPARTMENT/FIRE ZONE.
17. ALL WINDOWS IN STAIRCASE AND CORRIDORS SHALL BE SLIDING TYPE (NOT FIXABLE).
18. HVAC SHALL BE INTERFACED WITH FIRE ALARM PANEL.
19. ROOF SMOKE CONTROL SYSTEM SHALL BE INTERLOCKED WITH FIRE ALARM SYSTEM.
20. CUT OUT AND PENETRATION SHALL BE SEALED WITH APPROVED FIRE RESISTANT SEALANT.
21. SPRINKLER RISER AND WET RISER; (LANDING VALVES) SHALL BE BE PROVIDED WITH RISER CHECK VALVE WITH TAMPER SWITCH AT BASE OF THE RISER WITH DRAIN VALVE AND RATED FOR THE PRESSURE RATING.
22. THE BREECHING INLET SHALL BE PROVIDED ON THE SPRINKLER LINE AT ALARM CHECK VALVE DOWN STREAM AND THE COMMON HEADER OF THE LANDING VALVE.
23. SUBMIT DETAILED SCHEMATIC DIAGRAM SHOWING ALL VALVES, INSTRUMENTS AND CONTROLS.
24. SUBMIT EQUIPMENT LIST WITH TECHNICAL DATA SHEETS GIVING MAKE, MATERIAL SPECIFICATION FOR ALL PURPOSE PIPING SYSTEM COMPONENTS PROPOSED TO BE USED ALONG WITH CIVIL DEFENSE APPROVAL.
25. FIRE EXTINGUISHER AND FIRE BLANKET SHALL BE PROVIDED THE KITCHEN AS PER LOCAL AUTHORITY REGULATIONS.
26. SUBMIT FIRE PUMP GENERAL ARRANGEMENT, SHOWING LAYOUT AND DETAIL OF PUMP, WATER STORAGE TANK WITH LEVELS, FLOW MEASURING AND MONITORING DEVICE. FILLING AND DRAWING ARRANGEMENT AND HOSE HEADER FOR FIRE PUMP FLOW TEST.
27. SUBMIT COMPUTER GENERATED HYDRAULIC CALCULATION REPORT. CALCULATION SHALL BE PREPARED ON FORM SHEET AS PER NFPA 13 FORMAT WHICH INCLUDES SUMMARY SHEET, GRAPH SHEET, A WATER SUPPLY ANALYSIS, A NODE ANALYSIS, AND DETAILED WORK SHEET.
28. THE CALCULATION SHALL BE COMBINED OPERATION OF SPRINKLER AND HOSE STREAM (LANDING VALVE) DETERMINING THE:
    (A) FAVORABLE DEMAND
    (B) FARTHEST/HIGHEST REMOTE DEMAND
29. THE SELECTED PUMP CHARACTERISTIC SHALL MEET THE REQUIREMENT OF THE SYSTEM DEMAND CALCULATION.
30. THE PUMP SHALL DELIVER AT 150% OF RATED CAPACITY; AND SHALL DEVELOP AT LEAST 65% OF ITS RATED HEAD AND SHALL NOT EXCEED 140% OF THE RATED HEAD AT NO FLOW.
31. THE PRESSURE REDUCING VALVE SHALL BE PROVIDING TO LIMIT THE EXCESSIVE PRESSURE; DO NOT USE PRESSURE RELIEF VALVE TO LIMIT PRESSURE.
32. THE WATER STORAGE CAPACITY FOR 60 MINUTES OPERATION SHALL BE MAINTAINED AT ALL TIMES.
33. AIR RELEASE VALVE SHALL BE PROVIDED AT THE HIGHEST POINT.
34. SPRINKLER HEADS SHALL BE SELECTED AS PER HAZARD REQUIREMENT.
35. PROVIDE ADDITIONAL SPRINKLER HEADS ON HORIZONTAL OBSTRUCTION MORE THAN 457 MM BELOW SPRINKLER DEFLECTOR (e.g. DUCTS, DECKS AND OVERHEAD DOORS).
36. CONTRACTOR TO ENSURE SPRINKLER ARE PROVIDED IN CONCEALED SPACES WITH COMBUSTIBLE MATERIAL GREATER THAN 800 MM (e.g. CEILING VOIDS).
37. THE SPECIALIST FIRE PROTECTION CONTRACTOR SHALL COMPLETE FULL HYDRAUL IC CALCULATIONS FOR THE SPRINKLER, WET RISER & HOSE REEL SYSTEM. ALL CALCULATIONS SHALL BE IN ACCORDANCE WITH NFPA AND AS PER THE GUIDE LINES ISSUED BY LOCAL AUTHORITIES A FULL SET OF CALCULATIONS AND DRAWINGS SHALL BE ISSUED TO THE ENGINEER FOR APPROVAL PRIOR TO SUBMISSION TO THE LOCAL AUTHORITY.
38. CONTRACTOR TO APPOINT QUALIFIED FIRE/SAFETY ENGINEER AND PROVIDE PROVISION OF TEMPORARY FIRE FIGHTING SYSTEM WITH DEDICATED FIRE PUMP AND WATER SUPPLY TO PREVENT FIRE INCIDENT DURING CONSTRUCTION.
39. FLEXIBLE COUPLINGS SHALL BE PROVIDED ON PIPES PASSING ALONG EXPANSION JOINTS.
40. THE BASEMENT LEVEL CAR PARK SHALL BE SPRINKLER PROTECTED TO ORDINARY HAZARD GROUP-I.
41. ALL FITTINGS,GAUGES,VALVES,SPRINKLER HEADS,PRVS ETC. SHALL BE SUITABLY RATED FOR WORKING PRESSURE STATED IN SPECIFICATION/REGULATION REQUIREMENTS.
42. ALL VALVES SHALL BE IDENTIFIED BY A NUMERICAL CODE.
43. ALL PRVS SHALL BE UL/FM RATED WITH DRAIN FACILITY.

GENERAL NOTES - FIRE PROTECTION

1. THE INTENT OF THE DRAWINGS AND SPECIFICATIONS IS TO PROVIDE A COMPLETE FIRE PROTECTION SYSTEM FOR THE PROPOSED PROJECT. THE SYSTEMS PROVIDED SHALL CONFORM TO THE DETAILS STATED IN THE SPECIFICATIONS AND SHOWN ON THE DRAWINGS. ITEMS OR WORK NOT SHOWN OR SPECIFIED, BUT REQUIRED FOR A COMPLETE FIRE PROTECTION SYSTEM, SHALL BE PROVIDED AND SHALL CONFORM TO ACCEPTED LOCAL CODES, AND GOVERNING AUTHORITIES. THE DRAWINGS AND SPECIFICATION ARE PRESENTED TO DEFINE SPECIFIC SYSTEM REQUIREMENTS OF PROVIDING COMPLETE SYSTEM. THE DRAWINGS ARE DIAGRAMMATIC AND INDICATE ONLY THE GENERAL ARRANGEMENT OF THE ITEMS COMPRISING THE SEVERAL SYSTEMS INCLUDED IN THE FIRE PROTECTION WORK.
2. DO NOT SCALE THE DRAWINGS. BECAUSE OF THE SCALE OF THE DRAWINGS, IT IS NOT POSSIBLE TO INDICATE OFFSETS, FITTINGS, VALVES OR SIMILAR ITEMS WHICH MAY BE REQUIRED TO MAKE A COMPLETE OPERATING SYSTEM. CAREFULLY INVESTIGATE CONDITIONS AFFECTING THE WORK. INSTALL THE WORK IN SUCH A MANNER THAT INTERFERENCES BETWEEN PIPES, CONDUIT, DUCTS, EQUIPMENT, ARCHITECTURAL AND STRUCTURAL FEATURES ARE AVOIDED. PROVIDE ITEMS THAT MAY BE REQUIRED TO MEET THE CONDITIONS AT THE BUILDING, WITHOUT ADDITIONAL COST TO THE OWNER.
3. PROTECT FLOORING FROM DAMAGE DURING THE CONSTRUCTION PERIOD. PROVIDE PLYWOOD OR SIMILAR MATERIAL UNDER EQUIPMENT OR MATERIALS STORED ON FLOORS, AND IN AREAS WHERE CONSTRUCTION MAY DAMAGE THE FLOOR SURFACES. FLOOR SURFACES (INCLUDING SEALER) DAMAGED DURING CONSTRUCTION SHALL BE REPLACED AT THE COST OF THE CONTRACTOR AT FAULT.
4. FIRE PROTECTION BRANCH LINES SHALL BE SLOPED TO DRAIN BACK TO CROSS MAINS. CROSS MAINS SHALL BE SLOPED TO DRAIN BACK TO BULK MAINS OR MAIN RISER. INSTALL AUXILIARY DRAINS WHERE TRAPPED PIPING RUNS ARE UNAVOIDABLE.
5. UNLESS OTHERWISE NOTED, ALL PIPING IS OVERHEAD, TIGHT TO UNDERSIDE OF FLOOR SLAB WITH SPACE FOR HANGERS AS REQUIRED.
6. INSTALL PIPING SO THAT VALVES ARE ACCESSIBLE. VALVE STEMS SHALL BE VERTICAL, POINTING UP. ADJUST VALVES FOR SMOOTH AND EASY OPERATION.
7. COORDINATE ALL WORK WITH THE WORK OF OTHER SERVICES SHOWN ON OTHER DRAWINGS.
8. PROVIDE APPROVED FIRE STOPPING AT ALL FLOOR AND WALL PENETRATIONS.
9. NO PIPING SHALL BE LOCATED IN ANY ELECTRICAL ROOMS, CLOSETS, OR TELECOMMUNICATION ROOMS UNLESS THOSE PIPES SERVE ONLY THAT SPACE AND ARE NO PIPING SHALL BE LOCATED IN ANY ELECTRICAL ROOMS, CLOSETS, OR INDICATED ON DRAWINGS. DO NOT RUN SPRINKLER PIPING, EQUIPMENT, ETC. OVER ELECTRICAL PANELS.
10. ALL VALVES AND EQUIPMENT IDENTIFICATION SHALL BE IN ACCORDANCE WITH OWNER'S IDENTIFICATION SYSTEM. CONTRACTORS ARE RESPONSIBLE FOR ANY REQUIRED CROSS REFERENCE BETWEEN THESE DRAWINGS, SPECIFICATIONS AND OTHER DISCIPLINES.
11. MEANS OF ACCESS SHALL BE PROVIDED TO CONCEALED TRAPS, VALVES, CLEANOUTS, DRAIN POINTS OR SIMILAR ITEMS. COORDINATE LOCATIONS AND QUANTITIES OF ALL ACCESS PANELS DURING THE BIDDING PHASE. ACCESS PANELS SHALL BE FURNISHED UNDER ANOTHER DIVISION.
12. SET PIPE SLEEVES PRIOR TO POURING CONCRETE.
13. COORDINATE THE EXACT LOCATION OF ALL FIRE PROTECTION EQUIPMENT AND DEVICES WITH ARCHITECTURAL DRAWINGS PRIOR TO ROUGH-IN AND INSTALLATION.
14. REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF EQUIPMENT AND SPRINKLERS.
15. ALL SPRINKLERS SHALL BE CENTERED WITHIN THE 600MM SQUARE CEILING TILES AND WITHIN THE QUIATERS POINTS OF 600MM X 1200MM TILE UNLESS NOTED OTHERWISE.
16. MAXIMUM FLOW RATE IN FIRE PROTECTION PIPE SHALL NOT EXCEED 5.0 METERS PER SECOND. FIRE PUMP SUCTION SHALL NOT EXCEED 4.57 MPS.
17. PROVIDE CHAIN WHEEL OPERATORS FOR ALL VALVES IN EQUIPMENT ROOMS MOUNTED HIGHER THAN 2.13 METERS ABOVE FLOOR LEVEL. CHAIN SHALL EXTEND TO 2.13 METERS ABOVE FLOOR.
18. ALL BUTTERFLY VALVES SHALL BE PROVIDED WITH POSITION INDICATORS AND MEMORY STOPS.
19. PROVIDE FLEXIBLE CONNECTORS IN ALL PIPING SYSTEMS CONNECTED TO PUMPS AND OTHER EQUIPMENT WHICH REQUIRE VIBRATION ISOLATION. FLEXIBLE CONNECTIONS SHALL BE PROVIDED AS CLOSE TO THE EQUIPMENT AS POSSIBLE OR AS INDICATED ON THE DRAWINGS.
20. THE CO-ORDINATED SHOP DRAWINGS SHALL BE PREPARED WITH ALL SERVICES FOR DESIGN CONSULTANTS REVIEW. ALL CRITICAL AREAS, SECTION SHALL BE PREPARED IN 1:20 SCALE. MINIMUM HEAD ROOM CLEARANCE SHALL BE MAINTAINED AS STATED ELSEWHERE IN ARCHITECTURAL DRAWINGS.
21. ALL FIRE PROTECTION SYSTEM INSTALLATION SHALL BE CARRIED OUT BY A LOCAL CIVIL DEFENSE APPROVED SUB CONTRACTOR.THE APPROVED SUB CONTRACTOR SHALL SUBMIT PRE QUALIFICATION DOCUMENTS WITH LOCAL CIVIL DEFENSE AUTHORITY CERTIFICATE FOR ENGINEER.
22. ALL FIRE EQUIPMENT & MATERIAL SHALL BE UL/FM APPROVED. CERTIFICATES FOR THE SAME SHALL BE SUBMITTED AS PART OF SUBMITTAL.

GENERAL SYMBOLS - FIRE PROTECTION

- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- AIR RELEASE VALVE
- DRAIN VALVE
- PRESSURE RELIEF VALVE
- PRESSURE REDUCING VALVE
- SOLENOID VALVE
- FLOW SWITCH
- PRESSURE SWITCH
- 2-WAY BREECHING INLET CONNECTION
- 4-WAY BREECHING INLET CONNECTION
- 9 KG CARBON DIOXIDE WATER TYPE FIRE EXTINGUISHER
- 4.5 KG CARBON DIOXIDE GAS TYPE FIRE EXTINGUISHER
- FIRE BLANKET
- WATER CURTAIN SPRINKLER
- PENDENT TYPE SPRINKLER
- PENDENT SPRINKLER
- HORIZONTAL SIDEWALL SPRINKLER HEAD (79°C)
- ZONE CHECK VALVE C/W SUPERVISORY BUTTERFLY VALVE,FLOW SWITCH & PRESSURE GAUGE
- LANDING VALVE
- FIRE HOSE CABINET
- PUMP
- METER (SEE CONNECTED PIPING FOR TYPE OF SERVICE)
- SIGHT GLASS
- PIPE TEE TURNED UP
- PIPE TEE TURNED DOWN
- PIPE TURNED UP
- PIPE TURNED DOWN
- DRAIN PIPE
- SPRINKLER PIPE
- WET PIPE
- STRAINER
- PRESSURE GAUGE
- ELECTRICAL PUMP
- JOCKEY PUMP
- SPRINKLER DRAIN PIPE
- SPRINKLER PIPE
- FIRE LINE
- CONTROL VALVE
- FIRE HOSE REEL
- FHC — FIRE HOSE CABINET
- PENDANT / SPRINKLER UPRIGHT HEAD AS PER SITE
- SPRINKLER HEAD (SIDE WALL NORMAL COVERAGE)
- SPRINKLER HEAD (SIDE WALL HIGH COVERAGE)
- INSPECTOR TEST VALVE
- ACV — ALARM CHECK VALVE

ABBREVIATIONS - FIRE PROTECTION

ARV	AIR RELEASE VALVE
ACV	ALARM CHECK VALVE
AFF	ABOVE FINISH FLOOR
BTM	BOTTOM
BOP	BOTTOM OF PUMP
CLG	CEILING
FHC	FIRE HOSE CABINET
FHR	FIRE HOSE REEL
FH	FIRE HYDRANT
EFH	EXTERNAL FIRE HYDRANT
LV	LANDING VALVE
RRL	REINFORCED RUBBER LINED
AB	ABOVE
CV	CHECK VALVE
ICV	INSTALLATION CONTROL VALVE
FS	FLOW SWITCH
FB	FIRE BRIGADE
ITV	INSTALLATION TEST VALVE
ZCV	ZONE CONTROL VALVE
HP	HORSE POWER
JP	JOCKEY PUMP
EL	ELECTRICAL PUMP
PG	PRESSURE GAUGE
PS	PRESSURE SWITCH
BFV	BUTTERFLY VALVE
SLV	SLUICE VALVE
GV	GATE VALVE
MS	MILD STEEL
GI	GALVANIZED IRON
PS	POT STRAINER
YS	'Y' STRAINER
NRV	NON RETURN VALVE
MH	MANHOLE COVER
RM	ROOM
DTV	DRAIN TEST VALVE
FRPT	GLASS REINFORCE PANEL TANK

NOTES:

1. THIS DRAWING REPRESENTS ONLY A FIRE FIGHTING DETAIL, FOR ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES REFER RELEVANT DRAWINGS.
2. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
3. ALL DIMENSIONS SHOWN IN DRAWINGS ARE IN MM AND MUST BE CO-ORDINATED WITH THE ARCHITECTURAL DRAWINGS.
4. THE SPRINKLER SHALL BE INSTALLED GENERALLY AS PER NBC GUIDELINES OR ANY OTHERS RELEVANT CODES & STANDARDS. IT SHALL BE THE RESPONSIBILITY OF THE EXECUTING AGENCY TO CHECK THE SITE CONDITION ACCORDINGLY.
5. THE LOCATION OF SPRINKLER MAY VARY AS PER ARCHITECTURAL CO-ORDINATION DRAWING. THE SPRINKLERS SHALL BE GENERALLY INSTALLED 3.5 M.C/C TO COVER AN AREA OF APPROX.12.0 SQ. M.
6. THE SPRINKLER INSTALLATION SHALL BE IN COMPLETE COMFORMANCE WITH CODE IS:15105 2002 & OTHER RELEVANT GUIDELINES
7. SHOP DRAWING TO BE PREPARED BY THE FIRE FIGHTING CONTRACTOR AND IS TO BE SUBMITTED TO CONSULTANTS FOR APPROVALE BEFORE EXECUTION.
8. EXACT LOCATION OF SPRINKLER HEADS/SLEEVES IN BEAM AS PER CO-ORDINATED ARCHITECTURAL DRAWING
9. SINCE THE FALSE CEILING DEPTH IS MORE THAN 800 MM FROM THE BOTTOM OF THE SLAB THEREFORE UPRIGHT SPRINKLER SHOULD ALSO BE PROVIDED.
10. EVERY FHC SHALL BE CONSISTING OF AS PER IS THE FOLLOWING
    (A) 80X63 MM DIA. SINGLE HEADED HYDRANT VALVE.
    (B) 2NOS. 63MMDIA. 15MTS LONG RL. HOSE REEL.
    (C) 20MM DIA 36.5MT FIRST AID HOSE REEL WITH 5MM BORE NOZZLE.
    (D) 63MM DIA. MALE AND FEMALE INST TYPE COUPLING.
    (E) 63MM DIA. BRANCH PIPE WITH 16MM. NOZZLE.
11. THIS IS A SCHEMATIC DIAGRAM ONLY MUST BE CO-ORDINATED WITH RELEVANT DRAWINGS OF FLOOR PLANS.
12. THE SUCTION TO THE PUMPS SHALL BE POSITIVE (FLOODED)
13. ACTUAL CAPACITY OF DOMESTIC OVERHEAD TANKS FOR EACH TANK MAY VARY AS PER DETAILED DESIGN
14. LOCATION OF FBC TO BE CO-ORDINTATED WITH SITE.
15. LOCATION OF SPRINKLERL TO BE CO-ORDINTATED WITH RESPECTIVE FLOOR PLAN.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

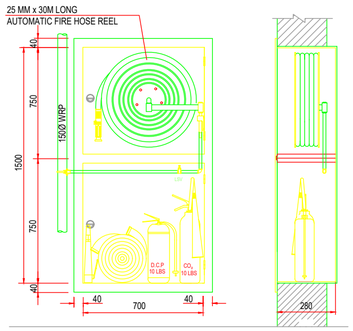
STANDARD LEGEND & NOTES - FIRE FIGHTING

Scale	Date	Rev.no.
NTS	31-05-22	R-00

DRAWING NO.
LUMB-FF-00-D-4001

ISSUED FOR:

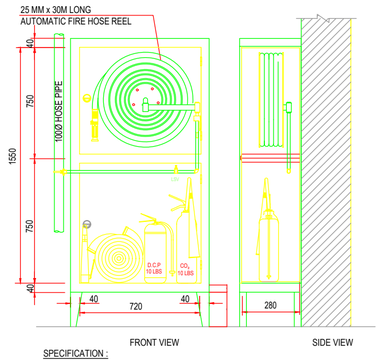
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



SPECIFICATION :

FIRE CABINET	FHC 1
TYPE	RECESSED
MATERIAL OF CONSTRUCTION	STEEL
- BACK BOX	ELECTRO GALVANIZED STEEL
- DOOR AND ARCHITRIVE	STANLESS STEEL
FINISH	TO ARCHITECT APPROVAL
HANDLE	TO CIVIL DEFENSE APPROVAL
NOTE: 1. ALL CABINET PENETRATION TO FIRE RATED WALL SHALL BE FIRE RATED MATERIAL TO ALL	

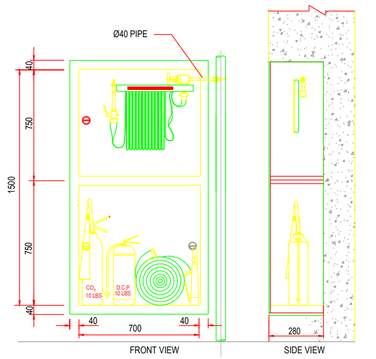
TYPICAL DETAIL OF FIRE HOSE CABINET (FHC-1)



SPECIFICATION :

FIRE CABINET	FHC 1S
TYPE	SURFACE / STAND ALONE
MATERIAL OF CONSTRUCTION	STEEL
- BACK BOX	ELECTRO GALVANIZED STEEL
- DOOR AND ARCHITRIVE	STANLESS STEEL
FINISH	TO ARCHITECT APPROVAL
HANDLE	TO CIVIL DEFENSE APPROVAL
NOTE: 1. ALL CABINET PENETRATION TO FIRE RATED WALL SHALL BE FIRE RATED MATERIAL TO ALL	

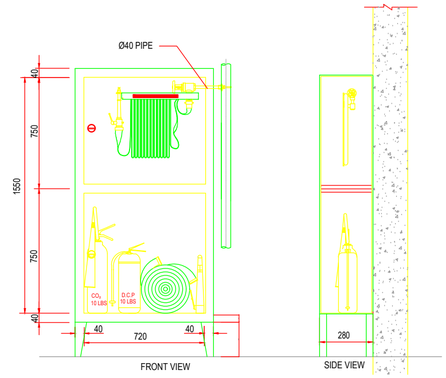
TYPICAL DETAIL OF FIRE HOSE CABINET (FHC-1S)



SPECIFICATION :

FIRE CABINET	FHC 2
TYPE	RECESSED
MATERIAL OF CONSTRUCTION	STEEL
- BACK BOX	ELECTRO GALVANIZED STEEL
- DOOR AND ARCHITRIVE	STANLESS STEEL
FINISH	TO ARCHITECT APPROVAL
HANDLE	TO CIVIL DEFENSE APPROVAL
NOTE: 1. ALL CABINET PENETRATION TO FIRE RATED WALL SHALL BE FIRE RATED MATERIAL TO ALL	

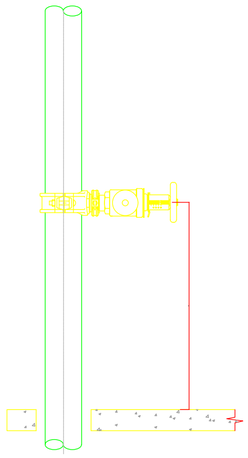
TYPICAL DETAIL OF FIRE HOSE CABINET (FHC-2)



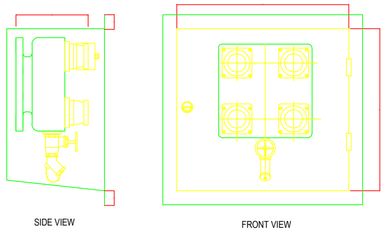
SPECIFICATION :

FIRE CABINET	FHC 2S
TYPE	SURFACE / STAND ALONE
MATERIAL OF CONSTRUCTION	STEEL
- BACK BOX	STAINLESS STEEL
- DOOR AND ARCHITRIVE	STANLESS STEEL
FINISH	TO ARCHITECT APPROVAL
HANDLE	TO CIVIL DEFENSE APPROVAL
NOTE: 1. ALL CABINET PENETRATION TO FIRE RATED WALL SHALL BE FIRE RATED MATERIAL TO ALL	

TYPICAL DETAIL OF FIRE HOSE CABINET (FHC-2S)



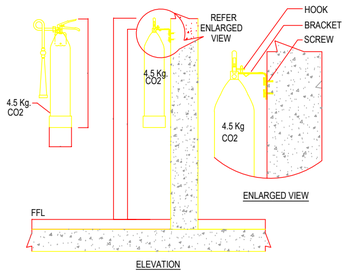
TYPICAL DETAIL OF LANDING VALVE

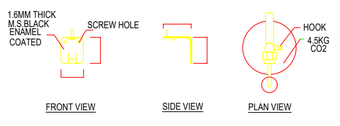


SPECIFICATION :

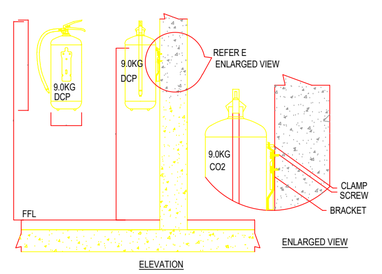
FIRE CABINET	INLET BREECHING
TYPE	RECESSED
MATERIAL OF CONSTRUCTION	STEEL
- BACK BOX	ELECTRO GALVANIZED STEEL
- DOOR AND ARCHITRIVE	STANLESS STEEL
FINISH	TO ARCHITECT APPROVAL
HANDLE	TO CIVIL DEFENSE APPROVAL
NOTE: 1. ALL CABINET PENETRATION TO FIRE RATED WALL SHALL BE FIRE RATED MATERIAL TO ALL	

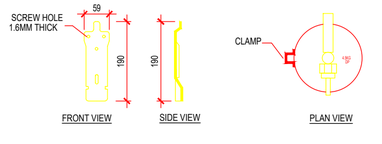
4-WAY BREECHING INLET DETAIL (RECESSED





CO2 4.5 KG GAS TYPE WALL MOUNTING DETAIL





CO2 9.0 KG WATER TYPE WALL MOUNTING DETAIL

NOTES:

1. THIS DRAWING REPRESENTS ONLY A FIRE FIGHTING DETAIL, FOR ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES REFER RELEVANT DRAWINGS.
2. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
3. ALL DIMENSIONS SHOWN IN DRAWINGS ARE IN MM AND MUST BE CO-ORDINATED WITH THE ARCHITECTURAL DRAWINGS.
4. THE SPRINKLER SHALL BE INSTALLED GENERALLY AS PER NBC GUIDELINES OR ANY OTHERS RELEVANT CODES & STANDARDS. IT SHALL BE THE RESPONSIBILITY OF THE EXECUTING AGENCY TO CHECK THE SITE CONDITION ACCORDINGLY
5. THE LOCATION OF SPRINKLER MAY VARY AS PER ARCHITECTURAL CO-ORDINATION DRAWING. THE SPRINKLERS SHALL BE GENERALLY INSTALLED 3.5 M.C/C TO COVER AN AREA OF APPROX.12.0 SQ. M.
6. THE SPRINKLER INSTALLATION SHALL BE IN COMPLETE COMFORMANCE WITH CODE IS:15105 2002 & OTHER RELEVANT GUIDELINES
7. SHOP DRAWING TO BE PREPARED BY THE FIRE FIGHTING CONTRACTOR AND IS TO BE SUBMITTED TO CONSULTANTS FOR APPROVALE BEFORE EXECUTION.
8. EXACT LOCATION OF SPRINKLER HEADS/SLEEVES IN BEAM AS PER CO-ORDINATED ARCHITECTURAL DRAWING
9. SINCE THE FALSE CEILING DEPTH IS MORE THAN 800 MM FROM THE BOTTOM OF THE SLAB THEREFORE UPRIGHT SPRINKLER SHOULD ALSO BE PROVIDED.
10. EVERY FHC SHALL BE CONSISTING OF AS PER IS THE FOLLOWING
(A) 80/63 MM DIA. SINGLE HEADED HYDRANT VALVE.
(B) 2NOS. 63MMDIA. 15MTS LONG RL. HOSE REEL.
(C) 20MM DIA 36.5MT FIRST AID HOSE REEL WITH 5MM BORE NOZZLE.
(D) 63MM DIA. MALE AND FEMALE INST TYPE COUPLING.
(E) 63MM DIA. BRANCH PIPE WITH 16MM. NOZZLE.
11. THIS IS A SCHEMATIC DIAGRAM ONLY MUST BE CO-ORDINATED WITH RELEVANT DRAWINGS OF FLOOR PLANS.
12. THE SUCTION TO THE PUMPS SHALL BE POSITIVE (FLOODED)
13. ACTUAL CAPACITY OF DOMESTIC OVERHEAD TANKS FOR EACH TANK MAY VARY AS PER DETAILED DESIGN
14. LOCATION OF FBC TO BE CO-ORDINTATED WITH SITE.
15. LOCATION OF SPRINKLERL TO BE CO-ORDINTATED WITH RESPECTIVE FLOOR PLAN.

LEGEND

SYMBOL	DESCRIPTION
	SPRINKLER DRAIN PIPE
	SPRINKLER PIPE
	FIRE LINE
	CONTROL VALVE
	FIRE HOSE REEL
FHC	FIRE HOSE CABINET
	PENDANT / SPRINKLER UPRIGHT HEAD AS PER SITE
	SPRINKLER HEAD (SIDE WALL NORMAL COVERAGE)
	SPRINKLER HEAD (SIDE WALL HIGH COVERAGE)
	INSPECTOR TEST VALVE
ACV	ALARM CHECK VALVE
	SLEEVE

SCHEDULE OF FIRE PUMPS

ITEM	PUMPS	QTY.
D.P.	DIESEL PUMP	1
M.F.P.	MAIN FIRE PUMP	1
J.P.	JOCKEY PUMP	1

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL

DRG. TITLE :

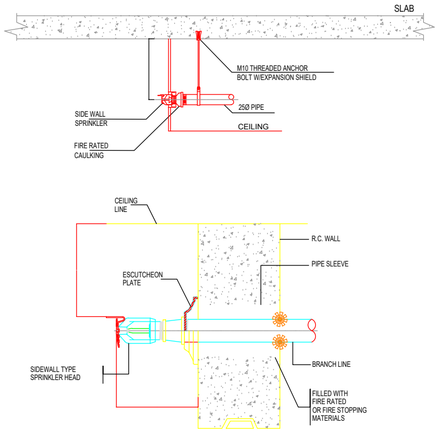
STANDARD DETAILS - FIRE FIGHTING (SHEET 2 OF 3)

Scale	Date	Rev.no.
NTS	31-05-22	R-00

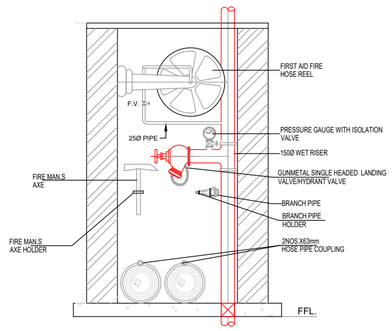
DRAWING NO.
LUMB-FF-00-D-4002

ISSUED FOR:

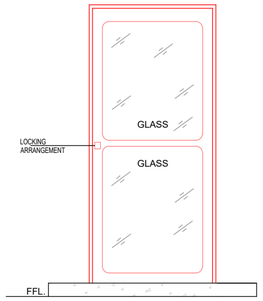
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



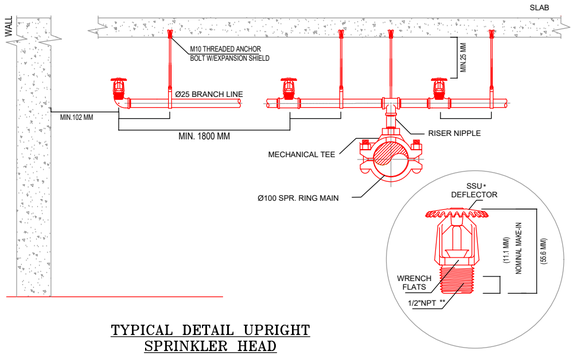
DETAIL OF FIRE HYDRANT STATION



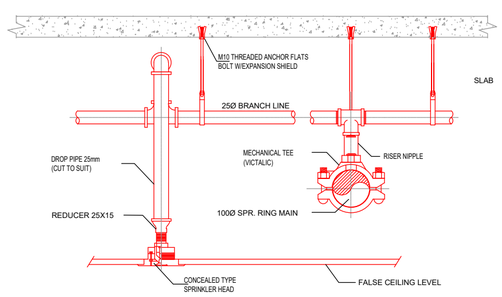
FIRE HOSE CABINET
SIDE ELEVATION



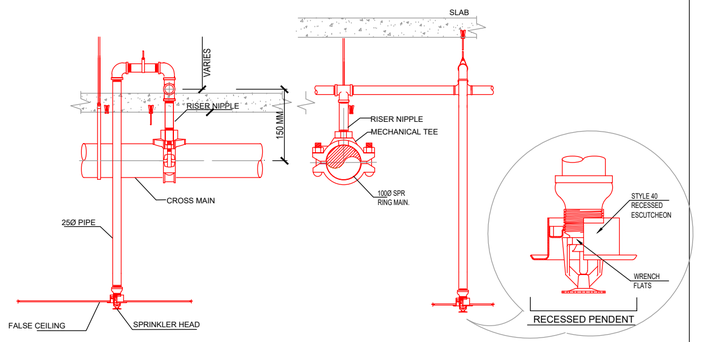
FIRE HOSE CABINET
FRONT ELEVATION



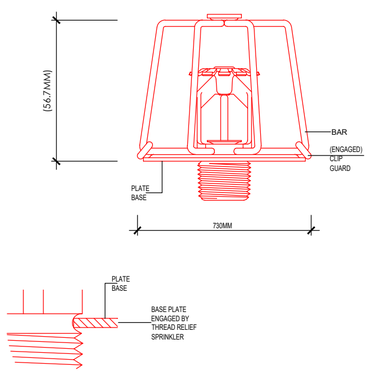
TYPICAL DETAIL UPRIGHT
SPRINKLER HEAD



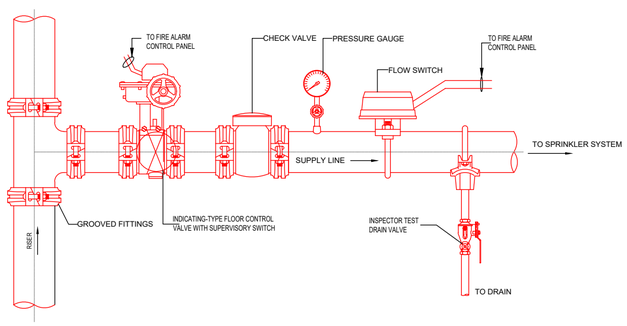
TYPICAL DETAIL OF CONCEALD
TYPE SPRINKLER HEAD



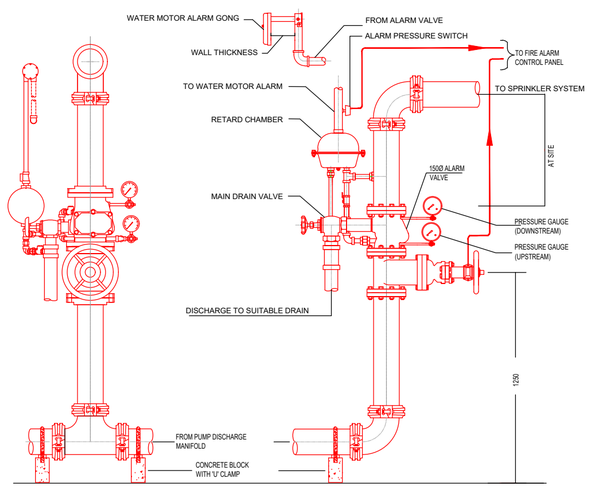
TYPICAL DETAIL RECESSED
PENDANT TYPE SPRINKLER



SPRINKLER GUARD DETAIL



TYPICAL DETAIL OF ZONE
CONTROL ASSEMBLY



TYPICAL DETAIL ALARM CHECK
ARRANGEMENT

NOTES:

1. THIS DRAWING REPRESENTS ONLY A FIRE FIGHTING DETAIL, FOR ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES REFER RELEVANT DRAWINGS.
2. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
3. ALL DIMENSIONS SHOWN IN DRAWINGS ARE IN MM AND MUST BE CO-ORDINATED WITH THE ARCHITECTURAL DRAWINGS.
4. THE SPRINKLER SHALL BE INSTALLED GENERALLY AS PER NBC GUIDELINES OR ANY OTHERS RELEVANT CODES & STANDARDS. IT SHALL BE THE RESPONSIBILITY OF THE EXECUTING AGENCY TO CHECK THE SITE CONDITION ACCORDINGLY.
5. THE LOCATION OF SPRINKLER MAY VARY AS PER ARCHITECTURAL CO-ORDINATION DRAWING. THE SPRINKLERS SHALL BE GENERALLY INSTALLED 3.5 M.C/C TO COVER AN AREA OF APPROX.12.0 SQ. M.
6. THE SPRINKLER INSTALLATION SHALL BE IN COMPLETE COMFORMANCE WITH CODE IS-15105 2002 & OTHER RELEVANT GUIDELINES
7. SHOP DRAWING TO BE PREPARED BY THE FIRE FIGHTING CONTRACTOR AND IS TO BE SUBMITTED TO CONSULTANTS FOR APPROVALE BEFORE EXECUTION.
8. EXACT LOCATION OF SPRINKLER HEADS/SLEEVES IN BEAM AS PER CO-ORDINATED ARCHITECTURAL DRAWING
9. SINCE THE FALSE CEILING DEPTH IS MORE THAN 800 MM FROM THE BOTTOM OF THE SLAB THEREFORE UPRIGHT SPRINKLER SHOULD ALSO BE PROVIDED.
10. EVERY FHC SHALL BE CONSISTING OF AS PER IS THE FOLLOWING

(A) 80X63 MM DIA. SINGLE HEADED HYDRANT VALVE.
(B) 2NOS. 63MMDIA. 15MTS LONG RL. HOSE REEL
(C) 20MM DIA 36.5MT FIRST AID HOSE REEL WITH 5MM BORE NOZZLE.
(D) 63MM DIA. MALE AND FEMALE INST TYPE COUPLING.
(E) 63MM DIA. BRANCH PIPE WITH 16MM. NOZZLE.

11. THIS IS A SCHEMATIC DIAGRAM ONLY MUST BE CO-ORDINATED WITH RELEVANT DRAWINGS OF FLOOR PLANS.
12. THE SUCTION TO THE PUMPS SHALL BE POSITIVE (FLOODED)
13. ACTUAL CAPACITY OF DOMESTIC OVERHEAD TANKS FOR EACH TANK MAY VARY AS PER DETAILED DESIGN
14. LOCATION OF FBC TO BE CO-ORDINTATED WITH SITE.
15. LOCATION OF SPRINKLERL TO BE CO-ORDINTATED WITH RESPECTIVE FLOOR PLAN.

LEGEND

SYMBOL	DESCRIPTION
	SPRINKLER DRAIN PIPE
	SPRINKLER PIPE
	FIRE LINE
	CONTROL VALVE
	FIRE HOSE REEL
FHC	FIRE HOSE CABINET
	PENDANT / SPRINKLER UPRIGHT HEAD AS PER SITE
	SPRINKLER HEAD (SIDE WALL NORMAL COVERAGE)
	SPRINKLER HEAD (SIDE WALL HIGH COVERAGE)
	INSPECTOR TEST VALVE
ACV	ALARM CHECK VALVE
	SLEEVE

SCHEDULE OF FIRE PUMPS

ITEM	PUMPS	QTY.
D.P.	DIESEL PUMP	1
M.F.P.	MAIN FIRE PUMP	1
J.P.	JOCKEY PUMP	1

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

STANDARD DETAILS - FIRE FIGHTING (SHEET1 OF 3)

Scale	Date	Rev.no.
NTS	31-05-22	R-00

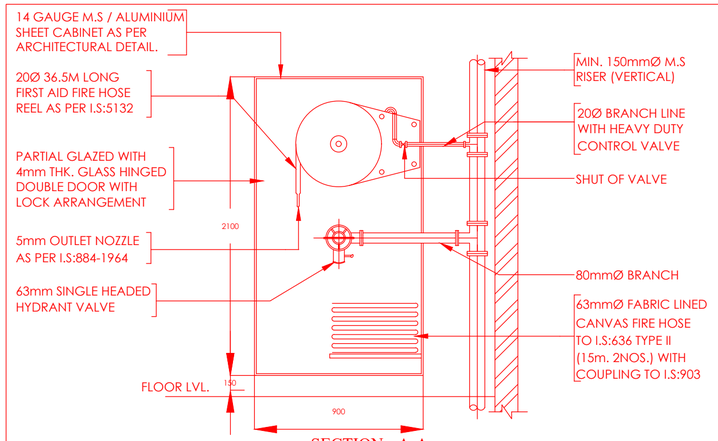
DRAWING NO.
LUMB-FF-00-D-4003

ISSUED FOR:

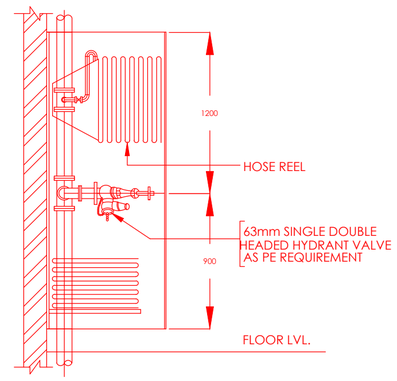
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

DETAIL OF FIRE HOSE CABINET

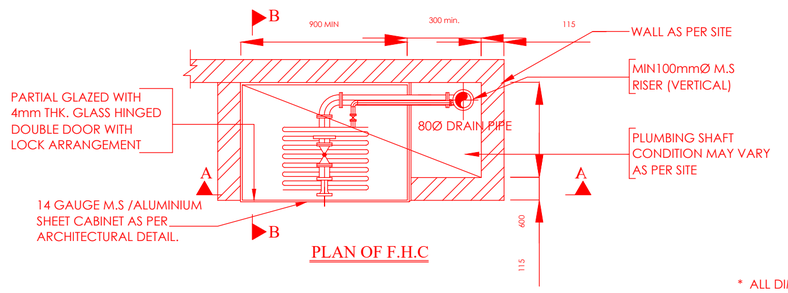
(.90x .715 x 2.10m) SINGLE HYDRANT VALVE



SECTION - A-A



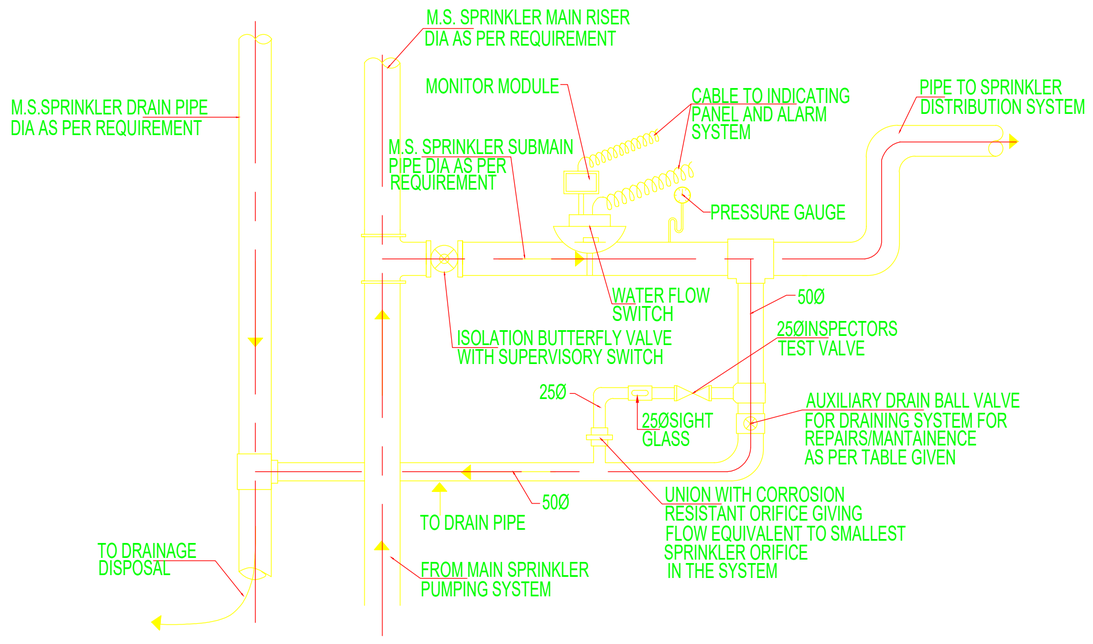
SECTION - B-B



PLAN OF F.H.C

* ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.

INSPECTOR TEST VALVE



NOTES:

1. THIS DRAWING REPRESENTS ONLY A FIRE FIGHTING DETAIL, FOR ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES REFER RELEVANT DRAWINGS.
2. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
3. ALL DIMENSIONS SHOWN IN DRAWINGS ARE IN MM AND MUST BE CO-ORDINATED WITH THE ARCHITECTURAL DRAWINGS.
4. THE SPRINKLER SHALL BE INSTALLED GENERALLY AS PER NBC GUIDELINES OR ANY OTHERS RELEVANT CODES & STANDARDS. IT SHALL BE THE RESPONSIBILITY OF THE EXECUTING AGENCY TO CHECK THE SITE CONDITION ACCORDINGLY
5. THE LOCATION OF SPRINKLER MAY VARY AS PER ARCHITECTURAL CO-ORDINATION DRAWING. THE SPRINKLERS SHALL BE GENERALLY INSTALLED 3.5 M C/C TO COVER AN AREA OF APPROX.12.0 SQ. M.
6. THE SPRINKLER INSTALLATION SHALL BE IN COMPLETE COMFORMANCE WITH CODE IS-15105 2002 & OTHER RELEVANT GUIDELINES
7. SHOP DRAWING TO BE PREPARED BY THE FIRE FIGHTING CONTRACTOR AND IS TO BE SUBMITTED TO CONSULTANTS FOR APPROVALE BEFORE EXECUTION.
8. EXACT LOCATION OF SPRINKLER HEADS/SLEEVES IN BEAM AS PER CO-ORDINATED ARCHITECTURAL DRAWING
9. SINCE THE FALSE CEILING DEPTH IS MORE THAN 800 MM FROM THE BOTTOM OF THE SLAB THEREFORE UPRIGHT SPRINKLER SHOULD ALSO BE PROVIDED.
10. EVERY FHC SHALL BE CONSISTING OF AS PER IS THE FOLLOWING

(A) 80X63 MM DIA. SINGLE HEADED HYDRANT VALVE.
(B) 2NOS. 63MMDIA. 15MTS LONG RL. HOSE REEL
(C) 20MM DIA 36.5MT FIRST AID HOSE REEL WITH 5MM BORE NOZZLE.
(D) 63MM DIA. MALE AND FEMALE INST TYPE COUPLING.
(E) 63MM DIA. BRANCH PIPE WITH 16MM. NOZZLE.

11. THIS IS A SCHEMATIC DIAGRAM ONLY MUST BE CO-ORDINATED WITH RELEVANT DRAWINGS OF FLOOR PLANS.
12. THE SUCTION TO THE PUMPS SHALL BE POSITIVE (FLOODED)
13. ACTUAL CAPACITY OF DOMESTIC OVERHEAD TANKS FOR EACH TANK MAY VARY AS PER DETAILED DESIGN
14. LOCATION OF FBC TO BE CO-ORDINTATED WITH SITE.
15. LOCATION OF SPRINKLERL TO BE CO-ORDINTATED WITH RESPECTIVE FLOOR PLAN.

LEGEND

SYMBOL	DESCRIPTION
	SPRINKLER DRAIN PIPE
	SPRINKLER PIPE
	FIRE LINE
	CONTROL VALVE
	FIRE HOSE REEL
FHC	FIRE HOSE CABINET
	PENDANT / SPRINKLER UPRIGHT HEAD AS PER SITE
	SPRINKLER HEAD (SIDE WALL NORMAL COVERAGE)
	SPRINKLER HEAD (SIDE WALL HIGH COVERAGE)
	INSPECTOR TEST VALVE
ACV	ALARM CHECK VALVE
	SLEEVE

SCHEDULE OF FIRE PUMPS

ITEM	PUMPS	QTY.
D.P.	DIESEL PUMP	1
M.F.P.	MAIN FIRE PUMP	1
J.P.	JOCKEY PUMP	1

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL

DRG. TITLE :

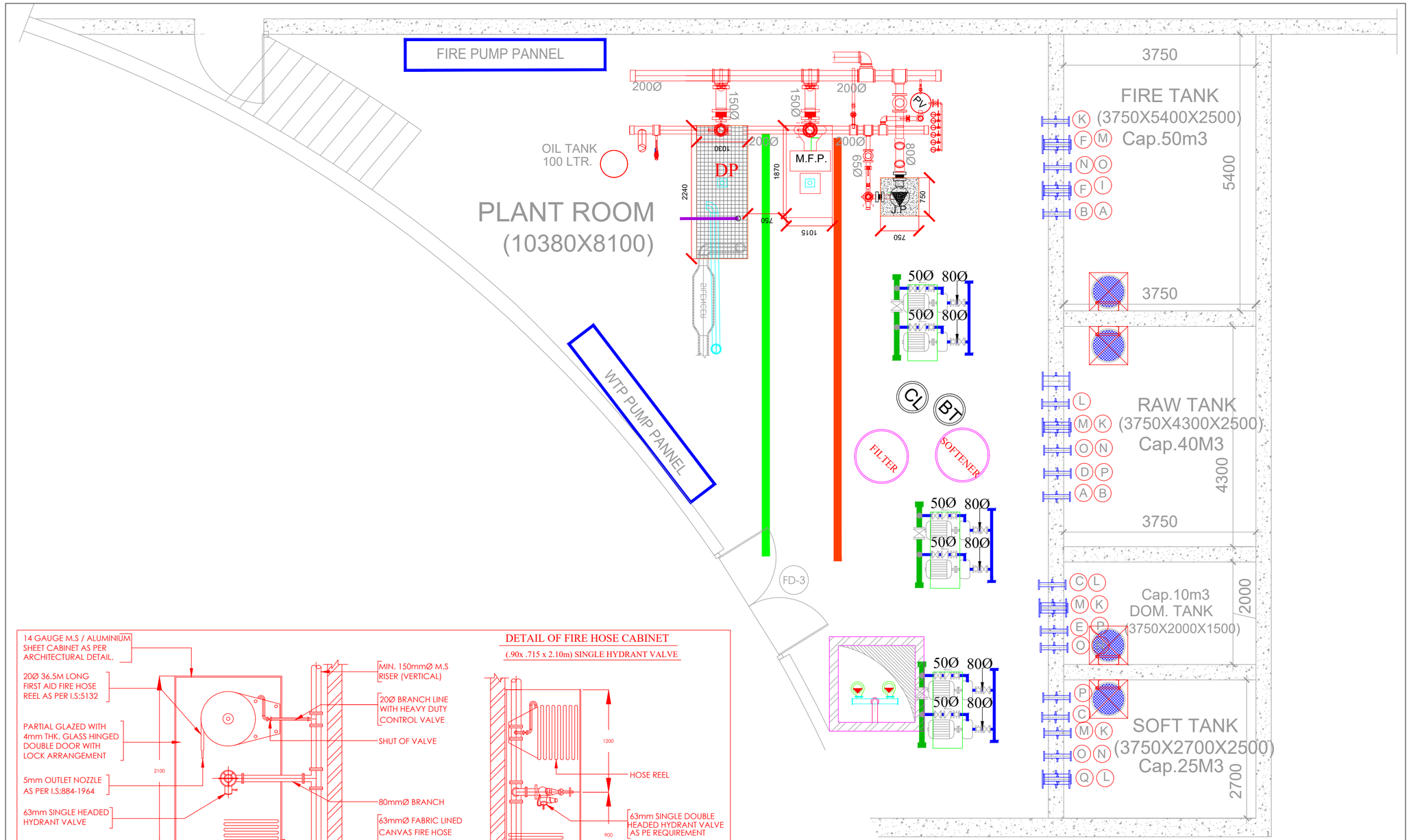
STANDARD DETAILS - FIRE FIGHTING (SHEET 3 OF 3)

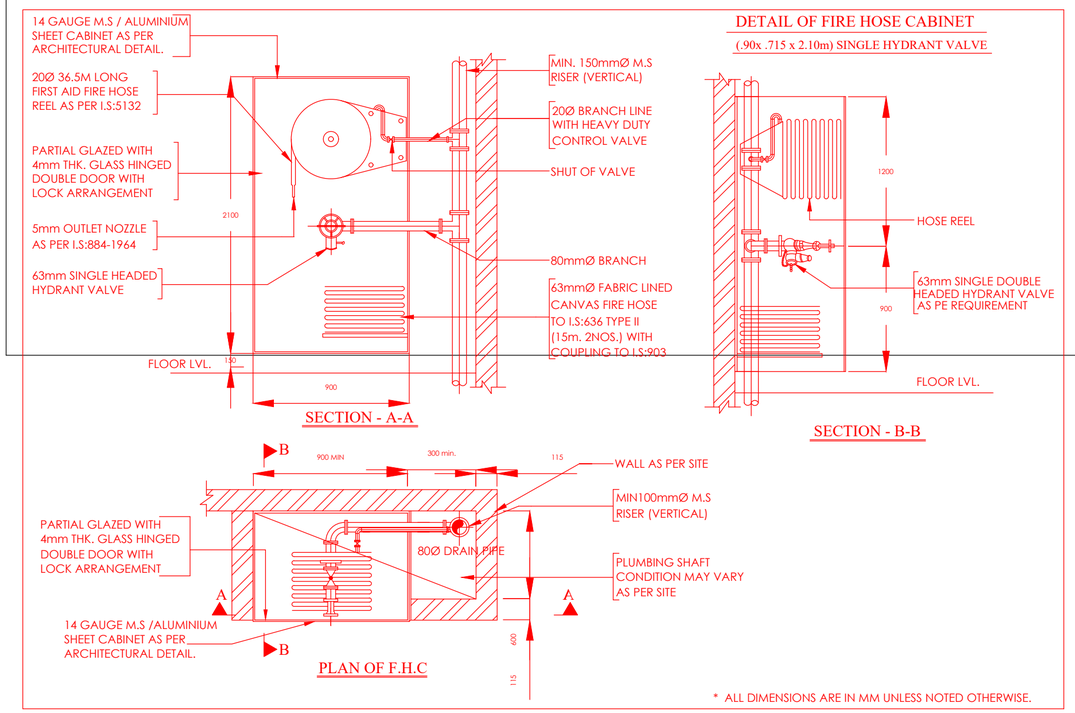
Scale	Date	Rev.no.
NTS	31-05-22	R-00

DRAWING NO.
LUMB-FF-00-D-4004

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE





	LEGEND FOR FIRE EXTINGUISHERS
SYMBOL	DESCRIPTION
I	9 litres capacity water type extinguishers with CO2 cartridge as per IS:15683 -Wall mounted type.
II	4.5 kg CO2 type cylindrical shape fire extinguisher as per IS:15683 - wall mounted type.

NOTES:

1. THIS DRAWING REPRESENTS ONLY A FIRE FIGHTING DETAIL, FOR ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES REFER RELEVANT DRAWINGS.
2. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
3. ALL DIMENSIONS SHOWN IN DRAWINGS ARE IN MM AND MUST BE CO-ORDINATED WITH THE ARCHITECTURAL DRAWINGS.
4. THE SPRINKLER SHALL BE INSTALLED GENERALLY AS PER NBC GUIDELINES OR ANY OTHERS RELEVANT CODES & STANDARDS. IT SHALL BE THE RESPONSIBILITY OF THE EXECUTING AGENCY TO CHECK THE SITE CONDITION ACCORDINGLY.
5. THE LOCATION OF SPRINKLER MAY VARY AS PER ARCHITECTURAL CO-ORDINATION DRAWING. THE SPRINKLERS SHALL BE GENERALLY INSTALLED 3.5 M C/C TO COVER AN AREA OF APPROX.12.0 SQ. M.
6. THE SPRINKLER INSTALLATION SHALL BE IN COMPLETE COMFORMANCE WITH CODE IS:15105 2002 & OTHER RELEVANT GUIDELINES
7. SHOP DRAWING TO BE PREPARED BY THE FIRE FIGHTING CONTRACTOR AND IS TO BE SUBMITTED TO CONSULTANTS FOR APPROVALE BEFORE EXECUTION.
8. EXACT LOCATION OF SPRINKLER HEADS/SLEEVES IN BEAM AS PER CO-ORDINATED ARCHITECTURAL DRAWING
9. SINCE THE FALSE CEILING DEPTH IS MORE THAN 800 MM FROM THE BOTTOM OF THE SLAB THEREFORE UPRIGHT SPRINKLER SHOULD ALSO BE PROVIDED.
10. EVERY FHC SHALL BE CONSISTING OF AS PER IS THE FOLLOWING
(A) 80X63 MM DIA. SINGLE HEADED HYDRANT VALVE.
(B) 2NOS. 63MMDIA. 15MTS LONG RL. HOSE REEL
(C) 20MM DIA 36.5MT FIRST AID HOSE REEL WITH 5MM BORE NOZZLE.
(D) 63MM DIA. MALE AND FEMALE INST TYPE COUPLING.
(E) 63MM DIA. BRANCH PIPE WITH 16MM. NOZZLE.
11. THIS IS A SCHEMATIC DIAGRAM ONLY MUST BE CO-ORDINATED WITH RELEVANT DRAWINGS OF FLOOR PLANS.
12. THE SUCTION TO THE PUMPS SHALL BE POSITIVE (FLOODED)
13. ACTUAL CAPACITY OF DOMESTIC OVERHEAD TANKS FOR EACH TANK MAY VARY AS PER DETAILED DESIGN
14. LOCATION OF FBC TO BE CO-ORDINTATED WITH SITE.
15. LOCATION OF SPRINKLERI TO BE CO-ORDINTATED WITH RESPECTIVE FLOOR PLAN.

LEGEND

SYMBOL	DESCRIPTION
	SPRINKLER DRAIN PIPE
	SPRINKLER PIPE
	FIRE LINE
	CONTROL VALVE
	FIRE HOSE REEL
FHC	FIRE HOSE CABINET
	PENDANT / SPRINKLER UPRIGHT HEAD AS PER SITE
	SPRINKLER HEAD (SIDE WALL NORMAL COVERAGE)
	SPRINKLER HEAD (SIDE WALL HIGH COVERAGE)
	INSPECTOR TEST VALVE
ACV	ALARM CHECK VALVE
	SLEEVE

SCHEDULE OF FIRE PUMPS

ITEM	PUMPS	QTY.
D.P.	DIESEL PUMP	1
M.F.P.	MAIN FIRE PUMP	1
J.P.	JOCKEY PUMP	1

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

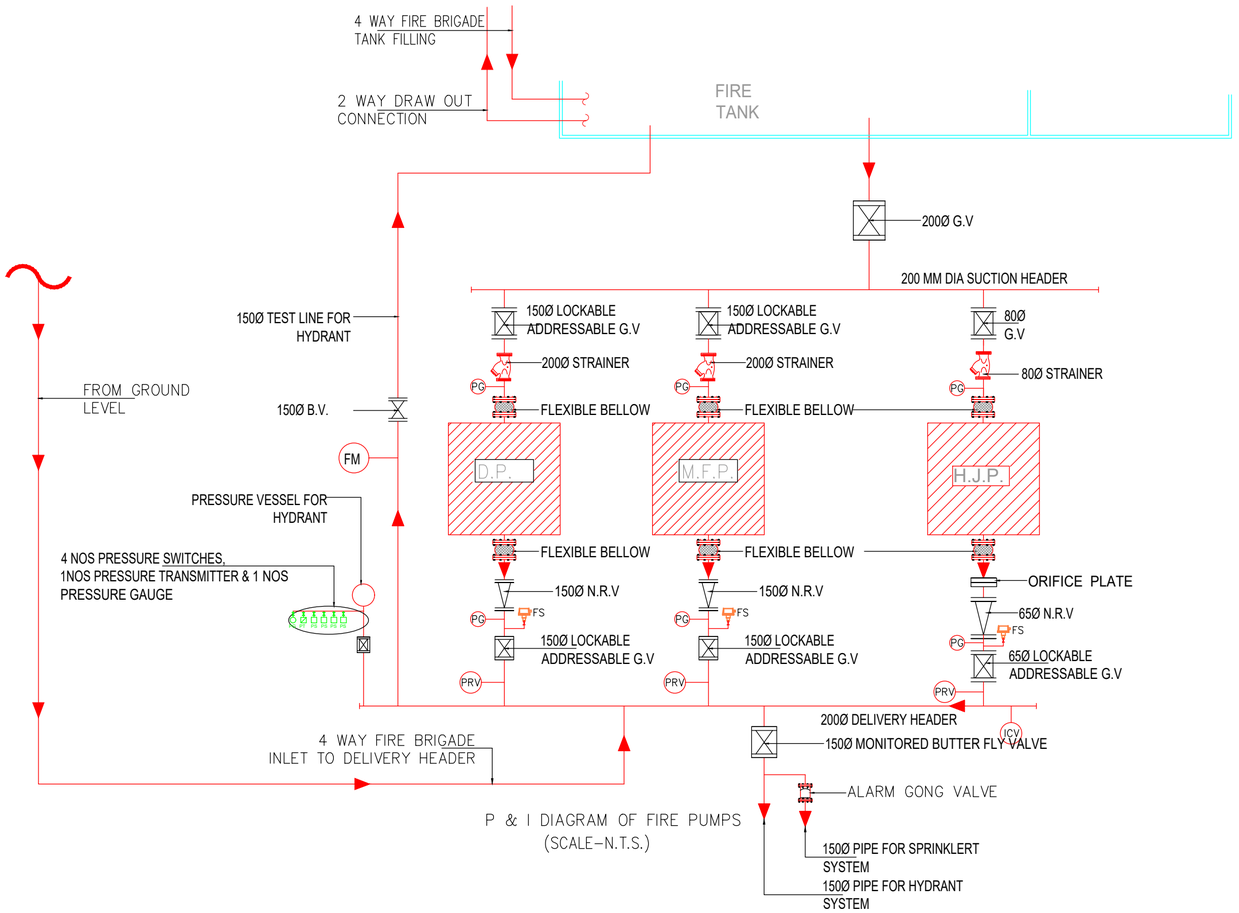
FIRE FIGHTING SYSTEM PUMP ROOM AND TANK DETAIL LAYOUT

Scale	Date	Rev.no.
NTS	31-05-22	R-00

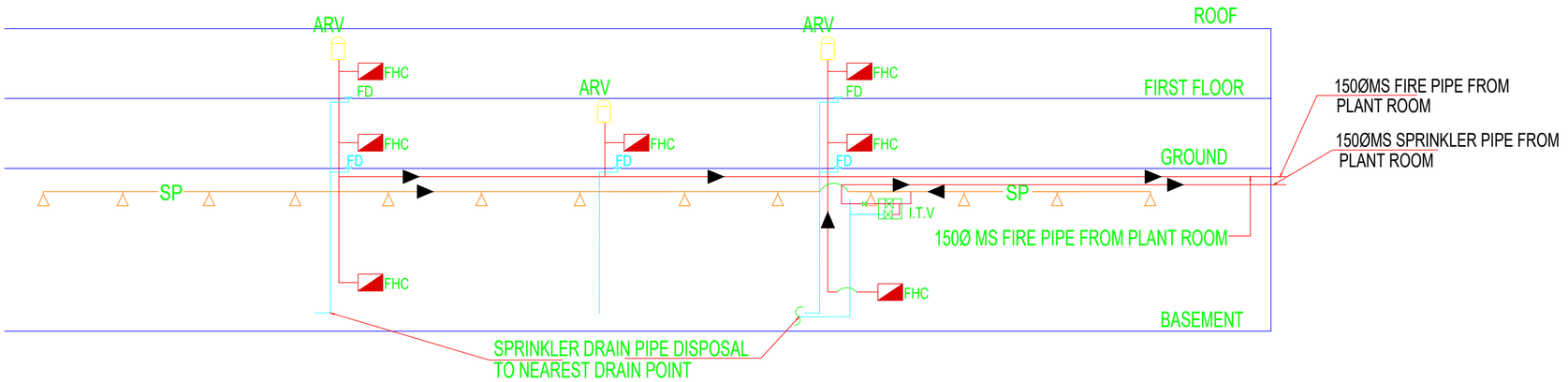
DRAWING NO.
LUMB-FF-00-PR-4010

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



P & I DIAGRAM OF FIRE PUMPS
(SCALE–N.T.S.)



NOTES:

1. THIS DRAWING REPRESENTS ONLY A FIRE FIGHTING DETAIL, FOR ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES REFER RELEVANT DRAWINGS.
2. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
3. ALL DIMENSIONS SHOWN IN DRAWINGS ARE IN MM AND MUST BE CO-ORDINATED WITH THE ARCHITECTURAL DRAWINGS.
4. THE SPRINKLER SHALL BE INSTALLED GENERALLY AS PER NBC GUIDELINES OR ANY OTHERS RELEVANT CODES & STANDARDS. IT SHALL BE THE RESPONSIBILITY OF THE EXECUTING AGENCY TO CHECK THE SITE CONDITION ACCORDINGLY.
5. THE LOCATION OF SPRINKLER MAY VARY AS PER ARCHITECTURAL CO-ORDINATION DRAWING. THE SPRINKLERS SHALL BE GENERALLY INSTALLED 3.5 M.C/C TO COVER AN AREA OF APPROX.12.0 SQ. M.
6. THE SPRINKLER INSTALLATION SHALL BE IN COMPLETE COMFORMANCE WITH CODE IS-15105 2002 & OTHER RELEVANT GUIDELINES
7. SHOP DRAWING TO BE PREPARED BY THE FIRE FIGHTING CONTRACTOR AND IS TO BE SUBMITTED TO CONSULTANTS FOR APPROVALE BEFORE EXECUTION.
8. EXACT LOCATION OF SPRINKLER HEADS/SLEEVES IN BEAM AS PER CO-ORDINATED ARCHITECTURAL DRAWING
9. SINCE THE FALSE CEILING DEPTH IS MORE THAN 800 MM FROM THE BOTTOM OF THE SLAB THEREFORE UPRIGHT SPRINKLER SHOULD ALSO BE PROVIDED.
10. EVERY FHC SHALL BE CONSISTING OF AS PER IS THE FOLLOWING
(A) 80X63 MM DIA. SINGLE HEADED HYDRANT VALVE.
(B) 2NOS. 63MMDIA. 15MTS LONG RL. HOSE REEL.
(C) 20MM DIA 36.5MT FIRST AID HOSE REEL WITH 5MM BORE NOZZLE.
(D) 63MM DIA. MALE AND FEMALE INST TYPE COUPLING.
(E) 63MM DIA. BRANCH PIPE WITH 16MM. NOZZLE.
11. THIS IS A SCHEMATIC DIAGRAM ONLY MUST BE CO-ORDINATED WITH RELEVANT DRAWINGS OF FLOOR PLANS.
12. THE SUCTION TO THE PUMPS SHALL BE POSITIVE (FLOODED)
13. ACTUAL CAPACITY OF DOMESTIC OVERHEAD TANKS FOR EACH TANK MAY VARY AS PER DETAILED DESIGN
14. LOCATION OF FBC TO BE CO-ORDINTATED WITH SITE.
15. LOCATION OF SPRINKLERL TO BE CO-ORDINTATED WITH RESPECTIVE FLOOR PLAN.

LEGEND

SYMBOL	DESCRIPTION
	SPRINKLER DRAIN PIPE
	SPRINKLER PIPE
	FIRE LINE
	CONTROL VALVE
	FIRE HOSE REEL
FHC	FIRE HOSE CABINET
	PENDANT / SPRINKLER UPRIGHT HEAD AS PER SITE
	SPRINKLER HEAD (SIDE WALL NORMAL COVERAGE)
	SPRINKLER HEAD (SIDE WALL HIGH COVERAGE)
	INSPECTOR TEST VALVE
ACV	ALARM CHECK VALVE
	SLEEVE

SCHEDULE OF FIRE PUMPS

ITEM	PUMPS	QTY.
D.P.	DIESEL PUMP	1
M.F.P.	MAIN FIRE PUMP	1
J.P.	JOCKEY PUMP	1

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

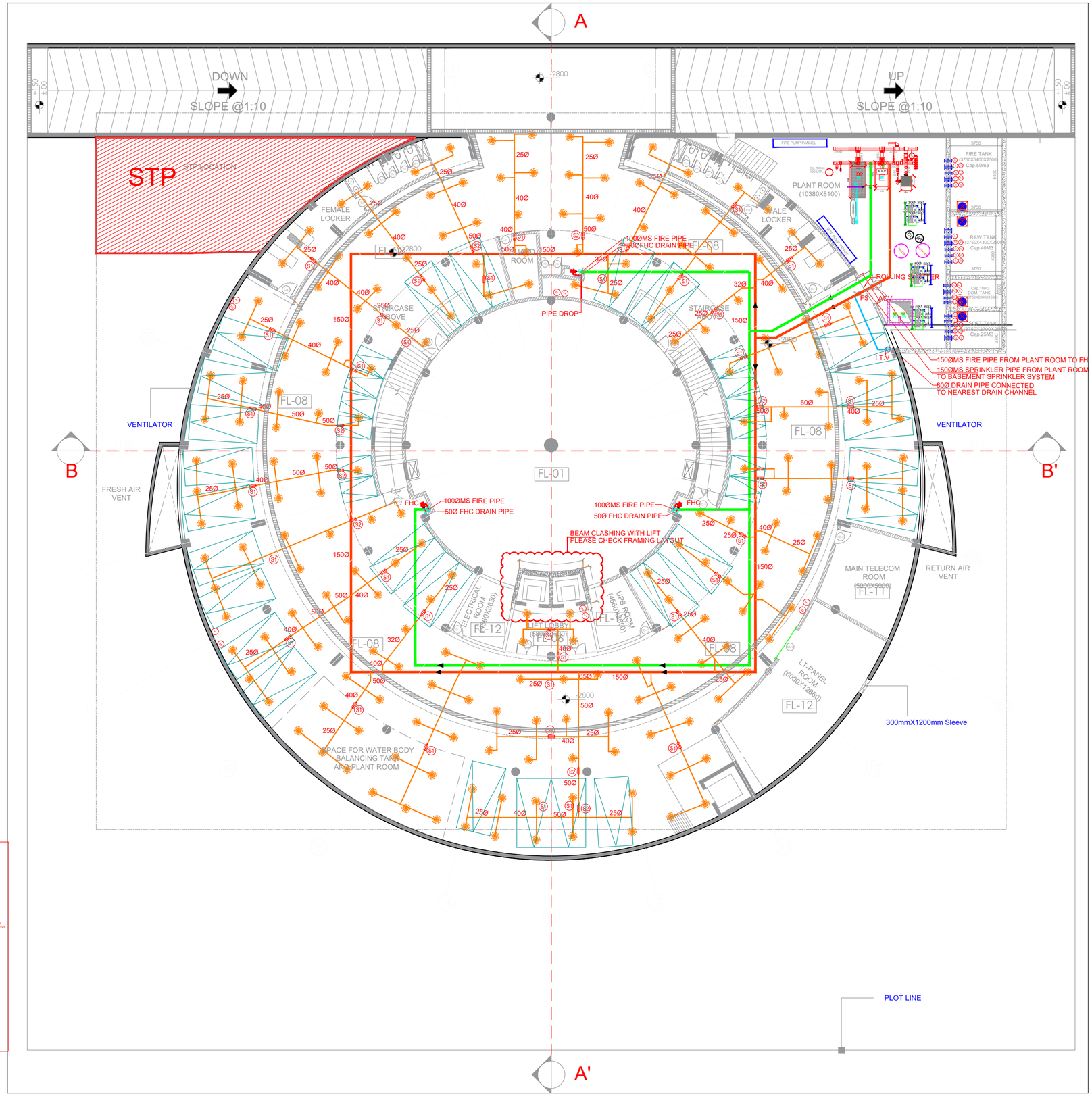
FIRE FIGHTING SYSTEM SINGLE LINE DIAGRAM

Scale	Date	Rev.no.
NTS	31-05-22	R-00

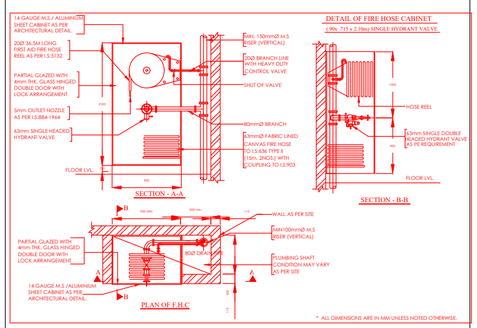
DRAWING NO.
LUMB-FF-00-SL-4013

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



	LEGEND FOR FIRE EXTINGUISHERS
SYMBOL	DESCRIPTION
(I)	9 litres capacity water type extinguishers with CO2 cartridge as per IS:15683 -Wall mounted type.
(II)	4.5 kg CO2 type cylindrical shape fire extinguisher as per IS:15683 - wall mounted type.



NOTES:

1. THIS DRAWING REPRESENTS ONLY A FIRE FIGHTING DETAIL, FOR ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES REFER RELEVANT DRAWINGS.
2. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
3. ALL DIMENSIONS SHOWN IN DRAWINGS ARE IN MM AND MUST BE CO-ORDINATED WITH THE ARCHITECTURAL DRAWINGS.
4. THE SPRINKLER SHALL BE INSTALLED GENERALLY AS PER NBC GUIDELINES OR ANY OTHERS RELEVANT CODES & STANDARDS. IT SHALL BE THE RESPONSIBILITY OF THE EXECUTING AGENCY TO CHECK THE SITE CONDITION ACCORDINGLY.
5. THE LOCATION OF SPRINKLER MAY VARY AS PER ARCHITECTURAL CO-ORDINATION DRAWING. THE SPRINKLERS SHALL BE GENERALLY INSTALLED 3.5 M C/C TO COVER AN AREA OF APPROX.12.0 SQ. M.
6. THE SPRINKLER INSTALLATION SHALL BE IN COMPLETE COMFORMANCE WITH CODE IS:15105 2002 & OTHER RELEVANT GUIDELINES
7. SHOP DRAWING TO BE PREPARED BY THE FIRE FIGHTING CONTRACTOR AND IS TO BE SUBMITTED TO CONSULTANTS FOR APPROVALE BEFORE EXECUTION.
8. EXACT LOCATION OF SPRINKLER HEADS/SLEEVES IN BEAM AS PER CO-ORDINATED ARCHITECTURAL DRAWING
9. SINCE THE FALSE CEILING DEPTH IS MORE THAN 800 MM FROM THE BOTTOM OF THE SLAB THEREFORE UPRIGHT SPRINKLER SHOULD ALSO BE PROVIDED.
10. EVERY FHC SHALL BE CONSISTING OF AS PER IS THE FOLLOWING
(A) 80X63 MM DIA. SINGLE HEADED HYDRANT VALVE.
(B) 2NOS. 63MMDIA. 15MTS LONG RL. HOSE REEL.
(C) 20MM DIA 36.5MT FIRST AID HOSE REEL WITH 5MM BORE NOZZLE.
(D) 63MM DIA. MALE AND FEMALE INST TYPE COUPLING.
(E) 63MM DIA. BRANCH PIPE WITH 16MM. NOZZLE.
11. THIS IS A SCHEMATIC DIAGRAM ONLY MUST BE CO-ORDINATED WITH RELEVANT DRAWINGS OF FLOOR PLANS.
12. THE SUCTION TO THE PUMPS SHALL BE POSITIVE (FLOODED)
13. ACTUAL CAPACITY OF DOMESTIC OVERHEAD TANKS FOR EACH TANK MAY VARY AS PER DETAILED DESIGN
14. LOCATION OF FBC TO BE CO-ORDINTATED WITH SITE.
15. LOCATION OF SPRINKLERI TO BE CO-ORDINTATED WITH RESPECTIVE FLOOR PLAN.

LEGEND

SYMBOL	DESCRIPTION
	SPRINKLER DRAIN PIPE
	SPRINKLER PIPE
	FIRE LINE
	CONTROL VALVE
	FIRE HOSE REEL
FHC	FIRE HOSE CABINET
	PENDANT / SPRINKLER UPRIGHT HEAD AS PER SITE
	SPRINKLER HEAD (SIDE WALL NORMAL COVERAGE)
	SPRINKLER HEAD (SIDE WALL HIGH COVERAGE)
	INSPECTOR TEST VALVE
ACV	ALARM CHECK VALVE
	SLEEVE

SCHEDULE FOR SPRINKLER PIPE DIA

S. No.	No. OF SPRINKLER	PIPE DIA
1	2	25Ø
2	3	32Ø
3	4-5	40Ø
4	6-18	50Ø
5	19-28	65Ø
6	29-46	80Ø
7	47-115	100Ø
8	115 TO ABOVE	150Ø

SCHEDULE FOR SPRINKLER PIPE SLEEVE

S. No.	SIZE OF SLEEVE	DIA OF SPRINKLER PIPE
S1	65mmØ	25Ø & 40Ø PIPE
S2	100mmØ	50Ø & 65Ø PIPE
S3	150mmØ	80Ø & Ø100 PIPE

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

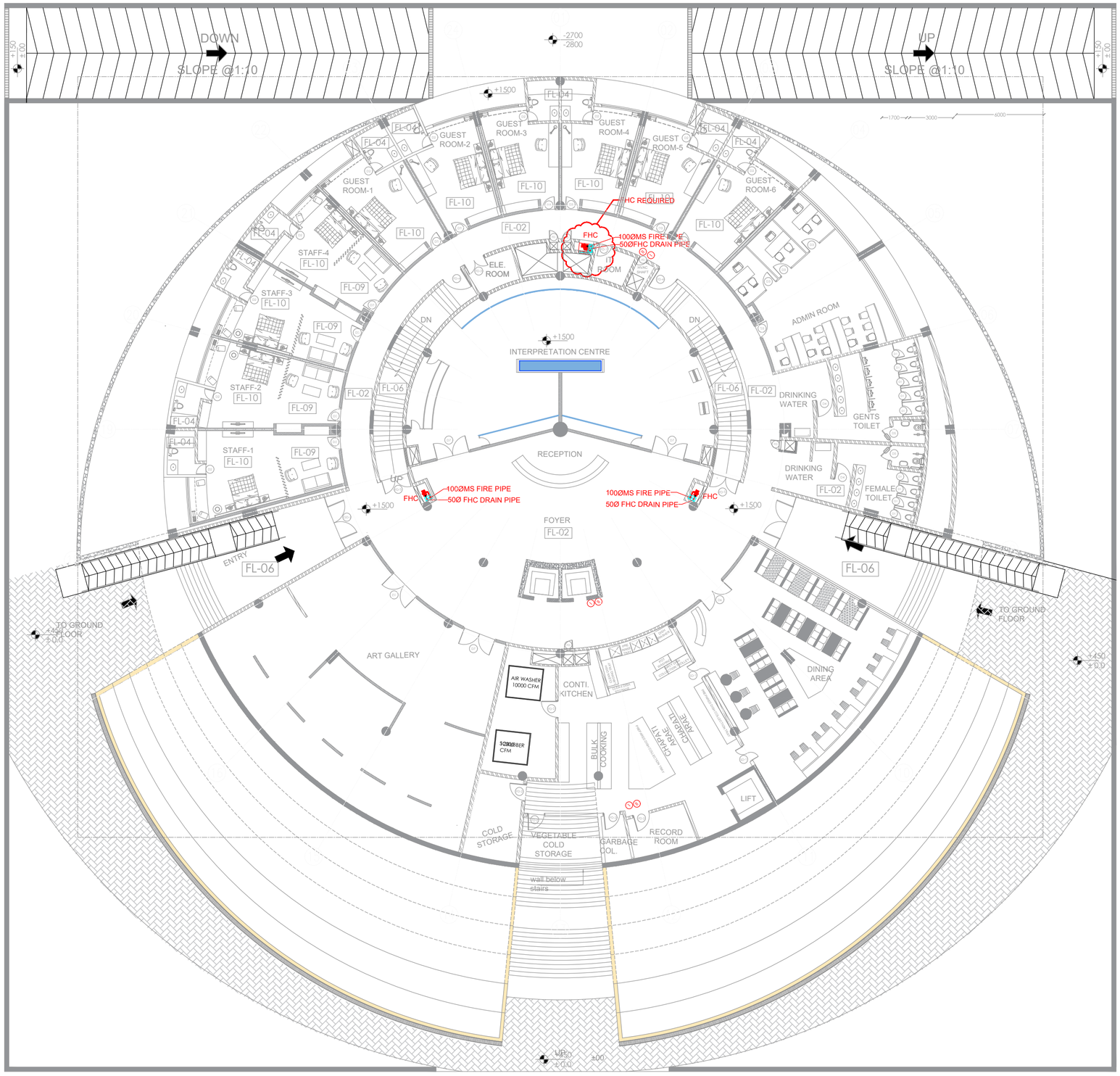
FIRE FIGHTING SYSTEM LAYOUT FOR BASEMENT FLOOR PLAN

Scale	Date	Rev.no.
NTS	31-05-22	R-00

DRAWING NO.
LUMB-FF-BF-P-4016

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

1. THIS DRAWING REPRESENTS ONLY A FIRE FIGHTING DETAIL, FOR ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES REFER RELEVANT DRAWINGS.
2. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
3. ALL DIMENSIONS SHOWN IN DRAWINGS ARE IN MM AND MUST BE CO-ORDINATED WITH THE ARCHITECTURAL DRAWINGS.
4. THE SPRINKLER SHALL BE INSTALLED GENERALLY AS PER NBC GUIDELINES OR ANY OTHERS RELEVANT CODES & STANDARDS. IT SHALL BE THE RESPONSIBILITY OF THE EXECUTING AGENCY TO CHECK THE SITE CONDITION ACCORDINGLY.
5. THE LOCATION OF SPRINKLER MAY VARY AS PER ARCHITECTURAL CO-ORDINATION DRAWING. THE SPRINKLERS SHALL BE GENERALLY INSTALLED 3.5 M C/C TO COVER AN AREA OF APPROX.12.0 SQ. M.
6. THE SPRINKLER INSTALLATION SHALL BE IN COMPLETE COMFORMANCE WITH CODE IS-15105 2002 & OTHER RELEVANT GUIDELINES
7. SHOP DRAWING TO BE PREPARED BY THE FIRE FIGHTING CONTRACTOR AND IS TO BE SUBMITTED TO CONSULTANTS FOR APPROVALE BEFORE EXECUTION.
8. EXACT LOCATION OF SPRINKLER HEADS/SLEEVES IN BEAM AS PER CO-ORDINATED ARCHITECTURAL DRAWING
9. SINCE THE FALSE CEILING DEPTH IS MORE THAN 800 MM FROM THE BOTTOM OF THE SLAB THEREFORE UPRIGHT SPRINKLER SHOULD ALSO BE PROVIDED.
10. EVERY FHC SHALL BE CONSISTING OF AS PER IS THE FOLLOWING

(A) 80X63 MM DIA. SINGLE HEADED HYDRANT VALVE.
(B) 2NOS. 63MMDIA. 15MTS LONG RL. HOSE REEL.
(C) 20MM DIA 36.5MT FIRST AID HOSE REEL WITH 5MM BORE NOZZLE.
(D) 63MM DIA. MALE AND FEMALE INST TYPE COUPLING.
(E) 63MM DIA. BRANCH PIPE WITH 16MM. NOZZLE.

11. THIS IS A SCHEMATIC DIAGRAM ONLY MUST BE CO-ORDINATED WITH RELEVANT DRAWINGS OF FLOOR PLANS.
12. THE SUCTION TO THE PUMPS SHALL BE POSITIVE (FLOODED)
13. ACTUAL CAPACITY OF DOMESTIC OVERHEAD TANKS FOR EACH TANK MAY VARY AS PER DETAILED DESIGN
14. LOCATION OF FBC TO BE CO-ORDINTATED WITH SITE.
15. LOCATION OF SPRINKLERL TO BE CO-ORDINTATED WITH RESPECTIVE FLOOR PLAN.

FHC
ACV

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

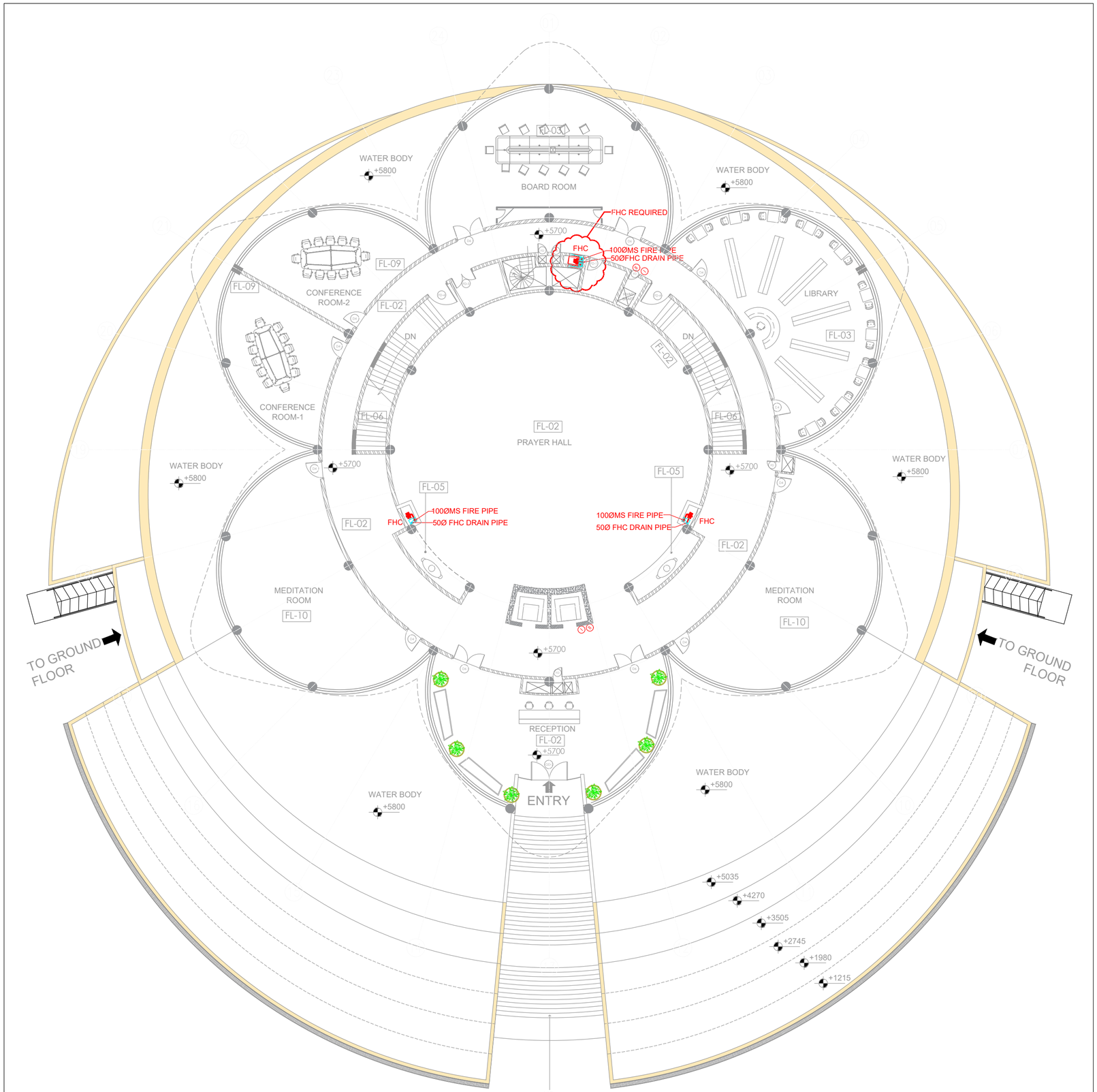
FIRE FIGHTING SYSTEM LAYOUT FOR GROUND FLOOR PLAN

Scale	Date	Rev.no.
NTS	31-05-22	R-00

DRAWING NO.
LUMB-FF-GF-P-4017

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

1. THIS DRAWING REPRESENTS ONLY A FIRE FIGHTING DETAIL, FOR ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES REFER RELEVANT DRAWINGS.
2. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
3. ALL DIMENSIONS SHOWN IN DRAWINGS ARE IN MM AND MUST BE CO-ORDINATED WITH THE ARCHITECTURAL DRAWINGS.
4. THE SPRINKLER SHALL BE INSTALLED GENERALLY AS PER NBC GUIDELINES OR ANY OTHERS RELEVANT CODES & STANDARDS. IT SHALL BE THE RESPONSIBILITY OF THE EXECUTING AGENCY TO CHECK THE SITE CONDITION ACCORDINGLY
5. THE LOCATION OF SPRINKLER MAY VARY AS PER ARCHITECTURAL CO-ORDINATION DRAWING. THE SPRINKLERS SHALL BE GENERALLY INSTALLED 3.5 M.C/C TO COVER AN AREA OF APPROX.12.0 SQ. M.
6. THE SPRINKLER INSTALLATION SHALL BE IN COMPLETE COMFORMANCE WITH CODE IS-15105 2002 & OTHER RELEVANT GUIDELINES
7. SHOP DRAWING TO BE PREPARED BY THE FIRE FIGHTING CONTRACTOR AND IS TO BE SUBMITTED TO CONSULTANTS FOR APPROVALE BEFORE EXECUTION.
8. EXACT LOCATION OF SPRINKLER HEADS/SLEEVES IN BEAM AS PER CO-ORDINATED ARCHITECTURAL DRAWING
9. SINCE THE FALSE CEILING DEPTH IS MORE THAN 800 MM FROM THE BOTTOM OF THE SLAB THEREFORE UPRIGHT SPRINKLER SHOULD ALSO BE PROVIDED.
10. EVERY FHC SHALL BE CONSISTING OF AS PER IS THE FOLLOWING

(A) 80X63 MM DIA. SINGLE HEADED HYDRANT VALVE.
(B) 2NOS. 63MMDIA. 15MTS LONG RL. HOSE REEL.
(C) 20MM DIA 36.5MT FIRST AID HOSE REEL WITH 5MM BORE NOZZLE.
(D) 63MM DIA. MALE AND FEMALE INST TYPE COUPLING.
(E) 63MM DIA. BRANCH PIPE WITH 16MM. NOZZLE.

11. THIS IS A SCHEMATIC DIAGRAM ONLY MUST BE CO-ORDINATED WITH RELEVANT DRAWINGS OF FLOOR PLANS.
12. THE SUCTION TO THE PUMPS SHALL BE POSITIVE (FLOODED)
13. ACTUAL CAPACITY OF DOMESTIC OVERHEAD TANKS FOR EACH TANK MAY VARY AS PER DETAILED DESIGN
14. LOCATION OF FBC TO BE CO-ORDINTATED WITH SITE.
15. LOCATION OF SPRINKLERL TO BE CO-ORDINTATED WITH RESPECTIVE FLOOR PLAN.

FHC
ACV

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

FIRE FIGHTING SYSTEM LAYOUT FOR FIRST FLOOR PLAN

Scale	Date	Rev.no.
NTS	31-05-22	R-00

DRAWING NO.
LUMB-FF-FF-P-4018

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

ABBREVIATIONS - PLUMBING SERVICES

TAG.	DESCRIPTION
FD	FLOOR DRAIN
FT	FLOOR TRAP
UT	URINAL TRAP
COP	CLEAN OUT PLUG
FCO	FLOOR CLEAN OUT PLUG
WP	WASTE PIPE
SP	SOIL PIPE
IL	INVERT LEVEL
CL	CONNECTION LEVEL
GL	GROUND LEVEL
FFL	FINISH FLOOR LEVEL
AB	ABOVE
D/N	DOWN
DWS	DOMESTIC WATER SUPPLY
FWS	FLUSHING WATER SUPPLY
HWS	HOT WATER SUPPLY
HWR	HOT WATER RETURN
ST	STRAINER
BFV	BUTTERFLY VALVE
SLV	SLUICE VALVE
GT	GULLY TRAP
MH	MAN
CB	CATCH BASIN
UGT	UNDER GROUND TANK
AFL	ABOVE FLOOR LEVEL
BFL	BELOW FLOOR LEVEL
DMH	DRAINAGE MANHOLE
SMH	SEWER MANHOLE
GI	GALVANIZED IRON
WM	WATER METER
IV	ISOLATING VALVE
MT	MOTORIZED VALVE

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION
GL.	GROUND LEVEL RAIN WATER PIPE
IL.	INVERT LEVEL
COP	CLEAN OUT PLUG

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

STANDARD LEGENDS - PLUMBING SERVICES

Scale	Date	Rev.no.
NTS	31-05-22	R-00

DRAWING NO.
LUMB-PL-00-D-3001

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

GENERAL NOTES:-

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COORDINATION OF ALL SERVICES.

2. ALL ABOVE GROUND FLOOR DRAINAGE SHALL BE CAST IRON TO WASTE PIPE SHALL BE TO UNLESS OTHERWISE SPECIFIED.

3. ALL DOMESTIC KITCHEN AND LAUNDRY WASTE PIPE SHALL BE IN CAST IRON PIPES.

4. ALL PIPING UNDER GROUND FLOOR SLAB SHALL BE OF CAST IRON.

5. ANY PIPING PASSING UNDER THE BUILDING AND UNDER PAVED AREA SHALL BE PROTECTED WITH CONCRETE SURROUNDINGS.

6. ALL FLOOR DRAINS SHALL HAVE RODDING ACCESS AND INCORPORATE HEAVY DUTY COVERS.

7. BENDS AT BASE OF STACKS SHALL BE SLOW RADIUS TYPE.

8. ALL FLOOR DRAINS SHALL HAVE 75MM DEEP SEAL.

9. COVERS AND INVERT LEVELS OF DRAINAGE MANHOLE TO BE COORDINATED BY CONTRACTOR WITH FINAL COVER LEVELS.

10. CONDENSATE DRAIN FROM ALL AIR-CONDITIONING UNITS SHALL BE CONNECTED TO THE NEAREST FLOOR TRAP/WASTE STACK, THROUGH A U-TRAP, INDIRECTLY CONNECTED WITH 25MM(MIN) AIR GAP, FOR LOCATION OF AIR CONDITIONING UNITS, REFER HVAC DRAWING.

11. THE HORIZONTAL DRAINAGE PIPES (SP,WP,KWP & RWP) IN CEILING VOID OF ALL AREAS IN THE BUILDING EXCEPT THE AREAS LISTED BELOW SHALL BE WRAPPED WITH ACOUSTIC LAGGING MATERIAL SIMILAR TO KINETICS TYPE KNM-100ALQ OR APPROVAL EQUAL.
a) PLANT ROOMS
b) CAR PARKING FLOORS

12. ALL VERTICAL DRAINAGE PIPES IN CAR PARKING AREA SHALL BE COVERED/PROTECTED AS PER ARCHITECTURAL DETAIL. ACCESS PANELS SHALL BE PROVIDED FOR EACH INSPECTION WHEREVER REQUIRED.

13. PROVIDE VELOCITY BREAKERS IN VERTICAL DRAINAGE STACKS AT INTERVALS OF FIVE FLOORS, TO THE APPROVAL OF THE ENGINEER.

14. ALL DRAINAGE PIPE WORK IS BELOW SLAB UNLESS NOTED.

GENERAL NOTES WATER SUPPLY:-

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

2. ALL WORKS, SETTING OUT, SLOPES, APPURTENANCES, MATERIALS & FINISHES ARE TO BE INSPECTED & APPROVED BY THE CONSULTANTS PRIOR TO COMMENCEMENT OF WORKS.

3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL THE OTHER SERVICES, STRUCTURAL & ARCHITECTURAL DRAWINGS.

4. SPECIALIST CONTRACTOR SHALL ENSURE THAT THE INSTALLATIONS BE CARRIED OUT PER RELEVANT CODE SPECIFICATIONS & REGULATIONS.

5. ANY DISCREPANCIES FOUND SHALL BE BROUGHT TO THE ATTENTION OF THE CONSULTANT DURING THE TENDER STAGE ONLY. NO VARIATION SHALL BE ACCEPTED AFTER THE FINALIZATION OF CONTRACT.

6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CO-ORDINATION OF ALL SERVICES.

7. UNLESS OTHERWISE INDICATED ALL PIPE WORK IN TOILETS/BATH ROOMS SHALL BE 20mm DIA. WITH REDUCTIONS TO 15mmDIA. ONLY FOR LAST BRANCH FEEDING A SINGLE CONNECTION. CONNECTIONS TO ALL FIXTURES SHALL BE 15mm DIA.

8. PUMP CONTROL PANEL TO INCORPORATE INCOMING MCCB, OUTGOING MCCB FOR EACH PUMP, CYCLIC EACH PUMP, DUTY/STANDBY SELECTOR SWITCH, AUTOMATIC CHANGEOVER IN CASE OF DUTY PUMP FAILURE, RUN/TRIP/OFF INDICATOR LAMPS FOR EACH PUMP, LOW LEVEL INDICATOR AND HIGH LEVEL ALARM FOR WATER TANK. CONSTRUCTION DETAILS SHALL BE AS PER THE ELECTRICAL SPECIFICATION.

9. ALL COLD WATER SERVICES DOWN RISERS SHALL BE IN COPPER AS SPECIFIED.

10. ALL COLD WATER VERTICAL PIPE DROP CONCEALED IN WALLS SHALL BE AS SPECIFIED.

11. CONTRACTOR SHALL INCLUDE FOR WATER HAMMER ARRESTORS TO BE INSTALLED ON COLD WATER SYSTEM BRANCH PIPES AT THE END & BEFORE THE LAST VERTICAL DROP CONNECTION OF EVERY CIRCUIT FOR ALL (KITCHEN, TOILETS, PANTRY ETC.) WHETHER SHOWN OR NOT ON LAYOUT.

12. FINAL COLD WATER PIPE DISTRIBUTION & CONNECTION IN PANTRIES, ETC. SHALL BE CO-ORDINATED WITH THE FINAL EQUIPMENT LAYOUT.SAME SHALL BE INCLUDED IN MEP CONTRACTOR SCOPE OF WORK.

13. ALL HIGH POINTS OF EVERY BOOSTED WATER SYSTEM SHALL BE PROVIDED WITH AUTOMATIC AIR VENT & THE LOW POINT SHALL BE PROVIDED WITH DRAIN POINT WHETHER SHOWN ON LAYOUT OR NOT.

14. CONTRACTOR TO ENSURE THAT ALL PUMPS AND MECHANICAL PLANT ARE INSTALLED ON MINIMUM 150mm CONCRETE PLINTH.

15. FINAL SHOW BIB TAP LOCATION/HEIGHT SHALL APPROVED BY ARCH. AND ALL BIB AP SHALL BE LOCKABLE TYPE FITTED WITH DOUBLE CHECK VALVE.

16. DOMESTIC COLD WATER PIPE WILL BE COPPER TYPE L MATERIAL.

17. ALL DOMESTIC HOT WATER PIPES WILL BE INSTALLED COPPER TYPE L.

NOTE

1. PLEASE CO-ORDINATE THIS DRAWING WITH ALL OTHER RELEVANT DRAWINGS OF ALL THE SERVICES.
2. ALL EXTERNAL SEWAGE, DRAINAGE PIPES SHALL BE EMBEDDED IN 150mm THICK CEMENT CONCRETE 1:4:8 AT SLOPE AS SPECIFIED.
3. THE FOUNDATION OF ALL CATCH BASINS, CHAMBERS, CATCH BASIN AND PIPE SUPPORTS SHALL REST ON FIRM GROUND AS PER SITE CONDITIONS.
4. THE FINAL LOCATION OF CATCH BASIN, C.B. AND FIRE HYDRANT ETC. TO BE INCORPORATED AS PER LANDSCAPE DRG.
5. STROM WATER DRAINAGE SYSTEM SHALL BE DONE AS PER FINAL LANDSCAPE/ARCHITECTURAL PLANNING AS PER SITE CONDITION.
6. THE FINAL DISPOSAL OF SEWAGE & DRAINAGE TO MUNICIPAL LINE AS PER SITE CONDITIONS.
7. SEWAGE SUMP VENT PIPE TO BE TERMINATED ATMOSPHERE AS PER SITE .

GUIDELINE FOR SELECTING THE SIZE OF MANHOLES

S.No.	SIZE OF MH.	DEPTH OF MH
1	MH 900x800	0.90m.TO 1.20M.DEPTH
2	MH 910Ø	0.91 TO 1.65m.DEPTH
3	MH 1220Ø	1.65 TO 2.3m.DEPTH
4	MH 1520Ø	2.3 TO 9m.DEPTH

GUIDELINE FOR SELECTING THE SIZE OF MANHOLES & CATCH BASIN

S.No.	SIZE OF CB.	DEPTH OF CB.
1	CB 450x450	450 TO 600mm
2	CB 600x600	600 TO 750mm
3	CB 750x750	750 TO 900mm

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

STANDARD NOTES - PLUMBING SERVICES

Scale	Date	Rev.no.
NTS	31-05-22	R-00

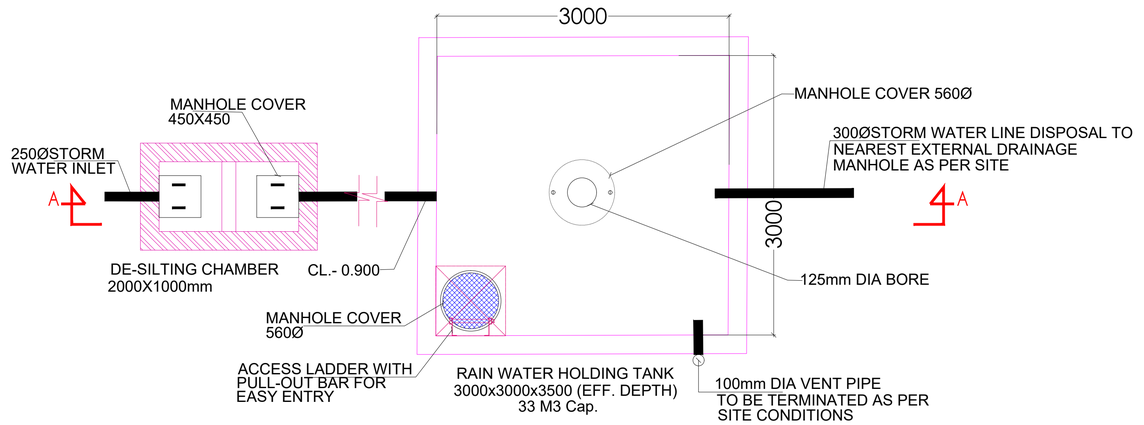
DRAWING NO.

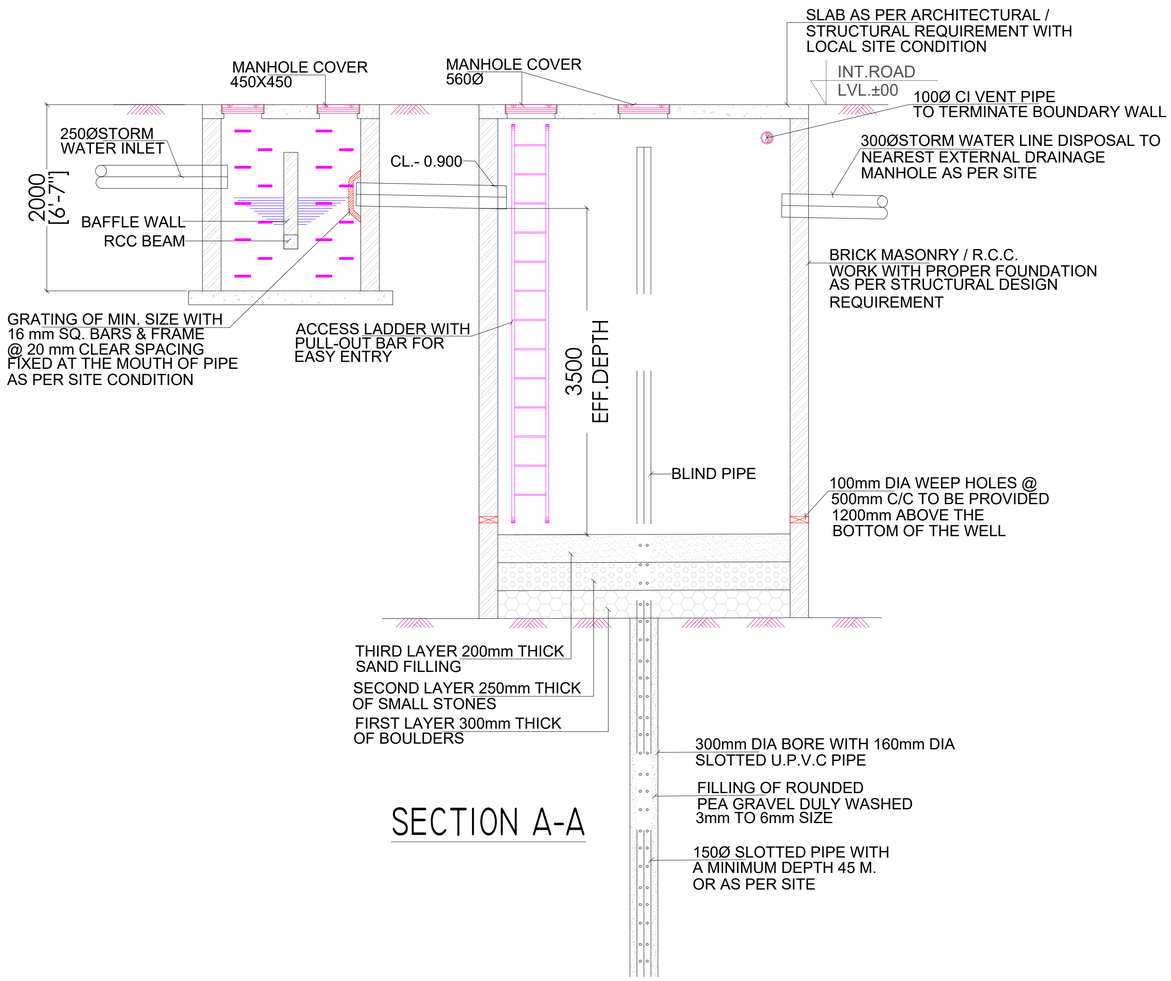
LUMB-PL-00-D-3002

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

RAIN WATER HARVESTING WELL





SECTION A-A

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

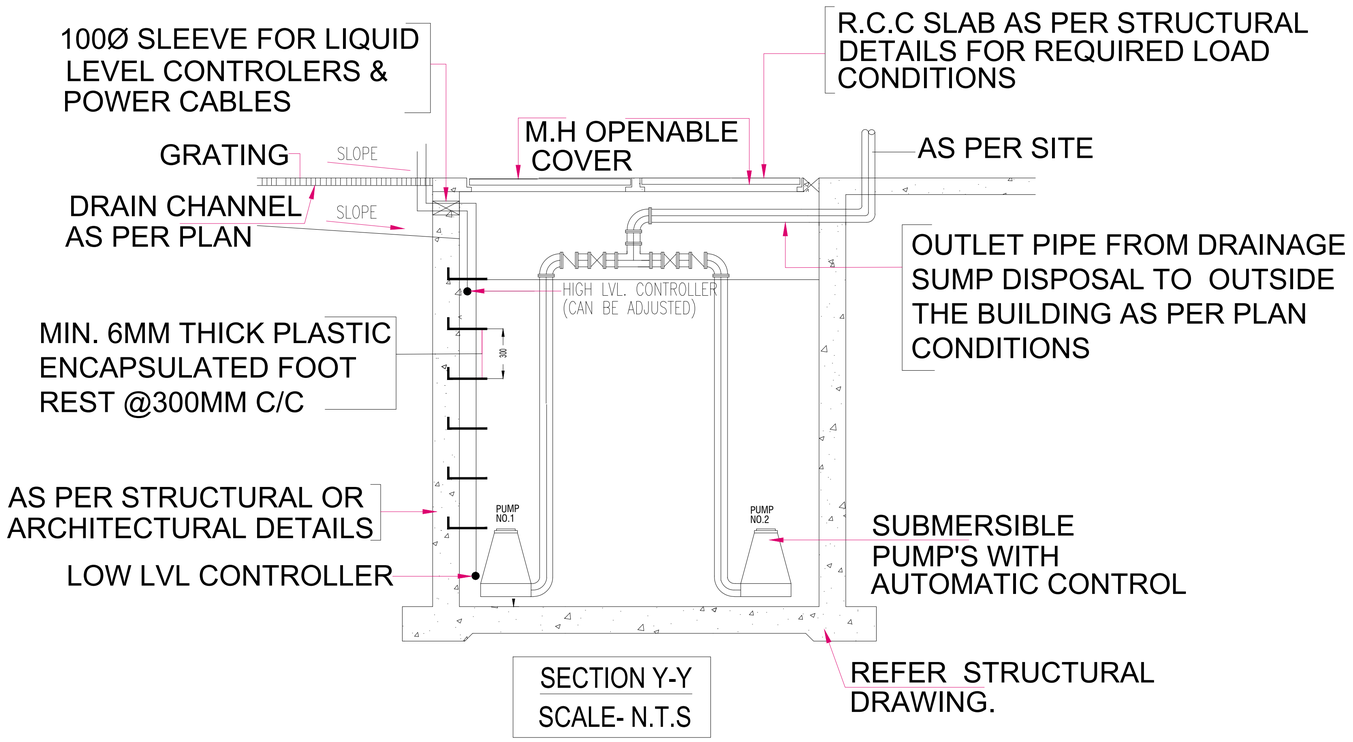
STANDARD DETAILS - PLUMBINGS SERVICE (SHEET 1 OF 2)

Scale	Date	Rev.no.
NTS	31-05-22	R-00

DRAWING NO.
LUMB-PL-00-PR-3003

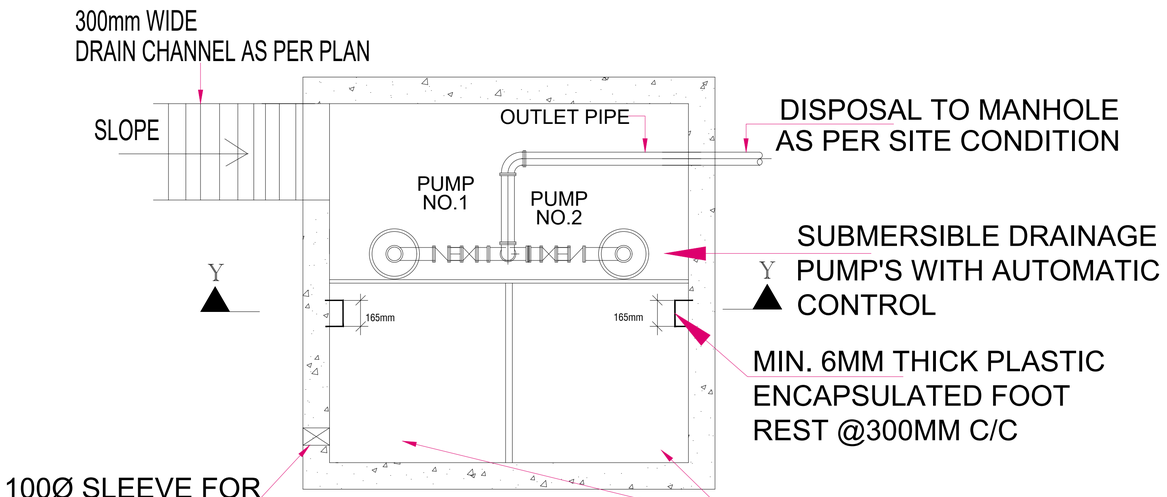
ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



SECTION Y-Y

SCALE- N.T.S



PLAN

SCALE- N.T.S

DIMENSION AS PER SITE DIRECTION

DETAIL OF DRAINAGE SUMP

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

STANDARD DETAILS - PLUMBINGS SERVICE (SHEET 2 OF 2)

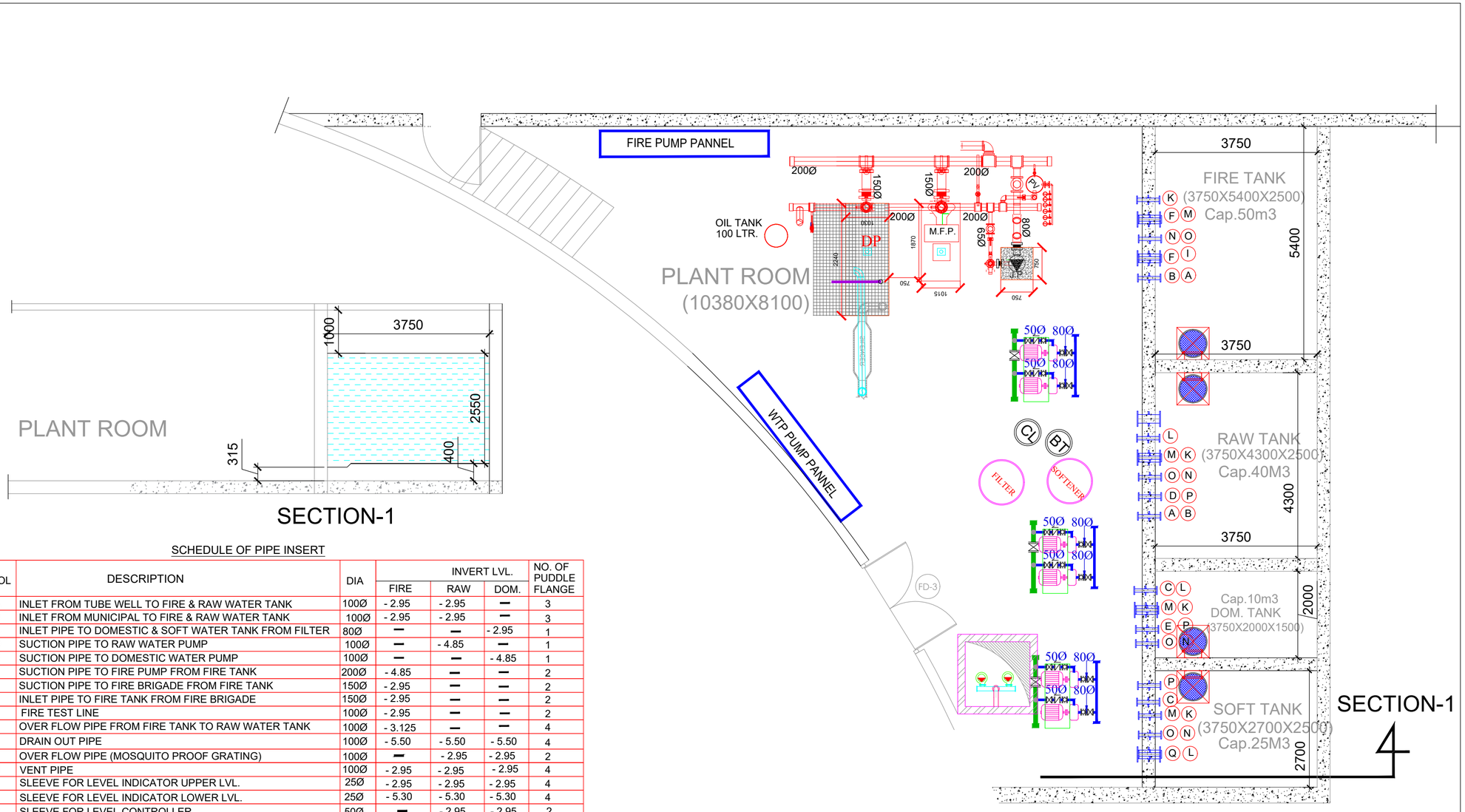
Scale	Date	Rev.no.
NTS	31-05-22	R-00

DRAWING NO.

LUMB-PL-00-PR-3004

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



SECTION-1

SCHEDULE OF PIPE INSERT

SYMBOL	DESCRIPTION	DIA	INVERT LVL.			NO. OF PUDDLE FLANGE
			FIRE	RAW	DOM.	
A	INLET FROM TUBE WELL TO FIRE & RAW WATER TANK	100Ø	- 2.95	- 2.95	—	3
B	INLET FROM MUNICIPAL TO FIRE & RAW WATER TANK	100Ø	- 2.95	- 2.95	—	3
C	INLET PIPE TO DOMESTIC & SOFT WATER TANK FROM FILTER	80Ø	—	—	- 2.95	1
D	SUCTION PIPE TO RAW WATER PUMP	100Ø	—	- 4.85	—	1
E	SUCTION PIPE TO DOMESTIC WATER PUMP	100Ø	—	—	- 4.85	1
F	SUCTION PIPE TO FIRE PUMP FROM FIRE TANK	200Ø	- 4.85	—	—	2
G	SUCTION PIPE TO FIRE BRIGADE FROM FIRE TANK	150Ø	- 2.95	—	—	2
H	INLET PIPE TO FIRE TANK FROM FIRE BRIGADE	150Ø	- 2.95	—	—	2
I	FIRE TEST LINE	100Ø	- 2.95	—	—	2
J	OVER FLOW PIPE FROM FIRE TANK TO RAW WATER TANK	100Ø	- 3.125	—	—	4
K	DRAIN OUT PIPE	100Ø	- 5.50	- 5.50	- 5.50	4
L	OVER FLOW PIPE (MOSQUITO PROOF GRATING)	100Ø	—	- 2.95	- 2.95	2
M	VENT PIPE	100Ø	- 2.95	- 2.95	- 2.95	4
N	SLEEVE FOR LEVEL INDICATOR UPPER LVL.	25Ø	- 2.95	- 2.95	- 2.95	4
O	SLEEVE FOR LEVEL INDICATOR LOWER LVL.	25Ø	- 5.30	- 5.30	- 5.30	4
P	SLEEVE FOR LEVEL CONTROLLER	50Ø	—	- 2.95	- 2.95	2
Q	SUCTION PIPE TO SOFT WATER PUMP					

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

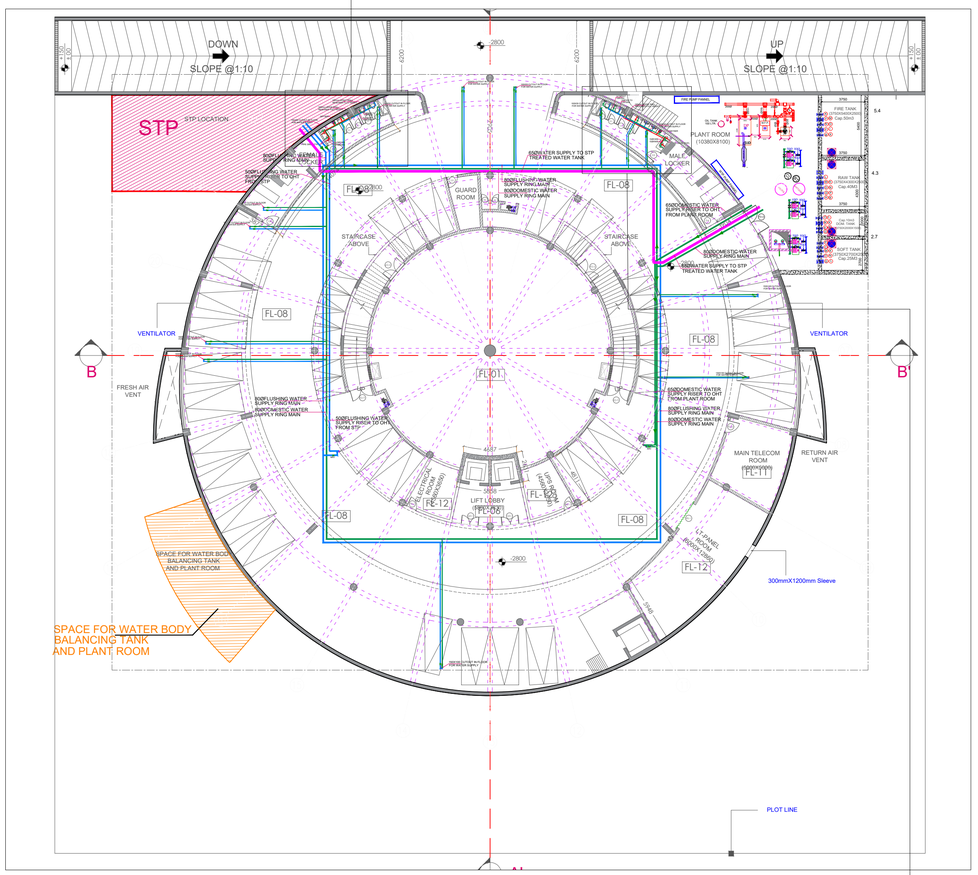
PLUMBING SYSTEM PUMP ROOM AND TANK DETAIL LAYOUT

Scale	Date	Rev.no.
A1	31-05-22	R-00

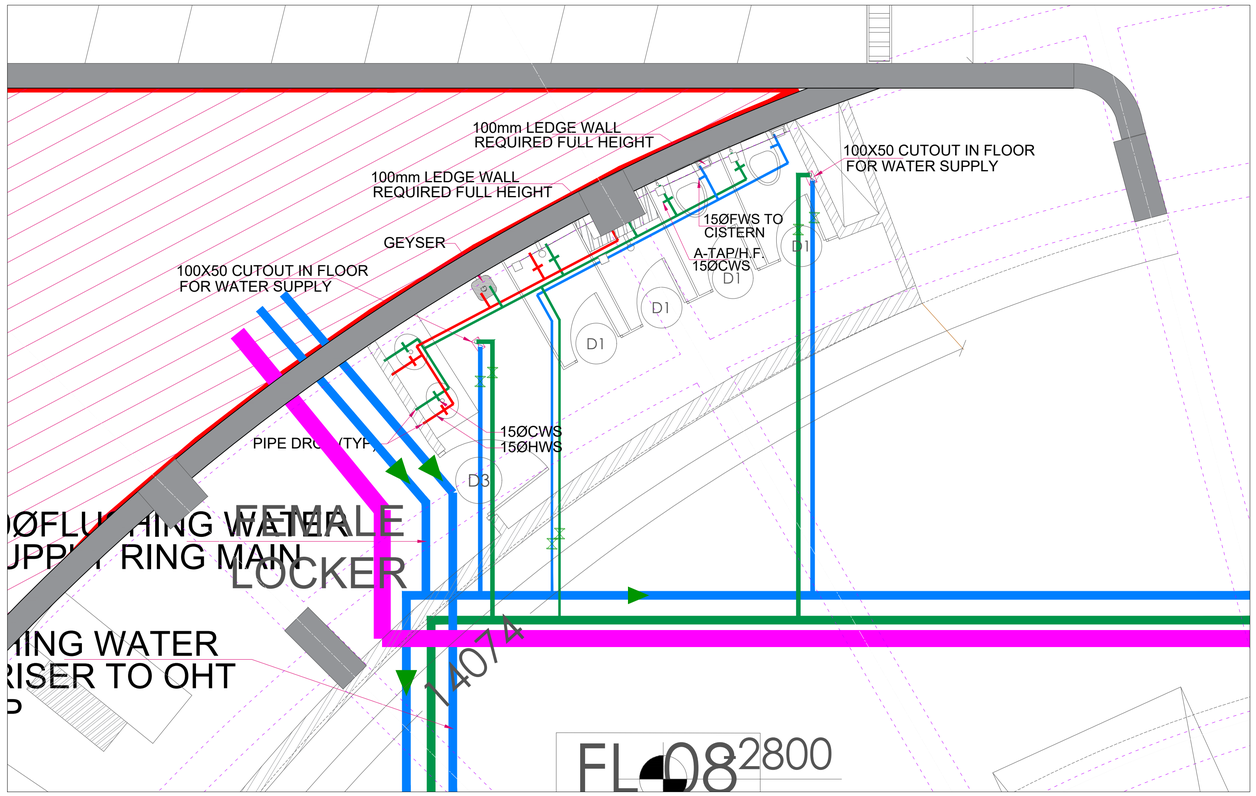
DRAWING NO.
LUMB-PL-00-PR-3010

ISSUED FOR:

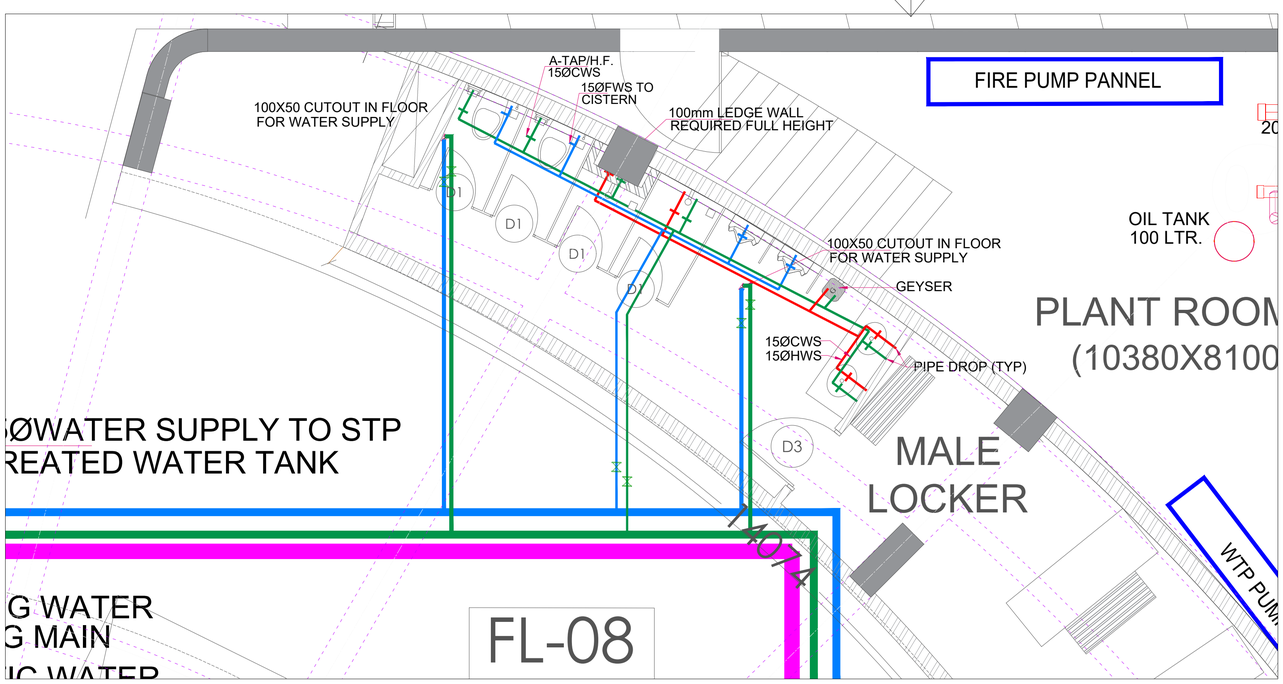
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



BASEMENT PLAN



TOILET DETAIL 1



TOILET DETAIL 2

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

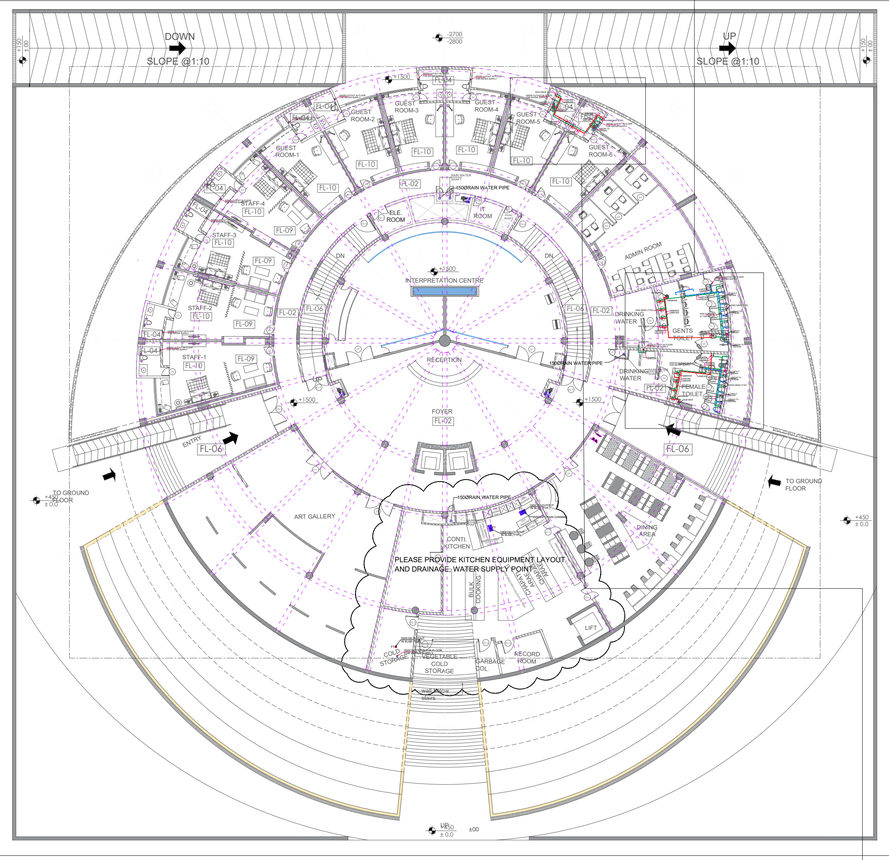
PLUMBING SYSTEM LAYOUT FOR BASEMENT FLOOR TOILET DETAIL DRAINAGE & WATER SUPPLY

Scale	Date	Rev.no.
A1	31-05-22	R-00

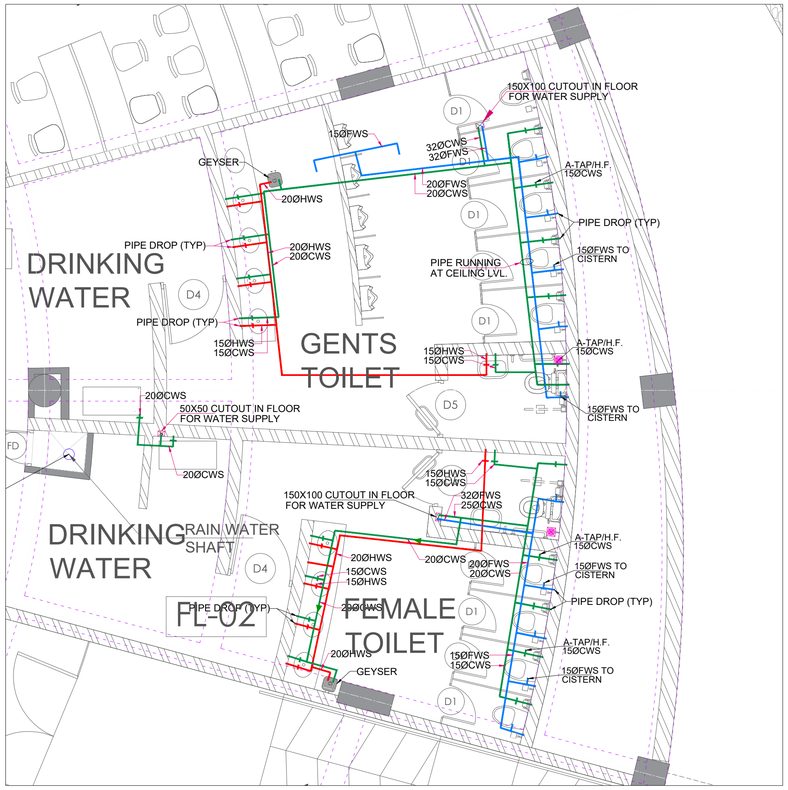
DRAWING NO.
LUMB-PL-BF-TD-3011

ISSUED FOR:

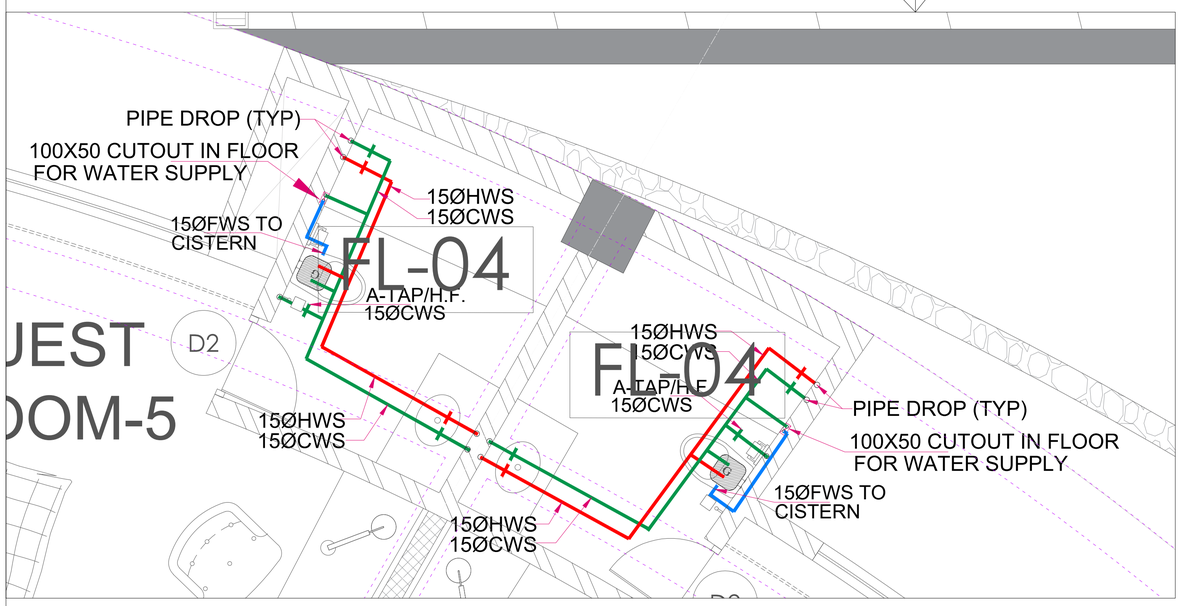
- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



GROUND FLOOR PLAN



TOILET DETAIL 1



TOILET DETAIL 2

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF; CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE, ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TIE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

PLUMBING SYSTEM LAYOUT FOR GROUND FLOOR TOILET DETAIL DRAINAGE & WATER SUPPLY

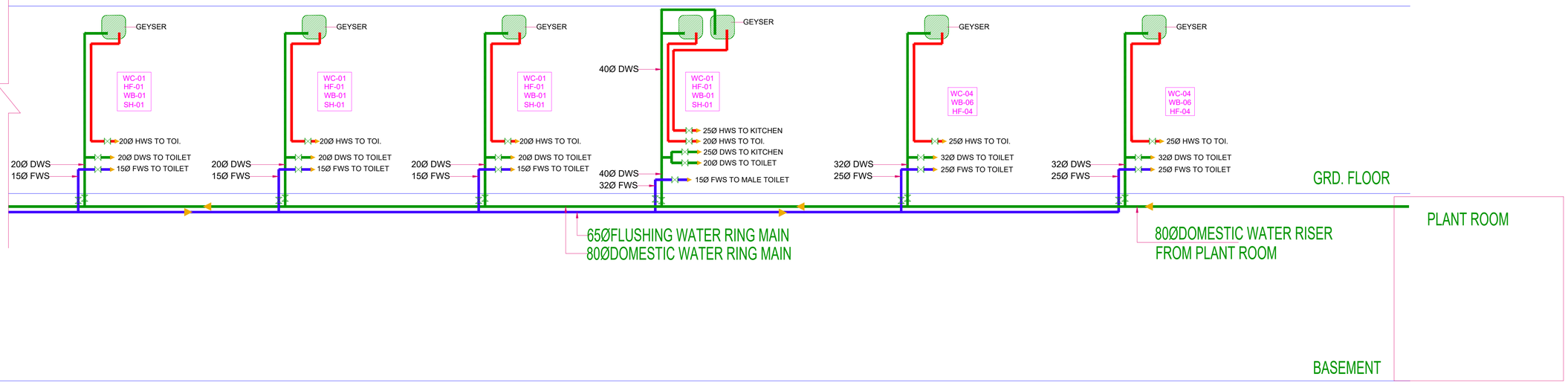
Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.
LUMB-PL-BF-TD-3012

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE

PART-1

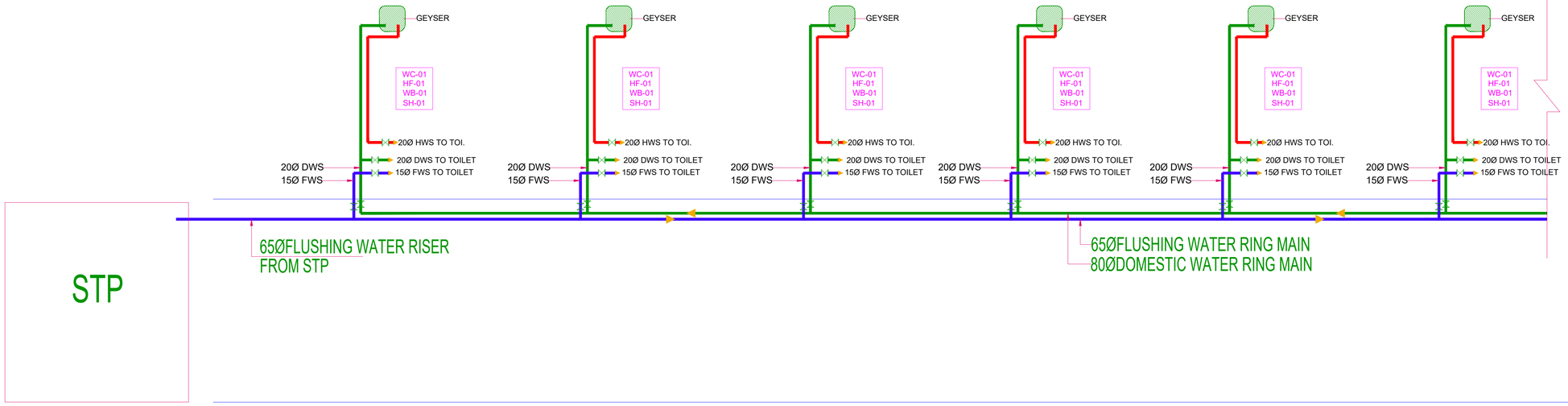


PART-2

LEGEND

SYMBOL	DESCRIPTION
HWS	HOT WATER SUPPLY
DWS	DOM. WATER SUPPLY
	SWIMMING POOL WS LINE
	CONTROL VALVE

WC	WATER CLOSET
HF	HEALTH FAUCET
WB	WASH BASIN
SH	SHOWER
BT	BATH TUBE
DWS	DOMESTIC WATER SUPPLY
FWS	FLUSHING WATER SUPPLY
UN	URINAL TRAP



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF; CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE, ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

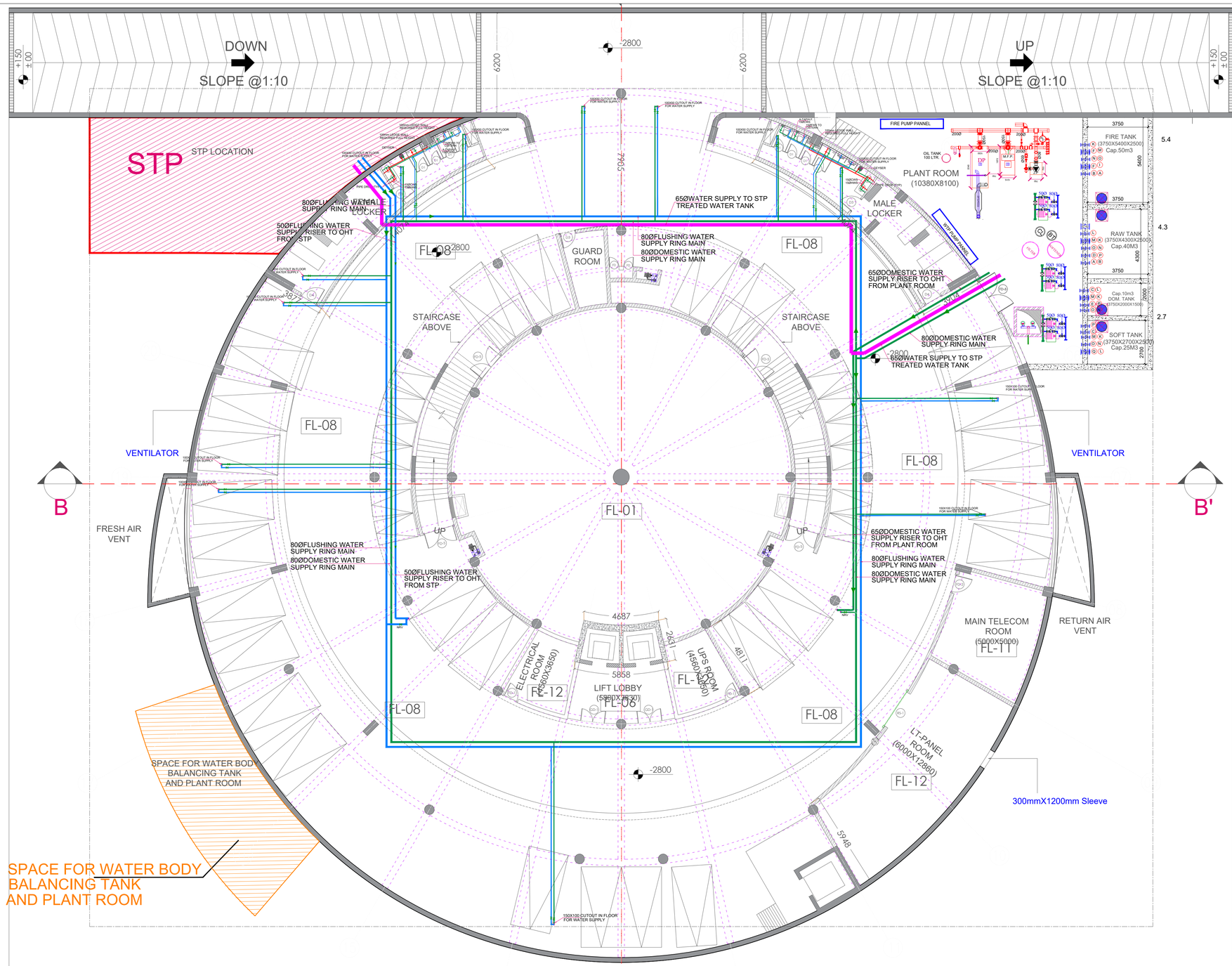
PLUMBING SYSTEM WATER SUPPLY SINGLE LINE DIAGRAM

Scale	Date	Rev.no.
A1	31-01-22	R-00

DRAWING NO.
LUMB-PL-WS-SL-3016

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE, ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

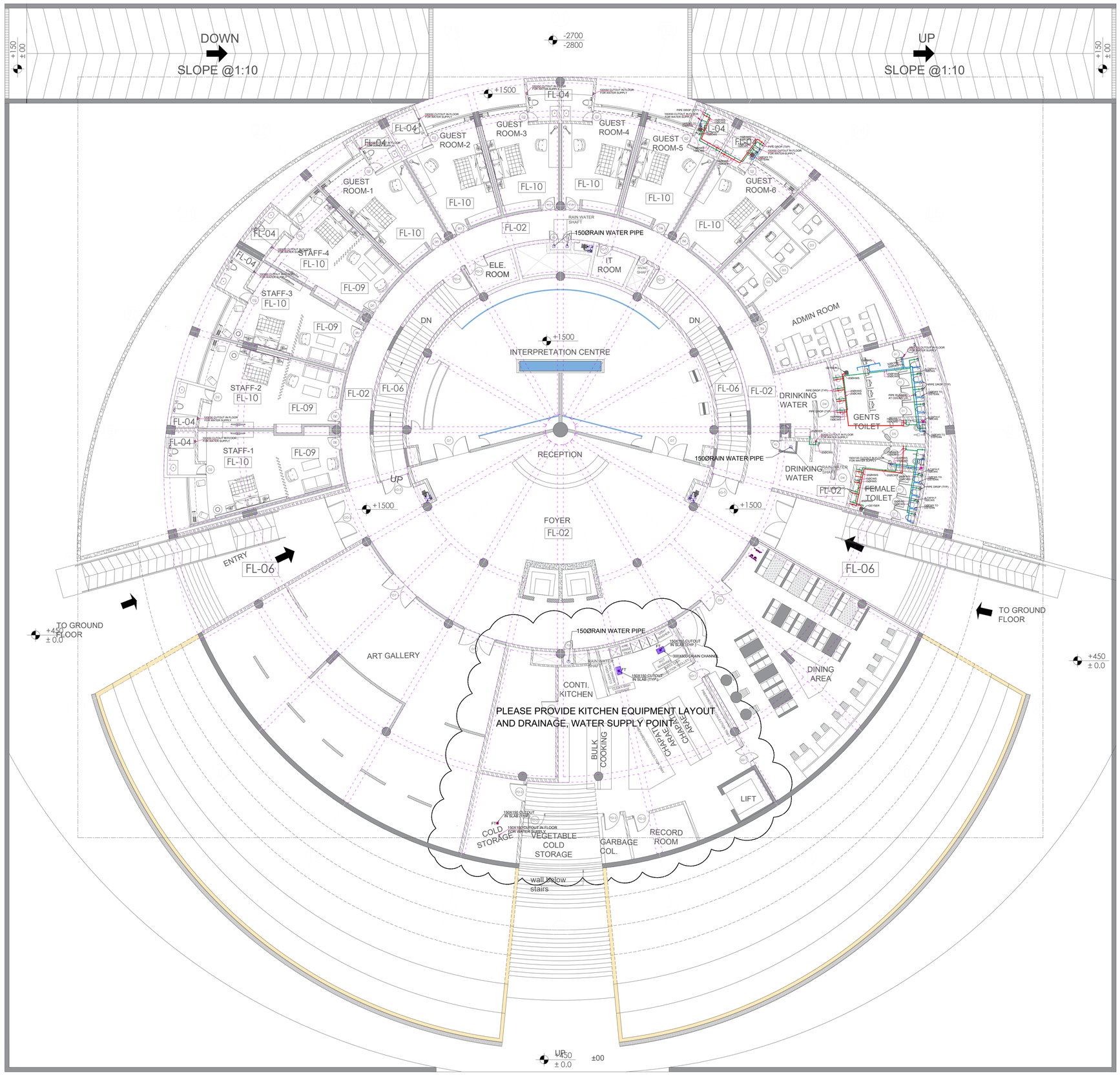
PLUMBING SYSTEM LAYOUT FOR BASEMENT CEILING WATER SUPPLY

Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.
LUMB-PL-BF-WS-3018

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

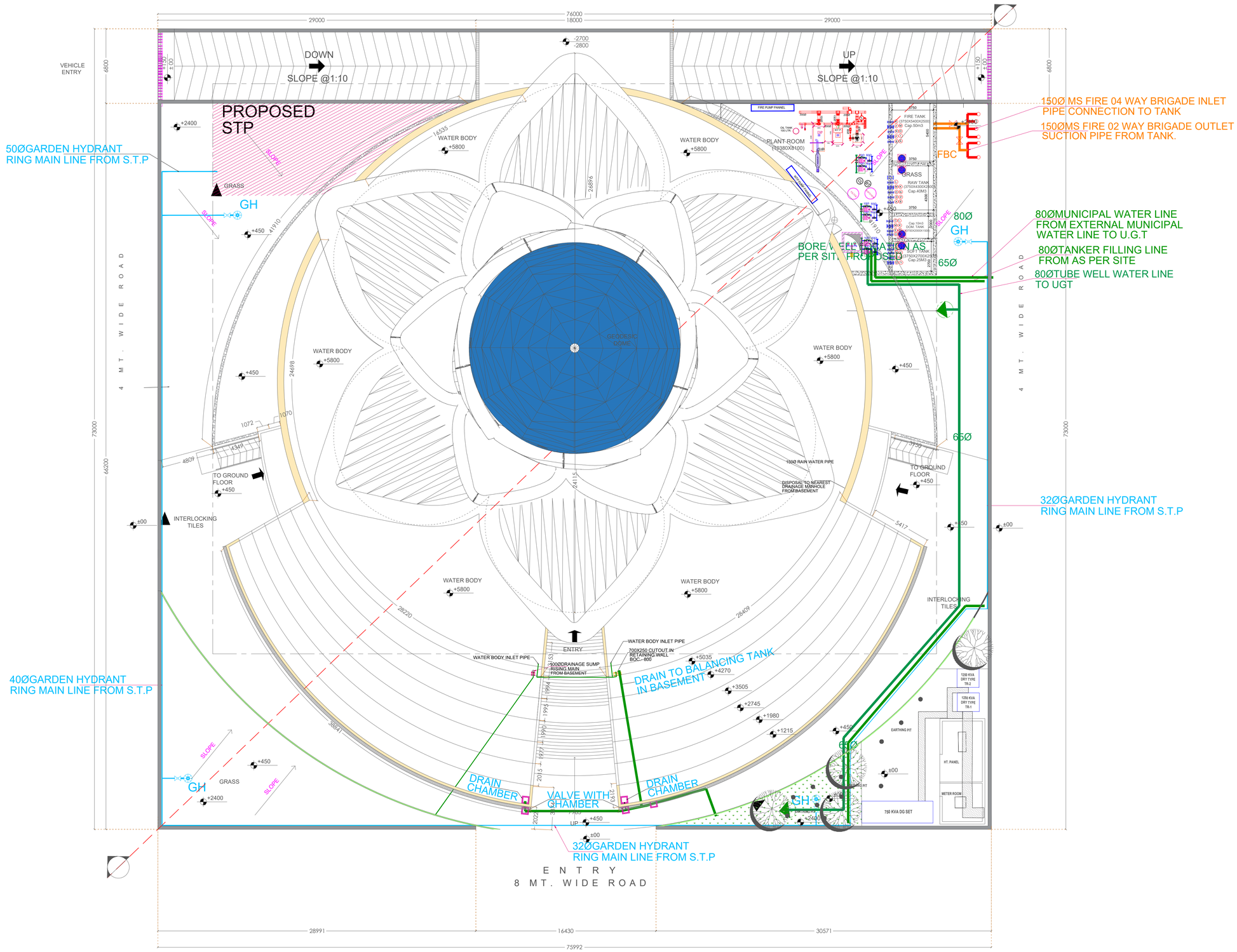
PLUMBING SYSTEM LAYOUT FOR GROUND FLOOR WATER SUPPLY

Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.
LUMB-PL-GF-WS-3019

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



SITE PLAN

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

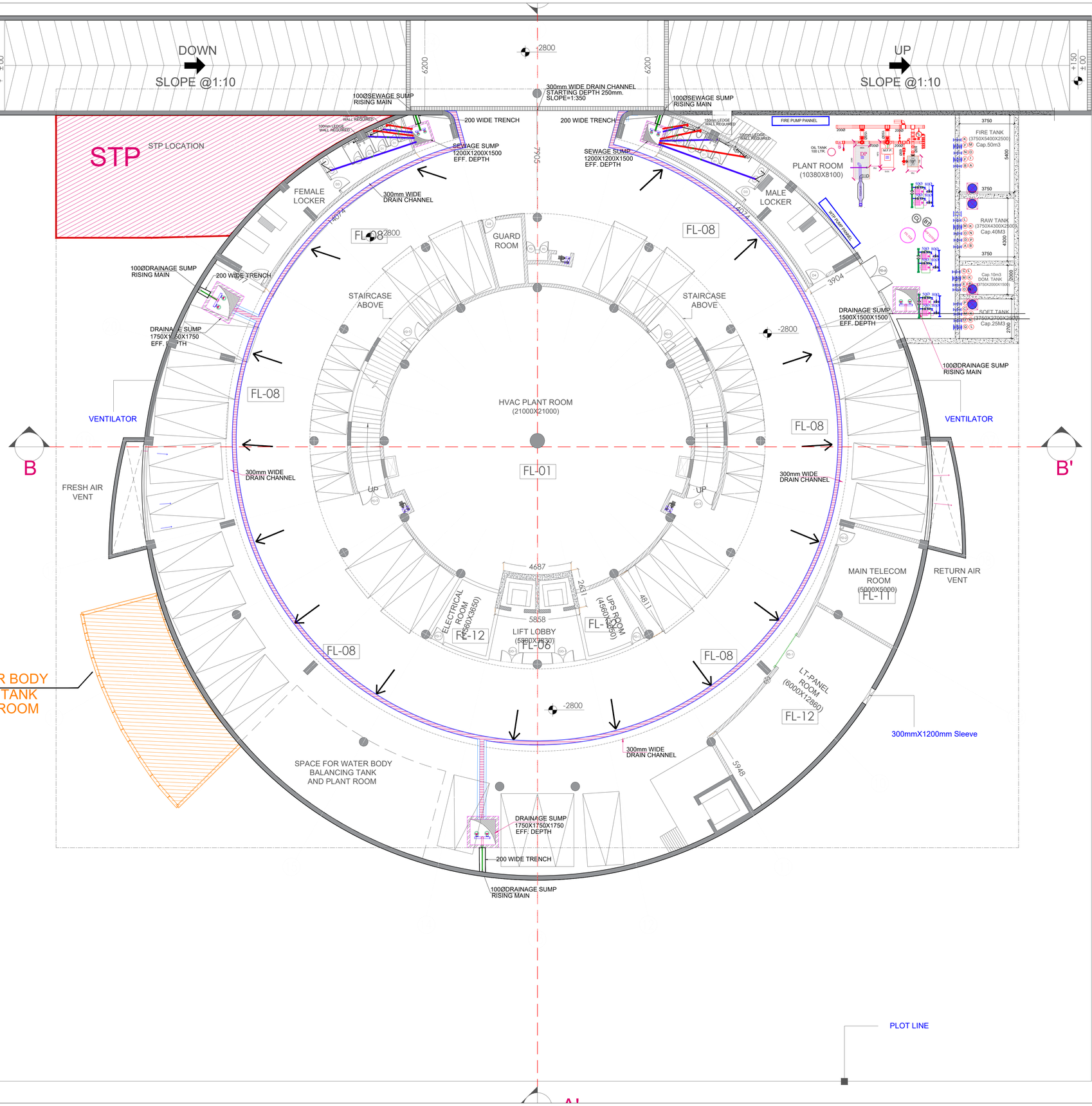
PLUMBING SYSTEM LAYOUT FOR EXTERNAL WATER SUPPLY AND IRRIGATION

Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.
LUMB-PL-EX-WS-3022

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE, ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
①	100Ø SOIL & VENT PIPE
②	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
③	150Ø RAIN WATER PIPE
④	DOMESTIC WATER RISER
⑤	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

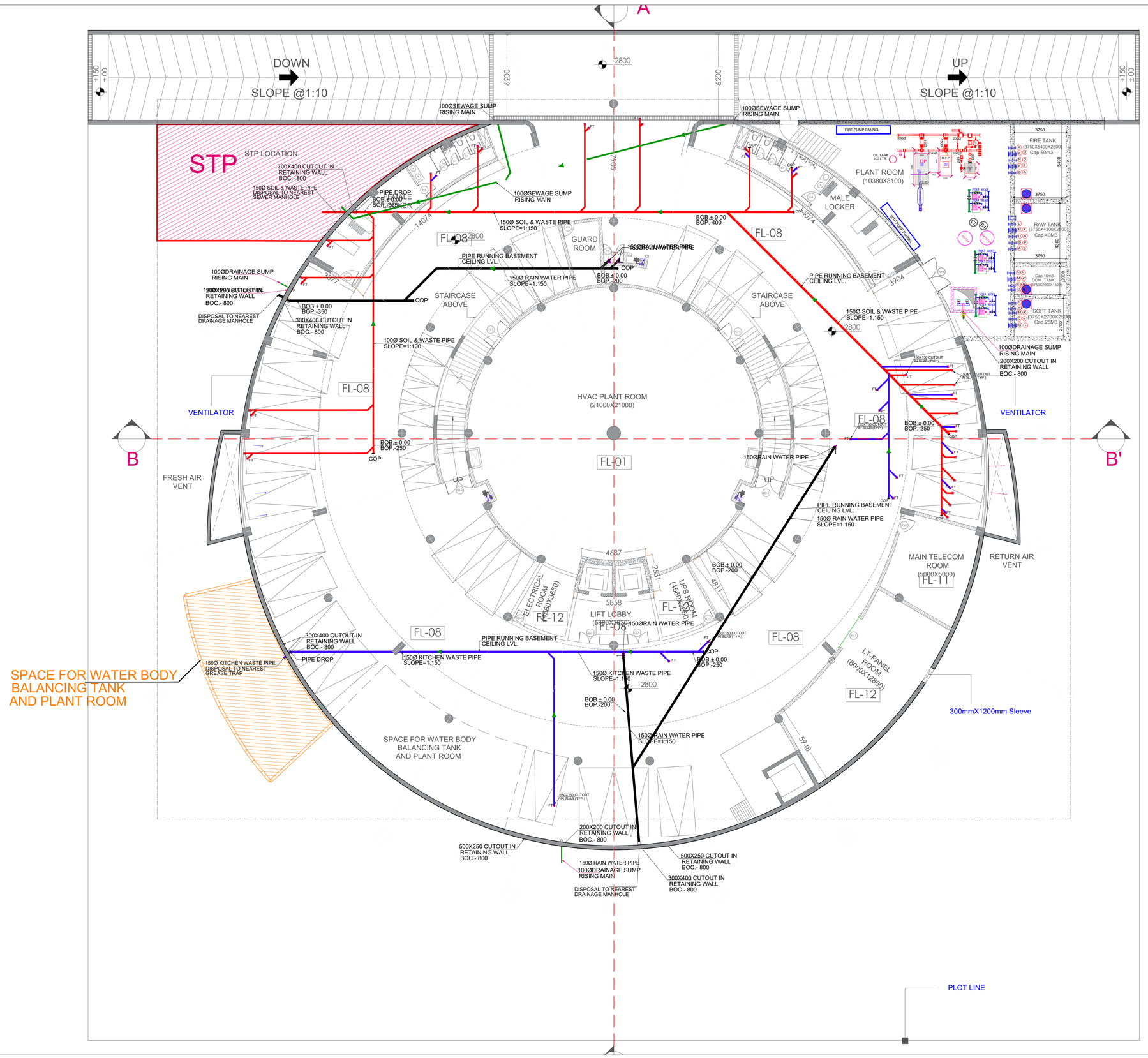
PLUMBING SYSTEM LAYOUT FOR BASEMENT FLOOR DRAINAGE AND SEWARAGE

Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.
LUMB-PL-BF-DR-3025

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE, ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

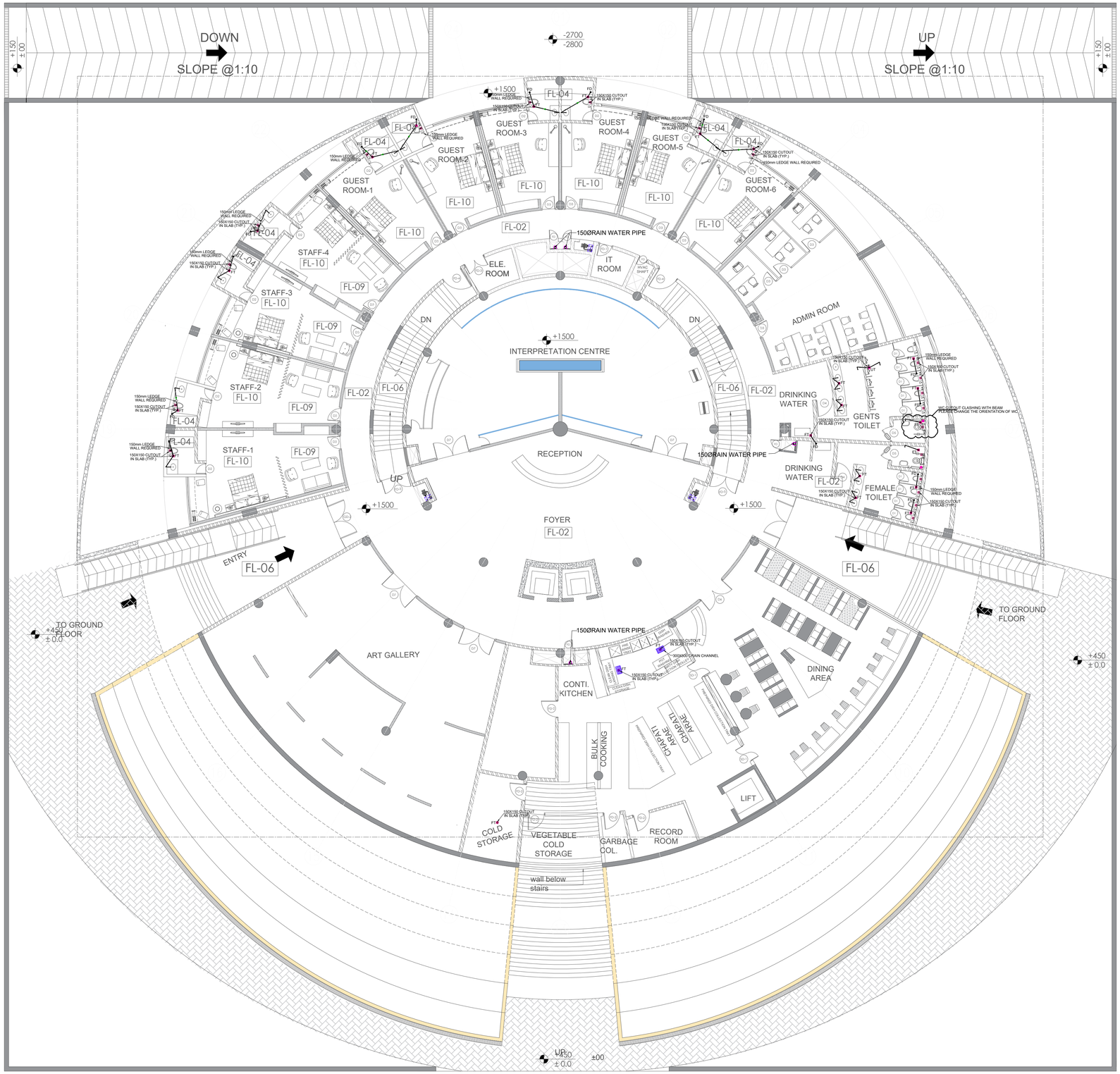
PLUMBING SYSTEM LAYOUT FOR BASEMENT FLOOR SOIL WASTE DRAINAGE AND SEWARAGE

Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.
LUMB-PL-BF-DR-3026

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

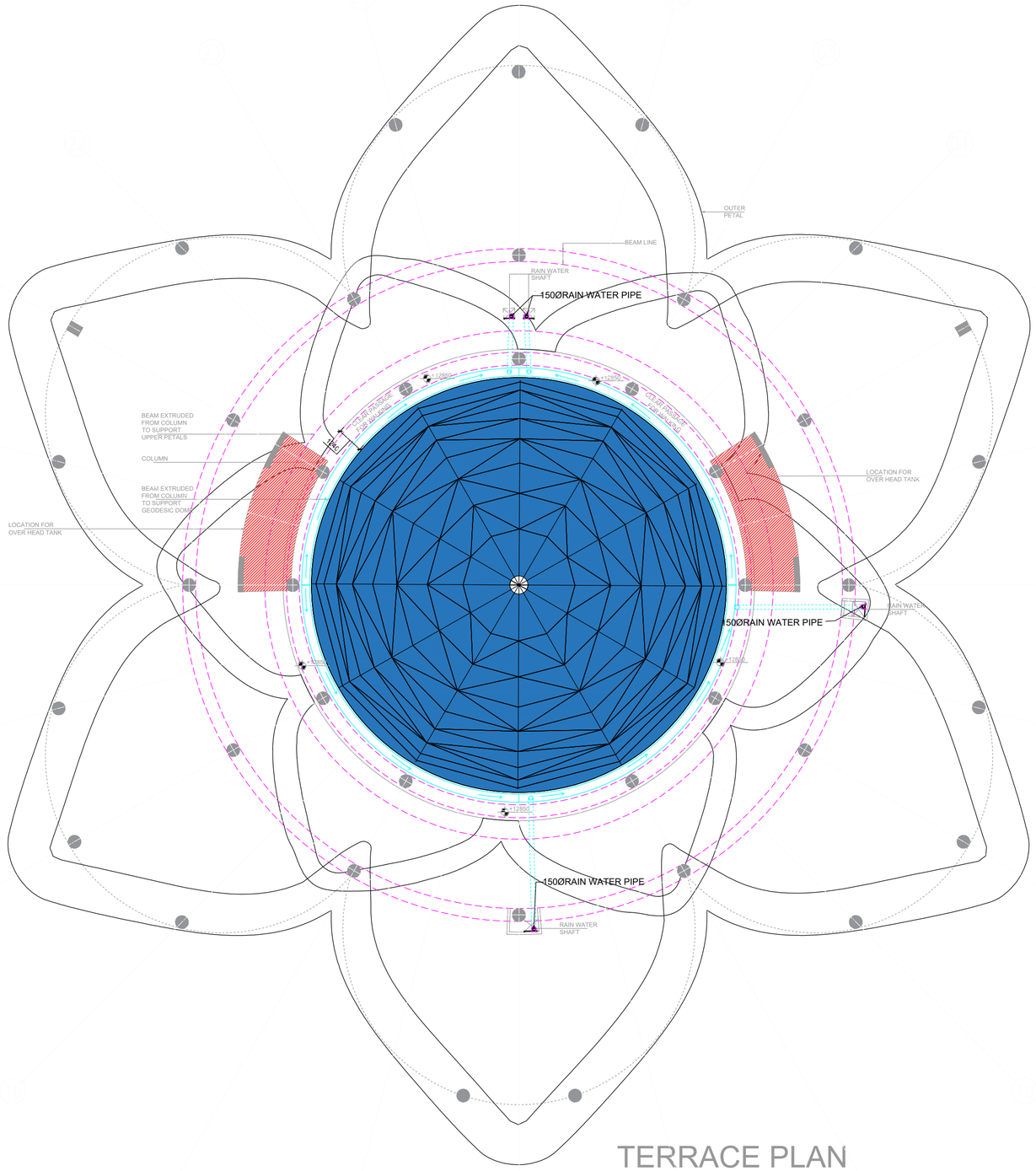
PLUMBING SYSTEM LAYOUT FOR GROUND FLOOR DRAINAGE AND SEWARAGE

Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.
LUMB-PL-GF-DR-3027

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



TERRACE PLAN (SECTION AT YY')

NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

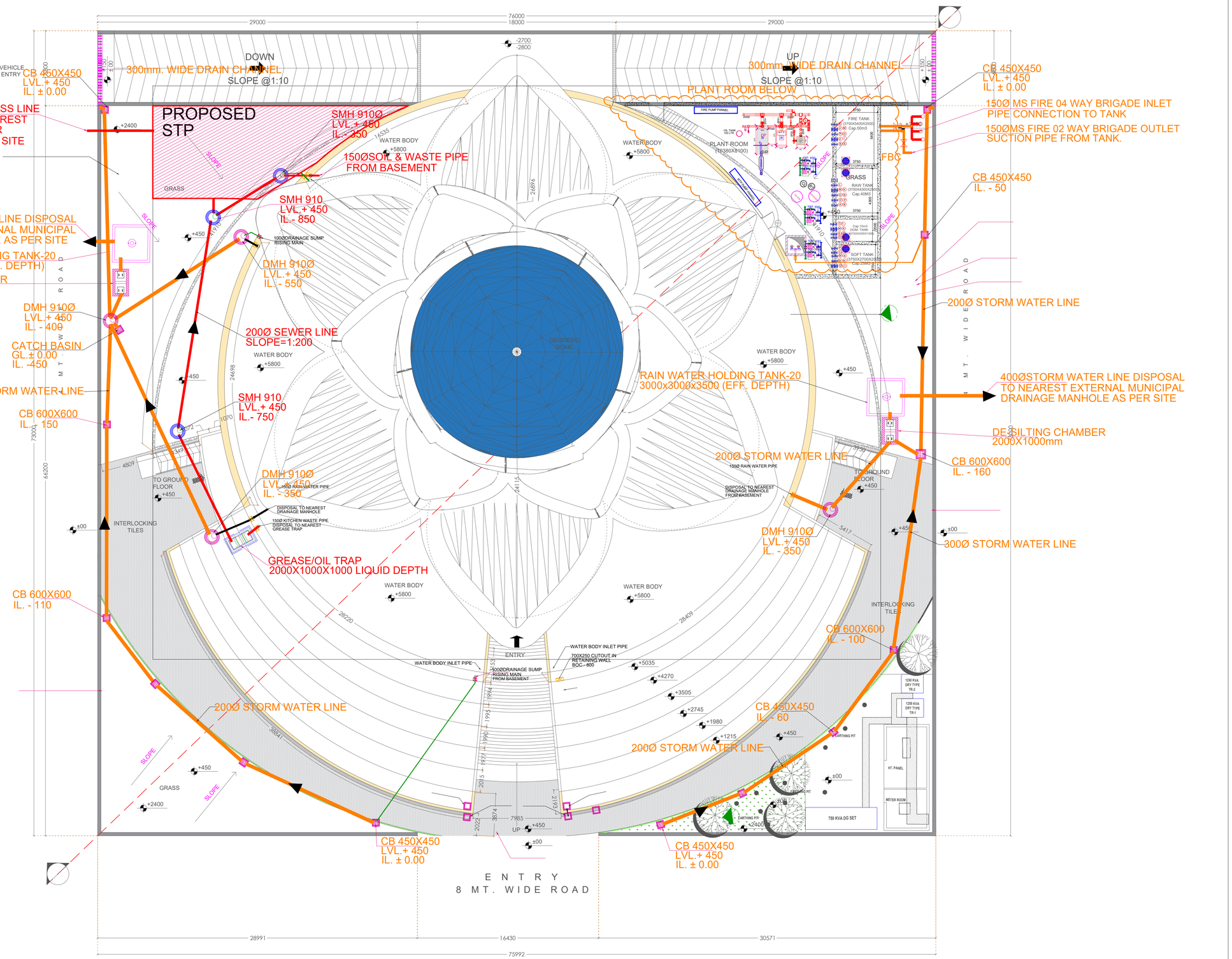
DRG. TITLE :
PLUMBING SYSTEM LAYOUT FOR TERRACE FLOOR DRAINAGE

Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.
LUMB-PL-TF-DR-3028

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF CSRD., MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
①	100Ø SOIL & VENT PIPE
②	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
③	150Ø RAIN WATER PIPE
④	DOMESTIC WATER RISER
⑤	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

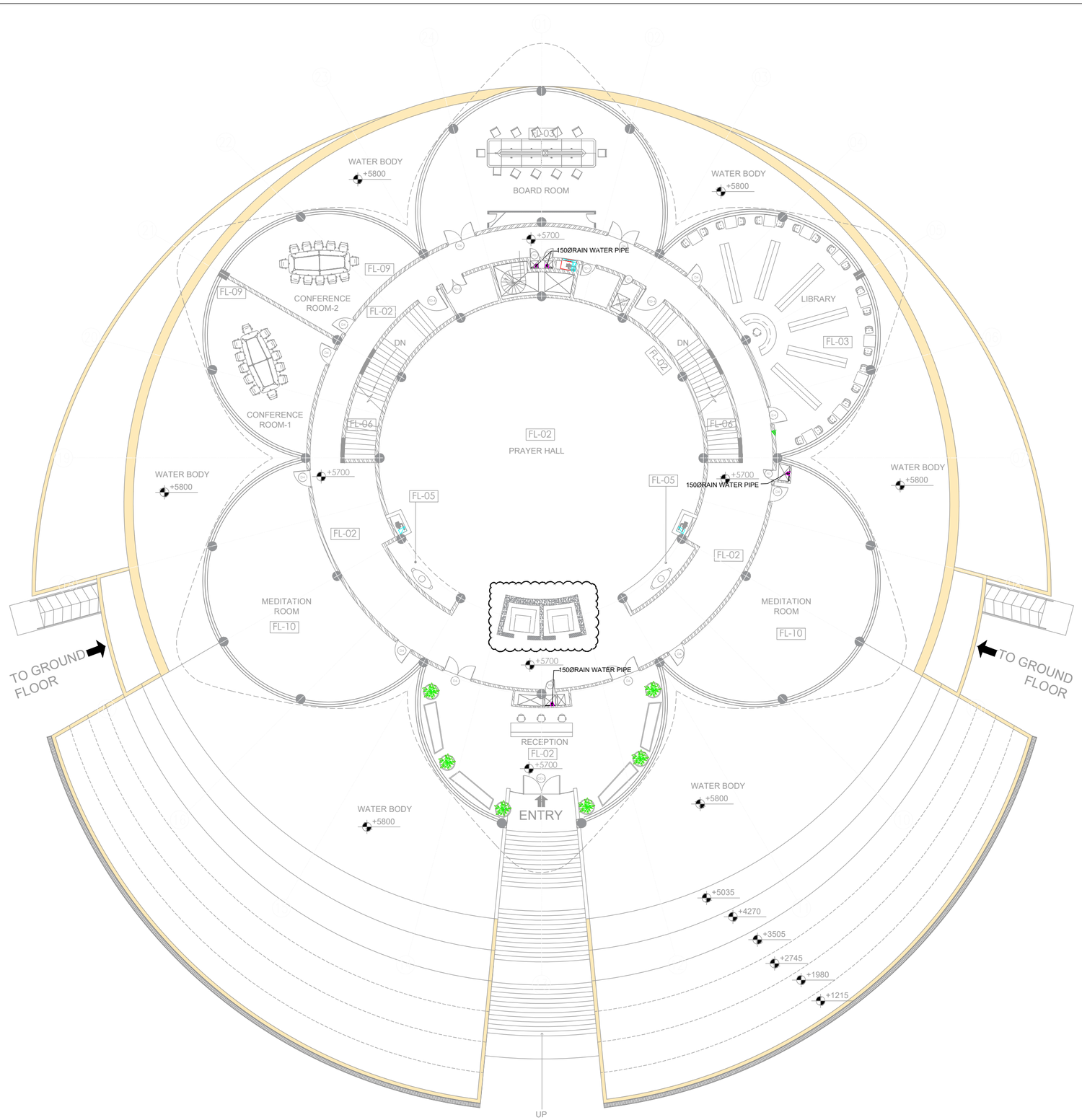
PLUMBING SYSTEM LAYOUT FOR EXTERNAL DRAINAGE AND SEWARAGE

Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.
LUMB-PL-EX-DR-3029

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE



NOTES:

(1) THIS DRAWING IS THE COPYRIGHT OF: CSRD, MUST NOT BE RETAINED, COPIED OR USED WITHOUT THE ABOVE CONSULTANT'S AUTHORITY.

(2) ALL DIMENSIONS ARE IN MILLIMETER AND LEVELS IN METRES UNLESS NOTED OTHERWISE. ALL DIMENSIONS TO BE VERIFIED ON SITE AND APPROVED BY THE ENGINEER.

(3) ALL DRAWINGS SHOULD BE READ IN CONJUNCTION WITH OTHER RELEVANT ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL DRAWINGS AND ALL RELEVANT SECTIONS OF THE SPECIFICATIONS.ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND RESOLVED BEFORE COMMENCEMENT OF ANY WORK.

(4) THE LOCATION AND SIZE OF ROOM AND EQUIPMENT ONLY TENTATIVE FOR THIS ISSUE CONSIDER ONLY FOR CO-ORDINATION.

LEGEND

SYMBOL	DESCRIPTION
TW	TUBE WELL WATER LINE
MU	MUNICIPAL WATER LINE FROM EXTERNAL MUNICIPAL WATER LINE TO U.G.T
	CONTROL VALVE
CWS	COLD WATER SUPPLY
FWS	FLU. WATER SUPPLY
SWS	SOFT WATER SUPPLY
WM	WATER METER
	GARDEN HYDRANT PIPE
GH	GARDEN HYDRANT
	CONTROL VALVE
	SEWER LINE
	STORM WATER LINE
	CIRCULAR MANHOLE
	CATCH BASIN 600X600
	100Ø SOIL PIPE
	100Ø WASTE PIPE
	100Ø SUMP RISING
FT	FLOOR TRAP 110x110 OD WITH 125mm GRATING
FD	FLOOR DRAIN 110x63 OD WITH 125mm GRATING
UT	URINAL TRAP 110x110 OD WITH 125mm GRATING
COP	CLEAN OUT PLUG
	RAIN WATER PIPE
1	100Ø SOIL & VENT PIPE
2	100Ø WASTE & VENT PIPE
2a	100Ø WASTE & VENT PIPE FOR KITCHEN
3	150Ø RAIN WATER PIPE
4	DOMESTIC WATER RISER
5	FLUSHING WATER RISER
	DRAIN CHANNEL
	FLOW DIRECTION

Rev.no.	Date	Description
R00		

REVISION INDEX :

CONSULTANTS :

CSRD
CENTRE FOR SUSTAINABLE RESEARCH AND DEVLOPMENT.

CLIENT :

INTERNATIONAL BUDDHIST CONFEDERATION
COLLECTIVE WISDOM UNITED VOICE

PROJECT TITLE :

INDIA INTERNATIONAL CENTRE FOR BUDDHIST HERITAGE & CULTURE
LUMBINI, NEPAL.

DRG. TITLE :

PLUMBING SYSTEM LAYOUT FOR FIRST FLOOR DRAINAGE

Scale	Date	Rev.no.
A1	31-05-22	R-00

DRAWING NO.

LUMB-PL-TF-DR-3030

ISSUED FOR:

- [ ] GFC
- [ ] APPROVAL
- [x] TENDER
- [ ] REFERENCE