REDEVELOPMENT OF MOIN-UL-HAQ CRICKET STADIUM AT PATNA, BIHAR

DESIGN BASIS REPORT

ARCHITECTURE

BIHAR CRICKET ASSOCIATION

AFFILIATED TO

THE BOARD OF CONTROL FOR CRICKET IN INDIA

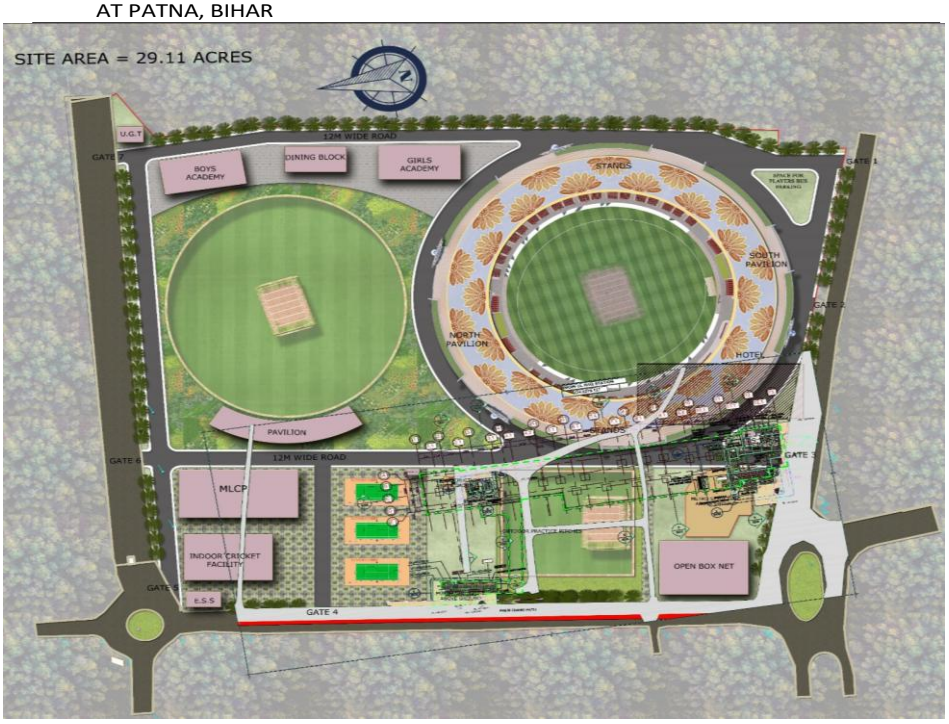
Contents

1. INTRODUCTION

Bihar, the 12th largest and third most populous state in India, is embarking on a major initiative to enhance its sports infrastructure. Bihar Urban Infrastructure Development Corporation Ltd called BUIDCO under the State Government's, is leading the development of a new Cricket Stadium in Patna, Bihar, as part of the state's broader development plan.

This Design Basis Report outlines the fundamental considerations and technical parameters for the construction of proposed Cricket Stadium, which shall accommodate a total of 40,000 spectators APPROX, along with ancillary spaces. The initiative aligns with the state's broader vision of enhancing sports infrastructure, providing world-class facilities, and promoting cricket at both professional and grassroots levels in the region. The report serves as a guiding document for the design, construction, and operational readiness of the stadium, ensuring that it meets the needs of the state, national, and international sporting events

The Design Basis Report describes the functional and performance requirements for the proposed Cricket Stadium for national and international events, to host variety of matches, competitions, ceremonies and concerts.



2. PROJECT DESCRIPTION

2.1 General

The new stadium shall be comparable in all respects with international standard professional contemporary sports stadia recently constructed or under construction and meet with the requirements of all applicable National Building Codes and Standards as well as the United Kingdom's Guide to Safety of Sports Grounds (The Green guide) as published by Sports Grounds Safety Authority.

The stadium is to be designed as a multi-use stadium capable of hosting International Test Cricket, International One Day Cricket, International 20-20 Cricket as well as major concerts, events and ceremonies. The stadium shall meet the requirements of the Governing Bodies of ICC to allow national and international events to be staged in the stadium.

The seating shall be as close to the playing field as possible, sightlines shall be optimum and viewing unobstructed for all sports.

2.2 Objectives

The stated objectives and goals of the Cricket Stadium are:

- To develop a stadium with 30,000 net seating capacity for a range of uses including, but not limited to: Cricket, concerts and other entertainment events.

- To create a stadium that can allow for future expansion.
- In addition to the standard codes, the stadium shall meet the requirements of the latest versions of the following codes:
  - ✓ ICC Guidelines for Stadiums
  - ✓ Guide to Safety of Sports Grounds (The Green Guide)
  - ✓ National Building Codes 2016
  - ✓ Bihar building Bye laws
  - ✓ Ministry of Road Transport and Highway (MORTH Codes)
  - ✓ IS Code
  - ✓ Indian Road Congress (IRC)
- To provide a highly cost-effective low maintenance facility.
- To complement a sports and entertainment precinct that can be used seven days a week by ensuring the stadium integrates with, and makes use of, adjacent civic spaces and commercial and community facilities.
- To act as a catalyst for complementary development in the surrounding area.
- To provide a facility that can be utilised all year for a number of events, in order to maximize opportunity for revenue generation and sustainability.

- To provide an "Iconic" stadium facility that reflects the growth of cricket in Bihar and is a showcase for these sports and the state both nationally and internationally.
- To provide a facility that shall allow Bihar to effectively compete for international sports events against comparable facilities in North India.
- To provide a sustainable development that shall enhance public utilization of facility and ancillary structures.
- That shall control and mitigate effects on local communities surrounding the stadium.
- The seating bowl shall be provided to maximize the atmosphere and locate patrons as close as possible to the field of play.
- The seating bowl shall be column free and allow excellent viewing conditions for all sports and events held in the stadium.

In addition to the stated Objectives, it has been the design team's objective to establish the following goals:

- To create a multi-use, 30,000 net seating capacity stadium that maximizes atmosphere and intimacy and shall enhance the event experience for spectators for all sports.
- To create a stadium that is internationally recognised as a world class venue for the showcasing of professional sport and entertainment.
- To develop a proposal that can be constructed within an established construction time and budget.
- Sufficient entry plaza area to allow for safe entry and egress for the stadium in the event of an emergency.
- Sufficient infrastructure to allow for safe entry and egress for the site.
- To provide a design that adheres to the principles of Environmental Sustainable Design with a minimal ecological footprint.
- To provide an iconic design solution that represents the unique environment of Bihar along with the aspirations of the community which it serves.

2.3 Project Site

The Project site is located in Rajendra Nagar , Patna , Bihar

Total Land area allotted for the project is 29.11 Acres, out of which development area for Stadium is approx. 29.11 Acre The site is located at a distance of 10.0 KM from Patna Airport, 4 KM from Patna Junction Railway Station.

2.4 Scope of Work

2.4.1 Details of buildings:

A. Main Stadium Structure			
Sr. No.	**Building Name**	**Facilities**	**Remarks**
A1	**East Stand:**		
a	GROUND FLOOR	Parking & Services	
b	FIRST FLOOR	Spectator Concourse, Spectator Toilets & Drinking water facility, DA Toilets, Services rooms, First aid rooms, Merchandise stores,	Toilets as per National Building Code 2016
c	SEATING BOWL	Spectator Seating + DA seating + Video Board	14490 nos. seats
A2	**West Stand:**		
a	GROUND FLOOR	Parking & Services	
b	FIRST FLOOR	Spectator Concourse, Spectator Toilets & Drinking water facility, DA Toilets, Services rooms, First aid rooms, Merchandise stores,	Toilets as per National Building Code 2016
c	SEATING BOWL	Spectator Seating + DA seating + Video Board + Mid-wicket Camera Platform	14480 nos. seats
A3	**North Pavilion:**		
a	GROUND FLOOR	Media Entrance Lobby, Broadcasting Control Room, Equipment Storeroom, Kitchen & Stores, Services & Utility area	
b	FIRST FLOOR	Stadium Security Offices including Police & VOC, Broadcasting Sponsor Rooms, Media Lounge & facilities, Services & Utility area	
c	SECOND FLOOR	Written Press tribune, TV & Radio Commentator boxes, Media Dining area, Services & Utility area	
e	TERRACE	Main Camera Platform + Terrace + Mumty + Services	
A4	**South Pavilion:**		
a	GROUND FLOOR	Players' Lounge, Press Conference Room, Player Changing Rooms, Match officials Changing Rooms, First-Aid room, Doping Control room, VVIP entrance Lobby, Main Stadium Kitchen, Services & utility rooms.	

b	FIRST FLOOR	Match Officials lounge & Umpire/referee boxes, Anti-corruption box, Scorer box. VIP Corporate boxes 5 nos., VIP seating bowl, VIP lounge & Dining area.	VIP Corporate boxes 5 nos. with 8-person seating in each box, VIP seating bowl 920 seats
c	SECOND FLOOR	Presidential Suite with separate entry exit lobby, Corporate box type-A (12 nos.), Corporate Box Type-B (5 nos.), VIP lounge, Services & Utility rooms	Corporate box type-A with 12 seats each, Corporate box type-B with 30 seats each
e	TERRACE	Main Camera Platform + Terrace + Mumty + Services	

B. Field of Play		
a	**Main Ground**- 9 playing pitches as per ICC requirements.	
b	**Practice Pitches:** 9 nos. Practice pitches	
c	**Main Stadium Sports Lighting:** 6 nos. high mast with suitable foundation, electrical panels, cables, optical fibres etc. as required, and **lux level required as per ICC Standards for HDTV Broadcasting.**	High mast details: Stadium high mast lighting shall be designed to ensure uniform illumination across the entire cricket field, with no shadows cast within the boundary line, taking into account the maximum projected extent of the roof structure Driver: The driver must have control interface compatible with DMX-RDM protocol and shall have suitable RJ45 ports in electrical compartment of the driver box for integration with Dynamic Lighting Control Systems and 3rd Party A-V Systems.

C. Gate & security Room			
a	Gate Type-1: 2 Nos.	Vehicular & pedestrian Entry/Exit Gate with security Room & Ticket counter	167.32
b	Gate Type-2: 2 Nos.	Gate with security Room- for Vehicular Entry/Exit of Players & Media	147.43
c	Gate Type-3: 1 Nos.	Gate with security Room-Spectator Pedestrian Entry/Exit	81.53
d	Gate Type-4: 4 Nos.	Gate with security Room-Spectator Vehicular Entry/Exit	104.65
e	Gate Type-5: 4 Nos.	Gate with security Room-Spectator Vehicular Entry/Exit	104.65

f	Gate Type-6: 4 Nos.	Gate with security Room-Spectator Vehicular Entry/Exit	104.65
g	Gate Type-7: 4 Nos.	Gate with security Room-Spectator Vehicular Entry/Exit	104.65
	Total		**814.88**

D. Site Development & Utility Works		
a	Underground Water Tank	1675 KLD
b	Sewage Treatment Plant	875 KLD
c	Roads	24m ROW Main Internal roads
d	Driveways	6.50M Internal driveways in parking areas
e	Car Parking	1500nos. parking bays in open and some in stilt areas of East & West stand.
f	Storm Water Drains	Drain width:-450, 600 & 900 mm
g	Hardscapes	
	(i) Roads & Driveways (Tremix)	39,334 Sq.M
	(ii) Pathways(pavers)	18,476 Sq.M

2.4.2 Silent Features of the Design

- Spectator-Centric Design: Ensures easy navigation and accessibility for Spectators and Players.
- Zoning: Separate zones for different Users (e.g. Players, Media, Support staff, VIPs & VVIPs and General Spectators) to streamline Circulation & Maintain Privacy.
- Fire Safety: Includes fire alarms, sprinklers, and clear evacuation routes.
- Seismic Safety: Designed to withstand earthquakes, especially in seismic zones.
- Energy Efficiency: Use of LED lighting, energy-efficient HVAC systems, and solar panels.
- Buildings have been planned with Eco-Friendly Environment to provide maximum green space, lawns, trees and shrubs.
- Optimum Utilization of FAR and height as per Building Byelaws.
- Provision of maximum light and ventilation to all spaces.
- Provision of facilities for disabled persons.
- Adequate holding areas have been provided for general Spectators as well as for other users.
- All efforts shall be taken to make the building in accordance with the green building concept by using various techniques.
- Provision of Horticulture work as par site Requirement.

2.4.3 Energy Efficiency Feature for Green Building

- AAC Block shall be used.
- LGSF Partition work shall be used.

- Use of ready-mix concrete
- Use of ready-mix Gypsum plaster
- Use of LED fittings.
- Use of adequate window areas for getting natural light and ventilation.
- Use of energy efficient electrical fitting, fans, Air-conditioning units, pumps and plants to save electricity.
- Provision of sewage treatment plant and re-use of wastewater for flushing, horticulture and Flushing purpose.
- Provision of low flow plumbing fixture.

2.4.4 Landscape

- Designing a landscape concept that incorporates a peripheral zone, parking zone, drop-off zone, and arrival zone can create a harmonious and functional space.
- Ensure smooth transitions between zones, using paths, plantings, or materials to guide movement from one area to another. The landscape should feel cohesive, not fragmented.
- Focus on sustainability by using native plants, water-efficient systems, and eco-friendly materials.
- Ensure all zones are accessible to people with disabilities by incorporating smooth paths, ramps, and benches at appropriate heights.

3. ARCHITECTURAL REQUIREMENTS

3.1 Seating Bowl

The total minimum ground spectator capacity upon completion is to be net 30,000 seats. This excludes seat kills from camera positions and excludes seating in restaurant and lounges.

The functional requirements are summarized here:

- Edge of the seating bowl shall be at least 77.45m from the centre of the Field of Play.
- A variety of seating types shall be configured around the circular ground, consisting of a combination of general admission seating, members seating, private boxes, dine & view seating and press seating.
- Seating for people with disabilities shall be available within each seating category and distributed at various locations within the seating bowl.

3.1.1 Seating Standards Adopted

General spectator seating (colour to be selected) to west, east, north and south stands shall comprise fixed non-combustible polypropylene seats with backs.

3.1.2 Tread width

- General Spectator Seating – 850 mm
- VIP Seating – 850 mm
- Corporate Boxes- 950 mm

3.1.3 Riser Height

- Maximum riser height – 570 mm

3.1.4 Seat spacing

- General Spectator Seating – 480 mm
- VIP Seating – 550 mm
- Corporate Boxes- 600 mm

3.1.5 Disabled Seating Provision

- Based on Total Capacity - 0.5%, disabled wheelchair positions, plus companion seat nearby each wheelchair position

3.1.6 Seat Numbering System

- Each seat to be individually numbered by a vandal-proof proprietary metal numbering system by the seat manufacturer.
- Each row to have luminous Row Numbering system on each aisle Step.
- Each aisle to have a full width Luminous Strip integral with the Nosing to each step.

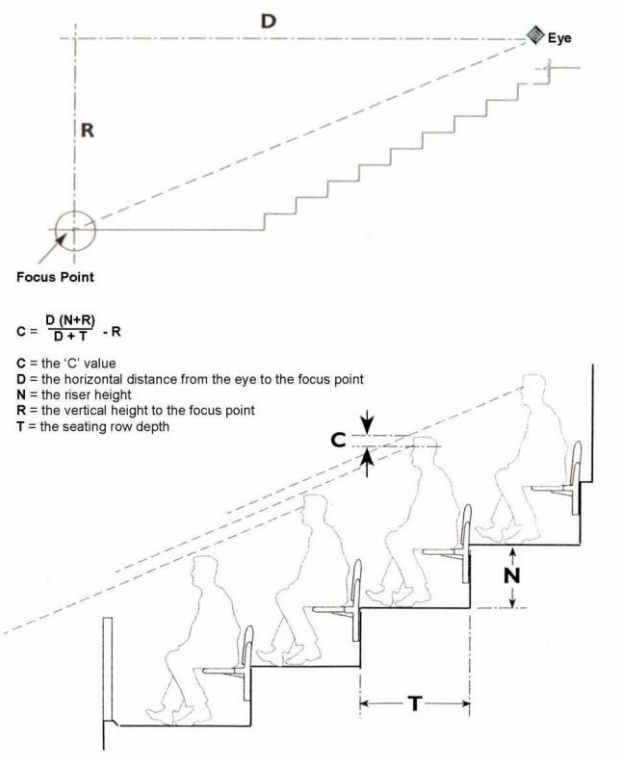
3.1.7 Seating

The positioning of vomitories shall facilitate an even evacuation of the bowl in emergencies; so that statutory egress times can be achieved. For all seating tiers, maximum 28 seats per row between gangways shall be adopted, though this might be increased to 32 seats on radial seating areas.

The stands shall be set out to ensure all parts of the field are visible to all spectators with a maximum gradient of 34° to minimise the potential of vertigo in the spectators.

3.1.8 Sightline Criteria

The sightline from the eye level of every spectator shall not be inferior to the following two criteria as defined below. The eve level is defined as a point 1150 mm above the floor level and 90mm forward of the rear of each seating plat, centered on the seat location.



- **Sightline Standard 1**

The General spectator seats should provide a minimum sightline quality of 3½" or 90mm (C90). VIP seating and hospitality box seating should provide a minimum sightline quality of 4¾" or 120mm (C120). The focus of the sight line shall be a maximum of 6m inside the boundary on the surface of the playing field.

- **Sightline Standard 2**

Sightlines shall be uninterrupted by any solid part of any balustrade or balustrade mounted signage panel except as following: Any metal balustrade that interrupts the sightline shall be of "open" construction so that less than 20% of its area

presents a solid obstruction when measured normal to the sightline, the remaining 80% being unobstructed.

- **High Ball Criteria**

A sightline from eye level for all spectators shall have uninterrupted viewing angle of 30 ° to the ground.

- **Focus Point**

The focus of the sight line shall be a maximum of 6m inside the boundary on the surface of the playing field.

3.1.9 Railings and Barriers

Railings and Barriers shall be provided at appropriate locations in Seating bowl for safety of spectators. Dimensions and Loads imposed on railings and barriers shall comply to the guidelines given in Guide to Safety of Sports Grounds (The Green Guide)

3.2 Architectural Design Objectives

The major design issues that shall need to be addressed as a result of the development are as follows:

- Careful consideration shall be given to the bowl geometry, seat spacing, and access to amenities to provide optimum levels of comfort and viewing standards for all patrons.
- The composition of the external envelope shall incorporate issues of context, transparency, climate and durability into the design.
- The public concourse areas of the Stadium are to be designed to be as open as possible whilst retaining a sense of shelter and security.
- The Stadium shall indicate a strong and impressive architectural form reflecting its function.
- The design shall achieve regulatory standards to NBC, Green guide and Fire Engineering in relation to access and egress under normal and emergency conditions.
- A variety of hospitality spaces is to be available to members, public and corporate patrons including dining and lounges.
- Both the external and internal concourses shall facilitate continuous circulation around the Stadium to the appropriate entry.
- The stadium is to provide an 'active edge' and engage with the local surroundings to provide a destination 365 days a year.
- The stadium is to be of a high architectural standard with a contextual relationship to its surroundings. Urban Design of the immediate surroundings is to be developed to compliment the stadium and to create a lively, social environment.

3.3 Façade Design

- The entries shall be read from the same architectural language with their own individual identity.
- The external façade massing and form shall follow the architectural intent given in Tender drawings & Documents.
- The facades shall be designed such that they shall maintain a maximum amount of visual transparency through the external envelope when viewed from both sides.
- No reflective or tinted glass shall be used on field of play site of the stadium. Clear glass or glass with a similar level of light transmittance is acceptable.
- Enhanced solar performance glazing is required to all external glazing to internal air-conditioned spaces.
- The main concourse façade system is to maintain maximum transparency from both internal and external. A lesser amount of solid panels shall be used to provide a level of solar protection. The facade has a high level of

transparency. The underside of the upper tier shall be visible through the façade.

- The face of the stairs and ramps shall be designed to allow for the addition of large external signage banners.
- The facades shall be designed to achieve a comfortable level of thermal performance to the main serviced elements of the building.
- Facades shall respond to the environmental conditions and relate to their specific orientation.

3.4 Provision for Roof

The stadium shall be designed and constructed with adequate provisions to accommodate the future installation of a roof structure. The design of the stadium, including but not limited to the foundation, superstructure, and other structural components, shall be executed in such a manner as to ensure the seamless integration of a roof system at a later date. The structural elements shall be capable of supporting the anticipated load and forces associated with the roof installation, and the design shall consider necessary provisions for the attachment, anchorage, and alignment of the future roof structure. All relevant considerations for future roof installation shall be incorporated into the design to avoid the need for substantial alterations or modifications to the existing stadium framework.

3.5 Environmental / ESD Requirements

The design and construction of the Stadium shall incorporate principles of Ecologically Sustainable Development. This shall appropriately incorporate environmentally responsible materials and processes at the time of design/construction and to reduce energy consumption and adverse effects on the environment in both construction and operation which are financially viable.

4. FIELD OF PLAY

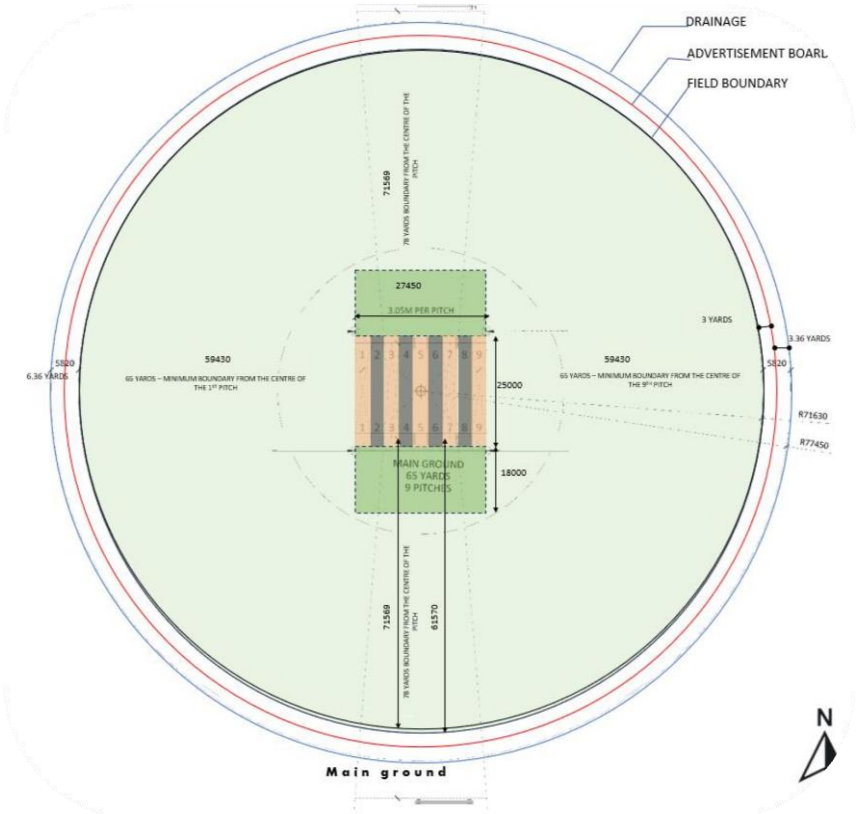
A minimum of 2 emergency vehicle access routes onto the playing field, 6-meter-wide and fitted with suitable security gates, shall be provided.

4.1 Cricket Ground

The ICC minimum standards for new cricket grounds are as follows.

4.1.1 The Field

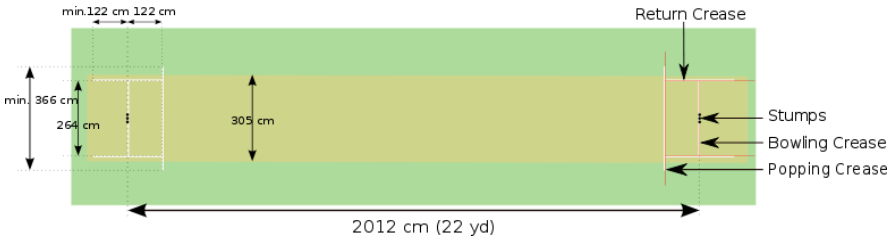
- The aim shall be to maximize the size of the playing area at each venue. With respect to the size of the boundaries, no boundary shall be longer than 90 yards (82.29 meters), and no boundary should be shorter than 65 yards (59.43 meters) from the center of the pitch to be used.



- At all times, there must be 3 yards (2.74 meters) from the boundary rope to the first solid object (advertising boards/LEDs, photographers, cameramen, dug outs, covers, perimeter fence) for the player's safety run off.
- If the boundary is positioned less than 90 yards (82.29 meters) from the Centre of the pitch, the boundary rope cannot be set at a distance of more than 10 yards (9.14 meters) from the perimeter fence. The 10 yards shall be inclusive of the 3 yards (2.74 meters) provided for the player's safety run-off.
- The playing surface shall be reinforced natural grass incorporating permanent subsoil drainage and irrigation points. The field and pitch must drain well and the grass be cut short to result in a fast outfield as per relevant Cricket Board requirement.
- Requirement Soil mix type for the pitches & surface of outfield shall be as per relevant Cricket Board requirement.

4.1.2 The Pitch

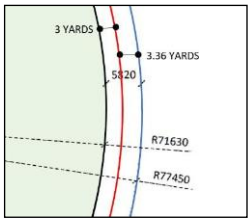
Pitches shall be orientated north to south. A total of 7 pitches shall be provided with the spacing of 3.05 meters per pitch.



The pitch should have 'true bounce' throughout for the duration of the game and be of reasonable pace. The pitch cover shall be provided to cover all pitches and shall have a raised rim built into its edge and have 4 discharge outlets at its corners to allow water that collects on the cover during rain to be discharged into the field drainage system. The bowler's run-ups shall be provided with adequate covers.

4.1.3 Boundary

The boundary shall be a minimum distance of 3 yards (2.74 m) inside the perimeter fencing, advertising signs, or first obstruction.



ENLARGED PLAN

A continuous Fence shall be provided around the stadium in front of the spectator seating.

It is important under emergency circumstances to allow access across the fence on to the playing area.

5. SPECTATOR FACILITIES

5.1 Capacity

The approximate net seating distributions, including wheelchair positions as currently planned are listed in the table below. It is proposed to offer various levels of season ticket and associated amenity packages which shall be incorporated into the General Admission and VIP seating configurations.

The following table is based on a net stadium capacity of 30,000 seats. Refer Annexure-A for detailed seat count.

5.1.1 General seating requirements

A variety of seating types shall be configured around the playing field, consisting of a combination of general admission seating, reserved seating, corporate seating including corporate boxes and suites, press seating and team seating.

- A variety of seating types shall be provided and configured around the circular ground (arena), consisting of a combination of disabled seating, general admission seating, corporate box and dine & view seating.
- Total net capacity of at least 30,000 spectators. The seating capacity net figure excludes 'seat kills' associated with camera positions, written media seats, team benches and team coaches' accommodation.

5.1.2 General admission seating

New general admission seating shall meet the following criteria:

- Bucket seats with backs.
- Seats to have a spacing of 500mm minimum when measured centre to centre.
- Lower tier tread width to be 850mm.
- Upper-tier seating shall have a plat width of 850mm.
- Maximum number of seats between two aisles shall be 28 seats but can be increased to 32 seats. Maximum number of seats in a row shall be 18 where seats are served by only single aisle.

5.1.3 Corporate suite seating

- The term "suite" refers to the enclosed Air-Conditioned private hospitality space with fixed pitch view seating in front of the suite glazing. 48 suites shall be located to allow an excellent viewing angle to the pitch.

- Each suite shall be an enclosed space with direct access to seating located in front of the glazed line.
- Total 48 private/corporate suites, seating 20 persons in indoor / outdoor seating shall be provided.
- There shall be 2 types of corporate boxes (Type-1 & Type-2). Area of Type-1 corporate box shall be minimum 29 Sq.M. Area of Type-2 corporate box shall be minimum 60 Sq.M.
- Spectator seating per private suite shall be accommodated in two / three rows of tiered seating.
- Toilets for male, female and disabled spectators shall be provided separate to the Corporate Suites in multiple locations easily accessible from all boxes
- Corporate suites shall be located in such a way that they get complete view of the field of play without any obstructions like columns, Sight screens, Player benches, Camera platforms etc. Seating to be provided in interior of the suite.

5.1.4 VIP seating

- The term VIP seating refers to the open seating located within the seating bowl contained by a rail and consisting of 568 seats located at the South side of the stadium.
- Seat spacing of 550mm centre to centre as a minimum
- Dedicated access to VIP seating areas away from general seating concourses.
- Dedicated male and female toilets are to be provided in close proximity to the seating.
- Access to dedicated dining facilities is to be provided from the VIP area.

5.1.5 Presidential Suite

In addition to corporate suites, one larger size presidential suite of around 150 Sq. M. area shall be provided, and it shall have same facilities as corporate suites. Presidential Suite shall have an attached unisex toilet facility.

5.1.6 Bihar Cricket Association Box

One larger size box of around 150 Sq.M. area shall be provided for Bihar Cricket Association, and it shall have same facilities as corporate suites. Additionally, this box shall have an attached unisex toilet facility.

5.1.7 Accessible (Disabled Seating)

Seating for People with Disabilities shall be distributed at various locations within the seating bowl within all seating categories and all tiers of the stadium. The criteria to be allowed for are:

- Wheelchair and helper: 1% of capacity, which is made up of 0.5% for wheelchair and 0.5% for helper. Space allowance for wheelchair shall be 1400mm x 900mm and shall have an accelerated sightline condition to allow

unobstructed view of the field of play to a comparable standard of patrons within the stadium whilst seated or standing.

- Wheelchair seating areas shall be conveniently located for toilet and concession stand access. Elevators and ramps shall be utilized where necessary to provide wheelchair/handicap access to the various levels.
- Other facilities: Lowered counters at ticket booths, separate entry for disabled

5.2 VIP Entrance Lobby & Hall of fame

A dedicated VIP lobby shall be incorporated into the North Pavilion, designed to offer an exclusive space for VIP guests. This lobby will feature a designated area for the display of trophies and memorabilia, providing an elegant and prominent showcase for the venue's achievements and historical items. The layout and design of the VIP lobby shall ensure a premium experience for distinguished visitors, with careful attention to aesthetics and accessibility.

5.3 Public & Corporate Dining Rooms

The public and corporate dining areas shall provide the following amenities:

- 300-person Restaurant shall be provided with access to the Corporate & VIP seating.
- Catering kitchens and other support space shall be provided adjacent to the function rooms, as required to provide superior food product and service.
- All dining rooms and lounges shall be air-conditioned.
- Provision for Television monitors shall be located throughout the dining rooms and lounge areas.
- Restaurant shall also be fitted out with appropriate technologies for PA services and wiring shall allow for easy use of plug-in mobile audio-visual equipment.
- Dining rooms and Lounges to have either Field view or external view.
- Dining rooms to have separate lockable storage for marketing equipment and audio-visual equipment.
- Toilets to dining rooms shall be in close proximity to each dining room.
- Separate chair stores shall be provided adjacent to the dining rooms.

5.4 Public Toilet facilities

Adequate public toilets shall be provided throughout the stadium evenly distributed off the public concourses located behind the seating tiers.

- The general number of facilities shall be based on the number of spectators per individual fixture. The ratio of spectators to fixtures shall be based on **66.6 percent male** and **33.4 percent female** attendance based on the public capacity of the area of the ground served by the toilets.

- Toilets shall be provided containing mirrors, toilet partitions, fixtures, general lighting and ventilation etc.
- Separate disabled toilet rooms shall be provided. They shall accommodate a wheelchair and include accessible height water closets and grab bars, etc.
- Washrooms shall be generally equally distributed in the public concourses and must be of durable construction and easy maintenance.
- Final fixtures count to be based upon following table. :

User Type	Min. No. of Urinals	Min. No. of WCs	Min. no. of Washbasins
Male	2 per 75 users	1 per 100 users	1 per 200 users
Female	-	1 per 100 users	1 per 200 users

- Urinals shall be provided in the male toilets in addition to WC's. Mirror, hand drying facility, soap dispensers, lavatories and toilet partitions
- Public toilets shall be served with cold water only.
- Cleaner's rooms with storage shall be provided to service the toilet blocks.
- The detail design of the public toilets shall allow for at least two entrances and preferably a one-way circulation system through the area where possible.
- Toilet blocks shall be distributed proportionately around the concourses to minimize travel distances.
- Toilet block entrances and exits to the concourses shall be fitted with lockable doors to allow for their closure when not in use and during non-peak events.
- All toilet fittings shall be durable.
- The PA system shall be capable of broadcasting match commentary within the toilet blocks; an override function shall enable emergency, and information broadcasts and allows for muting to the toilet areas if required.
- All pipework, conduit and flush valves within public toilet blocks are to be concealed.
- Unisex family/P.H. toilet rooms shall be provided at each concourse level in close proximity to wheelchair platforms. These rooms shall house a standard WC pan with horizontal side grab rail and hand wash basin. One PWD toilet room shall be provided for every 15 wheelchair positions. Distance between any wheelchair position and P.H. Toilet shall not be greater than 40M.
- All toilets shall be equipped with general lighting and exhaust.
- Floors are to be graded to floor waste and finished in a non-slip ceramic or vitrified tile over waterproof membrane.

- All walls are to be tiled over waterproof membrane including all reveals and end walls.
- All cubicles are to incorporate laminated heavy-duty toilet partitions, vandal proof fittings and concealed vandal proof flush.
- Filtered Drinking Water Facility shall be provided with each toilet block.

5.5 Corporate & VIP Toilets

VIP Seating / Dining areas and Private Box toilets shall be of a higher quality finish. Fixtures shall, where practicable be provided based on the following:

- Final fixtures count to be based upon following table.:

User Type	Min. No. of Urinals	Min. No. of WCs	Min. no. of Washbasins
Male	2 per 75 users	1 per 100 users	1 per 200 users
Female	-	1 per 100 users	1 per 200 users

- Corporate Box and Suite toilets shall have cold-water service
- Appropriate unisex disabled toilet facilities, including grab rails, sinks, etc. shall be provided per toilet block and in close proximity of the wheelchair seating areas. Distance between any wheelchair position and disabled toilet shall not be greater than 40M.
- Cleaner's rooms with a service sink and storage shall be provided to service the toilet blocks.
- All toilet fittings shall be durable.
- The PA system shall be capable of broadcasting match commentary within the toilet blocks; an override function shall enable emergency and information broadcasts and allows for muting to the toilet areas if required.
- All pipework, conduit and flush valves within public toilet blocks are to be concealed.
- All toilets shall be equipped with general lighting and exhaust.
- Floors are to be graded to floor waste and finished in a non-slip ceramic or vitrified tile over waterproof membrane.
- All walls are to be tiled over waterproof membrane including all reveals and end walls.
- All cubicles are to incorporate laminated heavy-duty toilet partitions, vandal proof fittings and concealed vandal proof flush.
- Filtered Drinking Water Facility shall be provided with each toilet block.

5.6 Merchandising outlets

Space planning for Merchandising outlets shall be done at locations within the public concourses with provision of power, telephone and data.

5.7 Public first aid rooms

Satellite first aid stations shall be distributed throughout the public concourses. Spectators requiring more extensive treatment and/or x-rays shall be evacuated by ambulance to local hospitals.

- All first aid stations shall have double leaf doors designed to accommodate stretcher access.
- A priority access route shall be identified through the venue, preferably utilizing back of house access for transfer of patients from the pitch and public levels.
- All first aid rooms shall be accessible to wheelchair users.
- All first aid rooms shall be clearly signed posted and easily locatable.
- Work counter with sink and hot/cold water, power, data, and telephone outlets to be provided.

5.8 Match Day Public Information Office

Match Day Public Information Office to be provided. It is to be accessible both externally and internally to the ground. This facility shall be used for Lost Children, Lost & Found etc. All power, data, and telephone outlets shall be provided.

5.9 Ticketing Windows

Ticketing windows shall be provided at all Main Gates into site. Non-event day ticket sales shall be provided in the South Pavilion.

- Secure entry / exit for staff members with optional safe room.
- Each unit shall be provided with electricity/phone/data connections as required.
- Dedicated accessibility counter at each ticket office.

5.10 Video Boards

2 nos. of Video Boards excluding video screens shall be provided on Upper tier of the Stadium. Size of each video board shall support minimum screen size of 13m (Wide) X 8m (High). Video board shall include the support structure, maintenance platforms, ladders, provision for cabling etc.

5.11 Food and Beverage Service

An efficient and effective system for serving food and beverages to spectators, suites and boxes, hospitality spaces, and athletes is an important component of successful stadium operations. The assumptions laid out herein are based on similar facilities that have been completed in India.

5.11.1 Concession Stands

Concession services shall be distributed around the concourses. Food and beverage stands shall be sized based on 7.5 linear meters of counter front per 1,000 spectators based on 5.0m for food service and 2.5m for beverage service. Food & Beverage stands shall have a depth of 3.7m for storage and food preparation. A minimum 2m queue zone should be allowed in front of all food and beverage stands which shall be independent of the concourse circulation zone.

- Planning shall be based on “speed line” type service but consideration should be given for “point of sale” service.
- Location of queue lines should be considered when placing concession stands, to minimise congestion in the concourses. A minimum of 2m queue depth is required for each concession, for the full length of the service counter.
- A basic shell space is to be provided, which allows easy conversion from one type operation to another.
- All units shall have capability of serving hot beverages and soft drinks throughout every concession stand.
- Provision of grease exhaust and grease traps.
- Security/smoke shutters shall be provided at each counter front.
- Provision of TV at all concessions, positioned to allow a view by spectators standing in the queue,
- All food and beverage areas shall be designed with appropriate hygienic, washable and durable finishes, in accordance with local and national Environmental Health standards.

5.11.2 Hawking and Vending Cart Services

Hawking and vending cart services shall be provided. The vendor facility shall consist of a series of satellite areas. Tray vendors shall have their own pantries, strategically located, from which they shall be issued their supplies. Vending equipment and cart vending units shall be stored in these locations after use.

Provide one storage area at each side of the stadium, accessible to both the service tunnel and the pitch entry, for the vending operation.

5.11.3 Catering Support

The main kitchen / kitchens and commissary shall be located in south pavilion with immediate access to the loading docks and service lifts and shall be designed to accommodate all match day catering requirements.

- The kitchen and commissary shall be located on the service level of the stadium to support concession and catering needs at the point of major usage.

- Deliveries shall be made to the loading bay directly adjacent to the Commissary.
- Any goods requiring processing/cooking shall be prepared in the main Kitchen before transporting to concession stands or hospitality spaces.
- Finish materials shall be easy to clean and food acid resistant. Flooring materials shall be non-slip with coved skirting; ceiling materials shall be moisture resistant.
- Rubbish collection rooms shall be distributed around the facility for storage and processing of waste products.
- Storage space throughout shall be provided.

Finishing kitchens (Pantry) shall be provided in north pavilion to service all dining rooms, corporate suites, lounges etc. Finishing kitchen (Pantry) shall be located to minimise travel distance between the finishing kitchen and the point of service and shall have direct access to back of house areas and service lifts to the service level of the stadium. Circulation conflicts between front of house and back of house catering operation shall be avoided.

Separate Kitchen facilities to be provided in North and South Pavilion.

5.11.4 Catering Staff Facilities

Space shall be provided near Kitchen for Catering administrative offices, staff lockers, uniform distributing, and event-day briefing. Laundry facilities are to be included within the facility. Space shall be provided for temporary catering staff in close proximity to the main catering facilities and a briefing room on the service level of the stadium.

6. ENTRANCES AND CIRCULATION

6.1 Entrances / Ticketing & Ticket Booths

An efficient and effective control system for access into and exit from the stadium shall be provided for all users, including both Event-day and non-Event day times.

- Event-day operations shall provide segregated entry points for general admission spectators, VIPs, staff, media, and players.
- Non-Event day entry points shall anticipate needs of staff, club members, athletes, and general public.
- Emergency egress routes shall be considered for both Event-day and non-Event day modes.

6.1.1 Turnstiles

Space provision shall be made at public entrances for a minimum of 1 turnstile per 660 spectators

- Space provision of 1000 mm width shall be made for

- Additionally, an exit gate is required at each block of turnstiles to facilitate ejection of unwanted spectators.
- Space provision shall be made for confiscation storeroom & collection room which can be provided as overlay during event.

6.1.2 Access and Circulation

A system for the efficient and effective control of access into and out of the Stadium and circulation around the outside and within the Stadium shall be provided for all users. This shall include:

- Controlled access to the building, using tickets or accreditation, at convenient entry points for different user groups.
- An egress system.
- An emergency egress system.

This system shall include provision for following:

- A computer-based access control system for staff and accredited visitors.
- Integration of the turnstile control with a separate electronic ticketing system provided by an external agency.
- Barriers which can be located between turnstiles and shall be positioned for entry control.
- Entry plazas shall be designed to accommodate magnetometers and bag search as required for major event overlays.
- Entry plazas shall allow for the safe queuing and entry of patrons and shall avoid excessive congestion around changes of levels and entry turnstiles.
- As a guide an area of 0.35 m2 / person shall be allowed for the external plazas located in front of the entry turnstiles.

6.1.3 Corporate and VIP Entrance

A separate entrance lobby is to be provided for the Corporate Suite, Corporate Box, VIP, sponsors and guests on the main public access level and preferable in close proximity to car parking

- Ticketing shall be controlled with handheld ticket readers at each entry. Provision shall be made for, all power and data cabling as required at entry.
- Lifts at each VIP entry shall be provided to serve corporate suites and dining rooms and cater for disabled access to all floor levels.

6.1.4 Players Entrance

- A secure Players' entry within the building with bus drop-off. This entrance shall be protected from public exposure and shall be able to accommodate at least two team buses parked in front of the Main entry or Secondary entry.
- Direct access from the entrance area to the changing rooms shall be provided.

6.1.5 Staff Entrance

A single-entry point shall be provided for all event staff and catering staff with access to the external plaza areas surrounding the stadium. This space shall be adjacent to the events offices and catering offices, including changing rooms, dining room and uniform distribution.

6.1.6 Media Entrance

Media parking to be located as close as possible to the media access/egress point. A lift is to be available for use by the media staff to allow the vertical circulation of media personnel and equipment. All media facilities are to be separated from the public by secure means.

6.2 Access and Egress

A public egress system shall be provided so that in emergencies it allows the public to leave the Stadium by smooth unimpeded exit routes to adequately lit and clearly indicated assembly points in safe areas. The emergency egress system shall be designed in accordance with the "Guide to Safety at Sports Grounds" (The Green Guide) and in consultation with the CFO.

- The emergency egress system design shall use the "timed exit analysis" method as per the recommendations of the Green Guide.
- All access and circulation areas shall be free from hazards, adequately drained where necessary, and slip resistant. Slip-resistance should be appropriate for the specific areas and comply with the standards in both wet and dry conditions.

6.3 Concourses

6.3.1 Public Concourses

The main public concourse shall be located behind all main seating tiers and shall serve directly all vomitories, concessions, and toilets.

The concourses shall be designed to ensure the safe passage of spectators in the event of an emergency to appropriate exits. The basis for the width of the concourse shall be as set out in the United Kingdom "Guide to Safety at Sports Grounds" (Green Guide) and in accordance with good international practice and local and national regulations.

- A minimum area allowance of 0.3 sqm per person shall be used when determining the appropriate area of the concourse.
- Maximum distance from vomitory to concession / toilets = 40m.
- Concourse widths shall be designed to allow a pleasant spectator experience and shall be wide enough to allow 360-degree circulation as well as emergency egress. Concourse shall be designed to be a part of the safe egress system from the seating bowl to the outside.
- The emergency egress system design shall use the "timed exit analysis" method with the adoption of an egress time of 8 minutes from the seating bowl to a free-flowing exit system as set out in the Green Guide.

- Concourses shall be designed to sustain the point-loading situation typical for heavy equipment, such as forklifts, access equipment, and pallet loaders, without cracking or deflection.
- The concourses shall be designed to enhance the experience of visiting the stadium and shall provide facilities to allow people to congregate and relax prior to and after the match.
- The concourse shall incorporate clear graphics to ensure the orientation and safe passage of patrons.
- Maximum use of daylight shall be made to all concourse areas.
- The public circulation system on the concourses shall facilitate exit along the same path of travel as entry, which reflects the preferred pattern of use by spectators.
- The main entry level pedestrian walkway shall encircle the stadium bowl, with 360 uninterrupted circulations.
- All spectator amenities shall be distributed around the concourse to minimise spectator travel distances.
- Concourses shall be designed as low fire risk areas, with all potential risks (e.g. catering and merchandise units) enclosed by fire resistant construction and fitted with automatic fire detection system, sprinklers, and/or smoke shutters.

The following provisions shall be included in the public concourses:

- PA system
- Waste Collection system.

6.3.2 Corporate Suite Concourse

Private corridors shall provide access to the Suites and Boxes and associated toilet facilities. These corridors shall feature upgraded finishes, similar to the suite finishes.

- These corridors shall include PA, for emergency announcements only.
- Generous reception and meet and greet areas shall be located at the entry points to the corporate facilities.

6.4 Passenger Lifts

Passenger lifts shall serve all main levels of the stadium. All lifts shall conform generally to National Building Code and other safety guidelines.

- Minimum capacity of the lift shall be 16 passengers.
- Lifts shall have centre opening.
- At least one lift in each stand to be sized to accommodate wheelchair and in case of emergencies shall accommodate stretcher.
- Lift lobbies shall be designed to be 'safe havens' during emergency for disabled.

- Security / Key switch to all lifts shall be required.
- Security camera and access control card reader shall interface with CCTV and security system within each lift.

6.5 Service Elevators

Service Elevators shall be provided with fully opening doors and durable stainless-steel finish. Goods lifts shall have a minimum 2500 kg load capacity. Goods lifts required to be close to kitchens, storage and service areas.

6.6 Stairways and Ramps

Stairways and ramps shall be designed for Emergency Exit in accordance with the Green Guide, the NBC and in consultation with Fire officer. Stairways shall be distributed throughout the building, from lowest level to the upper floor, allowing for both public and service use.

- Stairs are to be divided into channels with a central handrail barrier where widths are in excess of 2500mm.
- Public stairs shall be generally provided with natural ventilation.
- Anti-skid flooring to be provided on stairs and ramps.
- Design for exiting stairs and ramps directly into wide open spaces.

6.7 Field Entrances

A minimum of two pitch access points shall be provided from the Service Road to the FOP. These shall provide access for service vehicles, pitch maintenance vehicles and emergency vehicles as well as providing alternate means of egress from the field of play for events where patrons are located on the field (Concerts, Opening Ceremonies etc.).

Each field access shall be minimum 5.5 m wide and 4.5m clear head height.

7. TEAM FACILITIES

Team facilities shall be located in the South Pavilion and shall have direct access to the playing field. There shall be ramped entrances for player's access onto the field.

Team facilities shall be completed to include air conditioning, finished walls, floor finishes, ceilings, general lighting, furniture, electrical sockets and media requirements.

Parking for two team buses shall be required as close as possible to the team change facilities.

7.1 Teams Changing Rooms – Cricket (2 Nos)

Air-conditioned changing room that shall accommodate 25 players, including locker space (25) hanging space and benches in front of lockers with direct access to shower area.

- Lockers to be individual 'carrel' style with integral bench, locker and hanging space.
- All locker positions shall face common column free area and shall allow one free wall to be visible for briefing.
- Coach office along with support staff areas.
- Shower, Toilets and drying areas shall consist of the following:
  - ✓ 7 showerheads with cubicles
  - ✓ 8 hand basins
  - ✓ 8 urinals
  - ✓ 4 lavatories
  - ✓ 2 hand dryers
- Recovery area to be located adjacent to showers, this area shall include:
  - Jacuzzi
  - Cold plunge pool / ice baths
  - 8-person steam room
- Massage with benches and tables for strapping. Office for the trainer and storage shall be included.
- Boot & Kit storage together with storage for laundry and drying equipment shall be provided.
- Team briefing room with seating, projection screen, whiteboard writing surface, TV and video facilities to sit up to 25 persons. (This could be located in the changing area or as a separate room.)
- Safe non-slip surfaces wet/dry carpet required throughout change room, apart from wet areas.

- Unisex disabled persons shower and toilet to be provided in each change room for injured players.
- Provide power, data, telephone outlets and TV monitors.
- Discrete dedicated back of house access shall be provided between the Team changing room and the Coaches Area
- Discrete dedicated back of house access shall be available from the changing rooms to the player's lounge.
- Player's dining area shall be part of the Lounge Area. Discrete service access from Pantry.
- A Team Doctor's room shall be provided adjacent to the Changing Room with access to the First Aid Facility.
- Separate Outdoor viewing gallery for both team attached to the Players' Lounge.

7.2 Umpire Changing Rooms

Air-conditioned changing rooms shall be provided for match officials. The room shall be located with direct access to the Field of Play and secure access to the Broadcast Areas.

- Change room for 5 match umpires.
- Provision for double width 'carrel' style lockers that shall have direct access to shower area and report writing area.
- Safe non-slip surfaces wet/dry carpet shall be required throughout change room apart from wet areas.
- Writing area to be located in the room for writing of match reports.
- Provide power, data, telephone outlets and TV monitors.
- 2 Showerheads with cubicle, 2 WCs, drying areas, 2 hand basins, 2 urinals.
- Separate lounge area connected to dining area. Discrete service access from Pantry.

7.3 First Aid

Provide an air conditioned first aid treatment suite for use by players (spectators in extreme emergencies) as needed on match days. The main first aid suite shall be situated at pitch level on the team changing room side of the service level with direct access to the field through the pitch access vomitories for the transfer of injured players by Ambulance. Two ambulance bays shall be located adjacent to the facility.

This suite shall incorporate the following:

- A screening area at the entry point, large enough for a stretcher
- Three cot areas with three stretcher beds and screening curtains

- Lockable medical cabinets for storage of supplies
- Work counter with sink and hot/cold water
- A refrigerator and ice bin
- A unisex disabled toilet room
- Work area for staff
- Stretcher width doors shall be provided from the pitch access vomitories and to the Ambulance Parking Bays located in the Service Road.

7.4 Drug Testing Room

A drug testing room shall be provided adjacent to the Team Changing Rooms. The facility shall be located away from media accessible areas to provide players privacy.

- Drug testing facilities shall include the following:
- WC and hand basin.
- Small waiting area and Interview Room, with desk and chairs.
- Room to be air conditioned
- Under bench refrigerator
- Space provision shall be made to allow for a stretcher bed and curtain to allow for possible blood testing of players.
- Direct access from the Drug Testing Room to the Access Road shall be provided to allow the secure collection of samples by couriers for testing.

7.5 Player's Lounge and Family Room

An air-conditioned player's lounge shall be shared by all teams and shall be located in close proximity to the central drop off area for the teams with access to both changing areas. It shall accommodate 50 people and shall include the following:

- A serving counter and a finishing kitchen to serve snacks and light meals.
- Lounge chairs and coffee tables
- Provide a disabled/unisex toilet room in this area.
- Provide power, data, telephone outlets and TV monitors.

7.6 Entrance Lobby

The Main Entrance Lobby to the Players shall be in South Pavilion.

7.7 Player's Benches

Two team portable benches shall be located either side of the Sight Screen with direct access to the centre line Player's Tunnel to the team changing rooms.

The interchange bench shall include the following:

- The benches shall be enclosed with a glass canopy and walls that shall offer protection from the public patrons located behind in the lower tier.
- Players' benches shall be sized to accommodate 12 persons each.
- Space shall be allowed within the bench area to accommodate players' kit bags, storage boxes and portable drink / ice boxes.
- There shall be a phone link and between this point, the Coaches Box and the changing rooms. Refer to Coaches Boxes for details.
- Internal telephone line between interchange benches to doctor's room.
- Power and data lines shall be provided at these locations.

7.8 Open Fitness Centre

Common Players Warm-up Room & Fitness centre shall be in Players and Match Officials Areas (PMOA)

- Large, robust space facilitate stretching and limbering up
- Room size to be a minimum of 180Sq.M

The Open Fitness Centre shall have a clear, open floor plan for flexibility in equipment placement and movement. It shall have separate areas for cardio, strength training, and stretching. The stretch area should be supplied with vinyl covered padded floor matting and wall mounted mirrors. The Cardiovascular (CV) area should contain fitness machines with integral visual displays. The strength training area shall have dumbbell weights which are normally stored on open racks grouped in weight ranges, with additional benches and stands provided for heavier barbell weights

The floor structure shall be able to resist high dead loads imposed by the equipment, along with the potential for high live loads from:

- Users
- Accidental point load impact (e.g. dropping of free weights)
- Dynamic effects (harmonic vibration from users on machines)

8. PRESS FACILITIES

8.1 Media Access

Media parking is to be provided on the entry level and is to be located as close as possible to the media access/egress point. A lift shall be located as close as possible to the media area to allow the vertical circulation of media personnel and equipment. All media facilities are to be separated from the public by secure means.

8.2 Written Press Box

A written press box shall be provided with a clear elevated view on the field on the North Pavilion. The permanent-Press box meets the following requirements:

- It shall be fitted out with continuous rows of work counters and quality mobile adjustable chairs to accommodate 100 journalists
- The written press box shall incorporate tiered seating located behind a glass line.
- A minimum allowance of 750mm counter width for each journalist shall be provided.
- Double electrical outlets, data, and telephone outlets to each work point.
- All wiring to be provided within cable management system.
- Elevated television monitors above the glazing at the front of the Press Box shall be provided, with a direct feed from the host broadcaster or scoreboard operators, as well as receiving all regular network channels.
- Audio outlets from the interview room between the player's rooms so interviews can be heard in the press box.
- Press workroom to be air-conditioned.
- Access to media lounge facilities.
- Unobstructed view lines to the pitch and scoreboards shall be provided.

8.3 Media Facility – Lounge

Provide a lounge area within the press area. This lounge shall be capable of serving food and beverages to all written press, TV and radio broadcasters. It may be used as the expansion space for the main press workroom for major events.

This facility shall contain casual sit-down dining tables and chairs for approximately 25 persons.

- Provide Serving Counter within the lounge
- Provide general lighting, air conditioned, plumbing and electrical, telephone and communication services.
- Provision for TV monitors to be setup within lounge to view play on ground.

8.4 Toilets

The press shall have dedicated male and female toilets adjacent to the media lounge.

8.5 Player Interview/Conference Room

A conference & interview room shall be provided for interviewing players and coaches in an 'official' setting with appropriate lighting, backdrop, air conditioned and adequate space for reporters and cameras. The interview room shall be in close proximity to the team change rooms. This room shall be provided with television cable links, radio broadcasting, television box and links back to all press areas.

- The interview room shall be setup to accommodate 50 seated on tiered seating plus cameras with an elevated platform at the front of the room to contain a desk and chairs for the interview subjects.
- Seating for up to 50 journalists. Seating to be provided with a fixed "tablet" on one arm.
- This room to have acoustic treatment to walls and ceiling surfaces to allow for high quality sound transmission for TV and radio broadcast.
- Direct cable connections shall be located in the rear of the room for TV and radio broadcast.
- Storage space shall be provided within close proximity to the interview room. This is to store equipment.
- TV lighting, ceiling lighting grid and power to be provided.
- Provision for two smaller Interview spaces shall be provided for interviews adjacent to the main conference room.

8.6 Interview Areas at Pitch Level

In addition to the main press conference room located in close proximity to the players and media facilities on the service level the following zones shall be provided at pitch level.

- Flash interview zone shall be provided near the field of play to allow primary broadcasters to interview players as they leave the field.
- The Flash Interview area shall be able to accommodate TV crew lights and a sponsor's logo backdrop.

9. BROADCAST FACILITIES

9.1 Television Broadcasting Boxes

Three television broadcasting booths shall be provided with special acoustic treatment to walls and ceilings. Allow for the maximum flexibility for the producer's camera positions and presenters backdrop of the arena. Sufficient height shall be provided to ensure adequate lighting positions.

- TV boxes to have flat floor
- Box to include seating space for 7 commentators with counter bench in front of operable windows.
- Centre of box to be set up for use as 'set'.
- Solid wall to sides with curtain behind which allows camera to film through with the arena as background, no joints in glass panel to centre of box.
- High level of acoustic isolation shall be required within box from external noise.
- Direct feed from stats box and interview room to be provided.
- Operable or removable glazing to the right and left-hand side of box to be provided.
- Direct cabling between OB Vans and Broadcast Box and camera positions to be provided.
- TV Broadcast Room shall be air conditioned designed to handle additional heat loads from equipment and lighting. Air conditioning equipment and ducts to be acoustically treated to attain required noise control.

9.2 Television Pre / Post-production Studio

Two nos. of Presentation studio shall be provided in the North Pavilion at the same level as the Commentator rooms.

- The studio shall be sized to accommodate 4 presenters (located at the front of the booth), camera operators and sound engineers, for a total of 10 persons at one time.
- The front of the booth shall be fixed with anti-reflective glass to allow the presenters to be shot with the pitch as a backdrop.
- These spaces shall be built as shell space only to be fitted out by the TV networks.

9.3 Radio Broadcaster Booth

Radio broadcasting booth shall be provided for radio commentators and shall have built-in counters and special acoustic isolation treatment on walls and ceilings to each box. The spaces shall be flexible to accommodate the varying broadcasting media requirements.

- Booth enclosed on all four sides with fully operable windows at the front (pitch side), tiered seating, built-in counter with 4 electrical, 4 data/phone outlets along the front with suitable cable management.
- Soundproof radio booths shall be required with the ability to sit six persons in one row across front with clear sightlines to all parts of the ground and scoreboard.
- Space at back of boxes for technical equipment. This is to be housed within a lockable closet with suitable ventilation and cable management access.
- Large bench at rear of box at which a technician can be seated behind commentators to operate broadcast equipment.
- Operable glazing to field of play.
- Each box to have provision for TV monitors, to be able to be viewed whilst facing the ground.
- Power, data, telephone outlets and to each box shall be provided.
- Direct feed from Stats shall be provided.
- Audio split facility, data cabling required in each radio commentary booth back to interview, change rooms and press areas.
- Radio boxes to back on to broadcasting lounge area.
- Radio boxes to be air-conditioned.
- Air conditioning equipment and ducts to be acoustically treated to attain required noise control.

9.4 Match offficials' facilities

Match officials' facilities shall be located at an elevated position with preferential view to pitch and scoreboards. Following rooms shall be provided in Match officials' area:

- Third Umpire's Room: This room shall include space for 5 umpires with counter bench in front of Glazing.
- Referee Room: This room shall include space for 5 referees with counter bench in front of Glazing.
- Scorer Room: This room shall include space for 5 scorers with counter bench in front of Glazing.
- Anti-Corruption room

These rooms shall have following facilities:

- High level of acoustic isolation shall be required within rooms from external noise.
- Direct feed from stats box and interview room to be provided.
- Operable or removable glazing to the right and left-hand side of box to be provided.

- Direct cabling between OB Vans, Scoreboard, Production Control Room and camera positions to be provided.
- Rooms shall be air conditioned designed to handle additional heat loads from equipment and lighting. Air conditioning equipment and ducts to be acoustically treated to attain required noise control.

9.5 Production Control Room

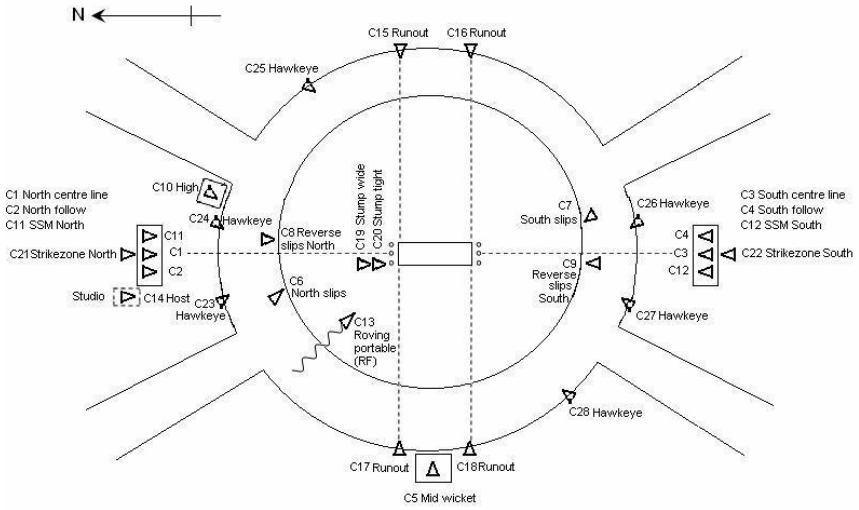
The Production Control Room shall be located in the lower level of the building to facilitate ease of movement of Heavy Equipment.

- The room shall be minimum 225 SQM column free space with high ceiling
- High level of acoustic isolation shall be required within room from external noise.
- The room shall directly connect to the outdoor Broadcast Compound
- Large Door opening with provision for multiple cable entry provisions.
- PCR shall be air conditioned designed to handle additional heat loads from equipment and lighting. Air conditioning equipment and ducts to be acoustically treated to attain required noise control.
- Toilet facilities (Male & female) shall be provided in close proximity to the PCR
- Separate Dining Area for 30 within

9.6 Camera Platforms

Final camera positions shall be subject to the requirements of individual broadcasters and producers for each particular sport. However, the camera and cabling requirements positions shall be as follows:

Television camera positions shall be located around the ground. Camera positions to be designed to minimise obscuring sightlines from seating and shall not reduce the net spectator capacity of 30000.



Camera Positions for Cricket Match:

Main Camera platforms shall be provided at both ends of the north - south axis of the stadium. These stands shall be part of the north and south pavilions.

Additional camera platforms shall be provided for Cricket

9.7 Television Outside Broadcast Vehicle

Parking for OB Vans (two OB Vans, one generator van, one 20-foot truck shall be provided within the stadium compound within 100m of the main TV Box and with minimum clearance height 4600mm. Patch room to be provided within the OB Van parking area with direct link to all camera outlets and Broadcast Box and interview rooms.

9.8 Cabling/Service Provisions

The cable route from the OB Van compound and parking area into the building shall allow for easy access to cabling routes.

Permanent fibre optic cabling shall be installed to the primary broadcast facilities between Broadcast Room, OB Van Area and all the camera positions.

10. STADIUM OPERATIONS FACILITIES

10.1 Stadium Management

The stadium management requirements shall be developed further in consultation with the stadium operator as the design progresses. At this feasibility stage the following provisions shall be made:

10.1.1 Stadium Management Offfices

Stadium Management offices shall be provided with access to natural light and ventilation. A space allocation of 300m2 shall be made at this stage.

10.1.2 Maintenance Staff Lockers

Locker / shower / toilet rooms for full-time staff, including grounds keeping and maintenance personnel, shall be provided. Separate shower facilities shall be required for male and female staff, each with the following provisions:

- 5 full-height lockers, 300mm wide
- Shower stalls
- Women: 2 WC's and 2 wash basins

10.2 Security

This brief allows for the inclusion of separate facilities for privately contracted Stadium Security and the Bihar Police, which shall work jointly during events.

Further discussions shall be needed to verify appropriate space allocations.

10.2.1 Main Security Offfice

The main security office suite shall be located on the lower level in close proximity to the main entry. It shall be used for coordinating security personnel and stewarding operations on event days. It must be able to accommodate all emergency services in case of building evacuation, so all basic facilities within the event control room shall be duplicated, in a reduced fashion. It shall be located in a different quadrant than the Event Day Command Post. Other requirements for the security offices are as follows:

- Workstations for eight staff
- A briefing room
- Equipment storage space
- A staff break room
- Unisex / people with disabilities toilet room

10.2.2 Event Command Post

Following rooms shall be included in Event command post area located in North Pavilion

Control & Surveillance Room:

A Control and surveillance Room shall be provided, overlooking the main seating bowl in the North Pavilion.

- Locate adjacent to the Police Office.
- Provide workstations for six staff.

Venue Operations Centre:

Venue Operations Centre shall be provided in Event command post area in with the view of Field of play. This room shall be co-located with the Video board control room and PA announcer booth.

Police Offfice

The main Police office shall be located within event command post area. Whilst no liaison with the Bihar Police has occurred at this stage the following Police facilities have been assumed based on similar stadia facilities:

- A public waiting area for 4 people, separate from forward reception area by internal doors, and to be fitted with an automatic entry system for security.
- Forward reception shall accommodate 2 officers behind the counter. Provide counter with cabinets, seats and space for police designated computer terminals.
- Interview rooms for 4 people with seating and a desk. It shall allow access from the public and police side of counter.
- An office located off the forward reception area. It shall allow access from the police side of counter only.
- Photocopy room to be accessible from the police side of counter only.
- A secured storage room to be used to store kit bags and other specialty equipment.
- Break room shall have comfortable seating for 4-6 persons and kitchenette facilities

10.2.3 Security Help Desks

Space provision for Security help desks shall be made near main entry points.

10.2.4 Toilet Facilities for Security areas

The dedicated male and female toilets shall be provided adjacent to the security areas.

10.3 Event Storage

10.3.1 Cricket Equipment

- Storage for athletic equipment, including boundary ropes, sight-screens, nets, and balls, shall be provided on the Field Level, with direct access to the field.

10.3.2 Entertainment Equipment

- Storage for pre-event and half-time entertainment production equipment shall be provided in the service level. This may be a lockable multi-purpose room, or other service level rooms not required for concert / opening ceremony use.
- On site storage shall be required for seats removed to allow for stage set-up.

10.3.3 Rigging Store

- Storage for rigging equipment shall be provided within the entertainment equipment stores and main facility workshops.

10.4 Grounds keeping

10.4.1 Grounds keeping Store

- A large storage area for grounds keeping materials and equipment shall be provided. This shall be located adjacent to the pitch, with direct access by grounds keeping vehicles. Other provisions to include:
- Overhead doors which lead to pitch access.
- Ventilated area for parking of forklifts, tractors and other motor driven equipment.
- Separate secure chemical storage room.
- Separate drive-in bin areas for the storage and separation of pitch material.

10.4.2 Grounds keeping Office

- Provide a secure Grounds keeping Office for two people adjacent to the main storage office. This office shall house the irrigation control systems.

10.4.3 Staff Room

- Provide a break room for Grounds keeping staff with kitchenette facilities, and a toilet room.

10.4.4 Chemical Shower

- An emergency shower shall be provided, adjacent to the Grounds keeping Storage areas near the pitch access tunnel. This is to enable personnel to wash contaminants off in the event of an emergency.

10.4.5 Water Retention Tanks

- Water retention tanks for irrigation of the playing field shall be provided. Size to be determined in accordance with recommendations by the pitch and hydraulics consultants.

10.5 Janitorial

10.5.1 Central Supply Storage

- A centralized storeroom shall be provided on the Service Level for storage of bulk cleaning supplies.

10.5.2 Cleaner's Closets

- Each pair of public toilet rooms shall have a cleaner's closet, with a mop sink and space for storing toilet room supplies.

10.5.3 Rubbish Collection

- Rubbish collection rooms shall be distributed on each level for handling of waste collections.
- Refuse Chutes shall be located in fire protected risers adjacent to the service lifts.
- Bins shall be located close to all Food and Beverage and Bar outlets and shall accommodate recycling compartments. Bins are to be located in defined locations away from the main congestion points in the concourses.

10.5.4 Waste Compactors

- Space provision shall be made for waste Compactor units and shall be located beneath all refuse chutes. Space provision for a refrigerated compactor area shall also be made adjacent to the central kitchen.

10.5.5 Waste Management Office

- A Waste Management office shall be located adjacent to the main service drive and in close proximity to the main refuse transfer point.

10.6 Maintenance

10.6.1 Maintenance Shops

- A general trade's workshop shall be provided, to include workspace and equipment for plumbing, carpentry, electrical and general maintenance. It shall include space for workbenches for small item workings by all trades and storage for immediate materials only.
- Ceiling height shall be approximately 3.5 meters.
- It shall have provisions for water, portable compressed air and 3-phase electrical service.

10.6.2 Maintenance Storage

- A large storage room shall be provided for storage of materials and supplies.
- Caged, locked space within for electrical (15m2), general maintenance (60m2), directional signage (15m2) and banners/flags (15m2).
- The cages shall include warehouse-type storage shelving.
- Overhead door access shall be provided into this space from the service tunnel.

10.6.3 General Building Storage

- A large storage room shall be provided for miscellaneous building storage.

10.7 Loading Dock/Staging

- One loading bay shall be provided for food service deliveries, located directly adjacent to the Main Kitchen.
- Waste management system and recycling policy for food service and for stadium operations shall require further study, but assume that some recycling bins shall be provided for the appropriate materials – glass, aluminium, clean paper and cardboard, etc.

10.8 Building Services

Space allocation shall be allowed for the following building services. Reference should be made to the DBR for services for design criteria.

- Mechanical
- Electrical
- IT/ Communications
- PA Systems
- Fire
- BMS
- Lifts

Noise generating plant equipment shall be ideally located away from acoustically sensitive areas. Where possible, roof top equipment shall be attenuated and isolated to avoid noise breakout. Consideration is being given to utilising the principles of environmentally sustainable design to minimise the use of air conditioning plants.

11. EXTERNAL DEVELOPMENT

- On-site parking shall be provided for non-event day. This parking will serve as an enhancement to the surrounding developments. On an event day, use of these car parks will be restricted. The public plaza of the stadium shall create an area for pedestrian circulation and other activities.
- Any adjacent car parks and kerbing shall accommodate pedestrian flow and the finishes of the car park will be integral with the plaza so it appears as one space but shall align with local road policy. In addition, dedicated stadium parking shall be provided for administration, operations, media, team and possibly VIP parking.
- Event day vehicular access to the site shall be accommodated within the design as it will be required primarily for media, services and operational teams, VIPs and emergency vehicles.
- Boulevard-type atmosphere. The plaza shall be an open space to allow for maximised and safe pedestrian circulation during events. Some hard landscaping components, such as benches shall be integrated in strategic locations to enhance the plaza and break down the scale of the open space.
- Power outlets for plaza use to be incorporated into the enclosure of the stadium exterior.
- The main public entries shall respond to the largest influx of spectators.
- Provisions for local weather and topographical conditions based on the consultant's recommendations and as reviewed with the local council.
- Environmentally sustainable design:
- Provisions for storm water retention shall be included.
- Storage tanks shall be included for fire protection; capacity shall be confirmed.
- Compaction shall be performed during the filling work to achieve a minimum of 95% of the Proctor density.

11.1 Podium and Public Plaza

11.1.1 Podium

A dedicated podium level shall be incorporated around the stadium to ensure the segregation of spectator movement from the flow of other stakeholders, including but not limited to players, VIPs, media representatives, and officials. This measure shall be implemented to prevent any interference or overlap between the various parties, thereby maintaining operational efficiency and safety throughout the venue.

11.1.2 Public Plaza

A public plaza shall be designated and developed in front of the East stand, serving as a regulated gathering area for all attendees, and providing a controlled access point to the stadium on event days. This provision is intended to ensure orderly

movement and facilitate efficient ingress and egress for all persons attending the venue.

On non-event days, the public plaza in front of the East stand shall remain accessible to the general public, serving as a civic space for leisure, social interaction, and community engagement. The plaza shall be maintained for public use and may be subject to specific regulations or restrictions as deemed necessary for its upkeep and safety. Access to the stadium and surrounding areas shall be controlled in accordance with applicable policies, ensuring the plaza remains a secure and welcoming environment for all visitors.

The plaza shall be accessible from the approach road located on the northern side of the site. Multiple entry points shall be strategically planned at various locations along the length of the road to ensure efficient and regulated access to the plaza.

Plaza shall include Hardscape as well as soft cape areas. Hardscape areas shall be 80% and Soft cape area shall be 20% of the total Plaza.

11.2 Parking

Parking distribution will be as follows:

- Spectator Parking: as per local by-laws
- Parking Bays for People with disabilities. Number to be as per NBC
- Staff / Team Parking Bays: 20 nos.
- VIP / Corporate Parking: 30 nos.
- VVIP Parking with support vehicles: 30 nos.
- Police: 2 nos.
- Ambulance: 2 nos.
- Provide parking spaces for 3 Broadcast Trucks and 4 Team Buses.

11.3 Entrances

- Five (5) public entrances shall be provided at the periphery of the Stadium. These entrances shall serve as designated security control points on event days, where all security checks and screenings will be conducted.
- Space provision at the entrances shall be in such a way that all necessary security equipment, including but not limited to Door Frame Metal Detectors (DFMDs), baggage scanners, turnstiles, and other related devices, can be installed to ensure the safety and security of all individuals entering the venue.

11.4 Vehicular Gates

- The stadium premises shall have five (4) Main Vehicular gates and Three (3) exit gates, strategically located along the main approach roads along plot boundary

- Of these, two gates shall facilitate the entry and exit of spectator vehicles, including those of general admission spectators, players, VIPs, VVIPs, media, and other stakeholders.
- One gate shall be designated for buses accessing the bus drop-off point.
- The remaining two gates shall serve the proposed training facility located on the west side of the stadium.
- The vehicular gates designated for spectators shall be equipped with a set of two (2) boom barriers to effectively manage vehicular flow on event days and ensure orderly ingress and egress to the venue.
- Each vehicular gate will have 2 numbers of security cabins with connectivity to intercom network.

11.5 Pedestrian Gates

The stadium shall have seven (2) pedestrian gates, located along the north & west side roads. One of these gates will provide access to the podium level. The remaining one gate will open into the plaza and will facilitate the entry of spectators.

11.6 Compound Wall

The stadium facility shall be enclosed by a robust and secure compound wall designed to ensure safety, privacy, and control of access to the premises. The compound wall will demarcate the boundaries of the site, providing a clear separation between the facility and surrounding areas.

The design of the wall shall incorporate access control points, including gates for vehicles and pedestrians which are mentioned above to regulate ingress and egress.

11.7 Service Buildings

The stadium facility shall include Sewage Treatment Plant (STP) and an Electrical Substation, both of which are integral to the operational functionality of the facility.

11.7.1 The Sewage Treatment Plant (STP)

It shall be designed and constructed to meet all applicable environmental and regulatory standards. It will be responsible for the treatment and disposal of wastewater generated within the stadium premises. Refer MEP DBR for more details.

11.7.2 The Electrical Substation

It shall be constructed to provide a stable and reliable power supply to the entire stadium facility. It will be equipped with all necessary transformers, switchgear, and associated equipment specified in MEP DBR to support the electrical demands of the venue, including lighting, security systems, and other essential functions.

Both the STP and Electrical Substation buildings shall be securely located within the compound, with restricted access to authorized personnel only.

11.8 Softscape/ Landscape

Different zones are identified in the external development to create planting softscape concept different variety of plants are proposed so that it can align with the purpose of each zone-whether it's to welcome visitors, provide comfort, define boundaries, or offer ecological benefits. Each zone benefits from specific planting strategies that not only improve the experience of the space but also contribute to a harmonious and well-balanced design.

11.8.1 Peripheral Zone

The Peripheral Zone refers to the outer edges of a site or landscape area over **52800 sqm.** This area often serves a functional purpose but also plays a role in framing the site and enhancing its overall aesthetic.

Planting Objectives:

- **Framing and Boundary Deffinition**: Planting in the peripheral zone can help define the boundaries of a space and create a sense of enclosure or connection with the surrounding environment.
- **Transition and Integration**: The Peripheral Zone often serves as a transition space between the site and the outside world, so plantings can help integrate the space into its broader context.
- **Ecological Function**: Plants in this zone can also help with environmental benefits such as erosion control, managing stormwater, and supporting biodiversity.
- **Tree to be Plants To be provided :**Raphis , palm , Foxtail , Tabebuia, Plam Cyrus Revolura, Duranta Golden , Toparies , Golden Bottle brush , Casurina , Ficus Resonalt, Areca Palm , Draceana , Croton Varities , Deffenbachia , Aglonema , Fishtail Palm , Champagne Palm etc.(All 80 Nos)
- **Plants to be provided**: Albizia Procera, Azadirachta Indica, Palm -Wodyetia Bifurcata, Palm- Brahea Armata
- **Shrubs to be provided:** Bougainvillea Species, Lagerstroemea Indica, Calliandra Brevipes, Nerium Oleander, Hamelia Patens, Duranta Speciosa Variegated, Ixora Species, Jatropha Multifida, Tecoma Stans, Tulsi, Thevetia Peruviana.(All 50 Nos)
- **Ground covers to be provided:** Wedelia Trilobata, White Lantana, Variegated Mondo Grass, Rhoeo Compacta, Ruellia Devosiana. (All 100 Nos).
- SS Planter 18” dia.
- Electrical Lawn mover Frass Cutter & power Weed Shear.

11.8.2 Parking Zone

The Parking Zone is typically a functional area where aesthetics may take a back seat to practicality. However, the right planting design can make this space more inviting and reduce the visual impact of vast, open parking lots.

Planting Objectives:

Shading and Comfort: Incorporating trees that offer shade can help reduce heat

buildup in the parking lot and improve comfort for both pedestrians and drivers.

Safety and Trafffic Flow: Planting can help delineate pedestrian pathways, marking safe routes and creating visual cues for navigation.

- **Tree to be Plants To be provided :**Raphis , palm , Foxtail , Tabebuia, Plam Cyrus Revolura, Duranta Golden , Toparies , Golden Bottle brush , Casurina , Ficus Resonalt, Areca Palm , Draceana , Croton Varities , Deffenbachia , Aglonema , Fishtail Palm , Champagne Palm etc.(All 80 Nos)
- **Plants to be provided**: Albizia Procera, Azadirachta Indica, Palm -Wodyetia Bifurcata, Palm- Brahea Armata
- **Shrubs to be provided:** Bougainvillea Species, Lagerstroemea Indica, Calliandra Brevipes, Nerium Oleander, Hamelia Patens, Duranta Speciosa Variegated, Ixora Species, Jatropha Multifida, Tecoma Stans, Tulsi, Thevetia Peruviana.(All 50 Nos)
- **Ground covers to be provided:** Wedelia Trilobata, White Lantana, Variegated Mondo Grass, Rhoeo Compacta, Ruellia Devosiana. (All 100 Nos).
- SS Planter 18" dia.
- Electrical Lawn mover Frass Cutter & power Weed Shear.

11.8.3 Roadside Zone

The Roadside Zone is a critical area along the edges of roadways, serving both functional and aesthetic roles. This zone is typically the first interaction people have with a site as they approach, making its design essential in guiding and enhancing the experience of travellers. The roadside zone, often an overlooked space, can contribute significantly to the overall character of the area while improving safety, accessibility, and environmental health.

Planting Objectives:

- **Safety and Visibility:** Plantings in the roadside zone should prioritize clear sightlines and unobstructed views for drivers and pedestrians. Careful selection of low-growing vegetation or strategic placement of trees can help maintain visibility while adding visual appeal.
- **Traffic Calming and Aesthetic Appeal:** A well-designed roadside zone can enhance the experience of movement along the road. Plantings, whether through uniform rows or naturalistic groupings, can visually break up the monotony of paved surfaces, creating a more pleasant and inviting atmosphere for travelers.
- **Environmental Sustainability:** The roadside zone can serve as an effective space for mitigating environmental impacts, such as reducing the urban heat island effect, managing stormwater runoff, and preventing soil erosion. Plant species suited to the local climate and soil conditions can also contribute to biodiversity by providing habitat for local wildlife.
- **Noise and Air Quality Improvement:** Strategic planting in the roadside zone can act as a buffer to reduce noise pollution from traffic and improve air quality. Dense, evergreen hedges or trees can filter pollutants and provide sound insulation, enhancing the overall quality of life for both residents and commuters.

Planting Ideas:

- **Tree to be Plants To be provided :**Raphis , palm , Foxtail , Tabebuia, Plam Cyrus Revolura, Duranta Golden , Toparies , Golden Bottle brush , Casurina , Ficus Resonalt, Areca Palm , Draceana , Croton Varities , Deffenbachia , Aglonema , Fishtail Palm , Champagne Palm etc.(5000 Nos)
- **Plants to be provided**: Albizia Procera, Azadirachta Indica, Palm -Wodyetia Bifurcata, Palm- Brahea Armata (800 nos)
- **Shrubs to be provided:** Bougainvillea Species, Lagerstroemea Indica, Calliandra Brevipes, Nerium Oleander, Hamelia Patens, Duranta Speciosa Variegated, Ixora Species, Jatropha Multifida, Tecoma Stans, Tulsi, Thevetia Peruviana.(800 Nos)
- **Ground covers to be provided:** Wedelia Trilobata, White Lantana, Variegated Mondo Grass, Rhoeo Compacta, Ruellia Devosiana. (1600 Nos).
- SS Planter 18" dia.
- Electrical Lawn mover Frass Cutter & power Weed Shear.

12. SIGNAGE / GRAPHICS

A comprehensive, visible, readable, flexible and effective signage system shall be provided both outside and inside the building. The graphics shall be coordinated with those for the entire complex and provide signing as follows:

- Direction to and identification of Stadium entrances including Gates, ticket booths, turnstiles and special entrances.
- Signage within the Stadium to indicate Levels, Rooms, Aisles, Rows and Seat numbers; to be integrated with the ticketing and seat numbering system to provide a simple and easily understood method for spectators finding their seats.
- Direction to and identification of toilets, first aid rooms, exits, Police, Security and other public facilities.
- Direction to and identification of vending facilities (merchandising, food and beverage, etc.
- Direction to and identification of all cafes. Bars, dining rooms, function rooms, club rooms and corporate facilities.
- All signage to be provided including all back of house areas, Coaches, Player's facilities, Car parks, Kitchens, stores, operations and plant rooms.
- External signage should meet with the local planning authority guidelines.
- Each entry point and exit gate to be named.
- Road markings and signage to be included.

13. GREEN BUILDING CERTIFICATION

The environmental impact of the building design, construction and operation industry is significant. Buildings annually consume more than 20% of the electricity used in India.

Development shifts land usage away from natural, biologically diverse habitats to hardscape that is impervious and devoid of biodiversity. The far-reaching influence of the built environment necessitates action to reduce its impact.

Green building practices can substantially reduce or eliminate negative environmental impacts and improve existing unsustainable design, construction and operational practices. As an added benefit, green design measures reduce operating costs, enhance building marketability, increase worker productivity and reduce potential liability resulting from indoor air quality problems.

Studies of workers in Green buildings reported productivity gains of up to 16%, including reductions in absenteeism and improved work quality, based on "people-friendly" green design. In other words, sustainable building design has environmental, economic and social elements that benefit all building stakeholders, including owners, occupants and the general public.

GRIHA 3 STAR RATING shall be achieved and for that following Green Building features shall be incorporated in Stadium**:**

13.1 Sustainable site Planning.

- Project team shall make efforts to minimize the cutting of trees on site. Also, Compensatory tree Plantation will be done in 1:5 ratios in the campus
- Reduce exposed hard paved surface on site with shade by trees and Structures
- High SRI Roof surfaces shall be proposed to mitigate urban Heat Island effect
- Soil Erosion and sedimentation control measures shall be implemented
- Landscape design shall integrate native and draught tolerant species to reduce impact on local biodiversity.
- Basic facilities for construction workforce

13.2 Water Efficiency

- Water Efficient (Low flow and Flush fixtures) shall be proposed to reduce water demand by more than 50%
- Landscape water demand shall be reduced by more than 50%
- 100% rainwater shall be harvested and recharged
- 100% wastewater shall be treated by STP
- STP treated water shall be reused for flushing and irrigation

13.3 Energy Efficiency

- Building orientation shall be designed to reduce Heat Gain and enhance the cross-Ventilation potential and Day Light.
- Efficient envelope like walls and roofs, Low SHGC Glass and Optimized Shading devices reduce Heat Load
- LED Lighting fixtures shall be used for artificial lighting to reduce electricity consumption
- LPD less than 4.0 W/m2 (60% reduction than conventional buildings)
- Highly Efficient HVAC system and 5 Star appliances to reduce consumption for air conditioning.
- Solar PV system

13.4 Material and Resources

- Use of Low embodied energy sustainable material in construction and Interior Works has been proposed
- Waste management system. Organic waste composter
- Local material and material with recycled content will be used
- Best Construction waste management practices will be implemented

13.5 Indoor Environment quality

- Optimized Fenestration also ensures daylight penetration for more than 90% of regularly occupied areas.
- Enhance ventilation as per ASHRAE 62.1 Codes to ensure health and wellbeing of the occupants.
- Low VOC paints adhesives and sealants being proposed

14. AREA STATEMENT

14.1 Cricket Stadium Built-up Area Statement

Sr. No.	Building Name	Floor Height	Built-up Area in Sq. M
A1	**East Stand:**		
a	GROUND FLOOR	6.60M	1804.59
b	FIRST FLOOR	3.90M	1685.28
c	SEATING AREA	3.90M	585.70
d	Seating Area	3.90M	585.70
		Total	**4661.27**
A2	**West Stand:**		
a	GROUND FLOOR	6.60M	2541.89
b	FIRST FLOOR	3.90M	1912.70
c	SEATING AREA	3.90M	628.34
d	Seating Area	3.90M	628.34
		Total	**5711.27**
A3	**North Pavilion:**		
a	GROUND FLOOR	5.05M	2111.82
b	FIRST FLOOR	3.90M	1810.18
c	SECOND FLOOR	3.90M	2094.54
d	THIRD FLOOR	3.90M	2086.58
e	FOURTH FLOOR	3.90M	2086.58
		Total	**10189.70**
A4	**South Pavilion:**		
a	GROUND FLOOR	5.05M	2090.26
b	FIRST FLOOR	3.90M	1936.92
c	SECOND FLOOR	3.90M	2066.12
d	THIRD FLOOR	3.90M	2156.28
e	FOURTH FLOOR	3.90M	2156.28
		Total	**10405.85**
A5	**DINING BLOCK**		
a	GROUND FLOOR	4.00	556.64
		Total	**556.64**
A6	**MLCP BUILDING**		
a	GROUND FLOOR	3.50 M	1933.39
b	FIRST FLOOR	3.50 M	1933.39
c	SECOND FLOOR	3.50 M	1933.39
d	THIRD FLOOR	3.50 M	1933.39
e	FOURTH FLOOR	3.50 M	1933.39
f	FIFTH FLOOR	3.50 M	1933.39

g	SIXTH FLOOR	3.50 M	1933.39
h	SEVENTH FLOOR	3.50 M	1933.39
i	EIGHT FLOOR	3.50 M	1933.39
		Total	**17400.48**
A7	**BOYS HOSTEL**		
a	GROUND FLOOR	3.50 M	519.19
b	FIRST FLOOR	3.50 M	555.88
c	SECOND FLOOR	3.50 M	555.88
d	THIRD FLOOR	3.50 M	555.88
e	FOURTH FLOOR	3.50 M	555.88
		Total	**2742.71**
A8	**GIRLS HOSTEL**		
a	GROUND FLOOR	3.50 M	519.19
b	FIRST FLOOR	3.50 M	555.88
c	SECOND FLOOR	3.50 M	555.88
d	THIRD FLOOR	3.50 M	555.88
e	FOURTH FLOOR	3.50 M	555.88
		Total	**2742.71**
A9	**HOTEL**		
a	GROUND FLOOR	3.50 M	1456.15
b	FIRST FLOOR	3.50 M	1037.25
c	SECOND FLOOR	3.50 M	960.50
d	THIRD FLOOR	3.50 M	876.80
e	FOURTH FLOOR	3.50 M	796.97
F	SWIMMING POOL TERRACE		796.97
		Total	**5924.39**
	TOTAL STADIUM BUILT UP AREA		**60335.27**

15. ARCHITECTURAL FINISHES

S.No.	Particulars	Brief Details of provisions
B.	**Door and Windows**	
(i)	Frame of Doors	Powder coated Aluminium Section/ Teak wood
(ii)	Shutter	35 mm thick flush door shutters with decorative Laminated on both sides.
(iii)	Windows & Ventilators	UPVC
(iv)	Frame & Shutter in toilets	WPC Frame -50X100m & WPC 30mm thick. shutter.
(v)	Fittings	Stainless Steel fittings (Grade 304) and Aluminium fittings.
(vi)	Fire Check Doors	Two-hour fire rated metal and Glazed door with Fire rated accessories.
C.	**Flooring**	
(i)	Stamp Concrete flooring	Podium, Concourse areas + Ramps
(ii)	Kota stone	a) Services room, AHU & Stores.
(iii)	Vitrified tiles	All rooms expect service room.
(iv)	Ceramic glazed floor and wall tiles	Toilets & Kitchen
(v)	Granite	For decorative purpose in Common areas (staircase, entrance lobby, Lift lobby, corridor, etc.)
(vi)	IPS	Storage & Services areas
(vii)	Railing	SS Railing (Grade 304) In staircases + MS railing with Epoxy paint for all other areas
D.	**Water prooffing**	a. Terrace: - Brickbat Koba Treatment in All Buildings b. Sunken portion - integral cement based IV-course waterproofing treatment all Toilets & Kitchen. c. Seating Bleachers: Integral Crystalline waterproofing d. STP & UGT - Integral Crystalline waterproofing
E.	**False Ceiling**	
(i)	Calcium Silicate tile & Boards false ceiling	All Wet areas such as Toilets, Pantry & Kitchen
(ii)	Mineral Fibre grid false ceiling	All rooms in South & North Pavilion except Storerooms
(iii)	Aluminum False ceiling	Labs, Corridor etc.
(iv)	Metal baffle Ceiling	Entrance lobby, reception area & Lounges
G.	**Finishing/ Painting**	
(i)	Premium acrylic smooth exterior paint	External walls
	Natural Stone Texture Painting	External walls in line with facade

S.No.	Particulars	Brief Details of provisions
(ii)	Aluminium fins 84R	External façade
(iii)	Structural Glazing	External façade
(iv)	Gypsum Plaster	Internal walls-in Premium areas
(v)	Cement plaster	External & Internal wall and Internal ceiling
(vi)	Distempering with 1st quality acrylic distemper, and Wall painting with acrylic emulsion paint, having VOC (Volatile Organic Compound)	Internal in All Buildings
(vii)	Distempering with oil bound washable distemper	All ceiling area.
(Viii)	Plastic Emulsion paint	Internal wall
H.	**Site Development**	
(i)	Earth Work	Site requires earth filling of approx. 1036 cum to brought from outside.
(ii)	Proposed cross section for internal roads	1. As per IRC: SP: 62-2014 2. Guidelines for design and construction of cement concrete pavements for low volume roads. 3. Traffic up to 50 CVPD CBR- 5% 4. M-30 Grade CC = 200 mm 5. WMM = 75 mm 6. GSB = 100 mm (Approach roads to site are not considered part of this DPR)

16. STATUTORY APPROVALS

Contractor shall strictly comply with all the provisions of all relevant Statutory Acts and obtain NOCs, as deemed necessary from agencies including, but not limited to:

- Forest Conservation Act of 1980. (Tree transplantation, tree cutting, afforestation)
- Fire Services
- Nagar Nigam Patna
- Other relevant agencies providing Utilities (Power, Water Supply, Sewerage) in the area
- Environmental Clearances

Annexure-A

SNO	COMPONENT	LEVEL	AMENITIES	NO OF SEATS
1	NORTH PAVILION	LEVEL-1	PLAYERS CONFERENCE/ BRIEFING ROOM	
			LOUNGE-1	
			LOUNGE-2	132
			TV PRODUCTION ROOM + FOOD COURT	
			BANQUET HALL	125
			KITCHEN WITH STORE	
			MALE TOILET	
			FEMALE TOILET	
			HANDICAPPED TOILET	
			GALLERY	145
		LEVEL-2	LOUNGE	125
			AUDIO VISUAL ROOM	38
			ACADEMIC LIBRARY	18
			CONFERENCE	53
			VENUE CONTROL ROOM	18
			ROOM	
			MALE TOILET	
			FEMALE TOILET	
			HANDICAPPED TOILET	
		LEVEL-3	MEDIA BOX	105
			RADIO COMMENTARY BOX	4
			HINDI COMMENTARY BOX	4
			ENGLISH COMMENTARY BOX	4
			STUDIO	105
			ROOM	
			ROOM WITH LIVING & DINING	
			MALE TOILET	
			FEMALE TOILET	
			HANDICAPPED TOILET	
		LEVEL-4	CORPORATE BOX	58
			ROOM	
			ROOM WITH LIVING & DINING	
			MALE TOILET	
			FEMALE TOILET	
			HANDICAPPED TOILET	

		LEVEL-5	SEATS	3450
				3653
			LOUNGE	
			PHYSIOTHERAPY	
			ROOM	
			DIRECTOR'S ROOM	
			ANTE ROOM	
			PANTRY	
			CONFERENCE	
			WAITING AREA	
			ROOM	
			I.C.U PHARMACY	
		LEVEL-1	KITCHEN	
			FIRST-AID/ DOPE TEST ROOM	
			ACSU	
			FIELD UMPIRE ROOM	
			ROOM	
			MALE TOILET	
			FEMALE TOILET	
			HANDICAPPED TOILET	
			V.I.P. TOILET	
			GALLERY	145
2	**SOUTH PAVILION**		HOME TEAM PLAYERS DRESSING	
			HOME TEAM PLAYERS DINING WITH PANTRY	
			HOME TEAM PLAYERS TOILET	
			GYM	
			ICE BATH	
			SAUNA	
			STEAM	
			JACUZZI	
		LEVEL-2	MASSAGE	
			GYMNASIUM AREA	
			THIRD UMPIRE ROOM	
			LOCKER ROOM	
			TOILET	
			AWAY TEAM PLAYERS DRESSING	
			AWAY TEAM PLAYERS DINING WITH PANTRY	
			AWAY TEAM PLAYERS TOILET	
			GYM	
			ICE BATH	

			SAUNA	
			STEAM	
			JACUZZI	
			MASSAGE	
		LEVEL-3	LOUNGE	84
			PLATINUM LOUNGE	188
			THIRD UMPIRE ROOM	15
			BCCI LOUNGE	93
			ROOM	
			ROOM WITH LIVING & DINING	
			KITCHEN	
			HANDICAPPED TOILET	
			TOILET	
			HOUSEKEEPING ROOM	
		LEVEL-4	CORPORATE BOX	64
			ROOM	
			ROOM WITH LIVING & DINING	
		LEVEL-5	SEATS	3450
				4024
3	**HOTEL**	GROUND FLOOR	BANQUET	16 ROOMS
			RESTAURANT	
			KITCHEN	
			STORE	
			HOUSE KEEPING	
			MALE TOILET	
			FEMALE TOILET	
			ROOMS	
		FIRST FLOOR		8 ROOMS
			PANTRY	
			STORE	
			HOUSE KEEPING	
			MALE TOILET	
			FEMALE TOILET	
			ROOMS	
		SECOND FLOOR	GYMNASIUM	16 ROOMS
			RECREATIONAL ROOM	
			PANTRY	
			STORE	
			HOUSE KEEPING	
			MALE TOILET	
			FEMALE TOILET	
			ROOMS	

		THIRD FLOOR	PANTRY	12 ROOMS
			HOUSE KEEPING	
			ROOMS	
		FOURTH FLOOR	PANTRY	12 ROOMS
			HOUSE KEEPING	
			ROOMS	
4	**STANDS**	LVL 1	SEATING	7950
		LVL 2	SEATING	4694
		LVL 3	SEATING	15922
		LVL 4	SEATING	7750
			TOTAL NO OF SEATS	**36316**
5	**BOYS HOSTEL**	GROUND FLOOR	DINING HALL	**1 SEATER**
			LOUNGE	
			SICK ROOM	
			HANDICAP ROOM	
			WARDEN ROOM	
			COMMON TOILETS	
		FIRST FLOOR	LOUNGE	**36 SEATER**
			12 ROOMS TRIPLE SEATER	
			COMMON TOILET	
		SECOND FLOOR	LOUNGE	**30 SEATER**
			10 ROOMS TRIPLE SEATER	
			COMMON TOILET	
		THIRD FLOOR	LOUNGE	**36 SEATER**
			12 ROOMS TRIPLE SEATER	
			COMMON TOILET	
			TOTAL SEATER	**103 SEATER**
6	**GIRLS HOSTEL**	GROUND FLOOR	DINING HALL	**1 SEATER**
			LOUNGE	
			SICK ROOM	
			HANDICAP ROOM	
			WARDEN ROOM	
			COMMON TOILETS	
		FIRST FLOOR	LOUNGE	**36 SEATER**
			12 ROOMS TRIPLE SEATER	
			COMMON TOILET	

		SECOND FLOOR	LOUNGE	**30 SEATER**
			10 ROOMS TRIPLE SEATER	
			COMMON TOILET	
		THIRD FLOOR	LOUNGE	**36 SEATER**
			12 ROOMS TRIPLE SEATER	
			COMMON TOILET	
			TOTAL SEATER	**103 SEATER**

The above count does not include seat loss due to camera platforms and temporary installations as per event requirement such as fan boxes etc. Hence extra seat buffer is proposed in design. In all situations saleable tickets shall be **40,000 nos minimum**.

DESIGN BASIS REPORT
STRUCTURE

REDEVELOPMENT OF MOIN-UL-HAQ CRICKET STADIUM
AT PATNA, BIHAR

सक्षम् SAKSHHAM CONSULTANTS
Structural Engineers & Project Management Consultants

collage design

BIHAR CRICKET ASSOCIATION
AFFILIATED TO
THE BOARD OF CONTROL FOR CRICKET IN INDIA

Contents

1 Brief Description of the Project:

PROJECT: International Cricket Stadium, Patna

SITE LOCATION: Patna, Bihar

PROPOSED BUILDING:

Proposed stadium has four blocks:

East Block (STAND -1),

West Block (STAND-2)

North Block(PAVILION)

South Block(PAVILION)

These blocks have combined seating capacity of 40000.

East and West block have Ground floor (parking) + Concourse / Podium + Spectator seating + Roof Canopy provision. This block has Spectator seating, spectator facilities and Broadcast facilities.

North and South block have Ground floor + 2 floor + Roof Canopy provision. North block have media facilities, broadcast facilities and ground resource facilities. South block have facilities for VIP, Area for players and match officials and have camera platform.

In general, the site is flat with a level difference of around 1m between highest and lowest NGL within the building footprint.

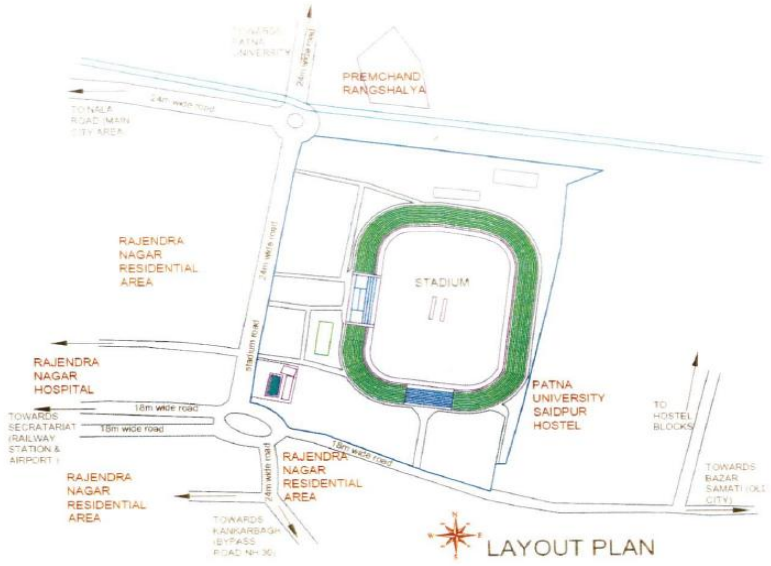
Overall site is proposed to raise by an average 1.7m w.r.t. the natural ground by filling soil from outside.

Pile & Pile cap will be executed after completion of soil filling; and Pile shall be designed for 20m Depth below NGL level. Tie Beams should be provided pile cap top level connecting all columns.

2 Scope of the Design Basis Report:

- This document covers material grade, loading data, design parameters and analysis & design philosophy for the detailed structural design of the buildings and structures.
- The site location and some of the site surroundings are as shown below.

SITE LOCATION



SITE SURROUNDINGS

3 Soil Parameters:

- In the soil investigation carried out by Agrawal Associates, 2nos of SPT was done for up to 20m depth and 4nos of borehole was done for up to 15m depth. Soil investigation report no: Soil AA-391 dated 02 January 2025 has been submitted to us.
- Groundwater was observed in the range 3.0 below the existing ground level.
- As per the soil report the strata available is sandy clay (CL) up to the depth of 0m to 15m and poorly graded sand (SP) from 15m to 20m depth of ground. N-value observed in range of 3 to 7 blows from 0m to 15m depth and in range of 16 to 27 blows from 15m to 20m depth.
- Based on boreholes investigation and subsequent laboratory test results, proposed
  foundation type is bored cast in situ piles with pile cap.

3.1 Foundation Recommendations:

- The proposed structure, considering the nature of subsoil and the type of structure open/raft foundations are not suitable foundation type for the proposed project.
- Deep foundation like piles should be more adequate here for higher load capacity.
- Safe load carrying capacity of pile may be confirmed by initial pile load test as per IS 2911 (Part-IV).

4 Structural System and Materials of Construction:

4.1 Structural System: Salient features of the structural system

4.1.1 Pile Foundation:

- For the foundation system pile foundation is considered as per geotechnical
- report recommendations.
- The depth of pile and size of piles shall be decided based upon the pile
- capacity achieved at site.
- Foundation/Pile cap shall be placed over 100mm thick PCC.
- Increase in SBC under Seismic load shall be considered as per IS-1893 (Part-1): 2016, Cl.6.3.5.2

1.1.2 • All the pile caps shall be connected through tie beams at pile cap top level. Columns/Shear Walls:

- Columns/Shear walls shall be designed to transfer the loads from superstructure to foundations.

- Columns/Shear walls shall be designed considering Ductile RC structural walls/Columns frame as per IS-1893 (Part-1):2016.
- Ductile detailing shall be done as per requirements of IS-13920:2016

1.1.3 Plinth Level:

- Conventional RCC beams shall be considered at Ground level of the building.
- Floor slab at plinth level shall be designed as structural slab & not grade supported slab

1.1.4 Floor level:

- Conventional RCC slab with RCC beams shall be considered for floor plate.

1.1.5 Masonry Walls:

- Lightweight blocks (Density not more than 8 kN/m^3) shall be used as infill walls in the building.
- Lightweight blocks load shall be considered as per architectural layout.
- All Masonry work below plinth/ground level shall be in brick work as per tender specs.

1.1.6 Water Tank:

- Water tank location, capacity and size shall be as per approved MEPF/Architectural layout.

1.2 Materials Properties

- Materials used as constituents of concrete shall be as per IS-456:2000. The properties of hardened concrete shall be as per IS-456:2000.

PCC		
	Concrete	M10
Pile Foundation		
	Concrete	M30
	Reinforcement	Fe550 D
Column		
	Concrete	M30/M35
	Reinforcement	Fe550 D

RCC Beam / Floor Slab		
	Concrete	M30/M35
	Reinforcement	Fe550 D
UGT		
	Concrete	M30
	Reinforcement	Fe550 D
OHT		
	Concrete	M30
	Reinforcement	Fe550 D
Grade slab		
	Concrete	M25
	Reinforcement	Fe550 D
Chajja / lintel / mullion / band		
	Concrete	M25
	Reinforcement	Fe550 D

- All reinforcement shall be TMT Fe550 D with a minimum elongation index of 14.5% to be used. All other mechanical and chemical properties are to be in accordance with the code IS-1786:2008.

1.3 Cover to Reinforcement

For the proposed structure **2 Hrs. Fire Rating, Moderate** environmental exposure condition for all RCC work is considered. Thus, the nominal cover to main reinforcement shall be as follows.

- Sub-Structure
  - Raft = 50mm
  - Retaining Wall = 45mm

- Columns Below Ground = 40mm
- Beams Below Ground = 40mm

- Super Structure
  - Slab = 30mm
  - Columns = 40mm
  - Floor Beams (Continuous) = 30mm
  - Floor Beams (Simply Supported) = 30mm
  - RC Structural Walls = 40mm
- Water retaining structure
  - Footing = 50mm
  - Walls = 45mm
  - Slab = 45mm

- Fire resistance of 2 hours is considered for structural elements as per IS-456:2000.

". " Stiffness Modifiers

- There are different parameters for Serviceability state (Wind storey Drift Control) and Ultimate Limit State. (Design against Wind and seismic Loads and also for seismic inter storey drift control). The term Ig is the Gross moment of Inertia of section.
- Stiffness modifiers for structural elements are as per the table below:

Stiffness Modifier (Serviceability Limit State)		
Structural Elements	Cross-Sectional Area	Modifiers for Moment of Inertia
Slabs	1.0Ag	0.35Ig
Beams	1.0Ag	0.7Ig
Columns	1.0Ag	0.9Ig
Shear Walls	1.0Ag	0.9Ig
Stiffness Modifier (Ultimate Limit State)		
Structural Elements	Cross-Sectional Area	Modifiers for Moment of Inertia
Slabs	1.0Ag	0.25Ig
Beams	1.0Ag	0.35Ig
Columns	1.0Ag	0.7Ig

Shear Walls	1.0Ag	0.7Ig

Where, Ag: Gross area of member and Ig: Moment of Inertia of members.

".5 Serviceability Criteria

".5.1 Deflection limits:

- Lateral Deformation:

Wind	Seismic
Maximum building drift	Maximum inter-storey drift
H_1/500	H_2/250

H_1: Building height

H_2: Story height

These limits are referenced from

IS-456:2000 plain and reinforced concrete-code of practice: Cl. 20.5

IS-1893:2016 Criteria for earthquake resistant design of structures: Cl. 7.11.1

".5.2 Vertical Deformation

Type of Member	**Deflection to bg considered**	**Deflection Limitation**
Supports of floors, roofs, and all other horizontal members	The final deflection due to all loads including the effects of temperature, creep, and shrinkage from the as cast level of supports of the floor.	L/250
Supports of floors, roofs, and all other horizontal members	The deflection due to the live load and the effects of temperature creep and shrinkage occurring after erection of partition.	L/350 or 20mm (whichever is less)
Long span roof canopy	Final deflection due to 'total' loads (girders/purlins)	L/180
	Deflection due to live/wind loads (girders/purlins)	L/240
	Deflection due to live/wind loads (primary cantilever trusses)	L/120

".5.3 Vibration

- Motion perception is a complex phenomenon as it is perceived differently by different people depending on the situations and enclosures. The natural frequency of the system (seating unit + raker) shall be higher than the limits specified in IStructE guidelines. RMS (Root Mean Square) Accelerations can be checked in case of non-compliance of natural frequency per IStructE guideline. Rhythmic Excitation acceleration limits would be targeted to 5-7% and Raker sizes with seating span tuned to limits such that this requirement is met. Pre-cast seating unit is recommended to be so chosen such that we ensure a (frequency to be finalized) or higher unit response. Overall system frequency is targeted at a minimum threshold of 3.5 Hz and largely up to 6 Hz to allow greater functional flexibility to owner and prevent occupant discomfort during a dynamic motion scenario(s). The recommendations are in line with IStructE Guidelines and as per past Sport portfolio experiences.
- The considerations for motion perception are good design practices for patron comfort.

2 Loading

2.1 Dead Loads

Dead Loads shall be calculated as per the densities given in IS-875 (Part-1):1987

Densities of commonly used but specific materials shall be as follows:

Density of Reinforced Cement Concrete	25 kN/m^3
Density of Plain Cement Concrete	24 kN/m^3
Density of Steel	78.5 kN/m^3
Density of Soil	18 kN/m^3
Density of Water	20 kN/m^3
Density of Lightweight Block Masonry	8 kN/m^3
Density of Plaster	20 kN/m^3
Density of Sunk Filling Material	20 kN/m^3
Floor Finish (Regular Floors)	1.5 kN/m^2
Floor Finish (Staircase)	1.5 kN/m^2
Floor Finish (Terrace)	2.5 kN/m^2

Floor Finish (Seating Bowl)	1 kN/m^2
False Ceiling Load	0.5 kN/m^2
Service Load	0.5 kN/m^2
Roof Sheeting Load	0.25 kN/m^2
Solar Panel Load	1 kN/m^2
Water tank load shall be as per location, capacity, type and size as per MEPF layout.	

2.2 Live Loads

Live load intensities specific to this project shall be as follows:

All Floors	5.0 kN/m^2
Toilets	2.0 kN/m^2
Staircases	5.0 kN/m^2
Seating Bowl	4.0 kN/m^2
Non-Accessible Roofs	0.75 kN/m^2

- Any other live load shall be as pe IS-875 (Part-2):1987
- According to the Indian codes, IS-1893:2016 and IS-875 (Part-2):1987, live load reductions can be considered in the analysis and design. The proposed structure is Ground + 3 + Roof / Ground + Podium + Bowl. Hence **No Live Load** reduction is considered.

2.3 Seismic Loads

- The Seismic Loads shall be calculated as per IS-1893 (Part 1): 2016.
- Important seismic parameters shall be as follows:

Seismic Zone	IV
Zone Factor	0.24
Importance Factor (I)	1.5

Response Reduction Factor (R)	5 [RC buildings with special moment resisting frame (SMRF)]
Soil Type	As per Soil Report
Damping	5%
Percentage of imposed loads considered as seismic weight	25% if LL = <3 kN/m^2 50% if LL = >3 kN/m^2
Time period	Time period is as per IS:1893 (Part-1):2016 – cl.7.6.2

- Since the building is in Zone –IV, Vertical Earthquake shall also be considered in the design in addition to the earthquake in two horizontal lateral directions.

5. " Wind Loads

- The wind load calculation is determined as per IS-875 (Part-3): 2015
- Wind load parameters shall be as follows:

Basic wind speed	47 m/s
Risk Coefficient factor, k1	1.07 (as per table-1 of IS 875 part-III)
Terrain & Height multiplier, k2 (considering category 1)	1.13 (as per table-2 of IS 875 part-III)
Topography factor, k3	1.0 (as per IS 875 part-III, cl. 6.3.3)
Importance Factor	1.0 (as per IS 875 part-III, cl. 6.3.4)
Windward coefficient	As per IS 875 part-III
Leeward coefficient	As per IS 875 part-III

- Kd, Kc, & Ka factors shall be considered as per relevant clauses.
- Designed wind pressure and designed wind forces shall be calculated as per clause 7 of IS 875, part 3.
- It is recommended to consider dynamic wind effects in the design of the roof structure.

5.5 Temperature load

- Overall stadium structure is separated with expansion joints. Pour strips shall be provided to control the effects of shrinkage. However as per recommendation of Cl. 27.2. of IS456:2000, when the dimension exceeds ~45 m thermal effects shall be generally accounted for in the analysis.
- The chart below illustrates the average maximum day and minimum night temperatures in Patna by month:

The lowest temperatures typically occur between 4 AM and 6 AM, while the peak temperatures are generally observed around 3 PM, when the sun's heating is most intense.

5.6 Load Combinations

Load cases and Load combination shall be as follows: -

5.6.1 Load cases

1. Dead load (DL)
2. Live load (LL)
3. Response Spectrum in x- direction (SPECX)
4. Response Spectrum in y- direction (SPECY)
5. Response Spectrum in z- direction (SPECZ)
6. Wind load in x-direction (WLX)
7. Wind load in y-direction (WLY)
8. Temperature Load (TL)

- The building shall be designed for load combinations as per IS-456:2000 and IS-1893 (Part-I):2016.

5.6.2 Load Combinations

- Standard load combination as per IS-456:2000, IS-1893 (Part-I):2016 & IS-875 (Part-V):1987 shall be considered in structural analysis & design.

Design Load Combinations – Service Condition
DL
(DL+LL)
(DL±SPECX)
(DL±SPECY)
(DL±WLX)
(DL±WLY)
(DL+0.8LL±0.8SPECX)
(DL+0.8LL±0.8SPECY)
(DL+0.8LL±0.8WLX)
(DL+0.8LL±0.8WLY)
(DL±TL)

(DL+LL±TL)
(DL±SPECX±TL)
(DL±SPECY±TL)
(DL±WLX±TL)
(DL±WLY±TL)
(DL+1.0SPECX±0.3SPECY+0.3SPECZ)
(DL+1.0SPECY±0.3SPECX+0.3SPECZ)
(DL+0.8LL+0.8SPECX±0.24SPECY+0.24SPECZ)
(DL+0.8LL+0.8SPECY±0.24SPECX+0.24SPECZ)
(DL+1.0SPECX±0.3SPECY+0.3SPECZ±TL)
(DL+1.0SPECY±0.3SPECX+0.3SPECZ±TL)

Dgsign Load Combinations – Limit statg.
(1.5DL)
(1.5DL+1.5LL)
(1.5DL±1.5SPECX)
(1.5DL±1.5SPECY)
(1.5DL±1.5WLX)
(1.5DL±1.5WLY)
(1.2DL+1.2LL±1.2SPECX)
(1.2DL+1.2LL±1.2SPECY)
(1.2DL+1.2LL±1.2WLX)
(1.2DL+1.2LL±1.2WLY)
(0.9DL±1.5SPECX)
(0.9DL±1.5SPECY)
(0.9DL±1.5WLX)
(0.9DL±1.5WLY)
(1.4DL±1.4TL)

(1.4DL+1.4LL ±1.4TL)
(1.05DL+1.28LL±1.28SPECX±1.05TL)
(1.05DL+1.28LL±1.28SPECY±1.05TL)
(1.05DL+1.28LL±1.28WLX±1.05TL)
(1.05DL+1.28LL±1.28WLY±1.05TL)
(0.9DL±1.28SPECX±1.05TL)
(0.9DL±1.28SPECY±1.05TL)
(0.9DL±1.28WLX±1.05TL)
(0.9DL±1.28WLY±1.05TL)
(1.5DL+1.5SPECX±0.45SPECY±0.45SPECZ)
(1.5DL+1.5SPECY±0.45SPECX±0.45SPECZ)
(1.2DL+1.2LL+1.2SPECX±0.36SPECY±0.36SPECZ)
(1.2DL+1.2LL+1.2SPECY±0.36SPECX±0.36SPECZ)
(0.9DL+1.5SPECX±0.45SPECY±0.45SPECZ)
(0.9DL+1.5SPECY±0.45SPECX±0.45SPECZ)
(1.05DL+1.28LL+1.28SPECX±0.38SPECY±0.38SPECZ±1.05TL)
(1.05DL+1.28LL+1.28SPECY±0.38SPECX±0.38SPECZ±1.05TL)
(0.9DL+1.28SPECX±0.38SPECY±0.38SPECZ±1.05TL)
(0.9DL+1.28SPECY±0.38SPECX±0.38SPECZ±1.05TL)

3 Software for Analysis and Design of Structures

- Prevalent computer software like ETABS, SAFE, RCDC, spread sheets etc. shall be used for structural analysis and design of the structural elements.
- Drawings shall be made using CAD tools.
- A 3-dimensional structural model of a typical bay is prepared using EATBS v21 to perform structural analysis at schematic level.
- Dynamic analysis using Response spectrum method would be used to perform seismic analysis.
- P-Δ Effects are considered in the analysis and design of the members of the structure.

4 Civil Specifications of the Buildings

S.No.	Particulars	Brigf Details of provisions
	Cricket Stadium: -	
1.	Pile Foundation	450 mm Pile Dia. With 20m Depth below NGL having load carrying capacity of 74.00 T in Compression has been considered in design.
2.	Additional provision in foundation	Pile & Pile cap will be executed after completion of soil filling; hence Pile will be designed for 20m Depth below NGL level.
3.	East & West Block	Trimix finish has been considered in the floor at Plinth Level.
4.	North & South Block	Structural Slab has been Considered at Plinth Level.
5.	Structural System	RCC Framed structure with special moment resisting ductile frame
6.	Expansion joint	200 mm gap
7.	Durability Consideration	**2 Hrs. Fire Rating & Moderate** environmental exposure Condition for all RCC work is considered.
8	Material Properties	For Sub Structure – M30 For Super Structure – M30/M35 Reinforcement Grade – Fe550D
9.	Building Plinth Height	Plinth is Considered 600mm above from FGL,
10.	Internal Partition	The partition wall in between columns shall be AAC block work.
11.	Dead Load	Self-weight, Floor Finish, Sunk Load, False Ceiling Load, Service Load has been considered.
12.	Live Load	Live load shall be as per IS-875 (Part-2):1987
13.	Seismic Consideration	Earthquake **Zong-IV** with importance factor of **1.5** & Response Reduction Factor 5 has been Considered. Since the building is in Zone –IV, **Vertical Earthquake** shall also be considered in the design.
14.	Wind Parameters	Wind Speed **"7m/s** with **100-ygar** design life having open terrain (Category 1) has been Considered.
15.	Temperature Load	Overall stadium structure is separated with expansion joints. Pour strips shall be provided to control the effects of shrinkage. However as per recommendation of Cl. 27.2. of IS 456:2000, when the dimension exceeds ~45 m thermal effects shall be generally accounted for in the analysis.
16.	Additional Consideration in Design	Provision is made for additional loading of roof is considered in design.

S.No.	Particulars	Brigf Details of provisions
17.	Load Combination	Standard load combination as per IS-456:2000, IS-1893 (Part-I):2016 & IS-875 (Part-V):1987 shall be considered in structural analysis & design.

5 Design Code and References

- The main design standards proposed to be used for structural design are given below, indicating their area of application.

SR. No.	CODE	TITLE
1	IS-456:2000	Code of Practice for Plain & Reinforced Concrete
2	IS-875:1987/2015 (Part-I to V)	Code of Practice for Design loads (other than Earthquake) for Building and Structures
3	IS-13920:2016	Ductile Design and Detailing of reinforced Concrete Structures subjected to seismic forces
4	IS-1893 (Part-I) :2016	Criteria for Earthquake Resistant Design of structures (Part-1)
5	IS-4326:2013	Code of Practice for Earthquake Resistant Design and Construction of buildings
6	IS-800:2007	Code of Practice for General construction in steel
7	IS-3370 (Part-II) :2021	Concrete Structures for Retaining Aqueous Liquids - Code of Practice: Part 2 Plain and Reinforced Concrete Structures
8	IS-1786:2008	Spec for High Strength Deformed steel bars and wires for concrete reinforcement
9	IS-1905:1987	Code of Practice for Structural Use of Un-Reinforced Masonry
10	SP 34	Handbook on Concrete Reinforcement & Detailing

11	IS-1904:2021	General Requirements for Design & Construction of Foundations on Soils – Code of Practice
12	IS-2950 (Part-I) :1981	Code of Practice for Design and Construction of Raft Foundations
13	IS-2911 (Part 4) :1985	Code of Practice for Design and Construction of Pile Foundations
14	IS-2911 (Part 1/Sec 2) : 2010	Design And Construction Of Pile Foundations Part 1 Concrete Piles Section 2 Bored Cast In-Situ Concrete Piles

ISO 9001 2015 CERTIFIED

GST NO: 09ABHFA6943 N1ZU
PAN : ABHFA6943N

2023-24

ABC/23-24/RS/ 00298
TESTING DATE: 21-01-24

GEO-TECHNICAL INVESTIGATION AND SOIL EXPLORATION

TEST – REPORT ON SUB-SOIL INVESTIGATION AT THE PROPOSED SITE FOR CONSTRUCTION OF MOIN-UL-HAQ CRICKET STADIUM BUILDING IN PATNA, DISTRICT- PATNA (BIHAR).

FIELD AND LABORATORY TEST WORK CONDUCTED BY :

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ABC CONSULTANTS

-: HOUSE FOR :-

Soil / Material Testing, Geological Investigation, Quality Control & Survey of sites

Administrative Office: - C-1074/75, SECTOR – B. MAHANAGAR, LUCKNOW

ACKNOWLEDGEMENT

We are grateful to the We are grateful to Ar. Sanjay Sinha & Vijay Sinha M/s. Sky Line Infra World Pvt. Ltd. Gomti Nagar Lucknow providing an opportunity to carry out soil investigation work for proposed Construction of Moin-ul-Haq Cricket Stadium Building in Patna, District- Patna (Bihar).

ABC CONSULTANTS

(Soil Investigations and Laboratory Works)

ABC CONSULTANTS • Architect, Engineer, Surveyors • C-1074/75, Sec-B, Mahanagar, Lucknow

Authorized Signatory

INDEX

1.0 INTRODUCTION :

1.1 This report cover the results of field and Laboratory test conducted at the proposed site for Construction of Moin-ul-Haq Cricket Stadium Building in Patna, District- Patna (Bihar). These Investigations have been made to find out the allowable pressure of the soil required for the safe and economical design and execution of engineering works. The work of soil investigation was entrusted to **ABC CONSULTANTS**, **Administrative Office:- C-1074/75, SECTOR – B. MAHANAGAR, LUCKNOW**

1.2 It was decided by the concerned to conduct boring at five points up to depth of 30.0 meter each at the points marked by them at the site. Accordingly, the boring was conducted in accordance to I.S:1892–1979. Disturbed & undisturbed soil samples were collected along with conducting the standard penetration test at an interval of 1.5 meter. Or change of strata which ever met earlier starting from boring points to the termination of bore holes.

2.1.1 **UNDISTURBED SOIL SAMPLES:**

These samples have been collected by the oven dry sampler. After recovery of soil samples from the bore holes the ends of the tube have been cleaned waxed and marked properly. The depth of undisturbed soil samples have been indicated on the bore log chart as well on the Laboratory test result sheet attached. The soil samples have been collected as per I.S. 1892 – 1979.

2.1.2 **DISTURBED SOIL SAMPLES:**

The depth of the disturbed soil samples have been indicated on the bore log chart as well as on the Laboratory test result and were collected in polythene bags & properly leveled.

2.2 **STANDARD PENETRATION TEST:**

The Standard Penetration Test has been conducted in the bore log charts at the intervals of 1.5 meter as per latest IS: 2131-1981 i.e. "Method for standard penetration test for soils".

In this depth Standard split spoon sampler is driven in to the soil are required depth, with the help of drive weight of 63.5 kg falling freely under

gravity through a vertical height of 75cm. The number of blows for every 15 cms is recorded. The number of below for the first 15 cm. is neglected due to local disturbance and as a seating drive. The number of blows next 30 cm. are recorded as penetration blows 'N' of the soil at the depth. The result of the standard penetration test have been indicated on the laboratory test results sheet as well as on the bore log chart.

3.0 LABORATORY WORK

3.1 UNDISTURBED SOIL SAMPLES:

The Undisturbed soils collected from the bore holes have been tested for the following to determine the engineering properties of soil as per requirement.

a) Sieve Analysis (I.S. Code 2720 (Part IV)-2007
b) Atterberg's Limit (Via Liquid and Plastic Limit & Plasticity Index) (I.S. Code 2720 (Part V)-2007
c) Particle size analysis (I.S. Code 2720 (Part IV)-2007
d) Bulk and Dry Density (I.S. Code 2720 (Part XXIX)-2007
e) Natural Moisture Content (I.S. Code 2720 (Part II)-2010
f) Shear Parameters C & Φ (I.S. Code 2720 (Part XII & XIII)-2007
g) Consolidation Test (For determination of Cc values of clayey soil samples) (I.S. Code 2720 (Part XV)-2007
h) Specific Gravity (I.S. Code 2720 (Part III)-2007

3.2 DISTURBED SOIL SAMPLES :

The disturbed soil samples have been tested for the following parameters.

a) Sieve Analysis (I.S. Code 2720 (Part IV)-2007
b) Atterberg's Limits (I.S. Code 2720 (Part IV)-2007

The entire Laboratory has been carried out as per relevant I.S. code & has been tabulated.

4.0 SOIL CLASSIFICATION:

Soil classification has been done with the help of the soil properties obtained by laboratory test as per I.S. 1498 "Methods of classification and identification of soil for general engineering purposes".

5.0 The general nature of the soil strata met during boring in each of bore holes are indicated on the bore log charts as well as on the laboratory test results sheet. The filled-up soil met up to 0.50m depth below existing ground level. The entire Strata comprises of 'CI' silty clay of medium plasticity

STANDARD PENETRATION TEST:

The 'N' values (or SPT values recorded) during penetration test in the strata in all the bore hole No. 1, 2, 3, 4 & 5 were found vary from 8 to 48 indicate the consistency of the soil as medium.

6.0 WATER TABLE:

The depth of water table was met at about of 10.50 m depth during boring operation in bore hole at the time of soil exploration in the month of since January 2024. Water is expected 1.00 m rise in post monsoon period. Accordingly, water table is assuming 9.50 m for calculation purpose.

7.0 INTERPRETATION OF THE TEST RESULTS:

7.1 The choice of the type of foundation depends upon the safe bearing capacity, design and layout of super structure, relative economics of various alternatives and practical consideration. In case of strip footing the safe bearing capacity / allowable bearing pressure, calculation is governed by IS: 6403-1981, for shear consideration & IS: 1904-1986 & IS: 8009 (Part-I)-1976, for consideration of settlement.

7.2 SHEAR CONSIDERATION:

The modified bearing capacity formula are as below considering the shape of footing, inclination of loading, depth of embedment and effect of water table.

$$Qs = 1/F\ [C.Nc.Sc.dc.ic. + q(Nq-1)\ Sq.dq.iq. + 0.50\ \gamma'\ B.\ N\gamma.s\gamma.d\gamma.i\gamma.w']$$

Where:

Qs = Bearing capacity on shear consideration in Kg/cm^2

F = Factor of safety

γ = Unit weight of soil

C = Cohesion in Kg/cm^2

q = effective overburden pressure Kg/cm^2

B = Width of footing

w' = Correction factor for position of water table.

$N_c.N_q.N_\gamma$ = Non dimensional bearing capacity factors depends upon angle of internal friction ϕ and void ratio e

$S_c.S_q.S_\gamma$ = Shape factors

$d_c.d_q.d_\gamma$ = Depth factors

$i_c.i_q.i_\gamma$ = Inclination factors

7.3 SETTLEMENT CONSOLIDATION: (For Plastic soil)

The settlement in the plastic soil indicating some cohesion is given by the formula:

$$S = \frac{C_c}{1 + e_o} \times H \times \log_{10} \frac{P_o + \Delta P}{P_o}$$

Where:

Cc = Compression Index

H = Thickness of Plastic layer

P_o = Original Pressure at mid depth of Plastic layer

ΔP = Change in Pressure at mid depth of Plastic layer

e_o = Void ratio for pressure P_o

7.4 SETTLEMENT CONSIDERATION: (For non-Plastic soils)

The allowable bearing pressure is also to be so restricted that the anticipated settlement does not except the permissible settlement as specified in IS: 1904-1986, for a particulars type of structure and nature of soil.

8.0 COMPUTATION OF BEARING CAPACITY:

8.1 BEARING CAPACITY FROM SHEAR CRETERIA:

Bearing capacity calculations were carried out Isolated / R.C.C. Raft Foundation at depth 1.50m, 2.00m below ground level with size of footing 1.50m, 2.00m & (10.0x10.0) m However governing values of bearing capacity was found the calculations for the same are produced below:

8.1.1 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 01

1. Angle of internal friction ϕ = 5^0
2. Cohesion C = 0.39 Kg/cm^2
3. Unit weight of soil γ = 1.77 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.72
6. Dry Density = 1.61 gm/cc
7. Void ratio e_0 = 0.69
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	6.490	1.570	0.450
Local Shear failure > = 0.75	6.040	1.380	0.300
Interpolated value for e_0= 0.69	6.175	1.437	0.345

10. Water Table correction Factor w' = 1.0
11. Overburden pressure q at depth 1.50 m = 0.266 Kg/cm^2
12. Type of foundation = Isolated Foundation
13. Depth of foundation df = 1.50 m
14. Width of foundation = 1.50 m
15. Shape factors

Sc = 1.30 Sq = 1.20, Sγ = 0.80

16. Inclination factors

ic = 1.0, iq = 1.0, i_γ = 1.0

17. Depth Factors

dc = 1.218 dq & d_γ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc = 1/3 [0.2987 x6.175x1.218x1.30x1.0+0.266x (1.437-1.0) x1.20x1.0 +0.5 x1.77 x 1.50 x 0.345 x0.80x 1.0x1.0/10.0]

= 1/3 [2.921+ 0.139+ 0.037] Kg/cm²

= 1.032 Kg/cm²

8.1.2 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 01

1. Angle of internal friction ϕ = 6^0
2. Cohesion C = 0.38 Kg/cm²
3. Unit weight of soil γ = 1.79 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.72
6. Dry Density = 1.62 gm/cc
7. Void ratio e_o = 0.68
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	6.860	1.750	0.604
Local Shear failure > = 0.75	6.220	1.456	0.360
Interpolated value for e_0= 0.68	6.444	1.559	0.445

10. Water Table correction Factor w' = 1.0
11. Overburden pressure q at depth 2.00 m = 0.358 Kg/cm²
12. Type of foundation = Isolated Foundation
13. Depth of foundation df = 2.00 m
14. Width of foundation = 2.00 m

15. Shape factors

Sc = 1.30 Sq = 1.20, S_γ = 0.80

16. Inclination factors

ic = 1.0, iq = 1.0, i_γ = 1.0

17. Depth Factors

dc = 1.222 dq & d_γ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc = 1/3 [0.2975 x6.444x1.222x1.30x1.0+0.358x (1.559-1.0) x1.20x1.0 +0.5 x1.79 x 2.00 x 0.445 x0.80x 1.0x1.0/10.0]

= 1/3 [3.046+ 0.240+ 0.064] Kg/cm^2

= 1.117 Kg/cm^2

8.1.3 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 01

1. Angle of internal friction ϕ = 6^0
2. Cohesion C = 0.38 Kg/cm^2
3. Unit weight of soil γ = 1.79 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.72
6. Dry Density = 1.62 gm/cc
7. Void ratio e_o = 0.68
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	6.860	1.750	0.604
Local Shear failure > = 0.75	6.220	1.456	0.360
Interpolated value for e_0= 0.68	6.444	1.559	0.445

10. Water Table correction Factor w' = 0.875
11. Overburden pressure q at depth 2.00 m = 0.358 Kg/cm^2
12. Type of foundation = R.C.C. raft foundation

13. Depth of foundation df = 2.00 m

14. Width of foundation = (10.0x10.0) m

15. Shape factors

Sc = 1.20 Sq = 1.20, S_γ = 0.60

16. Inclination factors

ic = 1.0, iq = 1.0, i_γ = 1.0

17. Depth Factors

dc = 1.044 dq & d_γ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc = 1/3[0.2975x6.444x1.044.x1.20x1.0+0.358x (1.559- 1.0) x1.20x1.0 +0.5 x1.79 x 10.00 x 0.445 x0.60x 1.0x0.875/10.0]

= 1/3 [2.402+ 0.240+ 0.209] Kg/cm^2

= 0.950 Kg/cm^2

8.2.0 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 1.50 m Depth

Description	Calculation
Thickness of compressible layer	2.25
Mid depth of clay layer	1.125
Pressure at foundation level	0.266
Po original pressure at mid depth	0.465
Net safe bearing capacity	1.032
Change pressure at foundation level	0.767
Influence factor	0.688
Change pressure at mid layer	0.528
P0+Δ P/ P0	2.135
Log P0+Δ P/ P0	0.329

Void ratio e_o	0.69
Compression Index Cc	0.154
Settlement	6.75
Settlement after applying rigidity & depth factor	3.943

The settlement is less than permissible limit 5.0 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 10.32 t/m2.

8.2.1 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 2.00 m Depth

Description	**Calculation**
Thickness of compressible layer	3.00
Mid depth of clay layer	1.50
Pressure at foundation level	0.358
Po original pressure at mid depth	0.627
Net safe bearing capacity	1.117
Change pressure at foundation level	0.759
Influence factor	0.688
Change pressure at mid layer	0.522
P0+Δ P/ P0	1.833
Log P0+Δ P/ P0	0.263
Void ratio e_o	0.68
Compression Index Cc	0.151
Settlement	7.10
Settlement after applying rigidity & depth factor	4.146

The settlement is less than permissible limit 5.0 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 11.17 t/m2.

8.2.2 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 2.00 m Depth

Description	Calculation
Thickness of compressible layer	15.00
Mid depth of clay layer	7.50
Pressure at foundation level	0.358
Po original pressure at mid depth	1.701
Net safe bearing capacity	0.950
Change pressure at foundation level	0.592
Influence factor	0.688
Change pressure at mid layer	0.408
P0+Δ P/ P0	1.240
Log P0+Δ P/ P0	0.094
Void ratio e_o	0.68
Compression Index Cc	0.151
Settlement	12.68
Settlement after applying rigidity & depth factor	7.405

The settlement is less than permissible limit 10.0 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 9.50 t/m2.

9.0 SAFE LOAD FROM ULTIMATE LOAD CAPACITY:

The Ultimate bearing capacity of pile can be calculated from soil properties as per IS: 2911 (Part-I /Sec 2)-2010. The soil properties required are strength properties, cohesion, angle of internal friction and soil density. If these properties are not available directly from laboratory and field tests, they me be indirectly obtained from in situ penetration test data.

STATIC FORMULA: -

(A) **Clayey soil: -**

The ultimate bearing capacity of pile in cohesive soil may be worked out from the following formula: -

$$Qu = Ap.\ Nc.\ Cp. + \sum_{i=1}^{n} \alpha_i.\ C_i.\ A_{si}$$

Where

Qu = Ultimate bearing capacity of pile (Kg.).

Ap = Cross sectional area of pile stem at toe Level (Cm^2).

Nc = Bearing Capacity Factor Usually taken as (9.0).

Cp = Average Cohesion at pile tip (Kg/ Cm^2).

α_i = Adhesion factor = 1.0

C_i = Average Cohesion throughout the length of pile (Kg/ Cm^2).

A_{si} = Surface area of the pile shaft (Cm^2).

(B) **For Sandy Soil: -**

The ultimate bearing capacity of pile in non-cohesive soil may be worked out from the following formula: -

$$Qu = Ap\,(0.50.\gamma.D.Nr. + P_D.Nq) + \sum_{i=1}^{n} K.\,P_{D\,i}.\tan\delta\,Asi$$

Where

Ap = Cross-sectional area of pile toe in cm^2.

D = Stem diameter in cm.

γ = Effective unite weight of soil at pile toe Kgf/Cm^3.

P_D = Effective over burden pressure at pile toe Kgf/Cm^2.

N q& Nr = Bearing Capacity Factors depending upon the angle of internal friction Φ at toe.

K = Earth pressure coefficient

δ = Angle of wall friction (may be taken equal to the angle of internal friction of soil.

$\sum_{i=1}^{n}$ = Summation for n layers which piles is installed

$P_{D\,i}$ = Effective over burden pressure in Kgf/Cm^2 for the i^{th} layer where i various from 1 to n.

Asi = Surface area of the pile stem in Cm^2 in the i^{th} layer where i various from 1 to n.

9.01 Calculation

The soil strata comprise of cohesion soil the safe load may be estimated using clayey soil formula and tabulated below.

Length of pile = 15.0m
Dia of pile = 0.50m

Depth (m)	Ap (cm²)	Nc	c_p (kg/cm²)	α	c_i (kg/cm²)	As /Asi(cm²)	D (cm)	Y	P_d	Nq	Nr	K	P_{di}	ø	Qu (Kg)	Qu (Tone)	F.O.C.	Safe load on pile (tone)
1.50	1962.5	9	0.39	1	0.39	27475	50.0	-	-	-	-	-	-	-	17603.63	17.60	2.50	7.04
1.50	1962.5	9	0.38	1	0.38	27475	50.0	-	-	-	-	-	-	-	17152.25	17.15	2.50	6.86
1.50	1962.5	9	0.46	1	0.46	27475	50.0	-	-	-	-	-	-	-	20763.25	20.76	2.50	8.31
1.50	1962.5	9	0.40	1	0.40	27475	50.0	-	-	-	-	-	-	-	18055.00	18.06	2.50	7.22
1.50	1962.5	9	0.41	1	0.41	27475	50.0	-	-	-	-	-	-	-	18506.38	18.51	2.50	7.40
1.50	1962.5	9	0.36	1	0.36	27475	50.0	-	-	-	-	-	-	-	16249.50	16.25	2.50	6.50
1.50	1962.5	9	0.32	1	0.32	27475	50.0	-	-	-	-	-	-	-	14444.00	14.44	2.50	5.78
1.50	1962.5	9	0.38	1	0.38	27475	50.0	-	-	-	-	-	-	-	17152.25	17.15	2.50	6.86
1.50	1962.5	9	0.39	1	0.39	27475	50.0	-	-	-	-	-	-	-	17603.63	17.60	2.50	7.04
1.50	1962.5	9	0.40	1	0.40	27475	50.0	-	-	-	-	-	-	-	18055.00	18.06	2.50	7.22
Total length= 15.0m																Total Safe load		70.23

9.02 Calculation

The soil strata comprise of cohesion soil the safe load may be estimated using clayey soil formula and tabulated below.

Length of pile = 18.0m
Dia of pile = 0.60m

Depth (m)	Ap (cm²)	Nc	c_p (kg/cm²)	α	c_i (kg/cm²)	As /Asi(cm²)	D (cm)	Y	P_d	Nq	Nr	K	P_{di}	ø	Qu (Kg)	Qu (Tone)	F.O.C.	Safe load on pile (tone)
1.50	1962.5	9	0.39	1	0.39	27475	50.0	-	-	-	-	-	-	-	17603.63	17.60	2.50	7.04
1.50	1962.5	9	0.38	1	0.38	27475	50.0	-	-	-	-	-	-	-	17152.25	17.15	2.50	6.86
1.50	1962.5	9	0.46	1	0.46	27475	50.0	-	-	-	-	-	-	-	20763.25	20.76	2.50	8.31
1.50	1962.5	9	0.40	1	0.40	27475	50.0	-	-	-	-	-	-	-	18055.00	18.06	2.50	7.22
1.50	1962.5	9	0.41	1	0.41	27475	50.0	-	-	-	-	-	-	-	18506.38	18.51	2.50	7.40
1.50	1962.5	9	0.36	1	0.36	27475	50.0	-	-	-	-	-	-	-	16249.50	16.25	2.50	6.50
1.50	1962.5	9	0.32	1	0.32	27475	50.0	-	-	-	-	-	-	-	14444.00	14.44	2.50	5.78
1.50	1962.5	9	0.38	1	0.38	27475	50.0	-	-	-	-	-	-	-	17152.25	17.15	2.50	6.86
1.50	1962.5	9	0.39	1	0.39	27475	50.0	-	-	-	-	-	-	-	17603.63	17.60	2.50	7.04
1.50	1962.5	9	0.40	1	0.40	27475	50.0	-	-	-	-	-	-	-	18055.00	18.06	2.50	7.22
1.50	1962.5	9	0.34	1	0.34	27475	60.0	-	-	-	-	-	-	-	15346.75	15.35	2.50	6.14
1.50	1962.5	9	0.41	1	0.41	27475	60.0	-	-	-	-	-	-	-	18506.38	18.51	2.50	7.40
Total length= 18.0m																Total Safe load		83.78

9.0 RECOMMENDATION:

9.1 The soil strata are effective zone comprises of cohesive layers. The design load has therefore to ensure safety against failure due to shear failure.

9.2 The water table was met up to 10.50 m depth below existing ground level. Water is expected 1.00 m rise in post monsoon period. Accordingly, water table is assuming 9.50 m for calculation purpose.

9.3 The filled-up soil met maximum up to 0.50m depth.

9.4 The values of net safe bearing capacity for Isolated / R.C.C. Raft foundation below existing ground level are tabulated below: -

S. L. No.	Depth (m)	Type of foundation	Width of foundation (m)	Allowable Bearing Capacity	
				Kg/cm^2	T/m^2
1	1.50	Isolated foundation	1.50	1.032	10.32
2			2.00	1.117	11.17
3	2.00	R.C.C. Raft foundation	(10.0x10.0)	0.950	9.50

If above values do not suit the designer alternately pile foundation may be provided at this site.

9.5 The safe load on pile is calculated as per I.S. 2911(Part III)-1980. As per Static formula calculations are assumed for design and tabulated below

Length of Pile(m)	Dia of Pile (cm)	Safe Load On Pile (Tone)
15.00	50.0	70.23
18.00	50.0	83.78

Final design diameter & length of pile etc. will depend on incoming loads and capacity of piles, as determine by load test at site.

The above recommendations are based on the field investigation data and the laboratory test result of the sample collected from site and our experience in this regard.

If the actual sub – soil condition during excavation for foundation differs from that has been reported a reference should be made to us for suggestion

ABC CONSULTANTS

(Soil Investigations and Laboratory Works)

Authorized Signatory

ABC
CONSULTANTS

DESIGN BASIS REPORT

MEP

International Cricket Stadium - Patna, Bihar

BIHAR CRICKET ASSOCIATION

AFFILIATED TO

THE BOARD OF CONTROL FOR CRICKET IN INDIA

Contents

1. PROJECT BRIEF

The proposed International Cricket Stadium is located in Patna in the Bihar, Northen state of India. The stadium is designed to accommodate 30,000 Spectators. The stadium consists of Following Levels & Major infrastructure.

- East and West block has Spectator seating, spectator facilities and Broadcast facilities.
- North block have media facilities, broadcast facilities and ground resource facilities. South block have facilities for VIP, Area for players and match officials and have camera platform on terrace.

2. Major MEP Infrastructure Summary

SR. NO	EQUIPMENT DESCRIPTION	CAPACITY	UNIT	QUANTITY	TYPE	REMARKS
I	**HVAC System.**					
	VRF System	1523	HP	-	Heating + Cooling Type	
	DX System	23	TR	-	Cooling Only type	Working + Standby Configuration
	Kitchen Ventilation					As per Facility Design Requirement
I	**Electrical Substation**					
1.1	Total Demand Load (kW)	1941	kW	-	-	As per the Current Plans
1.2	Selected Transformer	1250	kVA	2#Nos	Oil Cooled	
1.3	Selected DGs	750	kVA	2#Nos	Prime Rated	
		625	kVA	2#Nos	Prime Rated	
		400	kVA	2#Nos		Provision only

SR. NO	EQUIPMENT DESCRIPTION	CAPACITY	UNIT	QUANTITY	TYPE	REMARKS
		250	KVA	1#Nos	Prime Rated	
II	**Electric Geysers**	60	Nos		For Players' Lounge only	
III	**PHE System**					
1.1	Sewage Treatment Plant - STP	300	KL	1#Nos	SBR Type	
a	**WATER TANKS**					
1.1	Fire Fighting-UG	200	KL	2		As per NBC-2016
1.3	Fire Fighting-OH	20	KL	2		As per NBC-2016
1.4	Domestic-UG	125	KL	1		1.0 days of storage combined
1.5	Irrigation Main pitch	150	KL	1		
1.6	Irrigation Practice pitch	100	KL	1		
1.7	Raw Water -UG	125	KL	1		
1.8	Flushing	125	KL	2		1.0 days of storage
1.9	Rainwater	200	KL	2		

3. HEATING, VENTILATION & AIR CONDITIONING

3.1 DESIGN APPROACH:

The Section outlines HVAC system design parameters, system selections and extent of provisions for the project. The air conditioning will be designed to maintain specified temperature, humidity, and supply of outdoor air within occupied spaces.

All Air conditioning & Ventilation systems shall be in conformity with the codes and standards mentioned in ASHRAE, ISHARE Design Data book 2017, and ECBC 2017 for following purpose:

- To create a comfortable and safe HVAC environment for the development is a Prime objective.
- To maintain good indoor environment in terms of temperature and Air movement & Air Quality.
- To create a relatively quiet and low vibration control AC system.
- To make the HVAC system energy efficient eco-friendly & easily maintainable.

The scope of HVAC work shall include complete design engineering & calculation, approval from statutory authority wherever required, approval from the Engineer- in-charge / architect / consultant, supply, installation, testing, commissioning, TAB (Testing, Adjusting, and Balancing by third party), & handing over in satisfactory working condition. Specification & list of makes given in the tender shall be followed. The HVAC part of MEP design objective is to achieve a sustainable building that are energy and resource efficient and promote a healthier environment for building occupants & also to achieve GRIHA 3 STAR RATING Certification. Capacity will increase in the design stage. DBR are minimum.

3.2 CODES & STANDARDS

- ISHRAE Design Data book 2017
- ECBC 2017
- NBC 2016
- ASHRAE – 62.1 (2022) Ventilation for acceptable indoor air quantity
- ASHRAE – 90.1 (2022) Energy standard for buildings except low-rise residential buildings
- ASHRAE -55 (2023) for thermal comforts
- SMACNA (latest edition) – Sheet Metal and Air Conditioning Contractors National Association
- AHRI – Air conditioning, Heating and Refrigeration Institute
- NFPA 96 – For Kitchen related HVAC systems

- AMCA- Air Movement & Control Association- (Latest Edition)
- UL standards -For Fire Dampers - (Latest Edition)
- ASHRAE BOOK OF FUNDAMENTALS for swimming Pool Design
- GRIHA latest Guidelines

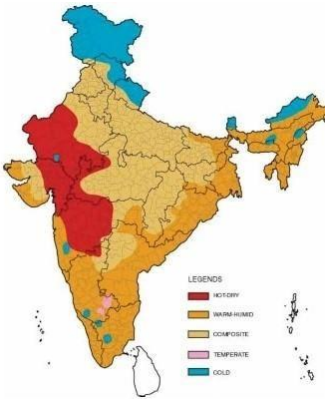
3.3 HVAC SYSTEM DESIGN

3.3.1 OUTDOOR DESIGN CONDITIONS

- The site is located in Patna city Bihar State in India.
- Coordinates – 26.740'N 83.450'E; Elevation – 79m

3.3.2 WEATHER DESIGN DATA

The Location Patna comes under composite zone as per ECBC 2017 and ISHRAE 2017 Databook. However, the design conditions are complex as mentioned below.



Picture 1 ECBC Climate Zone Map

Following is the data for peak design considerations from ISHRAE DESIGN DATABOOK AND EN CLIMATE DATA. Design Weather conditions are derived from complex conditions considering actual weather scenarios in recent days.

The selected weather conditions for design are as mentioned below.

PATNA WEATHER DESIGN CONDITIONS				
Parameter	DB (Deg.F)	WB (Deg.F)	Source	Remark
Summer	105.5	84.5	ASHRAE METEO	Complex/As per Current Scenario
Monsoon	87.0	84.49	ASHRAE METEO	
Winter	45.7	40.96	ASHRAE METEO	

3.3.3 INDOOR DESIGN CONDITIONS

Indoor Design considitons will be as per ASHRAE 55 thermal confort standard. Following are the design conditions of General areas.

Sr No	Areas	Design Temperature	Design RH	Occupancy	Minimum ventilation
1	Office Areas	23°C±2°C	50%±10%	As per Architectural Drawings	As per ASHRAE 62.1 / ISHRAE Design Databook 2017
2	Changing Rooms	24°C±2°C	50%±10%		
3	Toilets	Exhaust			
4	Locker Rooms	Exhaust & Makeup			
5	Staff Rooms	24°C±2°C	50%±10%		
6	Lounges	24°C±2°C	50%±10%		
7	VIP areas	23°C±2°C	50%±10%		
8	Lift Lobbies	24°C±2°C	50%±10%		
9	Entrance Lobbies	24°C±2°C	50%±10%		
10	Player Rooms	24°C±2°C	50%±10%		
11	Utility Rooms				
12	IT/ELV Rooms	22°C±2°C	50%±10%		
13	Server Rooms	22°C±2°C	50%±10%		
14	Kitchen	As per Facility consultant Requirement			
15	Restaurant	23°C±2°C	50%±10%		
16	Media Dining Areas	24°C±2°C	50%±10%		

Note –

- Server Rooms, IT Room, Fire Control Room will be provided with DX Units/VRF units.
- During Heating Mode , Design Temperature shall be 2°C lower than summer design conditions mentioned above.

3.3.4 COOLING & HEATING DEMAND CALCULATIONS

The U Values for the calculation will be considered as per architetural inputs, following values are considered due to unavailability of data at this stage.

Sr No	Parameter	Value	Unit	Remark
1	Glass SHGC	0.33	Ratio	Considered Due to unavailability of Data
2	Glass U Value	0.56	(Btu/ (hr ft2 oF))	
3	Wall	0.33	(Btu/ (hr ft2 oF))	
4	Partitions	0.20	(Btu/ (hr ft2 oF))	
5	Ceiling	0.20	(Btu/ (hr ft2 oF))	
6	Floor	0.15	(Btu/ (hr ft2 oF))	
7	Insulated Roof	0.15	(Btu/ (hr ft2 oF))	

Double Glaze type Glass is considered for the calculation of Heating & Cooling Loads. Contractor shall design the system & select U values in accordance with architectural specifications and in compliance with NBC 2016 , ECBC 2017 and GRIHA Requirements.

Following is the basis for load calculations.

Sr No	Particular	Considerations	Reference
1	Weather Data	As Mentioned Above	En Climate / ISHRAE
2	Heat Gain	As Per Application	ISHRAE Table 1.24
3	Lighting Load	As Mentioned Below	
4	Equipment Load	As Mentioned Below	
5	Sensible Fos	10%	
6	Latent Fos	7%	
7	ADP	52 F	
8	Fresh Air	As Per Application	ASHRAE 62.1

Following are the considerations for Occupants Load

Sr No	Area / Zone	Occupancy	Unit
1	VIP Areas / Corporate Boxes & Lounges	80	Sqf / Person
2	Corridors & Movement Areas	100	Sqf / Person

6	Office Areas	50	Sqf / Person
7	VIP Lounge	80	SQF / Person
8	Other Air-Conditioned Areas	80	SQF / Person

Following are the considerations for Lighting Load

Sr No	Area / Zone	Lighting Load	Unit
1	VIP Areas / Corporate Boxes & Lounges	1	W/SQF
2	Corridors & Movement Areas	0.7	W/SQF
3	Office Areas	0.7	W/SQF
4	Other Air-Conditioned Areas	0.7	W/SQF

Following are the considerations for Equipment Load

Sr No	Area / Zone	Equipment Load	Unit
1	VIP Areas / Corporate Boxes & Lounges	1	W/SQF
2	Corridors & Movement Areas	0.5	W/SQF
3	Office Areas	1	W/SQF
4	Other Air-Conditioned Areas	1	W/SQF

Note: Above are the considerations. Values has to be verified.

3.4 HEAT LOAD SUMMARY SHEET.

Following is the load summary based on above considerations.

There are two different load summaries as follows

Sr No	Stand	Cooling Load (HP)
1	North Pavilion	410
2	South Pavilion	490
3	North Stand	185
4	South Stand	192
5	Hotel	204
6	Dining Hall	42
Total Of Above		**1523**

Note: Above load does not contain TFA units Load. Hence the system selection may be on Higher side & as mentioned in below sections.

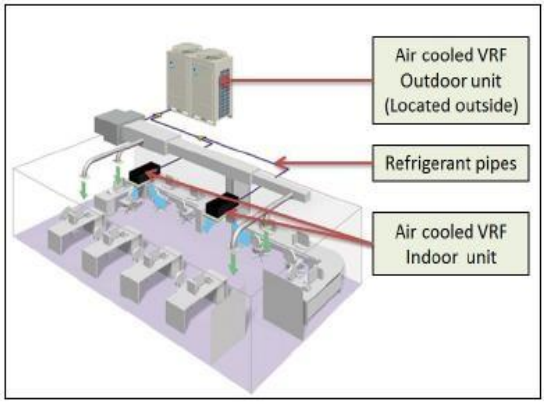
3.5 HVAC DESIGN PRINCIPLE

- The objective of HVAC System Design is to ensure proper thermal comfort & Indoor Air Quality as per design standard mentioned above along with Energy Efficiency, Flexibility of Operation, Cost Optimization, BMS Compatibility and GRIHA Rating Compliances.

- The ratings and capacities of various equipment are indicative and subject to upgradation / revision during detailed designing stage as per final architectural layouts. However, VRV / VRF capacity specified in the tender shall be minimum & any enhancement in capacity if required shall be done as per the engineer in charge without any extra cost.
- Equipment sizing of HVAC system shall take into account factors such as geographical location, climatic conditions etc.
- The cooling requirements shall be achieved through an efficient air conditioning system having VRV / VRF outdoor & indoor units.
- Winter heating shall be inbuilt feature of VRV / VRF System.
- Fresh Air Supply & Smoke Extraction in case of fire, from Passage / Fire Escape Route / Waiting Area / Any high occupancy area or others shall be provided. Smoke extraction to be done by installing the fan at terrace level & preferably using internal/external shafts in the building. Fresh air supply shall be from shafts. Fresh air grills shall be provided at floor level in individual area & smoke extraction grills at ceiling level.
- In the case of Air-Cooled Package / Ductable / Precision Units the Outdoor Unit shall be air cooled. This system shall be cooling only type.

3.6 HVAC SYSTEM SELECTION.

As per the above load calculation, we have proposed VRF System. In VRF system one outdoor section connect to several evaporators. VRF systems continually adjust the flow of refrigerant to each indoor evaporator. The control is achieved by continually varying the flow of refrigerant through a pulse modulating valve (PMV) whose opening is determined by the microprocessor receiving information from the thermistor sensors in each indoor unit. The indoor units are linked by a control wire to the outdoor unit which responds to the demand from the indoor units by varying VRF systems promise a more energy-efficient strategy (estimates range from 11% to 17% less energy compared to conventional DX units). Different IDU options can be used like Hi-wall unit, cassette unit, concealed unit, and ducted type units and so on. This can help in blending the air conditioning system with the appropriate interior design of the space.



Picture 2 Typical VRF System

Advantages of VRF System

- VRF system provides superior comfort, energy efficiency, easy design, easy installation & maintenance.
- Choice of designer indoor units: Different IDU options can be used like Hi- wall unit, cassette unit, concealed unit, ducted, floor mounted, TFA unit and so on. This can help in blending the air conditioning system with the appropriate interior design of the space.
- Operation is very simple, probably as simple as operating a split air conditioning system and hence no separate manpower is required for operating the system.
- Individual control for cabin.
- Use of minimal outdoor units ensures that valuable space is saved.
- Saving on electricity bills.
- Compatibility with BMS system.
- Compatibility with AHU.
- Minimal noise & vibration.
- Fresh air provision.
- Refrigerant used (R410A) is eco-friendly.
- Operates in extreme ambient temperature.

DX System will be proposed for

- Server/IT room
- UPS room

Considering the need for Heating as well in Winter , It is proposed to Have heating + Cooling type VRF outdoor units (Heat Pump Series)

3.7 INDOOR AIR QUALITY

3.7.1 MINIMUM OUTDOOR AIRLFLOW RATES

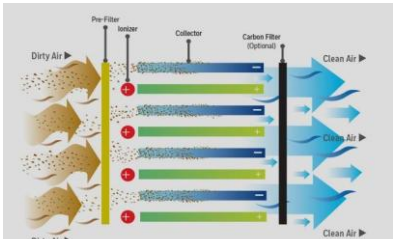
The Fresh Air calculation will be strictly followed Ashrae 62.1 and ISHRAE table 1.53 latest version. Separate summary sheet is attached as annexure for fresh air calculation. The methods followed are

- by People and by Area
- by Area
- by Air Changes per Hour

The Actual values of Fresh Air are dependent on Application of that specific room in compliance with ASHRAE 62.1 and ISHRAE design Databook table 1.53.

3.7.1 USE OF ELECTRONIC AIR CLEANERS.

The electronic air cleaner or electrostatic precipitator is filter that works on Air Ionization principal to remove solid or small liquid air impuritis.

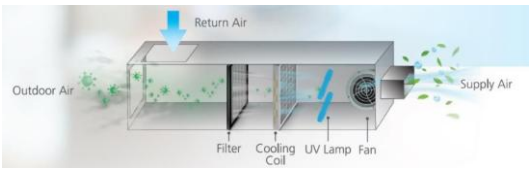


ESP Working Principle

3.7.2 ULTRAVIOLET GERMICIDAL IRRADIATION (UVGI) LAMPS

The use of UVGI on coils is proposed for all Floor Mounted Air Handling Units over coil.

For UVGI, the required average irradiance for a typical in-duct system is on the order of 1000 to 10,000 µW/cm2, but it could be higher or lower depending on the application requirements as per ASHRAE Handbook-2019



The use of Coil UVGI will facilitate

- Reduced chances of bacterial growth on coil surface
- Reduced Bacterial contamination in Airstream.
- Disinfected filter internal surface.

The intensity of UVGI shall be suitable for Sensitive virus like Coronavirus. As per NCBI(US), "The upper limit determined for the log-reduction dose (90% reduction) is approximately 10.6 mJ/cm2 (median), while the true value is probably only 3.7 mJ/cm2 (median)." This Valve can be achieved depending on duct sizes, lamp wattage and number of passes. A detailed selection will be carried out to ensure the same. Following is the approximate selection for typical duct size.

Coronavirus (SARS)								
Pass number	1	2	3	4	5	6	7	8
Min:	97.26 %	99.92 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
Average:	99.37 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %
Average Log:	2	4	6	8	11	13	15	>16

3.7.3 OTHER PROVISIONS FOR IAQ

- IAQ Monitor (Indoor Air Quality Monitor) shall be installed in each AHU Room to monitor CO2 Level, O2 Level, PM1, PM2.5, PM10, VOC level along with temperature & RH in designated areas.
- Pre filters of MERV 8 rating shall be installed in all the AHU / FCU as detailed above.
- Fine filters of MERV 13 Rating shall also be installed in FM-AHU.
- All AHU shall be provided with one set of commissioning Pre Filters which shall be replaced with actual pre filter after testing and commissioning.
- All the floor mounted AHU will have UL certified and UL listed UVC Emitters inside the AHU by providing 600 mm length extra section in AHU.
- Duct Mounted UVGI shall also be provided for designated areas.

3.8 VENTILATION SYSTEM

3.8.1 TOILET VENTILATION

Toilet ventilation shall be provided with mechanical ventilation system. It shall be designed as per 10 ACPH with reference to ASHRAE 62.2 / NBC Vol 2 part 8, Section 3. All the toilets in the building will have centralized ventilation fan of Cabinet type at terrace level. The toilet which are not having centralized system will be provided with In-line/Cabinet Fans.

3.8.2 GENERAL & UTILITY ROOM VENTILATION

All the Plant rooms like Firefighting, Plumbing shall be provided with mechanical ventilation system as per ASHRAE 62.2 / NBC Vol 2 part 8, Section 3. The system shall consist of fans, fresh air grille with filters, air distribution system with grilles, electrical panel, power cabling, control wiring and earthing. Fresh air shall be drawn from outside & shall be supplied to these areas by means of ducts and grilles. Ventilation fan & duct shall be provided for exhausting equivalent amount of air.

Recommended Rate Of Air Circulation For Different Areas (Clause 11.3)		
Nbc-2016-Table No-11		
Sr.No	**Application**	**Air Changes Per Hour**
1	Changing Rooms	06-10.
2	Laundries	10-30.
3	Stores	03-06.
4	Stp Rooms	30. MIN
5	Toilets	06-10.
6	Utility Rooms	15-30.

3.8.3 KITCHEN VENTILATION

Kitchen ventilation will depend on exhaust hood systems designed by kitchen consultant, but generally will be 40- 60 ACPH. Double skin Ecology units with electronic scrubbers (Dry type) will be provided for kitchen exhaust ducting. Kitchen exhaust ducting will be MS CRCA ducting with welding joints. The kitchen shall be maintained in Negative pressures to avoid the smell travelling in adjacent areas. It will be done through providing exhaust fan as per requirement from Kitchen consultant, Raw fresh air (40% of Exhaust capacity) and Treated chilled Fresh air for spot cooling (45% of Exhaust capacity). This will enable us to maintain the kitchen area temperature lower for comfort of Kitchen occupants while working.

The equipment selection shall be done based on relevant standards. For Fan selection in ECOLOGY Unit, the NFPA 96 compliance shall be followed i.e., the fan shall be compliant to UL762, or equivalent certification shall be there. For TFA unit selection, the unit shall be compliant with either EUROVENT or AHRI requirements.

Similarly, the ancillary work material and methodology shall be selected as per NFPA 96, which defines the installation method requirements for the commercial kitchen.

Due to unavailability of Facility consultant data, the provision for Kitchen Ventilation is considered at 60 ACPH for Equipment selection. OTHER AREA VENTILATION

All other area Ventilation shall be as per relevant standards

- NBC 2016
- ISHRAE Design Databook 2017
- ASHRAE Handbook of Applications 2019

3.9 SHEET METAL DUCTING & INSULATION

3.9.1 SHEET METAL DUCTING

The ducting will be of galvanised sheet steel conforming to SMACNA standards.120 GSM Factory Fabricated Ducting will be used for Air Conditioning as well as Ventilation Requirement. All AC open area ducting will have 9mm thick Class 0 nitrile rubber Insulation. All AC Non-Exposed ducts with ducted return or the non- air-conditioned areas where air conditioning duct is passing will be used with 19 mm Class 0 nitrile rubber Insulation. The ducting insulation will be applied from inside for all exposed ducts. The acoustic insulation will be used for supply and return air ducts of air handling units. The length of duct to be covered under acoustic insulation will be minimum 3m for supply air duct after plenum. The design velocities/friction loss limits will be:

Alternatively, Preinsulated ducts are proposed which will be of minimum 20mm thick PUF with Aluminium embossing on both sides. The thickness of PUF & AL Embossing will change based on location of Installation i.e. internal or external.

Parameter	Value
Maximum Velocity – Air Conditioning Duct	2000 FPM

Parameter	Value
Maximum Velocity – Ventilation Duct	2000 FPM
Maximum Velocity – Pressurization Duct	3000 FPM
Maximum Friction – Air-Conditioning Duct	0.10" WG / 100 Ft Run
Maximum Velocity At Supply Air Outlet	500 FPM (Except Pressurization)
	1000 FPM (For Pressurization)

STP ventilation duct shall be with 180 GSM coating.

3.9.1 PREINSULATED DUCTING

The PIR Ducting shall be used in specified areas only. 'Green' PIR (Poly-Iso-cyanurate) Panels coated with a Lacquer based 80 microns Embossed Aluminium foil on both sides having Density not less than 45 kg/m3 ± 3 and thermal Conductivity not more than 0.019 W/(mK). Panels will be closed cell exceeding 95%, CFC, HCFC, HFC free and Certified with Class 'I', Class 'O', Class 'A', Class 'P' & UL 94 fire ratings. The toxicity Index will be below 5.5 & Oxygen index not be more than 26%. All the ducts will be supported by wire hangers only.

3.10 ENERGY EFFICIENCY:

Energy efficiency becomes critical when operating cost is considered. The system power requirement should be lowest at different loading scenarios. Following measures shall be considered while selecting complete system. The energy monitoring is also similarly need to be considered for measuring, monitoring, Billing while operation. This recorded data will help Facility team to judge near future demands & plan for the same.

3.10.1 VRF SYSTEM

- VRF system is proposed with Centralized control system to monitor & control the units.
- Zone wise Power consumption will be monitored
- All Indoor Unit Fans will be DC with modulating step control speed.
- Outdoor unit Fan will be with Inverter control.
- Compressor unit will be with high COP rating in compliance with ECBC 2017.

3.10.2 AIR HANDLING UNITS

- All Air Handling units will be EUROVENT certified.
- Motors will be with minimum efficiency of IE3.
- Fan will be Plug type centrifugal fan with Variable Frequency Drive.
- For UVGI, the required average irradiance for a typical in-duct system is on the order of 1000 to 10,000 μW/cm2, but it could be higher or lower depending on the application requirements as per ASHRAE Handbook-2019.

- High efficiency filtration system for Air Handling units.

3.10.3 FANS / BLOWER

- All Regular Working Units will be with minimum IE3 Motor efficiency.
- Fan Efficiency will be more than 70 %.
- All Fans will be with Statically & Dynamically balanced Rotors.

3.11 INTERFACE WITH OTHER SERVICES

3.11.1 ELECTRICAL

Power Supply for all equipment will be provided with Local HVAC DB. Dedicated feeders will be arranged from Mail LT panel to major areas like Outdoor Service areas where majorly ODUs are located.

3.11.2 PLUMBING

AHU room shall be provided with water supply point to facilitate filter cleaning. Drain point shall be provided in each AHU Room. Drain from Individual units will be connected to nearest drain point from PHE lines.

3.11.3 FIRE ALARM SYSTEM

All AHUs shall be interlocked with the fire alarm system to switch off in case of fire. Only designated equipment will be continued with power supply in case of emergency.

4. PUBLIC HEALTH ENGINEERING

4.1 DESIGN APPROACH

The plumbing design for the development is designed keeping in mind below parameters: -

Adequate and equal pressure of cold water will be maintained in bathrooms, Toilets and urinals, common toilets, and other designated areas. Water Efficient Plumbing Low flow - fixtures will be considered.

The primary source of water supply is considered from the Local Municipal authority/Bore-well. In case of non-availability of sufficient water supply for the project Tanker water supply should be provided as alternate source of water supply. Water treatment plant is proposed to use tanker/bore well water for domestic purpose in case of scarcity.

The total water tanks capacity will be of 1.0 days of match day requirement for stadium which will support more than 2.0 days demand for non-match day scenario.

Domestic and flushing water supply for entire project will be through Stainless Steel pipes and fittings of grade 316L as per IS 6911:2017 and conforming to EN-10312 standards complete with press type fitting (fitting shall be paid for separately) i/c fixing of the pipe with clamps at 1.00 m spacing including cutting and making good the walls including testing of joints complete as per direction of Engineer-in-charge. (The pipe length inserted in the fitting shall not be measured for payment)

All drainage will be taken to STP proposed location. It will be then treated and reused for Flushing, gardening purpose.

4.2 CODES & STANDARDS

- NBC 2016
- BIS relevant codes
- IS:1172 2007 Code of Basic Requirements for Water Supply, Drainage and Sanitation
- IS:1742 2007 Code of practice for building drainage
- IS:2064 2007 Code of practice for selection, installation and maintenance of sanitary appliances
- IS:2065 2000 Code of practice for water supply in buildings
- IS:5329 2007 Code of practice for sanitary pipe work above ground for building
- IS:7558 2001 Code of practice for domestic hot water installations
- IS:10500 2012 Drinking Water
- IS:12251 2004 Code of practice for drainage of building basement
- IS:12976 2006 Solar water heating systems- Code of practice
- IS: 1742 – 1983 Code of practice for Building Drainage

- IS :2065 -1983 Code of practice for water supply in buildings
- CPHEEO Manual on Water Supply and treatment
- American Society of Plumbing Engineers (ASPE), Design Data Book Volume I to IV
- Uniform Plumbing code (UPC)-2008
- Good Engineering Practices

4.3 SCOPE OF WORK

Plumbing, Part of MEP design objective, is to achieve a sustainable building that is energy and resource efficient and promote a healthier environment for building occupants & also to achieve **GRIHA 3 STAR RATING** Certification.

The scope shall include the followings services.

- Source of water supply.
- Water treatment process from raw water to potable water.
- Storage Tanks of raw water, domestic water, flushing water, RO water, fire water, irrigation water & solar hot water (20% minimum of total hot water requirement).
- Water from the domestic water storage tank will be pumped to main building
- overhead water tank through multiple sets of VFD pumps, where one will be working & other will be on standby.
- Internal water supply including Hot & Cold.
- Water Supply / Irrigation System to Cricket Ground / Outfield
- Sanitary ware & water conservation using low flow Fixtures fittings.
- Hot water supply System.
- Internal soil, waste and rain water pipes disposal to 1st manhole.
- Disposal to external sewerage system.
- Sewage Treatment Plant (STP).
- Reuse of treated water from STP for flushing of toilets, Irrigation purposes, etc.
- Disposal of surplus treated effluent to external sewer.
- Storm Water Drainage system.
- Rainwater harvesting for recharging and disposal of surplus storm water to nearby Authority drain/nallah.
- Pitch Drainage System
- The Garden Hydrant system consisting of pumps, piping and hydrants.

- Reverse Osmosis System (RO) wherever required
- Hot water Geysers
- Solid Waste/Waste Water Management.

4.4 WATER DEMAND CONSIDERATIONS

Water demand will be calculated based on demand considerations as mentioned in NBC 2016

Table 1 Water Requirements for Buildings Other than Residences
(*Clause* 4.1.2)

Sl No.	Type of Building	Domestic Per Day litre	Flushing Per Day litre	Total Consumption Per Day litre
(1)	(2)	(3)	(4)	(5)
i)	Factories including canteen where bath rooms are required to be provided	30 per head	15 per head	45 per head
ii)	Factories including canteen where no bath rooms are required to be provided	20 per head	10 per head	30 per head
iii)	Hospital (excluding laundry and kitchen) (*see* Note 2):			
	a) Number of beds not exceeding 100	230 per head	110 per head	340 per head
	b) Number of beds exceeding 100	300 per head	150 per head	450 per head
	c) Out patient department (OPD)	10 per head	5 per head	15 per head
iv)	Nurses' homes and medical quarters	90 per head	45 per head	135 per head
v)	Hostels	90 per head	45 per head	135 per head
vi)	Hotel (up to 3 star) excluding laundry, kitchen, staff and water bodies	120 per head	60 per head	180 per head
vii)	Hotel (4 star and above) excluding laundry, kitchen, staff and water bodies	260 per head	60 per head	320 per head
viii)	Offices (including canteen)	25 per head	20 per head	45 per head
ix)	Restaurants and food court including water requirement for kitchen:			
	a) Restaurants	55 per seat	15 per seat	70 per seat
	b) Food court	25 per seat	10 per seat	35 per seat
x)	Clubhouse	25 per head	20 per head	45 per head
xi)	Stadiums	4 per head	6 per head	10 per head
xii)	Cinemas, concert halls and theatres and multiplex	5 per seat	10 per seat	15 per seat
xiii)	Schools/Educational institutions:			
	a) Without boarding facilities	25 per head	20 per head	45 per head
	b) With boarding facilities	90 per head	45 per head	135 per head
xiv)	Shopping and retail (mall)			
	a) Staff	25 per head	20 per head	45 per head
	b) Visitors	5 per head	10 per head	15 per head

NBC Water Demand Chart

4.4.1 MAIN SPECTATOR SEATING

- Gross water demand for Fixed Population = 10 LPCD
- Net Water Demand for Domestic Use = 4 LPCD
- Net Water Demand for Flushing Use = 6 LPCD

4.4.2 GENERAL LOBBY AREAS IN VIP & VVIP

- Gross water demand for Fixed Population = 45 LPCD
- Net Water Demand for Domestic Use = 25 LPCD
- Net Water Demand for Flushing Use = 20 LPCD

4.4.3 OFFICE ROOM, UMPIRE ROOM, COACH ROOMS, ETC.

- Gross water demand for Fixed Population = 45 LPCD
- Net Water Demand for Domestic Use = 25 LPCD
- Net Water Demand for Flushing Use = 20 LPCD

4.4.4 LOUNGE AREAS

- Gross water demand for Fixed Population = 10 LPCD
- Net Water Demand for Domestic Use = 4 LPCD
- Net Water Demand for Flushing Use = 6 LPCD

4.4.5 SECURITY GUARDS, STAFF

- Gross water demand for Fixed Population = 45 LPCD
- Net Water Demand for Domestic Use = 25 LPCD
- Net Water Demand for Flushing Use = 20 LPCD

4.5 WATER DEMAND

Sr. No.	COMPONENT / HEAD	OCCUPANCY / ROOM OR UNIT OR AREA OR FACTOR	TOTAL OCCUPANCY (NOS.)	CRITERIA FOR WATER REQUIREMENT		WATER REQUIREMENT		
				(LPCD)		(LPD)		
				Domestic	Flushing	Domestic Cold	Flushing	Total
1	**FIXED POPULATION**							
1	SPECTATORS	AS PER RECEIVED MAIL	30740	4	6	122960	184440	307400
2	FACILITY REQUIREMENT (KITCHEN, PANTRY, FACILITY SERVICES, ETC)	CONSIDERED				25000		
	Sub Total for "1" (Liters)		**30740**			**147960**	**184440**	**307400**
2	**OTHER POPULATION**							
1	Security Guards/ Employee -	CONSIDERED - 5%	1537	25	20	38425	30740	69165
	Sub Total for "2" (Liters)		**1537**			**38425**	**30740**	**69165**
3	**Other Water Usage**							
1	FOP Irrigation (Main)	120 TO 130 KL PER DAY BASED ON PAST EXPERIENCE ON MATCH DAY FOR MAIN FOP					120000	120000
1	FOP Irrigation (Practice)	100 TO 120 KL PER DAY BASED ON PAST EXPERIENCE ON MATCH DAY FOR PRACTICE FOP- (For Future Expansion)					100000	100000
2	LANDSCAPE IRRIGATION	6 liters per Sqmt for 19245 SQM (30% Relaxation for Efficient Irrigation)					80829	80829

3	STP BACKWASH & WASTE DISCHARGE	CONSIDERED					10000	10000
	Sub Total for "3" (Liters)						**310829**	**310829**
SUMMARY OF REQUIREMENT (IN CMD)								
BREAK UP (A)	**Other Purpose (FOP Irrigation)**						**220000**	
BREAK UP (B)	**Other Purpose (Landscape Irrigation)**						**80829**	
BREAK UP (C)	**Total Water Demand for the Project (Flushing only) in CMD**						**215180**	
BREAK UP (D)	**Total Water Demand for the Project (for Domestic Storage Requirement) in CMD**						**186385**	
BREAK UP (E)	**Misc. in CMD**						**10000**	
TOTAL DEMAND	**Total Water Demand for the Project (Including ALL) in CMD**						**712394**	

4.6 WATER STORAGE tanks summary

TYPE	COMPONENT	REMARK	REQUIREMENT (KL)	DAY STORAGE/ CRITERIA	TOTAL STORAGE PROPOSED(KL)	COMPARTMENTS	PROVIDED
UG	**FIRE TANK**	AS PER NBC TABLE 7 - 13.9 M HEIGHT ASSEMBLY BUILDING, 10M & ABOVE, NOT EXCEEDING 15M, CATEGORY D3, REQ. 100 KL	200	AS PER NBC	400	C1	200
		REFERENCE NOTE 22 & 23, HYDRANT EXCEEDING 100 NOS, STORAGE DOUBLED - TOTAL REQUIREMENT - 200 KL				C2	200
UG	**DOMESTIC**	AS PER CALCULATIONS ABOVE	186.385	1.0 DAY FOR MATCH DAY	190	C1	125
						C2	125
UG	**FLUSHING**	AS PER CALCULATIONS ABOVE	215.18	1.0 DAY FOR MATCH DAY	220	C1	125
						C2	125
UG	**MAIN FOP IRRIGATION WATER TANK**	AS PER CALCULATIONS ABOVE	120	1.0 DAY	120	C1	150

UG	**PRACTICE FOP IRRIGATION WATER TANK**	AS PER CALCULATIONS ABOVE (For Future Expansion)	100	1.0 DAY	100	C1	100
UG	**LANDSCAPE IRRIGATION WATER TANK**	AS PER CALCULATIONS ABOVE	80.83	1.0 DAY	81	C1	125
UG	**RAINWATER**	FOR 1 DAY OF FLUSHING + IRRIGATION DEMAND	338.99	1.0 DAY	340	C1	200
						C2	200
OH	**FIRE WATER**	PROPOSED IN EACH STAND	20	AS PER NBC	20	C1	20

Location & Area Requirements for Plant Room & Storages

The U.G. water tanks shall be located separately as marked in the drawing by the Architect and the Plumbing & Fire Fighting plant room shall be adjacent to the underground tank. The plant room has fire pumps, water supply pumps, water treatment plant and all other related equipment located there. These services shall act as a centralized system for building. All underground Tanks shall be provided with RCC structural compartmentation.

4.7 WATER SOURCE

Water requirement shall be met from the following sources: -

- • Municipal water
- • Bore well Water
- • Tanker Supply

The information with regard to the availability of water from all the above three sources shall be as per confirmation from client & local authorities.

The ultimate source of water supply for the proposed buildings shall be Municipal Water supply. The external pipeline up to underground water tank shall be designed; the source of water supply shall be Municipal & Tube wells/ Bore wells. However, if water is not found suitable for construction, Developer shall make alternate arrangements for getting water fit for constructions at his cost.

4.8 WATER TREATMENT & DISTRIBUTION SCHEME

It is assumed that the water quality received from the source is of potable quality warranting only minimal treatment with filtration & disinfection. The treated raw

water is supplied by means of Hydro pneumatic system to all draw off points for domestic purposes.

The treated raw water is supplied to the Wash basin, Shower. The treated water is further subjected to RO treatment to meet the drinking water needs and supplied by means of Hydro pneumatic system. RO water floor standing units to be provided in each stand as per required capacity.

The STP treated water is supplied by means of Hydro pneumatic system to all draw off points for Flushing purpose.

The STP treated water is supplied to landscape irrigation through transfer pumps.

4.9 WATER TREATMENT PLANT

1. Water Treatment Plant to ensure that the chemical and bacteriological parameters of water supply in the building are in accordance with WHO standards. Since, quality of water from borewells not known but known to authority; considered treated/potable, the WTP design shall be as per water test report of borewell as per IS:10500.
2. Domestic water shall be supplied through combination of gravity feed and hydro-pneumatic system for making water available at all toilets, pantry and required wet area at constant pressure. Upper two floors shall be fed by hydro-pneumatic system, wherein lower floors shall be fed by gravity system.
3. Hot water supply for adequate places shall be through Geysers.
4. Soft water supply shall be from STP for making water available for Flushing Water and green area inside stadium.
5. Sewage and waste water system shall be based on guidelines of NBC.
6. Storm/rain water drainage system from the roof terrace and various levels of the building including balcony drains, planter & fountain drains; in required by means of draining and surface run-off water to rain water recharge pits for ground water recharging.
7. Sewage treatment plant for treatment of sewage, waste water and other effluents. The plant shall comprise of primary, secondary (chemical & biological) and tertiary treatment units. The treated effluent shall be recycled ad reused for cooling towers and gardening. As per the commitment to MoEF, it will be ensured earned to provide high flow UV system in tertiary treatment plant of STP.
8. Water storage tank of adequate capacity to ensure availability of water for one and a half days requirement.
9. Implementation of MoEF regulations relating to rainwater harvesting, water conservation, solar water heating system etc.
10. Drainage and water supply provision for landscape and water bodies . Water treatment process will depend on the quality of raw water from various sources like Municipal/Borewell/Tanker Water. The treatment will involve feeding water pumps, chlorine dosing, Multimedia filter and Activated carbon filters to reduce the suspended

solids and to reduce the turbidity anticipant dosing to prevent scale formation on the membrane surface. UV system to be provided for further enhanced water quality. Micron cartridge filter prevents the passage of particles to treated water exceed WHO portable water quality standards. Water used for flushing should meet the following parameters at the minimum.

11. Water requirement

S.No.	Buildings	Rooms/ amnities	Population	Water required per Day per person		Water required per Day	
				Domestic	Flushing	Domestic	Flushing
1	Hotel (48 rooms x 1.5 persons)		72	135	45	9,720	3,240
1.1	restaurant					10,000	
1.2	Pool						
	pool size (16.85x4.85x1.2 - 2nos)					10,000	
2	Boys Hostel		80	90	45	7,200	3,600
2.1	Kitchen					5,000	
3	Girls Hostel		80	90	45	7,200	3,600
3.1	Kitchen					5,000	
4	Dinning Hall					10,000	
5	New South Paveilion						
	chairs	5000	5000	5	10	25,000	50,000
	rooms	36	54	105	45	5,670	2,430
	corporate rooms	26	78	105	45	8,190	3,510
6	North Pavilion						
	chairs	5000	5000	5	10	25,000	50,000
	rooms	24	36	105	45	3,780	1,620
	corporate rooms	14	42	105	45	4,410	1,890
7	Stands		36316	5	10	1,81,580	3,63,160
	seats - lvl 4	7750	7750				
	lvl 3	15922	15922				
	lvl 2	4694	4694				
	lvl 1	7950	7950				
	Total Water Requirement					3,17,750	4,83,050
	adding 20%					3,81,300	5,79,660
	Total Water Requirement					9,60,960	
	CONSIDERING WATER REQUIREMENT					**1,000**	**KLD**
	green area						
	inside stadium	15,800	15,800	5		79,000	
	inside stadium	15,400	15,400	5		77,000	
	garden area		20,000	3		60,000	
	total water required for green area					2,16,000	
	CONSIDERING					**225**	**KLD**
	Daily Water requirement					1000	KLD
	90% of WATER REQUIREMENT TO STP					900	KLD
	ADDING 10% RAIN FALL INFILTRATION TO MANHOLES					90	
	TOTAL FLOW IN STP					990	KLD
	CONSIDERING STP					1000	KLD
	RECOVERY FROM STP			85%		850	KLD
	GREEN AREA REQUIREMENT					225	KLD
	BALANCE WATER AT STP					625	KLD
	flushing water requirement					580	KLD
	balance at STP					45	KLD

TDS <200 ppm

TSS < 5 ppm

BODS < 5 ppm

Hardness < 50 ppm

(If TDS contents are higher than 1000 mg/l, the R.O. system should be provided for all water)

Daily Demand (Kl)	186.4
Hours Of Operation (HRS)	12
WTP Size (CMH)	16
Selected Pump Size	8 CMH X 2 NOS WORKING + 1 STANDBY
Number Of Filtration System	2 SET

NOTE: WTP provision is considered.

Water Source

Authority water may not be sufficed to fulfill the water requirement; hence the 3 nos (2 duty + 1 stand by) of bore wells of 50,000 LPH (10 hours fill time) shall be planned.

WATER STORAGE REQUIREMENT

S.No.	Item Description	Daily Requirement		Factor of storage		Total water Requirement	
1	Fresh Water Requirement from Bore well / Authority		10,00,000		1.5	15,00,000	
2	Treated Water From STP		8,50,000		1	8,50,000	
3	Fire Protection – Ground level		2,00,000		1	2,00,000	
4	Fire Protection – Roof Level		20,000		3	60,000	
5	Fire Protection – Roof Level		25,000		2	50,000	
	Total Requirement					26,60,000	Litres

Water Storage

S.No.	Tank type	No of Partition	Tank Capacity per partition	Total Tank Capacity	Tank Location
1	Fire Water	2	1,00,000	2,00,000	UG
2	Untreated Water	2	2,50,000	5,00,000	UG
3	Treated Water	2	2,50,000	5,00,000	UG
4	Soft Water (Flushing & Green)	4	2,00,000	8,00,000	UG at STP
5	Treated Water (Pavellion, stands)	3	50,000	1,50,000	terrace
6	Treated Water (Hostels, hotel)	3	50,000	1,50,000	terrace
7	Flushing Water (Pavellion, stands)	3	50,000	1,50,000	terrace
8	Flushing Water (Hostels, hotel)	3	25,000	75,000	terrace
9	Fire Water (Pavellion, stands)	3	20,000	60,000	terrace
10	Fire Water (Hostels, Hotel)	3	25,000	75,000	terrace
	Total Water Requirement			26,60,000	

WATER SUPPLY PUMPS

S. No.	Item Description	Qty of Water in KL	No. of Workings Hours	Total Capacity of Equipment LPS	Capacity of Each equipment in LPS	Remarks
1	Water Treatment Plant Feed Pumps.	1000	10	27.78	7	5 PUMPS - 4 W + 1 S
2	Treated Water Transfer Pumps (Hydro-pneumatic system)	525	4	36.46	10	5 PUMPS - 4 W + 1 S

At STP

S. No.	Item Description	Qty of Water in KL	No. of Workings Hours	Total Capacity of Equipment LPS	Capacity of Each equipment in LPS	Remarks
1	Softening Plant Feed Pump	850	10	23.61	6	5 PUMPS - 4 W + 1 S
2	Flushing Water transfer pumps	290	4	20.14	5	5 PUMPS - 4 W + 1 S
3	Green area Water Transfer Pump	225	4	15.63	8	3 PUMPS - 2 W + 1 S

11.1 DISTRIBUTION SCHEME

SCOPE MATRIX

Scope Matrix For PHE System					
Sr. No	**Description**	**Vip Louge**	**Player Change Room**	**Public Toilet**	**Other Toilet**
1	LOW IMPACT SANITARY FITTING & FIXTURE	✓	✓	✓	✓
2	INTERNAL COLD-WATER SUPPLY	✓	✓	✓	✓
3	INTERNAL HOT WATER SUPPLY THROUGH LOCALIZED GEYSER	✗	✓	✗	✗
4	INTERNAL DRAIANGE SYSTEM	✓	✓	✓	✓
5	LOCALIZED RO SYSTEM FOR DRINKING WATER	✓	✓	✗	✗

Detailed Scheme to be developed in Detail design stage.

11.2 HYDRO PNEUMATIC SYSTEM

- In this system, water supply will be catered by hydro pneumatic system with uniform residual head of 1.5 kg/cm2- 2.5 kg /cm2 at every fixture at topmost level. No OHT is required for domestic & flushing water. Water distribution for domestic water supply for the building has been proposed based on the buildings and height of the same. It shall be ensured that Pressure reducing valves (PRV) are provided (if required) to limit water distribution pressure to 1.5 – 4.5 Kg/cm². The distribution system will be designed considering domestic & flushing water requirement of units on each floor, frictional losses,
- Static head available and residual head required. Water meters shall be provided in identified areas normally at primary supply for water consumption recording for efficient monitoring and assessment. Head losses through water meter shall be accounted for in water distributions calculations. The water meter used shall be of BULK Type confirming to ISO4064 / OIML R49 or equivalent & measuring unit is Cubic Meter/ kilo litters.

a.	Flow	As per Fixture Unit Table
b.	Residual Head	Min. 1.5kg/cm2
c.	Velocity of flow	Up to 2.4 m/s for cold water & 1.5 m/s for hot water
d.	Pipe Sizing	As per Hazen-William's Formula

11.3 PIPE MATERIALS & PIPE SIZES

Table 18 Drainage Fixture Units (DFU) for Different Fixtures with Minimum Pipe Sizes
(*Clause* 4.5.3.5.1)

Sl No.	Type of Fixture	Application		Minimum Trap Size mm
		Private	Public	
(1)	(2)	(3)	(4)	(6)
i)	Bathroom group (water closet, wash basin, bidet and tub or shower)			
	a) Water closet (flush valve)	8	—	—
	b) Water closet (flush tank)	6	—	—
ii)	Bathtub	3	—	40
iii)	Bar sink	1	2	40
iv)	Ablution faucet/Bidet	1	2	40
v)	Clothes washer	3	3	50
vi)	Dishwasher	2	2	40
vii)	Drinking fountain	—	0.5 (0.75)	32
viii)	Floor drain	1	2	50
ix)	Wash basin	1	1	32
x)	Service or mop basin/sink	1.5	3	50
xi)	Kitchen sink	2	2	40
xii)	Shower	2	2	50
xiii)	Laundry sink	2	2	40
xiv)	Clinical or surgeon's scrub sink	—	6	80
xv)	Urinal (with flush valve)	2	2 (3)	50
xvi)	Urinal (with flush tank)	2	2 (3)	50
xvii)	Urinal with sensor operated	2	2 (3)	50
xviii)	Water closet (flush valve)	4	6 (8)	80
xix)	Water closet (flush tank)	3	4 (6)	80
xx)	Combination fixture (faucet)	1	2	40

Water Supply Pipe Sizing (NBC Vol2 P9)

11.4 PIPE MATERIALS & PIPE SIZES

11.4.1 TYPES OF PIPES & INSULATION

Following are the pipe materials proposed for the various purpose.

Sr No	Description	Type Of Pipe/Insulation
1	Domestic Water Supply (Plant Room, Service Trenches, Exposed Headers Etc.).	GI Heavy Class as per IS 1239
2	Main Transmission (Water Supply)	DI K9
3	Internal Hot Water & Cold-Water Supply.	CPVC SDR 11.
4	Irrigation Piping.	CPVC SC80 / HDPE
5	Internal Drainage	uPVC
7	RO Water Tapping In Kitchen Area	SS 316 L
8	Hot Water Insulation Material.	Antimicrobial Fire-Retardant Closed Cell Chemically Cross-linked PE foam (XLPE)/NBR of required thickness with AL foil

4.13.1 Material Specifications for the Sewerage System

S.W. Pipes- for dia. 150mm & 200mm grade 'A' as per IS:651 up to first manhole only depending upon on site conditions with laying, jointing &bedding as per IS:4127- 1983

R.C.C Pipes class NP2 - minimum dia. 250 mm & above to be provided as per IS:458, for normal slopes & general site conditions

R.C.C Pipes class NP3 - for road crossing 300 mm dia. & above as per IS:458, for normal slopes & general site conditions

Ductile Iron pipes: for exposed pipes running along the basement ceiling for final disposal to external sewerage system ductile iron pipes conforming to IS:8329& class K-9.

4.13.1 Manholes

The manholes shall be constructed of brick masonry as per standard specifications of National Building Code and shall be having details as follows:-

Rectangle of size 900x800mm up to 900mm depth as per CPWD specification.

Circle of size 910mm dia. from 900mm up to 1670mm depth as per CPWD specification.

Circle of size 1220mm dia. from 1668mm up to 2290mm depth as per CPWD specification.

Circle of size 1520mm dia. from 2290mm up to 4180mm depth as per CPWD specification.

4.13.2 MANHOLE COVERS

Medium duty S.F.R.C. manhole covers for manholes on service roads, gully traps and manholes /chambers not following in the road / pedestrian ways.

Heavy duty S.F.R.C. manhole covers for manholes on main roads.

Steel fiber reinforced concrete (SFRC) Manhole cover with frame conforming to IS: 12592 shall be provided.

4.13.3 WATER SUPPLY PIPES design

Hydraulic design involves optimizing the suitable diameter to get residual pressure at tap point with head loss in transit and static head due to height of building. The pipe sizing shall be based on fixture unit calculation as per NBC 2016 table Vol2 part 9. The pipe size of riser shall be restricted to nearest 4" size to optimize on capital cost, and for ease of installation and maintenance. However, the maximum velocity in the water supply piping shall not exceed 2.4 m/second. Following table from NBC 2016 indicates pipe sizes as per DFUs.

4.13.4 DRAINAGE PIPE SIZE & design

The Drain lines will be designed as per NBC 2016. The design will be based on connected drainage fixture units. Minimum gradient will be maintained insider the building & buried line.

Table 20 Horizontal Fixture Branches and Stacks[1)]
(*Clause* 4.5.3.5.1)

Sl No.	Diameter of Pipe	Maximum Number of Drainage Fixture Units[2)] (DFU) that can be Connected to			
		Branch	Stacks[3)]		
		Total for Horizontal Branch	Total Discharge into One Branch Interval	Total for Stack of Three Branch Intervals or Less	Total for Stack Greater than Three Branch Intervals
	mm				
(1)	(2)	(3)	(4)	(5)	(6)
i)	32	1	2	2	2
ii)	40	3	2	4	8
iii)	50	6	6	10	24
iv)	65	12	9	20	42
v)	75	20	20	48	72
vi)	100	160	90	240	500
vii)	125	360	200	540	1 100
viii)	150	620	350	960	1 900
ix)	200	1 400	600	2 200	3 600
x)	250	2 500	1 000	3 800	5 600
xi)	300	3 900	1 500	6 000	8 400
xii)	375	7 000	See Note	See Note	See Note

Drainage Pipe Sizing (NBC Vol2 P9)

4.13.5 SEWAGE WATER TRATMENT PLANT

We are proposing common STP for phase 01 combined at Service yard location. We need a STP which will work fine in both the requirement scenario.

The following conditions will be considered during selection of summary.

- Match Day Demand for Stadium

Below is the calculated summary of STP capacities for match day

The treated water generated shall be used for following purpose.

- Flushing

4.13.6 STP SELECTION

SEWAGE TREATMENT PLANT

Type of STP considered - **SBR type**
Capacity of STP - 850 KLD

The sewage will be first passed through a **Bar Screen Chamber** where any extraneous matter would get trapped.

The sewage would then collected in a **Receiving Sump** where the variations in flow and characteristics are dampened, which otherwise can lead to operational problems and moreover it allows a constant flow rate downstream. Here the sewage is kept in mixed condition by means of coarse air bubble diffusion.

The equalized sewage is then be pumped to the **Sequential Batch Reactors (SBR)** where BOD/COD reduction is achieved by virtue of aerobic microbial activities. The FAB reactors would be running in series. The oxygen required will be supplied through coarse air bubble diffusers.

The excess bio-solids formed in the biological process are separated in the downstream **Tube**

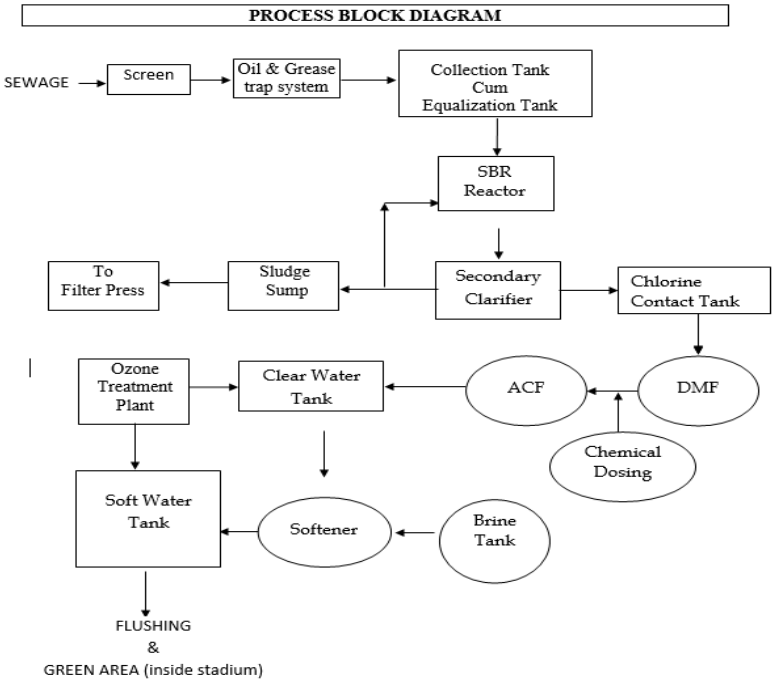
Settler Tank. The clear supernatant will now be sent to the tertiary polishing section.

The tertiary treatment consists of removing the residual organics load, by filtering through **Dual Media Filter**, and passing the water through **Activated Carbon Filter** so that traces of BOD / COD and excess chlorine are removed.

The tertiary treated water is passed through the **Softener** and the water can now safely be used for cooling tower make-up & Irrigation System applications etc.

The biological sludge generated from the FAB, which is settled in the Tube Settler, can be either drained to the filter press.

The percolated filtrate from the sludge drying beds will be sent back to the Equalization Tank and the dried cakes can be disposed-of suitably.



Flow Restrictors:

Appropriate flow restrictors shall be provided for economizing on water consumption. The flow resistors shall be typically for following flow/discharge:

Wash Basin: 6.0 LPM @ 80 PSI

Shower	:	9.5 LPM @ 80 PSI
Kitchen Sink	:	6.3 LPM @ 80 PSI
WC Flushing	:	3/6 LPF @ 80 PSI
Urinal Flushing	:	3.0 LPF @ 80 PSI

Sewage, waste, effluent and storm water drainage: -

The following parameters/site conditions shall be kept in mind while designing this system:

1. Natural slope of plot / authority disposal location.
2. Sub-soil water table.
3. Soil conditions.
4. Provision of venting arrangement of manholes.
5. Construction of manholes & lying of pipes as per ground conditions.
6. Termination of vent cowl at terrace level.
7. Provision of adequate slope for horizontal header in the under slung pipes.

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

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

It is proposed to use cast iron (hubless) for soil / waste drainage. The soil & Waste piping shall be under-slung (below the slab or ceiling of floor below) and the horizontal header shall be subsequently connected to the vertical stack located inside the associated pipe shaft which shall be coordinated carefully with other services and in consultation with Architect. Care shall be taken to avoid pipe runs in electrical switch rooms, EPABX room, server room and other critical areas.

Provision of cleaning and rodding eyes shall be made at strategic locations to allow the system maintenance.

Grease interceptors are proposed for kitchen waste, located close to the grease source. The grease separator shall include cleanout at entry and exit. The cover of same shall be non-slippery.

Catch basin & waste pipe shall be provided at the upper basement level and Open drains with grating shall be provided at lower basement level drainage and all waste pipes from basement shall be connected with these open drains. The design of open drain network shall be done in such a way that the maximum depth of open drains less than 300mm. The open drain shall be connected with sump pit.(Each sump pit 2 nos. Submersible pumps provided)

Design Criteria:

The system shall be designed as per following design criteria stipulated in the “manual for sewerage & treatment” published by the Central Public Health and Environment engineering organization, ministry of urban development, Govt. of India, IS-SP/35 (S&T)-1987 and National and international practices on this subject:

1.	Flow of sewage:	90% of water supply (Peak flow)	
2.	Peak Flow :	3 times average flow	
3.	Minimum diameter of pipe	:	150/200 mm dia
4.	Minimum velocity in pipe	:	0.6 mps
5.	Maximum velocity in pipe	:	3 mps
6.	Flow conditions in pipes		
a.	Pipes upto 450mm dia :	½ of full running	
b.	Pipes above 450mm dia	:	2/3 of full running
7.	Minimum depth of pipe below ground level		
a.	For branches :	600mm	
b.	Other than branches :	1000mm	
8.	Formulae for calculation and design of sewer lines	:	Manning Formula

Sanitary Fixtures & Fittings:

All sanitary wares for common areas shall be selected as per the interior layout and architect/client.

1. It is suggested that WC for common areas shall be European pattern, wall hung, vitreous china, having "P" traps. All water closets shall have concealed dual flush cisterns of 3 to 6 liters capacity.
2. All wash basins throughout the building shall be of vitreous china with sensor based faucets and waste coupling with CP bottle trap fixed to the outlet. Inlet connections shall be made by CP angle stop cocks below the counter.
3. Urinals shall be large flat back vitreous china with full height vitreous partition mounted on wall, auto-flushing system, CP spreader and waste coupling with CP bottle trap connected to deep seal floor trap.
4. All sinks in pantries and kitchen shall be of stainless steel with single / double drain board and cold and hot water mixer fittings. CP waste coupling and bottle trap shall be provided in the pantries.
5. Accessories such as toilet paper holder, towel rails, soap dispenser and hand drier shall be provided for public toilets at suitable locations.

Rain Water Disposal

1. System shall be provided for collecting rain water from terrace. Rain water down takes of appropriate size and number shall be provided in shafts. These shall be integrated with the external facade of the building. The final drainage of rain water shall be routed through catch basins and in line Rain water harvesting pits and thereafter overflow connection shall be fed to municipal storm water drain through an overflow connection of the last harvesting pit. Provision in catch basin shall be kept also for outside external areas (paved, lawn and roads) and additionally perforated pipe drainage system shall be provided at open-to-sky courtyard / lawn (if required).
2. The lower floor construction shall be such to prevent direct ingress of rain water.
3. However, sumps shall be designed to collect all drainage into these sumps. These sumps shall be provided with minimum 2 pumps (1 working + 1 standby). The water from these sumps shall be pumped to the nearest storm water manhole/catch basin.

Material Recommended:

1. Water Supply Pipes
a. Inside shaft – CPVC, exposed Galvanized Iron (GI)
2. Soil & Waste pipes
a. Heavy Cast Iron as per IS:15905

3. Rain Water pipes
a. uPVC (6 Kg/cm2)
4. Fire pipes
a. MS class “C” piping
5. Concealed Cistern with WCs
6. Push Taps / sensor taps

DISTRIBUTION OF TREATED COLD WATER

CPVC pipes shall be used for cold water supply for all concealed pipes and G.I. (Class C) pipes shall be used for all exposed piping network.

SOFT WATER DISTRIBUTION

Soft water make up line from roof soft water tank shall be used to provide connection to flushing equipments and green area tanks.

IRRIGATION WATER SUPPLY NETWORK

Irrigation water supply to all green area shall be through STP water tanks.

11.5 GREASE TRAP FOR KITCHEN: -

According to the Plumbing standard 1.4(b) and European Norm 1825, commercial kitchens generating wastewater must have pre-treatment plants (Preferably automatic type) to ensure that fat, oil and grease (FOG) are not discharged into the public sewerage network. Otherwise, very greasy wastewater puts the pipe systems and drainage equipment at risk. Grease and oils are deposited with other wastewater components on the walls of the pipes and can lead to corrosion, blockages, and noxious smells. Hence, grease separators, also known as grease traps or grease interceptors, must be installed to retain greasy wastewater. The separator sizes will depend upon the Actual Data of meals that prepared in kitchen. The grease separator shall be provided with Lifting station as required.

Grease trap shall be located at suitable accessible place such that it can be accessed properly.

Grease Separator

11.6 STORM WATER DRAINAGE

The following parameters/ site conditions will be kept in mind when designing the sewage and storm water drainage system:

Storm water drain will be provided with adequate slope to ensure self-cleansing velocity. The rainwater collected from Super structure and runoff from open surfaces will be collected through a separate piping system and will be discharged over a common road. Drain channels will be provided in the car parking areas. Drain channels will be provided with adequate slope to achieve self-cleansing velocity. The storm water drain will be discharged in the proposed channel in plot.

The drains to be designed in terms of run-off generated within the site only. The runoff water at ground level, beside areas, road / paved areas and harvesting tanks overflow will be drained through RCC Box drain (covered by RCC / FRP heavy duty grated covers) and connected to the nearest connection.

PIPING: RCC NP2 / NP3 pipe will be used in underground drainage systems for the transport of storm water.

11.7 RAINWATER HARVESTING TECHNIQUE

The Roof rainwater harvesting is proposed. The system will collect the rainwater from the slanting Roof above the concourse. The collected water then will be carried to the Rainwater tanks after cleaning flush out is completed. The Rainwater tanks are proposed to be located in Detailed Layouts.

11.7.1 ROOF RAINWATER COLLECTION

The terrace floor rainwater drain will be drained vertically through natural flow Drainage system. There will be gutters and specific locations defined as per roof profile. It will be taken to the rainwater storage tanks. The first flush chamber and break chamber shall be provided. Once the rainwater tank if completely filled, further water shall be discharged to external rainwater network. Rainwater storage tank shall be designed to cater minimum 1 Day flushing & irrigation requirement.

4.16.1 BOWL RAINWATER COLLECTION & DISCHARGE

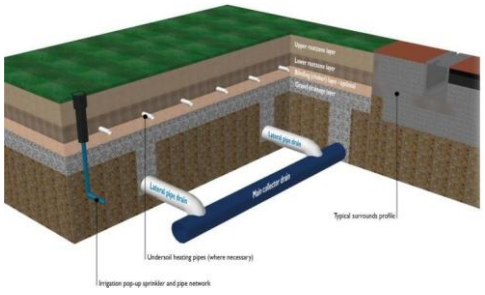
Bowl Rainwater will be collected form the Lowest step of respective Bowl & shall be taken to the lowest level. Dummy shafts to be proposed to take rainwater to the lowest level. Then further rainwater will be discharged to the external storm water network.

Special fixture/trap will be used at lowest stair level.

11.8 FIELD OF PLAY DRAINAGE & irrigation system

11.8.1 Subsoil Drainage

Field of play (FOP) shall have subsurface drainage system with gravel base layer, coarse sand, lower root zone, and upper root zone finished with seed / sprig. The field of play shall have necessary irrigation system to maintain the turf in good condition in FOP area.



A pitch that drains freely is better able to provide the required playing characteristics on the surface. The minimum design for a professional football pitch usually includes an imported sand-dominant root zone overlying a pipe-drained sub-base (Fig. 1), together with an automatic pop-up irrigation system. In some cases, the sand-dominant root zone can be created by mixing known quantities of a carefully selected sand with the existing soil in order to improve the physical properties of the surface layer.

Ideally, there should be a constructed gravel drainage layer between the sand-dominant root zone and the underlying pipe drainage system (Fig. 1). A gravel drainage layer is primarily used in wet areas, where good drainage is essential, but it can also be useful in dry climates, where water tends to be held in the sand profile layer. The selection of compatible materials for the different layers is critical to the success of this type of pitch construction, as is the correct calculation of the sizing, depth and spacing of lateral and main drainage pipes to a suitable outfall.

4.17.1 IRRIGATION SYSTEMS

There are several systems used to irrigate pitches (e.g. self-travelling sprinklers, static sprinklers, canon sprinklers and pop-up sprinklers). It is strongly recommended that only fully automatic pop-up irrigation systems be installed in pitches, because such systems are easier to control and

manage and ensure uniform distribution of water, fast irrigation times and a syringe cycle of water post-match and at half-time. An automatic pop-up irrigation system also can apply water during the night, thereby reducing evaporation losses.

Fig. 3. Types of irrigation systems used in the sports turf industry. From left to right: cannon type, self-travelling type, static type and pop-up type. Only automatic pop-up irrigation systems are considered appropriate for pitches

Like with pitch drainage and profiles, designing a fully automatic pop-up irrigation system is a specialist task. The most important considerations are:

- the supply, storage and quality of irrigation water (mains, bore hole, etc.);

- the quantity of irrigation water required.
- the uniform application of irrigation water.
- the number and arrangement of irrigation heads.
- 'block' or 'individual head' control.

A suitable system may have around 20 pop-up sprinkler heads per pitch, but some have 24 to 35 with full overlap between adjacent sprinklers (Fig. 4). Most existing irrigation systems have solid plastic sub-surface infield sprinkler heads with a small diameter at the surface (approx. 50mm). In-field sprinkler heads tend to be located 10-15mm below the soil surface and should not be detectable on the surface

Water Storage

To provide a reliable supply of water 2 days water requirement is considered which will be fed through City Water supply. The quality of water is important as turf quality can be significantly

diminished if the water contains a high level of dissolved salts.

A standard football pitch requires a minimum of 50,000 litres of water per application. Approximately 3 applications are required per week (150,000 litres per week) to keep a pitch in a healthy and safe condition. Accordingly, Irrigation water tank proposed of 150 Cum with Suitable Treatment based on Water Test report of city Supply.

The EPC Contractor shall appoint the third party experienced expert agency to carry out calculations, design, installation and commissioning of the system as per site requirements. It is the responsibility of EPC contractor to execute fully functional complete system.

11.9 WATER METERING STRATEGY

Water metering is an important aspect in terms of measuring, monitoring, analyzing, and examining the usage of water in different zones and applications. It also involves measuring of incoming water to the complete system.

In few cases it is mandatory to meter the incoming water such as from municipal connection. In our case we are including water metering for following areas.

Sr No	Metering Purpose	purpose	Significance
1	Incoming municipal connection	To track Municipal consumption	Accordingly, it can be analyzed and decided how much water shall be used from each source,
2	Incoming Bore well connection	To track bore well consumption	
3	Kitchen usage (Cold & hot Water)	To track Kitchen usage	Recorded data can be analyzed to identify the actual requirement based on occupancy and future planning can be done to plan water demand for Match days & Non-Match days.
4	Irrigation Purpose consumption	to track Irrigation usage season wise	
5	FOP Irrigation Purpose consumption	to track Irrigation usage In FOP	

11.10 IS Code for Plumbing Work

- IS 651-1965 Specification for salt Glazed stoneware pipes and fittings (First revision).
- IS 782-1978 Specification for caulking lead.
- IS 1172-1971 Code of basic requirements for water supply, drainage and sanitation (revised).
- IS 1239-2004 (Part-I) Specifications for mild steel tube, tubular and other steel pipe fittings.
- IS 1239-2011 (Part-II) Specifications for mild steel tube, tubular and other steel pipe fittings.
- IS 1537-1976 Specification for vertically cast iron pressure pipes for water, gas and sewage.
- IS 1536-1976 Specification for centrifugally Cast (Spun) Iron pressure pipes for water, gas and sewage.
- IS 1538 (Part 1 to 23) Specification for Cast Iron fittings for pressure pipes for water, gas and sewage.
- IS 1626-1960 AC building pipes, gutters and fittings (Spigot and socket type).
- IS 1726-1960 Code for cast iron manhole frame and cover.
- IS 1729-1979 Specification for Sand cast iron Spigot and Ventilating pipes, fittings and accessories.
- IS 1742-1960 Code of practice for building drainage.
- IS 2064-1962 Code of practice for selection, installation and maintenance of sanitary appliances.
- IS 2065-1963 Code of practice for water supply to buildings.
- IS 3114-1965 Code of practice for laying of C.I. Pipes.
- IS 3589-1981 Specification for electrically welded steel pipes for water, gas and sewage.
- IS 3989-1970 Centrifugally cast spun iron and socket soil and ventilating pipe, fittings and accessories.
- IS 4111-1967 Code of practice for Ancillary structure in sewerage system.
- IS 4127-1967 Code of Practice for laying glazed stone ware pipe.
- IS 4515 Specification for uPVC pipe fittings.

- IS 4985-1981 Specification for uPVC pipes for portable water supplies.
- IS 1703-1984 Ball Valves
- IS 2548-1970 Toilet Seat Cover
- IS 4736-1986 Galvanizing G.I. Pipes
- IS 780-1984 Cast iron sluice valves
- IS 778-1984 Full way valves
- IS 2692-1978 Brass ferrule
- IS 458-1971 R.C.C. pipes
- National building code for water supply, drainage and sanitation Part IX Plumbing services section 1 & 2.

The mentioned code requirements are purely for reference only.

The installation shall also be in conformity with the bye-laws and a requirement of the local authority is so far as these become applicable to the installation. Where ever this specification calls for a higher standard of materials and/or workmanship then those required by any of the above regulations and standards, hen this specification shall take precedence over the said regulations and standards. Wherever drawings and specifications require something that may violate the regulations, the regulation shall govern.

11.11 FIRE FIGHTING SYSTEM.

11.11.1 FIRE FIGHTING SYSTEM

Reference Standards

The design and planning of fire protection system shall be done keeping in view following criteria:

- National Building Code 2005; Part IV
- Local Bye-Laws
- Relevant BIS Codes – IS-3044, IS:5290, IS:5312, IS:908, IS:2190, IS:780:1984, IS:1200 (Part-16):1979, IS:1200(PART-19):1981, IS:13095:1991, IS:5312 (part 1) :1984, IS:1726:1991, IS:884:1985, IS:901:1988, IS:903:1984, IS:3844-1989, IS:2190:1992, IS:6382:1984, IS:933-1989, IS:2171-1985
- In consultation with local Chief Fire Officer.

Basis of Design

The firefighting arrangement shall be designed as per the requirement of local guidelines & engineering design standard.

The entire fire safety installation shall be compliant with the most stringent codes / standard for the entire building to ensure the highest safety standard and uniformity of system.

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

1. Piping System : Piping System Confirming to IS:1239 - MS Heavy Class
2. Fire water static storage : Fire water static storage has been provided in accordance to NBC 2016 guideline.
3. Fire pumping system : as per NBC 2016 guidelines
4. Hydrant System : as per NBC 2016, complete with hose reel.
5. Sprinkler System : as per NBC 2016, complete with suitable type for suitable areas.
6. Handle held fire extinguishers : Strategically placed at designated areas.

Minimum Requirement for Fire Fighting Installation as per NBC, 2005

The campus has been designed for duly approval by concerned authorities as Fire Classification of all building:- pavilion Block (Assembly Class) and Hotel & Hostel Block (Residence Class) .

Following table is drawn from NBC 2016; Part IV, Table 7

S. No.	Description	Remarks
1	**Type of Installation**	
1.1	Fire Extinguisher	Required (All Block)
1.2	Hose Reel	Required (All Block)
1.3	Dry Riser	Not Required
1.4	Wet Riser	Required (pavilion & stands)

Commented [MP1]: But not proposed in Auditorium.

1.5	Down comer	Required (Hotel & Hostel Room)
1.6	Yard Hydrant	Required
1.7	Automatic Sprinkler System	Required (All buildings except hostels)
1.8	Manually Operated Electric Fire Alarm System	Required
1.9	Automatic detection and Alarm System	Required

2. Water Supply (in Liters)

2.1	Under Ground Static Water Storage Tank	200,000 Liters
2.2	Terrace Tank (all assembly)	20,000 Liters
2.3	Terrace Tank (All Residence)	25,000 Liters

3. Pump Capacity (in LPM)

3.1 Pump Near Underground Static Water Storage Tank (Fire pump) with Minimum pressure of 3.5 Kg/Sqcm at terrace level.	Required, 2280 LPM (2 Electrical, 2 Jockey & 1 Diesel)
3.2 At the Terrace Pump	Not Required (pavilion Block)900 LPM (Residence Block)

System Description

Fire water storage

Static fire water storage tank for Fire Protection System shall be provided at basement level of 200 kl capacity. The whole building shall be divided into required fire zones depending on the height of each building.

The fire zones shall be fed with the help of fire pumps installed near UG Fire tank.

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

These shall be mounted in specially identified boxes.

Fire pumping system

The fire pumping system shall comprise of independent electrical pumps for hydrant, sprinkler system, diesel engine driven pump & jockey pump.

a. Electric Fire Hydrant Pump Capacity - 2280 LPM 80 Mt head
b. Electric Fire Sprinkler Pump Capacity - 2280 LPM 80 Mt head
c. Diesel Engine Driven Pump Capacity - 2280 LPM 80 Mt head
d. Jockey Pump- Low Zone Capacity - 180 LPM 80 Mt head

Electrical pump shall provide adequate flow for catering requirement of hydrant system. Diesel

engine driven fire pumps shall be provided for ensuring operation & performance of the system in case of total electrical power failure. Jockey pumps shall compensate for pressure drop and line leakage in the hydrant and sprinkler installation. Provision of orifice plate shall be made in all riser to restrict pressure on sprinkler/hydrant system.

Individual suction lines shall be drawn from the fire reserve tanks at the UG level and connected to independent fire suction header. The electric fire pumps, diesel engine driven fire pumps and the jockey pumps shall all draw from this suction header.

Delivery lines from various pumps shall also be connected to a common header in order to ensure that maximum standby capacity is available. The sprinkler pump shall be isolated from the main discharge header by a non-return valve so that the hydrant pump can also act as standby for the sprinkler system. The ring main shall remain pressurized at all times and Jockey pumps shall make up minor line losses. Automation required to make the system fully functional shall be provided.

Fire hydrant system

Internal and external standpipe fire hydrant system shall be provided with landing valve, hose reel, first aid hose reels, complete with instantaneous pattern short gunmetal pipe in the Complex.

The internal diameter of inlet connection shall be atleast 80/100 mm. The outlet shall be of instant spring lock type gunmetal ferrule coupling of 63 mm dia for connecting to hose pipe.

Provision of flow switch on riser shall be made for effective zone monitoring. The flow switch shall be wired to FAP and shall indicate water flow on hydrant of the identified zone.

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

External hydrant shall be located within 2 m to 15 m from the building to be protected such that they are accessible and may not be damaged by vehicle movement. A spacing of about45-50 m between hydrants for the building shall be adopted.

Sprinkler system

Elaborate automatic sprinkler system shall be provided throughout the Public areas as explained above. The system shall be suitably zoned for its optimum functional performance.

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

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

Wet pipe sprinkler shall be provided for all habitable spaces such as guest rooms, guest room corridors, restaurants, ball rooms/ meeting rooms and other public areas. Sprinkler shall also be provided in all public toilets.

Hand held fire extinguishers

Portable fire extinguishers of water (gas pressure), Carbon-di-oxide and foam type shall be provided as first aid fire extinguishing appliances. These extinguishers shall be suitably distributed in the entire public as well as service areas.
The appliances shall be so distributed over the entire floor area, that a person is not required to travel more than 15 m to reach the nearest extinguisher.

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

Class of Fire	Description	Suitable Type of Appliances
A	Fires in ordinary combustibles (wood, fibres, rubber plastics, paper and the like)	Gas Expelled Water Type
B	Fires in flammable liquids, paints, grease, solvents and the like.	Chemical extinguishers of carbondioxide, dry powder type and buckets.
C	Fire in gaseous substances under pressure including liquefied gases (Class C fire-Not Gases but Electrical Equipment)	Chemical extinguishers of carbondioxide and dry powder type

Further, for rooms containing electrical transformers, switchgears, motors and of electrical apparatus, minimum 2 No. dry powder or carbon di oxide type/sand buckets extinguishers shall be additionally provided within 15 m of the apparatus.

Brief for Major Equipment Piping

Mild steel pipes (heavy class) as per IS:1239 shall be provided throughout the Complex. Pipes buried below ground shall be suitably lagged with 2 layers of 400 micron polythene sheet over 2 coats of bitumen.

All pipe clamps and supports shall be fabricated from MS steel sections and shall be factory galvanised before use at site. Welding of galvanised clamps and supports shall not be permitted. Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanised nuts and bolts. The size/diameter of the anchor fastener and the clamps shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

Hangers and supports shall be thoroughly galvanized after fabrication. The selection and design of the hanger & support shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchors, braces, dampener, expansion joint and structural steel shall be attached to the building/structure.

Flanged joints shall be used for connections for vessels, equipment, flanged valves and al soon two straight lengths of pipelines of strategic points to facilitate erection and subsequent maintenance work.

Fire Hydrants

External Hydrants

- External hydrants shall be provided all around the Complex. The hydrants shall controlled by a cast iron sluice valve or butterfly valve. Hydrants shall have instantaneous type 63mm dia outlets. The hydrants shall be double outlet with CI duck foot bend and flanged riser or required height to bring the hydrant to correct level above ground.
- For each external fire hydrant two numbers of 63mm dia. 15 m long controlled percolation hose pipe with gunmetal male and female instantaneous type couplings machine wound with GI wire, gunmetal branch pipe with nozzle shall be provided.
- Each external hydrant hose cabinet shall be provided with a drain in the bottom plate.
- Each hose cabinet shall be conspicuously painted with the letters “FIRE HOSE”.

Internal Hydrants

- Internal hydrant shall be provided on each landing and other locations as required by NBC with double headed gunmetal landing valve with 100 mm dia inlet, with shut off valves having cast iron wheels. Landing valve shall have flanged inlet and instantaneous type outlets.

- Instantaneous outlets for fire hydrants shall be standard pattern and suitable for fire hoses.
- For each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric lined hose pipes with gunmetal male and female instantaneous type coupling machine would with GI wire, fire hose reel, gunmetal branch pipe with nozzle shall be provided.

- Standard fire hose reels of 20mm dia high pressure rubber hose 36.5 m long with gunmetal nozzle, all mounted on a circular hose reel of heavy duty mild steel construction having cast iron brackets shall be provided. Hose reel shall be connected directly to the wet riser with an isolating valve. Hose reel shall be mounted vertically.

- Each internal hydrant hose cabinet shall be provided with a drain in the bottom plate. The drain point shall be led away to the nearest general drain.

- Each internal hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner and a Fireman’s Axe. The cabinet shall be recessed in the wall.

- Each hose cabinet shall be conspicuously painted with the letters “FIRE HOSE”.

Hose Reel

Hose reel shall be heavy duty, 20 mm dia length shall be 36.5 metre long fitted with gun metal chromium plated nozzle, mild steel pressed reel drum which can swing upto 170 degree with wall brackets of cast iron finished with red and black enamel complete.

Sprinkler System

Quartzoid Bulb Automatic Sprinkler

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

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

The sprinklers shall have 15 mm nominal size of the orifice for ordinary hazard. The orifice size shall be marked on the body or the deflector of the sprinkler. Metal guards for protection of sprinkler against accidental or mechanical damage shall be provided.

Sprinkler Installation

Sprinkler heads (fully recessed or semi-recessed) shall be quick response type, located in positions shown on the drawings. The maximum spacing between sprinkler heads and coverage area shall not exceed those stipulated in the NFPA 13 Rules.

The Fire Protection Services Trade shall co-ordinate with the ceiling Trade to set out the sprinkler locations to suit the site location of the unit grid. Chrome plated wire mesh guards shall be used to protect the sprinkler heads which are liable to accidental or mechanical damage.

Flow Requirements

The flow requirement for sprinkler heads shall be specifically approved for the designated area of installation to ensure compliance to AMAO based upon hazard classification.

Orifice Plates

For restricting pressure at lower levels in the sprinkler system, orifice plates of appropriate sizes

shall be fitted at different floor levels, at the branching points from Riser Main.

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

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

Installation Control Valves

Each installation shall be provided with a set of installation control valves comprising:-

- An Alarm Valve.
- A Water Motor Alarm & Gong.
- Installation valves shall be installed on the sprinkler circuits as shown on the drawings.
- Installation valve shall comprise of a cast iron body with gunmetal trim, and double seated clapper check valves, pressure gauges, test valve and orifice assembly and drain valve with pressure gauges, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system. A cast iron isolation valve with lock and chain at the inlet of the installation valve shall be provided.

Inspection and Test Valve Assembly

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

Flow Switch

Flow switch shall have a paddle made of flexible and sturdy material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket. The Switch shall be potential free in either NO or NC position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring the seat shall be of S.S to the Annunciation Panel. The flow switch shall have IP: 55 protections.

The flow switches work at a triggering threshold bandwidth (flow rate) of 4 to 10 GPM. Further, it shall have a 'Retard' to compensate for line leakage or intermittent flows.

Fire Pump

The fire pump shall be horizontally mounted, variable speed type. It shall have a capacity to deliver and developing adequate head so as to ensure a minimum pressure at the highest and the farthest outlet.

The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

The pump casing shall be of cast iron and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be of stainless steel. Provision of mechanical seal shall also be made.

Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5times the working pressure.

ELECTRICAL LOADS

S. NO	ITEM DESCRIPTION	CONNECTEDLOAD	RUNNING LOAD
	PLUMBING LOAD		
A)	**IN PLUMBING PLANT ROOM (PANEL – P1) FEEDER -I**		
1)	Water Treatment Feed Pump Set, 5 Pumps (4 Duty + 1 Stand by) @ 5 KW - 7.0 LPS @ 35 m	20.0 KW	25 KW
2)	Hydro pneumatic system, 5 Pumps (4 Duty + 1 Stand by) @ 12.0 KW - 10 LPS @ 60 m	48.0 KW	60.0 KW
3)	Waste Water Pumps, 2Nos @ 1.0 KW – 2 LPS @ 10 meter	2.0 KW	1.0 KW
	SUB TOTAL PLUMBING PLANT ROOM	**70.0 KW**	**86 KW**
B)	**IN SEWAGE TREATMENT PLANT ROOM (PANEL P2) FEEDER-II**		
1)	Sewage Treatment Plant	30.0 KW	30.0 KW
2)	Soft Water Transfer pump Set, 5 Pumps (4 Duty + 1 Stand by) @ 6 KW - 5 LPS @ 60 m	24.0 KW	30.0 KW
3)	Soft Water Feed Pump Set, 5 Pumps (4 Duty + 1 Stand by) @ 4KW –6 LPS @ 35 m	16.0 KW	20.0 KW
4)	Irrigation Water Transfer pump Set, 3 Pumps (2 Duty + 1 Stand by) @ 4.0 KW - 8 LPS @ 30 m	10.0 KW	15.0 KW
5)	Sewage Water Sump Pumps , 2 Nos @ 1.5 KW	2.00 KW	1.0 KW
	SUB TOTAL SEWAGE TREATMENT PLANT ROOM	**82.0 KW**	**96.0 KW**
	TOTAL PLUMBING LOAD	**152.0 KW**	**182.0 KW**
E)	**FIRE FIGHTING PUMP – SECOND BASEMENT LVL (PANEL**		

	F1) FEEDER XI		
1)	Main Electric Fire Hydrant Pump – 2280 LPM @ 80 meter	60.00 KW	-
	Main Electric Fire sprinkler Pump – 2280 LPM @ 80 meter	60.00 KW	
2)	Jockey Pump @ 2 Nos. – 180 LPM @ 80 meter	15.00 KW	15.00 KW
3)	Battery Charge for Diesel fire pump	1.00 KW	1.00 KW
4)	Roof fire pumps 12Nos. – 900 LPM @ 35 meter	30.00 KW	30.00 KW
	TOTAL LOAD – FIRE FIGHTING	**166.00 KW**	**46.00 KW**
	TOTAL LOAD – (PLUMBING & FIRE FIGHTING)	**318.00 KW**	**228.00 KW**

11.11.2 Codes and Standards

- NBC -2016 Part -4
- Relevant IS codes published by Bureau of Indian Standards.
- NFPA 10 Standard for Portable Fire Extinguishers
- NFPA 13 Installation of Sprinkler Systems
- NFPA 14 Standard for the Installation of Standpipe, Hydrant System

- NFPA 20 Standard for the Installation of Centrifugal Fire Pumps
- NFPA 22 Water Tanks for Private Fire Protection
- IS: 3844-1989-Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises.
- IS: 13039-2011-Code of practice for external hydrant system provision and maintenance.
- IS: 2190-2010-Code of practice for selection, and maintenance of first aid fire extinguishers.
- IS: 15105:2016-Design & Installation of Fixed Automatic Sprinkler.

11.12 Firefighting system

The scope shall include the followings services.

- Static water storage tanks.
- Fire Pumps & Accessories.
- External Fire Hydrants.
- Wet Riser System.
- Fire Sprinkler System.
- Portable Fire extinguishers.
- Clean agent gas suppression system for HT, LT panel, Server room clean agent gas flooding system, Floors electrical panel, HVAC, Plumbing & Fire panel fire suppression system.
- Chemical wet system for kitchen hood.

The Fire Fighting System shall consist of Diesel Fire Pumps, Electrical Driven Fire Hydrant pump, Jockey Pumps, Fire hydrant (Internal & External), Air Cushion Tank with air release valves for all risers, Down corner system with /without terrace pumps, Pressure vessel, associated instruments, cabling, piping (internal & external), valves, Fire Brigade inlet connections, draw out connections for each wet riser, fire signage's, extinguishers, Gas based fire suppression system, Fire detectors, Discharge Nozzles, control panel etc. as per NBC 2016 requirements. Jockey pumps shall maintain pressure in all water lines for Hydrants & Sprinklers fully charged under pressure for fully Automatic operation in case of fire. In case of slow pressure loss, jockey pump will start after loss of about 1 kg/cm2 pressure in the system. However, in case of sudden pressure loss of more than 1 kg/cm2, jockey pump will not start and main pump will start automatically.

11.12.1 LOCATION & SIZE OF FIRE PUMP HOUSE

- The fire pump house shall be located adjacent to underground fire tanks. The slab of UGT shall be designed structurally to take the load of fire rescue tender (if coming in the drive way area).
- The base of the water tank shall be kept at a level preferably 450 mm to 600 mm (or as desired as per codes) above the level of base of fire pump room so that pumps operate under positive suction condition& the entire water capacity is above the body of the fire pumps as per best fire engineering practice.
- Fire Pump House shall be separated by fire walls all around & doors shall be protected by fire doors (120 mins rated).

- The size of Fire pump house & distance between pumps, pumps & walls, panel & wall etc. shall be as per latest IS codes/NBC 2016. Sufficient maintenance space shall be provided inside the fire plant room for accessibility of various pumps, panels etc. during repair & maintenance activities.
- Fire Plant Room shall be suitably ventilated considering adequate ACPH as per NBC 2016 code.
- Suitable size sumps with sufficient sized submersible pumps & level indicators to be considered in plant room for drainage. Also, proper slope to be provided in Fire Pump room so that there is no stagnancy of water during any leakage & it is properly channelized to nearest drainage sump.
- Firefighting pipes from Fire Pump Room to buildings shall be laid underground at suitable depth as per CPWD specs. Adequate no. of Hume pipes having suitable dia. with spare shall be laid across the roads/pathways etc.
- Fire Pump Room shall be provided with safety equipment/items like suitable elastomeric mat (as per relevant IS codes) for Panels, fire buckets, fire extinguishers, hand gloves, safety charts, framed Schematic/SLD etc.

11.13 FIRE HYDRANT SYSTEM:

11.13.1 External Hydrant System:

External standpipe fire hydrant system shall be provided with landing valve, hose reel, complete with instantaneous pattern short gunmetal pipe in the Complex.

The internal diameter of inlet connection shall be at least 80 mm. The outlet shall be of instant spring lock type SS ferrule coupling of 63 mm dia. for connecting to hose pipe. External hydrants shall be provided with Cabinet.

Recessed cupboard/ fire hydrant cabinet of size 750 mm (L) x 600mm (w) x 250 mm (D) shall be strategically located for firefighting requirement. Location of cabinets shall be accessed as per compartment plan in consultation with the Architect. Provision of fireman's axe shall be made for internal hydrant.

External hydrant shall be located within 2 m to 15 m from the building to be protected such that they are accessible and may not be damaged by vehicle movement. A spacing of not more than 45 m between hydrants for the building shall be adopted.

11.13.2 Internal Hydrant System:

Internal hydrant shall be provided at each lift lobby with single / double-headed SS landing valve with 100 mm dia. inlet, with shut off valves having cast iron wheels. Landing valve shall have flanged inlet and instantaneous type outlets.

Instantaneous outlets for fire hydrants shall be standard pattern and suitable for fire hoses.

For each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric lined hose pipes with SS male and female instantaneous type coupling machine would with GI wire, fire hose reel, SS branch pipe with nozzle shall be provided.

Standard fire hose reels of 20mm dia. high pressure rubber hose 30 m long with SS nozzle, all mounted on a circular hose reel of heavy-duty mild steel construction having cast iron brackets shall be provided. Hose reel shall be connected directly to the wet riser with an isolating valve. Hose reel shall be mounted vertically.

Each internal hydrant hose cabinet shall be provided with a drain in the bottom plate. The drain point shall be led away to the nearest general drain.

Each internal hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner and a Fireman's Axe. The cabinet shall be recessed in the wall. Each hose cabinet shall be conspicuously painted with the letters FIRE HOSE.

Fire hose with double headed landing valve at every alternate floor shall be provided for parking tower.

11.13.3 SPRINKLER SYSTEM:

Elaborate automatic sprinkler system shall be provided in all areas including Flats, lift lobbies, common corridors and parking areas.

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

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

Wet pipe sprinkler shall be provided for flats at the wall, corridors, club house, and parking. Side wall sprinkler shall be provided in stack & parking tower.

Quartzoid Bulb Automatic Sprinkler

Sprinkler heads shall be made of brass/ quartzoid bulb sufficiently strong, in compression to withstand any pressure, surge or hammer likely to occur in the system. The yoke & body shall be made of high-quality SS with arms streamlined to ensure minimum interference with the spread of water. The deflector of suitable design shall be fitted to give even distribution of water over the area commanded by the sprinkler.

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

The sprinklers shall have 15 mm nominal size of the orifice for ordinary hazard. The orifice size shall be marked on the body or the deflector of the sprinkler. Metal guards for protection of sprinkler against accidental or mechanical damage shall be provided.

Sprinkler Installation

Sprinkler heads shall be standard response type, located in positions shown on the drawings. The maximum spacing between sprinkler heads and coverage area shall not exceed those stipulated in the NFPA 13 Rules.

The Fire Protection Services Trade shall co–ordinate with the ceiling Trade to set out the sprinkler locations to suit the site location of the unit grid. Chrome plated wire mesh guards shall be used to protect the sprinkler heads which are liable to accidental or mechanical damage. Upright sprinklers shall be provided above false ceiling having space above 800mm height.

Flow Requirements

The flow requirement for sprinkler heads shall be specifically approved for the designated area of installation to ensure compliance to AMAO based upon hazard classification.

Orifice Plates

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

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

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

Installation Control Valves

Each installation shall be provided with a set of installation control valves comprising: –

- An Alarm Valve.
- A Water Motor Alarm & Gong shall be at Gr floor level.
- Installation valves shall be installed on the sprinkler circuits as shown on the drawings.

- Installation valve shall comprise of a cast iron body with gunmetal trim, and double seated clapper check valves, pressure gauges, test valve and orifice assembly and drain valve with pressure gauges, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system. A cast iron isolation valve with lock and chain at the inlet of the installation valve shall be provided.

Inspection and Test Valve Assembly

Inspection and testing of the automatic starting of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye–pass valve and orifice assembly.

Flow Switch

Flow switch shall have a paddle made of flexible and sturdy material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket. The Switch shall be potential free in either NO or NC position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring the seat shall be of S.S to the Annunciation Panel. The flow switch shall have IP: 55 protections.

The flow switches work at a triggering threshold band with (flow rate) of 4 to 10 GPM. Further, it shall have a Retard to compensate for line leakage or intermittent flows.

11.13.4 HAND HELD FIRE EXTINGUISHERS:

Portable fire extinguishers of Dry chemical powder type, ABC type shall be provided as first aid fire extinguishing appliances as per CFO NOC / local authority guideline. These extinguishers shall be suitably distributed in the entire public as well as service areas as mentioned below,

- One Dry Chemical Powder (D.C.P.) ABC type extinguisher 9 Kg. capacity having ISI certification mark and 2 Nos. fire buckets filled with dry clean sand shall be kept in Electrical Meter Room & Lift Machine room.
- One Dry Chemical Powder (D.C.P.) ABC type extinguisher 6 Kg. capacity having ISI certification mark and one no. fire buckets filled with dry clean sand shall be kept in each floor as well as in each NR on Ground to 2nd floor.
- One Dry Chemical Powder (D.C.P.) ABC type extinguisher 6 Kg. capacity having ISI certification mark and one no. fire buckets filled with dry clean sand shall be kept in each floor as well as in each NR on Ground to 2nd floor.
- One D.C.P. ABC type extinguisher 9 Kg. capacity shall be kept for every 100 sq meter area in basement.

The extinguishers shall be planned in architectural niche/cabinet such that it shall not be manhandled by spectators, however shall be easily accessible in case of fire.

11.13.5 GAS BASED FIRE SUPPRESSION SYSTEM

SERVER ROOMS & DATA CENTRE

The Total Room Flooding system of fire detection and quenching is proposed in all Low Voltage Equipment rooms where Water sprinklers cannot be used. The Gas cylinder assembly should be UL/FM approved with seamless CCOE approved cylinder and will be connected to discharge nozzles through metal Piping. The master cylinder Kit fitted on Gas cylinder will be operated through separate Fire detection Panel and will release zero Ozone depletion potential Gas (Novec 1230) through the nozzles in case of fire.

ELECTRICAL PANELS

Tube based Fire protection system is used in the Electrical Panels to be installed in substations. The detection Tube shall be installed throughout the compartment of panels. The location and spacing of tube shall be above the hazard to be protected. Seamless aluminium PESO approved Cylinder equipped with brass valve, pressure Gauge isolation valve will be fitted on the wall of the panel with suitable brackets and will be connected to the detection tube. in case of fire the tube shall rupture at a point. The rupture Tube (UL Listed) shall result in formation of discharge point and release Gas Agent (Novec 1230) in Uniform pattern. The cylinder shall be helium leak tested

to 10^-7 mbar litre per second.

11.13.6 FIRE SIGNAGE

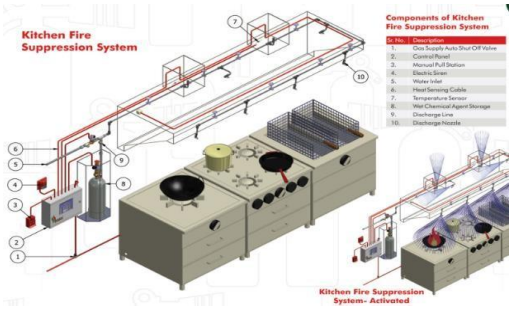
- Various types of signage are proposed as per NBC 2016 Part -4. Material of signage shall be of acrylic/aluminum of required dimensions. At every floor

near Lift landing diagram showing stairways shall be provided mentioning instructions - 'IN CASE OF FIRE, USE STAIRS UNLESS INSTRUCTED OTHERWISE'.

- The signage shall be above call push button in Lift Lobby. Floor Signage will be provided in each floor within the staircase & should easily readable. Each corridor of every floor will have directional signage indicating Fire Escape Proposed route.
- These Signage may be LED lit with UPS power backup or of photo Luminescent paints that they can be visible even in dark in case of power failure.

11.13.7 KITCHEN FIRE SUPRESSION SYSTEM: - (WET CHEMICAL FOAM AGENT)

Risk of fire hazard proves to be very dangerous in the modern commercial kitchen. Fire in kitchen is generally due to burning of oil particles. However, oil & fats burn at relatively high temperature and hence once they catch fire, extinguishing them is very difficult. Open flames, red hot cooking surfaces and a heavily grease-laden environment help the kitchen fire to spread quickly and have proven to be very difficult to extinguish. With the aim to protect modern kitchens from such risks, Fire suppression plays the important role.



General Sequence of Operation –

- Kitchen hoods suppression activation should send a fire alarm signal to the FACP and activate general alarm.
- Cut off fuel and electricity to those appliances and lights directly under kitchen hood (protected by the kitchen hood suppression system)
- Shut down kitchen hood make-up air fan, but the hood exhaust fan should keep running.

EPC Contractor shall design and execute the system work based on Kitchen System design.

11.13.8 BRIEF FOR MAJOR EQUIPMENT:

Piping:

Galvanized steel pipes (heavy class) as per IS: 1239 shall be provided throughout the Complex. Pipes buried below ground shall be suitably lagged with 2 layers of 400-micron polythene sheet over 2 coats of bitumen.

All pipe clamps and supports shall be fabricated from MS steel sections and shall be factory galvanized before use at site. Welding of galvanized clamps and supports shall not be permitted.

Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanized nuts and bolts. The size/diameter of the anchor fastener and the clamps shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

Hangers and supports shall be thoroughly galvanized after fabrication. The selection and design of the hanger & support shall can carry the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchors, braces, dampener, expansion joint and structural steel shall be attached to the building/structure.

Flanged joints shall be used for connections for vessels, equipment, flanged valves and on two straight lengths of pipelines of strategic points to facilitate erection and subsequent maintenance work.

Hose Reel:

Hose reel shall be heavy duty, 20 mm dia. length shall be 36.5-metre-long fitted with gun metal chromium plated nozzle, mild steel pressed reel drum which can swing up to 170 degrees with wall brackets of cast iron finished with red and black enamel complete.

11.13.9 FIRE PUMP:

The fire pump shall be horizontally mounted, fixed speed type. It shall have a capacity to deliver and developing adequate head to ensure a minimum pressure at the highest and the farthest outlet (as acceptable under IS 12469.

The pump shall can give a discharge of not less than 150 per cent of the rated discharge, at a he ad of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

The pump casing shall be of cast iron and parts like impeller, shaft sleeve, wearing ring etc. shall be of non−corrosive metal like bronze/brass/gun metal. The shaft shall be of stainless steel. Provision of mechanical sea l shall also be made.

Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

11.14 IS Code for Fire Fighting Work

- 1239-2004Part-I) Specifications for mild steel tube, tubular and other steel pipe fittings.
- IS 1239-2011 (Part-II) Specifications for mild steel tube, tubular and other steel pipe fittings.
- IS 1536-1976 Specification for centrifugally Cast (Spun) Iron pressure pipes with flanges for water, gas and sewage.
- IS 1538 (Part 1 to 23) Specification for Cast Iron fittings for pressure pipes for water, gas and sewage.
- IS 1726-1960 Code for cast iron manhole frame and cover.

- IS 3589-1981 Specification for electrically welded steel pipes for water, gas and sewage.
- IS 4736-1986 Galvanizing G.I. Pipes
- IS 636-1988 Non percolating flexible fire fighting delivery hose (third revision)
- IS 694-1990 PVC insulated cables for working voltages up to and including 1.100 volts (third revision)
- IS 778-1984 Copper alloy gate, globe and check valves for water works purposes (fourth revision) (Amendment 2)
- IS 780-1984 Sluice valves for water works purposes (50 to 300 mm) size (sixth revision) (amendment 3)
- IS 884-1985 Specification for first-aid hose-reel for fire fighting (for fixed installations) (first revision) (with amendment No.1)
- IS 900-1992 Code of practice for installation and maintenance of induction motors (second revision)
- IS 901-1988 Specification for couplings, double male and double female, instantaneous pattern for firefighting (third revision)
- IS 902-1992 Suction hose coupling for fire fighting of purposes (third revision)
- IS 903-1984 Specification of fire hose delivery couplings branch pipe, nozzles and nozzle spanner (third revision) (Amendment 5)
- IS 937-1981 Specification for washers for water fittings for fire fighting purposes (revised) (with amendment No, 1)
- IS 1520-1980 Horizontal centrifugal pumps for clear cold, fresh water (second revision)
- IS 1536-1976 Horizontally cast iron pressure pipes for water, gas & sewage (first revision) (with Amendments No. 1 to 4)
- IS 1554-1988 Part I PVC insulated (heavy duty) electric cables (working voltage up to and including 1100 volts (third revision)
- IS 1554-1988 Part II PVC insulated (heavy duty) electric cables (working voltage from 3.3 KV up to and including 11 KV (second revision)
- IS 1648-1961 Code of practice for fire safety of buildings (General) Fire fighting equipment and its maintenance (with amendment No.1)
- IS 3624-1987 Pressure and vacuum gauges (Second revision)
- IS 4736-1968 Hot-dip zinc coatings on steel tubes (with Amendment No.1)
- IS 5290-1983 Specification for landing valves (second revision) (with Amendments No.6)
- IS 5312- 1984 Part I Swing check type reflux (non-return) valves Part I single door pattern (with amendments nos. 1 & 2)

- IS 5312- 1986 Part II Swing check type reflux (non-return) valves Part II Multi door pattern (with amendments nos. 1 & 2)
- IS 7285 Seamless cylinders for storage of gas at high pressure.
- IS 2189-1962 Code of practice for Automatic Fire alarm system
- IS 2195-1962 Specification for heat sensitive fire detectors
- IS 732-1973 Code of practice for electrical wiring installation

The Codes mentioned are for reference. The work shall be done considering local authority requirements and up to the satisfactory level of Engineer in charge.

REDEVELOPMENT OF MOIN-UL-HAQ CRICKET STADIUM AT PATNA, BIHAR

Design Basis Report

Electrical System

BIHAR CRICKET ASSOCIATION
AFFILIATED TO
THE BOARD OF CONTROL FOR CRICKET IN INDIA

12. ELECTRICAL SYSTEM

12.1 DESIGN BASIS REPORT–ELECTRICAL SERVICES

DESIGN BASIS REPORT–ELECTRICAL SERVICES

1. ELECTRICAL&ELVSYSTEM

1.1 Intent

The intent of this report is to define the basis and enlist the salient features of electrical system design for "Construction of International Cricket Stadium at Patna". This report will be a guideline to take forward the detailed engineering design and will help in the preparation of:

1. Design Calculations
2. Engineering Drawings

This report is a preliminary report which needs to be read in conjunction with other Project Documents and Drawings. Should there be any ambiguity, the same shall be brought into the notice of "The Architect Consultant".

This report also defines the broad system requirements pertaining to electrical systems, defining the standards to be followed along with a broad scope of work, so that the battery limits gets broadly specified. It is required that the system shall be energy efficient, easy to operate and maintain, robust and reliable.

1.2 Scope of Work

The electrical services scope of work for design, supply, erection, testing and commissioning for the complete Phase-I include the following:

- Incoming 2nos.11KVpower supply feeder 1 working & one standby or provisional from State Electricity Board Grid station 1nos. bus coupler & 4nos. 11KV outgoing for Transformers.
- HT meter, Panel Board, HT Switchgear, Transformers and LV Switchgear, Main Power Distribution.
- Battery, Battery charger with DCDCB etc.
- Power Generating System
- UPS for ELV system & Emergency Lighting System.
- Lighting, LED light fixtures, occupancy & day light sensor etc.
- Lightning Protection System
- Earthing and grounding system
- Solar System as per requirement (but the quantity not less than mentioned in DBR).
- External Lighting, landscape lighting system
- Life safety and emergency public announcement system.
- Fire detection & Alarm system.
- Centralize metering & Billing system
- Elevators.
- IP CCTV System.
- Two-Way Audio-Visual System.
- Video Conferencing System.
- IT Data & Voice Networking system including Passive, Active, Wi-Fi and Hybrid EPBAX system
- Telephone & TV system

- External Façade lighting system.
- Clean Agent Suppression System for Electrical Substation H.T & L.T Panels and sub panels.
- Electrical Vehicle Charging
- Physical Security System
- Sports Lighting System.
- Dynamic Lighting System.
- Media Broadcasting System.
- IBMS System.
- Score Board.
- Provision for Live Recording and Videography System as per BCCI/BCA.
- Provision of OB Van Connection System as per BCCI/BCA.
- Access Control System

Note: -The size and rating of Transformers, DG sets, lifts, Solar PV power, UPS system, H.T & L.T Panels, power distribution system, ELV (i.e., FAS & PAS & Talkback system, CCTV, Data, Voice, Wi-Fi, Audio-Visual system etc.) systems etc. are minimum. This requirement is based on the estimated calculations. If any additional capacity is required in the above based on statutory norms, the same shall be provided without any cost implications.

Codes and Regulations

The electrical design and installation of the electrical systems will comply with the latest edition of the codes, regulations and standards of the following organizations:

- International Electric Code (IEC)
- Energy Conservation Building Code (ECBC)
- Bureau of Indian Standard Code of Practice
- Indian Electricity Rules & Regulations (IE Rules)
- National building Code (NBC)
- Institute of Electrical and Electronic Engineers (IEEE)
- National Electrical Manufacturer's Association (NEMA)
- National Electric Code (NEC)
- Indian Electricity Act (IEA)

- National Fire Protection Association (NFPA)
- Under writer's Laboratories (UL/EN-54)
- CPWD Specifications
- Local Bye-laws
- NBC 2016.

1.3 Electrical Power Demand of Campus.

The total maximum electrical power demand of campus is 3.88 MVA after considering the demand factor as per appendix-I

The detailed load calculations are given below.

These are minimum requirements and the same shall be worked out at the detailed design state and executed with prior approval of UP PWD / consultant.

Electrical Load Calculation

Appendix-I

Attached as an annexure.

Note: - The 3 nos. 20000KVA CSS and 4nos. 750KVA + 2 Nos. 400KVA DG sets are minimum requirement.

1.4 Incoming Supply

EPC Contractor shall do all necessary documentation required for getting power supply from State Electricity Board at 11KV, Double circuit for complete building to meet power demand of 3.88 MVA, for which nothing extra shall be paid apart from the electricity charges to the state electricity department.

1.5 Power Distribution System

The power supply made available from State Electricity Board Grid station to the Building at 11KV, in double circuit to cater power supply. State Electricity meter board room and 11 KV panel board room located at the main gate of campus. The 11KV power supply feeders from SEB Grid station shall be terminated at building meter board rooms.

The 11 KV power supply from SEB meter room shall be terminated in H.T. panel room near building. Further the 11 KV power supply feeders shall be taken to dry type

transformer located at service floor through 11 KV XLPE power cables.

The ESS shall have 3 no. 2000 KVA CSS with OLTC & AVR, 11 KV indoor panel board, with 2nos.Incoming, 1 nos. bus coupler& 4 nos. outgoing., 4X750KVA+2X400KVA silent D.G. sets, Main L.T. panel, DG Panel, PLC panel, APFC Panels, Utility Panel etc.

The power supply received at 11 KV H.T panel board is further connected to 11/0.433 KV, 2000 KVA indoor type Dry Type OLTC Transformer and 433V L.T. power supply connected to Main L.T. panel through bus-duct and D.G. power supply is also fed to main L.T. panel board through bus-duct as shown in schematic drawings.

The Main L.T. panel board shall supply power to various buildings main distribution panel boards, utility service panel boards, etc. as shown in schematic drawings.

The power distribution will be carried out through 1.1 KV grade, Bus Duct and Rising Mains, overhead cable trays inside the buildings.

Separate floor panels will be provided for light & fans, power and UPS power and equipment supply. Each panel or rising main shall supply power to floor panel boards located at each floor electrical room through tap-off box and further connected various utility services distribution boards etc. each small distribution incoming feeders shall be provided MCB and ELCB / RCCB & Surge protectors as incomer and outgoing feeder with MCB.

All motor control centers (MCC's), power control centers (PCC's)distribution boards shall be provided with required rating of MCCBs/ ACBs and required no. outgoing feeders with MCCBs/ ACBs of suitable rating and twenty (20) percent of spare feeder for maintenance purposes and twenty (20) percent spare space with complete wiring & bus- bars etc. for future use.

1.6 Emergency Power Supply

Emergency Power Supply Generating System

To meet the emergency power supply of Campus, Diesel Generating Sets are proposed and installed at near ESS are given below: -

I. DG Sets- 4x750KVA + 2x400KVA 415V Silent type, radiator cooled DG Sets.

These generating sets shall be providing power supply in the absence of SEB power supply or when the supply voltage drops below the preset value through DG panel. The no. of DG sets running at a time will depend on load requirement through PLC in the absence of normal supply automatically (i.e. supply from SEB).

1.7 Uninterruptible power supply (UPS)

De-centralized UPS equipment planned for some critical loads which shall be capable of providing uninterrupted power during changeover period of SEB power to DG power.

De-centralized UPS installed for back-up power to following areas:

- UPS power points for common area work stations in Admin/ Academic/Library.
- UPS power points for all ELV services viz., Fire Alarm System, Data, Voice, CCTV Security, AV & sound system etc.

UPS shall be of 3 phase input and 3 phase output configurations with 'N+1' configuration. Batterybackupupto30minutesshallbeprovided.StoragebatteriesshallbeVRLAsealed maintenance free type.

The UPS systems (True online double conversion VFI type as per IEC 62040-3) are being proposed with battery backup shall be as per requirement. Batteries shall be placed in separate room near to the UPS.

UPS are of modular design of controlled circuitry easy to install having high efficiency, low heat generation and noise. Invertors & rectifiers of UPS shall be with IGBT (Insulated Gate Bipolar Transistor) Isolation Transformer with K-13 copper winding, to achieve high reliability in the system. UPS shall have excellent dynamic control due to high switching frequency. Transient conditions and disturbance are corrected quickly to avoid any stress to the connected loads.

Intelligent Computer Interface in-built to provide software communication with almost all standard operating systems.

Considering the fact that DG back-up is planned, there shall be a UPS system for the building with batteries to provide a backup of 30 minutes to the UPS. The minimum capacity of UPS system are given below.

The UPS / Inverter Capacity will be given below as per **Appendix-II**

Hotel Block	**:**	**40KVA**
South Block	**:**	**80KVA**
North Block	**:**	**80KVA**
Hostel Block	**:**	**10KVA**
ELV Services	**:**	**80KVA**
Stands	**:**	**2x80KVA**

1.8 Sub-Board, Distribution Board and Rising Main /Busduct

- Al Sandwich Type Bus Ducts shall be provided from Transformers to main LT Panels.
- Sub-mains will be provided for mechanical equipment e.g. domestic water pump, water feature equipment, medical equipment, lift equipment etc.
- Fire Survival cable shall be provided for mechanical equipment e.g. mechanical ventilation fan, mechanical pressurization fans, fire equipment etc.

- Distribution boards shall be provided for lighting, power and UPS distribution with per phase isolation facility.
- Cables shall be provided from main LT panel to end feed units for all sub main services, above 16 Sq.mm shall be aluminum and including & upto 16 Sq.mm. shall be copper.
- All life safety equipment's cabling shall be fire survival category viz. Fire Lift, Fire Pumps, UPS, cables for Fire Alarm system, Emergency Voice Evacuation system, Security System, Emergency Lighting distribution system, Pressurization fans, smoke exhaust system.

1.9 Wiring

- PVC insulated copper conductor stranded flexible FRLS wires of 1100V grade of insulation will be used for all sub mains and final circuit wiring in conduit.
- The minimum size of copper conductor shall be 1.5 Sq.mm for light point wiring, 2.5 Sq.mm for light circuiting and 4.0 Sq.mm for power circuiting.
- In all other areas surfaced mounted MS conduit will be used for extra low voltage wiring e.g. Telephone cable, data cable, and security co-axial cable, etc.
- Armored cable will be used for external, landscape, façade etc lighting power.

S.No.	Buildings	Type of Conduits	
		In Slab	On Surface
1	All Blocks	2MM FRLS PVC	MS

1.9.1 Wiring Accessories

Electrical accessories provided for the development will include:

- All Switch Socket will be of anti-bacterial modular type.
- Socket for electric water heater, surface mounted metal clad sockets in plantrooms.
- Switch socket on table for work station will be considered separately.
- Weather proof switches and switch socket outlets for wet areas
- Isolator for, air-con. compressor, pumps and other mechanical equipment.

RCCBs for life safety with 30mA Trip subject to Local Authority Compliance.

1.10 Earthing

Safetyinusingelectricalenergyisofparamountimportanceconsideringitsdangers.Theearthing system will be in conformity with the IS: 3043. All non-current carrying metal parts forming part of the electrical system shall be connected to the grounding system. The requirement of Indian

Electricity Rules and statutory requirement of local Electricity authority shall also be met fully.

Thefunctionoftheearthing(grounding)systemistoestablishandprovide:

- T-N-S grounding system for connection of all electronic/electrical equipment to the ground grid system.
- Protection of personnel and equipment from electrical shock hazard.
- Protection of personnel, structures, and equipment from lighting hazard.
- Return ground path for ground fault protective devices.

T-N-S earthing system will comply with IS 3043, NBC and local Authority standards. All main plant rooms, electrical rooms, lift motor rooms and ELV rooms will be provided with dedicated earth bars/stations where appropriate. All equipment within the vicinity will be connected to the earth bars through appropriately sized earth cables, which will be sized in detail design stage. The generator room will also be provided with earth bars/stations.

- T-N-S earthing system will comply with IS3043, NBC and local Authority standards.

The Earthing System is divided into Two Sections:

i.	Main Receiving Substation earthing (Copper)	A	Transformer neutral earthing solidly earthed
		B	DG sets neutral earthing solidly earthed
ii.	Main Receiving Protective earthing (GI)	A	HT panel body earthing.
		B	Transformer & DG set body earthing
		c.	LT Panels
		d	Power Panel
		e	Equipment's

The earthing system for each block substation shall be provided through mat earthing with overallresistancelessthan1ohm.ProtectiveearthingmatshallbeprovidedforeachBlock/ Hall separately with overall resistance less than 0.5 ohm. The substation and protective earthing mat shall be provided below ground floor.

1.11 Lightning Protection System

A complete lightning protection system complying comprising horizontal G.I. tapes around the roof perimeter, and 25 mm x 3 mm G.I. conductor with PVC sheath and down conductor to earth electrode on ground level will be provided.

Heavy duty hinged cover inspection pit will be provided at Ground floor for the earth electrode.

Test clamp will be provided at Ground floor.

As per Indian Standard suggested early streamer emission (ese) type lightning to be used for this development and confirming to NBC-2016.

1.12 Power Factor Correction

HPFC filter having microprocessors, capacitors and other associated accessories and Step-less Power Factor Correction (for lagging current) Capacitor Bank stored enharmonic for power factor correction to near unity shall be provided to optimize power consumption along with IGBT thyristor-based switching. These panels will be connected main LT Panels in sub- station located in Utility building to maintain minimum 0.99 power factor.

1.13 Voltage Drop

Voltage Drop are not more than 5% from the output of the distribution Transformer to the final distribution board.

1.14 Lighting

Installation

1.15 System Description

The average illumination levels area as per below with Suitable LED lighting will be selected in accordance to IS-3646, NBC.

S.No.	Areas	Lux level (Eav)
1	Office areas /Classrooms	300-500-750Lx
2	Staircase	50-100-150Lx
3	Plantrooms & Substation	100-150-200Lx
4	Electrical rooms	100-150-200Lx
5	Meeting rooms	300-500-750Lx
6	Utilityareas	100-150–200Lx
7	Multipurpose hall	300-500-750Lx
8	Admin block	300-400-500Lx
9	Kitchen area	200-300-400Lx
10	Carparking area	5-20Lx
11	Landscape	20-50 Lx
12	Façade	20-50 Lx
13	Elevator lobbies/Corridors	50-100-150Lx

14	Sports Area and Other Areas	As Per NBC

All other place as per norms.

1.16 SOLAR PV SYSTEM

It is proposed that power for lights, raw power etc. shall be supplied through solar PV. These loads shall get two supplies. One from normal panel and other from solar PV. The solar panels shall be of monocrystalline type and to be installed in the terrace area of building with minimum capacity of 350KWp.

1.17 Clean Agent Suppression System

Main panels like HT, LT and main power distribution, DG change over and main supply panels for the station shall be protected with the above system. Suitable detection mechanism shall be provided for triggering the system automatically as per NBC-2016 and any other relevant standards and its amendments upto date.

1.18 LIFT & ESCALATOR SYSTEM (IN ALL BLOCKS)

26 Passenger Elevator	**:**	**26Nos.**
26 Passenger Capsule Elevators	**:**	**4Nos.**

1.18.1 General

- An efficient and effective vertical transportation system plays an important role in the successful operation of high-rise structures.
- The primary objective of the traffic study is to identify the current and practical criteria such as types of traffic, critical period, population, handling capacity and acceptable interval that would affect the traffic performance and then to evaluate the optimum speed, capacity, stops arrangement etc with the factors of cost and utilization in mind.

1.18.2 Codes and Regulations

The latest edition of the following statutory codes, regulations and specifications will be complied with:

- Local authority requirement / Vertical transportation consultant's recommendation
- BS5655 Part1 to Part13 safety rules for the construction and installation of electric lifts, and hydraulic lifts published by the British Standards Institution (BSI)

- N81 Part1 to Part13 safety rules for the construction and installation of electric lifts and hydraulic lifts, published by the European Committee for Standardization (CEN)
- As per CPWD latest specification.
- As per specification of state lift rules.
- BS7255 Code of Practice for safe working on lifts, published by the British Standards Institution (BSI)
- IS:3696 (Part I) – 1966 Safety code for scaffolds and ladders: Part I Scaffolds
- IS:3696 (Part II)-1966 Safety code for scaffolds and ladders: Part II Ladders
- Recommendations of CIBSE guide book.

1.18.1 FIRE DETECTION & ALARM SYSTEM:

This will comprise of below mentioned components

- Intelligent addressable Fire Detection system with communication, notification & Interface capability. The fire alarm control panel shall be microprocessor based with redundant CPU.
- Addressable Multi sensor detectors, Smoke detectors, heat detectors, Beam detectors with inbuilt isolators or isolator base/module.
- Manual / Addressable Manual call points for activation of fire alarm system annually with inbuilt isolators or isolator module.
- Interlocking with other equipment's likes Elevators, AHUs, Smoke Extraction system, Security system, public address system
- Manual / Addressable notification appliances like hooters, strobes within built isolator or isolator module.
- Graphic software work station shall be provided.
- Active repeater panel should be considered at security control room & Telecom room.
- Fire fighting telephone system shall be considered and shall be worked stand alone and also integrate with FAS.
- Fire telephone system shall be provided at all exits, staircase in addition to fire pump room, elevator room, electrical utility room.
- Fire survivable cable to be considered.
- Loop length not more than1.5Km.

- Each loop support maximum 240 detector/devices.
- 20% component spare to be considered in each loop and panel.
- Cablesize2C x 1.5sq. mm to be considered
- FAP with TCP/ IP port.
- Display of FAP shall be 860 character or Touch screen.
- Nickel cadmium battery for 24 hours in normal condition and 30 minute in alarm condition shall be considered.
- Location of addressable Fire alarm panel at individual blocks.
- Fire alarm system should with UL-FM/EN-54,VDSCertified

1.18.2 EMERGENCY VOICE EVACUATION SYSTEM:

- PA controller shall have digital matrix system.
- PA system shall have PC software.
- Shall support DANTE/ Cobra net.
- PA controller shall have TCP/IP.
- Pre-programmed emergency EVAC messages.
- PA controller with minimum 32 zones.
- Integrated supervision and scheduling.
- DualchannelAmplifierwith2X1000W.

1.19 TV system

- TV cabling system and associated accessories shall be provided for all buildings including wiring alongwith all the necessary equipment, active/passive devices required to complete the system upto the point where service provider can connect their equipment.

1.20 CCTV System

Surveillance systems for facilities that have high/critical security need the high definition video delivered by megapixel cameras to address surveillance and monitoring. An information security risk may have physical security ramifications and vice versa. A comprehensive look at all identified risks can assist in determining mitigation strategies. The solution design envisaged for the project

looks at implementing a surveillance and site monitoring system taking into consideration the above. Central Command Centre to be made for surveillance from a single place.

Specific Area of Implementation:

- All Common and Sitting area of South and North pavillian.
- Entry/Exit inside of all Building.
- Stair, Lift and Lift Lobbies of all Building.
- Main Entry/Exit coverage all Building.

Total Quantity of CCTV as follows but not limited to

- 5MP Dome Camera : 362Nos.
- 5MP Bullet Camera : 131Nos.
- 5MP Outdoor Bullet Camera: 100Nos.
- Lift Camera : 30Nos.
- ANPR Camera : 6Nos.
- PTZ Camera : 6Nos.

CCTV system will be IP based centrally controlled through Control Room/ Security room with reqd. displays & recording devices as per reqt. – Main Control will be provided in Admin Bldg. with suitable Monitors/Display's at center & for individual bldg. with reqd. NVR, recording & display.

Access System,

Main Gates (IN & Out) will be equipped with automatic boom barrier system with Surveillance & driver face identification system

Server Rooms, EPABX Room will be equipped with Biometric door access system.

Server Room, EPABX room & all Hub rooms will be equipped with Rodent repellent system.

Machine should be with GUI Interface, display screen, with COMMUNICATIONT CP/IP

1.21 Audio Visual System

The Audio-Visual system will ensure the institute stands up to the rigorous standards of the Global lecture delivery standards. Enabling students and faculties to use world-class technology infrastructure to accelerate learning process and creating a truly global standard institution.

A truly State of the Art Facility can be achieved with:

- High Quality classrooms equipped with technology, increased flexibility and interaction.
- A stimulated Learning environment
- Technology Customization to meet Comfort level of user.
- MeetingAcousticrequirementstocreateafatiguefreelisteningenvironment.
- State of art Audio Visual infrastructure with all modern equipment's.
- Specialist requirements for Videoondem and, Archival and Live Streaming.

HerearethelistoflocationsfeaturingstateofthearteAudioVisualSystems.

S.No.	Places
1	Conference Room
2	Boardroom
3	Meeting Room
4	Executive Rooms
5	Video conferencing Room
6	Faculty Common room
7	Seminar Hall

1. General

Supply, Installation, testing and Commissioning of Audio-Visual system complete in all respect as per drawings, BOQ and Specification.

The system shall be designed in accordance with the appropriate IS, BS or IEC recommendation.

2. Scope of Work

1. General Scope of Work:

The scope of work shall include the supply, installation, testing and commissioning of all Audio-Visual system services, equipment, components, accessories and fittings required for the operation of the facility to the extent specified and detailed on the Drawings and Specifications.

Supply and installation of Audio/Visual and control equipment in the Ceiling, Walls and Floors with all cables as required for the proper functioning of the system.

Supply and installation of all cables, outlets, etc. associated with audio-visual systems. Anything that has been omitted in any item of works and materials usually furnished with is necessary for the completion of A/V works as outlined herein before, then such items shall be and are hereby included in the section of work. The scope of work covers an Audio-Visual system in accordance with the specifications, drawings and relevant tender documents regardless of whether they are explicitly mentioned or not for the proper functioning of the AV System. The Bidder shall have to submit a detailed design after evaluating the requirement of an audio-visual system as per the details given below to AV Consultant for approval.

Projection and Display:

To ensure optimum visual impact, the classroom shall be equipped with a high-brightness 5000 lumens DLP projector to ensure crisp and vivid visuals, enhancing the clarity of educational materials presented on the screen. For optimal viewing, a motorized projection screen shall be thoughtfully selected and sized to a minimum of 115 inches diagonal, ensuring excellent visibility for all students based on the room size and seating arrangement.

Audio System:

To ensure crystal-clear audio delivery, 6 units of 6.5-inch ceiling-mount speakers shall be meticulously distributed across the classroom, ensuring uniform sound coverage. To power the loudspeakers and optimize audio performance, a high-quality Class D power amplifier shall be provided.

An effective communication setup is paramount for successful lectures. To facilitate dynamic and articulate discussions, the classroom shall feature a wireless lapel microphone, providing instructors with the flexibility to move freely around the room while maintaining clear audio transmission. Additionally, a gooseneck microphone will be installed at the podium to capture and amplify the instructor's voice with exceptional clarity. To ensure seamless integration and smooth signal management, a 12-input analogue mixer shall be utilized, allowing for effortless control and routing of audio inputs from microphones and other audio sources.

As per the tender specifications, the entire AV system must be comprehensively equipped with all essential components, including necessary wiring, connectors, and equipment racks. The Cat 6 cables should be shielded to ensure optimal signal integrity and minimal interference. For seamless high-quality video transmission, HDMI cables employed in the system should adhere to the standards of 4K Premium High-Speed HDMI Ultra-Flexible Cable. This ensures the delivery of crystal-clear and high-resolution visuals, meeting the demands of modern audio-visual presentations. To enable smooth and efficient functionality, the proposal must encompass all mandatory video switchers, network switches, routers, and access points. These components play a critical role in establishing a robust and reliable AV infrastructure, facilitating seamless data transfer and signal distribution throughout the system. Moreover, it is of utmost importance that the bidder strictly adheres to the specified tender requirements when proposing the above-mentioned products. Conformity to the tender specifications ensures that the proposed AV system will align precisely with the intended project objectives and meet the specific needs of the classroom.

15 pax Board Room/Meeting Room/Conference Room

The audio-visual system for the Board Room shall be carefully designed to cater to meetings, presentations, and video conferencing needs. A 65" 4K UHD professional display will be installed on the front wall, complemented by an all-in-one Video Conferencing Bar featuring an integrated Camera, Microphone, and Speakers. The Video Bar should support popular platforms such as Microsoft Team, Zoom, Google Meet, and others. In addition, a flush mount cable manager will be incorporated into the board

room, equipped with 1x HDMI, 1x USB, 2x USB Charger, 1x LAN, and 2x power outlets for seamless connectivity. The bidder is responsible for providing all the necessary cables, connectors, mounting brackets, and other essential components required to ensure the system's optimal functionality.

Large Conference Room /Meeting Room/Board Room

The Audio-Visual System in Conference Room shall be designed for Meetings and Video Conferencing. The Room should have 1 unit of 85" 4K UHD Interactive Flat panel Display with built-in white board, should support wireless content sharing up to 4 or more source simultaneously on single screen. The Room Should have 4 units of 55" 4K UHD Professional display. This display shall be used as extended display to make proper visibility for each delegate.

The Room should have 6 units of Table Mount enclosure with 1xHDMI and 1xUSB with F-pigtail connectors and 2 x Universal Power sockets. Manually open and close lid with Black and Clear anodize color options.

The Room should have a 4K Network PTZ Conference camera with 20x optical zoom & 60-degree horizontal coverage and 1 units of Network 4K PTZ Conference camera with 12x optical zoom & 80-degree horizontal coverage.

The room should also have a recorder and streaming device with built-in 1 TB HDD storage, can record up to any 3 sources simultaneously.

The Room should have 3 units of 1G HDMI Video Encoder having Inputs- 3 HDMI capable of streaming of 3-HDMI sources simultaneously. Resolution-up to 4K60 4:4:4 and 7 unit of 1G HDMI Video Decoder having Inputs- 1 HDMI and 1 HDBT, 1 USB C and 1 HDMI Output. Resolution-up to 4K60 4:4:4.

The Room should have a 10" Wireless Touch panel to control All AV Devices.

The Room should also have a Digital Signal Processor with minimum 12 Mic/Line Inputs and 12 Line Outputs. AEC Channels - minimum 12 assignable & routable with minimum tail length of 200ms. The room should have

The Room should also be designed for audio conferencing as well, and shall have 1 unit of Central Audio Conference controller with Recording & Web Server, Conference Controller with built-in Digital Signal Processing, Control up to minimum 50 Discussion Unit and expandable up to 150 Discussion Unit. The room should have a flush mount Chairman microphone unit with

Gooseneck Microphone of minimum Length 400mm with Bi-color led ring indication, Priority and Next-in-Line Configuration Priority button silences all delegate microphones and allows only the chairperson to speak. Next-in-line button gives the floor to the next speaker in a waiting list of speakers who requested to speak. The room should also have Delegate microphone unit with Gooseneck Microphone in two to one sharing basis, minimum Length 400mm with Bi-color led ring indication and built-in Digital Signal Processing, Unit with Microphone On / Off Button. Shall have 2 units of wireless Handheld Microphones.

The Room shall have 10 units of 4.5-inch, 2-way, Full Range, Ceiling-mount loudspeaker. To power these loudspeakers there should be an adequate class D power Amplifier with min. 1.25 times headroom.

The whole AVC system has to be complete in terms of necessary wiring, connectors and equipment rack. Cat 6 cables should be shielded, and HDMI cables should be 4K Premium High-Speed HDMI Ultra-Flexible Cable. All necessary video Switcher, Network Switch and router/ Access point to make above system functional should be provided.

Multipurpose hall cum examination hall

The audio-visual system in Divisible Multipurpose Hall cum examination hall shall be designed for presentations and teachings. The control rack shall be located at one place in the corner. The comprehensive design intends to elevate the educational experience for both instructors and students, facilitating seamless communication, engagement, and knowledge sharing within the Multipurpose Hall.

Projection and Display:

To ensure optimum visual impact, the MPH shall be equipped with 2 units of high-brightness 5000 lumens DLP projector to ensure crisp and vivid visuals, enhancing the clarity of educational materials presented on the screen. For optimal viewing, 2 units of motorized projection screen shall be thoughtfully selected and sized to a minimum of 115 inches diagonal, ensuring excellent visibility for all students based on the room size and seating arrangement.

Signal Distribution and:

A cutting-edge 4x4 HDMI matrix switcher with audio output shall be provided to manage seamless signal distribution to various endpoints. Transmitters and receiver's

unit shall be provided as per the requirement to extend HDMI signals over long distances, ensuring consistent and high-quality audio and video delivery.

Control and Accessories

The AV system shall be controlled by a sophisticated Hardware/Software-based control system. The centralized control, combined with a wireless touch display, shall offer a user-friendly interface for seamless management of audio, and video.

As per the tender specifications, the entire AV system must be comprehensively equipped with all essential components, including necessary wiring, connectors, and equipment racks. The Cat 6 cables should be shielded to ensure optimal signal integrity and minimal interference. For seamless high-quality video transmission, HDMI cables employed in the system should adhere to the standards of 4K Premium High-Speed HDMI Ultra-Flexible Cable. This ensures the delivery of crystal-clear and high-resolution visuals, meeting the demands of modern audio-visual presentations. To enable smooth and efficient functionality, the proposal must encompass all mandatory video switchers, network switches, routers, and access points. These components play a critical role in establishing a robust and reliable AV infrastructure, facilitating seamless data transfer and signal distribution throughout the system. Moreover, it is of utmost importance that the bidder strictly adheres to the specified tender requirements when proposing the above-mentioned products. Conformity to the tender specifications ensures that the proposed AV system will align precisely with the intended project objectives and meet the specific needs of the MPH.

1.22 IT Data Networking System Including Passive, Active, Wi-Fi and Hybrid EPABX System

Overview:

An IT Data network is a digital telecommunications network, which allows nodes to share resources. In computer networks, computing devices exchange data with each other using connections (datalinks) between nodes. These data links are established over cable media such as wires or optic cables, or wireless media such as WiFi.

Network computer devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as personal computers, phones, servers as well as networking hardware. Two such devices can be said to be networked

together when one device is able to exchange information with the other device, whether or not they have a direct connection to each other.

Computer networks support an enormous number of applications and services such as access to the World Wide Web, digital video, digital audio, shared use of application and storage servers, printers, and fax machines, and use of email and instant messaging applications as well as many others.

IT LAN Networking System:

General

To effectively manage and utilize available services such as Data, Voice, CCTV Surveillance & Video and other mission critical services requires a well-designed LAN infrastructure. It is in this context the Local Area Networking was envisaged as a robust and highly secured communication network. The following are the objectives that have been addressed: -

(a) Provide a common Infrastructure to all EndUsers.

(b) Ability to provide a common platform for all strategic and operation applications which require robust infrastructure.

(c) The Passive network shall serve as the transport infrastructure for data, VOIP, CCTV camera and Wi-Fi Access Points and voice telephony signals throughout the network

(d) The Network should be scalable to cater for expansion by addition of more communication nodes.

(e) The Passive infrastructure should support Quality of Service (QoS) from end to end.

3. SCOPE OF WORK:

Its plans to create a secured, ultra-high Speed Wi-Fi and Wired campus area network. This will be implemented on turnkey basis along with Path Redundancy, High Availability and Centralized Network Admission Control. The scope includes supply, installation, integration, commissioning and management. We request all interested OEMs/System Integrators/Vendors to visit Campus for further clarifications.

3.1 Requirements

1. The implementation should be able to provide network and internet services (both wired and Wi- Fi) to all the users of the campus without performance degradation. A performance metric must be defined; the design should be scalable and must ensure that the performance metric is honored for a predefined/proposed scalability/load matrix.
2. The network topology must be multi-tiered with physical and logical redundancy at each tier for High Availability, Fail over and band width maximization (and many more). All tier must be intelligent and fully manageable.
3. The entire area of ICS Patna accept stands must be Wi-Fi enabled.

4. Wireless system to be deployed should be fully integrable with the centrally controlled wireless system at campus so as to make use of the investment made by the institute on acquiring a state-of-the-art wireless network.
5. The solution must be capable of guest user management and Single Sign On across the intranet for both wired and Wi-Fi network.
6. Network security must be implemented and upgraded (for the existing) to avoid any normal or advanced threats such as zero-day attacks, bots etc. The proposed solution must be capable of identifying and quantifying network resources/entities (e.g be it user, devices, applications, software, hardware etc.) and their behavior, context, pattern in the network.
7. Cabling must be structured. Best effort must be made to maximize the use of existing cabling.
8. All the components related to passive cabling (Fiber & Copper) must be from a single OEM only.

All the active devices must be from the single OEM only. This applies to both wired and wireless Network.

AS PER NETWORK DESIGN:

a) Complete Building including Gates etc would be on Structured cabling network. Having Consolidation points at block Low Voltage (LV) room.

b) Main NOC (Network operating center) / Data Center is located in Server Room.

c) A Single Mode, Bend Insensitive Fiber Optic (SMFO) cable shall be laid in rings for each Loop/zone. Maximum facilities/ units connected to each Loop/zone are limited to 12 as one loose tube of SMFO cable caters to one facility/unit. laid through the HDPE/HUME pipes.

d) Different Hume pipes should be used if the same cable is returning from any tap off point. One Hume pipe is used for laying the cable till the destination and other Hume pipe is used for return path.

e) All passive components including Cat 6A I/O Copper patch panels, Fiber Patch Panels, Fiber pigtails, patch cords etc. as required for structured cabling shall be provided.

f) All pipe and cable laying including termination accessories like conduits/Channels/Cable trays/supporting structure, clamps, identification tags as required for laying of cables.

g) Storage of all equipment in proper environmental condition by the tenderer.
h) Supply of all special tools and tackles as required for erection, testing, commissioning
and warranty, maintenance of system at tenderer's own cost.

Expectation from New Network

2.2 Fiber Backbone

1) 3 Tier Network Architecture – Core, Distribution & Access.
2) Distribution network with 10 G / 40 Gand access with 10 G / 40 G Reliable, Future proof & Scalable.

2.3 Horizontal Copper Network

1) 1 G Ethernet & Upgradable upto 10 G Ethernet.
2) Copper Media CAT6AU/UTP solution or Better.

Application Support:

2.4 **The SCS shall be capable of supporting, at minimum, the following**

applications:

(a) Fiber Backbone Upgradable at Distribution Level 10G, 40G &100G and more.
(b) 10 Gigabit Ethernet (10GBase-T)
(c) Giga bit Ethernet (1000BASE-Tx),
(d) Analog and digital video and analog and digital voice (VoIP)

Network Architecture

LAN infrastructure should be capable of supporting a multiproduct, multi-vendor environment for services such as voice, data, video and multimedia services to all users. The Network architecture should be in a STAR configuration as per ANSI/TIA 568 C.0 standards. The Structure should be designed in such a way that the connectivity caters all the applications and provides redundancy at each point to avoid disruption of services at each level.

1. Active Part

a. Core Switch
b. Distribution Switch (Layer2and3)
c. Access Switches
d. Firewall-Network Security
e. Wireless Access Points
f. WLAN Controller etc.

g. NMS

2. Passive part

a. Cat6A Structured Cable

b. Fiber Back Bone – Single Mode, Multimode

c. Accessories such as Jack Panel, LIU, Racks, I/O Ports etc.

Main IP-PBXTelephoneExchange

1.1 The offered system shall be modular in design. The Architecture of the EPABX shall be capable of seamless migration to its maximum capacity by simply adding peripheral cards / Expansion Cabinets and without compromising on any function / features of this system or any degradation of service. The system should be capable to expand up to at least 2000 extensions, including Analog, Digital and IP. System should cover the billing system along with software & associated system

1.2 The EPABX shall support IP distributed architecture for future scope. IP access points shall be centrally administrable from the host system. Peer to Peer connectivity shall be possible on IP end points. The system shall have universal ports for line/trunk cards, where in any peripheral card can be inserted in any slot of the peripheral shelf, thereby enhancing the flexibility of the configuration

1.3 The system should be having a total equipped capacity of 4 PRI / 16 CO Lines/ IP Phones/ Digital/ Analog extensions spread over Building, namely Admin Block, Academic Block, Boys Hostel, Library, and Gates etc.

The Breakup is follows ;

3. General Terms

3.1 Any application software as required for completion of the project shall be within the scope of the bidder.

3.2 The supplier shall be responsible for all upgrades and updates of the firmware and application software during the warranty period and no separate amount should be claimed for this.

3.3 Supply, Installation and Commissioning of MDF/IDF with their all accessories required will be in supplier's scope.

3.4 Cabling & Termination from EPABX upto MDF/IDF with their accessories required will be in supplier's scope. Internal Cable, LAN Network, OFC, and UPS will be in the scope of the department.

4. SYSTEM FEATURE AND FACILITIES: -

1. Central Processing Unit:

The Central Processing Unit of the EPABX shall be Next Generation Converged, Linux based Unified Communication Server, with in-built, Ethernet LAN Port Connectivity, and Maintenance Port, MOH Connectivity, External Paging Connectivity, and USB Port for Up-gradation Purpose. No additional hardware or ports shall be utilized for these functions.

2. **Trunks ISDN (Integrated Services Digital Network)-** The offered exchange shall support ISDN & only the necessary ISDN BRI & PRI Cards (Basic Rate Interface & Primary Rate Interface) need to be added for functionality.

3. **Operating System:** The system should be ready to connect Analog Phones and Digital Phones. In addition, the system should support IP extensions, (Proprietary IP and SIP Phone soft he same make as the EPABX / IP-PBX) using MGCP/SIP Protocol resp. The operating system of EPABX should be reliable or proprietary make and should be protected against loss / alteration of memory due to power failure / unauthorized command or due to any other faulty condition The system should support Auto Restore of data in case of Power Failure; No Manual intervention should be required and all Features and facilities should be working on Power Restore.

4. **Network:** The EPABX system should support DHCP server, built-in Router / functionality with capability to its own Network.

5. **Voice Response System:** The system shall be equipped with integrated (in- built) Voice Response System (VRS) with a minimum of 4 channels for voice processing applications allowing the incoming call to be directly connected to the desired extension number after the voice response from the VRS. OGM messages could be uploaded as wave file using PC, to be used to Voice Response from within the system, without using any 3rdParty Hardware. The system should support DISA restriction to designated subscriber through Programming. At least 16 Multi Levels of DISA / Voice prompts should be supported by the system. The Multi-Level should be Upgraded to 64 Level as required, within the same embedded Server, with no additional Hardware.

The offered system shall have the following standard features i.e. Direct Inward Dialing (DID),

Direct Inward Station Access (DISA), Direct Outward Dialing (DOSA), password protected. The

system should support subscriber feature access by remote using Password.

6. **Voice Mail:** The system shall be equipped with an integrated (in-built) 4 Port Voice Mail System to be accessible to all ports of the EPABX. The recording time for voice Mail should be 200 Hours, Expandable to 1000 hours without using and 3rdParty

device. The User shall be able to access the system internally or remotely from any phone and shall be able to record standard / personal greetings within the mailbox. The system shall be able to inform the outside caller about the exact status of the desired extension (no answer / busy). The system should support Name dialing to reach the designated user. The system shall also support recording of name & personalized greeting within each mailbox. In the event of a Voice message, the system should support the following Notifications, an email should be sent to the designated user to inform the user of the message, If configured the entire message should be sent on the email in a wave file format. Message Indication on Digital Phones/ Voice Call to be made by the Voice Mail to advice of the pending Message. The Voice mail should be equipped for 2-way Manual Call Conversation recording by Attendant Console in case of an Emergency, by giving a command on the Attendant Console / Digital Phone or PC.

7. **Conversation Recording:** System should be equipped for 2-way call recording and should have option to select different extensions for recording based on number of Licenses available for simultaneous recordings. Supervisor should be able to select and record Analog / Digital / Proprietary IP phones without using any 3rd party Hardware or Application

9 **Caller Line Identification CLI on Analog Extension and Trunks:** The offered system shall have the capability to offer CLI on Analog Extensions for all internal calls. The system shall also offer CLI on Analog Trunks. The CLI shall provide Name/Number on the display of the Analog Extension. (If the Analog Phone support this feature) It should also support CLI based Routing.

10 The legacy TDM circuits should not utilize any IP bandwidth when any TDM- TDM switching is being done in the system.

11 **Conference:** It shall be possible for Digital extension user to initiate a conference of maximum 8 parties each and for Analog Phones a 3 Party Conference with any combination of internal stations & outside circuits to talk to each other at the same time on the conference circuit, (Conference without using Conference Bridge) It should support 30 Party Conference capacity for a meet-me conference facility, both by Analog and Digital Phone users.(SIP based Meet -Me Conference to be integrated with EPABX/IP-PBX). Recoding of Conference Calls should be possible if so required by the department.

The system should support Group Dial for Outbound Calls where participants can be dialed using ISDN PRI Lines. Upto 8 such groups should be supported by the system.

12 **VOIP-Voice over IP: The system shall support Voice over IP(V0IP) applications; the system should support SIP trunks, SIP and H.323Protocol for Gateway functioning, SIP Extensions for remote extensions, the remote Extensions should be able to work without any VPN and use Built-in functioning of the EPABX System.**

13. Music-On-Hold: The system shall support in-built music-on-hold. It shall also be able to upload

wave file for customized Music on Hold.

14. Message Waiting Indication for Voice Mail: The system shall have facility for lighting a Message

Waiting Lamp provided on Digital Phones. The Analog Extensions Telephone Instruments should

get a Voice prompt Notification of the Waiting Message on the voice mail unit.

15. Networking: The offered system shall be capable of networking with other exchanges using

normal LAN cable, signaling interfaces E1, ISDN, BRI/PR Ian IP Trucking. The system support in built

Logical Portioning, without any external hardware or Software on an external device or PC. Log

for Logical Portioning should be available for audit and control purposes.

16. DECT/IP DECT: The system should support DECT Handsets for Future Wireless communication. The DECT Base unit and the DECT Phones should be of the same make as that of the EPABX Main Unit. The Base station should also support connectivity on LAN, i.e. IP DECT Base Station. Each DECT Base Station shall be capable of handling minimum of 2/4/8DECT Phones calls Simultaneously. The DECT communication should support call handover without call disconnect.

17. Networking with Multiple Exchanges / Remote Sites The system should support IP networking with other remote sites on VOIP connectivity. The remote sites should be of the same make as the make of the Central EPABX /IP-PBX (No 3rd.Party Gateway is to be used) . The Command and Control of the entire Network should be with the Central unit and the slave / remote site should work seamlessly without any feature loss. The system solution should support minimum 12 such remote site connectivity in Master Slave/site Concept.

18. Unified Messaging: The system should be capable of In Skin; Card based Unified Messaging facility to provide Fax and E-mail on the same desktop. The same will be required for Future use and should be possible with additional Hardware or

equipment from the same OEM.

19. **UCD / ACD**: The system should support ACD routing for Contact Center/Helpdesk functionality, with Queue Message announcing Caller, waiting number and time, without using any 3rdParty Hardware. The same will be required for Future use and should be possible with additional Hardware or equipment from the same OEM.

20. **Diagnostic & Enhanced Maintenance Facility: The system shall have in-built diagnostic features. The system should be programmable using Browser, without using /installing any Application in the PC. The offered system shall have remote maintenance facility over IP. The system should have in - built Web Server for Remote Web-based Maintenance and support, SNMP, FTP, HTTPS, IMAP4, NTP, NAS connectivity ON NFS, In case of an error an email should to the Administrator, conveying the error message. The system should be capable of firmware update.**

The system shall be capable of working in a suitably ventilated non-air-conditioned environment. System design shall be immune to noise from various sources like power supplies, lighting system etc. The Power Supply of the equipment should be Fan cooled to provide maximum uptime.

All components should be rated for continuous operation of the system. It should be designed in such away that any damage in any circuit /subassembly /assembly should be self-containing and should not be propagate to other parts of the system. The system should support Hot Swappable facility for Trunk, Extension & Interface Cards.
EPABXs operating on AC shall have in built battery charging arrangement within the Power Unit for providing battery Backup for 1 hr minimum. Batteries for this purpose shall be ordered Separately.

21. **ATTENDANT CONSOLE: The offered exchange should include 1 No. of Attendant Console. Exchange shall be capable of supporting up to a minimum of 2 nos. of Attendant Consoles. The administrator should be able to monitor the status of trunks & should be capable of attending / holding multicalls at one time. The Attendant Console should have dual color LED Indication for differentiating between the used & self used lines. It should also have a Large Graphic Display, to distinguish between Trunk call sand Extension calls.**

Following minimum facilities in console shall be

- 6 lines Graphic Display with LCD back lit
- Visual Display of Calling & Called Station
- Missed Call List, minimum 10 calls

- Volume Control
- Handset and Headset MIC Mute
- Keypad Dialing
- Computer Software based Call Control with Caller ID Display, Call Hold, Call transfer, Conference, Speed Dialing, Presence for Specified Extensions, Missed Call, Contact List of 100 Users.
- Interface for Headset Operations-Wired
- Electronic Hook Switch Control Port (EHS)
- Busy Override
- Subscriber Identity for incoming Call
- Call Splitting
- Trunk to Trunk access/Transfer
- Transfer of trunk call to another Console
- Breaking into busy extension with an interruption tone
- External Line Hold
- Call Parking
- Selective pickup of calls on Hold
- Call Pickup
- Camp on Busy
- Night Service Control
- DSS (Direct station selection) with at least 40 keys indication.
- OHCA, Off Hook Call Announcement (in case of Busy Operator)
- Call Waiting

22. Subscriber Facility

(i) The offered system shall have the capability of assigning to use extension a variety of specified services. Further class of service restriction shall be available

to the subscribers. Call forwarding shall be available in the offered system.

(ii) The system shall support abbreviated dialing system for numbers.

(iii) The system shall be capable of allowing the users to access all the facilities from any extension of the EPABX. The system shall allow user to assign passwords to their phones to prevent misuse of subscriber's facilities provided.

(iv) Least cost routing through alternate public networks on different time of day basis shall be available

(v) Night Service: When night service is activated, the operator calls shall be routed to predefine answering position**.**

23. The offered system shall have the following minimum features for the subscriber:

Hotline Attendant

Recall

Call forwarding preset/busy/No answer

Smart Desk for Walking Extension/ Free seating across Campus

Call Hunting

Automatic Call Back

Call Waiting

Station Camp on Call back on busy

Hunting method change for each type of calls

DND (Do Not Disturb)

DNDO (Do Not Disturb Override)

Consultation hold

Call Pickup

Call Parking and Retrieve

Extension to extension inter combarring

Storage of last number dialed

Discriminative Ringing–between Internal and external Calls

Class of Service Control Busy Override

Auto Answer on Digital Phones Boss- Secretary Functioning

One Extension for Sr. executives (2 Digital Phones should work in parallel as a single extension, Table /Sofa Concept)

24. The system should support UCD/ACD based routing and MIS reporting. The group members should be able to LOGIN and LOGOUT for Receiving Call son the Analog and Digital Phone. The Data should be available on the MIS Reporting Software. Queue Message should be available by default in case the members are All Busy, Routing to Operator / Supervisor should be available

25. The system should support ACD based Reporting for Future use by Activating Feature Key

Objective

- Resource sharing is the main objective of the computer network. The goal is to provide all the program, date and hardware is available to everyone on the network without regard to the physical location of the resource and the users
- Provide the high Reliability. It is achieved by replicating the files on two or more machines, so in case of unavailability (due to fail of hardware) the other copies can be used
- Computer network have provided means to increase system performance as the workload increases (load balancing). In the days of mainframe when the system was full it was to replace with the other large mainframe computer, usually at and expensive rate not convenience for user
- Computer network help people who live or work apart to report together. So, when one user prepared some documentation, he can make the document online enabling other to read and convey their opinions. Thus computer network is a powerful communication medium

General Terms and Conditions:

- All copper & Fiber component should be from single OEM as per the makes given in the tender documents.
- All passive components should be RoHS (Restriction of Certain Hazardous Substances) complied. Declaration-RoHS should be clearly mentioned on datasheet of each Passive Component

- There should be a minimum of 25 years warranty assurance for all supplied cabling components.

Guidelines for Copper and Fiber Installation

6.1 Copper Cabling Installation Specifications

Telecommunications Outlet& Horizontal cross connect Installation

(a) Cables shall be coiled in the surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. No more than 12" of slack shall be stored.

(b) In addition, each cable type shall be terminated as indicated below:

- Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-B document, manufacturer's recommendations and/or best industry practices.
- PairuntwistshallnotexceedO.5inchesandSheathremovalwith in 1 Inches at the termination for Category 6 connecting hardware. SL Series Termination Tool helps us to achieve the better results.
- Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.
- The cable jacket shall be maintained as close as possible to the termination point.
- Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

Horizontal Distribution Cable & Installation

(a) Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

(b) Cable raceways shall not be filled greater than the manufacturer recommended guidelines.

(c) Cablesshallbeinstalledincontinuouslengthsfromorigintodestination (no splices).

(d) The cable's minimum bend radius and maximum pulling tension shall not be exceeded.

(e) Horizontal distribution cables shall be bundled into groups of not greater than 40 cables. Cable bundle quantities in excess of 40 cables may cause deformation of the bottom cables within the bundle.

(f) Cables shall not be attached to ceiling grid or lighting support wires.

(g) A self-adhesive label or PVC marker ferules shall identify the Cables. A cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate. Similar label or marker ferrules shall also be placed on a section of the cable near to the patch panel termination.

(h) Unshielded twisted pair cable shall be installed so that there are no bends less than four times the cables outside diameter (4 X cable outside diameter) at any point in the run.

(i) Pulling tension on 4-pair UTP cables shall not exceed 25-pounds for a single cable or cable bundle. The pathway shall be adequately sized so as not to exceed the 80% cross-section fill of cables. The pathway shall be securely installed in the facility.

(j) HorizontalCabledistanceshallbewithin90 Meter.

6.2 Installation Guide Line for Fiber Optic Cable: Internal

(a) General

This section describes general precautions to be taken when installing fiber optic cable in a building and the safe handling and disposal of optical cable. The methods and instructions provided are intended only as guidelines, as each installation will be influenced by local conditions and user preferences.

The reader should be experienced in fiber optic cable installation

Methods used for installing fiber optic cables are very similar to those used for installing standard copper cable. However the qualities and characteristics fiber optic cable can be degraded when it is subjected to:

- Excessive pulling.
- Excessive tension.

• Crushing forces.

(b)Safety Precautions

It is important to observe the following safety precautions when installing cable in a building and between buildings. These practices may change, or may not be suitable for a specific situation, so are therefore only suggested guidelines. Cairn Energy safety precautions and practices take precedence over any conflicting recommendations given in this section.

Caution: Before starting any cable installation, all personnel must be thoroughly familiar with all applicable Occupational Safety and Health regulations, local regulations, and company practices and policies. To minimize hazards to yourself and others in or near the work area, follow all company rules for setting up barricades, ladders, scaffolding, and warning signs. Any material used above the floor should be arranged so that it cannot fall and hit individuals underneath. Observe standard safety precautions. Wear safety headgear, eye protection, gloves, etc., as specified in your company's practices.

Pulling Precautions:

• Personnel normally should not remain in an area where a cable is being pulled under tension around a piece of hardware. Personnel can remain in such an area (e.g., to observe the alignment of a cable around a corner block), if he or she stays clear of the hardware under tension and has a clear path to safety.

• If you use a cable lubricant during a pull operation, make provisions to clean up any spilled lubricant to prevent slipping and possible injury. (Care must be taken if using lubricants as they may react with certain cable sheath types.)

Laser Precautions:

Laser light can damage your eyes. Laser light is invisible. Viewing it directly does not cause pain. The iris of the eye will not close involuntarily as when viewing a bright light. Consequently, serious damage to the retina of the eye is possible. Never look into the end of a fiber, which may have a laser, coupled to it. Should accidental eye exposure to laser light be suspected, arrange for an eye examination immediately.

Cable Handling Precaution sand Specifications

The following section provides general guidelines for internal

installation of fiber optic cable. (This information is based upon standard cable designs). Mechanical specifications, minimum bend radii and cable temperature ranges can be obtained by contacting the OEM.

Caution: Fiber optic cable is sensitive to excessive pulling, bending, and crushing. Any such damage may alter the cable's characteristics to the extent that the cable may have to be replaced. To ensure all specifications are met, consult the specific cable specification sheet for the cable being installed.

Note: Zip twin and Single Fiber Cables are designed for use as "jumpers," "patch cords" or "pigtails". These cables are not intended for use in installations requiring long or difficult "pulls" or routing between buildings.

• Leave the protective covering on the reel intact until it arrives at the installation site. If the covering has been previously removed, secure the cable end(s) during transit to prevent damage.

• Cable reels should be stored vertically on their flanges, end-to-end in rows and chocked to prevent rolling. Make sure that reels rest edge-to-edge with reels in adjacent rows to prevent damage to cables.

• Before the installation begins, carefully inspect the cable reel for protrusions such as nails and broken flanges which might cause damage to the cable as it is unreeled.

• Take precautions to protect reeled cable from mishaps or other sources of possible damage. Any damage to a section of cable may require replacement of the entire section.

• If the cable must be unreeled during installation, use the "figure-eight" configuration to prevent kinking or twisting. Do not coil fiber optic cable in a continuous direction except for lengths of 30 m (100 ft.) or less.

Installation Considerations

Fiber optic cable can be installed inside buildings using the same methods as coax or twisted pair; however, the following guidelines should be observed:

• Do not deform the cable sheath, specifically when using cable fasteners or ties to secure the cable to a support or hardware

• Do not exceed the cable's maximum pulling tension.

• Do not pull fiber optic cables with copper cables

• Do not pull fiber optic cables over existing cables. The friction could be excessive and cause cable damage. The cables may also become entangled, resulting in damage to the fiber optic cable.

• Do not exceed minimum (installed and long-term) bend radius. (The minimum bend radius varies with the cable diameter. Consult the appropriate Cable specification.)

• Do not pull the cable around sharp corners, such as support brackets.

• Provide additional crush / mechanical protection in high-risk environments.

• Secure the cable to larger permanent cables or available supports when possible. Do not attach the cable to cables that may be removed later or to steam or water lines

Caution: Installation tension exerted on fiber cables may cause the buffered fibers to a sinusoidal “wave” appearance. This effect is caused by installing the cable incorrectly. OEMs generally recommend that all tight-buffered cable pulls employ a grip on the pull end of the cable coupled to the aramid strength member, not the cable jacket.

Pulling grips should be used regardless of the length or duration of the pull. If the pulling end of the cable has not been connectorized, then a knot can be tied in the pull-end of the cable before attempting the pull. If cables are pulled without coupling to the strength member, the cable jacket will stretch. When the jacket relaxes, it may bunch up the fibers underneath the jacket, which may result in degraded fiber performance.

Conduit/InnerductUsethefollowingguidelineswheninstallingcableinarigidconduit:

• Ensure the conduit system does not exceed minimum bend radius.

• Do not pull the cable through pull boxes or junction boxes unless the cable's bend radius can be maintained through the use of conduit or inner duct

• Avoid the use of elbows if possible and use an elbow only if the cable's long-term bend radius can be maintained. Never pull cable "through" an elbow. Pull the cable out of the elbow and “back-feed” it into the conduit exiting the elbow for a second pull.

• Inner duct is semi-rigid plastic tubing commonly used in fiber optic installations to subdivide the duct and to provide for future cable pulls. Proper size and installation of the inner duct is critical for ease of cable installation.

• If additional cables, specifically larger, bulkier cables, are to be installed in the same conduit, install the fiber optic cable inside an inner duct for mechanical protection

• Eliminate sharp

edges. Tension

Monitoring

• Fiber optic cable is subject to damage if the cable's specified maximum tensile force is exceeded. Except for short runs or hand pulls, tension must be monitored. Maximum pulling tension varies with the cable fiber count. Refer to cable specification sheets for maximum tension.

• All pulling equipment and hardware which will contact the cable during installation must maintain the cable's minimum bend radius.

Vertical Runs

• Each fiber optic cable in the vertical run needs to be supported by its own support grip at the top of the run.

• Never use fiber optic cables as support for other cables.

• Cables that are individually supported may be taped or cable-tied together every 3 meters (10 ft.)for cable management – not support.

Fiber Optic Cable Disposal

At the end of the products service life there is the potential to recover and recycle component parts of the cable.

When handling and disposing of waste fiber optic cable, observe the following guidelines:

• Comply with Local legislation.

• Consider recycling opportunities.

• Fiber waste should bed is posed of safely, the use of sharps containers is recommended for waste fiber shards

7. Important Specifications of Networking Passive Components

Reference Standards

Design, manufacture, test, and install data distribution systems per manufacturer's requirements and in accordance with NFPA 70 (National Electric Code), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following ANSI/TIA/EIA Standards.

1) This Technical Specification and Associated Drawings
2) ANSI/TIA/EIA/568-C.1, Commercial Building Telecommunications Cabling Standard – 2009
3) ANSI/TIA/EIA568-C.2, Copper Cabling Components Standard
4) ANSI/TIA/EIA568-C.3, Optical Fiber Cabling Components Standard
5) ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces
6) ANSI/TIA/EIA-606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
7) ANSI/J-STD-607-A, Commercial Building Grounding (Earthing)and Bonding Requirements for Telecommunications
8) Building Industries Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM)
9) ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers

One of the following types of cables shall be used for backbone wiring as defined in schedule of quantities.

1. 100-ohmUTP/STP multipair backbone cable.
2. 50/125 umOM3/OM4 optical fiber cable.
3 9/125umoptical fiber cables

The EPC Contractor has to assure that cross talk coupling between individual, unshielded twisted-pairs shall not affect the transmission performance of multi-pair cables.

Grounding Considerations

Grounding system shall be an integral part of the telecommunications wiring system. In addition to helping protect personnel and equipment from hazardous voltages, the grounding system shall reduce the effect of electromagnetic interference ((EMI) to and from the telecommunications wiring system.

Grounding shall meet the NEC requirements and practices or local authorities or codes whichever impose a more stringent requirement.

Essential Eligibility Criteria OEM for Passive Components:

a) OEMshouldbeISO9001ISO14000Certified.

b) The vendor /OEM should provide test reports generated from any testing software / deviceforminimum15000nodesinsupportofexperiencetoexecutingsuchrequirement of margin (3 dB or higher) for Cat 6A of NEXT (worst case) for entire frequency range specified in ISO/IEC 11801. (Details must be provided).

c) The OEM of Passive components is required to provide the Product warranty and Performance warranty of minimum 20 – 25 years from the date of commissioning. (Details must be provided).

d) The OEM of Passive Components should have minimum 3 RCDD (Registered Communication Distribution Designer) certified people on the OEMs payroll sitting in India whose services can be utilized for this project. Valid Certificates of the OEM employees along with a letter from the OEM HR Department verifying that the employees are in fact sitting in India should be submitted. (Details must be provided).

e) The OEM of passive components should provide UL/ETL certification for the full Cat 6A U/UTP copper channel link (UL/ETL 4 connector test report) with at least 3 dB NEXT headroomandCAT6atleast6dBNEXTheadroomforentirefrequencyrangespecifiedin ISO/IEC 11801 also the individual copper components and fiber cable should be UL/ETL listed.

f) AllpassivenetworkcomponentsquotedbythebiddershouldbefromasingleOEMonly (Copper & Fiber).

g) All the Single mode and Multi-mode fiber cables & fiber patch cords should be **Bend insensitive**. Single Mode fiber cable should be as perITU-TG.657withzero/ low water peak construction, OS2. (Details must be provided).

h) TheCat6AU/UTPCableshouldbecompliedwith**IEC60332-3-22**featuresfor environment safety.

i) Cat 6Aperformance even when termination is within 15meters thus ensuring eliminating short resonance for 4-connector channel (UL/ETL Report for 4 Connector need to be submitted).

j) The supplied passive product must have capability to upgrade to Intelligent Cabling System without any downtime and they must have their own solution of Intelligence including software Reference with product data sheet must be provided.

k) The Cat 6A U/UTP Cable Should be **ETL Verified** and all passive components should be RoHS complied. Declaration of RoHS compliant should clearly be mentioned on datasheets of each Passive Components.

l) All Cables (Copper or Fiber) should have a unique number printed on the cable jacket. This unique identifier shall be used for on-line reference to a full set of factory tests that were performed on a sample from the same mater reel. The on-line reference must be available on the SCS vendor public website, such that it can be accessed at any time.

m) Data Sheets of all proposed products should be available on the OEM public website. The data sheets provided on the OEM public website and submitted data sheets should be the same.

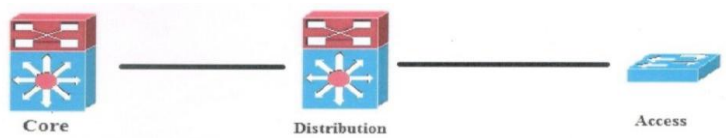
n) All passive components should be RoHS complied. Declaration of – ROHS compliant should clearly be mentioned on data sheets of each Passive Components.

o) The OEM of passive components to be quoted by the bidder should be present in India from at least past 10 years. (Details must be provided).

p) OEM should have technology development program partnership with minimum of 1Active networking (Switches and Routers) OEM's globally. (Reference required).

Note: Failing to comply with any of these terms and condition will lead to rejection of the offer.

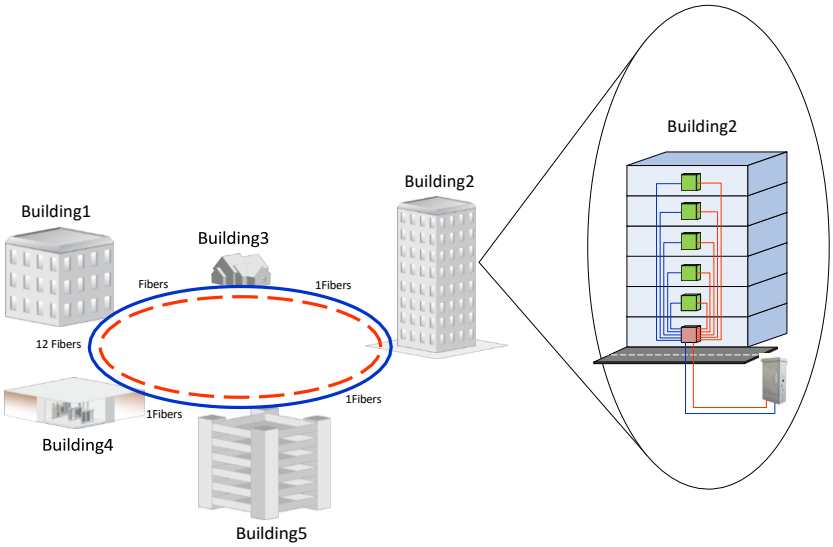
Hierarchical



Three - Tier Architecture (with physical and logical redundancy at each layer)

Ring Redundancy Architecture for Campus Distribution Connectivity:

Within Building : Star Topology.
Building to Building : Ring Topology.



IMPORTANT NOTE: All the works will be done as per relevant standards amended upto date with prior approval from the EIC/Consultants considering all requirement mentioned in the DBR is the bare minimum. Also all the calculations to be done by EPC contractor shall have prior approval of EIC/Consultant before execution.

ACCESS CONTROL SYSTEM

The Access Control system shall be fully integrated and installed as a complete package by the Access/Security Control Contractor. The ACS shall be able to provide for and integrate (as required) the following subsystems:

·Integrated Access Control
· Alarm Monitoring
·Integrated Digital Video Management (CCTV system)
·Interactive Alarm/Facility Graphics Display
Associated Access Control and Alarm Equipment Control
·Access Initiated and Event Initiated Control

The Controller shall be based upon a distributed system of fully intelligent, stand-alone con trollers, operating in a multi-tasking, multi-user environment on a true peer-to-peer,token passing Local Area Network (LAN). The SMS shall be capable of monitoring,recording, and d isplaying card access activity and supervised alarm inputs/outputs on a continuous,real tim e basis. Each installation shall comply with local, state, and federal code requirements as ap plicable. The system shall be user friendly, providing a user interface that allows for training of non- technical personnel to effectively operate and administer the system.

The ACS shall be designed to provide a centralized location with the ability to monitor,cont rol,view, and communicate from a secure location within a facility or within the facilities or systems network.

System expansion capability: Minimum 100% over specified requirements with no addition al software or required software upgrades.

Following spaces shall be provided with Access control system:

1) Main Building Employee Entry & Exits
2) Data Server/HUB Rooms
3) Main HT/LT Electrical Rooms
4) Floor level service Rooms
5) UPS & Battery Rooms
6) IBMS/Security Control Room at Basement floor
7) Main Fire Control Room at ground floor

7.BUILDING MANAGEMENT SYSTEM

7.1 GENERAL

Building Management System (BMS) has become an essential and vital mean for good esta te management of modern building developments.

The system provides effective remote control and monitoring of all building service system s and equipment. It also provides assistance in essential tasks such as energy audit /consu mption management, maintenance management of all mechanical and electrical services,f ailure and other important event records, etc.

Substantial operating cost savings can be possible from optimum energy usage,minimizing

equipment failures, minimizing human resources for estate management,etc. All these are expected from the proper implementation and operation of the BMS.

7.2 SCOPE OF WORK

The scope of the BMS installation works will generally consist of the following:

Central equipment comprising dual microcomputer-based server, CRT monitor,keyboard, m ouse, back up tape drive, printer and Ethernet switch, mimic panel, etc.located in the Cont rol Room for central monitoring and control purposes

High speed communication link and distributed intelligent field panels with complete integ ration of local communication loops and Direct Digital Control (DDC) to control and monito r mechanical and electrical systems. Status and fault monitoring, sequenced and scheduled starting and stopping, optimization of plant operation, duty cycling of standby/duty plants, run time totalisation, etc. are some of the typical functions

Interfacing between building mechanical/electrical systems inclusive of security systems,A HU, MV fans, Electrical HV, LV, generator, transformer, lighting timer control, pump contro l and monitoring,etc.

7.3 SYSTEM DESCRIPTION

General

The BMS will be designed and configured to perform the following functions:

·Basic status/alarm monitoring

·Analogue parameter monitoring

·Remote/programmed start/stop controls

·Direct Digital Control (DDC) of air-conditioning systems

· Optimization of plant operation to meet demand by matching demand calculation with runni ng capacity

·Duty cycling of duty and standby plants and run time totalisation

·Report generation,alarm,fault and change of status reporting·Dynamic grap hics representing the mechanical and electrical Systems.

In addition, the following software functions will be specified:

·Hot redundancy standby at the CPU level

·Graphics of mechanical/electrical systems

·Prioritizing of alarm messages to be displayed without affecting the current screen contact

·Multi-tasking,multi user capability for current real time usage

·Real time event based reporting and recording plus alarm management with relative instructi on capability

·Security level access limit

·Help menu for software package to include run time totalisation,time programme and mainte nance management

There will be two printers, one for printing alarm reports; another one is for trend logging.

The main equipment in the Engineers Office and all field panels will be supported up by UP S.

The following systems will be connected to and integrated with the BMS:

·Fire protection and alarm system

·Plumbing and drainage system

·ACMV/HVAC system

·Electrical system

·Security system

·Lift system

7.4 FIRE SERVICES SYSTEM INTERFACE

The system will receive signals from the Fire Services Interfacing Panel and perform the f ollowing monitoring functions:

·General fire alarms indication

·"On-off" status indication of fire pump motors

·"Low and high" level alarms for sprinkler/hose reel tanks

7.5 PLUMBING & DRAINAGE SYSTEM INTERFACE

·"On-off" status indication of all the pump motors

·"Alarm"indication of all the pump motors

·“Low and high" level alarms of water tanks

·"High level" alarm of sump pits and sewage tanks

7.6 ELECTRICAL SYSTEM INTERFACE

The following monitoring functions will be provided for HV switchboards, transfor mers and LV switchboard:

· Voltage, current and kW monitoring of main power supply from Power Grid

·"On-off" status indication of all ACBs

·"Trip"alarm of all ACBs

·“Voltage,ampere,kWh"indications for primary all ACBs

·“On-off" status indications and operation time control for all common area lighting dist ribution boards

·Amp/Volts/kW/Power Factor readings of major switchboard incomers

·Temperature alarm indication for transformer

·Temperature trip indication for transformer

·Centralised standby Generator on / off/alarm status indication

7.7 LIGHTING CONTROL

"On/off" control of public lighting on a predetermined time programme for comm on areas such as corridors, staircase, external facade, roof, landscape, etc.

7.8 OTHER FUNCTION

All abnormal conditions will be displayed at the monitor and logged by printer with audible alarms inside the FCC

Energy audit of kWh for each building component and entity and other serv ices required by local authority.

7.9 AIRCONDITONING SYSTEM INTERFACE

The control system will generally be of Direct Digital Control (DDC) with software a nd energy management system residing in memory to execute optimum control,m onitor and maintain the desired conditions by operating the appropriate actuators and switching devices.

Monitoring Functions

·“On/off" status indications of all AHUs

·"Alarm" indication of all AHUs

·"Totalised run time" indication of all AHUs· "On/off" status indication o f all ventilation fans

·"Alarm"indication of all ventilation fans

·"Totalised run time" indication of all ventilation fans and AHU

· Supply and return air temperature indication of all AHUs. High/low limits can be assigned to each temperature point to alert the operator when these limits are reached

·Filter cleanliness indication for each air handling unit or primary air plant,A/C units serving lift machine rooms and major plant rooms

·AHU/PAU chilled water control valve positions and status

·Chilled water flow rate of all tenant AHU

·Temperatures of chilled water supply from the chilled water plant

· High temperature alarm of transformer rooms, generator rooms, switch rooms and major plant rooms

7.10 CONTROL FUNCTIONS

·All air handling units and primary air units will be controlled by the BMS.The following functions will be incorporated:-

- 'Start-stop' of all handling units
- Variable air volume control (if applicable) of the air handling units
- Supply air temperature reset in response to load variation
- Minimum outside air control
- Early morning cycle

·ON/OFF control of all ventilation fans on an optimised time schedule

·ON / OFF control of air conditioning equipment according to a predetermined time schedule which is adjustable via the BMS

·Secondary chilled water pump ON/OFF and pump speed control

·ON/OFF control of air-to-air heat exchangers

·ON/OFF control of all retail unit FCUs

7.11 OTHER FUNCTIONS

·All abnormal conditions will be logged by printer and displayed on the monitor with audible alarms

·During fire situation, ON/OFF control of all related ventilation fans

8. INTELLIGENT, ADDRESSABLE & MONITORED EMERGENCY & EXIT LIGHTING SYSTEM:

8.1 OBJECTIVE

The objective is to install an addressable & monitored emergency & exit lighting system interfaced w ith third party fire alarm system to provide emergency escape route lighting & exit directions in case of emergency. The purpose is to illuminate the escape route &directional signs to enable safe evacu ation & to avoid panic & stampedes. It shall also include input/output modules for integration with t hird party building management system,etc. The system shall be state of the art, capable to provide pinpoint location of fault in emergency lighting circuit, fast acting, and microprocessor based, appro ved &reliable electrically operated System.

REFERENCE STANDARDS

EN50171,EN1838,EN60598-2-22 compliant

SGS & CE Approved

8.2 SYSTEM DESCRIPTION

Addressable & Monitored Emergency & Exit Lighting System is proposed on all thefloors in all escape routes.

The addressable & monitored emergency lighting system is designed as per EN50172,EN1838, BS 54 99 standards.The emergency & exit lighting system shall be treated as a life safety system, and shall have approvals from EN60598-2-22, EN1838 & EN50171.

The Emergency Escape route Exit lights shall be installed in following locations as per NBC of India & NFPA101:

At each Exit door intended to be used in an emergency

At mandatory emergency Exits

At each change of directions on the escape route

At each intersection of corridors

On other suitable locations on Emergency Escape route depending on the Exit light visibility & viewing distance

At every change in floor level

· Above all fire alarm call points & fire-fighting equipment

In each toilet exceeding 8sq.m of area

At every flight of stairs In open areas There shall be a Main Emergency & Exit Lighting Central Battery System Panel (Henceforth termed as Central Battery System Panel) with Battery Bank caterin g to all floors and located in the BMS Room.

The Central Battery Panel shall consist of multiple circuits to accommodate all the luminaries and de

vices with the spare circuit capacity of 20%.

All the luminaries and devices are connected to main panel and all output circuits are activated from the same.

The Central Battery System Panel can be hard wired integrated with the building fire alarm panel usi ng output relay modules & input relay modules. In this configuration,when the fire is detected by fir e alarm pane, the central battery system panel will switch on all the emergency & exit luminaries co nnected to it.

The components of the system shall be as described below.

8.2.1 Addressable Central Battery System Panel

It is proposed to install addressable EN50171 approved Central Battery System Panel with LCD displa y, Circuit cards catering to the no. of luminaries & devices, Processing unit,Power supply unit with Ba ttery charging circuit. The panel shall be microprocessor based with all required mandatory circuits & relays housed in aesthetically pleasing MS powder coated Cabinet with optional IP 31 rating.

8.2.2 Addressable Emergency Luminaries

It is proposed to install Emergency luminaries in Rooms, Escape routes & Open areas.Rectangular dir ectivity type luminaries are proposed in the corridors & office areas (exit access). Higher lumen outp ut luminaries are proposed in staircases, parking driveways,basements, high ceiling height areas etc. The luminary placing shall comply to relevant standards & manufacturer guidelines.

8.2.3 Addressable Exit Luminaries

Exit Luminaries shall be mounted on all escape routes & at all exit points from the floors of a building . Exit luminaries shall be mounted as low as possible with a minimum height of 2.5m from the floor. The maximum viewing distance for anyone to view Exit lights in order to view the correct direction s hall not be more than 25m. Addressable Exit lights with Single/Double side directional pictogram sha ll be used.

Sub-Circuit Monitoring Devices

Sub-circuit monitoring devices (Intelligent Controllers) are proposed in order to monitor the power s upply status of the local normal lighting floor DB. Sub-circuit monitoring devices shall be placed on t he floors near normal lighting DB.

8.2.4 Battery Bank

The System is proposed with backup power from Battery bank through maintenance-free VRLA stora ge batteries capable of providing 90 minutes of power backup in emergency condition with 100% lu

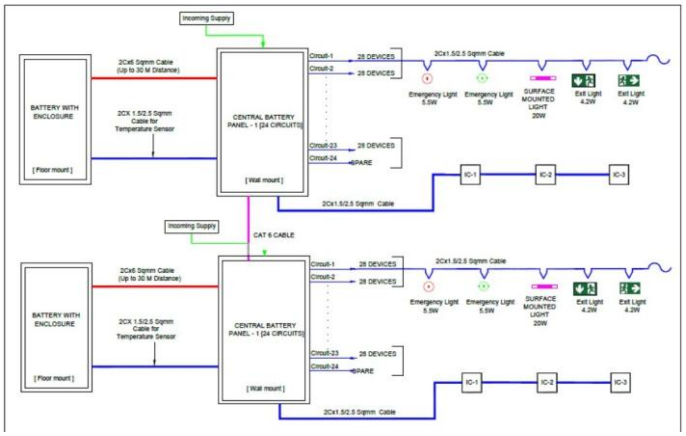
minaires in operation. The system shall consist of 18 numbers of 12Vdc SLA VRLA type batteries in se ries to provide a backup power with nominal voltage of 216Vdc.

8.2.5 Cables & Containment

Cabling shall be with copper multi stranded conductor Armored FRLS Cables with conductor cross se ction 2.5 sq.mm suitable to the length of loop/type of sensor used as per manufacturer's specs.

Cable shall be laid on surface/true ceiling slab with GI saddle & spacers with required MS powder co ated/galvanized junction boxes, single compression Glands and necessary ferrules & tags.

Any vertical movement of unexposed Cables shall be through GI perforated cable trays.Multiple cabl e drops for exposed cables terminating in all Panels shall be through MS Powder coated Trunks.



DG Set Exhaust Piping System

DG Set Exhaust Piping is a system of pipes and components that directs **engine exhaust gases** from the **diesel engine** to the atmosphere, while minimizing **noise, heat, and backpressure**. It also ensures safe dispersal of **harmful gases** like CO_2, CO, NOx, etc.

1. Design Objectives

- Remove exhaust gases efficiently
- Minimize back pressure on the engine
- Reduce noise via silencers
- Prevent heat damage and fire risk
- Eliminate vibration transmission
- Ensure water drainage and prevent rain ingress

2. System Components

Component	Function
Exhaust Manifold	Collects exhaust gases from the engine cylinders
Flexible Bellow	Absorbs vibration and thermal expansion
Silencer / Muffler	Reduces noise from exhaust gases
Exhaust Piping	Transports gases from silencer to outside
Rain Cap / Flap	Prevents rainwater entry at exhaust termination
Support Hangers	Holds and aligns piping, reduces stress on engine flange
Drain Plug / Condensate Trap	Removes accumulated moisture to avoid corrosion or backflow

3. Materials

- **Pipe Material**:
  - **Mild Steel (MS)** – Common, cost-effective
  - **Stainless Steel (SS304/SS316)** – For corrosion-prone or marine areas
- **Insulation**:
  - Rockwool / Ceramic wool with aluminium or stainless steel cladding
  - Temperature rating ≥ 600°C

4. Design Parameters

Parameter	Typical Range / Notes
Pipe Diameter	Based on engine exhaust gas flow (typically 3" to 10"+)
Exhaust Gas Velocity	30–60 m/s recommended
Back Pressure	≤ 10–20 kPa (check OEM spec; excessive = engine derating)
Pipe Slope	1–2% downward (away from engine) for condensate drainage
Length Limit	Keep short; use larger diameter if long distance needed
Bend Radius	Smooth long-radius bends preferred over sharp elbows

5. Back Pressure Calculation (Simplified)

Total back pressure =

Friction loss (due to pipe length & bends) + Silencer resistance + Vertical lift (if any)

Use:

- **Darcy–Weisbach equation** for pressure loss
- Consult engine manufacturer for allowable limit

6. Noise Reduction

Types of Silencers:

Type	Use Case	Noise Attenuation
Reactive	Low-frequency noise	Medium
Absorptive	High-frequency noise	Medium
Combination	Balanced solution for all types	High

Ensure silencers match engine size and application (hospital, residential, etc.).

7. Installation Guidelines

- Avoid placing load of pipe on engine flange – use independent supports
- Use **flexible connectors** near the engine to absorb movement
- Support piping every **2–3 meters** using clamps or hangers
- Allow thermal **expansion gap** or expansion joints (bellows)
- Paint external pipe with **heat-resistant paint**
- Use **fire sleeves** where pipe passes through walls

8. Safety & Compliance

- Ensure **gas discharge height** is above nearby buildings and openings
- Comply with **local emission & noise control regulations**
- Provide **exhaust gas detectors** in enclosed generator rooms
- Use **insulation** on all exposed hot surfaces to prevent burns or fire
- Keep clearances from combustible materials

DG Set HSD Tank Work For Holding Capacity of 24Hrs

An **HSD tank system** is the complete **fuel storage and delivery system** used to store diesel and supply it to a **diesel generator set (DG Set)**. It includes the **main diesel storage tank**, **day tank**, **transfer pumps**, **piping**, and **monitoring systems**.

1. Main Components of HSD Tank System

Component	Function
Main Storage Tank	Stores bulk diesel fuel (underground or above ground)
Day Tank	Smaller tank near DG set supplying fuel directly to the engine
Fuel Transfer Pump	Transfers fuel from main tank to day tank automatically or manually
Fuel Return Line	Returns unused diesel from engine to the day tank
Level Sensors	Monitor fuel levels and control pumps or alarms
Vent Pipe	Prevents vacuum/pressure buildup in tanks
Breather Filter	Allows air in/out while filtering dust/moisture
Fuel Piping & Valves	Transfers fuel between components safely
Drain Valve	Removes water/sludge from tank bottom
Bund Wall / Dyke	Containment wall to prevent leakage spread (for safety compliance)

2. Working Principle of DG Set HSD Tank System

ormal Operation Flow:

1. **Diesel is delivered** and stored in the **main HSD tank** (could be U/G or A/G).
2. A **diesel transfer pump** (manual or automatic) transfers fuel to the **day tank**.
3. The **DG set draws fuel** from the **day tank** via a suction line.
4. **Unused fuel** from the DG engine is returned back to the day tank through a **return line**.
5. Level sensors in the day tank **monitor low/high levels** and trigger alarms or start/stop transfer pumps accordingly.
6. **Breather vents** maintain air pressure inside tanks and avoid vacuum formation.
7. **Drain valves** allow cleaning water or sediment that collects at tank bottom.
8. The **bund wall or containment area** around the tank ensures safe spillage control.

3. Design Guidelines

lain Tank Sizing

- Based on required **autonomy (24 hrs)** of DG Set
- Volume = Fuel consumption per hour × hours of autonomy × No. of DGs

💧 Day Tank Sizing

- Sized for **24 hours of operation**
- Mounted on a **stand/frame** near DG for gravity feeding or inline feeding

ransfer Pump

- Rated for appropriate flow rate (e.g., 30–100 LPM)
- Can be **submersible** or **external gear pump**

- Controlled by **automatic level switch** in day tank

🔄 Fuel Supply & Return Lines

- Usually **MS/GI/SS or copper** pipe
- Supply and return should not be mixed
- Slope fuel lines for gravity return where applicable

4. Safety Features

Feature	Description
Flame Arrestor	On vent pipes to prevent fire ingress
Bund Wall / Dyke	Should hold 110–120% of tank capacity (mandatory for above-ground tanks)
Low-Level Alarm	To prevent dry running of DG and trigger refilling
High-Level Alarm	Prevent overflow during transfer from main tank
Emergency Shutoff Valve	For isolating fuel in case of fire/emergency
Leak Detection System	Especially for underground tanks
Double-Walled Tank	For environmental protection

INTERNATIONAL STADIUM SCOREBOARD

1. GENERAL OVERVIEW

Type: Outdoor, LED Digital Scoreboard

Usage: Multi-sport compatibility (e.g., football, cricket, rugby, athletics)

Viewing Distance: Minimum 200 meters

Brightness: ≥ 6000 nits (daylight viewable)

Mounting: Wall-mounted / gantry / free-standing pole-based

2. LED DISPLAY MODULELED Type: SMD 3-in-1 (RGB)Pixel Pitch: P10mm / P8mm / P6mm (customizable based on viewing distance)Resolution: Minimum 1280 × 720 pixels (HD)Color Capability: 281 trillion colors (16-bit processing)Viewing Angle: Horizontal ≥ 160°, Vertical ≥ 120°Refresh Rate: ≥ 3840 Hz (to prevent flickering on broadcast)Contrast Ratio: ≥ 5000:1Lifetime: ≥ 100,000 hours3. CONTROL SYSTEMController: Advanced LED control system with real-time data inputConnectivity: Fiber Optic / Ethernet / Wireless (Wi-Fi/5G optional)Input Interfaces:HDMI / DVI / SDI / VGA / USBSerial/RS232 for scoreboard consolesReal-time data integration from scoring systemsSoftware Features:Multi-sport scoring templatesLive video support (optional with video processor)Sponsor/logo displayMatch timer, countdown, and programmable animations

4. POWER SUPPLYVoltage Input: AC 100–240V, 50/60 HzPower Consumption:Max: ~800 W/m²Average: ~250–350 W/m²Power Redundancy: Dual power input (optional)Surge Protection: Built-in to meet IEC 61000 standards

5. ENVIRONMENTAL PARAMETERS
Operating Temperature: -20°C to +60°C

Humidity Range: 10%–90% RH (non-condensing)

IP Rating: IP65 front / IP54 rear (for outdoor use)

Cabinet Material: Die-cast aluminum / Galvanized steel

6. DIMENSIONS & STRUCTURE
Standard Sizes:

Large: 13m x 8m or custom

Cabinet Dimensions: Modular, e.g., 960mm x 960mm panels

Weight: Approx. 50–60 kg/m² (varies by cabinet type)

7. AUDIO SYSTEM (Optional)Integrated PA system with:100V line audio outputWeatherproof speakersEmergency announcement override8. MAINTENANCEAccess Type: Front/rear maintenanceMonitoring: Optional remote monitoring system for diagnosticsSpare Parts: LED modules, power supplies, receiving cards included

9. COMPLIANCE & CERTIFICATIONSCertifications:CE, RoHS, FCC, ISO 9001EN50121 (for EMC compliance)Standards:FIFA / ICC / IAAF display and timing compliance (depending on sport)10. OPTIONAL ADD-ONSInstant Replay SystemVideo Processor (4K/HDMI)Live Score Interface (API for integration with 3rd-party apps)Weatherproof CCTV for officiatingSolar Backup / UPS Integration

****ICC Playing Handbook**
Requires digital scoreboards showing team names, scores, batsmen, overs, run rate, etc.
****DRS Integration****
Scoreboards must support DRS (Decision Review System) output and real-time stats.

SUB HEAD :1 CCTV Surveillance Work
Scope of work involves IP based CCTV system for security comprising of PTZ/ fixed camera, cabling, digital recording, HD display system with display and hardware & software support both for indoor and external surveillance.
CCTV cameras and storage server/ NVR shall have compliance for interoperability. The proposed IP CCTV camera: NVR and VMS shall have cyber security certificate BIS, UL, EN, CE, FCC certifications. The proposed IP CCTV camera, NVR and VMS shall be compliant to original licensed H.265 video compression for recording and

streaming. The recorded images to be stored for at least 30 days.
The proposed camera should use signed firmware to validates the firmware's integrity before accepting to install it.
The proposed camera should use secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.
The proposed camera should have built in feature of Brute force delay protection to prevent camera from hacking.
The camera shall provide a platform allowing the upload of third-party analytics applications into the camera.
The proposed camera should have a built-in Memory of 1024 MB RAM, 512 MB Flash
The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.
The OEM should have own RMA centre located in India for at least 10 years or more.
MTBF of minimum 100,000 hours for cameras
The camera should send trigger via HTTP/HTTPS to IP Speaker for active alerts.
The proposed camera should be NDAA compliant.
The Camera to be provided by the bidder should not have Hisilicon chipset/Processor.
The OEM should either have an IPR of technology (for both Software and Hardware) being deployed in offered models or Design for each offered model registered in their company name.
OEMs of equipment, Hardware, Software and Firmware (proposed to be supplied for this tender) own the Intellectual Property Rights of Hardware and "Source Code" of Firmware & Software, and that they are actual manufacturers, and are not getting any 3rd party manufacturing done e.g., branding & reselling in India through importing/ trading from a country that shares a Land Border with India.
5Years OEM Warranty

IR PTZ Cameras with mounting arrangement & power supply in weather-proof enclosure should be provided at all parking entrances and main gates of the campus.
License for camera & software for minimum 10 years.

CCTV Camera Dome (for indoor/ Outdoor application): -
Supply, installation, testing and commissioning of 5 MP Dome camera with following specifications:

Sr. No.	Camera Characteristics	Minimum Specifications
1	Sensor type	1/2.7" progressive scan RGB CMOS
2	True Day and Night	The camera shall provide a removable IR-cut filter, providing day/night functionality
3	Lens type	The camera shall be equipped with a varifocal 3-8 mm IR-corrected megapixel P-Iris lens with a 5MP image sensor and The camera shall provide remote zoom and remote focus functionality.
4	Field of View	The camera shall be equipped with P-Iris, providing a horizontal field of view between 100˚-40˚
5	Sensitivity	The camera shall meet or exceed the following illumination specifications: a. Color: 0.15 lux at 50 IRE, F1.3, B/W: 0.05 lux at 50 IRE, F1.3, 0 lux with IR illumination on
6	Shutter Speed	The camera shall incorporate an electronic shutter operating in the range of 1/33,000s to 2s.
7	Video Compression	The camera shall provide independently configured H.264, H.265 and Motion JPEG streams.
8	Total sensor pixels & FPS	The camera shall support video resolutions including: 5MP (2592x1944) at up to 25 frames per second (50Hz mode) with WDR using H.264, H265 or Motion JPEG.

9	Video Streams	Minimum Two simultaneous H.265 streams in 5MP at 25/30 fps or four simultaneous H.265 streams in HDTV 1080P at 60 fps or eight simultaneous H.265 streams in HDTV 1080P at 25/30 fps.
10	Smart compression	The camera shall support scene adaptive bitrate control with one of the following capabilities to lower bandwidth and storage: a. Automatic dynamic Region of Interest to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements. b. Automatic dynamic Group of Pictures to lower bandwidth and storage requirements c. Automatic dynamic Frames per Second to lower bandwidth and storage requirements
11	Image Settings	The camera shall support manually defined values for: a. Saturation b. Brightness c. Sharpness d. Contrast
12	Intelligent defog	The camera shall incorporate automatic defog functionality
13	IR Range	The camera shall be equipped with built-in IR LEDs with adjustable angle of illumination and intensity and with a range of up to 40 m (130 ft) with a wavelength of 850 nm
14	IP addresses	a. The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server. b. The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a computer with an operating system supporting this feature. c. The camera shall provide support for both IPv4 and IPv6. d. The camera shall provide support for IPv6 USGv6.
15	Protocol	1. The camera shall incorporate support for at least HTTPS, HTTP/2, TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP,DNS/DNSv6, DDNS, NTP, NTS, RTSP, RTP, SRTP/RTSPS, TCP, UDP,RTCP, DHCPv4/v6, SSH, LLDP, CDP, MQTT.
16	Text Overlay	Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds
17	Security	The use of HTTPS and TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
18	Password Protection	Restrict access to the built-in web server by usernames and passwords at three different levels.
19	Centralized certificate management	Provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust

		services
20	Hardware for data security	The product shall include a tamper-resistant hardware module, certified to at least Common Criteria EAL6+. The product shall include a tamper-resistant hardware module. The module shall use a Trusted Execution Environment (TEE), providing a set of cryptographic features suitable for protecting private keys from unauthorized access.
21	Signed Firmware	The use of signed firmware validates the firmware's integrity before accepting to install it
22	Secure Boot	The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.
23	Brute force attacks	The proposed camera should have builtin feature of Brute force delay protection to prevent camera from hacking.
24	Connectivity	Profile G,S,T and M
25	Application Programmers Interface	The camera shall provide a platform allowing the upload of third-party applications into the camera.
26	Analytics	The camera shall support advanced video analytics capabilities with a built-in hardware-accelerated object detect engine, capable of automatically detecting several simultaneously visible objects metadata from a set of pre-trained object categories (such as vehicles, license plates, people and faces). line crossing, object in area, Cross line counting, Loitering, occupancy, Video Motion Detection, Tampering, Audio Detection
27	Ethernet	The camera shall be equipped with one 10BASE-T/100BASE-TX PoE Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed and transfer mode (full and half duplex).
28	Digital I/O (Alarms)	The camera shall be equipped with one digital (alarm) input and one digital output.The output shall be able to provide 12 V DC, 15 mA.
29	Local Storage	The camera shall have built-in SD card slot upto 1 TB and The camera shall incorporate encryption functionality for the SD card (AES-XTS-Plain64 256bit).
30	Audio In	The camera shall be equipped with one 3.5 mm jack for line/mic input.
31	Audio Out	Speaker pairing
32	Encoding	AAC-LC 8/16/32/44.1/48 kHz, G.711, G.726
33	Housing	IP52 and IK10 impact-resistant aluminum enclosure
34	Power	The camera shall support power over Ethernet IEEE 802.3at Type 1 Class 3
36	Access log	The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart.

37	Firmware Update	The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.
38	Operating Temp	Operate in a temperature range of 0 °C to 50 °C
39	Operating Humidity	Operate in a humidity range of 10–85% RH
40	WDR approved	The camera shall incorporate forensic wide dynamic range functionality providing up to 120 dB dynamic range.
41	Camera OS	The camera shall operate Linux-based platform, and include a built-in web server.
42	Cybersecurity Approval	The camera OS should be ETSI EN 303 645
43	Certifications	NIST SP500-267,UL/cUL, IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-6, IEC 60068-2-14,EN 55035, EN 55032 Class A, IEC/EN 60529 IP52/IP66, IEC/EN 62262 IK10, BIS
44	Memory	2048 MB RAM, 8192 MB Flash
45	Protocol	The Camera to be provided by the bidder all the components / parts / assembly / software used in the offered hardware and software, should not be complying to GB28181, GB/T 28181-2011; GB/T28181-2011; GBT 28181-2011; GBT28181-2011 standards. There should be no option to activate or deactivate these standards in the camera web page/Settings.
46	Active alerts on speaker	The camera should send trigger via HTTP/HTTPS to IP Speaker for active alerts.
47	NDAA Compliant	The proposed camera should be NDAA compliant.
48	Chipset/Processor	The Camera to be provided by the bidder should not have Hisilicon chipset/Processor.
49	Warranty	5 Years OEM Warranty

CCTV Camera Bullet (for indoor/ Outdoor application): -
Supply, installation, testing and commissioning of 2 MP Bullet camera with following specifications:

Sr. No.	Camera Characteristics	Minimum Specifications
1	Sensor type	1/2.8"Progressive Scan CMOS or better
2	True Day and Night	The camera shall provide a removable IR-cut filter, providing day/night functionality
3	Lens type	The camera shall be equipped with a varifocal 3-9 mm lens with and a 2 MP image sensor and The camera shall provide remote zoom and remote focus functionality.
4	Field of View	The camera shall be equipped with P-Iris, providing a horizontal field of view between 113˚-37˚
5	Sensitivity	The camera shall meet or exceed the following illumination specifications: a. Color: 0.1 lux at 50 IRE, F1.6, B/W: 0.05 lux at 50 IRE, F1.6, 0 lux with IR illumination on
6	Shutter Speed	The camera shall incorporate an electronic shutter operating in the ranges of - 1080p @25/30 fps: 1/50,500 s to 2 s

7	Video Compression	The camera shall provide independently configured H.264, H.265 and Motion JPEG streams.
8	Total sensor pixels & FPS	The camera shall support video resolutions including: 2 MP (1920x1080) at up to 25 frames per second (50Hz mode) with WDR using H.264, H265 or Motion JPEG.
9	Video Streams	Minimum 4 simultaneous Streams @ H.265 with 25fps @1920 x1080 or better
10	Smart compression	The camera shall support scene adaptive bitrate control with one of the following capabilities to lower bandwidth and storage: a. Automatic dynamic Region of Interest to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements. b. Automatic dynamic Group of Pictures to lower bandwidth and storage requirements c. Automatic dynamic Frames per Second to lower bandwidth and storage requirements
11	Image Settings	The camera shall support manually defined values for: a. Saturation b. Brightness c. Sharpness d. Contrast
12	Intelligent defog	The camera shall incorporate automatic defog functionality
13	IR Range	The camera shall be equipped with built-in IR LEDs with adjustable angle of illumination and intensity and with a range of up to 40 m (131 ft) with a wavelength of 850 nm
14	IP addresses	a. The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server. b. The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a computer with an operating system supporting this feature. c. The camera shall provide support for both IPv4 and IPv6. d. The camera shall provide support for IPv6 USGv6.
15	Protocol	1. The camera shall incorporate support for at least HTTPS, HTTP/2, TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP,DNS/DNSv6, DDNS, NTP, NTS, RTSP, RTP, SRTP/RTSPS, TCP, UDP,RTCP, DHCPv4/v6, SSH, LLDP, CDP, MQTT.
16	Text Overlay	Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds
17	Security	The use of HTTPS and TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
18	Password Protection	Restrict access to the built-in web server by usernames and passwords at three different levels.

19	Centralized certificate management	Provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services
20	Hardware for data security	The product shall include a tamper-resistant hardware module, certified to at least Common Criteria EAL6+.
21	Signed Firmware	The use of signed firmware validates the firmware's integrity before accepting to install it
22	Secure Boot	The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.
23	Brute force attacks	The proposed camera should have builtin feature of Brute force delay protection to prevent camera from hacking.
24	Connectivity	Profile G,S,T and M
25	Application Programmers Interface	The camera shall provide a platform allowing the upload of third-party applications into the camera.
26	Analytics	The camera shall be equipped with a built-in, Machine-learning processing unit capable of executing neural network algorithms, such as object detection, classification and segmentation (including vehicle types, license plates, people and faces. line crossing, object in area, Loitering, Video Motion Detection, Tampering, Time in area.
27	Ethernet	The camera shall be equipped with one 10BASE-T/100BASE-TX/1000BASE-T PoE Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed and transfer mode (full and half duplex).
28	Digital I/O (Alarms)	The camera shall be equipped with one digital (alarm) input and one digital output.The output shall be able to provide 12 V DC, 15 mA.
29	Local Storage	The camera shall have built-in SD card slot upto 1 TB and The camera shall incorporate encryption functionality for the SD card (AES-XTS-Plain64 256bit).
30	Audio In	The camera shall be equipped with one 3.5 mm jack for line/mic input.
31	Audio Out	Speaker pairing
32	Encoding	AAC-LC 8/16/32/44.1/48 kHz, G.711, G.726
33	Housing	IP66/IP67-, and NEMA 4X-rated IK10 impact-resistant aluminum enclosure
34	Power	The camera shall support power over Ethernet IEEE 802.3at Type 1 Class 3
35	Access log	The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart.
36	Firmware Update	The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.
37	Operating Temp	Operate in a temperature range of -40 °C to 60 °C
38	Operating Humidity	Operate in a humidity range of 10–100% RH (condensing).

39	WDR approved	The camera shall incorporate forensic wide dynamic range functionality providing up to 120 dB dynamic range.
40	Camera OS	The camera shall operate Linux-based platform, and include a built-in web server.
41	Cybersecurity Approval	The camera OS should be ETSI EN 303 645
42	Certifications	NIST SP500-267,UL/cUL, IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-6, IEC 60068-2-14,EN 55035, EN 55032 Class A, IEC/EN 60529 IP66, IEC/EN 62262 IK10, BIS
43	Memory	1024 MB RAM, 512 MB Flash
44	Protocol	The Camera to be provided by the bidder all the components / parts / assembly / software used in the offered hardware and software, should not be complying to GB28181, GB/T 28181-2011; GB/T28181-2011; GBT 28181-2011; GBT28181-2011 standards. There should be no option to activate or deactivate these standards in the camera web page/Settings.
45	Active alerts on speaker	The camera should send trigger via HTTP/HTTPS to IP Speaker for active alerts.
46	NDAA Compliant	The proposed camera should be NDAA compliant.
47	Chipset/Processor	The Camera to be provided by the bidder should not have Hisilicon chipset/Processor.
48	Warranty	5 Years OEM Warranty

CCTV Camera Bullet (for indoor/ Outdoor application): -
Supply, installation, testing and commissioning of 5 MP Bullet camera with following specifications:

Sr. No.	Camera Characteristics	Minimum Specifications
1	Sensor type	1/1.2.8” progressive scan RGB CMOS
2	True Day and Night	The camera shall provide a removable IR-cut filter, providing day/night functionality
3	Lens type	The camera shall be equipped with a varifocal 3-8 mm IR-corrected megapixel P-Iris lens with a 5MP image sensor and The camera shall provide remote zoom and remote focus functionality.
4	Field of View	The camera shall be equipped with P-Iris, providing a horizontal field of view between 105˚-38˚
5	Sensitivity	The camera shall meet or exceed the following illumination specifications: a. Color: 0.1 lux at 50 IRE, F1.3, B/W: 0.05 lux at 50 IRE, F1.3, 0 lux with IR illumination on
6	Shutter Speed	The camera shall incorporate an electronic shutter operating in the range of 1/33500s to 1/5 s.
7	Video Compression	The camera shall provide independently configured H.264, H.265 and Motion JPEG streams.
8	Total sensor pixels & FPS	The camera shall support video resolutions including: 5MP (2592x1944) at up to 25 frames per second (50Hz mode) with WDR using H.264, H265 or Motion JPEG.
9	Video Streams	Minimum Two simultaneous H.265 streams in 5MP at 25/30 fps or eight simultaneous H.265 streams in HDTV 1080P at 25/30 fps.

10	Smart compression	The camera shall support scene adaptive bitrate control with one of the following capabilities to lower bandwidth and storage: a. Automatic dynamic Region of Interest to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements. b. Automatic dynamic Group of Pictures to lower bandwidth and storage requirements c. Automatic dynamic Frames per Second to lower bandwidth and storage requirements
11	Image Settings	The camera shall support manually defined values for: a. Saturation b. Brightness c. Sharpness d. Contrast
12	Intelligent defog	The camera shall incorporate automatic defog functionality
13	IR Range	The camera shall be equipped with built-in IR LEDs with adjustable angle of illumination and intensity and with a range of up to 40 m (131 ft) with a wavelength of 850 nm
14	IP addresses	a. The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server. b. The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a computer with an operating system supporting this feature. c. The camera shall provide support for both IPv4 and IPv6. d. The camera shall provide support for IPv6 USGv6.
15	Protocol	1. The camera shall incorporate support for at least HTTPS, HTTP/2, TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP,DNS/DNSv6, DDNS, NTP, NTS, RTSP, RTP, SRTP/RTSPS, TCP, UDP,RTCP, DHCPv4/v6, SSH, LLDP, CDP, MQTT.
16	Text Overlay	Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds
17	Security	The use of HTTPS and TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
18	Password Protection	Restrict access to the built-in web server by usernames and passwords at three different levels.
19	Centralized certificate management	Provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services

20	Hardware for data security	The product shall include a tamper-resistant hardware module, certified to at least Common Criteria EAL6+. The product shall include a tamper-resistant hardware module. The module shall use a Trusted Execution Environment (TEE), providing a set of cryptographic features suitable for protecting private keys from unauthorized access.
21	Signed Firmware	The use of signed firmware validates the firmware's integrity before accepting to install it
22	Secure Boot	The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.
23	Brute force attacks	The proposed camera should have builtin feature of Brute force delay protection to prevent camera from hacking.
24	Connectivity	Profile G,S,T and M
25	Application Programmers Interface	The camera shall provide a platform allowing the upload of third-party applications into the camera.
26	Analytics	The camera shall support advanced video analytics capabilities with a built-in hardware-accelerated object detect engine, capable of automatically detecting several simultaneously visible objects metadata from a set of pre-trained object categories (such as vehicles, license plates, people and faces). line crossing, object in area, Loitering, occupancy, Video Motion Detection, Tampering
27	Ethernet	The camera shall be equipped with one 10BASE-T/100BASE-TX/1000BASE-T PoE Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed and transfer mode (full and half duplex).
28	Digital I/O (Alarms)	The camera shall be equipped with one digital (alarm) input and one digital output.The output shall be able to provide 12 V DC, 15 mA.
29	Local Storage	The camera shall have built-in SD card slot upto 1 TB and The camera shall incorporate encryption functionality for the SD card (AES-XTS-Plain64 256bit).
30	Audio In	The camera shall be equipped with one 3.5 mm jack for line/mic input.
31	Audio Out	Speaker pairing
32	Encoding	AAC-LC 8/16/32/44.1/48 kHz, G.711, G.726
33	Housing	IP66/IP67-, and NEMA 4X-rated IK10 impact-resistant aluminum enclosure
34	Power	The camera shall support power over Ethernet IEEE 802.3at Type 1 Class 3
35	DC Input, Power	The camera shall be equipped with one DC input connector - 10–28 V DC
36	Access log	The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart.

37	Firmware Update	The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.
38	Operating Temp	Operate in a temperature range of -40 °C to 60 °C
39	Operating Humidity	Operate in a humidity range of 10–100% RH (condensing).
40	WDR approved	The camera shall incorporate forensic wide dynamic range functionality providing up to 120 dB dynamic range.
41	Camera OS	The camera shall operate Linux-based platform, and include a built-in web server.
42	Cybersecurity Approval	The camera OS should be ETSI EN 303 645
43	Certifications	NIST SP500-267,UL/cUL, IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-6, IEC 60068-2-14,EN 55035, EN 55032 Class A, IEC/EN 60529 IP66, IEC/EN 62262 IK10, BIS
44	Memory	2048 MB RAM, 8192 MB Flash
45	Protocol	The Camera to be provided by the bidder all the components / parts / assembly / software used in the offered hardware and software, should not be complying to GB28181, GB/T 28181-2011; GB/T28181-2011; GBT 28181-2011; GBT28181-2011 standards. There should be no option to activate or deactivate these standards in the camera web page/Settings.
46	Active alerts on speaker	The camera should send trigger via HTTP/HTTPS to IP Speaker for active alerts.
47	NDAA Compliant	The proposed camera should be NDAA compliant.
48	Chipset/Processor	The Camera to be provided by the bidder should not have Hisilicon chipset/Processor.
49	Warranty	5 Years OEM Warranty

CCTV Camera ANPR Bullet (for indoor/ Outdoor application): -
Supply, installation, testing and commissioning of 2 MP ANPR Bullet camera with following specifications:

Sr. No.	Camera Characteristics	Minimum Specifications
1	Sensor type	1/2.8"Progressive Scan CMOS or better
2	True Day and Night	The camera shall provide a removable IR-cut filter, providing day/night functionality
3	Lens type	The camera shall be equipped with a varifocal 3-9 mm lens with and a 2 MP image sensor and The camera shall provide remote zoom and remote focus functionality.
4	Field of View	The camera shall be equipped with P-Iris, providing a horizontal field of view between 113˚-37˚
5	Sensitivity	The camera shall meet or exceed the following illumination specifications: a. Color: 0.1 lux at 50 IRE, F1.6, B/W: 0.05 lux at 50 IRE, F1.6, 0 lux with IR illumination on
6	Shutter Speed	The camera shall incorporate an electronic shutter operating in the ranges of - 1080p @25/30 fps: 1/50,500 s to 2 s
7	Video Compression	The camera shall provide independently configured H.264, H.265 and Motion JPEG streams.

8	Total sensor pixels & FPS	The camera shall support video resolutions including: 2 MP (1920x1080) at up to 25 frames per second (50Hz mode) with WDR using H.264, H265 or Motion JPEG.
9	Video Streams	Minimum 4 simultaneous Streams @ H.265 with 25fps @1920 x1080 or better
10	Smart compression	The camera shall support scene adaptive bitrate control with one of the following capabilities to lower bandwidth and storage: a. Automatic dynamic Region of Interest to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements. b. Automatic dynamic Group of Pictures to lower bandwidth and storage requirements c. Automatic dynamic Frames per Second to lower bandwidth and storage requirements
11	Image Settings	The camera shall support manually defined values for: a. Saturation b. Brightness c. Sharpness d. Contrast
12	Intelligent defog	The camera shall incorporate automatic defog functionality
13	IR Range	The camera shall be equipped with built-in IR LEDs with adjustable angle of illumination and intensity and with a range of up to 40 m (131 ft) with a wavelength of 850 nm
14	IP addresses	a. The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server. b. The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a computer with an operating system supporting this feature. c. The camera shall provide support for both IPv4 and IPv6. d. The camera shall provide support for IPv6 USGv6.
15	Protocol	1. The camera shall incorporate support for at least HTTPS, HTTP/2, TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP,DNS/DNSv6, DDNS, NTP, NTS, RTSP, RTP, SRTP/RTSPS, TCP, UDP,RTCP, DHCPv4/v6, SSH, LLDP, CDP, MQTT.
16	Text Overlay	Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds
17	Security	The use of HTTPS and TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
18	Password Protection	Restrict access to the built-in web server by usernames and passwords at three different levels.
19	Centralized certificate management	Provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services

20	Hardware for data security	The product shall include a tamper-resistant hardware module, certified to at least Common Criteria EAL6+.
21	Signed Firmware	The use of signed firmware validates the firmware's integrity before accepting to install it
22	Secure Boot	The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.
23	Brute force attacks	The proposed camera should have builtin feature of Brute force delay protection to prevent camera from hacking.
24	Connectivity	Profile G,S,T and M
25	Application Programmers Interface	The camera shall provide a platform allowing the upload of third-party applications into the camera.
26	Analytics	The camera shall be equipped with a built-in, Machine-learning processing unit capable of executing neural network algorithms, such as object detection, classification and segmentation (including vehicle types, license plates, people and faces. line crossing, object in area, Loitering, Video Motion Detection, Tampering, Time in area.
27	Ethernet	The camera shall be equipped with one 10BASE-T/100BASE-TX/1000BASE-T PoE Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed and transfer mode (full and half duplex).
28	Digital I/O (Alarms)	The camera shall be equipped with one digital (alarm) input and one digital output.The output shall be able to provide 12 V DC, 15 mA.
29	Local Storage	The camera shall have built-in SD card slot upto 1 TB and The camera shall incorporate encryption functionality for the SD card (AES-XTS-Plain64 256bit).
30	Audio In	The camera shall be equipped with one 3.5 mm jack for line/mic input.
31	Audio Out	Speaker pairing
32	Encoding	AAC-LC 8/16/32/44.1/48 kHz, G.711, G.726
33	Housing	IP66/IP67-, and NEMA 4X-rated IK10 impact-resistant aluminum enclosure
34	Power	The camera shall support power over Ethernet IEEE 802.3at Type 1 Class 3
35	Access log	The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart.
36	Firmware Update	The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.
37	Operating Temp	Operate in a temperature range of -40 °C to 60 °C
38	Operating Humidity	Operate in a humidity range of 10–100% RH (condensing).
39	WDR approved	The camera shall incorporate forensic wide dynamic range functionality providing up to 120 dB dynamic range.
40	Camera OS	The camera shall operate Linux-based platform, and include a built-in web server.

41	Cybersecurity Approval	The camera OS should be ETSI EN 303 645
42	Certifications	NIST SP500-267,UL/cUL, IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-6, IEC 60068-2-14,EN 55035, EN 55032 Class A, IEC/EN 60529 IP66, IEC/EN 62262 IK10, BIS
43	Memory	1024 MB RAM, 512 MB Flash
44	Protocol	The Camera to be provided by the bidder all the components / parts / assembly / software used in the offered hardware and software, should not be complying to GB28181, GB/T 28181-2011; GB/T28181-2011; GBT 28181-2011; GBT28181-2011 standards. There should be no option to activate or deactivate these standards in the camera web page/Settings.
45	Active alerts on speaker	The camera should send trigger via HTTP/HTTPS to IP Speaker for active alerts.
46	NDAA Compliant	The proposed camera should be NDAA compliant.
47	Chipset/Processor	The Camera to be provided by the bidder should not have Hisilicon chipset/Processor.
48	Warranty	5 Years OEM Warranty

PTZ Camera (for outdoor application):
Supply, installation, testing and commissioning of 4 MP PTZ camera with following specifications:

Sr. No.	Camera Characteristics	Minimum Specifications
1	Sensor type	1/2.9" Progressive Scan CMOS or better
2	True Day and Night	The camera shall provide a removable IR-cut filter, providing day/night functionality
3	Lens type	The camera shall be equipped with a varifocal 4.5 – 135 lens with and a 4MP image sensor and The camera shall provide with autofocus and auto-iris.
4	Zoom ratio	The camera shall be equipped with a motorized 30x optical zoom lens and 12x digital zoom or better
5	PTZ	Pan: 360° endless, Tilt 0° to 90° Pan and Tilt speed : 0.1°–220° /sec Provide more than 255 manually set preset positions
6	Tour	Provide a tour functionality which allows the dome to automatically move between selected presets using an individual speed and viewing time for each preset.
7	Field of View	The camera shall be equipped with P-IRIS, providing a Horizontal field of view: 57˚–2˚
8	Sensitivity	The camera shall meet or exceed the following illumination specifications: a. Color: 0.2 lux at 50 IRE, F1.6, B/W: 0.05 lux at 50 IRE, F1.6, 0 lux with IR illumination on
9	Shutter Speed	The camera shall incorporate an electronic shutter operating in the range of 1/50,000 s to 1/2 s.
10	Video Compression	The camera shall provide independently configured H.264, H.265 and Motion JPEG streams.
11	Total sensor pixels & FPS	The camera shall be designed to provide video streams in 4MP (2688x1512) at up to 30 frames per second (60Hz mode) or 25 frames per second (50Hz mode) using H.264, H265 or Motion JPEG.

12	Video Streams	Minimum 2 simultaneous H.265 streams in HDTV 4MP at 25/30 fps.
13	Smart compression	The camera shall support scene adaptive bitrate control with one of the following capabilities to lower bandwidth and storage: a. Automatic dynamic Region of Interest to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements. b. Automatic dynamic Group of Pictures to lower bandwidth and storage requirements c. Automatic dynamic Frames per Second to lower bandwidth and storage requirements
14	Image Settings	The camera shall support manually defined values for: a. Saturation b. Brightness c. Sharpness d. Contrast
15	Electronic Image Stabilization (EIS)	The camera shall incorporate a function for Electronic Image Stabilization (EIS) for real-time image stabilization.
16	Intelligent defog	The camera shall incorporate automatic defog functionality
17	IR Range	The camera shall be equipped with built-in IR LEDs with adjustable angle of illumination and intensity and with a range of up to 200 m with a wavelength of 850 nm
18	IP addresses	a. The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server. b. The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a computer with an operating system supporting this feature. c. The camera shall provide support for both IPv4 and IPv6. d. The camera shall provide support for IPv6 USGv6.
19	Protocol	The camera shall incorporate support for at least HTTPS, HTTP/2, TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP,DNS/DNSv6, DDNS, NTP, NTS, RTSP, RTP, SRTP/RTSPS, TCP, UDP,RTCP, DHCPv4/v6, SSH, LLDP, CDP, MQTT.
20	Text Overlay	Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds
21	Security	The use of HTTPS and TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
22	Password Protection	Restrict access to the built-in web server by usernames and passwords at three different levels.
23	Centralized certificate management	Provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services

24	Hardware for data security	The product shall include a tamper-resistant hardware module, certified to at least Common Criteria EAL6+.
25	Signed Firmware	The use of signed firmware validates the firmware's integrity before accepting to install it
26	Secure Boot	The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.
27	Brute force attacks	The proposed camera should have builtin feature of Brute force delay protection to prevent camera from hacking.
28	Connectivity	Profile G,S,T and M
29	Application Programmers Interface	The camera shall provide a platform allowing the upload of third-party applications into the camera.
30	Analytics	The camera shall support advanced video analytics capabilities with a built-in hardware-accelerated object detect engine, capable of automatically detecting several simultaneously visible objects metadata from a set of pre-trained object categories (such as vehicles, license plates, people and faces). Built-in Analytics - line crossing, object in area, Loitering, Cross line counting, Video Motion Detection, Shock detection and Autrotracking.
31	Ethernet	The camera shall be equipped with one 10BASE-T/100BASE-TX Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed and transfer mode (full and half duplex).
32	Temperature control	The camera should have a built-in temperature control mechanism.
33	Local Storage	The camera shall have built-in SD card slot upto 1 TB and The camera shall incorporate encryption functionality for the SD card (AES-XTS-Plain64 256bit).
34	Housing	IP66, and NEMA 4X-rated IK10 impact-resistant aluminum enclosure
35	Power	The camera shall support power over Ethernet IEEE 802.3bt Type 4
36	Access log	The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart.
37	Firmware Update	The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.
38	Operating Temp	Operate in a temperature range of -20 °C to 50 °C, Maximum temperature : 65 °C during peak hours
39	Operating Humidity	Operate in a humidity range of 10–100% RH (condensing).
40	WDR approved	The camera shall incorporate forensic wide dynamic range functionality providing up to 120 dB dynamic range.
41	Camera OS	The camera shall operate Linux-based platform, and include a built-in web server.
42	Cybersecurity Approval	The camera OS should be ETSI EN 303 645

43	Certifications	NIST SP500-267,UL/cUL, IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-6, IEC 60068-2-14,EN 55035, EN 55032 Class A, IEC/EN 60529 IP66, IEC/EN 62262 IK10, BIS
44	Memory	1024 MB RAM, 512 MB Flash
45	Protocol	The Camera to be provided by the bidder all the components / parts / assembly / software used in the offered hardware and software, should not be complying to GB28181, GB/T 28181-2011; GB/T28181-2011; GBT 28181-2011; GBT28181-2011 standards. There should be no option to activate or deactivate these standards in the camera web page/Settings.
46	Active alerts on speaker	The camera should send trigger via HTTP/HTTPS to IP Speaker for active alerts.
47	NDAA Compliant	The proposed camera should be NDAA compliant.
48	Chipset/Processor	The Camera to be provided by the bidder should not have Hisilicon chipset/Processor.
49	Warranty	5 Years OEM Warranty

All-in-One Recording, Viewing and Management Solution with VMS:

Sr. No.	Description	Required Parameters
1	No. of Cameras supported	96 CH Included and can be upgraded to 150 CH by additional licenses.
2	Processor	Intel® Xeon® Silver
3	Memory	2x 16 GB
4	Storage	192 TB (12x16 TB) hot swappable Enterprise Class HDD, 160 TB usable space after RAID 6 RAID levels: 0, 1, 5, 6, 10
5	Operating Systems	Microsoft Windows 10 IoT Enterprise Operating system drive: 240 GB SSD
6	Network Card	2x RJ45 Ports 1GBPS
7	Recording	Shall support recording up to 150 video channels with a total recording rate up to 1.5 Gbit/s.
8	Software	Compatible with Cameras, Encoders including HD, Standard resolution, High Resolution, Pant Tilt, Zoom, Thermal, Cameras, Access Control, IP Speakers, Alarm IO Modules
9	Security	Support for encrypted operating system drive and recording drive FIPS 140-2 level 2 certified Trusted Platform Module (TPM 2.0)
10	Video compression	H.264 (MPEG-4 Part 10/AVC) Baseline, Main and High Profiles, H.265 (MPEG-H Part 2/HEVC) Main Profile, MPEG-4, Motion JPEG
11	Map function	Support Required
12	PTZ Control	Required
13	Smart Search for recordings	Required

14	Playback	Up to 64x or frame by frame Up to 25 cameras synchronized playback
15	Export	Manual and scheduled export, Digital signature on exported recordings, Password protection when exporting to ZIP, Export to ASF, MP4 and MKV
16	Scheduled recording	The software shall allow recordings for continous, motion based, event based, or customized as per user/ scheduled
17	Alarm Manager	Yes Required
18	Microsoft Active Directory support	Yes, multiple user access levels with password protection using local or Windows domain users (Active directory)
19	Event triggers	Events triggered by video motion detection, Active Tampering Alarm, Cross Line Detection, External I/O, Action button, System triggers and device event triggers, Manual Triggers, Edge Based Analytic Triggers
20	Power	2 x 800 W hot-plug redundant power supplies
21	Connectors	2x USB 2.0,1x USB 3.0,2x VGA,2x iDRAC dedicated Ethernet port,2x RJ45 1 Gbps
22	Operating conditions	10 °C to 35 °C (50 °F to 95 °F)
23	Certification	IEC/EN/UL 60950-1, IEC/EN/UL 62368-1, EN 62311, NOM-019-SCFI-1998, NDAA (National Defense Authorization Act), 55032 Class A, EN 55024, EN 55035, EN 61000-3-2, EN 61000-3-3,
24	Form Factor	Rack/ Tower
25	Warranty	5 Years

VMS- Video Management System:
SERVER for Viewing :

Intel i7 latest generation or equivalent AMD latest generation RAM: 16 GB (8 GB recommended for larger systems) Operating system: 64-bit operating system, 256 GB SSD, Nvidia T600 or similar, 1x NIC @ 1 Gbps,

VMS Software:

Sr. No.	Video Management System
1	The video management software shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
2	The video management software shall be based upon standard tools and proven technology using open and published protocols
3	The specified unit shall be manufactured in accordance with ISO 14001.
4	The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE)
5	The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).

6	The specified software shall support relevant parts of the following video standards: 1. Video a. SMPTE 296M (HDTV 720p) b. SMPTE 274M (HDTV 1080p) c. SMPTE ST 2036-1 (UHDTV)
7	Interoperability a. Support video from IEC 62676-2-3 conformant devices b. Support video from ONVIF Profile S conformant devices
8	The specified software shall meet the following standards: 1. MPEG-4: a. ISO/IEC 14496-10 Advanced Video Coding (H.264) b. ISO/IEC 14496-2 (Profiles ASP and SP) (MPEG-4 Part 2)
9	The proposed VMS Clients can connect to multiple servers simultaneously.
10	c. The video management app shall provide full functionality when operated in the following environment: 1. One of the following versions: a. Apple iOS 10.3 or higher b. Google Android 5.0 or higher
11	The video management software shall accept video and audio from network cameras and video encoders compliant with relevant parts of IEC62676-2-3.
12	The proposed VMS should have Private network setup with cloud connectivity
13	The proposed VMS web client using Cloud Connect for server acces.
14	Cloud Services:- cloud web client
15	The video management software shall support traditional network cameras and video encoders as well as thermal network cameras.
16	The video management software shall, when operating in a fully supportive environment, be able to record at least 70 individually configured full frame rate video streams in full HDTV 1080p (1920x1080 pixels) over IP networks
17	The video management software shall, when operating in a fully supportive environment, be able to record full frame rate video streams in 4K Ultra HD (3840x2160) over IP networks.
18	The video management software shall provide a total recording capacity of at least 2100 frames per second.
19	The video management software shall, for each channel: a. Support Motion JPEG recording in a selectable range up to 30 fps. b. Support MPEG4 Part 2 recording in a selectable range up to 30 fps. c. Support H.264 recording in a selectable range up to 120 fps. d. Support Baseline, Main and High Profile H.264 decoding in up to 120 fps. e. Support Main Profile H.265 decoding in up to 120 fps. f. Support dynamic media profile selection for live view with all supported profiles.
20	The video management software shall support the use of wide angle / 360 degree camera.
21	Transmission a. The video management software shall allow for video to be transported over: 1. Multipart HTTP (Unicast) 2. RTP or RTSP over HTTP (Unicast) 3. MP4 over HTTPS (mobile apps)
22	The video management software shall support the following audio specifications:
23	The video management software shall support two-way, full duplex audio encoded with the video stream with supported network cameras (one-way for third-party cameras).

24	The video management software shall support the following audio quality: 1. 24bit LPCM 2. AAC-LC 8/16/32/48 kHz 3. G.711 PCM 8 kHz, G.726 4. ADPCM 8 kHz 5. Opus 8/16/48 kHz
25	It shall be possible to assign/link a microphone or speaker to a defined video device.
26	The video management software shall support active echo cancellation and noise reduction.
27	The video management software shall support the following Input/Output functionality: 1. Accept notifications and alarms from an unlimited number of auxiliary devices connected to the network. 2. Received notifications and alarms shall be able to generate events within the video management software.
	Client functionality
28	a. The video management software shall be equipped with a graphical user interface, providing the following functionality:
	1. Display up to 25 different video streams.
	2. Display up to 100 different video streams using multiple split views.
	3. Support optimized rendering for smooth display of video in resolutions up to 4K.
	4. Provide real-time navigation between multi-views using a quick view button.
	5. Support drag and drop of video sources within the user interface.
	6. Support multiple screens when operating on a computer supporting this.
	7. Be able to display facility maps with interactive camera icons to call up live video and audio from the selected camera.
	8. Be able to import graphical map data in the following formats: a. JPEG b. BMP c. PNG d. GIF
	9. Access to functions such as floor plans, video streams, split views, input/outputs, playback, snapshots and alerts shall be configurable on a user level.
	10. Support any aspect ratio provided by the camera, including landscape format (4:3 and 16:9 aspect ratio) and corridor format (3:4 and 9:16 aspect ratio).
	11. Availability in at least 20 different languages and include support for double byte character set.
29	The video management software shall provide the following user functionality.
	1. Live view functionality: a. Single camera live view b. Multi-views c. Sequence views d. Multi Ultra HD camera live views (3x 4K views) e. Flexible live view configuration f. Site maps and web page view g. Digital PTZ

	2. Recording functionality: a. Continuous recording b. Locking of prioritized recordings c. Scheduled recording - customization of weekday and weekend recordings d. Event driven recording e. Manually initiated recording f. Individually and configurable resolution and frame rate for each video source. g. Unlimited recorded material based on availability of storage device. h. Smart search for recordings based on camera, date and timeline visualization i. Video and audio shall be recorded using a manufacturer-designed format preventing manipulation of the content and shall contain information about date, time and source of the recorded material. j. Retrieval of failover recordings from cameras or encoders.
	3. Playback functionality: a. Synchronized playback from up to 36 cameras of at least four different recorded video streams, up to 64x or frame by frame. b. Playback at least eight simultaneous full frame rate Full HDTV 1080p (1920x1080 pixels) video streams. c. Export (manual or scheduled) multiple selected video and audio sequences to ASF-formats together with standalone player. d. Digital signature on exported recordings.
	4. Search functionality a. Provide an ability to search for video based upon the following criteria's: 1. Time & Date 2. By camera 3. Motion detection within a customizable area of the video 4. Video streaming content b. Support so called scrubbing for effective search functionality.
30	PTZ functionality:
	a. The video management software shall for each video channel
	1. Provide the ability to control Pan, Tilt and Zoom functionality directly from the user interface.
	2. Provide at least 100 present positions, camera depending.
	3. Support guard tour functionality, which allows the PTZ device to automatically move between selected presets using an individual viewing time for each preset
	4. Support PanTilt control by clicking in the image to move the camera using the mouse.
	5. Support zoom control by selecting an area in the image using the mouse.
	6. Support the use of hotkeys, joystick, keyboard and other control boards.
31	Event functionality
	a. The video management software shall be equipped with an event functionality, supporting events trigged in a camera, encoder or other network connected device, and include support for the following triggers:

	b. Detectors functionality 1. Video motion detection 2. Audio detection 3. Alarm functionality c. Hardware functionality d. Storage functionality 1. Failover recording recovery - recovery of local recordings in camera or encoder after connection disruption 2. Recording error 3. Storage full e. System functionality 1. Embedded third-party applications 2. Cross Line Detection 3. Action button 4. Lost connection to network camera, encoder or network disk 5. Schedule 6. External I/O and external HTTPS triggers 7. Device event triggers f. Response to triggers shall include: 1. Selecting predefined live-view 2. Visual and audible notification 3. Recording of video at defined image quality and frame rate 4. Storing of pre-alarm video at the captured frame rate 5. Activating external outputs on a camera, encoder or other network connected device 6. PTZ control functionality 7. Notification of event, using email or HTTP
32	The video management software shall provide an event history list, containing up to one year of history
33	a. The video management software shall incorporate support for at least IP, HTTP, HTTPS, TCP, ICMP, RTSP, RTP, RTCP, SMTP, DHCP, UPnP, DNS, Bonjour and LDAP.
	b. The SMTP implementation shall include support for SMTP authentication.
34	a. The video management software shall operate using static or dynamic IP addresses.
	b. The video management software shall provide support for addresses provided by a Dynamic Name Server (DNS).
	c. The video management software shall allow for automatic detection of cameras and encoders using UPnP and Bonjour.
35	Time a. The video management software shall utilize NTP as provided by the server. b. The video management software shall support multiple date formats for regional adoption.
36	a. The video management software shall provide the following: 1. Authentication of nodes using Kerberos 2. Authentication using Microsoft Active Directory 3. Restrict access to the systems by usernames and passwords at a minimum of three different levels.

37	The video management software shall: 1. Provide the ability to create multiple users of the system, either from local PC users or through Active Directory, each with individual definable user rights. 2. Provide the ability to assign IP address and configure new and replaced cameras and encoders. 3. Provide an ability to back up system configuration. 4. Provide the ability to upgrade firmware in individual cameras and encoders. 5. When connected to Internet, be able to locate suitable firmware updates and download these. 6. Provide an ability to create a system report of the complete system. This report shall include at least camera name, IP-address and firmware version. 7. Utilize a license model supporting unlimited and flexible system growth where scalability is only limited by overall server performance. 8. Support defining of individual database retention per camera for a selectable number of days or hours.

BROADCAST FACILITIES

9.1 Television Broadcasting Boxes

Three television broadcasting booths shall be provided with special acoustic treatment to walls and ceili ngs. Allow for the maximum flexibility for the producer's camera positions and presenters backdrop of t he arena. Sufficient height shall be provided to ensure adequate lighting positions.

- TV boxes to have flat floor
- Box to include seating space for 7 commentators with counter bench in front of operable windows.
- Centre of box to be set up for use as 'set'.
- Solid wall to sides with curtain behind which allows camera to film through with the arena as back ground, no joints in glass panel to centre of box.
- High level of acoustic isolation shall be required within box from external noise.
- Direct feed from stats box and interview room to be provided.
- Operable or removable glazing to the right and left-hand side of box to be provided.
- Direct cabling between OB Vans and Broadcast Box and camera positions to be provided.
- TV Broadcast Room shall be air conditioned designed to handle additional heat loads from equipm ent and lighting. Air conditioning equipment and ducts to be acoustically treated to attain requi red noise control.

9.2 Television Pre/Post-production Studio

Two nos.of Presentation studio shall be provided in the North Pavilion at the same level as the Commen tator rooms.

- The studio shall be sized to accommodate 4 presenters (located at the front of the booth), camera operators and sound engineers, for a total of 10 persons at one time.

- The front of the booth shall be fixed with anti-reflective glass to allow the presenters to be shot with the pitch as a backdrop.

These spaces shall be built as shell space only to be fitted out by the TV networks.

9.3 Radio Broadcaster Booth

Radio broadcasting booth shall be provided for radio commentators and shall have built-in counters and special acoustic isolation treatment on walls and ceilings to each box. The spaces shall be flexible to accommodate the varying broadcasting media requirements.Booth enclosed on all four sides with fully operable windows at the front (pitch side), tiered seating, built-in counter with 4 electrical, 4 data/phone outlets along the front with suitable cable management.

Soundproof radio booths shall be required with the ability to sit six persons in one row across front with clear sightlines to all parts of the ground and scoreboard.

Space at back of boxes for technical equipment. This is to be housed within a lockable closet with suitable ventilation and cable management access.

- Large bench at rear of box at which a technician can be seated behind commentators to operate broadcast equipment.

Operable glazing to field of play.

- Each box to have provision for TV monitors, to be able to be viewed whilst facing the ground.

Power, data, telephone outlets and to each box shall be provided.

- Direct feed from Stats shall be provided.
- Audio split facility, data cabling required in each radio commentary booth back to interview, change rooms and press areas.
- Radio boxes to back on to broadcasting lounge area.
- Radio boxes to be air-conditioned.
- Air conditioning equipmment and ducts to be acoustically treated to attain required noise control.

9.4 Match officials' facilities

Match officials' facilities shall be located at an elevated position with preferential view to pitch and score boards. Following rooms shall be provided in Match officials'area:

- Third Umpire's Room: This room shall include space for 5 umpires with counter bench in front of Glazing.
- Referee Room: This room shall include space for 5 referees with counter bench in front of Glazing.
- Scorer Room:This room shall include space for 5 scorers with counter bench in front of Glazing.
- Anti-Corruption room

These rooms shall have following facilities:

- High level of acoustic isolation shall be required within rooms from external noise.
- Direct feed from stats box and interview room to be provided.

· Operable or removable glazing to the right and left-hand side of box to be provided. · Direct cabling between OB Vans,Scoreboard,Production Control Room and camera positions to be provided.

Rooms shall be air conditioned designed to handle additional heat loads from equipment and lig hting. Air conditioning equipment and ducts to be acoustically treated to attain required noise con trol.

9.5 Production Control Room

The Production Control Room shall be located in the lower level of the building to facilitate ease of move ment of Heavy Equipment.

· The room shall be minimum 225 SQM column free space with high ceiling

· High level of acoustic isolation shall be required within room from external noise.

· The room shall directly connect to the outdoor Broadcast Compound

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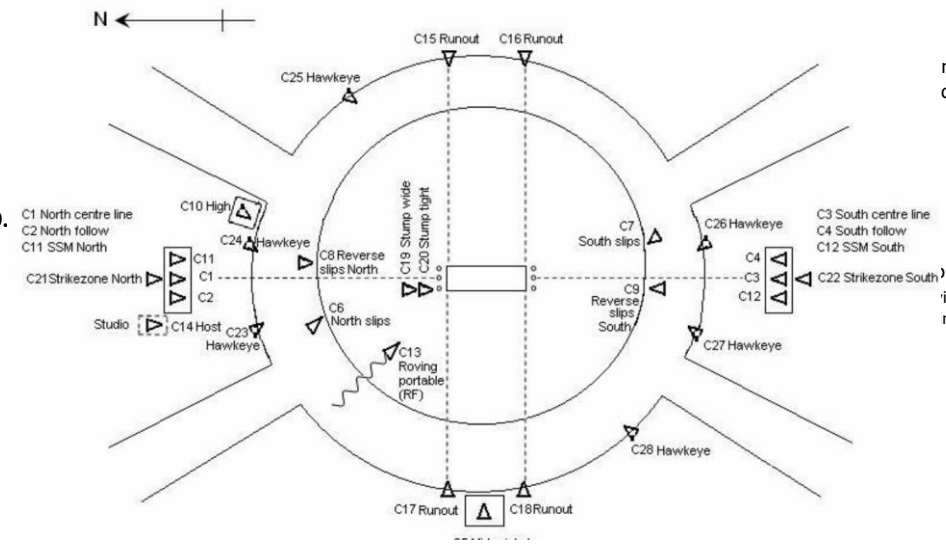

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5 Mid wicket

Camera Positions for Cricket Match:

Main Camera platforms shall be provided at both ends of the north -south axis of the stadium. These stands shall be part of the north and south pavilions.

Additional camera platforms shall be provided for Cricket

9.7 Television Outside Broadcast Vehicle

Parking for OB Vans (two OB Vans, one generator van, one 20-foot truck shall be provided within the stadium compound within 100m of the main TV Box and with minimum clearance height 4600mm.Patch room to be provided within the OB V an parking area with direct link to al camera outlets and Broadcast Box and interview rooms.

9.8 Cabling/Service Provisions

The cable route from the OB Van compound and parking area into the building shall allow for ea sy access to cabling routes. Permanent fibre optic cabling shall be installed to the primary broad cast facilities between Broadcast Room, OB Van Area and all the camera positions.

Physical Security System

Supply, Installation, Testing & Commissioning of Motorised Boom Barrier: Electromechanical Boom Barrier of 6 Mtr Boom Length, Opening Closing Time 2.0 Sec (adjustable) I.P. 54, MTBF 2 Million etc. all complete, CE Certified.etc. all complete WITH RFID /Tokan Intigration alongwith printer.
Make- Somfy / IRAM/ Neptune/ IICONS

Supply, Installation, Testing & Commissioning of Motorised Boom Barrier: Electromechanical Boom Barrier of 2 Mtr Boom Length, Opening Closing Time 2.0 Sec (adjustable) I.P. 54, MTBF 2 Million etc. all complete, CE Certified.etc. all complete WITH RFID /Tokan Intigration alongwith printer.
Make- Somfy / IRAM/ Neptune/ IICONS

X- ray Screening Baggage/ Inspection System Multi Energy Imaging (4 color) Tunnel Size 500 x 300 mm can view Previous / next bag, Manual Image Archive, should have configurable image processing keys with Date & time display facility Search Indicator including Flat monitor panel with UPS should have Fixed zoom 64 x or more, equipment should have standard like TIP Approved EU CE EWSTP STAC Certification etc. all complete.
Make- Rapiscan/ Astrophysics / Detec

Walk Through Metal Detector with Auto Tune with side panel One Horizontal Zones to Indicate Detection 100 Sensitivity Step in each program Outer dimension 2240 x 900 x 700 Inner dimension 2050 x760 should comply the standard of international standards for Human Safety CE & EU certified with Sanitizer Spray Facility etc. all complete.
Make- Rapiscan/ Astrophysics / Detec

Handheld Metal Detector 3 ways Push button Operation can detect all metals, both ferrous & non-ferrous standard 9v battery light weight 260g Dimension: 410 x 140 mm with safety Standard EU directives CE Certification etc. all complete.
Make- Rapiscan/ Astrophysics / Detec

Supply, Installation, Testing & Commissioning of Electromachanical driven stainless steel Turnstile,voltage AC 220-240,IP-55 with facility of drop arm feature sensor compatible to BCCI guideline complete in all respect alongwith control cabling & required operation devices

Location of the above said equipment is to be provided in drawing and at site as per requirement of Cricket Board.

DESIGN BASIS REPORT

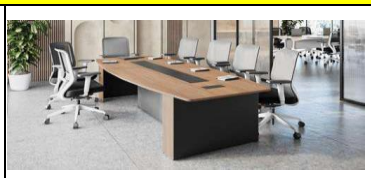
REDEVELOPMENT OF MOIN-UL-HAQ CRICKET STADIUM AT PATNA, BIHAR

FURNITURE

BIHAR CRICKET ASSOCIATION
AFFILIATED TO
THE BOARD OF CONTROL FOR CRICKET IN INDIA

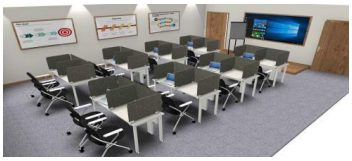
BIHAR CRICKET ASSOCIATION
AFFILIATED TO
THE BOARD OF CONTROL FOR CRICKET IN INDIA

SR.NO	REF. IMAGE	MODEL NAME & DESCRIPTION	QTY
NORTH PAVILLION BLOCK			
LVL 1			
LOUNGE 17200X12810			
1		GLAMOUR CHAIR FOR LOUNGE	240
PLAYERS CONFERENCE ROOM			
1		DIAS TABLE MINGLE	7
2		ACE HIGH BACK CHAIR	56
TV PRODUCTION ROOM & FOOD COURT			
1		1200X600 RECTA WORKSTATION WITH KBPT, CPU TROLLEY & PEDESTAL	20
2		THRILL HIGH BACK PLUS CHAIR	20
FOYER LOBBY			
1		REFLECTION TABLE	1
		OXBO HIGH BACK CHAIR	3

2			
SEMINAR ROOM			
1		ENLIGHTEN ACTIV	60
2		OXBO HIGH BACK CHAIR	3
LVL 2			
LOUNGE 30840x10340			
1		GLAMOUR CHAIR FOR LOUNGE	288
LOUNGE 17200X10340			
1		GLAMOUR CHAIR FOR LOUNGE	117
CONFERENCE ROOM			
1		MEETING ROOM TABLE MINGLE MODULAR 17 SEATER	1
2		ACE HIGH BACK CHAIR	1
		ACE MID BACK CHAIR	16

3			
4		PARTO 2 STR SOFA	6
5		VEGAS CORNER TABLE	7
ACADEMIC LIBRARY			
1		ORION DISCUSSION TABLE	4
2		THRILL HIGH BACK CUSHION CHAIR	20
AUDIO VISUAL ROOM			
1		SCINTILLA CHAIRS	28
2		110 INCH DISPLAY DELTA	1
ROOM			
1		KING BED GRANDE	6
		BED SIDE TABLE	12

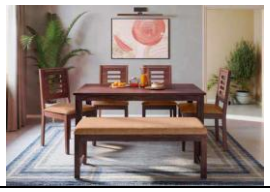
2			
3		ORTHO DELUXE MATTRESS	6
4		PILLOW	12
5		EQ STUDY TABLE	6
6		SIENNA TV UNIT	6
7		ALANTRA 1 STR RECLINER SOFA	12
8		VEGAS CORNER TABLE	6
LVL 3			
MEDIABOX			
1		RECTA WORKSTATION UPBEAT 4X2	49
		THRILL HIGH BACK MESH CHAIR	49

2			
3		ORLANDO 3 STR SOFA	4
4		ORLANDO 1 STR SOFA	8
5		ALICE COFFEE TABLE	4
STUDIO			
1		RECTA WORKSTATION UPBEAT 4X2	74
2		THRILL HIGH BACK MESH CHAIR	74
3		ORLANDO 3 STR SOFA	3
4		ORLANDO 1 STR SOFA	6
		ALICE COFFEE TABLE	3

5			
COMMENTARY BOXES			
1		RECTA WORK DESK FOR COMMENTARY	20
2		EMERALD HIGH BACK CHAIR	20
ROOM			
1		KING BED GRANDE	8
2		BED SIDE TABLE	16
3		ORTHO DELUXE MATTRESS	8
4		PILLOW	16
5		EQ STUDY TABLE	8
		SIENNA TV UNIT	8

6			
7		ALANTRA 1 STR RECLINER SOFA	16
8		VEGAS CORNER TABLE	8
LIVING ROOM			
1		ORLANDO 3 STR SOFA	2
2		ORLANDO 1 STR SOFA	4
3		ALICE COFFEE TABLE	2
4		4 STR DINING TABLE INGRID IN LIVING & ROOM	4
5		ROSE DINING CHAIR	16
LVL 4			
CORPORATE BOX 10 NOS			

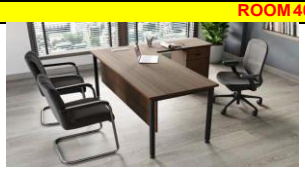
1		GLAMOUR CHAIR FOR LOUNGE	340
STORE ROOM			
1		COMPACTOR DRIVE TYPE 2 BAY	1
ROOM			
1		KING BED GRANDE	8
2		BED SIDE TABLE	16
3		ORTHO DELUXE MATTRESS	8
4		PILLOW	16
5		EQ STUDY TABLE	8
6		SIENNA TV UNIT	8
		ALANTRA 1 STR RECLINER SOFA	16

7			
8		VEGAS CORNER TABLE	8
LIVING ROOM			
1		ORLANDO 3 STR SOFA	2
2		ORLANDO 1 STR SOFA	4
3		ALICE COFFEE TABLE	2
4		4 STR DINING TABLE INGRID IN LIVING & ROOM	4
5		ROSE DINING CHAIR	16
SOUTH PAVILLION BLOCK			
LVL 1			
DINING 15190X10040			
		ELIXIR DINING TABLE 4 STR	7

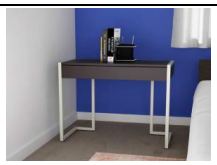
1			
2		RADIANCE DINING CHAIR	35
LOUNGE 27600X10040			
1		TERRENE TABLE 6 STR	7
2		TERRENE CHAIR	35
DIRECTOR ROOM			
1		MAESTRO MAIN DESK	1
2		EMERALD HIGH BACK CHAIR	1
3		MARVEL VISITOR CHAIR	4
4		MAJESTA SOFA 3 STR	2
		MAJESTA SOFA 1 STR	4

5			
6		VICTORIA CENTER TABLE	2
7		EDWARD CORNER TABLE	2
CONFERENCE ROOM			
1		MEETING ROOM TABLE MINGLE	1
2		ACE HIGH BACK CHAIR	1
3		ACE VISITOR	14
WAITING AREA			
1		PARTO 3 STR SOFA	3
2		ACURA CENTER TABLE	3
		REFLECTION RECEPTION TABLE	1

3			
4		OXBO HIGH BACK CHAIR	1
	ANTE ROOM		
1		ADRIA SINGLE BED	2
2		ADRIA SIDE TABLE	2
3		ORTHO SINGLE BED MATTRESS	2
4		WONDER PILLOW	2
	BANDAGE & STICHING		
1		ACURA PRIME 5F BED	2
2		MATTRESS ACURA	2
		CHRYSALIS ICU 7F BED	1

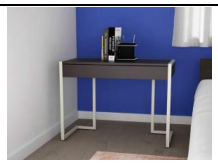
3			
4		CHRYSALIS MATTRESS	1
FIELD UMPIRE/ACSU			
1		MANAGER MODULE WISH PENTA	2
2		EMERALD HIGH BACK CHAIR	4
3		PARTO SOFA 2 STR	4
4		BLOOM CENTER TABLE	2
ROOM 4000X4200			
1		T-25 TABLE	1
2		THRILL HIGH BACK CHAIR	1
FIRST AID/DOPE TEST			
		T-25 TABLE	1

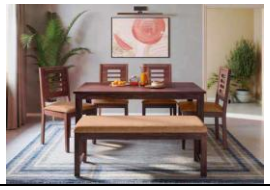
1			
2		THRILL HIGH BACK CHAIR	1
3		THRILL FABRIC VISITOR CHAIR	2
4		REVIVE EXAMINATION COUCH	1
LVL 2			
PLAYERS DINING ROOM			
1		SPICE 8 STR DINING TABLE	6
2		TERRENE CHAIR	48
PLAYERS DRESSING ROOM			
1		GAIN PRO 4 DOOR LOCKERS	26
LVL 3			
ROOM			
		KING BED GRANDE	10

1			
2		BED SIDE TABLE	20
3		ORTHO DELUXE MATTRESS	10
4		PILLOW	20
5		EQ STUDY TABLE	10
6		SIENNA TV UNIT	10
LIVING ROOM			
1		ORLANDO 3 STR SOFA	2
2		ORLANDO 1 STR SOFA	4
		ALICE COFFEE TABLE	2

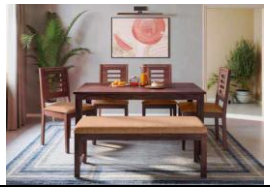
3			
4		4 STR DINING TABLE INGRID IN LIVING & ROOM	2
5		ROSE DINING CHAIR	8
6		REWIND SOFA 2 STR	2
7		BLOOM CORNER TABLE	1
CORPORATE BOX 4 NOS			
1		GLAMOUR CHAIR FOR LOUNGE	176
2		ORLANDO 3 STR SOFA	2
3		ORLANDO 1 STR SOFA	4
		ALICE COFFEE TABLE	2

4			
BCCI LOUNGE/LOUNGE			
1		GLAMOUR CHAIR FOR LOUNGE	438
2		ORLANDO 3 STR SOFA	6
3		ORLANDO 1 STR SOFA	12
4		ALICE COFFEE TABLE	6
THIRD UMPIRE ROOM			
1		ORLANDO 3 STR SOFA	6
2		ORLANDO 1 STR SOFA	12
3		ALICE COFFEE TABLE	6
		MANAGER MODULE WISH PENTA	1

4			
5		EMERALD HIGH BACK CHAIR	3
LVL 4			
ROOM			
1		KING BED GRANDE	12
2		BED SIDE TABLE	24
3		ORTHO DELUXE MATTRESS	12
4		PILLOW	24
5		EQ STUDY TABLE	12
6		SIENNA TV UNIT	12
LIVING ROOM			
		ORLANDO 3 STR SOFA	2

1			
2		ORLANDO 1 STR SOFA	4
3		ALICE COFFEE TABLE	2
4		4 STR DINING TABLE INGRID IN LIVING & ROOM	2
5		ROSE DINING CHAIR	8
6		REWIND SOFA 2 STR	4
7		BLOOM CENTER TABLE	2
CORPORATE BOX 11 NOS			
1		GLAMOUR CHAIR FOR LOUNGE	484
		ORLANDO 3 STR SOFA	11

2			
3		ORLANDO 1 STR SOFA	22
4		ALICE COFFEE TABLE	11
		LVL 5	
		ROOM	
1		KING BED GRANDE	12
2		BED SIDE TABLE	24
3		ORTHO DELUXE MATTRESS	12
4		PILLOW	24
5		EQ STUDY TABLE	12
		SIENNA TV UNIT	12

6			
LIVING ROOM			
1		ORLANDO 3 STR SOFA	2
2		ORLANDO 1 STR SOFA	4
3		ALICE COFFEE TABLE	2
4		4 STR DINING TABLE INGRID IN LIVING & ROOM	2
5		ROSE DINING CHAIR	8
6		REWIND SOFA 2 STR	4
7		BLOOM CENTER TABLE	2
CORPORATE BOX 11 NOS			
		GLAMOUR CHAIR FOR LOUNGE	484

1			
2		ORLANDO 3 STR SOFA	11
3		ORLANDO 1 STR SOFA	22
4		ALICE COFFEE TABLE	11
OUTDOOR SEATING CHAIR			
1		UTDOOR SEATING CHAIR	35000
			GRAND TOTAL