# TENDER FOR

## PROPOSED HIGH PERFORMANCE CENTRE AT SPORTS AUTHORITY OF INDIA, NSSC CAMPUS, BENGALURU, KARNATAKA ON EPC MODE

NIT NO: 01-11010(02)/2/2024-HO - Infra Division/HPC
DATE: 12-11-2025



## TABLE OF CONTENT


| Sr.No. | Sections | Volume | Page No. |
|---|---|---|---|
| 1 | Disclaimer | A | |
| 2 | Data Sheet | A | |
| 3 | Notice Inviting Tender | A | |
| 4 | Pre-Qualification Criteria | A | |
| 5 | Instructions to Bidder | A | |
| 6 | Mode of Submission | A | |
| 7 | Quoting of Rates & Amounts | A | |
| 8 | Performance Guarantee | A | |
| 9 | Security Deposit | A | |
| 10 | Escalation/Price Variation | A | |
| 11 | Scope of Work | A | |
| 12 | PROFORMA I – Acceptance of Tender Conditions | A | |
| 13 | PROFORMA II – Form of Tender | A | |
| 14 | PROFORMA III – General Information | A | |
| 15 | PROFORMA IV – List of Major Plant and Machinery in Possession | A | |
| 16 | PROFORMA V – Annual Turnover for the Last Five Years | A | |
| 17 | PROFORMA VI – Details of the Similar Works Completed in Last 7 Years | A | |
| 18 | PROFORMA VII – Details of Ongoing/Existing Works | A | |
| 19 | PROFORMA VIII – Past Contractual Performance | A | |
| 20 | PROFORMA IX – Bank Account Particulars for Refund of EMD | A | |
| 21 | PROFORMA X – Litigation History | A | |
| 22 | PROFORMA XI – GST Registration Details | A | |
| 23 | PROFORMA XII – Undertaking - Percentage of Local Content | A | |
| 24 | PROFORMA XIII – Solvency Certificate | A | |
| 25 | PROFORMA XIV – Pre-Contract Integrity Pact | A | |
| 26 | PROFORMA XV – Integrity Pact (IP) | A | |
| 27 | PROFORMA XVI – Bid Security Declaration | A | |
| 28 | PROFORMA XVII – Site Visit Certificate | A | |

| | | | |
|---|---|---|---|
| 29 | General Conditions of Contract (GCC) | A | |
| 30 | Special Conditions of Contract (SCC) | A | |
| 31 | List of Approved Makes | A | |
| 32 | Design Basis Report | A | |
| 33 | Technical Specifications | B | |

| Sr. No. | Sections | Volume | Page No. |
|---|---|---|---|
| 34 | Tender Drawings | C | |
| 35 | Price Schedule | D | |

## 1. DISCLAIMER

1.1 The information contained in this Request for Proposal ("RFP") or subsequently provided to Bidder (s), whether verbally or in documentary or any other form by or on behalf of the Authority or any of its employees or advisers, is provided to Bidder(s) on the terms and conditions set out in this RFP and such other terms and conditions subject to which such information is provided.

1.2 This RFP is not an agreement or an offer by the Authority to the prospective Bidders or any other person. The purpose of this RFP is to provide interested parties with information that may be useful to them in the formulation of their Proposals pursuant to this RFP (the "Bid"). This RFP includes statements, which reflect various assumptions and assessments arrived at by the Authority in relation to the Project Management Services (PMS). Such assumptions, assessments and statements do not purport to contain all the information that each Bidder may require. This RFP may not be appropriate for all persons, and it is not possible for the Authority, its employees or advisers to consider the objectives, technical expertise and particular needs of each party who reads or uses this RFP. The assumptions, assessments, statements and information contained in this RFP, may not be complete, accurate, adequate or correct. Each Bidder should, therefore, conduct its own investigations and analysis and should check the accuracy, adequacy, correctness, reliability and completeness of the assumptions, assessments and information contained in this RFP and obtain independent advice from appropriate sources.

1.3 Information provided in this RFP to the Bidder(s) may be on a wide range of matters, some of which may depend upon interpretation of law. The information given is not intended to be an exhaustive account of statutory requirements and should not be regarded as a complete or authoritative statement of law. The Authority accepts no responsibility for the accuracy or otherwise for any interpretation or opinion on the law expressed herein.

1.4 The Authority, its employees and advisers make no representation or warranty and shall have no liability to any person including any Bidder under any law, statute, rules or regulations or tort, principles of restitution or unjust enrichment or otherwise for any loss, damages, cost or expense which may arise from or be incurred or suffered on account of anything contained in this RFP or otherwise, including the accuracy, adequacy, correctness, reliability or completeness of the RFP and any assessment, assumption, statement or information contained therein or deemed to form part of this RFP or arising in any way in this Selection Process.

1.5 The Authority also accepts no liability of any nature whether resulting from negligence or otherwise, howsoever caused, arising from reliance of any Bidder upon the statements contained in this RFP.

1.6 The Authority may in its absolute discretion, but without being under any obligation to do so, update, amend or supplement the information, assessment or assumption contained in this RFP.

1.7 The issue of this RFP does not imply that the Authority is bound to select a Bidder or to appoint the Selected

Bidder, as the case may be, for the PMC and the Authority reserves the right to reject all or any of the Bids without assigning any reasons whatsoever.

1.8 The Bidder shall bear all its costs associated with or relating to the preparation and submission of its Bid including but not limited to preparation, copying, postage, delivery fees, expenses associated with any demonstrations or presentations which may be required by the Authority or any other costs incurred in connection with or relating to its Bid. All such costs and expenses will remain with the Bidder and the Authority shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by a Bidder in preparation for submission of the Bid, regardless of the conduct or outcome of the Selection Process.

1.9 The Authority reserves the right to, but without being under any obligation to do so, amend or supplement the statements, information, assessment or assumptions contained in this bid at any time during the bidding process by way of revision, deletion, update or supplement and annulment through issuance of appropriate addendum as the Authority may deem fit without assigning any reason thereof.

1.10 No objections raised by any Bidder(s) or any third party to such changes/modifications/additions/alterations as provided above, whether explicit or implicit, shall be entertained. Any such objection by the Bidder shall make the Bidder's Bid liable for rejection by the Authority.

1.11 The Authority reserves its right to withdraw from the process at any stage of the process and/or modify the process or any part thereof or to vary any terms at any time or stage without assigning any reasons whatsoever. In such an event, no financial obligation of whatsoever nature shall accrue to SAI or any of its respective officers, employees, advisors, or agents.

1.12 This RFP document supersedes and replaces any previous public documentation & communications, and Bidders should place no reliance on such communications. The Bidders shall bear all its costs associated with or relating to the preparation and submission of Proposal pursuant to this RFP.

1.13 SAI also accepts 'no liability' of any nature, whether resulting from negligence or otherwise howsoever caused, arising from the reliance of any Bidder upon the statements contained in this RFP.

**SPORTS AUTHORITY OF INDIA**

**Registered Office:** Jawaharlal Nehru Stadium Complex (East Gate), Lodhi Rd, New Delhi, Delhi - 110 003
https://sportsauthorityofindia.nic.in

**2. Data sheet**

| Sr. No. | Particular | Details |
|---|---|---|
| 1. | Name of the Work | Construction of High Performance Centre at SAI, NSSC Bengaluru Campus, Karnataka, India on Engineering, Procurement and Construction (EPC), Mode 1 Contract Basis. |
| 2. | Estimated cost of Project Management Services (in figures and words) | Rs.73,23,08,363.00/- (Rs. Seventy-Three Crores Twenty-Three Lakh Eight Thousand Three Hundred Sixty-Three Only) |
| 3. | Estimated period for completion of project | 18 Months (Eighteen Months) |
| 4. | Date of Publication: | 12-11-2025 |
| 5. | Document Downloading Start Date: | 12-11-2025 |
| 6. | Last date and time of submission of queries for Pre-Bid Conference | 15-11-2025 5:00PM |
| 7. | Virtual Pre-Bid conference | 17-11-2025 2:00 PM<br>Link:- meet.google.com/gwj-tmqc-eyv |
| 8. | Bid submission start date and time | 18-11-2025 5:00 PM |
| 9. | Bid submission end date and time | 03-12-2025 till 11:00 AM |
| 10. | Bid Validity Period | 120 days from the last date of submission |
| 11. | Mode of Submission | Online submission on e-procurement portal |
| 12. | Opening of Technical Bid date and time | 04-12-2025 at 11:00 AM |
| 13. | Opening of Financial Bids | To be Intimated later (minimum of 48 hours from opening of technical bid) |
| 14. | Consortium/Joint Venture | Not allowed |
| 15. | RFP document Fee | NIL |
| 16. | Bid Security/EMD | Rs. 2,19,69,251.00/- |
| 17. | Bank Account Details of the Authority | Secretary/Sports Authority of India<br>Union Bank of India<br>Account No: 108510100032325,<br>IFSC No. UBIN0810851 |
| 18. | Authority's Representative for this RFP purpose & Address of Correspondences | The Deputy Director (Infra), SAI<br>Email: infra-sai@gov.in |

**NIT No.: 01-11010(02)/2/2024-HO - Infra Division/HPC** **Date: 12-11-2025**

## 3. NOTICE INVITING TENDER

Engineering Wing, Sports Authority of India (SAI) on behalf of Sports Authority of India (SAI) invites Item rate tenders in electronic tendering system **from** the experienced and financially as well as technically sound agencies working in Central/PSU/State Government Departments of National repute. The tenders shall be available on website https://etenders.gov.in/eprocure/app on dates as mentioned above, "List of Important Dates."

Tender document is also available for viewing on the "Notices and Tenders" link of SAI website http://sportsauthorityofindia.gov.in. and CPP portal.

Bids to this tender will be accepted only through **ONLINE** mode through the website https://eprocure.gov.in/eprocure/app. No other mode of bid will be considered and accepted. For applying online, the bidder should get itself registered at https://eprocure.gov.in/eprocure/app. Bid submission and System Requirement Manual are also available on https://eprocure.gov.in/eprocure/app.

| NameofWork | Approx. Estimated Cost | Earnest Money Deposit (EMD) | Completion Period (including rainy season |
|---|---|---|---|
| Construction of High Performance Centre at SAI, NSSC Bengaluru Campus, Karnataka, India on Engineering, Procurement and Construction (EPC), Mode 1 Contract Basis. | Rs.73,23,08,363.00 /- | Rs. 2,19,69,251.00/- | 18 Months |

The intending bidders may download tender documents from e-procurement portal https://eprocure.gov.in/eprocure/app from the date & time mentioned above .The technical bid and bid documents duly filled and digitally signed in all respect may be submitted online through the-portal within the date and time(as per server clock)on **as mentioned under "List of Important Dates".** SAI does not take any responsibility for the delay caused due to non-availability of internet connection or traffic jam etc. for online bidding.

EMD for the work is shown in the table above. EMD (Refundable) will be submitted online in following SAI Bank Account:

| S.No. | Particulars | Details |
|---|---|---|
| 1. | Name of Beneficiary | **Secretary/Sports Authority of India** |
| 2. | Name of Bank | **Union Bank of India** |
| 3. | Bank A/C No. | **108510100032325** |
| 4. | IFSC Code | **UBIN0810851** |

The EMD in any other form shall not be accepted. The proof of payment indicating UTR No. needs to be uploaded in technical bid folder. The bidder has to submit the proof of payment on date as specified in the NIT.

The EMD will be returned to all unsuccessful bidders after opening of Price Bid. EMD of successful bidder shall be refunded after submission of Performance Guarantee duly verified from issuing bank.

1. Validity of Tender will be120 days.
2. Validity of EMD will be 165 days.

3. The tenderer shall quote their rates inclusive of GST, turnover tax/ sales tax on works and Labour Cess payable to Central/State Government along with other taxes, duties, levies etc. in conjunction with other terms and conditions.

**Note:** Custom Duty Exemption Certificate will be provided by Sports Authority of India (SAI) to the specialized vendors as per Custom Notification No. 146/94-Customs.

1. The final selection will be based on Low-Cost system of Selection.

2. Third Party Quality Assurance (TPQA) for the project will be executed by SAI/PMC from IIT/NIT/ Govt. Engg. Colleges/CBRI/Other Central/State Govt. Institute. The payment of TPQA will be borne by the contractor, for finalizing the TPQA agency approval from SAI shall be required.

3. The construction agency has to successfully complete the entire Scope of Work as mentioned in the tender document within the approved cost and agreed time period. Additional Items/ Deviations (if any) beyond the Scope of Work shall be intimated immediately to the Engineer-In-Charge in writing and the same shall be carried out only after the approval/ sanction of the same from SAI/ Owner.

4. Names of the technically qualified bidders on the basis of information furnished in the checklist and in "My Document" uploaded by concerned bidders after technical evaluation and verification will be displayed on the portal.

5. In case, due to any reason the scheduled dates for opening of technical and financial parts as mentioned above are holidays or due to any reason the office remains closed or due to any acts of God it becomes unapproachable (solely at the discretion of tender inviting authority), the next working day will be applicable while the previous specified time will remain the same.

6. Sports Authority of India (SAI) reserves the right to reject or cancel any or all pre-qualification documents and bid document without assigning any reasons whatsoever.

7. At any time prior to the deadline for submission of bid, SAI may, for any reason whether at its own initiative or in response to a clarification required by a prospective bidder, modify the bid document by issuing suitable amendment(s) to it. Such an amendment to the bid document will be uploaded on SAI website: www.sportauthorityofindia.nic.in. Prospective bidders are advised in their own interest to regularly visit website of Sports Authority of India (SAI) for any amendment or information etc. before submitting their bids. In order to afford prospective bidders reasonable time to take into account the amendments in preparing their bids, SAI may, at its discretion, suitably extend the deadline for submission of bids.

8. For participating in the-Tendering process of SAI, the contractor shall have to get them registered on the website https://eprocure.gov.in/eprocure/appso that they will get User ID and Password. This will enable them to access the website https://eprocure.gov.in/eprocure/appwith the help of Digital Signature by which they can participate in e-Tender of SAI. For this intending bidder may contact E- Procurement Helpdesk: 0120-4001 002, 0120-4001 005, 0120-6277 787, support-eproc@)nic.in.

9. Any corrigendum/ addendum/ errata in respect of the above tender shall be made available only at our official website https://sportsauthorityofindia.nic.in and https://eprocure.gov.in/eprocure/app.No further press advertisement will be given. Hence all bidders are advised to check SAI website https://sportsauthorityofindia.nic.in and website

10. https://eprocure.gov.in/eprocure/appregularly.

11. Due Diligence by the Bidders:
    11.1. Bidders may before submitting their Proposals, examine the requirements at their own expense and obtain and ascertain for themselves, at their responsibility and other information necessary for preparing their Proposals.

    11.2. Bidders shall be deemed to have full knowledge of the requirements of the work. SAI will not accept any responsibility or liability for any errors, omissions, inaccuracies, or errors of judgment concerning information or materials provided by SAI in this RFP Document or otherwise, with respect to this Project. Although such information and materials are to the best of SAI's belief, however, their verification is the sole responsibility of Bidder.

12. Neither SAI, nor their employees make any representation or warranty as to the accuracy, reliability or completeness of the information provided nor will have any liability to any bidder which may arise from or be incurred or suffered in connection with anything contained in this RFP and the award of the work or otherwise arising in any way from the selection process.

**4. PRE-QUALIFICATION CRITERIA**

The intending Bidder should fulfill the following minimum pre - qualifying criteria:

1. **Turnover**: Average Annual Financial Turn over on construction works during the last 3 years, ending 31st March of the previous financial year i.e., 2024-25, should be at least 100% of the estimated cost. Applicant has to attach the Balance Sheet along with profit & loss statement duly certified by Chartered Accountant for last five years.
    1.1. **Note:** In case the Balance sheet for FY 2024-25 has not been audited yet then Audited balance sheet for FY 2021-22, FY 2022-23 and FY 2023-24 shall be considered for evaluation. Applicant has to attached Balance sheet along with profit and Loss Statement duly certified by Chartered Accountant.

2. **Experience**:
    2.1. Bidder should have the experience of completion of similar works on EPC mode during last 7 years ending last day of month previous to the one in which tenders are invited should be either of the following, at least one work shall be completed for Central/State Governments/PSUs.

    (a) Three similar completed works each costing not less than the amount equal to 40% of the estimated cost. Work order and completion Certificate should be attached.

    (Or)

    (b) Two similar completed works each costing not less than the amount equal to 50% of the estimated cost. Work order and completion Certificate should be attached.

    (Or)

    (C)One similar completed work costing not less than the amount equal to 80% of the estimated cost. Work order and completion Certificate should be attached.

    (a) **Similar works mean**: Construction of high-end Building Projects comprising composite civil, structural, architectural, MEP (Mechanical, Electrical, and Plumbing) works, Fire-Fighting Systems, HVAC Systems, External Development, and Approach Road Works, executed under a single composite contract in India for Central/State Government Departments, Central/State Government Undertakings, or Public Sector Units (PSUs).

High end buildings shall include, Commercial Complexes, Institutional Campuses, IT Parks, Airports, International Terminals, Convention Centers, High-End Sports Infrastructure Facilities (Stadiums and Arenas), High end Hotels or Hospitality complex, Hospitals demonstrating coordination of multiple engineering services, advanced building systems, and high standards of finishing and functionality.

2.2. The value of executed works shall be brought to the current level by enhancing the actual value of work done at a simple rate of 7% per annum, calculated from the date of completion to previous day of last day of submission of tenders.

3. **Profitability:** The applicant should be a profit-making firm and have not incurred losses for more than two years out of last five years ending 31stMarch, 2025 duly certified by Chartered Accountant with his Seal/signatures and registration number. In case the annual accounts for the latest financial year are not yet audited and therefore the Tenderer is unable to provide the same, then the Tenderer shall give an undertaking to this effect and the Chartered Accountant/statutory auditor shall certify the same.

4. In such a case, the Tenderer shall provide the Audited Annual Reports for 5(five) years preceding the year for which the Audited Annual Report is not being provided.

**Note:** Applicant has to attached Balance sheet along with profit and Loss Statement duly certified by Chartered Accountant

5. **Solvency Certificate:** Tenderer must have solvency for an amount equal to 40% of the estimated cost duly certified by the bank and to be uploaded while submitting the tender on website. Solvency Certificate upto 6 (six) months before the last date of submission of tender will be acceptable.

6. **Net Worth:** The company/firm as on 31st March of previous Financial Year should be minimum 15% of the estimated cost of work put to tender.

7. Credit Facility: The Tenderer shall submit existing Credit facility from Bankers for Rs 15.00 Crores (Fifteen crores only).

Intending Tenderer must not be placed in the Negative List of firms of any department/organization for any reason including failure abandoning the project without permission of the department/ organization, unethical practices, failure to abide by Integrity Pact or failure to follow any lawful directions given by the department/ organization. A Tenderer, whose proprietor/ partner/ director/ organization is having any F.I.R./ police case/ CBI case / any ongoing cases on due to corrupt or unethical practices during tenders/execution of contracts, or is/was barred from participating in the tenders/during execution of contract in any Central/State Govt. Organization or Central/State Public Sector Units (PSU) or Autonomous bodies or Public Listed Company or Private Limited Company Govt or PSU Work Agency, such shall not be allowed to participate in the tender process– A Tenderer will have to submit an affidavit in compliance to this clause. A general practice Format of Affidavit has to be submitted and it has to be notarized. All the Central/State Government and/or State/Central Govt undertaking PSUs are exempted from this clause. All other terms and conditions will be applicable as due. If any Tenderer is found engaged in activities specified under this clause, then they shall be debarred or banned for a period of 3 years.

9. **EPF Registration:** Preferably agency should have EPF registration, incase EPF registration is not there, the agency should obtain EPF registration on allotment of work. In case of failure, SAI will deduct EPF & deposit as per EPF norms.

10. **Goods & Service Tax (GST) Registration:** Bidder must have valid Goods & Services Tax Registration. Also, the GST filing should be submitted up to 31 March 2025 from 1st April 2022.

11. **Joint Venture**: Joint Ventures are not permitted.

12. **Bid Capacity:** Agencies who meet the minimum qualification criteria will be qualified only if their available bid capacity is more than the total bid value. The available bid capacity will be calculated as under:

    **Assessed available bid capacity= (AxNx2)- B**

    *N = Number of years rounded up to first decimal prescribed for completion of the subject contract.*
    *A = Maximum value of works executed in anyone year during last five years (updated to the price level of current financial year with percentage stated in the PQ document).*
    *B = Value at current price level of existing commitments and ongoing works to be completed in the next 'N' years.*

    *Note:*

    12.1. TheApplicantshallfurnishstatementsshowingthevalueofexistingcommitments and on-going works as well as the stipulated period of completion remaining for each of the works preferably counter signed by the Nodal Officer or his nominee- in-charge in the format available in documents.

    12.2. Financial Turnover ofpreviousyearsshallbegivenweightageof5% (simple rate) per annum based on rupee value to bring them to current financial year price level.

    12.3. The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum calculated from the date of completion to last date of receipt of applications for tenders.

    **Existing commitment and ongoing works:** Intending bidders must submit this information in specified format uploaded with Tender Documents.

13. **PAN:** Bidder should have valid Permanent Account Number of Income tax

14. **Registration:** The Bidder must submit valid registration certificate of civil contractor in proper category issued by any Central/State Govt Department Organization.

15. **Labour License**: Bidder should have Labour License from Central government. If not, they may participate in tender but on being awarded they must Obtain license from central government within one month form the date of issue of letter of acceptance.

16. **Other Information**: Intending bidder must submit the following inspecified format uploaded with Tender Document.

    a) List of Key Personnel

17. The applicant must have adequate organizational set up as well as having sufficient numbers of experienced personnel ,technical knowledge-how and infrastructure to complete the project well within time frame.

18. SAI is free to get documents verified and agency shall have no objection to it. In case , if it is found at any stage that the agency has made any false information will be disqualified & blacklisted.

19. The Tender has been invited in e-tender mode. For download of tender document, uploading of tender document along with Financial Bid, opening of Technical Bid, notification of any corrigendum and addendum etc. the website https://eprocure.gov.in/eprocure/appis to be used. The intending bidder must get themselves registered with the service provider for participating in e-tender.

20. The intending Bidder is requested to upload the Bid well in time to avoid any difficulty due to failure of server etc. For any clarification about the website, our service provider needs to be contacted.

21. Issuance of tender document does not mean the agency has been technically qualified. Hence agencies/ bidders are advised to submit all the relevant documents/ credentials required intender for technical qualification along with their bid.

22. Tender documents can also be downloaded from our official website https://sportsauthorityofindia.nic.in, CPP Portal & website https://eprocure.gov.in/eprocure/app and the agencies fulfilling the requirements may submit the tender along with the tender processing fee stated in the above table.

23. Tender documents can be seen at our official website https://sportsauthorityofindia.nic.in and CPP Portal which is only for viewing not for quoting.

24. Interested bidders may contact The Director, Infra Division**, SAI,** Jawaharlal Nehru Stadium Complex (East Gate), Lodhi Rd, New Delhi, Delhi - 110 003orhisauthorized officials for seeking any details regarding execution of proposed work.

25. Tender documents duly completed in all respects shall be received on the date & up to the time as specified above and Technical Bid shall be opened at date & time as specified above. Documents received after the stipulated date & time are liable to be summarily rejected.

26. The Interested bidders are requested to submit all forms, annexures, proforma, details (in the required format) which are required for eligibility and evaluation criteria at the time of submission of their bids. No short documents, clarification shall be sought after opening of technical bids.

27. Any corrigendum/ addendum/ errata in respect of the above tender shall be made available only at our official website https://sportsauthorityofindia.nic.inand https://eprocure.gov.in/eprocure/app. No further press advertisement will be given. Hence, all prospective bidders are advised to visit SAI website https://sportsauthorityofindia.nic.in and website https://eprocure.gov.in/eprocure/app regularly for above purpose.

28. Bid Rejection Criteria:

    (i) Tenderer has to submit the supporting documents as per sought in clause 2 to 20 above.

29. Evaluation Criteria:

The financial bids of only those Tenderers who qualify the technical evaluation criteria shall be opened.

**5. INSTRUCTIONS TO BIDDER:**

5.1. The applicant must have adequate organizational setup and reasonable presence in the work area or nearby as well as having sufficient number of experienced personnel, technical know-how, and infrastructure to complete the project well within time frame.

5.2. SAI is free to get documents verified and agency shall have no objection to it. Incase, if it is found at any stage that the agency has made any false information will be disqualified and blacklisted.

5.3. Bidders are required to submit full biodata giving details about their organization, experience, technical personnel & manpower available in their organization, equipment holding, PF registration number, Balance Sheet and Turnoverdetailsforlast5yearsdulycertified by CA, Litigation History Affidavit, Bank Certificate etc. in order to assess their financial and technical capabilities etc. in the enclosed forms which will be kept confidential.

5.4. While deciding upon the technical qualification of applicant great emphasis will be given on the ability and competence of applicants to do good quality works within the specified time schedule and in close coordination with other agencies.

5.5. The documents shall be signed by person(s) on behalf of the organization having necessary authorization/power of attorney to do so (certified copies to be enclosed).

5.6. If the space in the proforma is insufficient for furnishing full details, such information may be supplemented on separate sheets of paper, stating there in the part of the proforma and serial number. Separate sheets shall be used for each part. However, the format shall be as per proforma.

5.7. Applications containing false / incomplete and / or inadequate information are liable to be rejected. Also, mere fulfillment of eligibility criteria does not guarantee for selection.

5.8. Clarification, if any required, may be obtained from the office of the Engineering Division, SAI, Jawaharlal Nehru Stadium Complex (East Gate), Lodhi Rd, New Delhi, Delhi - 110 003

5.9. Canvassing in any form in connection with pre-qualifications is strictly prohibited andtheapplicationofsuchpersons/organizationsthatresorttocanvassingwill be liable to rejection.

5.10. **Additional Requirement:**

Even though the bidders meet the above qualifying criteria, they are liable to be disqualified if they have:

(a) Made misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.

(b) Records of poor performance such as abandoning the work, not properly completing the contract, inordinate delays in completion, litigation history or financial failures etc.

(c) Their business banned by any Central/ State Govt. Department/ Public Sector Undertakings or Enterprises of Central/ State Govt.

(d) Not submitted all the supporting documents or not furnished the relevant details as per the prescribed format.

(e) A declaration on the above effect should be submitted as per Proforma-IX.

(f) Bidder shall submit the General Information about bidder as per Proforma-III.

(g) Bidder shall submit the list of major plant & machinery available with the firm as per Proforma-IV.

**5.12 Site Visit:**

(a) The bidder is advised to visit and examine the Site of Work sand its surroundings and obtain for itself on its own responsibility and cost all information that may be necessary for preparing the bid and entering into a contract for construction of the Works.

(b) The bidder and any of its personnel or agents will be granted permission by the Employer/Owner to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder, its personnel, and agents will release and

(c) Indemnify the Employer/ Owner and its personnel and agents from and against all liability in respect there of and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

(d) Before submitting a Bid, the Bidder shall be deemed to have satisfied himself by actual inspection of the site and locality of the works, that all conditions liable to be encountered during the execution of the works are taken into account and that the rates entered in the Price Bid document are adequate and all-inclusive for the completion of work to the entire satisfaction of the Employer/Owner.

**5.13 Preparation of Bids: Documents Comprising the Bid**

**I. Bid Security/ EMD**

1. The bidder shall furnish Bid Security/EMD for an amount as shown in the bid document. The Bid Security is required to protect SAI against any non-compliance, misconduct, or withdrawal by the bidder. Failure to submit the Bid Security in the prescribed manner and within the stipulated timeline shall result in outright rejection of the bid, without any further consideration.

2. In case, as per notification of Government of India, the bidder falls in the category of exemption of Bid Security/EMD, it should submit a Bid security declaration as per format given at Proforma XVIII and furnish the relevant notification along with required documents like valid Registration Certificate etc.

3. The bidder seeking EMD exemption, must submit the valid supporting document for the relevant category as along with the bid.

4. The Bid Security/ EMD shall be furnished in one of the following forms:
   a) Account Payee Demand Draft
   b) Fixed Deposit Receipt
   c) Banker's cheque / Pay Order
   d) Bank Guarantee (including e-PBG) from any of the commercial banks (as per the format at Annexure V),
   e) NEFT transfer to "Secretary SAI, Union Bank of India Account No: **108510100032325**, IFSC No. **UBIN0810851**(Bidder has to upload challan/proof along with Bid one procurement portal).
   f) Valid Insurance Surety Bonds

In case, submission of Bid Security in the form of a) to d) and f), following shall be ensured:

i. A scanned copy of the document shall be uploaded on e-Procurement Portal while applying to the tender.
ii. The original document should be delivered to the official nominated as indicated in the tender document before closing date and time for submission of bids.

iii. Non submission of scanned copy of bid security document with the bid on e-tendering portal and/or non-submission of original bid security document within the specified period shall lead to summary rejection of bid. Further. No request on account of postal delay shall be entertained.

5. The Demand Draft, Fixed Deposit Receipt, Banker's Cheque, Insurance Surety Bonds or Bank Guarantee (including e-PBG) shall be drawn on any Nationalized/Scheduled Bank in India, in favor of the "Secretary, Sports Authority of India", payable at New Delhi. In case of Bank Guarantee, the same is to be obtained from any Nationalized /Scheduled bank in India as per the format specified under Annexure V of the Bid Document.

6. The Bid Security shall be valid for a period of forty-five (45) days beyond the validity period of the bid.

7. Bid Security of a bidder will be forfeited, if the bidder withdraws or amends its bid or impairs or derogates from the bid or is breach of any condition of the tender documents in any respect within the period of validity of its bid without prejudice to other rights of SAI. Further, if successful bidder fails to furnish the required Performance Security and sign the contract / agreement within the period as specified by SAI in the Letter of Intent/ Notification of Award (NoA), its Bid Security/EMD will be forfeited.

8. The EMD serves as a safeguard for SAI against any misconduct or non-compliance by the bidder. The Bid Security shall be forfeited without any further notice if the bidder withdraws, amends, revises, or modifies its bid in any manner within the bid validity period. It shall also be forfeited if the bidder submits false, misleading, forged, or incorrect information or documents, whether deliberately or due to negligence. Additionally, if the successful bidder fails to furnish the required Performance Security within the specified period or engages in fraudulent practices, misrepresentation, or attempts to unduly influence the bidding process at any stage, the Bid Security will be forfeited. Moreover, non-compliance with any conditions outlined in the tender document, as determined by SAI, shall also result in forfeiture of the EMD.

9. Bid securities of the unsuccessful bidders shall be returned to them before expiry of the final bid validity and latest on or before the 30th day after the award of the contract. Bid securities of unsuccessful bidders during first stage i.e., technical evaluation etc. shall be returned within 30 days of declaration of result of first stage i.e., technical evaluation etc.

**I. Financial Bid:**

Duly quoted and digitally signed Volume E Price Schedule in the file supplied by the employer shall be uploaded.

Thetendersshallbestrictlyasperthecondi tionsofcontract.Tenderswithany additional condition(s)/ modifications shall be rejected.

NOTE: All the documents should be digitally signed.

**II. Online Submission of Bids:** Bidding through E- Tendering System:

The bidding under this contract is electronic bid submission through website https://eprocure.gov.in/eprocure/app. Detailed guidelines for viewing bids and submission of online bids are given on the website. Any citizen or prospectivebiddercanlogontothiswebsiteandviewtheinvitationforbidsandcanview the details of work for which the bid is invited. The prospective bidder can submit bids online; however, the bidder is required to

have enrolment/ registration in the website and should have valid Digital Signature Certificate (DSC) in the form of smart card/ e-token. The DSC can be obtained from any authorized certifying agencies. The bidder should register in the website https://eprocure.gov.in/eprocure/appusingthe relevant option available. Then the digital signature registration has to be done with the-token, after logging into the site. After this the bidder can login the site through secured login by entering the password of the e-token & the user id/ password chosen during registration. After getting the bid schedules, the Bidder should go through them carefully and then submit the documents as asked, otherwise, the bid will be rejected.

The completed bid comprising of documents, should be uploaded on the website https://eprocure.gov.in/eprocure/app through e-tendering along with scanned copies of requisite certificates as are mentioned in different sections in the bidding document and scanned copy of bid security.

**III. Bid Opening and Evaluation:**

a) The Employer inviting bids, or its authorized representatives will open the bids online and this could be viewed by the bidders also online. In the event of the specified date for the opening of bids being declared a holiday for the Employer, the bids will be opened at the appointed time on the next working day.

b) The file containing the Part of the bid will be opened first.

c) In all cases, the amount of bid security, cost of bid documents, processing fee for e- tender and validity of the bid shall be scrutinized. Thereafter, the bidders' name and such other details as the Employer may consider appropriate, will be notified as Part I bid opening summary by the authority inviting bids at the online opening.

d) Evaluation of Part Io bids with respect to **bid security, qualification information and other information furnished in Part of the bid**, shall be taken up, and a list will be drawn up of the qualified bidders whose Part II of bids will be eligible for opening.

e) The result of evaluation of Part I of the Bids shall be made public on e- procurement.

f) The Employer shall inform the bidders who have technically qualified during evaluation of Part of bids, of the date, time of online opening of Part of the bid. In the event of the specified date being declared a holiday for the Employer, the bids will be opened at the appointed impend location on the next working day.

g) Part II of bids of only these bidders will be opened online, who have qualified in Part of the bid. The bidders' names, the Bid Prices, the total amount of each bid, and such other details as the Employer may consider appropriate will be notified online by the Employer at the time of bid opening.

h) Financial proposal with any counter conditions or ambiguous remarks shall be rejected.

i) The final selection will be based on Lowest Offer i.e.L-1.

j) In case there is tie i.e. two or more than two bidders quoted the same rate and are lowest then

final selection will be based on lottery among the bidders who have quoted the same rate.

**IV. Process to be Confidential.**

Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award to the successful bidder has been announced. Any attempt by a bidder to influence the Employer's processing of bids or award decisions may result in the rejection of his/her Bid.

Any attempt by a Tenderer to influence SAI in the evaluation of the Tender or decisions pertaining to award of the Contract may result in the rejection of the Tender of such Tenderer.

From the date of release of this RFP to the date of award of the Contract, the Tenderer shall not contact SAI or the Engineer's Representative, except to respond to the SAI's request for clarification on the Tenders Proposal, as per this RFP, and in such instances, all communications must be in writing and should pertain only to the clarifications sought by SAI.

**V. Examination of Bids and Determination of Responsiveness**

Prior to the detailed evaluation, Employer shall determine whether each bid is of acceptable quality, is generally complete and is substantially responsive to the Tender documents. For purposes of this determination, a substantially responsive bid is one that conforms to all the documents as specified in the Tender document without material deviations, objections, conditionality or reservation. A material deviation, objection, conditionality or reservation is one:

a) That affects in any substantial way the scope, quality or performance of the contract.

b) That limits in any substantial way, inconsistent with the bidding documents, the Employers' rights or the successful Bidder's obligations under the Tender document, or

c) Whose rectification would unfairly affect the competitive position of other Bidders who are presenting substantially responsive bids.

**6. MODE OF SUBMISSION:**

As notified in Notice Inviting Tender

a. Once the bidder has given an unconditional acceptance to the terms and contract conditions, bidder will not be permitted to put any remark(s)/conditions(s) (except unconditional rebate on price quoted, if any) in/along with the tender document.

b. In case the conditions 3.2 mentioned above is found violated at any time after opening of tender, the tender shall be summarily rejected and SAI shall, without prejudice to any other right remedy, be at liberty to forfeit the Earnest Money Deposit as specified above.

c. SAI reserves the right to reject any or all the tenders in part or full without assigning any reason what so ever thereof. SAI does not bind itself to accept the lowest tender. SAI also reserves the right to split up the work among two or more agencies.

**7. QUOTING OF RATES & AMOUNTS:**

a. The tenderers should quote rate/amount in figures and words. The rate shall be quoted up to 2 decimals.

b. Special care should be taken to fill the rates and amounts in figures as well in words in such away that any alteration is not possible. The total amount should be written both in figures and in words. In case of figures; the word 'Rs.' should be written before the figure of Rupees and word 'P' after the decimal figure e.g.Rs.2.15p. Rs.2.15 shall be written as Rupees two and fifteen paisa only. Unless the rate/amount is in whole Rupees it should invariably be up to two decimal places.

c. In case of any discrepancy between the rates/percentage/amount quoted in figures and words, then the rate/percentage/amount quoted by the contractor in words shall be taken as correct.

d. The tenders shall be strictly as per the conditions of contract. Tenders with any additional condition(s)/modifications shall be rejected.

e. The witnesses to the Tender/Contract Agreement shall be other than the tenderer/ tenderers competing for this work and must indicate full name, address, status/occupation with dated signatures.

f. The tenders for works shall remain open for acceptance for a period of 120 (One Hundred Twenty) days from the date of opening of the tenders. If any tenderer withdrawshistenderbeforevalidityperiodormakesanymodificationintermsand conditions of the tender to his benefit which are not acceptable to SAI then SAI shall without prejudice to any other right or remedy, be at liberty to forfeit the EMD.

g. The acceptance of tender will rest with SAI who does not bind itself to accept the lowest tender and reserves to itself the right to reject any or all the tenders received without assigning any reason thereof. Tenders in which any of the prescribed conditions are not fulfilled or found incomplete in any respect are liable to be rejected.

h. Canvassing whether directly or indirectly in connection with tenders is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable for rejection.

**8. PERFORMANCE GUARANTEE:**

To ensure due performance of the contract, the successful bidder shall furnish a Performance Security in the form of a Performance Unconditional Bank Guarantee (PBG) or other acceptable instruments. The Performance Security shall be:

- **Amount:** Equivalent to five percent (5%) of the total contract value.
- **Forms Accepted:** Insurance Surety Bond, Account Payee Demand Draft, Fixed Deposit Receipt from a commercial bank, unconditional Bank Guarantee issued/confirmed by any commercial bank in India, or online payment in an acceptable form.
- **Joint Ventures (JV):** In case of a JV, the Performance Security shall be provided by all partners in proportion to their participation in the project.

Performance Security must be submitted within fourteen (14) days from the date of notification of award and shall remain valid for sixty (60) days beyond the completion of all contractual obligations, including the Defect Liability Period (DLP).

In the event of breach of contract by the contractor, the Performance Security shall be forfeited and credited to the SAI's account. Upon successful completion of all contractual obligations, the Performance Security shall be refunded to the contractor without interest, no later than three hundred sixty-five (365) days from the completion of the DLP.

a. If the contractor fails to submit the Performance Guarantee within the stipulated period, a penalty equivalent to 0.1% of the Performance Guarantee amount per day shall be imposed for the delayed period. However, such an extension shall not exceed Seven (07) days under any circumstances. Non-submission of the Performance Guarantee within the stipulated or extended period shall be deemed as a refusal to execute the contract, and in such a case, SAI shall have the absolute right to forfeit the Earnest Money Deposit (EMD)/ Bid Security without any further notice and take appropriate legal action.

b. Upon submission and confirmation of the Performance Guarantee from the issuing bank, the EMD shall be refunded to the successful bidder. If the EMD was deposited online into SAI's bank account, the refund shall be processed directly to the bidder's registered bank account through electronic transfer.

**9. SECURITY DEPOSIT:**

In addition to the Performance Security, contracts for works shall include a provision for Security deposit/retention money, whereby five percent (5%) of the value of each running bill (periodic/interim payment) shall be withheld as Security Deposit until final acceptance of the works.

Replacement with Bank Guarantee: The contractor may, at their discretion, replace the accumulated retention amount with an unconditional Bank Guarantee (BG) from a bank acceptable to the Procuring Entity at the following stages:

- Upon reaching 50% of the retention money limit.
- Upon reaching the full retention money limit.

**Release of Retention Money / BG:** One-half of the retention money (or BG replacing it) shall be released upon issuance of the Taking Over Certificate (TOC). If TOCs are issued in parts, the release shall be in proportion to the value of the respective part or section, as determined by the Engineer.

The remaining half shall be released upon expiration of 365 days after the Defect Liability Period (DLP) or final payment, whichever is earlier, subject to certification by the Engineer. Multiple DLPs: In cases where different DLPs apply to different sections or parts of the works, the final release shall be based on the latest applicable DLP.

**10. ESCALATION/PRICE VARIATION:**

10CC clause of GCC of EPC contract form of CPWD shall be considered for price escalation.

**11. SPECIFICATIONS**

All specifications for the works as provided in the latest of CPWD publications shall be followed and binding the contract.

**12. SCOPEOFWORK:**

Detailed Scope of Works has been provided in Clause 4 of GCC.

**PROFORMA– I**

(On the letter head of the Tenderer)

To,
Sports Authority of India (SAI),
Jawaharlal Nehru Stadium Complex
East Gate, Lodhi Rd,
New Delhi, Delhi - 110 003

**ACCEPTANCE OF TENDER CONDITIONS**

The tender documents for the work of **(Name of work) _** has been downloaded by me/us/ from official website/e-tendering site of Sports Authority of India and I/We hereby unconditionally accept the tender conditions and tender documents in its entirety for the above work.

1. The contents of the Tender documents have been noted wherein it is clarified that after unconditionally accepting the tender condition in its entirety, it is not permissible to put any remark(s)/conditions(s) (except unconditional rebate on price, ifany )in the tender enclosed in"Envelope-2and the same has been followed in the present case. Incase this provision of the tender is found violated at any time after opening of the Envelope

2. 2, I/we agree that the tender shall be summarily rejected, and SAI shall, without prejudice to any other right or remedy beat liberty to forfeit the full SAI earnest money absolutely.

3. I/we have not made any misleading or false representation in the forms, statements, and attachments in proof of the qualification requirements. In case this provision of the tender is found violated at any time before or after opening of the Price Bid/ Award, I/we agree that the Tender/ Award shall be summarily rejected and SAI shall, without prejudice to any other right or remedy be at liberty to forfeit the full SAI earnest money/ any other amount payable under this contract absolutely.

4. The required earnest money for this work is enclosed here with.

5. If I/we will not fulfil the minimum qualifying criteria of the tender I/we not lodge any claim for opening of Envelope 2 of the tender.

Yours faithfully,

Dated: _____

(Signature of the tenderer) with rubber stamp

**PROFORMA– II**

**FORMOFTENDER**

(OntheletterheadoftheTenderer)

To,
Sports Authority of India (SAI),
Jawaharlal Nehru Stadium Complex
East Gate, Lodhi Rd,
New Delhi, Delhi - 110 003

1. I/We,……[Name & address of the Bidder] …have read the various terms and conditions of the Bid documents together with Addendum no(s)/Errata no(s) attached here with duly signed by me/us and agree to abide by the same.
2. I/We hereby declare that we are aware of the site of work and have made ourselves fully conversant of the conditions there in and including the topography of area, soil strata at site of work, sources and availability of construction materials, rates of construction materials, water, electricity, all local taxes, royalties, octrois etc., availability of local labour (both skilled and unskilled),relevant labour rates and labour laws, the existing road and approaches to the site of work, requirements for further service roads / approaches to be constructed by me / us, the availability and rates of private land etc. that may be required by me /us for various purposes, climatic conditions, law and order situation and availability of working days.
3. I/We hereby tender for execution of **(Name of work)** as per tender documents within the time schedule of completion of work as per separately signed and accepted rates in the price schedule quoted by me/us for the whole work in the accordance with the Notice Inviting Tenders, conditions of contract, specifications of material sand workmanship, price schedule, Drawings, time schedule of completion of jobs and other documents and papers, all as in tender documents.
4. It has been explained to me/us that the time stipulated for jobs and completion of works in all respects and in different stages mentioned in the "Time Schedule for Completion of Job" and signed and accepted by me/us is the essence of the contract. I/We agree that in case of failure on my/our part to strictly observe the time of completion mentioned for jobs or any of the mandate final completion of works in all respects according to the schedule sat out in SAI "Time Schedule for Completion" of stipulations contained in the contract the recovery being made as specified therein. In exceptional circumstances extensions of time which shall always being in writing way, however be granted by SAI at its entire discretion for some items and I/we agree that such extension of time will not be counted for the final completion of work as stipulated in SAI "Time Schedule of Completion of Jobs."
5. **I/we agree to pay the Earnest Money Deposit, Performance Guarantee and Security Deposit and accept the terms and condition as laid down in the memorandum below in this respect.**

**MEMORANDUM**

| S.No. | Description | Values/ Description to be applicable for relevant clause(s) |
|---|---|---|
| 1. | Name of Work | Construction of High-Performance Centre at SAI, **NSSC** Bengaluru Campus, Karnataka, India on Engineering, Procurement and Construction **(EPC), Mode 1 Contract Basis.** |
| 2. | Client/Owner | SportsAuthorityofIndia(SAI) |
| 3. | Type of Tender | EPC. Mode 1 Contract |
| 4. | Estimated Cost | Rs.**73,23,08,363.00**/- |
| 5. | Earnest Money Deposit | Rs. **2,19,69,251.00/-** |
| 6. | Time for completion | 18 Months |
| 7. | Mobilization Advance | Mobilization Advance is payable maximum up to 10 (Ten) % of contract value. |
| 8. | Interest rate on Mobilization Advance | Simple Interest Rate of 12%( Twelve percent only) per annum. |
| 9. | Schedule of Rates applicable | Delhi Schedule of Rates 2023 with latest revisions along with Non-Schedule of Rate Works. |
| 10. | Validity of Tender | 120(one hundred and twenty days)days |
| 11. | Performance Guarantee | 5%ofcontractvaluetobe submitted within 14 days from the date of issue of LOI.Refer Clause No.10 of GCC. |
| 12. | Security Deposit/ Retention Money | To be deducted@5%of each R.A. bill and final bill till it reaches 5% of the contract value. |
| 13. | Time allowed for starting the work | Date of start of contract shall be reckoned 10 days after the date of issue of letter/Fax/E-mail of "Letter ofintent |
| 14. | Defect Liability Period | 36(Thirty-six)Months from the date of handing over of work is to SAI. Contractor shall also be liable to attend all defects for works which possess warranty period more than 12 months. |

6. Should this tender be accepted, I/We agree to abide by and fulfill all terms and conditions referred to above and in default thereof, to forfeit, and pay SAI or its successors or its authorized nominees such sums of money as are stipulated in the notice inviting tender documents.

7. If I/We fail to commence the work within 10 days on issue of LOI, or I/We fail to submit the Performance Guarantee as per General Conditions of Contract I/We agree that SAI shall, without prejudice to any other right or remedy, be at liberty to forfeit SAI earnest money deposited with SAI besides any other action as per terms of registration with SAI. SAI shall also beat liberty to cancel the notice of acceptance of tender if we fail to deposit the Performance Guarantee as contained elsewhere in the tender documents.

8. I/We are also enclosing herewith the Acceptance Letter on the prescribed pro- forma as referred to in condition of e-NIT.

Dated the_____day of _____

SIGNATUREOFTENDERER

NAME IN CAPITAL LETTERS_____

ADDRESS_____

TELEPHONE&FAXNO._____

E-mail ID_____

SEAL OF TENDERER

WITNESS

OCCUPATION_____

**PROFORMA-III**

**GENERALINFORMATION**

All individual firms and each partner of a joint venture participating in this Bid are requested to complete the information in this form.

| | | |
|---|---|---|
| 1 | Name of Bidder | |
| 2 | Head Office Address | |
| | Tel. No. | |
| | Mobile No. | |
| | Fax No. | |
| | E-mail address | |
| 3 | Address on which correspondence. Should be made | |
| | Tel. No. | |
| | Mobile No. | |
| | Fax No. | |
| | E-mail address | |
| 4 | Place of In Client/Registration | |
| 5 | Legal status of the applicant (attach copies of original documents defining the legal status) | |
| i) | Specify, if the bidder is | |
| | a)An individual | |
| | b) A proprietary firm | |
| | c)A firm in partnership | |
| | d)A Limited Company or Client | |
| | e)A group of firms/joint venture (if yes, give complete information in respect of each member) | **Not Applicable** |
| ii) | Attach a copy of Proprietorship or Partnership Deed or Article of Association. | |
| 6 | Name of Proprietor / Partners / Directors with their addresses, Mobile &Telephone numbers, Fax No.,E-mail address. | |
| 7 | Designation of individuals authorized to act for the organization with the address, Mobile & Telephone numbers, Fax, E-mail address.**(Enclose legal Power of a ttorney along with Board Resolution in case of Companies).** | |

| | | | |
|---|---|---|---|
| 8 | Was the applicant ever required to suspend any construction for a period of more than six months continuously after commencement of the construction? If so, give the name of the project & reasons of suspension of work. | | |
| 9 | Has the applicant of any constituent partner in case of partnership firm, ever abandoned the awarded work before its completion? If so, give name of the project and reasons for abandonment. | | |
| 10 | i) Is the applicant, or any constituent partner in case of partnership firm is debarred at the time of start date for submission of bids. | | |
| | ii)Debarment/blacklisting shall be as per Ministry of Finance, Procurement policy division office memorandum dated 02.11.2021. Provide details accordingly in Proforma-III. | | |
| 11 | Has the applicant or any constituent partner in case of partnership firm, ever been convicted by a court of Law ? If so, give details. | | |
| 12 | Credit Facility/Bank Solvency | | |
| 13 | Turn Over / Net Profit for the years given below: Copies of Audited Balance Sheets are to been closed with Proforma V. | Turn Over in Lakhs | Profit in Lakhs |
| | 2020-2021 | | |
| | 2021-22 | | |
| | 2022-23 | | |
| | 2023-24 | | |
| | 2024-25 | | |
| 14 | Other details: (Copies to be enclosed) | | |
| | a)EPF And ESI registrationNo.&validupto: | | |
| | b) Goods & Service Tax Registration No. | | |
| | b) PAN No. | | |
| 15 | Give particulars of registration with Govt./SemGovt./PublicSector Undertakings/Local Bodies. | | |
| 16 | **Preference to Make in India:** The bidder shall follow percentage of local content used during the execution of work as per the order of Public Procurement (Preference to Make in India) Order 2017 & amendments time to time which is sued by Department of Industrial Policy and Promotion under Ministry | | |

| | | | |
|---|---|---|---|
| | of Commerce & Industry vide No: P45021/2/2017-B.E-IIdated15.06.2017 | | |

Note: Use separate sheets for providing more information if any.

**Date & Place Signature & seal of the applicant.**

**PROFORMA-IV**

**ListofmajorPlantandMachineryinpossessionofthefirm**

| S.No. | Name of Plant & Machinery/Equipment | Minimum to be Deployed. | Available Owned | *Otherthan ColumnNo.D |
|---|---|---|---|---|
| A | B | C | D | E |
| 1 | Mobile type Fully automatic RMC batching plant(capacity30cum/hr.) | 1Nos. | | |
| 2 | Transit mixture with capacity not less than5Cum | 4Nos. | | |
| 3 | Concrete Pump | 2Nos. | | |
| 4 | Concrete mixture machine with weigh batcher | 3Nos. | | |
| 5 | Excavator | 1Nos. | | |
| 6 | Excavator Concrete Breaker/Cutter | 2Nos. | | |
| 7 | Shuttering (SteelAcroPlate,Plywood as approve by EIC) | 2000Sqm | | |
| 8 | Vibrator (Needle)+Surface Vibrator(Operating with Electricity)+Diesel Vibrator | 10Nos. | | |
| 9 | Water Tanker | 2Nos. | | |
| 10 | Trucks/Dumpers | 5Nos. | | |
| 11 | Pump/Motor(min.1.5HP) | 3Set | | |
| 12 | Diesel Generator/Electrical Inverter with 4hr. Battery backup | 3Set | | |
| 13 | Front end Loader | 1Nos. | | |
| 14 | Vibratory Roller | 1Nos. | | |
| 15 | Mini Roller/Vibrator | 1Nos. | | |

**Date&Place** **Signature &seal of the applicant.**

*Note:*

* *In case of any arrangement forgetting the equipment on lease/MoU etc., authenticated proof of the same is to be submitted.*

** *Use separate sheets for providing more information.*

**PROFORMA– V**
**ANNUAL TURN OVER FOR THE LAST FIVE YEARS**

| ANNUAL TURN OVER FOR THE LAST FIVE YEARS | | | | |
|---|---|---|---|---|
| **S.No.** | **YEAR** | **Turnover from Engineering Construction Works (InRs. Lakh)** | **Net Profit (InRs. Lakh)** | **Remarks (if any)** |
| 1 | 2020-21 | | | |
| 2 | 2021-22 | | | |
| 3 | 2022-23 | | | |
| 4 | 2023-24 | | | |
| 5 | 2024-25 | | | |

**Date&Place** **Signature & seal of the applicant**

**Note:**
The bidder **shall submit the attested copies of the Audited Balance Sheets** along with Profit and Loss Statements and Auditors Report and Schedules duly certified by the bidder and Chartered Accountant. Certificate from the Chartered Accountant, wherever the Annual Turnover is certified for the relevant financial year in which the minimum criteria of Annual Turnover is satisfied should also be submitted.

**PROFORMA–VI**

**DETAILSOFTHESIMILARWORKSCOMPLETEDINLASTSEVENYEARS**

| Sr.No. | Description ofthe Work with Contract No. | Name and address of the Employer with Contact No. | Date of award | Stipulated date of completion | Date of actual completion | Value of completed work | Reasons for delays, penalty if any | Any other relevant information |
|---|---|---|---|---|---|---|---|---|
| 1. | | | | | | | | |
| 2. | | | | | | | | |
| 3. | | | | | | | | |
| 4. | | | | | | | | |
| 5. | | | | | | | | |
| 6. | | | | | | | | |

**Note:**

1. The Bidder shall submit the attested Copies of the Work order/MoU and Completion Certificates from SAI certified by an authority equivalent to Executive Engineer or Project manager
2. The value of work executed should be inclusive of the value of free supply items.

**PROFORMA-VII**

**DETAILSOFON-GOING/EXISTINGWORKS**

| Sr.No. | Description of the Work with Contract No. | Name and address of the Employer | Date of award | Stipulated dateof completion | Value of work as perorder (InRs.) | Value of work completed so far (InRs.) | Anticipated date of completion of work | Anyother relevant information |
|---|---|---|---|---|---|---|---|---|
| 1. | | | | | | | | |
| 2. | | | | | | | | |
| 3. | | | | | | | | |
| 4. | | | | | | | | |
| 5. | | | | | | | | |
| 6. | | | | | | | | |
| 7. | | | | | | | | |
| 8. | | | | | | | | |
| 9. | | | | | | | | |

**Note:**

The copies of certificates of ongoing-awarded works issued by the owner shall be attached. Only those works shall be considered for evaluation for which copies of the certificates issued by the owner are attached.

**PROFORMA VIII**

**PASTCONTRACTUALPERFORMANCE**

(Affidavitonnon-judicialstamppaperofRs10/-dulyattestedbyNotary/Magistrate)

This is to certify that We, M/s *[Name of the Bidder with address]*, in submission of the Bid, *[Name of Bid with Bid No.]*

i) Have not made any misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.

ii) do not have records of poor performance such as abandoning the work, not properly completing the contract, inordinate delays incompletion, litigation history or financial failures etc.

iii) have never been banned by any Central/State Govt. Departments/Public Sector Undertakings or Enterprises of Central/State Govt.

iv) have submitted all the supporting documents and furnished the relevant details as per the prescribed format; and

v) have submitted all the information and the requisite documents with the Bid and further certify that we are fully responsible for the correctness of the information and documents submitted by us.

SIGNATURE OF THE BIDDER

SEAL

***Note:*** *Exceptions of the above, if any, shall be clearly mentioned with details by the bidder for evaluation/consideration if any.*

**PROFORMA IX**

**BANKACCOUNTPARTICULARSFORREFUNDOFEMDTHROUGHELECTRONICMODE**

| S.No. | Description | Particulars |
|---|---|---|
| 1 | Name of the Beneficiary | |
| 2 | Bank Name | |
| 3 | Bank Address | |
| 4 | Bank Branch code | |
| 5 | Account No. | |
| 6 | IFSC Code | |
| 7 | MICR No. | |

**Date & Place**

**Signature &seal of the applicant.**

**PROFORMA- X**

**LITIGATIONHISTORY**

(On the letter head of the Tenderer)

| Sr.No. | Name of Work | Client | Type of Case (Court Case/Arbitration Case) | Dateof Registering of Case | Name & Address of Court / Arbitrator | Amount involved | Present Status | Remarks (if any) |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| | | | | | | | | |

**Date & Place** **Signature & seal of the applicant.**

**Note:** Applicant has to submit the details of last 5years in respect of Court Cases / Arbitration Cases.

**PROFORMA XI**

**GSTREGISTRATIONDETAIL**

| S.NO. | CONTRACTOR/VENDORDETAILS | |
|---|---|---|
| 1 | Name | |
| 2 | Address(As per registration with GST) | |
| | City | |
| | Postal Code | |
| | Region/State(Complete State Name) | |
| 3 | GSTINID/Provisional ID No. (Copy of Acknowledgement required) | |
| 4 | Type of Business(As per registration with GST) | |
| 5 | Service Accounting Code/HSN Code | |
| 6 | Contact person | |
| 7 | Phone number and Mobile number | |
| 8 | Email id | |
| 9 | Compliance Rating (if fun dated by GSTN) | |

**PROFORMA–XII**

**UNDERTAKING REGARDING PERCENTAGE OF LOCAL CONTENT**

Self-Certification under preference to Make in India order Certificate.

1. In line with Government Public Procurement Order No. P-45021/2017-PP (BE-II) dated 04.06.2020 and its amendments, we hereby certify that we M/s_____ are local suppliers and the offered item having local content of _____% ( excluding Net Domestic Indirect Taxes, Transportation, Insurance, Installation, Commissioning, Training and after sales service support like AMC/CMC etc.) as defined in above orders for the material against Tender/Bid No._____ Dated _____

2. Details of location at which local value addition will be made as follows:

_____

3. We also understand, false declaration will be breach of the code of integrity under the rule 175(1)(i)(h) of the General Financial Rules for which a bidder or its successors can be debarred for up to two years as per rule 151 (iii) of the General Financial Rules along with such other actions as maybe permissible under law.

**Thanking You**

**_____**
**(Signature, name and designation of the authorized signatory)**
**(Name and seal of the Bidder)**

P **PROFORMA XIII**

**Solvency Certificate**

(On Banker's letter Head)

Dispatch number of bank /dates

This is to state that to the best of our knowledge and information that M/S_____
having/registered office address _____
customer of bank and has been maintaining his accounts with our branch since _____
As per records available with the bank, M/s _____can be treated as solvent up to a limit of Rs (Rupees in words)_____.

It is clarified that the above information is issued/furnished to SAI at Customer's request for their empanelment & participation in various tenders.

**Signature, Name & Designation Address of Bank**

**BANK'S SEAL**

***NOTE:***

1. *The above certificate shall be from the RBI Scheduled Bank.*
2. *In case of Partnership firm, Certificate should include names of all partners as recorded with the bank.*
3. *The Certificate should have been issued within 6 months from original last date of the submission of tender but in the current financial year.*
4. *Original certificates are to be submitted along with the bid documents.*

**PROFORMA XIV**

**PRE-CONTRACT INTEGRITY PACT**

This pre-bid /pre contract Agreement (hereinafter called Integrity Pact) is made on …… day of the month of …… 20. between, on one hand, Sports Authority of India, hereinafter referred to as "The Principal" which expression shall mean and include, unless the context otherwise requires, his successors in office and assigns of the First Part.
And
M/s_____, a company/ firm/ individual (status of the company), PSU/Partnership/Joint Venture and having its registered office at ……represented by Shri_____, hereinafter referred to as "The Bidder/Contractor" which expression shall mean and include, unless the context otherwise requires, his successors and permitted assigns of the Second Part.

WHEREAS the Principal proposes to procure _____ (Name of the work/ goods/ services) and The Bidder/Contractor is willing to offer against NIT No_____, said aforesaid proposal of the Principal.

WHEREAS the Bidder is a private company / public company/ Government undertaking/ partnership/ consortium/ joint venture company/ Firm/ Individual (status of the Company), constituted in accordance with the relevant law in the matter and the Principal is an autonomous body under Ministry of Youth Affairs and Sports.

NOW, THEREFORE, To avoid all forms of corruption by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to:-
Enabling the Principal to obtain the desired said (goods/ services) at a competitive price in conformity with the defined specifications by avoiding the high cost and the distortionary impact of corruption on public procurement, and
Enabling the Bidder(s) to abstain from bribing or indulging in any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and the principal will commit to prevent corruption, in any form, by its officials by following transparent procedures.

The parties here by agree to enter this Integrity Pact & agree as follows:

**1.0 Commitments of the Principal**

1.1 The Principal undertakes that no official of the Principal, connected directly or indirectly with the contract, will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favour or any material or immaterial benefit or any other advantage from the Bidder, either for themselves or for any person, organization or third party related to the contract in exchange for an advantage in the bidding process, bid evaluation, contracting or implementation process related to the contract.

1.2 The principal will, during the pre-contract stage, treat all Bidders alike, and will provide to all the Bidders the same information and will not provide any such information to any particular Bidder which could afford an advantage to that particular Bidder in comparison to other Bidders.

1.3 All the officials of the principal will report to the appropriate Authority any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach.

**2.0** In case any such preceding misconduct on the part of such official(s) is reported by the Bidder to the Principal with full and verifiable facts and the same is prima facie found to be correct by the Principal, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings may be initiated by the Principal and such a person shall be debarred from further dealings related to the contract process. In such a case while an enquiry is being conducted by the principal the proceedings under the contract would not be stalled.

**3.0 Commitments of the Bidder(s)**

The Bidder(s) commits itself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre-contract or post-contract stage in order to secure the contract or in furtherance to secure it and in particular commit itself to the following:

3.1 The Bidder(s) will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the Principal, connected directly or indirectly with the bidding process, or to any person, organization or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation/completion of the contract.

3.2 The Bidder further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the Principal or otherwise in procuring the Contract or forbearing to do or having done any act in relation to the obtaining or execution of the contract or any other contract with the Government for showing or forbearing to show favour or disfavor to any person in relation to the contract or any other contract with the Government.

3.3 The Bidder(s) shall disclose the name and address of agents and representatives, and Indian Bidder(s) shall disclose their foreign principals or associates.

3.4 The Bidder(s) shall disclose the payments to be made by them to agents/brokers or any other intermediary, in connection with this bid/contract.

3.5 If applicable, The BIDDER further confirms and declares to the PRINCIPAL that the BIDDER is the original manufacturer/integrator/authorized government sponsored export entity of the defence stores and has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the PRINCIPAL or any of its functionaries, whether officially or unofficially to the award of the contract to the BIDDER, nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.

3.6 The Bidder, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payments he has made, is committed to or intends to make to officials of the principal or their family members, agents, brokers or any other intermediaries in connection with the contract and the details of services agreed upon for such payments.

3.7 The Bidder will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

3.8 The Bidder will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.

3.9 The Bidder shall not use improperly, for purposes of competition or personal gain, or pass on to others, any information provided by the principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained in any electronic data carrier. The Bidder also undertakes to exercise due and adequate care lest any such information is divulged.

3.10 The Bidder(s) commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.

3.11 The Bidder(s) shall not instigate or cause to instigate any third person to commit any of the actions mentioned above.

3.12 If the Bidder or any employee of the Bidder or any person acting on behalf of the Bidder, either directly or indirectly, is a relative of any of the officers of the principal, or alternatively, if any relative of an officer of the Principal has financial interest/stake in the Bidder(s)(s) firm, the same shall be disclosed by the Bidder at the time of filling of tender.

The term 'relative' for this purpose would be as defined in Section 6 of the Companies Act 1956.

3.13 The Bidder(s) shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee of the principal.

3.14 The representative of the Bidder(s) signing Integrity Pact shall not approach the Courts while representing the matters to IEMs and he/she will wait their decision in the matter.

3.15 In case of sub-contracting, the bidder/principal contractor shall take the responsibility of the adoption of IP by the sub-contractor.

**4.0 Previous Transgression**

4.1 The Bidder(s) declares that no previous transgression occurred in the last three years immediately before signing of this Integrity Pact, with any other company in any country in respect on any corrupt practices envisaged hereunder or with any Public Sector Enterprise in India or any Government Department in India that could justify Bidder's exclusion from the tender process.

4.2 The bidder agrees that if I make incorrect statement on this subject, Bidder can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

**5.0 Earnest Money (Security Deposit)**

5.1 While submitting commercial bid, the bidder shall deposit an amount …… (to be specified in RFP) as Earnest Money/Security Deposit, with the principal through any of the following instruments:

i. Bank Draft or Pay Order in Favour of……..
ii. A confirmed guarantee by an Indian Nationalized bank, promising payment of guarantee sum to the principal on demand within three working days without any demur whatsoever and without seeking any reason whatsoever. The demand for payment by the principal shall be treated as conclusive proof of payment.
iii. Any other mode or through any other instrument (to be specified in the RFP)

5.2 The Earnest Money/Security Deposit shall be valid up to a period of five years or the complete conclusion of the contractual obligations to the complete satisfaction of both the BIDDER and the PRINCIPAL, including warranty period, whichever is later.

5.3 In case of the successful BIDDER a clause would also be incorporated in the Article pertaining to Performance Guarantee in the Contract that the provisions of Sanctions for Violation shall be applicable for forfeiture of Performance Guarantee in case of a decision by the PRINCIPAL to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

5.4 No interest shall be payable by the PRINCIPAL to the BIDDER on Earnest Money/Security Deposit for the period of its currency.

**6.0 Sanctions for Violations**

6.1 Any breach of the said aforesaid provisions by the Bidder or anyone employed by it or acting on its behalf shall entitle the principal to take all or any one of the following actions, wherever required:

i. To immediately call off the pre contract negotiations without assigning any reason or giving any compensation to the Bidder. However, the proceedings with the other Bidder(s) would continue.

ii. The Earnest Money Deposit (in pre-contract stage) and/or Security Deposit/Performance Guarantee (after the contract is Signed) shall stand forfeited either fully or partially, as decided by the Principal and the Principal shall not be required to assign any reason thereof.

iii. To immediately cancel the contract, if already signed, without giving any compensation to the Bidder.

iv. To recover all sums already paid by the PRINCIPAL, and in case of an Indian BIDDER with interest thereon at 2% higher than the prevailing Prime Lending Rate of State Bank of India, while in case of a BIDDER from a country other than India with interest thereon at 2% higher than the LIBOR. If any outstanding payment is due to the BIDDER from the PRINCIPAL in connection with any other contract for any other stores, such outstanding payment could also be utilized to recover the said aforesaid sum and interest.

v. To encash the advance bank guarantee and performance bond/warranty bond, if furnished by the BIDDER, in order to recover the payments, already made by the PRINCIPAL, along with interest.

vi. To cancel all or any other Contracts with the BIDDER. The BIDDER shall be liable to pay compensation for any loss or damage to the PRINCIPAL resulting from such cancellation/rescission and the PRINCIPAL shall be entitled to deduct the amount so payable from the money(s) due to the BIDDER.

vii. To debar the Bidder from participating in future bidding processes of the Govt. of India for a minimum period of five years, which may be further extended at the discretion of the Principal.

viii. To recover all sums paid in violation of this Pact by Bidder(s) to any middleman or agent or broker with a view to securing the contract.

ix. In cases where irrevocable Letters of Credit have been received in respect of any contract signed by the Principal with the Bidder, the same shall not be opened/operated.

x. Forfeiture of Performance Security in case of a decision by the Principal to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

6.2 The Principal will be entitled to take all or any of the actions mentioned at para 6.1 (i) to (x) of this Pact also on the Commission by the Bidder or any one employed by it or acting on its behalf (whether with or without the knowledge of the Bidder), of an offence as defined in Chapter IX of the Indian Penal Code, 1860 or Prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption.

6.3 The decision of the Principal to the effect that a breach of the provisions of this Pact has been committed by the Bidder shall be final and conclusive on the Bidder. However, the Bidder can approach the Independent External Monitor(s) appointed for the purposes of this Pact.

**7.0 Independent Monitors:**

7.1 The Principal has appointed Independent Monitors (hereinafter referred to as monitors) for this Pact in consultation with the Central Vigilance Commission.

7.2 The Name and contact details of Independent External Monitor (IEM) is as below:

1. Sh. P Mallikharjuna Rao, IFOS(Retd)
   72, Prashasan Nagar,
   Jubileehills, Hyderabad
   M. No – 9440576170
   Email: pmkrao72@gmail.com

2. Sh. Janak Digal,
Plot No. 1B/2, Sector-l1, CDA,
Markat Nagar, Cuttack, Odisha - 753015
M. No.- 09971116084, Email: janakdigal85@gmail.com

7.3 The task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.

7.4 The Monitors shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently.

7.5 Both the parties accept that the Monitors have the right to access all the documents relating to the project/procurement, including minutes of meetings.

7.6 As soon as the Monitor notices, or has reason to believe, a violation of this Pact, he will so inform the authority designated by the principal.

7.7 The Bidder(s) accepts that the Monitor has the right to access without restriction, to all Project documentation of the principal including that provided by the Bidder. The Bidder will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractor(s). The Monitor shall be under contractual obligation to treat the information and documents of the Bidder/Subcontractor(s) with confidentiality.

7.8 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the project provided such meetings could have an impact on the contractual relations between the parties. The parties will offer to the Monitor the option to participate in such meetings.

7.9 The Monitor will submit a written report to the designated authority of the Principal/Secretary in the Department within 8 to 10 weeks from the date of reference or intimation to him by the Principal/Bidder and should the occasion arise, submit proposals for correcting problematic situations.

**8.0 Facilitation of Investigation**

In case of any allegation of violation of any provisions of this Pact or payment of commission, the Principal or its agencies shall be entitled to examine all the documents including the Books of Accounts of the Bidder and the Bidder shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

**9.0 Law and Place of Jurisdiction:**

This Pact is subject to Indian Law. The place of performance and jurisdiction is the seat of the Principal.

**10.0 Other Legal Actions**

The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

**11.0 Validity**

11.1 The validity of this Integrity Pact shall be from date of its signing and extend upto 5 years or the complete execution of the contract to the satisfaction of both the Principal and The Bidder/Contractor, including warranty period, whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the signing of the contract.

11.2 Should one or several provisions of this Pact turn out to be invalid, the remainder of this Pact shall remain valid. In this case, the parties will strive to come to an agreement to their original intention.

**12.0** The Parties hereby sign this Integrity Pact as part of the contract at_____on_____

| | |
|---|---|
| (Principal) | (Bidder) |
| (Office Seal) | (Office Seal) |
| Place :……..Date:…… | Place :……..Date:…… |
| Witness 1: ,,,

**Proforma XV**

**PROFORMA OF BANK GUARANTEE(FOR MOBILIZATION ADVANCE)**

SPORTS AUTHORITY OF INDIA,

1. In consideration of SAI ..... (here in after called "Client" which expression shall unless repugnant to the subject or context include his success or and assigns)having agreed under the terms and conditions of Contract dated made between……and SAI inconnection with ( Here in after called "Said contract")to make at the request of the Contractor at Mobilization Advance of Rs ..... for utilizing it for the purpose of the Contract on his furnishing a guarantee acceptable to the Client, we the..... Bank(here in after referred to the "SaidBank") and having our Registered Office at… ..... do here by guarantee the due recovery by SAI of Said advance as provided according to the terms and conditions of the Contract. We… ..... do here by undertake to pay the amount due and pay able under this Guarantee without any demur, merely on a demand from SAI stating that the amount claimed is due to SAI under Said Agreement. Any such demand made on the ..... shall be conclusive as regards the amount due and payable by the……under this guarantee and…….agree that the liability of the..... to pay SAI the amount so demanded shall be absolute and unconditional not withstanding any dispute or disputes raised by the Contractor and not withstanding any legal proceeding pending in any Court or Tribunal relating there to .However, our liability under this Guarantee shall be restricted to an amount not exceeding Rs ……..We ..... Bank further agree that SAI shall be the sole judge of and as to whether the amount claimed has fallen due to SAI under Said agreement or whether Said Contractor has not utilized Said advance or any part thereof for the purpose of the Contract and the extent of loss or damage caused to or suffered by SAI on account of Said advance together with interest not being recovered in full and the decision of SAI that the amount has fallen due from contractor or Said Contractor has not utilized Said advance or any part there to for the purpose of the contract and as to the amount or amounts of loss or damage caused to or suffered by SAI shall be final and binding onus.

2. We, Said Bank, further agree that the Guarantee herein contained shall remain in full force and effect till Said advance has been fully recovered and its claims satisfied or discharged and till SAI certify that Said advance has been fully recovered from Said Contractor, and accordingly discharges this Guarantee subject, however, that SAI shall have no claims under this Guarantee after Said advance has been fully recovered, unless a notice of the claims under this Guarantee has been served on the Bank before the expiry of Said Bank Guarantee in which case the same shall been forceable against the Bank.

3. SAI shall have the fullest liberty without affecting in any way the liability of the Bank under this Guarantee or indemnity from time to time to vary any of the terms and conditions of Said Contract or the advance or to extend time of performance by Said Contractor or to postpone for any time and from time to time of the powers exercisable by it against Said Contractor and either to enforce or forbear from enforcing any of terms and conditions governing Said Contract or the advance or securities available to SAI and Said Bank shall not be released from its liability under these presents by any exercise by SAI of the liberty with reference to the matters said aforesaid or by reasons of time being given to Said Contractor or any other for bearance, actor omission on the part of SAI or any indulgence by SAI to Said Contractor or of any other matter or thing whatsoever which under the law relating to sureties would but for this provision have the effect of so releasing the bank from its such liability.

4. It shall not be necessary for SAI to proceed against the Contractor before proceeding against the Bank and the Guarantee herein contained shall be enforceable against the Bank notwithstanding any security which SAI may have obtained or obtain from the Contractor or shall at the time when proceedings are taken against the Bank here under be outstanding or unrealized.

5. We, Said Bank, lastly undertake not to revoke this Guarantee during its currency except with the previous consent of SAI in writing and agree that any change in the constitution of Said Contractoror Said Banks Hall not discharge our liability hereunder.

Dated this……..day of……

For and on behalf of Bank (NAME AND DESIGNATION)

Dated:

**GUARANTEETOBEEXECUTEDBYCONTRACTORFORANTI-TERMITET REATMENT**

THIS AGREEMENT made this__Day of Two Thousand _____between M /s_____ (hereinafter called the guarantor of the one part)and M/s SPORTS AUTHORITY OF INDIA, (hereinafter called SAI) the OWNER of the other part.

Whereas this agreement is supplementary to the contract hereinafter called the contract dated _made between the guarantor of the one part and Sports Authority of India of the other part whereby the contractor inter-alia, understood to render the buildings and structures in Said contract recited, completed, termite proof. And whereas the guarantor agreed to give a guarantee to the effect that Said structure will remain termite proof for TEN YEARS to be so reckoned from the date after the maintenance period prescribed in the contract expires.

During this period of guarantee, the guarantor shall make good all defects and for that matter shall replace at his risk and cost such wooden member as may be damaged by termite and in case of any other defect being found, he shall render the building termite proof at his cost to the satisfaction of the Engineer-In-Charge and shall commence the works of such rectification within seven days from date of issuing notice from the Engineer- In-Charge calling upon him to rectify the defects failing which the work shall be got done by SAI/ OWNER by some other contractor at the guarantor's cost and risk and in the latter case the decision of the Engineer-In-Charge as to the cost recoverable from the guarantor shall be final and binding.

That if the Guarantor fails to execute the Anti-Termite Treatment or commits breaches hereunder then the Guarantor will indemnify SAI against all losses damages, cost expensesorotherwisewhichmaybeincurredbyhimbyreasonsofanydefaultonthepart of the guarantor in performance and observance of this supplemental Agreement. As to theamountoflossandordamageand/orcostincurredbySAI/OWNERdecisionofthe Engineer-In-Charge will be final and binding on the parties.

In witness where of these presents have been executed by the guarantor_ and by_for and on behalf of SAI on the day of month and year first above written.

Signed sealed and delivered by(Guarantor) IN THE PRESENCE OF:

1.
2.

Signed for and on behalf of SAI by/in presence of:

1.
2.

**GUARANTEE BOND TO BE EXECUTED FOR WATER PROOFING TREATMENT**

THIS AGREEMENT made this__Day of Two Thousand _____between M /s_____ (hereinafter called the guarantor of the one part)and M/s SPORTS AUTHORITY OF INDIA, (hereinafter called SAI) the OWNER of the other part.

Whereas this agreement is supplementary to the contract hereinafter called the contract dated made between the guarantor of the one part and Sports Authority of India of the other part whereby the contractor inter-alia, understood to render the buildings and structures in Said contract recited, completed, Waterproof. And whereas the guarantor agreed to give a guarantee to the effect that Said structure will remain waterproof for TEN YEARS to be so reckoned from the date after the maintenance period prescribed in the contract expires.

During this period of guarantee, the guarantor shall make good all defects and for that matter shall replace at his risk and cost such member as may be damaged by water and in case of any other defect being found, he shall render the building water proof at his cost to the satisfaction of the Engineer-In-Charge and shall commence the works of such rectification within seven days from date of issuing notice from the Engineer- In-Charge calling upon him to rectify the defects failing which the work shall be got done by SAI/ OWNER by some other contractor at the guarantor's cost and risk and in the latter case the decision of the Engineer-In-Charge as to the cost recoverable from the guarantor shall be final and binding.

That if the Guarantor fails to execute the waterproof Treatment or commits breaches hereunder then the Guarantor will indemnify SAI against all losses damages, cost expenses or otherwise which may be incurred by him by reasons of any default on the part of the guarantor in performance and observance of this supplemental Agreement. As to the amount of loss and or damage and/or cost incurred by SAI/ OWNER decision of the Engineer-In-Charge will be final and binding on the parties.
In witness where of these presents have been executed by the guarantor and by for and on behalf of SAI on the day of month and year first above written.

Signed sealed and delivered by (Guarantor) IN THE PRESENCE OF:
1.
2.

Signed for and on behalf of SAI by/ in presence of:
1.
2.

**GUARANTEE TO BE EXECUTED FOR PLUMBING WORK**

THIS AGREEMENT made this__Day of Two Thousand
_____between M /s__ (hereinafter called the guarantor of the one part) and M/s SPORTS AUTHORITY OF INDIA, (hereinafter called SAI) the OWNER of the other part.

Whereas this agreement is supplementary to the contract hereinafter called the contract dated made between the guarantor of the one part and Sports Authority of India, of the other part whereby the contractor inter-alia, understood to render the buildings and structures in Said contract recited, completed, leak proof. And whereas the guarantor agreed to give a guarantee to the effect that Said structure will remain leak proof and all plumbing work including fitting and fixtures will be in good condition for THREE YEARS to be so reckoned from the date after the maintenance period prescribed in the contract expires.

During this period of guarantee, the guarantor shall make good all defects and for that matter shall replace at his risk and cost such part of the building as may be damaged by defective plumbing works and seepage and in case of any other defect being found, he shall render the building leak proof at his cost to the satisfaction of the Engineer-In-Charge and shall commence the works of such rectification within seven days from date of issuing notice from the Engineer- In-Charge calling upon him to rectify the defects failing which the work shall be got done by SAI/ OWNER by some other contractor at the guarantor's cost and risk and in the later case the decision of the Engineer-In-Charge as to the cost recoverable from the guarantor shall be final and binding.
That if the Guarantor fails to execute the Plumbing work or commits breaches hereunder then the Guarantor will indemnify SAI against all losses damages, cost expenses or otherwise which May be incurred by him by reasons of any default on the part of the guarantor in performance and observance of this supplemental Agreement. As to the amount of loss and or damage and/or cost incurred by SAI/ OWNER decision of the Engineer-In-Charge will be final and binding on the parties.
In witness where of these presents have been executed by the guarantor and by for and on behalf of SAI on the day of month and year first above written.

Signed sealed and delivered by (Guarantor) IN THE PRESENCE OF:
1.
2.

Signed for and on behalf of SAI by/ in presence of:
1.
2.

**AGREEMENTFORM**

This agreement made this day of (Month) (Year), between the SPORTS AUTHORITY OF INDIA(SAI), is a registered society under administrative control of Ministry of Youth Affairs and Sports (hereinafter referred to as the "SAI" which expression shall include its administrators, executor sand assigns) of the one part and M/s _____(NAME OF CONTRACTOR) (hereinafter referred to as the 'Contractor' which expression shall unless the context requires otherwise include its administrators, successors, executors and permitted assigns) of the other part.

WHEREAS, SAI, has desirous for **(Name of work)**(hereinafter referred to as the "PROJECT") on behalf of SAI, under Ministry of youth Affairs and Sports (hereinafter referred to as "OWNER"), had invited tender as per tender documents vide NIT No. _.
AND WHEREAS _____(NAMEOF CONTRACTOR) had participated in the above referred tender vide their tender dated __ _____and SAI has accepted theirsaid aforesaid tender and award the contract for**(Name of work)**on the terms and conditions contained in its Letter of Intent No. __and the documents referred to there in, which have been un equivocally and unconditionally accepted by_____ (NAME OF CONTRACTOR) vide their acceptance letter dated _____resulting into a contract.

NOWTHEREFORETHISDEEDWITNESSETHASUNDER:

**ARTICLE1.0–AWARDOFCONTRACT**

1.1 SCOPEOF WORK

SAI has awarded the contract to_____ (NAME OF CONTRACTOR) for the work of **(Name of work)** on the terms and conditions in its Letter of Intent No._____ dated_____and the documents referred to therein. The award has taken effect from___ (DATE) i.e., the date of issue of said aforesaid Letter of Intent. The terms and expressions used in this agreement shall have the same meanings asare assigned to them in the "Contract Documents" referred to in the succeeding Article.

**ARTICLE2.0–CONTRACTDOCUMENTS**

The contract shall be performed strictly as per the terms and conditions stipulated herein and in the following documents attached herewith (hereinafter referred to as "Contract Documents").

a) SAI Notice Inviting Tendervide No._____date _____
And SAI's tender documents consisting of:

i) General Conditions of Contract (GCC) & Special Conditions of Contract (SCC)including Appendices & Annexure along with amendment(s)/errata (if any) issued.

ii) Scope of Work, Design Basis Report, Schematic Drawings, Price Schedule along with amendment(s)/corrigendum(s),
If any,

iii) Technical Specifications along with amendment(s)/corrigendum(s),if any,

iv) Tender drawings along with amendment(s)/corrigendum(s),if any,

v) Any Other clauses in the Tender.

b) _____(NAMEOFCONTRACTOR)letter proposal dated (Date of Submission of Bid)_____and their subsequent communication:

i) Letter of Acceptance of Tender Conditions/Performance Bank guarantee dated._____

SAI's detailed Letter of Intent No. _____dated _____including Bill of Quantities, Agreed Time Schedule, Contractor's Organisation Chart and List of Plant and Equipment submitted by Contractor.

All the aforesaid contract documents referred to in Para 2.1 and 2.2 above shall form an integral part of this Agreement, in so far as the same or any part thereof column, to the tenderdocumentsandwhathasbeenspecificallyagreedtobySAIinitsLetterofIntent. Any matter inconsistent there with, contrary, or repugnant there to or deviations taken by the Contractor in its "TENDER" but not agreed to specifically by SAI in its Letter of Intent, shall be deemed to have been withdrawn by the Contractor without any cost implication to SAI. For the sake of brevity, this Agreement along with its aforesaid contract documents and Letter of Intent shall be referred to as the "Contract".

**ARTICLE3.0–CONDITIONS&CONVENANTS**

The scope of Contract, consideration, terms of payments, advance, security deposits, taxes wherever applicable, insurance, agreed time schedule, compensation for delay and all other terms and conditions contained in SAI's Letter of Intent No. _____ dated_____ are to be read in conjunction with other aforesaid contract documents. The contractor shall duly perform the contract strictly and faithfully in accordance with the terms of this contract.

The scope of work shall also include all such items which are not specifically mentioned in the Contract Documents, but which are reasonably implied for the satisfactory completion of the entire scope of work envisaged under this contract unless otherwise specifically excluded from the scope of work in the Letter of Intent. The Contractor shall adhere to all requirements stipulated in the Contract Documents.

Time is the essence of the Contract and it shall be strictly adhered to. The progress of work shall confirm to Agreed Works Schedule/ Contract Documents and Letter of Intent.

This agreement constitutes full and complete understanding between the parties and terms of the presents. It shall supersede all prior correspondence to the extent of inconsistency or repugnancy to the terms and conditions contained in Agreement. Any modification of the Agreement shall be affected only by a written instrument signed by the authorized representative of both the parties. The rate quoted by M/s _____(NAME OF CONTRACTOR) is _____. The total contract price for the entire scope of this contract as detailed in Letter of Intent is Rs._____(Rupees_____only), which shall be governed by the stipulations of the contract documents.

**ARTICLE4.0–NO WAIVER OF RIGHTS**

Neither the inspection by SAI or the Engineer-In-Charge or Owner or any of their officials, employees oragents nor order by SAI or the Engineer-In-Charge for payment of money or any payment for or acceptance of, the whole or any part of the work by SAI or the Engineer-In-Charge nor any extension of time nor any possession taken by the Engineer-In- Charge shall operate as waiver of any provisions of the contract, or of any power herein reserved to SAI, or any right to damage herein provided, nor shall any waiver of any breach in the contract be held to be a waiver or any other or subsequent breach.

**ARTICLE5.0–GOVERNING LAW AND JURISDICTION**

The Laws applicable to this contract shall be the laws in force in India and jurisdiction of New Delhi Court (s) only. Notice of Default given by either party to the other party under the Agreement shall be in writing and shall be deemed to have been duly and properly served upon the parties here to, if delivered against acknowledgment due or by FAX or by registered mail duly addressed to the signatories at the address mentioned here in above.

IN WITNESS WHEREOF, the parties through their duly authorized representatives have executed these presents (execution whereof has been approved by the Competent Authorities of both the parties) on the day, month and year first above mentioned at New Delhi.

| | |
|---|---|
| For and on behalf of: | For and on behalf of: |
| (NAME OF CONTRACTOR) | SPORTS AUTHORITY OF INDIA WITNESS: |
| 1. | 1. |
| 2. | 2. |

**BANK GUARANTEE FORM FOR PERFORMANCE SECURITY**

To

_____,

_____.

WHEREAS _____ (Name and address of the supplier) (Hereinafter called "the supplier") has undertaken, in pursuance of contract no._____ dated_____ for (description of services) (herein after called "the contract"). AND WHEREAS it has been stipulated by you in Said contract that the supplier shall furnish you with a unconditional bank guarantee from a scheduled commercial bank recognized by you for the sum specified therein as security for compliance with its obligations in accordance with the contract; AND WHEREAS we have agreed to give the supplier such a unconditional bank guarantee;

NOW THEREFORE we hereby affirm that we are guarantors and responsible to you, on behalf of the supplier, up to a total of. _____ (Amount of the guarantee in words and figures), and we undertake to pay you, upon your first written demand declaring the supplier to be in default under the contract and without cavil or argument, any sum or sums within the limits of (amount of guarantee) as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

We hereby waive the necessity of your demanding Said debt from the supplier before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the contract to be performed there under or of any of the contract documents which may be made between you and the supplier shall in any way release us from any liability under this guarantee and we hereby waive notice of any such change, addition, or modification.

This guarantee shall be valid up to -------- days beyond the date of expiry of contract period as per RFP.

(Signature with date of the authorized officer of the Bank)
……
Name and designation of the officer
……

……
Seal, name & address of the Bank and address of the Branch

**PROFORMA XVI**
**(To be submitted by bidder seeking EMD exemptions)**

Bidder's Reference No._____ Date…….

To
SECRETARY
Sports Authority of India
Jawaharlal Nehru Stadium
(Gate No. 10), Lodhi Road
New Delhi-11003

Ref: Tender Document No…… for ……..

Sir/ Madam,

We, the undersigned, solemnly declare that: We understand that according to the conditions of this Tender Document, the bid must be supported by a Bid Securing Declaration in case the bidder is seeking EMD exemption.

We unconditionally accept the conditions of this Bid Securing Declaration. We understand we shall stand automatically suspended from being eligible for bidding in any tender in Procuring Organization for 2 years from the date of opening of this bid if we breach our obligation(s) under the tender conditions if we:

a) withdraw/ amend/ impair/ derogate, in any respect, from our bid, within the bid validity; or
b) being notified within the bid validity of the acceptance of our bid by SAI:
   i. refused to or failed to produce the original documents for scrutiny or the required Performance Security within the stipulated time under the conditions of the Tender Document.
   ii. Fail or refuse to sign the contract.

We know that this bid-Securing Declaration shall expire if the contract is not awarded to us, upon:

i. receipt by us of your notification
(a) of cancellation of the entire tender process or rejection of all bids or
(b) of the name of the successful bidder or

ii. forty-five days after the expiration of bid validity any extension to it.

(Signature with date) ……..

(Name and designation)
Duly authorized to sign bid for and on behalf of…….
[name & address of Bidder and seal of company]
Dated on …… day of ……. [insert date of signing]
Place……[ insert place of signing]
DA:……

**13. GENERAL CONDITIONS OF CONTRACT (GCC)**

1.0GENERAL

The Contract means the documents forming the tender and acceptance thereof and the agreement executed between the competent person on behalf of SAI and the contractor, together with the documents referred to there in including these conditions, the specifications, designs, drawings and instructions issued from time to time by the Engineer-In-Charge and all these documents taken together, shall be deemed to form one contract and shall be complementary to one another.

1.1. SPORTS AUTHORITY OF INDIA, hereinafter called 'SAI' proposes to get the work sexecuted as mentioned in the Contract.

1.2. In case of EPC contract the work will be executed as per drawings "GOOD FOR CONSTRUCTION" submitted by the contractor and approved by SAI unless otherwise specified elsewhere in the tender documents.

1.3. In the contract, the following expressions shall, unless the context otherwise requires, have the meaning, hereby respectively assigned to them.

1.4. DEFINITIONS

a) APPLICABLE LAW" means all laws, rules, regulations, and notifications in force and applicable to this RFP and the subsequent contract, including amendments and modifications made from time to time.

b) **APPROVAL** means approval in writing including subsequent written confirmation of previous verbal approval.

c) **ENGINEER-IN-CHARGE** means the PROJECT MANAGER, or an officer nominated by Competent Authority of SAI who shall supervise and be in-charge of the work from time to time.

d) **WORKS OR WORK**: The expression works, or work shall unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the works by or by virtue of the contract contracted to be executed whether temporary or permanent, and whether original, altered, substituted or additional.

e) "**CONTRACT/AGREEMENT/MOU**" means the written agreement entered between the purchaser and the supplier, together with all the documents mentioned therein and including all attachments, annexure etc. therein.

f) **CONTRACTOR, AGENCY, FIRM, COMPANY, BIDDER, CONSULTANT, SERVICE PROVIDER** means the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal representative of such individual or the persons composing such firm or company, or the successors of such firm or company and the permitted assignees of such individual, firm or company.

g) **DRAWINGS** mean the drawings referred to in the Design basis report, Schematic Drawings, specificationsandanymodificationsofsuchdrawingsorsuchotherdrawings as may from time to time be furnished or approved by SAI.

h) **"DELIVERABLES"** means the measurable and verifiable outputs, reports, services, or any other obligation to be provided by the agency under the contract.

i) "**GOVERNMENT AUTHORITIES**" shall mean any or all governmental authority / authorities of India or any subdivision thereof, whether national, federal, provincial, regional, state, county, municipal, local or other and any ministry, department, agency, entity or other body duly exercising executive, legislative, regulatory or administrative functions of government, including any other body which may exercise similar and any other municipal/ local authority having jurisdiction over the parties herein, and shall include any authority established through a statute or an act of the Government of India.

j) **"LETTER OF AWARD" OR "LOA"** means the letter issued by SAI to the Successful Bidder to undertake and execute the project in conformity with the terms and conditions set forth in the RFP and any subsequent amendments thereof.

k) "**LICENSES & PERMITS"** means all statutory approvals required from local, state, or national authorities, including police permissions, fire safety clearances, municipal permits, Intellectual Property Rights, venue-related compliances, copyrights compliances, etc.

l) **"LIQUIDATED DAMAGES (LD)"** means the predetermined compensation payable by the agency to SAI in case of failure

to meet contractual obligations, including delays in service delivery.

m) **MATERIAL BREACH** refers to a substantial failure to perform a contractual obligation that defeats the purpose of the agreement or causes significant harm to the other party.

n) **"MATERIAL ADVERSE EFFECT"** with respect to a party means a material adverse change in or effect on the business, operations, financial condition, properties or liabilities of the party taken as a whole; provided, however, that a Material Adverse Effect shall not be deemed to include (i) changes as a result of the announcement of this transaction, (ii) events or conditions arising from changes in general business or economic conditions or (iii) changes in generally accepted accounting principles.

o) **"OVERLAYS"** means temporary infrastructure, facilities, branding, and equipment required for the successful execution of the event.

p) **"PERFORMANCE SECURITY"** means monetary or financial guarantee to be furnished by the successful bidder for due performance of the contract placed on it

q) **SITE** means the lands and other places on, under, in or through which the works are to be executed or carried out and any other lands or places provided by SAI or used for the purpose of theagreement.

r) **WRITING** means any manuscript typed written or printed statement under or over signature and/or seal as the case may be.

s) **MONTH** means English Calendar month, 'Day' means a Calendar Day of 24 Hrs.each.

t) **CONTRACT VALUE** means the sum for which the tender is accepted as per the letter of intent.

u) **LANGUAGE**: All documents & correspondence in respect of this contract shall be in English Language.

v) **BILL OF QUANTITIES** or **SCHEDULE OF QUANTITIES** means the priced and completed Bill of Quantities or Schedule of Quantities forming part of the tender.

w) **OWNER** means **Sports Authority of India (SAI)**

x) **TENDER** means the Contractor's priced offer to SAI for the execution and completion of the work and the remedying of any defects therein in accordance with the provisions of the Contract, as accepted by the Letter of Intentor Award Letter. The word TENDER is synonymous with Bid and the word TENDER DOCUMENTS with "Bidding Documents" or "Offer Documents".

y) **"INSPECTING OFFICER"** means the person or organization stipulated in the contract for inspection under the contract and includes his/ their authorized representative.

z) **"INTELLECTUAL PROPERTY RIGHTS" (IPR)** means the rights of the intellectual property owner concerning a tangible or intangible possession/ exploitation of such property by others. It includes rights to Patents, Copyrights, Trademarks, Industrial Designs, Geographical indications (GI).

aa) **"PARTIES":** The parties to the contract are the "Contractor" and SAI, as defined in this clause.

bb) **"GENERAL CONDITIONS"** means the General Conditions of Contract, also referred to as GCC.

cc) **SPECIAL CONDITIONS** means Special Conditions of Contract, which override the General Conditions, also referred to as

SCC.

dd) **"SIGNED"** means ink signed or digitally signed with a valid Digital Signature as per IT Act 2000 (as amended from time to time). It also includes stamped, except in the case of a Letter of Award or an amendment thereof.;

The headings in the clauses/ conditions of tender documents are for convenience only and shall not be used for interpretation of the clause/ condition.

Words imparting the singular meaning only also include the plurals and vice versa where the context requires. Words imparting persons or parties shall include firms, companies and other organizations having legal capacities.

**2.0 THE CONTRACT**

Language of Contract: Unless otherwise stipulated in SCC, the contract shall be written in the Official Language or English. All correspondence and other contract documents, which the parties exchange, shall also be written/ translated accordingly in that language. For purposes of interpretation of the contract, the English documents/ translation shall prevail.

The Entire Agreement: This Contract and its documents (constitute the entire agreement between SAI and the contractor and supersedes all other communications, negotiations, and agreements (whether written or oral) of the Parties made before the date of this Contract. No agent or representative of either Party has the authority to make, and the Parties shall not be bound by or be liable for, any statement, representation, promise or agreement not outlined in this Contract.

Severability: If any provision or condition of this Contract is prohibited or rendered invalid or unenforceable, such prohibition, invalidity or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of this

Modifications/ Amendments of Contract: If any of the contract provisions must be modified after the contract documents have been signed, the modifications shall be made in writing and signed by SAI, and no modified provisions shall be applicable unless such modifications have been done. No variation in or modification of the contract terms shall be made except by a written amendment signed by SAI. Requests for changes and modifications may be submitted in writing by the contractor to SAI. At any time during the currency of the contract, SAI may suo- moto or, on request from the contractor, by a written order, amend the contract by making alterations and modifications within the general scope of the Contract. If the contractor does not agree to the suo -moto modifications/amendments made by SAI, he shall convey his views within 14 days from the date of amendment/ modification. Otherwise, it shall be assumed that the contractor has consented to the amendment.

Any verbal or written arrangement abandoning, modifying, extending, reducing, or supplementing the contract or any of the terms thereof shall be deemed conditional and shall not be binding on SAI unless and until the same is incorporated in a formal instrument and signed by SAI, and till then SAI shall have the right to repudiate such arrangements.

Waivers and Forbearances: The following shall apply concerning any waivers, forbearance, or similar action taken under this Contract:

1) Any waiver of a Procuring Entity's rights, powers, or remedies under this Contract must be in writing, dated, and signed by an authorized representative of SAI granting such waiver and must specify the terms under which the waiver is being granted.

2) No relaxation, forbearance, delay, or indulgence by Procuring Entity in enforcing any of the terms and conditions of this Contract or granting of an extension of time by Procuring Entity to the contractor shall, in any way whatsoever, prejudice, affect, or restrict the rights of Procuring Entity under this Contract, neither shall any waiver by Procuring Entity of any breach of Contract operate as a waiver of any subsequent or continuing breach of Contract.

**3.0 SITE VISIT AND COLLECTING LOCAL INFORMATION**

Before tendering, the tenderer is advised to visit the site, its surroundings to assess and satisfy themselves about the local conditions such as the working and other constraints at site, approach to the site, availability of water & power supply, application of taxes, cess duties and levies as applicable, nature of ground, soil and sub-soil condition, underground water table level, accommodations they may requireetc.,riverregime,riverwaterlevels,otherdetailsofriver,streams&anyother relevant information required by them to execute complete scope of work.

The tenderer may obtain all necessary information as to risks, weather conditions, contingencies & other circumstances (insurgencies etc.), which may influence or affect their tender prices. Tenderer shall be deemed to have considered site conditions whether he has inspected it or not and to have satisfied himself in all respect before quoting his rate and no claim or extra charges whatsoever in this regard shall be entertained / payable by SAI at a later date.

3.1. **ACCESSBYROAD**

Contractor, if necessary, shall build temporary access roads to the actual site of construction for the works at his own cost to make the site accessible. The Contractor shall maintain the same in motorable condition at all the times as directed by Engineer-In-Charge at his own cost. The contractor shall be required to permit the use of any roads so constructed by him for vehicles of SAI or any other agencies/ contractors who may be engaged on the project site, free of cost. Non- availability of access roads or approach to site, for the use of the contractor shall in no case condone any delay in the execution of work nor be the cause for any claim for compensation.

3.2. **HANDING OVER & CLEARING OF SITE**

3.2.1. The Contractor should note that area for construction may be made available in phases as per availability and in conjunction with pace of actual progress of work. at site. The work may be required to be carried out in constrained situations. The work is to be carried out in such a way that the traffic, people movement, if any, is kept operative and nothing extra shall be payable to the contractor due to this phasing/ sequencing of the work. The contractor is required to arrange the resources to complete the entire project within total stipulated time. Traffic diversion, if required, is to be done and maintained as per specification by the contractor at his own cost and the contractor shall not be entitled for any extra payment, whatsoever, in this regard.

3.2.2. The efforts will be made by SAI to handover the site to the Contractor free of encumbrances. However, in case of any delay in handing over of the site to the Contractor, SAI shall only consider suitable extension of time for the execution of the work. It should be clearly understood that SAI shall not consider any revision in contract price or any other compensation whatsoever viz. towards idleness of Contractor's labour, equipment etc.

3.2.3. The Contractor shall be responsible for removal of allover- ground and under-ground structures (permanent, semi-permanent and temporary)and constructions from the site. The cost to be incurred in this regard shall be deemed to be included in the quoted price and contractor shall not be entitled for any extra payment whatsoever, in this regard.The contractor,if required, shall demolish old structures on the proposed site, properly. The use ful material obtained.

from demolition of structures & services shall be the property of the owner/SAI and these materials shall be stacked in workmanship like manner at the place specified by the Engineer-In-Charge.

3.2.4. If required, the contractor has to do site clearance, enabling work, barricading, diversion of Roads, shifting/realignment

of existingutility services, drains, nallahs etc. at his own cost as per direction of Engineer-In-Charge and the contractor shall not be entitled for any extra payment whatsoever in this regard.

3.2.5. Necessary arrangements including its maintenance are to be made by the contractor for temporary diversion of flow of existing drain and road, as the case may be. The existing drain,road would be demolished,wherever required,with the progressofworkunderthescopeofproposedproject.TheexistingRoadandDrain, which are not in the align ment of Said project butareaffected and/or need to be demolished during execution for smooth progress of the project, shall be rehabilitated to its original status and condition (including black topping) by the contractor at his own cost. The cost to be incurred by contractor in these regards shall be deemed to be included in the quoted price and contractor shall not be entitled for any extra payment whatsoever, in these regards.

3.2.6. The Contractor shall be responsible to co-ordinate with service provider/concerned authorities for cutting of trees, clearing of vegetations, shifting of utilities and removal of encroachments etc. and making the site un-encumbered from the project construction are required for completion of work. This shall include initial and frequent follow up meetings/ actions/discussions with each involved service provider/concerned authorities. The contractor shall not be entitled for any additional compensation for delay in cutting of trees, shifting of utilities and removal of encroachments by the service provider/ concerned authorities.

3.2.7. The information about the public utilities (whether over ground or underground)like electrical/ telephone/ water supply lines, OFC Cables, open drain etc. is the responsibility of contractor to ascertain the utilities that are to be affected by the works through the site investigation and collection of information from the concerned utility owners.

3.2.8. The contractor shall be responsible to obtain necessary approval from there spective authorities for shifting/ re-alignment of existing public utilities. SAI shall only assist the contractor for liasoning in obtaining the approval from the concerned authorities. Take all measures reasonably required by the various bodies to protect their services and property during the progress of works. It shall be deemed to be the part of the contract and no extra payment shall be made to the contractor for the same. Shifting/re-alignment of public utilities should be done without disturbing the existing one. New service lines should be laid and connected before dismantling the existing one.

3.2.9. Shifting/re-alignmentofexistingpublicutilitiesshallbedonebythecontractorasper technical requirement of respective bodies or as per direction of Engineer-In- Charge. Shifting/ re-alignment of public utilities include all materials, labours, tools and plants and any other expenses whatsoever for the same. The cost to be incurred in this regard shall be deemed to be included in his quoted price and the contractor shall not been titled for any extra payment, whatsoever, in this regard.

**4.0 SCOPE OF WORK**

4.1. The detailed scope of work of the project has been briefed in Volume B& C of this tender package. The work is to be executed on Engineering Procurement and Construction Basis. The suggestive layout plan and conceptual architectural plans of buildings has been provided by the department and the same is enclosed as Volume D. Such layouts provided has been developed by the Department Consultant and the same has been signed off by the Department. In case, if the tender intends to revise the drawings and schemes the process shall be approved by the Department or their approved consultants. This revision in layouts shall be considered as an alternative proposal by the tenderer and the base proposal.

shall be as per tender drawings & scope of works issued along with the tender. Acceptance of the base proposal or alternative proposal will be only on the Department's discretion considering the value additions, value engineering cost savings, etc., proposed by the bidder.

Such approved final layouts shall be considered by the Bidder by then the Contractor for pre & post construction

approvals, further detailing, complete Design & Engineering including peer review approval from department approved institutions, shop drawings, etc., with due considerations of tender documents issued.

All works shall be executed as per approved Good for Construction / detailed / shop drawings architectural drawings, structural drawings, MEP drawings, specialized sports drawings, Coordination drawings.

All works shall comply with latest CPWD Specifications, relevant IS codes, International Codes, National Building Code 2016, Sports facility guidelines, lab facility guidelines, Harmonized Guidelines and other standard specifications or other specifications indicated elsewhere in the Tender Document shall be followed excepting otherwise mentioned in bid document. Samples of the materials of approved make or otherwise shall be got approved from department before use in the work.

Cost for all the above scope shall be deemed included in Contractor's quoted price. The Contractor shall obtain all Pre & all Post construction clearances/approvals from Statutory Authorities. The scope of work includes topographical Survey, soil Investigation, preparation of architectural drawings, detailed working drawings, structural design & drawings of buildings along with detailed calculations, required services i.e. electrical installations including all electrical fittings/fixtures, water supply pumps, submersible pump, de-watering pumps etc. HT and LT including emergency and backup supply, sub-station, DG set with AMF panel, HT Panel, LT panel, feeder pillars. Lightning protection and Earthing system, External Lighting, Firefighting, fire detection, UPS and any other services required but not specifically indicated, Signages, liaising with statutory agencies like Fire Services, Telecom, Airports Authority of India, Central Electricity authority, Municipal Authority, Water supply & sewerage authorities, EIA, CPCB, CGWB / State Water Board etc., forest officer, fire officer, Electrical Service provider for obtaining the pre-construction and post construction clearances.

Liaisoningfor all approvals including but not limited to submissions to the agencies, followups, making time to time payments, shall be in the scope of the contractor for which nothing extra shall be paid to the contractor. Thereafter complete construction and commissioning of building(s) along with all mentioned services is in the scope of the work.

The project is required to be designed and constructed to the standards and specific requirements as detailed in this Tender Document vide tender drawings, Guide to safety of Sports Grounds (The GREEN guide) for design of Complex, Design of Spectator Seating, Lighting, Fire and Life Safety, Security provisions and Air Quality and Ambient Conditions. The specialized works shall be done by reputed agencies who has carried out similar type of works with high standards and having statutory registrations. Agency should submit the Vetted good for Construction & Working Drawings, Shop Drawings (Both structural and Architectural ) Technical Data Sheets, Test Certificates including all cost towards witnessing the tests, Manuals, other documents as sought by Engineer in charge or their authorized consultant's, formality and modality for the same shall be as per standard best practice.

The scope of work includes:

(a) Topographical& Contour Survey

(b) Soil Investigation for design and type of foundation and other criteria

(c) Design & Engineering Including,

i. Architectural, Structural, MEP, Sports Equipment's & Infrastructures as required for the HPC, External Development Works, Land & Hardscaping works, Approach Roads Development, etc., and submission of final GFC drawings to site.

ii. Proof checking of the Design & Engineering through SAI approved institutions.

iii. Submit the detailed proof checked Good for Construction & Working Drawings, Shop Drawings, Technical Data Sheets, Test Certificates including all cost towards witnessing the tests, Manuals, other documents as sought by SAI ortheir authorizedconsultant's, formality and modality for the same shall be as per standard best practice.

iv. The scope of work also includes modelling, designing, preparation of detailing/drawings in 3D Building Information Modeling (BIM) for Integration and Coordination of all services with LOD 400 and above type detailing.

(d) Construction Phase

i. Civil Works as per finalized & approved drawings and specifications.
ii. MEP Works as per finalized & approved drawings and specifications.
iii. HT Infrastructure& equipment's
iv. Substation Infrastructure & equipment's
v. Diesel Generator Sets
vi. Rising Main with Aluminum Bus Bar
vii. Bus Trunking (Sandwich Type with Aluminum Bus Bar)
viii. Uninterrupted Power Supply
ix. Solar Photovoltic system
x. Central AC Systems
xi. Solar Water Heating System
xii. Power Wiring & Plugs
xiii. Lighting Conductors
xiv. Telephone Conduits, Fire Fighting and Fire Alarm & Public Address System
xv. CCTV System.
xvi. Street Lighting with LED.
xvii. LAN
xviii. Lifts
xix. Plumbing & Water Supply system.
xx. Hydropneumatics Water Supply System
xxi. STP/ETP Plant
xxii. Emergency Light & Illuminated Signages.
xxiii. Water Cooler with RO.
xxiv. Tube well. Sewerage & Drainage System/Pumps
xxv. UGT/OHT
xxvi. Road, kerbs, Strom Water Drain, Land & Hardscaping, gates, retaining wall, compound wall, chain-link fencing, signages, external MEP works including irrigation, streetlights, etc., complete.

(e) Sports, Lab & other Infrastructure developments as sought in the scope of work.

(f) External Development including but not limited to tree cutting, bush clearance, site grading (Including cutting & filling), Internal Roads & Paths, Internal Roads with WMM and Bituminous Top, Footpath with PCC Base with paver blocks and kerb stone edging, External Sewerage, Filtered Water Supply, Strom Water Drains, Rain Water Harvesting (RWH), Trenches for Services, Boundary wall, retaining wall, chain-link fencing, signages, external MEP works including irrigation system, street lights,etc., Horticulture Works and Vertical Plantations., complete

(g) Approvals:

i. Liaison with statutory agencies like Municipal, Fire Services, AAI, EIA, BSNL etc. for obtaining the pre-construction and post construction clearances. The statutory payments to these agencies will be paid by the contractor which is in the scope of the work except the charges of HT Electrical Service connection from

local supply agency to the HT energy meter in the premises of the building which will be initially paid by the contractor and reimbursed by the department to the contractor on producing the proof of charges paid to the local concern agency. Liasoning with the local supply agency shall be in the scope of the contractor for which, nothing extra shall be paid to the contractor.

ii. Obtaining mandatory approvals (Pre & Post Construction) from all local bodies/ State & Central authorities/ Municipal Corporation, EIA (Environmental Impact Assessment) clearance, fire clearance, forest clearance etc. for the complete works in scope of this contract. Approvals as per latest Karnataka local building Byelaws / Town & Country Planning (Karnataka) Bye laws with up to date corrections slips, necessary Environmental Clearance from the appropriate authority, NOC from Fire Department, NOC from Airport Authority of India etc. and any other statutory approval/Central Licensing Approving Authority etc. related to building for office building, approval from authorities required for commencing the work, execution of work & services and handing over the assets.

(h) The defect liability period after completion of work shall be 12 months. The contractor must withstand the warranty and must provide repair services to the building and all equipment's & accessories during the defective liability period/specific warranty period. The contractor must attend to the complaints of minor nature within 24 hours and complaints of major nature within 3 days of receiving the complaints. For this purpose, the contractor must depute enough technical manpower within the building complex. In case, if the complaint is not attended and rectified by the contractor within the specified period as above the work shall be got rectified by the department and the recovery at the double rate of cost of execution of work shall be recovered from the dues of the contractor. LED fitting/fixtures shall withstand the warranty of five years from the date of handing over the installations to the client department.

(i) The cost of labour, material, tools and plants and machinery required for execution of the whole project as per Layout plan& detailed design and drawings to be approved, specifications etc. is within the scope of this work.

(j) The buildings are to be planned and registered to meet IGBC GOLD rating. The contractor is required to execute the work in a befitting manner to suit these standards. The contractor shall take all precautions and abide by all rules, regulations and directions of the regulatory authorities, municipalities, traffic, labour, green tribunal in respect of all kinds of pollution, C&D waste management, labour safety measure etc.

4.2. The scope of work covered in this tender shall be as per theclause 4.1 , specifications, Concept drawings, Design Basis Reports / Design Intents, provided along with the tender document.instructions, orders issued to the contractor from time to time during the work.

The drawings for this work, which may be referred for tendering, provide general idea only about the work to be performed under the scope of this contract. These may not be the final drawings and may not indicate the full range of the work under the scope of this contract. In case of EPC/Lumpsum contracts Drawings are prepared/submitted by the contractor as "GOOD FOR CONSTRUCTION" from time to time and approved by the Engineer-In-Charge of SAI and accordingly work will be executed. Any additions/modifications/alterations/ deletions made from time to time, as required by any other drawings that would be prepared by the contractor progressively during execution of work will be approved by SAI. It shall be the responsibility of the contractor to incorporate the changes that may be in this scope of work, envisaged at the time of tendering and as actually required to be executed.

The quantities of various items as entered in the "SCOPE OF WORK" are indicative only and may vary depending upon the

actual requirement. The contractor shall be bound to carry out and complete the stipulated work irrespective of the variation in individual items specified inthe scope of work, design basis report & drawings as shared along with the tender.

**5.0 VALIDITY OF TENDER**

The tender for the works shall remain open for acceptance for a period of **120days** from the last date of submission of tender. The earnest money will be forfeited without prejudice to any right or remedy, incase the contractor withdraws his tender during the validity period or in case he changes his offer to his benefits, which are not acceptable to SAI. The validity period may be extended on mutual consent.

**6.0 ACCEPTANCE OF TENDER**

SAI reserves to itself the authority to reject any or all the tenders received without assigning any reason. The acceptance of a tender shall be effective w.e.f. the date on which theletter of intent or the work is put in the communication by SAI. SAI also reserves the right to split the work among two or more parties at lowest negotiated rate without assigning any reason there of. The contractor is bound to accept the portion of work as offered by SAI after splitting up at the quoted/-negotiated rates.

**7.0SET OF CONTRACT DOCUMENTS**

1. Notice Inviting Tender
2. Corrigendum(s)and Addendum(s).
3. Pre-Qualification Documents
4. General Conditions of Contract
5. Special Conditions and Formats
6. Scope of Work/BOQ/ScheduleofRates
7. Technical Specifications
8. Tender Drawings

**8.0 EARNEST MONEY DEPOSIT**

8.1. Earnest Money Deposit of amount as mentioned in “Memorandum to Form of Tender” required to be submitted as mentioned in “NIT/Instructions to Bidders”.The EMD shall be valid for minimum period of 165days(One Hundred Twenty days)from last day of submission of Tender.

8.2. Any tender not accompanied with the requisite Earnest Money Deposit shall be rejected and such tenderer(s) will not be allowed to attend the opening of bids. Conditional tenders will be summarily rejected.

8.3. The EMD will be returned to all unsuccessful or technically unqualified tenderers after opening of Price Bid. EMD of successful tenderer shall be refunded after submission of Performance Guarantee/initia lsecurity deposit duly confirmed from is suing bank.

8.4. Once the tenderer has given an unconditional acceptance to the tender conditions in its entirety, he is not permitted to put any remark(s)/conditions(s) (except unconditional rebate on price, if any) in/ along with the tender.

8.5. In case the condition 8.4 mentioned above is found violated at any time after opening of tender, the tender shall be summarily rejected and SAI shall, without prejudice to any other right or remedy, be at liberty to forfeit the full said Earnest Money absolutely.

8.6. No interest shall be payable by SAI on Said amount covered under EMD/Other Security Deposits.

**9.0 MOBILIZATION ADVANCE**

9.1 Mobilization advance, up to the maximum amount specified in the "Memorandum to the Form of Tender," shall be granted to the contractor upon submission of an unconditional and non-revocable Bank Guarantee (BG) equivalent to 110% of the requested mobilization advance amount. The BG shall be issued by a Nationalized or Scheduled Bank, as per the approved list and in the prescribed format annexed to the tender document. The mobilization advance shall be subject to a simple interest rate of 12%, as stipulated in the "Memorandum to the Form of Tender.

This advance shall be paid in two installments as follows:

i. First Installment of 50 (Fifty) percent of total mobilization advance against unconditional Bank Guarantee shall be paid after the agreement is signed and upon submission of unconditional Performance Guarantee and its confirmation from issuing bank.

ii. 2nd installment of balance 50 (Fifty) percent of total mobilization advances against Bank Guarantee will be paid after the submission of UC of 1st Installment.

9.2 The mobilization advance bear simple interest at the rate as mentioned in the MEMORANDUM and shall be calculated from the date of payment to the date of recovery (365 days in a year) both days inclusive, on the outstanding amount of advance. Recovery of such sums advanced shall be made by the deduction from the contractor's bills commencing after first 10(ten) percent of the gross value of the work is executed and paid, on pro-rata percentage basis to the gross value of the work billed beyond 10% in such a way that the entire advance is recovered by the time 80 (eighty) percent of the gross value of the contract is executed and paid, together with interest due on the entire outstanding amount up to the date of recovery of the installment.

The Mobilization Advance bank guarantee shall essentially be made at least for the 110% (One hundred ten percent) of total mobilization advance payable and valid for the contract period and be kept renewed from time to time to cover the balance amount and likely period of complete recovery together with interest. However, the contractor can submit part bank guarantees against the mobilization advance in as many numbers as the proposed recovery installments equivalent to the amount of each installment.

9.3 NotwithstandingwhatiscontainedinclauseNo.9.1&9.2, no mobilization advance what so ever shall be payable, if payment of mobilization advance is not mentioned in the memorandum to the form of tender.

**10.0PERFORMANCE GUARANTEE**

To ensure due performance of the contract, the successful bidder shall furnish a Performance Security in the form of a Performance Bank Guarantee (PBG) or other acceptable instruments. The Performance Security shall be:

- **Amount:** Equivalent to five percent (5%) of the total contract value.
- **Forms Accepted:** Insurance Surety Bond, Account Payee Demand Draft, Fixed Deposit Receipt from a commercial bank, Bank Guarantee issued/confirmed by any commercial bank in India, or online payment in an acceptable form.
- **Joint Ventures (JV):** In case of a JV, the Performance Security shall be provided by all partners in proportion to their

participation in the project.

Performance Security must be submitted within fourteen (14) days from the date of notification of award and shall remain valid for sixty (60) days beyond the completion of all contractual obligations, including the Defect Liability Period (DLP).

In the event of breach of contract by the contractor, the Performance Security shall be forfeited and credited to the SAI's account. Upon successful completion of all contractual obligations, the Performance Security shall be refunded to the contractor without interest, no later than three hundred sixty-five (365) days from the completion of the DLP.

**11.0SECURITY DEPOSIT**

In addition to the Performance Security, contracts for works shall include a provision for Security deposit/retention money, whereby five percent (5%) of the value of each running bill (periodic/interim payment) shall be withheld as Security Deposit until final acceptance of the works.

Replacement with Bank Guarantee: The contractor may, at their discretion, replace the accumulated retention amount with an unconditional Bank Guarantee (BG) from a bank acceptable to the Procuring Entity at the following stages:

- Upon reaching 50% of the retention money limit.
- Upon reaching the full retention money limit.

**Release of Retention Money / BG:**

One-half of the retention money (or BG replacing it) shall be released upon issuance of the Taking Over Certificate (TOC). If TOCs are issued in parts, the release shall be in proportion to the value of the respective part or section, as determined by the Engineer.

The remaining half shall be released upon expiration of 365 days after the Defect Liability Period (DLP) or final payment, whichever is earlier, subject to certification by the Engineer.

Multiple DLPs: In cases where different DLPs apply to different sections or parts of the works, the final release shall be based on the latest applicable DLP.

**12.0 MOBILISATION OF MEN, MATERIALS AND MACHINERY:**

12.1 All expenses towards mobilization at site and de-mobilization including bringing in equipment, workforce, materials, dismantling the equipment, clearing the site etc. shall be deemed to be included in prices quoted and no separate payment on account of such expenses shall be entertained.

12.2 It shall be the responsibility of the Contractor to provide, operate and maintain all necessary construction equipment, scaffolding sand safety, gadget, lifting tackles, tools, and appliances to perform the work in a workman like and efficient manner and complete all jobs as per the specifications and within the schedule time of completion of work. Further, contractor shall also be responsible for obtaining temporary electric and water connection for all purposes. The contractor shall also make stand by arrangement for water &electricity to ensure un-interrupted supply.

12.3 It shall be the responsibility of the contractor to obtain the approval for any revision and/or modification of work desired by him from SAI before implementation. Also, such revisions and/or modifications if accepted / approved by SAI shall be carried at no extra cost to SAI.

12.4 The procurement and supply in sequence and at the appropriate time of all materials and consumable shall be entirely the contractor's responsibilities and his rates for execution of work shall be inclusive of supply of all these items.

12.5 It is mandatory for the contractor to provide safety equipment and gadgets to its all workers, supervisory and technical staff engaged in the execution of the work while working. The cost of the above equipment/ gadgets are deemed to be included in the rates quoted by the contractor for the items & works as per scope of work, design basis report, tender drawings and contractor shall not been titled for any extra cost in these regard. The above normis to be strictly complied with at site.In case the contractor is found to be deficient in providing Safety Equipment/ Gadgets in the opinion of Engineer-In-Charge,

the Engineer-In-Charge at his option can procure the same at the risk & cost of contractor and provide the same for the use of worksite and shall make the recoveries from the bills of the contractor for the same. The decision of the Engineer- In-Charge shall be final and binding on contractor in this regard.

12.6 All designs, drawings, bill of quantities, etc., shall be prepared by the contractor in case of EPC/Lumpsum contract for approval by SAI inphased manner as the works progress. However, It shall be the duty and responsibility of the contractor to bring to the notice of SAI in writing as to any variation, discrepancy or any other changes required and to prepare revised drawings and designs and / for approval of SAI in writing for the same.

12.7 One copy of contract documents including drawings furnished to the contractor shall be kept at the site and the same shall at all reasonable times be available for inspection.

12.8 All materials, construction plants and equipment etc. once brought by the contractor within the project area, will not be allowed to be removed from the premises without the written permission of SAI. Similarly, all enabling worksbuilt by the contractor for the main construction undertaken by him, shall not be dismantled, and removed without the written authority of SAI.

**13.0 INCOME TAX DEDUCTION**

Income tax deductions shall be made from all payments made to the contractor including advances against work done, as per the rules and regulations in force, in accordance with the Income Tax Act prevailing from time to time

**14.0 TAXES AND DUTIES**

The contract price is inclusive of all taxes, duties, cess and statutory levies payable under any law including but not restricted to Goods and Service Tax (GST) levied by Union and State Governments (CGST, SGST, UTGST, IGST), Labour Cess, Royalty, Toll Tax and any other such taxes and duties leviable by local/State/Union Government from time to time on all such articles, materials which may be used for this work or any other tax (duty etc.) paid by the contractor. It should be noted that tax deductions will be made for GST from the Bill of the contractor.

Incase of any change in rate of tax or any provision relating levy of tax resulting in increase in burden of tax on the contractor, the contractor shall not be entitled to receive any compensation for such increase in quantum of tax on the contractor, other than statutory taxes. Similarly, no recovery shall be made from the contractor on account of decrease of rate of tax or any provision relating to levy of tax, other than statutory taxes.

Contractor must be registered under Goods and Service tax (GST)laws in the state where the work is executed and copy of the registration certificate of the same shall be submitted to SAI.

Apart from the registration as mentioned above contractors shall also obtain all other necessary registrations required under any other Local/State/Union Government Statute, for the execution of this contract, if any.

Contractor must submit as a compliance of GST Laws, Tax Invoice, as per applicable rules and regulations under the GST Act(s), failing which GST amount will be recovered by SAI without any recourse or prior notice from the next Invoices/Security Deposit/Bank Guarantees and/or available dues with SAI.

The contractor/service provider shall be responsible for issuing of Tax Invoices, filing of statutory return and deposit of statutory taxes within the time limit as prescribed in law. Any interest/penalty/taxes (non availment of Input Tax Credit due to mismatch to GSTR2) which is required to be paid by SAI due to default by the Contractor/service provider to comply with the above-mentioned activity/provisions as prescribed in laws, rules and regulations shall be recovered from the Contractor/Service provider and adjustment shall be made when mismatch is attended and solved,and credit is extended to SAI.

Apart from compliance mentioned above, in the event of non payment/default in payment of taxes and duties and any other statutory compliances, under any other Local/State/Union Government Statute, SAI reserves the right to with hold the

dues/payment of contractor and make payment to Local/State/Union Government authorities or to Labourers, as may be applicable.

It is clearly understood that the contractor is fully aware of all GST Laws and his liabilities and responsibilities under said laws including but not restricted to correct HSN/SAC code, applicable rate of taxes of GST or otherwise on which his liability has to be paid and discharged. SAI shall have no liability or responsibility for any penalty or proceedings, or any other liability levied or leviable on the contractor because of lower deduction or any other such non- compliance of the contractor.

Bidders will examine the various provisions of the Central Goods and Service Tax Act, 2017 (CGST)/ Goods and Service Tax Act (IGST)/ Union Territory Goods and ServiceTaxAct,2017(UTGST)/respective state's State Goods and Service Tax Act (SGST) also, as notified by Central/State Government and as amended from time to time and applicable taxes before bidding. Bidders will ensure that full benefit of Input Tax Credit (ITC) likely to be availed by them is duly considered while quoting rates.

Anti-Profiteering Clause upon implementation of GST any reduction in tax on account of anti-profiteering on supply of goods or services, the benefit of input tax credit shall be passed on to SAI by way of commensurate reduction in prices.

In case of any law requires SAI to pay tax on the contract price on reverse charge basis, the amount of tax deposited by SAI would be considered as per Income Tax Act, GST Laws or any other law as applicable.

Stamp duty and registration charges, if any, payable on the executed contract document, shall be borne by the contractor.

**15.0ROYALTY ON MATERIALS**

The contractor shall be solely responsible for depositing the applicable royalty and obtaining all necessary permits from the relevant local authorities for the supply and use of bajri, stone, kankar, sand, and any other materials required for the execution of the work. The quoted rates shall be inclusive of all royalties, levies, and charges, and no additional claims in this regard shall be entertained by SAI under any circumstances.

**16.0 PRICE ESCALATION**

16.1. Clause 10 CC of GCC EPC 2024 of CPWD will be applicable.

16.2. The contractor shall be deemed to have inspected the site, it's surrounding and acquainted with the nature of the ground, accessibility of the site and full extent and nature of all operations necessary for the full and proper execution of the contract, space for storage of materials, constructional plant, temporary works, restrictions on the plying of heavy vehicles in area, supply and use of labour, materials, plant, equipment and laws, rules and regulations, if any, imposed by the local authorities.

16.3. The rates and prices given in the price schedule are for completed and finished items of works and complete in all respects. It will be deemed to include all constructional plant, labour, supervision, materials, transport, all temporary works, erection,maintenance,contractor'sprofitandestablishment/overheads,together with preparation of designs & drawings pertaining to casting yard, shop drawing, fabrication drawing (if required), staging form work, stacking yard, etc. all general risk, taxes, royalty ,duties, cess, octroi and other levies, insurance liabilities and obligations set out or implied in the tender documents and contract.

16.4. The contractor has to make his own arrangement for dewatering/ bailing out of water, effluent including strutting, shoring etc. at every stage of work wherever required including working under foul condition as per direction of Engineer-In-Charge at his own cost and the contractor shall not been titled for any extra payment, whatsoever, in this regard.

16.5. The contractor shall have to clear jungle including of rank vegetation, grass, trees etc., clear & clean existing drains/ canals (including strutting, shoring and packing cavities) and dispose them out of thesiteup-toanyleadandliftasperdirectionofEngineer-In-Charge.Thecontractor should inspect the site of work from this point of view. Unless otherwise specified in the scope of work, design basis report, tender drawings, the cost to be incurred in this regard shall be deemed to be included in his quoted rates of BOQ items and the contractor shall not been titled for any extra

payment in this regard.

16.6. If any temporary/ permanent structure is encountered or safety of such structure in the vicinity is endangered due to execution of the project, the contractor has to protect the structures by any means as per the directions of the Engineer-In-Charge. If any damage caused to any temporary or permanent structure(s) in the vicinity is caused due to execution of the project, the contractor has to make good the same by any means as per directions of the Engineer-In-Charge. The contractor should inspect the site of work from this point of view. The cost to be incurred in this regard shallbedeemedtobeincludedinhisquotedratesofBOQitemsandthecontractor shall not be entitled for any extra payment in this regard.

**17.0 ESCALATION/ PRICE VARIATION**

10CC clause of GCC EPC 2024 of CPWD shall be considered for price escalation. Rates for Extra Item(s) of Works:

1. Standard Schedule of Rates (latest CPWD Delhi Schedule of Rates ) Items: Any item of work carried out by the Contractor on the instructions of the Engineer in charge which is not included in the accepted Scope of Work but figures in the Standard Schedule of Rates (SSOR), shall be executed at the rates set forth in the "Standard Schedule of Rates (SSOR)"(Delhi Schedule of rates). For item(s) not covered in this sub clause, the rate shall be decided as agreed upon between the Engineer in charge and the Contractor before the execution of such items of work as per sub clause (2).

2. Other Items: For any item of work to be carried out by the Contractor but not included in the accepted Scope of Work and also not covered under sub clause (a) above, the Contractor shall be bound to notify the Engineer at least seven days before the necessity arises for the execution of such items of works that the accepted Bill(s) of Quantities does not include rate or rates for such extra work involved. The rates payable for such items shall be decided at the meeting to be held between the Engineer and Contractor, in as short a period as possible after the need for the special item has come to the notice. In case the Contractor fails to attend the meeting after being notified to do so or in the event of no settlement being arrived at, SAI shall be entitled to execute the extra works by other means and the Contractor shall have no claim for loss or damage that may result from such procedure. The assessment of rates for extra item(s) shall be arrived at based on the prevailing market rates of labour, machinery & materials and by taking guidance from the following documents in order of priority:

    1. Analysis of Rates for “Delhi Schedule of Rates issued by CPWD (DSR)”

    2. Market Analysis

**1 Handing over of Works:**

The Contractor shall be bound to hand over the works executed under the contract to SAI complete in all respects to the satisfaction of the Engineer. The Engineer shall determine the date on which the work is considered to have been completed, in support of which his certificate shall be regarded as sufficient evidence for all purposes. The Engineer shall determine from time to time, the date on which any section of the work shall have been completed, and the Contractor shall be bound to observe any such determination of the Engineer.

2 **Clearance of Site on Completion:**

On completion of the works, the Contractor shall clear away and remove from the site all constructional plant, surplus materials, rubbish and temporary works of every kind and leave the whole of the site and works clean and in a workman like condition to the satisfaction of the Engineer. No final payment in settlement of the accounts for the works shall be paid, held to be due or shall be made to the, Contractor till, in addition to any other condition necessary for final payment, site clearance shall have been affected by him, and such clearance may be made by the Engineer at the expense of the Contractor in the event of his failure to comply with this provision within 7 days after receiving notice to that effect. Should it become necessary for the Engineer to have the site cleared at the expenses of the Contractor, SAI shall not be held liable for any loss or damage to such of the Contractor's property as may be on the site and due to such removal there from which removal may be affected by means of public sales of such materials and property or in such a way as deemed fit and convenient to the Engineer.

**3 Offloading of Part(s) of Work:**

At the final stage of completion/ commissioning of work, in case the contractor fails to complete the final part(s) of the work and the value of such part(s) of the work is limited to 5% of the original contract value, the Engineer may allow/decide for offloading of such part(s) of works, either after the Contractor's request in writing to do so or after serving a 14 (Fourteen) days suo-moto notice , if the Engineer is of the opinion that :-

1.1. Such Offloading of works (up to 5% of original contract value) would enable successful completion of contract/work,

1.2. Termination/ Part termination of the contract at this stage is not be in the interest of SAI/work; and

1.3. The anticipated additional cost for execution of such works through other mode would not be substantial and can be recovered from the pending dues of the contractor.

1.4. The Contractor shall be informed, in due course, by the Engineer of the mode and cost of execution of such offloaded work through other agency (. The extra expenditure so incurred in execution of the offloaded work, shall be recovered from subsequent Bill(s) or any other dues of the Contractor, but not exceeding the value of Performance Guarantee available in the contract. There shall be no other repercussion of such offloading on execution of the balance contract. The Contractor shall have no claim on account of above-mentioned offloading of works.

**4 Modification to Contract to be in Writing:**

In the event of any of the provisions of the contract required to be modified after the contract documents have been signed, the modifications shall be made in writing and signed by SAI and the Contractor, and no work shall proceed under such modifications until this has been done. Any verbal or written arrangement abandoning, modifying, extending, reducing or supplementing the contract or any of the terms thereof shall be deemed conditional and shall not be binding on SAI unless and until the same is incorporated in a formal instrument and signed by SAI and the Contractor, and till then SAI shall have the right to repudiate such arrangements.

**5 Powers of Modification to Contract:**

The Engineer on behalf of SAI shall be entitled by order in writing to enlarge or extend, diminish or reduce the works or make any alterations in their design, character position, site, quantities, dimensions or in the method of their execution or in the combination and use of materials for the execution thereof or to order any additional work to be done or any works not to be done and the Contractor will not be entitled, to any compensation for any increase/reduction in the quantities of work but will be paid only for the actual amount of work done and for approved materials supplied against a specific order. .

Payment of deviations/variations beyond 1% of the accepted tendered amount.

In case there is any change in scope as defined in the contract, the contractors hall carry out the changes as per direction of Engineer in Charge and nothing extra shall be payable to the contractor on account of same if the additional cost of such work is up to 1% (one percent) of the accepted tendered amount and worked out as specified.Variations/deviations upto 1% (onepercent) of the accepted tendered amount shall be deducted from overall variations/ deviations for making payment.

**18.0 INSURANCE OF WORKS ETC.**

Contractor is required to take **contractor's all risk policy** or erection all risk policy(as the case may be)from an approved insurance company in the joint name with SAI and bear all costs towards the same for the full period of execution of works including the defect liability period for the full amount of contract against all loss of damage from whatever cause arising other than excepted risks for which he is responsible under the terms of the contract and in such manner that SAI and the contractor are covered during the period of construction of works and/or also covered during the period of defect liability for loss or damage:

a. The work and the temporary works to the full value of such works.

b. The materials, constructional plant, centering, shuttering and scaffolding materials and other things brought to the site for their full value.

Whenever required by SAI, the contractor shall produce the policy or the policies of insurance and the receipts for payment of the current premiums.

**19.0 INSURANCE UNDER WORKMEN COMPENSATION ACT**

Contractor is required to take insurance cover under the Workman Compensation Act, 1923 amended from time to time from an approved insurance company and pay premium charges thereof. Wherever required by SAI the contractor shall produce the policy or the policies of Insurance and the receipt of payment of the current premiums.

**20.0 THIRD PARTY INSURANCE**

Contractor is required to take third party insurance cover from an approved insurance company for insurance against any damage, injury or loss which may occur to any person or property including that of SAI, arising out of the execution of the work sort temporary works. Wherever required by SAI the contractor shall produce the policy or the policies of Insurance and the receipt of payment of the current premiums. Incase of failure of the contractor to obtain contractors all risk policy, insurance under workman compensation act and third-party insurance as described above within one month from the date of commencement of work, running account payments of the contractor shall be withheld till such time the contractor obtains the aforesaid insurance covers.

If the Contractor could not effect a comprehensive insurance cover against risks which he may be required to effect under the terms of the contract, then he shall give his attention to get the best insurance cover available and even in case of effecting a wider insurance cover than the one which the subsidiary of the General Insurance Company could offer, such an insurance is ought to be done after SAI's approval, by or through the subsidiary of the GeneralInsuranceCompany.

**21.0 INDEMNITY AGAINST PATENT RIGHTS**

The contractor shall fully indemnify and hold SAI harmless against any and all claims, demands, proceedings, liabilities, damages, costs, and expenses arising from or in connection with any infringement of patent rights, design rights, trademarks, trade names, or any other protected intellectual property rights related to the construction plant, machinery, works, or materials used in the execution of the project, including temporary works. In the event of any such claim, the contractor shall be solely responsible for defending SAI against such proceedings and shall bear all associated costs, including any damages or settlements that may be awarded.

**22.0 LABOUR LAWS TO BE COMPLIED BY THE CONTRACTOR**

The contractor shall obtain a valid license under the Contract Labour (Regulation & Abolition) Act, 1970, and the Contract Labour (Regulation & Abolition) Central Rules, 1971, as amended from time to time. The contractor shall ensure that the license remains valid throughout the execution of the work, including the Defect Liability Period.

22.1. The contractor shall strictly comply with the provisions of the Child Labour (Prohibition and Regulation) Act, 1986, as amended from time to time. No worker below the age of 18 years shall be engaged in the execution of the contract under any circumstances.

22.2. Any failure to comply with the above statutory requirements before the commencement of work or during execution shall render the contractor liable for penal action under this contract, including termination for default and forfeiture of

any dues, in addition to statutory penalties as prescribed by law.

**23.0 LABOUR SAFETY PROVISION**

The contractor shall be fully responsible to observe the labour safety provisions.

**24.0 OBSERVANCE OF LABOUR LAWS**

1.0 The contractor shall be solely responsible for the observance and compliance with all applicable labour laws, including local laws and any other statutory provisions governing employment, wages, working conditions, social security, and welfare of workers. The contractor shall also indemnify and keep SAI indemnified against any consequences, liabilities, penalties, or legal actions arising due to non-compliance or violations of such laws.

2.0 The contractor shall ensure timely payment to all employees, workers, and sub-contractors, in accordance with the applicable labour laws. In the event that SAI or its client/owner is held liable as the "Principal Employer" for any statutory contributions or liabilities under government legislation or a court ruling concerning the contractor's workforce, the contractor shall fully reimburse such payments to SAI. SAI shall have the right to recover such amounts by deducting them from the contractor's payments, security deposit, or any other dues payable.

3.0 The contractor shall be required to submit valid proof of registration under the Employees' Provident Fund (EPF) Act and ESI Act. In the absence of a valid EPF and ESI registration certificate, SAI reserves the right to withhold an amount equivalent to 3.94% of the value of each Running Account (R/A) Bill until the contractor submits proof of EPF and ESI registration from the relevant authorities. If it becomes necessary for SAI to deposit the withheld amount with the EPF and ESI authorities as per statutory requirements, SAI shall do so. In such a case, the withheld amount shall not be refunded to the contractor, even upon subsequent submission of the EPF and ESI registration certificates.

4.0 The contractor shall be liable to pay cess levied under the building and other Construction Workers Welfare CessAct ,1996, at such rates as may be notified by the Government from time to time.SAI shall deduct at source from every Running Account Bill of the Contractor, Said cess, at such rates for the time being prevailing, which shall not exceed 2% (two percent) but not be less than 1% (one percent) of the cost of construction incurred by SAI.

**25.0 LAW GOVERNING THE CONTRACT**

The Indian Laws shall govern this contract for the time being in force.

**26.0 LAWS, BY LAWS RELATING TO THE WORK**

The contractor shall strictly abide by the provisions, for the time being in force, of law relating to works or any regulations and bylaws made by any local authority or any water & lighting agencies or any undertakings within the limits of the jurisdiction of which the work is proposed to be executed. The contractor shall be bound to give to the authorities concerned such notices and take all approvals as may be provided in the law, regulations or by laws as a foresaid, and to pay all fees and taxes payable to such authorities in respect thereof.

**27.0 EMPLOYMENT OF PERSONNEL**

27.1 The contractor shall employ only Indian Nationals as his representatives, servants and workmen after verifying their antecedents and loyalty. He shall ensure that no personnel of doubtful antecedents and any other nationality in any way

are associated with the works.

27.2 SAI shall have full power and without giving any reason to the contractor, immediately to get removed any representative, agent, servant and workmen or employees on account of misconduct negligence or incompetence or whose continued employment may in his opinion be undesirable. The contractor shall not be allowed any compensation on this account.

**28.0 TECHNICAL STAFF FOR WORK**

28.1 The contractor shall employ at his cost the adequate number of technical staff during the execution of this work depending upon the requirement of work. For this purpose, the number Stob deployed, their qualification, experience as decided by SAI shall be final and binding on contractor. The contractor shall not be entitled for any extra payment in this regard. The technical staff should be available at site, whenever required by SAI to take instructions.

28.2 Within 10 days of letter of intent, the contractor shall submit a site organizational chartandresumeincludingdetailsofexperienceoftheProject-in-Chargeandother staff proposed by him and shall depute them on the Project after getting approval from Engineer-In-Charge. If desired by the contractor at a later date, the Project-in- Charge and other staff whose resume is approved by SAI can be replaced with prior written approval of SAI and replacement shall be with equivalent or superior candidate only. Decision of Engineer-In-Charge shall be final and binding on the contractor. Even after approving the site organizational chart, the Engineer-In- Charge, due to nature and exigency of work, can direct the contractor to depute additional staff as per the requirement.

28.3 The removal of such additional staff from the site shall only be with the prior written approval of Engineer-In-Charge. The contractor shall not be paid anything extra whatsoever on account of deployment of additional staff and decision of the Engineer-In-Charge shall be final and binding on the contractor.

**29.0 LAND FOR LABOUR HUTS/ SITE OFFICE AND STORAGE ACCOMMODATION**

29.1 The contractor shall arrange the land for temporary office, storage accommodation and labour hut sat his own cost and get the clearance of local authorities for setting up of labour camp and same is deemed to be included in the rates quoted by the contractor for the works. The contractor shall ensure that the area of labour huts is kept clean and sanitary conditions are maintained as laid down by the local authorities controlling the area. The labour huts shall be so placed that it does not hinder the progress of work or access to the worksite. Contractor shall give the vacant possession of the land utilized for this purpose back after completion of the work. The security deposit of the contractor shall be released only after contractor demolishes all structures including foundations and gives back clear vacant possession of this land.

29.2 In the event the contractor has to shift his labour campus at any time during execution of the work on the instructions of local authorities or as per the requirement of the work progress or as may be required by SAI, he shall comply with such instructions at his cost and risk and no claim whatsoever shall be entertained on this account.

29.3 FURNISHED OFFICE ACCOMMODATION & MOBILITY AND COMMUNICATION TO BE PROVIDED BY CONTRACTOR TO SAI

On account of furnished Project Office equipped with all facilities such as telephone, fax, internet, photocopier, computer/ laptop & printer along with operator, regular electric & purified drinking water supply and inspection vehicle etc. as per the requirement of the project an **amount equal to 1.00 % of gross bill** from all running account & final bill will be recovered.

The contractor shall also make sufficient arrangement for Photography/ Videography preferably by maintaining a camera/video camera at site so that video photographs can be taken of a specific activity at any point of time.

The contractor shall make all arrangements for groundbreaking ceremony/ inaugural function etc. for the project as required and the cost towards it deemed to be included in his rates/offer.

**30.0 WATCHING AND LIGHTING**

The contractor shall at his own cost take all precautions to ensure safety of life and property by providing necessary barriers, watchmen, illumination etc. during the progress of work as directed by Engineer-In-Charge.

**31.0 HEALTH & SANITARY ARRANGEMENTS**

In case of all labour directly or indirectly employed in work for the performance on the contractor's part of this contract, the contractor shall comply with all rules framed by Govt. from time to time for the protection of health and sanitary arrangements for workers.

**32.0 WORKMEN'S COMPENSATION ACT**

The contractor shall at all times indemnify SAI and Owner against all claims for compensation under the provision of Workmen's Compensation Act or any other law in force, for any workmen employed by the contractor or his sub-contractor in carrying out the contract and against all costs and expenses incurred by SAI there with.

**33.0 MINIMUM WAGES ACT**

The contractor shall strictly comply with all provisions of the Minimum Wages Act, 1948, the Contract Labour (Regulation & Abolition) Act, 1970, along with the rules framed thereunder, and any other applicable labour laws or local laws governing contract labour. The contractor shall also ensure compliance with any amendments or new legislations that may be enacted during the execution of the contract. Failure to adhere to these statutory requirements shall render the contractor liable for penalties, legal action, and any financial liabilities arising therefrom, and SAI shall have the right to recover such amounts from the contractor's payments, security deposit, or other dues.

**34.0 LABOUR RECORDS**

The contractor shall submit by the 4th & 19th of every month to the Engineer-In- Charge of SAI a true statement, showing in respect of the second half of the preceding month and the first half of the current month, respectively, of the following data:

a) The number of the labour employed by him(category-wise).
b) Their working hours.
c) The wages paid to them.
d) The accidents that occurred during Said fortnight showing the circumstances under which they happened, and the extent of damage and injury caused.
e) The number of female workers who have been allowed Maternity Benefits and the amount paid to them.
f) Any other information required by Engineer-In-Charge.

**35.0 MEASUREMENTS OF WORKS, Applicable for Non Tendered& Additional Works**

Unless otherwise mentioned in the Scope of Work the measurements of works shall be done as per CPWD specifications (as specified in Technical Specification of the Tender) and if the same is not given in the CPWD Specifications, the same shall be measured as per latest relevant BIS codes in force. The quantity of steelreinforcementandthestructuralsteelsectionsincorporatedintheworkshallbe measured & paid on the basis of standard coefficients of sections as per BIS Codes of practice.

**36.0 WORK ON SUNDAYS, HOLIDAYS AND DURING NIGHT**

If required to complete the work as per time schedule, the contractor may carry out work on Sunday and Holidays or during night, in this regard the contractor will intimate the Engineer-In-Charge or his representative in advance and obtain his permission. The contractor shall have no claim on this account whatsoever. If work demand, the contractor

shall make arrangements to carry out the work on Sundays, Holidays and in two, three shifts at no extra cost to SAI.

**37.0 NO IDLE CHARGES TOWARDS LABOUR OR P&M ETC.**

No idle charges or compensation shall be paid for idling of the contractor's labour, staff or P&M etc. on any ground or due to any reason whatsoever. SAI will not entertain any claim in this respect.

**38.0 WORK TO BE EXECUTED IN ACCORDANCE WITH SPECIFICATIONS, DRAWINGS AND ORDERS ETC.**

The contractor shall execute the whole and every part of the work in the most substantial and workman like manner both as regards materials and otherwise in every respect in strict accordance with the specifications. The contractor shall also conform exactly, fully and faithfully to the design, drawings and instructions in writing in respect of the work assigned by the Engineer-In-Charge and the contractor shall be furnished free of charge one copy of the contract documents together with specifications, designs, drawings.

The contractor shall comply with the provisions of the contract and execute the works with care and diligence and maintain the works and provide all labour and materials, tools and plants including for measurements and supervision of all works, structural plans and other things of temporary or permanent nature required for such execution and maintenance in so far as

the necessity for providing the security is specified or is reasonably inferred from the contract. The contractors hall take full responsibility for adequacy, suitability and safety of all the works and methods of construction.

**39.0 DIRECTION FOR WORKS**

39.1 All works to be executed under the contract shall be executed under the directions and subject to approval in all respects of the Engineer-In-Charge of SAI who shall been titled to direct at what point or points and in what manner the works are to be commenced and executed.

39.2 The Engineer-In-Charge and his representative shall communicate or confirm their instructions to the contractor in respect of the execution of work during their site inspection in a 'Works Site Order Book' maintained at the site office of Engineer-In- Charge. The contractor or his authorized representative shall confirm receipt of such instructions by signing against the relevant orders in the book.

**40.0 ORDER OF PRECEDENCE OF DOCUMENTS**

In case of difference, contradiction, discrepancy, dispute with regard to Conditions of Contract, Specifications, scope of work, design basis report, tender drawings and other documents forming part of the contract, the following shall prevail in order of precedence.

i) Letter of Intent, Letter of Award, Agreement along with statement of agreed variations and its enclosures.
ii) Special Conditions of Contract.
iii) Scope of Work, Design Basis Reports & Schematic Drawings as give in Tender documents.
iv) Technical Specifications(General, Additional and Technical Specification) as give in Tender documents.
v) General Conditions of Contract.
vi) CPWD Specifications (as specified in Technical Specification of the Tender) update with correction slips Is sued up to last date of receipt of tenders.
vii) Relevant B.I.S. Codes.
viii) Sound Engineering practices.

**41.0 TIME SCHEDULE & PROGRESS**

41.1 Time allowed for carrying out all the works as entered in the tender shall be as mentioned in the Tender conditions. The Date of Start of contract shall be reckoned 10days after the date of issue of letter/FAX/E-mail of intent/acceptance of tender. Time shall be the essence of the contract and contractor shall ensure the completion of the entire work within

the stipulated time of completion.

41.2 The contractor shall also furnish within 10daysof date of receipt of letter of Intent ,a CPM network/ PERT chart/ Bar Chart along with quarterly milestones and resources plan for man, material & machinery to achieve the milestones for completion of work within stipulated time. This will be duly got approved from Concerned Zonal/Unit Office of SAI. This approved Network/ PERT Chart shall form a part of the agreement. Achievement of milestones as well as total

completion has to be within the time period allowed.

41.3 Contractor shall mobilize and employ sufficient resources for completion of all the works as indicated in the agreed BAR CHART/Network. No additional payment will be made to the contractor for any multiple shift work or other incentive methods contemplated by him in his work schedule even though the time schedule is approved by the Engineer-In-Charge.

41.4 During the currency of the work the contractor is expected to adhere to the time schedule, milestones and total completion time and this adherence will be a part of Contractor's performance under the contract. During the execution of the work contractor is expected to participate in the review and updating of the Network/ BARCHART undertaken by SAI. These reviews may be undertaken at the discretion of SAI either as a periodical appraisal measure or when the quantum of work order on the contractor is substantially changed through deviation orders or amendments. There view shall be held at site or any of the offices of SAI/owner/ consultant at the sole discretion of SAI. The contractor will adhere to the revised schedule thereafter. The approval to the revised schedule resulting in a completion date beyond the stipulated date of completion shall not automatically amount to a grant of extension of time to the contractor.

41.5 Contractor shall submit fortnightly/ Monthly (as directed by Engineer-In-Charge) progress reports along with photographs on a computer-based program (program and software to be approved by Engineer-In-Charge) highlighting status of various activities and physical completion of work.

41.6 Thecontractorshallsendcompletionreportwithasbuiltdrawingsandmaintenance schedule to the office of Engineer-In-Charge, of SAI in writing within a period of 30 days of completion of work.

**42.0 WATER AND ELECTRICITY**

The contractor shall make his own arrangement for Water & Electrical Power for construction and other purposes at his own cost and pay requisite electricity and water charges. The contractor shall also make standby arrangement for water & electricity to ensure un-interrupted supply.

**43.0 MATERIALS and EQUIPMENT TO BE PROVIDED BY THE CONTRACTOR**

The contractor shall, at his own expense, provide all materials and equipment's required including Cement & Steel for the works.

The contractor shall at his own expense and without delay supply to the Engineer-In- Charge samples of materials to be used on the work and shall get the same approved in advance. All such material is to be provided by the Contractor shall be in conformity with the specifications laid down or referred to in the contract. The contractor shall, if required by the Engineer-In-Charge furnish proof, to the satisfaction of the Engineer-In-Charge that the materials so comply.

The contractor shall at his risk and cost, submit the samples of material is to be tested or analyzed and bear all charges and cost of testing unless specifically provided or otherwise elsewhere in the contract or specifications. The Engineer-In-Charge or his authorized representative shall at all times have access to the works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery are being obtained for the works and the contractor shall afford every facility and every assistance and cost in obtaining the right and visit to such access.

The Engineer-In-Charge shall have full powers to require the removal from the premises of all materials, which in his opinion are not in accordance with the specifications and in case of default, the Engineer-In-Charge shall be at liberty to employ at the expense of the contractor, other person store move the same without being answerable or accountable for any loss or

Damage that may happen or arise to such materials .The Engineer-In-Charge shall also have full power to require other proper materials to be substituted thereof and in case of default, the Engineer-In- Charge may cause the same to the supplies and all costs which may require such removal and substitution shall be borne by the contractor.

**43.1 CEMENT AND CEMENT GODOWN**

Cement shall be procured by Contractor confirming to BIS:8112 Specification latest edition Grades as directed by the Engineer-In-Charge. The cement shall be procured directly from the reputed manufacturers/ stockiest, which will have to be got approved from SAI in advance. Relevant vouchers and test certificates will be produced as and when required. The cement shall best or provided by the contractor in such suitable covered and lockable stores, well protected from climate and atmospheric affect. The cement go down shall be constructed by the contractor as per CPWD specifications at his own cost. The cement in bags shall be stored in godowns in easy countable position. Cement bags shall be used on first in first out basis. Cement stored for beyond 90days will be required to be tested at contractors' cost, before use in works

**43.2 STEEL&STEELSTOCKYARD**

Steel confirming to BIS specifications (latest edition) shall be procured by the contractor directly from reputed manufacturers The manufacturer has to give a certificate that the material supplied is not a re-rolled product. The contractor will produce relevant vouchers & test certificates. Re-rolled sections will not be allowed.

Reinforcement steel, structural steel shall be stored and stacked in such manner so as to facilitate easy identification, removal etc. The contractor shall take proper care to prevent direct contact between the steel and the ground/ water for which he shall provide necessary arrangement at his own cost including ensuring proper drainage of area to prevent water logging as per directions of the Engineer-In- Charge .Steel shall also be protected, by applying a coat of neat cement slurry over the bars for which no extra payment shall be made.

Test certificates for each consignment of steel shall be furnished and tests to be got carried out from the authorized laboratory as per the directions of Engineer-In- Charge, before incorporating the materials in the work.

**44.0MEASUREMENTS AND PAYMENTS:**

44.1**Measurement of Works by Contractor's Authorized Representative**

**(a)** The Contractor shall be paid for the works at the price in the accepted percentage mile stones or such part rates as decided by engineer in charge. The date and time on which 'on account' or 'final' measurements are to be made shall be communicated to the Engineer.

In recognition of timely and efficient execution, If the construction completion date for a facility occurs prior to the scheduled construction completion date then the contractor shall be eligible for an incentive for early completion of the of work under the contract, subject to the following conditions:

If the contractor completes the work ahead of the scheduled completion date, an incentive shall be payable at the rate of 0.75 percent (0.75%) of the contract value for each full block of thirty (30) calendar days of early completion.

Periods of early completion less than thirty (30) days shall be disregarded for the purpose of calculating the bonus.

To qualify for any early completion incentive, the contractor shall mandatorily report the actual date of completion to the Engineer in charge. The Engineer shall confirm and communicate the actual date of completion to the SAI via fax or email within seven (7) calendar days of completion. Incentives for early completion may be offered only where a demonstrable and tangible benefit to the procuring entity is established. If applicable, such incentives shall be explicitly stated in monetary terms within the contract.

In the event that the Contractor has received any incentive or bonus for early completion of works and, during the Defect

Liability Period (DLP), any defect, deficiency, or non-conformity arises in the executed works, it shall be the Contractor's responsibility to rectify such defects within the time frame stipulated by the Engineer-in-Charge. Failure of the Contractor to carry out the necessary rectification within the prescribed period shall render the Contractor liable for recovery of the incentive amount previously granted. The said amount shall be deducted from the Performance Bank Guarantee (PBG) or any other dues payable to the Contractor, without prejudice to any other rights of the Employer under the Contract.

| Sr No | Description of work | Weightage Major Centre of Cost | Main Head % | Total Project Cost % |
|---|---|---|---|---|
| **1.00** | **Table 1 - Survey, Planning, Designing, Drawings & all statutory approvals** | | | |
| 1.01 | Survey, Design& Drawings | | | 3.00% |
| | Planning, Detailed Design & Drawings and Approval from Statutory Bodies, Third party proof checking and approval of the same by the Engineer-In-Charge based on the Concept Plan, Arch Drgs, Soil Investigation & Survey provided. | | 3.00% | |
| i | On approval of All Architectural Drawings from Engineer in charge or Appointed representative by SAI. On Prorata Basis | 1.20% | | |
| ii | On approval of All Structural Drawings including steel structure and proof checking by IIT/NIT / Govt Engineering college and approval from Engineer in Charge.OnProrata Basis | 0.90% | | |
| iii | On approval of all MEP drawings & other services drawings from Engineer in charge or appointed representative.OnProrata Basis | 0.90% | | |
| **2.00** | **Table 2 - Construction** | | | |
| **2.01** | **CIVIL WORK (RCC, MASONARY, FINISHING & FLOORING WORKS etc.)** | | | 66.25% |
| i | On Completion of R.C.C work in foundation, Column upto plinth, plinth beam, Backfilling, Brick Work etc. all work upto Plinth Lvl. | | 11.02% | |
| a. | On completion of 50 % work Upto Plinth Level | 5.51% | | |
| b. | On completion of balance 50 % work Upto Plinth Level | 5.51% | | |
| ii. | R.C.C Work of Roof Level (Inc. Slab Conduiting) | | 24.81% | |
| | On Completion of GF Roof Slab | 9.07% | | |
| | On Completion of First Floor Roof Slab | 7.10% | | |
| | On Completion of Second Floor Roof Slab | 8.53% | | |
| | On Completion of terrace floor | 0.12% | | |
| iv. | Masonary Works | | 3.82% | |
| a. | On Completion of ground floor | 1.67% | | |

| | | | | |
|---|---|---|---|---|
| b. | On Completion of first floor | 0.92% | | |
| c. | On Completion of second floor | 1.03% | | |
| d. | On Completion of terrace floor | 0.20% | | |
| | | | | |
| v. | Internal Wall finishes (plaster works, Painting works etc) | | 2.19% | |
| a. | On Completion of ground floor | 0.55% | | |
| b. | On Completion of first floor | 0.66% | | |
| c. | On Completion of second floor | 0.87% | | |
| d. | On Completion of terrace floor | 0.11% | | |
| vi. | External Wall finishes (plaster works, Painting works etc) | | 0.58% | |
| a. | On Completion of ground floor | 0.18% | | |
| b. | On Completion of first floor | 0.18% | | |
| c. | On Completion of second floor | 0.19% | | |
| d. | On Completion of terrace floor | 0.02% | | |
| vii. | Water proofing works and final Testing | | 1.82% | |
| a. | Below ground floor - sub structure | 0.00% | | |
| b. | On Completion of ground floor | 0.17% | | |
| c. | On Completion of first floor | 0.03% | | |
| d. | On Completion of second floor | 0.03% | | |
| e. | On Completion of terrace floor | 1.58% | | |
| viii. | Flooring and wall tiling works | | 3.82% | |
| a. | On Completion of ground floor | 1.06% | | |
| b. | On Completion of first floor | 0.93% | | |
| c. | On Completion of second floor | 1.80% | | |
| d. | On Completion of terrace floor | 0.02% | | |
| ix. | Sports Flooring | | 2.68% | |
| a. | Supply of specialised flooring materials as per DBR, 60% | 1.61% | | |
| b. | Installation of specialised flooring materials as per DBR, 30% | 0.80% | | |
| c. | After Handover to client all test certificates, manuals & Training, 10% | 0.27% | | |
| x. | Fixing of door & windows | | 3.73% | |
| b. | On Completion of ground floor | 0.83% | | |
| c. | On Completion of first floor | 1.13% | | |
| d. | On Completion of second floor | 1.73% | | |
| e. | On Completion of terrace floor | 0.04% | | |
| xi. | Structural Steel fabrication & Railing Works | | 0.70% | |
| a. | On Completion of ground floor | 0.23% | | |

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|---|---|---|---|---|
| b. | On Completion of first floor | 0.23% | | |
| c. | On Completion of second floor | 0.20% | | |
| d. | On Completion of terrace floor | 0.03% | | |
| xii. | False Ceiling & Acoustic Panelling | | 2.98% | |
| a. | On Completion of ground floor | 0.43% | | |
| b. | On Completion of first floor | 1.18% | | |
| c. | On Completion of second floor | 1.37% | | |
| xiii. | All miscellaneous works such as railings, structural glazing, ramps, steps, toilet cubicals etc; | | | |
| a. | Façade work | | 4.43% | |
| | After 50% work completion | 2.22% | | |
| | After remaining 50% work completion | 2.22% | | |
| b. | Toilet cubicles & Lockers | | 0.63% | |
| | Supply | 0.38% | | |
| | Installation | 0.22% | | |
| | Handing Over | 0.03% | | |
| xiv. | Signages | | 0.85% | |
| a. | After 50% work completion | 0.43% | | |
| b. | After remaining 40% work completion | 0.34% | | |
| c. | After Handover to client all test certificates, manuals & Training | 0.09% | | |
| xv. | Jacuzzi | | 0.20% | |
| a. | Supplying of Equipments, 60% | 0.12% | | |
| b. | Installation of Equipments, 30% | 0.06% | | |
| c. | After Handover to client all test certificates, manuals & Training, On Completion, Testing & Commissioning of system, 10% | 0.02% | | |
| xvi. | SWIMMING POOL FILTRTION SYSTEM | 0.00% | 1.99% | |
| a. | Supplying of Equipments, 60% | 1.19% | | |
| b. | Installation of Equipments, 30% | 0.60% | | |
| c. | After Handover to client all test certificates, manuals & Training, On Completion, Testing & Commissioning of system, 10% | 0.20% | | |
| **2.02** | **SERVICES (ELECTRICAL & PLUMBING)** | | | 26.58% |
| a. | Electrical Installation | | | |

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|---|---|---|---|---|
| a.1 | Supplying, installation, testing and commissioning of HT panel, transformer, HT cable, bus trunking from transformer to LT panel, i/c earthing, inter connecting power cables in substation, safety equipment's, as per scope of work, Earthing System Technical Specification & Drawings etc. complete. | | 0.56% | |
| | Design,Drawings and approvals | 0.03% | | |
| | On Supply installation and erection | 0.34% | | |
| | On Completion, Testing & Commissioning of system | 0.14% | | |
| | On CEIG Approval | 0.03% | | |
| | On Handing over | 0.03% | | |
| a.2 | Supplying, installation, testing and commissioning of , LT Panel, automatic power factor corrector panel, essential panel i/c earthing, inter connecting power cables in substation, safety equipment's, Substation works including DG as per scope of work, Earthing System Technical Specification & Drawings etc. complete. as per scope of work, Technical Specification & Drawings etc. complete. | | 0.81% | |
| | Design,Drawings and approvals | 0.04% | | |
| | On Supply installation and erection | 0.49% | | |
| | On Completion, Testing & Commissioning of system | 0.20% | | |
| | On CEIG Approval | 0.04% | | |
| | On Handing over | 0.04% | | |
| a.2 | Supplying, installation, testing and commissioning of DG SET and associated works for the entire project as per scope of work, Technical Specification & Drawings etc. complete. | | 0.94% | |
| | Design,Drawings and approvals | 0.05% | | |
| | On Supply installation and erection | 0.57% | | |
| | On Completion, Testing & Commissioning of system | 0.24% | | |
| | On CEIG Approval | 0.05% | | |
| | On Handing over | 0.05% | | |
| a.3 | Supplying, installation, of Lightning arrester and earthing work as per scope of work, Technical Specification & Drawings etc. complete. | | 0.29% | |
| | Design,Drawings and approvals | 0.01% | | |
| | On Supply installation and erection | 0.18% | | |
| | On Completion, Testing & Commissioning of system | 0.07% | | |
| | On CEIG Approval | 0.01% | | |

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| | On Handing over | 0.01% | | |
| a.4 | Supplying, installation, of **LT Cabes& Cable Trays** as per scope of work, Technical Specification & Drawings etc. complete. | | 3.28% | |
| | Design,Drawings and approvals | 0.16% | | |
| | On Supply | 1.97% | | |
| | On installation and erection | 0.82% | | |
| | On Completion, Testing & Commissioning of system | 0.16% | | |
| | On Handing over | 0.16% | | |
| a.6 | On Supply and installation of **internal electrical works** which includes ceiling & wall conduiting, GI boxes fixing, PVC insulated copper wiring, Switches and sockets for light and power points, distributions board, MCB, earthing, lighting conductors, LED Light, fans fixtures supply and installation etc complete. | | 1.00% | |
| | Design,Drawings and approvals | 0.05% | | |
| | On Supply of all conduiting, boxes and wiring | 0.55% | | |
| | On Erection of conduiting and wiring with boxes | 0.23% | | |
| | On Supply of all Board fittings and light fittings & fans | 0.05% | | |
| | On Erection of all fittings | 0.02% | | |
| | On Completion, Testing & Commissioning of system | 0.05% | | |
| | On Handing over | 0.05% | | |
| a.7 | Supplying, Installation and commissioning of **UPS system** as per design load and requirement | | 0.47% | |
| | Design,Drawings and approvals | 0.02% | | |
| | On Supply | 0.28% | | |
| | On installation and erection | 0.12% | | |
| | On Completion, Testing & Commissioning of system | 0.02% | | |
| | On Handing over | 0.02% | | |
| a.8 | Supplying, installation testing & commissioning- **IT infrastructure** - Wifi telephony, Cabling, IT Control room ( LAN and IPBAX system), UPS, Access Control as per scope of work, Technical Specification & Drawings etc. complete. | | 0.34% | |
| | Design,Drawings and approvals | 0.02% | | |
| | On Supply | 0.21% | | |
| | On installation and erection | 0.09% | | |
| | On Completion, Testing & Commissioning of system | 0.02% | | |
| | On Handing over | 0.02% | | |
| a.5 | Supplying, installation, testing and commissioning of **LED lights** for the entire project as per scope of work, Technical Specification & Drawings etc. complete. | | 2.39% | |
| | Design,Drawings and approvals | 0.12% | | |

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| | On Supply | 1.44% | | |
| | On installation and erection | 0.60% | | |
| | On Completion, Testing & Commissioning of system | 0.12% | | |
| | On Handing over | 0.12% | | |
| a.9 | Design, Supplying, Installation, testing and commissioning of **Passenger Lifts & Service lift** as per scope of work, Technical Specification & Drawings etc. complete. | | 0.96% | |
| | Design,Drawings and approvals | 0.05% | | |
| | On delivery of Lift materials at site | 0.58% | | |
| | On Erection / installation of all lifts | 0.19% | | |
| | On Completion, testing &commisioning | 0.05% | | |
| | On Approval from lift Inspector & other statutory bodies, if applicable | 0.05% | | |
| | On Handing over | 0.05% | | |
| a.10 | Supply, Installation, Testing and Commissioning of on grid **Solar Photovoltaic Power Plant** conforming to MNRE specifications | | 0.29% | |
| | Design,Drawings and approvals | 0.01% | | |
| | On Supply | 0.17% | | |
| | On installation and erection | 0.07% | | |
| | On Completion, Testing & Commissioning of system | 0.01% | | |
| | On Handing over | 0.01% | | |
| b. | S/I/T/C Energy efficient **(HVAC) Air conditioning system** and Split units for UPS room, IBMS room, server room, BTU metering system , Close Loop Cooling Tower, | | 9.65% | |
| | Design,Drawings and approvals | 0.48% | | |
| | On Supply of all equipments - High Side | 2.47% | | |
| | On Supply of all equipments - Low Side | 3.32% | | |
| | On Erection of all equipments& materials | 2.41% | | |
| | On Completion, Testing & Commissioning of system | 0.48% | | |
| | On Handing over | 0.48% | | |
| c. | Design, Supplying, Installation, testing and commissioning **Firefighting system** with sprinkler system or as required i/c external Ring and plant room equipments. | | 1.77% | |
| | Design,Drawings and approvals | 0.09% | | |
| | On Supply installation and erection of piping | 1.06% | | |
| | On Supply installation and erection of Pumps | 0.44% | | |
| | On Completion, Testing & Commissioning of system | 0.09% | | |
| | On Handing over | 0.09% | | |

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| d. | Supplying, installation testing & commissioning CCTV, Fire Alarm,PA System, Access Control, etc., as per scope of work, Technical Specification & Drawings etc. complete. | | 0.86% | |
| | Design,Drawings and approvals | 0.04% | | |
| | On Supply of Fixtures | 0.52% | | |
| | On installation and erection | 0.22% | | |
| | On Completion, Testing & Commissioning of system | 0.04% | | |
| | On Handing over | 0.04% | | |
| f. | Plumbing Works | 0.00% | | |
| f.1 | Planning, Designing , supplying, installation of **internal plumbing works & sanitary fixtures** installation of all buildings i/c internal water supply system as per scope of work, Technical Specification & Drawings etc. complete. | | 0.56% | |
| i. | On designing and supplying drawings | 0.03% | | |
| ii. | On Supply of pipes, and sanitary fixtures | 0.34% | | |
| iii. | On installation of soil, waste and rain water piping at all floors | 0.08% | | |
| iv. | On installationg of sanitary ware and CP fittings and other accessories | 0.06% | | |
| v. | On Completion, Testing & Commissioning of system | 0.03% | | |
| vi. | On Handing over | 0.03% | | |
| f.2 | Planning, Designing, Construction of **External Sewerage and Drainage System** as per scope of work, Technical Specification & Drawings etc. complete. | | 0.06% | |
| i. | On designing and supplying drawings | 0.01% | | |
| ii. | On delivery of 50% pipes / fittings materials from total requirement | 0.01% | | |
| iii. | On delivery of balance 50% pipes / fittings materials from total requirement | 0.01% | | |
| iv. | On completion of laying pipe work, manholes, masonary chambers, laying concrete over pipes and back filling complete | 0.01% | | |
| v. | On Completion of all sewerage & drainage works , Testing & Commissioning | 0.04% | | |

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| f.3 | Planning, Designing, Construction of network for **strom drain / swales, Rain water Harvesting** as per scope of work, Technical Specification & Drawings etc. complete. | | 0.18% | |
| | On designing and supplying drawings | 0.00% | | |
| | On construction of 50% length of RCC drains / swales planned | 0.08% | | |
| | On construction of 50% length of RCC drains / swales planned | 0.08% | | |
| | On Completion of all works , Testing & Commissioning | 0.02% | | |
| f.4 | Design, Supplying, Installation, testing and commissioning of **Pump and Equipment's for Domestic Water Treatment system** as per scope of work, Technical Specification & Drawings etc. complete. | | 0.46% | |
| | On designing and supplying drawings | 0.02% | | |
| | On Supply of pipes, pumps & accessories | 0.28% | | |
| | On installation of pumps, accessories and piping network | 0.12% | | |
| | On Competion,Testing& commissioning | 0.02% | | |
| | On completion of RMO for one year | 0.02% | | |
| f.5 | Design, Supplying, Installation, testing and commissioning of **WTP &STP** as per scope of work, Technical Specification & Drawings etc. complete. | | 0.85% | |
| | On designing and supplying drawings | 0.04% | | |
| | On Supply of Equipments | 0.51% | | |
| | On installation | 0.21% | | |
| | On Competion,Testing& commissioning | 0.04% | | |
| | On completion of CTE / CTO submission | 0.04% | | |
| g. | Supplying and installation testing and commissioning of **BMS system** for building security comprising of all systems, cabling, display system and hard ware software support as per scope of work, Technical Specification & Drawings etc. complete. | | 0.86% | |
| | Design,Drawings and approvals | 0.04% | | |
| | On Progressive Supply | 0.51% | | |
| | On Progressive Installation | 0.21% | | |
| | On Completion, Testing & Commissioning of system | 0.04% | | |
| | On Handing over | 0.04% | | |
| | | | | |
| **3.00** | **SITE DEVELOPMENT WORKS** | | 4.17% | 4.17% |
| | LAND DEVELOPMENT WORKS | 4.03% | | |

| | | | | |
|---|---|---|---|---|
| | LANDSCAPING WORKS | 0.14% | | |
| | | | | |
| | **GRAND TOTAL** | **100.00%** | **100.00%** | **100.00%** |

The date and time of test checks shall be communicated to the Contractor who shall be present at the site and shall witness the test checks, failing the Contractor's attendance the test checks may be conducted in his absence and such test checks shall not withstanding such absence be binding upon Contractor provided always that any objection made by Contractor to test check shall be duly investigated and considered in the manner set out below:

(i) It shall be open to the Contractor to take specific objection to test checks of any recorded measurement within 7 days of date of such test checks. Any re-test check done by the concerned SAI's authority in the presence of the Contractor or in his absence after due notice given to him in consequent of objection made by the Contractor shall be final and binding on the Contractor and no claim whatsoever shall thereafter be entertained regarding the accuracy and classification of the measurements.

(ii) If an objection raised by the Contractor is found by the Engineer to be incorrect the Contractor shall be liable to pay the actual expenses incurred in measurements.

An amount of ad-hoc payment not less than 75% of the net amount of the bill under check (If found in order), shall be made within 10 working days of submission of the bill. The remaining payment is also to be made after final checking of the bill within 28 working days of submission of bill by the contractor. In case of delay in payment of intermediate bills after 30 days of submission of bill by the contractor, provided the bill submitted by the contractor found to be in order, a simple interest @ 5% (five percent) per annum shall be paid to the contractor from the date of expiry of prescribed time limit.

No Running Account Bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board, whatever applicable are submitted by the contractor to the Engineer-in-Charge.

The final bill shall be submitted by the contractor in the same manner as specified in interim bills within three months of physical completion of the work or within one month of the date of the final certificate of completion furnished by the Engineer-in-Charge whichever is earlier.

No further claims shall be made by the contractor after submission of the final bill and these shall be deemed to have been waived and extinguished. Payments of those items of the bill in respect of which there is no dispute and of items in dispute, for quantities and rates as approved by Engineer-in-Charge, will, as far as possible be made within the period of three months the period being reckoned from the date of receipt of the bill by the Engineer-in Charge.

If the final bill is submitted by the contractor within the period specified above and delay in payment of final bills is made by the department after prescribed time limit, a simple interest @ 5 % (five percent) per annum shall be paid to the contractor from the date of expiry of prescribed time limit, provided the final bill submitted by the contractor is found to be in order.

(iii) The rate quoted by the contractor shall be deemed to be inclusive of all taxes as per the laws applicable in the State/Central Government

(iv) The contractor shall obtain all the statutory clearance / permission / licenses on behalf of SAI from different Government and civic bodies for implementation of the project.

(v) The contractor shall submit to SAI monthly report indicating physical and financial progress by 5$^{th}$of every month.

(vi) The contractor shall confirm that the activities proposed under the project shall conform to all Environmental Legislations, any judicial orders in force at the site of work including the Environment and Social Safeguard measures as per the NGRBA framework.

(vii) The contractor shall obtain the required statutory approval on behalf/in the name of SAI (if applicable).

(viii) Itshallberesponsibilityofthecontractortosubmitthe3setsofcompletiondrawings, service drawings etc. to SAI after completion of work with the consultation of engaged architect by SAI.

(ix) The contractor shall be responsible for obtaining connections of water, sewerage andelectricityfromtheconcernedauthoritytoensuretheirpropercommissioningso that no defects in operation of connections exist, by carrying out necessary tests etc. SAI will render requisite assistance in making application etc. for the purpose.

(x) Operation and Maintenance (O&M)Manual shall be part of construction contracts and to be provided by the contractor wherever required

(xi) The contractor shall not beat liberty to release any news, information, advertisement and propaganda etc., regarding this AGREEMENT to the Press or any other broadcasting media, except with the prior written APPROVAL from SAI.

(xii) The contractor and their personnel shall not, either during the term or after expiration of the AGREEMENT, disclose any proprietary or confidential information relating to the network, AGREEMENT or Client's business or operations without the prior written consent of SAI.

(xiii) The contractor shall provide all information, news and pre-post work photos/video to SAI.

(xiv) During the performance of SERVICES hereunder, the contractor shall take out/carry/maintain insurance as "Builder All Risk Insurance".

**(b) Incorrect measurement, actions to be taken:** If in case during test check or otherwise, it is detected by the Engineer that agency has claimed any exaggerated measurement or has claimed any false measurement for the works which have not been executed; amounting to variation of 5% or more of claimed gross bill amount, action shall be taken as following:

(i) On first occasion of noticing exaggerated/ false measurement, Engineer shall recover liquidated damages equal to10% of claimed gross bill value.

(ii) On any next occasion of noticing any exaggerated/false measurement

(iii) , SAI shall recover liquidated damages equal to 15% of claimed gross bill value. In addition, the facility of recording of measurements by Contractor as well as release of provisional payment shall be withdrawn. Once withdrawn, measurements shall be done by SAI as per clause 45(i) above.

**(46)"On-Account " Payments:** The Contractor shall be entitled to be paid from time to time by way of "On-Account" payment only for such works as in the opinion of the Engineer he has executed in terms of the contract. All payments due on the Engineer's certified "Contractor's authorized Engineer's measurements" shall be subject to any deductions which may be made provided always that the Engineer in charge may by any certificate make any correction or modification in any previous certificate which shall have been issued by him and that the Engineer may withhold any certificate, if the works or any part thereof are not being carried out to his satisfaction.

**(46) Rounding off Amounts:** The total amount due on each certificate shall be rounded off to the nearest rupee, i.e. sum less than 50 paise shall be omitted and sums of 50 paise and more upto₹1 will be reckoned as ₹ 1.

**(46)On Account Payments not Prejudicial to Final Settlement:** "On-Account" payments made to the Contractor shall be without prejudice to the final making up of the accounts (except where measurements are specifically noted in the Measurement Book as "Final Measurements" and as such have been signed by the Contractor and Engineer/Engineer's Representative) and shall in no respect be considered or used as evidence of any facts stated in or to be inferred from such accounts nor of any particular quantity of work having been executed nor of the manner of its execution being satisfactory.

**(46)Final Payment:** On the Engineer's certificate of completion in respect of the works, adjustment shall be made and the balance of account based on the Engineer or the Engineer's representative's certified measurements or Engineer's certified "contractor's

authorized engineer's measurements" of the total quantity of work executed by the Contractor upto the date of completion and on the rates accepted in Bill(s) of Quantities and for extra works on rates determined above of these Conditions shall be paid to the Contractor subject always to any deduction which may be made and further subject to the Contractor having signed delivered to the Engineer enclosing either a full account in detail of all claims he may have on SAI in respect of the works.The Engineer having after the receipt of such account given a certificate in writing that the whole of the works to be done under the provisions of the Contracts have been completed, that they have been inspected by him since their completion and found to be in good and substantial order, that all properties, works and things, removed, disturbed or injured in consequence of the works have been properly replaced and made good and all expenses and demands incurred by or made upon SAI for or in the respect of damage or loss by from or in consequence of the works, have been satisfied agreeably and in conformity with the contract.

An amount of ad-hoc payment not less than 75% of the net amount of the bill under check (If found in order), shall be made within 10 working days of submission of the bill. The remaining payment is also to be made after final checking of the bill within 28 working days of submission of bill by the contractor. In case of delay in payment of intermediate bills after 30 days of submission of bill by the contractor, provided the bill submitted by the contractor found to be in order, a simple interest @ 5% (five percent) per annum shall be paid to the contractor from the date of expiry of prescribed time limit.

No Running Account Bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board, whatever applicable are submitted by the contractor to the Engineer-in-Charge.

The final bill shall be submitted by the contractor in the same manner as specified in interim bills within three months of physical completion of the work or within one month of the date of the final certificate of completion furnished by the Engineer-in-Charge whichever is earlier.

No further claims shall be made by the contractor after submission of the final bill and these shall be deemed to have been waived and extinguished. Payments of those items of the bill in respect of which there is no dispute and of items in dispute, for quantities and rates as approved by Engineer-in-Charge, will, as far as possible be made within the period of three months the period being reckoned from the date of receipt of the bill by the Engineer-in Charge.

If the final bill is submitted by the contractor within the period specified above and delay in payment of final bills is made by the department after prescribed time limit, a simple interest @ 5 % (five percent) per annum shall be paid to the contractor from the date of expiry of prescribed time limit, provided the final bill submitted by the contractor is found to be in order.

**1.0** The rate quoted by the contractor shall be deemed to be inclusive of all taxes as per the laws applicable in the State/Central Government

**2.0** The contractor shall obtain all the statutory clearance / permission / licenses on behalf of SAI from different Government and civic bodies for implementation of the project.

**3.0** ThecontractorshallsubmittoSAImonthlyreportindicatingphysicalandfinancial progress by 5th of every month.

**4.0** The contractor shall confirm that the activities proposed under the project shall conform to all Environmental Legislations, any judicial orders in force at the site of work including the Environment and Social Safeguard measures as per the NGRBA framework.

**5.0** The contractor shall obtain the required statutory approval on behalf/in the name of SAI (if applicable).

**6.0** It shall be responsibility of the contractor to submit the 3sets of completion drawings, service drawings etc. to SAI after completion of work with the consultation of engaged architect by SAI.

**7.0** The contractor shall be responsible for obtaining connections of water, sewerage andelectricityfromtheconcernedauthoritytoensuretheirpropercommissioningso that no defects in operation of connections exist, by carrying out necessary tests etc. SAI will render requisite assistance in making application etc. for the purpose.

**8.0** Operation and Maintenance (O&M) Manual shall be part of construction contracts and to be provided by the contractor wherever required.

**9.0** The contractor shall not beat liberty to release any news, information, advertisement and propaganda etc., regarding this AGREEMENT to the Press or any other broadcasting media, except with the prior written APPROVAL from SAI.

**10.0** The contractor and their personnel shall not, either during the term or after expiration of the AGREEMENT, disclose any proprietary or confidential information relating to the network, AGREEMENT or Client's business or operations without the prior written consent of SAI.

**11.0** The contractor shall provide all information , news and pre-post work photos/video to SAI.

**12.0** During the performance of SERVICES hereunder, the contractor shall take out/carry/maintain insurance as "Builder All Risk Insurance".

No payment shall be made for any damage caused by rain, snowfall, flood or any other natural calamity, whatsoever during the execution of the work. The contractor shall be fully responsible for any damage to the govt. property and the work for which payment has been advanced to him under the contract and he shall make good the same at his risk and cost. The contractor shall be fully responsible for safety and security of his material, T&P/Machinery brought to the site by him. Nothing extra shall be payable on this account. Also, no claims for hindrance shall be entertained on this account

Royalty at the prevalent rates shall be paid by the Contractor or by RMC supplier as per the terms of supply between them on all materials such as boulders, metals, sand and bajri etc. collected by him for the execution of the work, directly to the revenue authority of the state government concerned. Nothing extra shall be payable on this account.

The Contractor shall keep himself fully informed of all acts/laws of the Central/State/Local Governments, orders of central/state/local government, decrees of statutory bodies, tribunals having any jurisdiction or authority, which in any manner may affect those engaged or employed and anything related to carrying out the work. All the rules & regulations and bye-laws laid down by Collector / Municipal Corporation of area (where site is located) and any other statutory bodies shallbe adhered to, by the contractor, during the execution of work. The Contractor shall also adhere to all traffic restrictions notified by the national/state/local authorities. The contractor shall abide and ensure compliances to terms and conditions of various approvals obtained for the work/ project. He shall work and indemnify the Department and it's officials & employees against any claim and /or liability arising out of violations of any such laws, ordinances, orders, decrees, by himself or by his employees or his authorized

representatives. The Contractor shall indemnify the Department against all claims in respect of patent rights, royalties, design, trademarks- of name or other protected rights, damages to adjacent buildings, roads or members of public, in course of execution of work or any other reasons whatsoever and shall himself defend all actions arising from such claims and shall indemnify the Department in all respect from such actions, costs and expenses. Nothing extra shall be payable on this account.

The Contractor shall make available five (05) sets of "AS BUILT" architectural, structural, all services (internal & external) drawings (including soft copy of the same), along with literatures, maintenance manuals, warranty certificates etc. of various installed fittings, fixtures and equipment for the completed work / projects. This shall be the prerequisite for payment of final bill.

The contractor shall make available four (04) sets of computerized Standard Measurement Books (SMBs) having measurement of all the permanent standing.

**45.0 ANTI-TERMITE TREATMENT &WATERPROOF TREATMENT**

45.1 The Said work or such rectification or re-treatment within sevendays from the date of issue of such letter to him. If the contractor fails to commence such work within the stipulated period, SAI may get the same done by another agency at the Contractor's cost and risk and the decision of the Engineer-In-Charge of SAI for the cost payable by the contractor shall be final and binding upon him. Re-treatment if required shall be attended to and carried out by the Contractor within seven days of the notice from Engineer-In-Charge of SAI.

45.2 SAI reserves the right to get the quality of treatment checked in accordance with recognized test methods and in case it is found that the chemicals with the required concentration and rate of application have not been applied, or the water proof treatment is not done as per specifications, the contractor will be required to do the re- treatment in accordance with the required concentration & specifications at no extra cost failing which no payment for such work will be made. The extent of work thus rejected shall be determined by SAI.

45.3 Water proofing and anti-termite treatment shall be got done through approved / specialized agencies only with prior approval of Engineer-In-Charge.

45.4 The contractor shall make such arrangement as may be necessary to safe guard the workers and residents of the building against any poisonous effect of the chemicals used during the execution of the work.

45.5 During the execution of work, if any damage shall occur to the treatment already done, either due to rain or any other circumstances, the same shall be rectified and made good to the entire satisfaction of Engineer-In-Charge by the contractor at his costs and risks.

45.6 The contractor shall make his own arrangement for all equipment required for the execution of the job.

45.7 The contractor whose tender is accepted shall execute Guarantee Bond in the prescribed form as appended for guaranteeing the anti-termite treatment and waterproof treatment.

**46.0 INDIAN STANDARDS**

Wherever any reference is made to Indian Standards (IS) in the specifications, drawings, or bill of quantities, it shall be deemed to refer to the latest edition of the relevant Indian Standard, including all amendments, as applicable on the last date of receipt of the tender documents. The contractor shall be responsible for ensuring full compliance with these standards in the execution of the work. Any deviation from the prescribed IS specifications shall require prior written approval from SAI, failing which the work shall be considered non-compliant and subject to rectification at the contractor's cost.

**47.0 CENTERING & SHUTTERING**

Marine water proof ply wood or steel plates of minimum thickness and height adjustable steel props as approved by Engineer-In-Charge shall be used for formwork. The shuttering plates shall be cleaned and oiled after every repetition and shall be used only after obtaining approval of SAI's Engineers at site. The number of repetitions allowed for plywood and steel shuttering

shall be at the discretion of Engineer-In-Charge of SAI depending upon the condition of shuttering surface after each use and the decision of Engineer-In- Charge in this regard shall be final and binding on the contractor. No claim whatsoever on this account shall be admissible.

**48.0 RECORDS OF CONSUMPTION OF MATERIALS**

48.1 For the purpose of keeping a record of materials (Steel, Cement, Bitumen etc.) and other items (as decided by Engineer in Charge) received at site and consumed in works, the contractor shall maintain a properly bound register in the form approved by SAI, showing columns like quantity received and used in work and balance in hand etc. This register shall be signed daily by the contractor's representative and SAI's representative.

48.2 The register of material shall be kept at site in the safe custody of SAI's Engineer during progress of the work. This provision will not, however, absolve the contractor from the quality of the final product.

48.3 Incase cement or steel quantity consumed is less as compared to the theoretical requirement of the same as per CPWD specifications/ norms, the work will be de valued and/or a penal rate(i.e. double the rate at which cement/steel purchased last)recovery for lesser consumption of cement/steel shall be made in the rates of the work done subject to the condition that the tests results fall within the acceptable criteria as per CPWD specifications otherwise the work shall have to be dismantled and redone by the contractor at no extra cost.

In case of cement, if actual consumption is less than 98% of the theoretical consumption, a recovery shall be affected from the contractor's dues at the penal rate (Prescribed under relevant clauses of I.S.Code)for the actual quantity, which is lower than 98% of theoretical consumption.

**49.0 MATERIALS AND SAMPLES**

49.1 The contractor shall submit samples/ specimens out of approved makes of materials/ products to the Engineer-In-Charge for prior approval. In exceptional circumstances Engineer-In-Charge may allow alternate equivalent makes/brands of products/ materials at his sole discretion. The final choice of brand/ make shall remain with the Engineer-In-Charge, whose decision in this matter shall be final and binding and nothing extra on this account shall be payable to the Contractor.

49.2 In case no make or brand of any materials, articles, fittings and accessories etc. is specified, the same shall comply with the relevant Indian Standard Specifications and shall bear the ISI/BIS mark. The Engineer of SAI and the owner shall have the discretion to check quality of materials and equipment to be incorporated in the work, at source of supply or site. They shall also have the discretion to check the workmanship of various items of work to be executed in this work. The contractor shall provide the necessary facilities and assistance for this purpose.

The above provisions shall not absolve the contractor from the quality of final product and in getting the material and workmanship quality checked and approved from the Engineer-In-Charge of SAI.

49.3 The contractor shall well in advance, produce samples of all materials, articles, fittings, accessories etc. that he proposes to use and get them approved in writing by SAI. The materials articles etc.as approved shall be labeled as such and shall be signed by SAI and the Contractor's representative.

49.4 The approved samples shall be kept in the custody of the Engineer-In-Charge of SAI till completion of the work. Thereafter the samples except those destroyed during testing shall be returned to the contractor. No payment will be made to the contractor for the samples or samples destroyed in testing.

49.5 The brands of all materials, articles fittings etc. approved together with the names of the manufacturers and firms from which supplies have been arranged shall be recorded in the site order book.

49.6 The contractor shall set up and maintain at his cost, a field-testing laboratory for all day- to-day tests at his own cost to the satisfaction of the Engineer-In-Charge. This field- testing laboratory shall be provided with equipment and facilities to carry out all mandatory field tests as per CPWD (as the case may be) specifications. The laboratory building shall be constructed

and installed with the appropriate facilities; Temperature and Humidity controls shall be available wherever necessary during testing of samples.

AllequipmentshallbeprovidedbytheContractorsoastobecompatiblewiththe testing requirements specified. The Contractor shall maintain all the equipment in good working condition for the duration of the contract. The Contractor shall provide approved qualified personnel to run the laboratory for the duration of the Contract. The number of staff and equipment available must at all times be sufficient to keep pace with the sampling and testing program as required by the Engineer-In-Charge.

The Contractor shall fully service the site laboratory and shall supply everything necessary for its proper functioning, including all transport needed to move equipment and samples to and from sampling points on the site ,etc. The Contractor shall re-calibrate all measuring devices whenever so required by the Engineer-In- Charge and shall submit the results of such measurements without delay. All field tests shall be carried out in the presence of SAI representative. All costs towards samples, materials, collection, transport, manpower, testing etc. shall be borne by the Contractor and are deemed to be

included in the rates quoted by him in the price schedule.

**50.0 TESTS AND INSPECTION**

50.1 The contractor shall be responsible for carrying out all mandatory tests as per the approved specifications, technical documents, and directions of SAI during the execution of the work.

50.2 All tests on materials shall be conducted in accordance with the standards prescribed by CPWD (Central Public Works Department), and the relevant Indian Standard (IS) Codes, including all amendments applicable as of the last date of submission of tender documents.

50.3 The contractor shall arrange for all necessary tests at any recognized institution/NABL accredited laboratory, as directed by SAI. All testing charges, laboratory fees, and associated expenses shall be borne solely by the contractor.

50.4 All tests, whether conducted on-site or at external laboratories, relating to the execution of the work and supply of materials, shall be performed by the contractor or by SAI at the contractor's expense.

50.5 Failure to conduct the required tests or non-compliance with test results shall be considered a breach of contract, and SAI shall have the right to reject defective materials, halt work, impose penalties, or take any other necessary remedial action at the risk and cost of the contractor.

50.6 WORKSTOBEOPENTOINSPECTION

All works executed or under the course of execution in pursuance of this contract shall at all times be open to inspection and supervision of SAI and its designated representatives. The work during its progress or after its completion may also be inspected, by Chief Technical Examiner of Government of India (CTE) and/ or an inspecting authority of State Government of State in which work is executed and/or by third party checks by SAI The compliance of observations/ improvements as suggested by the inspecting officers of SAI/CTE/ State Authorities shall be obligatory on the part of the Contractor. Any rectifications, modifications, or corrective actions required pursuant to such inspections shall be executed at the sole cost and responsibility of the contractor, without any additional financial liability on SAI and failure to comply with inspection observations or corrective measures may lead to penalties, withholding of payments, rejection of work, or termination of contract as deemed necessary by SAI.

**51.0 BORROW AREAS**

Thecontractorshallmakehisownarrangementsforborrowpitsandborrowdisposal areas including their approaches and space for movement of man, machinery, other equipment as required for carrying out the works. The contractor shall be responsible for taking all safety measures, getting approval, making payment of royalties, charges etc. and nothing extra shall be paid to the contractor on this account and rates quoted by the contractor for various items of bill of quantities shall deemed to include the same.

**52.0 BITUMEN WORK**

Thecontractorshallcollectthetotalquantityoftarorbitumenrequiredforthework as per standard formula, before the work is started and shall hypothecateittotheEngineer-In-Charge.Althoughthematerialsarehypothecated to SAI, the Contractor undertakes the responsibility for their proper watch, safe custody and protection against all risks. The materials shall not be removed from site of work without the consent of the Engineer-In-Charge inwriting.

**53.0 CARE OF WORKS**

From the commencement to the completion of works and handing over, the contractor shall take full responsibility for care thereof all the works and in case of anydamage/losstotheworksortoanyparttthereofortoanytemporaryworksdue to lack of precautions or due to negligence on part of Contractor, the same shall be made good by the Contractor.

**54.0 WORK IN MONSOON AND DEWATERING**

The execution of the work may entail working in the monsoon also. The contractor mustmaintainlabourforceasmayberequiredforthejobandplanandexecutethe construction and erection according to the prescribed schedule. No special/ extra rate will be considered for such work in monsoon. The contractor's rate shall be considered inclusive of cost of dewatering required if any and no extra rates shall be payable on this account.

**55.0 NO COMPENSATION FOR CANCELLATION/ REDUCTION OF WORKS**

If at any time after the commencement of the work SAI shall for any reason what so ever is required to abandon the work or is not required the whole work there of as specified in the tender to be carried out, the Engineer-In-Charge shall given notice in writing of the fact to the contractor, who shall have no claim to any payment of compensation whatsoever on account of any profit or advantage which he might have derived from the execution of the work in full, but which he did not derive in consequence of the full amount of the work not having been carried out or fore- closure, neither shall he have any claim for compensation by reason of any alterations having been made in the original specifications, drawings, designs and instructions

which shall involve any curtailment of the work as originally contemplated. Provided that the contractor shall be paid the charges on the cartage only of materials actually and bon-A-fide brought to the site of the work by the contractor and rendered surplus as a result of the abandonment or curtailment of the work or any portion there of and then taken back by the contractor, provided however, that the Engineer-In-Charge shall have in all such cases the option of taking over all or any such materials at their purchase price or at local current rates whichever may be less. In the case of such stores having been issued by SAI and returned by the Contractor to SAI, credit will be given to him by the Engineer-In- Charge at rates not exceeding those at which they were originally issued to him after taking into consideration any deduction for claims on account of any deterioration or damage while in the custody of the contractor and in this respect the decision of the Engineer-In-Charge shall be final.

**56.0 RESTRICTION ON SUBLETTING**

The contractor shall not sublet or assign the whole or part of the works except where otherwise provided, by the contract and even then only with the prior written consent of SAI and such consent if given shall not relieve the contractor from any liability or obligation under the contract and he shall be responsible for the acts, defaults or neglects of any sub-contractor, his agents, servants or workman as full as if they were the acts, defaults or neglects of the contractor, his agent, servants or workman
provided always that the provision of labour on piece work basis shall not be deemed to be a subletting under this clause. The contractor may entrust specialized items of works to the agencies specialized in the specific trade. The contractor shall give the names and details of such firm whom it is going to employ for approval of SAI. These details shall include the expertise, financial status, technical manpower, equipment, and resources and list of works executed and on hand of the specialist agency.

**57.0 PROHIBITION OF UNAUTHORISED CONSTRUCTION & OCCUPATION**

The contractor shall not erect, construct, or install any unauthorized buildings, structures, temporary shelters, or any other installations anywhere within the project site without prior written approval from SAI. No building, structure, or facility constructed by the contractor shall be occupied, used, or retained by the contractor, its employees, workers, or sub-contractors beyond the permitted scope and duration of the contract. In case of any unauthorized construction or occupation, SAI reserves the right to:

A. Remove/Demolish such unauthorized structures at the contractor's cost and risk.
B. Levy penalties or withhold payments until compliance is ensured.
C. Initiate legal proceedings or terminate the contract for repeated violations.

~~Upon completion of the contract, the contractor shall ensure that the project site is cleared of all temporary~~ structures,

debris, and unauthorized constructions and restored to its original condition as per SAI's instructions.

**58.0 CO-ORDINATION WITH OTHER AGENCIES**

Work shall be carried out in such a manner that the work of other Agencies operating at the site is not hampered due to any action of the Contractor. Proper co-ordination with other Agencies will be Contractor's responsibility. In case of any dispute, the decision of SAI shall be final and binding on the contractor .No claim whatsoever shall be admissible on this account.

**59.0 SETTING OUT OF THE WORKS**

The contractor shall be responsible for the true and proper setting out of the works and for the correctness of the position, levels, dimensions and alignment of all parts of the works. If at any time during the progress of works, shall any error appear or arise in the position, levels, dimensions or alignment of any part of the works, the contractor shall at his own expenses rectify such error to the satisfaction of Engineer- In-Charge. The checking of any setting out or of any line or level by the engineers of SAI shall not in any way relieve the contractor of his responsibility for the correctness.

**60.0 NOTICE BEFORE COVERING UP THE WORK**

The contractor shall give not less than seven days' notice before covering up or otherwise placing beyond the reach of measurement any work, to the Engineer-In- Charge in order that the same may be inspected and measured. If any work is covered up or placed beyond there ach of inspection/measurement without such notice or his consent being obtained the same shall be uncovered at the contractor's expenses and he shall have to make it good at his own expenses.

**61.0 SITE CLEARANCE**

The contractor shall ensure that the working site is kept clean and free of obstructions for easy access to job site and also from safety point of view. Before handing over the work to SAI, the contractor shall remove all temporary structures like the site offices, cement godown, stores, labour hutments etc., scaffolding rubbish, leftover materials tools and plants, equipmentetc.,cleanand grade the site to the entire satisfaction of the Engineer-In-Charge. If this is not done the same will be got done by SAI at his risk and cost.

The contractor shall clean all floors, remove cement/lime/paint drops and deposits, clean joinery, glass panes etc., touching all painter's works and carry out all other necessary items of works to make the premises clean and tidy before handing over the building, and the Percentage/ Item Rates quoted by the contractor shall be deemed to have included the same.

**62.0 VALUABLE ARTICLES FOUND AT SITE**

All gold, silver and other minerals of any description and all precious stones, coins, treasure, relics, antiques and all other similar things which shall befound in, under or upon the site, shall be the property of the Owner/ Government and the contractor shall duly preserve the same to the satisfaction of Engineer-In-Charge and shall from time to time deliver the same to such person or persons indicated by SAI.

**63.0 MATERIALS OBTAINED FROM DISMANTLEMENT TO BE OWNER'S PROPERTY**

All materials like stone, boulders and other materials obtained in the work of dismantling, excavation etc. will be considered owner/ government property and may be is sued to the contractor by theowner/SAI, If required for use in this work atratesapprovedbySAIorthecontractormaybeaskedtodisposetheseitems at his cost.

**64.0 SET-OFF OF CONTRACTOR'S LIABILITIES**

SAI shall have the right to deduct or set off the expenses incurred or likely to be incurred by it in rectifying the defects and/or

any claim under this agreement against the Contractor from any or against any amount payable to the contractor under this agreement including Security Deposit and proceeds of Performance Guarantee.

**65.0 MATERIALS PROCURED WITH THE ASSISTANCE OF SAI**

If any material for the execution of this contract is procured with the assistance of SAI either by issue from its stores or purchase made under orders or permits or licenses obtained by SAI, the contractor shall hold and use Said materials economically and solely for the purpose of this contract and shall not dispose them without the permission of Engineer-In-Charge. The contractor, if required by SAI, shall return all such surplus or unserviceable materials that may be left with himafterthecompletionofthecontractoratitsterminationonwhatsoeverreason, on being paid or credited such price as SAI shall determine having due regard to the conditions of materials.

**66.0 ACTION AND COMPENSATION PAYABLE IN CASE OF BAD WORK**

If it shall appear to the Engineer-In-Charge or his authorized subordinate in charge of the work or to the Chief Technical Examiner or to any other inspecting agency of Government/ State Government/ SAI where the work is being executed, that any work has been executed with unsound, imperfect, or unskillful workmanship or with materials of any inferior description, or that any materials or articles provided by him for the execution of the work are unsound or of a quality inferior to that contracted for or otherwise not in accordance with the contract, the contractor shall on demand in writing which shall be made within one year of the completion of the work from the Engineer-In-Charge specifying the work, materials or articles complained of not with standing that the same may have been passed, certified and paid for forthwith rectify, or remove and reconstruct the work so specified in whole or in part as the case may require or as the case may be, remove the materials or articlessospecifiedandprovideotherproperandsuitablematerialsorarticlesathis own proper charge and cost, and in the event of his failing to do so within a period to be specified by the Engineer-In-Charge in his demand a foresaid,, the Engineer-In-Charge may rectify or remove and re-execute the work or remove and replace with others, the material or articles complained of as the case may be at the risk and expense in all respects of the contractor.

**67.0 POSSESSION PRIOR TO COMPLETION**

67.1 SAI shall have the right to take possession of or use any completed or partially completed work or part of the work. Such possession or use shall not be deemed to be any acceptance of any work not completed in accordance with the contract agreement.

If such prior possession or use by SAI delays the progress of work an equitable adjustment in the time of completion will be made and the contract agreement shall be deemed to be modified accordingly. The decision of SAI in this cases hall be final binding and conclusive.

67.2 When the whole of the works or the items or the groups of items of work for which separate periods of completion have been specified have been completed the contractor will give a notice to that effect to the Engineer-In-Charge in writing. The Engineer-In-Charge shall within 7 days of the date of receipt of such notice inspect the works and either the Engineer-In-Charge issues to the contractor a completion certificate stating the date on which in his opinion the works were completed in accordance with the contract or gives instructions in writing to the contractor specifying the balance items of work which are required to be done by the contractor before completion certificate could be issued. The Engineer-In-Charge shall also notify the contractor of any defect in the works affecting completion.

67.3 The contractor shall during the course of execution prepare and keep updated a complete set of 'as built' drawings to show each and every change from the contract drawings, changes recorded shall be countersigned by the Engineer-In-Charge and the contractor. Four copies of 'as built' drawings shall be supplied to SAI by the contractor within 30 days of the completion. All costs incurred in this respect shall be borne by the contractor only.

**68.0 COMPENSATION FOR DELAY AND REMEDIES**

68.1 If the contractor fails to maintain the required progress in terms of relevant clause of this contract to complete the work and clear the site on or before the contract or extended date of completion, he shall, without prejudice to any other right or remedy available under the law to SAI on account of such breach, pay as agreed compensation as per Clause 2 of CPWD-EPC Contract Manual shall be applicable.

68.2 Compensation for delay in completion of work shall be levied at the rate of **below milestone of the tendered value**, subject to a maximum of **5% of the tendered value** of the work or of the item/group of items for which a separate completion period was originally specified.

| Sr. No. | Description of Milestone (Physical) | Time allowed in days (From Date to Start) | Amount to be withheld in case of Non Achievement of Milestone |
|---|---|---|---|
| 1. | Work done amounting to 8% of accepted tender amount (Civil+Electrical/ Mechanical) | 3 Months | 0.8 % of the Accepted tendered value. |
| 2. | Work done amounting to 20% of accepted tender amount (Civil+Electrical/ Mechanical) | 6 Months | 0.8 % of the Accepted tendered value. |
| 3. | Work done amounting to 40% of accepted tender amount (Civil+Electrical/Mechanical) | 9 Months | 0.8 % of the Accepted tendered value. |
| 4. | Work done amounting to 70% of accepted tender amount (Civil+Electrical/Mechanical) | 12 Months | 0.8 % of the Accepted tendered value. |
| 5. | Work done amounting to 90% of accepted tender amount (Civil+Electrical/Mechanical) | 15 Months | 0.8 % of the Accepted tendered value. |
| 6. | All Civil, Electrical & Mechanical work complete in all respect, obtaining NOC from Fire dept.& occupancy certificate from local bodies. (100% complete in all respect) | 18 Months | 1.0 % of the Accepted tendered value. |

Note: -

1. With held amount shall be released if and when subsequent milestone is achieved within respective time specified. However, in case milestones are not achieved by the Bidder for the work, the amount shown against milestone shall be withheld.
2. Even though the above milestones are specified based on financial progress of the work commensurate Physical progress should also be achieved.

Monthly recovery for delay in submission of the monthly progress report within specified period - not exceeding Rs. 10000/- per month for each month default.

68.3 Requirement of Technical Representative(s) and Recovery Rate

The Contractor shall deploy the following personnel on a full-time basis at the designated site for the duration of the contract:

| Sr. No. | Min Qualification of Technical Representative | Discipline | Designation | Min Experience | Number | Rates at which Recovery shall be made from the contractor in the event of not fulfilling provisionof Clause68.3 | |
|---|---|---|---|---|---|---|---|
| | | | | | | Figures | Words |
| 1. | B.Tech | Civil Engineering | Project manager | Min 10 Years of Experience in the Similar Works | 01 | 150000 Per Month | One Lac Fifity Thousand per Month |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2. | B.Tech | Civil Engineer | Site Engineer | Min 08 Years of Experience in the Similar Works | 02 | 100000 Per Month | One Lac Per Month |
| 3. | B.Tech | Electrical / Mechanical Engineer | Site Engineer (MEP) | Min 08 Years of Experience in the Similar Works | 02 | 100000 Per Month | One Lac Per Month |
| 4. | B.Tech | Civil Engineer | QA/QC Engineer | Min 05 Years of Experience in the Similar Works | 01 | 75000 Per Month | Seventy Five Thousand per Month |
| 5. | B.Tech | Civil Engineer | Planning &Billing Engineer | Min 05 Years of Experience in the Similar Works | 01 | 75000 Per Month | Seventy Five Thousand per Month |
| 7. | EHSExpert | SafetyCertificate | HSE | Min 05 Years of Experience in the Similar Works | 01 | 75000 Per Month | Seventy Five Thousand per Month |

Failure to deploy any of the above-mentioned resources as per the agreed schedule will result in a monthly deduction from the Contractor's payment. The deduction amount shall be calculated on a per-resource basis.

68.4 CANCELLATION/DETERMINATIONOFCONTRACTINFULLORPART

Subject to other provisions contained in this clause the Engineer-In-Charge may, without prejudicetohisanyotherrightsorremedyagainstthecontractorinrespect of any delay, inferior workmanship, any claims for damages and / or any other provisions of this contract or otherwise, and whether the date of completion has or has not elapsed, by notice in writing absolutely determine the contract in any of the following cases:

i) If the contractor having been given by the Engineer-In-Charge a notice in writing to rectify, reconstruct or replace any defective work or that the work is being performed in an inefficient or otherwise improper or un-workmanlike manner shall omit to comply with the requirement of such notice for a period of seven days thereafter: or

ii) If the contractor has, without reasonable cause, suspended the progress of the work or has failed to proceed with the work with due diligence so that in the opinion of the Engineer-In-Charge (which shall be final and binding) he will be unable to secure completion of the work by the date for completion and continues to do so after a notice inwriting of seven days from the Engineer-In-Charge; or

iii) If the contractor fails to complete the work within the stipulated date or items of work with individual date of completion, if any stipulated, on or before suchdate(s) of completion and does not complete them within the period specified in a notice given in writing in that behalf by the Engineer-In-Charge; or

iv) If the contractor persistently neglects to carry out his obligations under the contract and / or commits default in complying with any of the terms and conditions of the contract and does not remedy it or take effective steps to remedy it within 7 days after a notice in writing is given to him in that behalf by the Engineer-In-Charge: or

v) If the contractor shall offer or give or agree to give to any person in SAI service or to any other person on his behalf any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any action in relation to the obtaining or execution of this or any other contract from SAI; or

vi) If the contractor shall obtain a contract with SAI as are result of wrong tendering or other non-bona-fide methods of competitive tendering; or

vii) If the contractor being an individual, or if a firm, any partner there of shall at any time be adjudged insolvent or have a receiving order or order for administrative of his estate made against him or shall take any proceedings for liquidation or composition(otherthanavoluntaryliquidationforthepurposeofamalgamationor reconstruction) under any Insolvency Act for the time being in force or make any convey an cero assignment of his effect Sor composition or arrangement for the benefit of his credit or Sor purport so to do, or if any application be made under any Insolvency Act for the time being in force for the sequestration of his estate or if a trust deed be executed by him for benefit of his creditors; or

viii) If the contractor being a company, shall pass are solution or the Court shall make an order for the winding up of the company, or are ceiver or manager on behalf of the debenture holders or otherwise shall be appointed or circumstances shall arise which entitle the Court or debenture holders to appoint are ceiver or manager; or

ix) If the contractor shall suffer an execution being levied on his goods and allow it to be continued for a period of 21 days; or

x) If the contractor assigns, transfers, sublets (engagement of labour on a piece- work basis or of the labour with materials not to be incorporated in the work, shall not be deemed to be subletting) or otherwise parts with or attempts to assign, transfer, sublet or otherwise parts with the entire works or any portion thereof without and prior written approval of the Engineer-In-Charge. Or:

xi) If the Contractor submit non-genuine and invalid or fraudulent/ forge documents, Bank Guarantee etc. to SAI.

xii) When the contractor has made himself liable for action under any of the cases aforesaid, the Engineer-In-Charge may without prejudice to any other right or remedy which shall have accrued or shall accrue here after to SAI, by a notice in writing, cancel the contract as a whole or only such items of working default from the Contract.

The Engineer-In-Charge shall on such cancellation by SAI have powers to:

a) Take possession of site and any materials, constructional plant, implements, stores, etc. thereon; and/ or

b) Carry out the incomplete work by any means at the risk and cost of the contractor; and/ or

c) To determine or rescind the contract as a foresaid (of which termination or rescission notice in writing to the contractor under the hand of the Engineer-In-Charge shall be conclusive evidence).Upon such determination or rescission, the full security deposit recoverable under the contract shall beliable to be forfeit demand un-used materials , construction plants, implements, temporary buildings, etc. shall be taken over and shall be absolutely at the disposal of SAI. If any portion of the Security Deposit has not been paid or received it would be called for and forfeited; and/or

d) To employ labour paid by the Department and to supply materials to carry out the work or any part of the work debiting the contractor with the cost of the labour and the price of the materials (of the amount of which cost and price certified by the Engineer-In-Charge shall be final and conclusive) against the contractor and crediting him with the value of the work done in all respects in the same manner and at the same rates as if it had been carried out by the contractor under the terms of his contract. The certificate of the Engineer-In-Charge as to the value of the work done shall be final and conclusive against the contractor provided always that action under the sub-clause shall only be taken after giving notice in writing to the contractor. Provided also that if the expenses incurred by the department are less than the amount payable to the contractor at his agreement rates, the difference shall not be paid to the contractor; and/ or

e) After giving notice to the contractor to measure up the work of the contractor and to take such whole, or the balance or part thereof as shall be un-executed or delayed with reference to the General Conditions of Contract Clause / relevant

clause of Special Conditions of Contract, out of his hands and to give it to another contractor to complete in which case any expenses which may be incurred in excess of the sum which would have been paid to the original contractor if the whole work had been executed by him (of the amount of which excess the certificate in writing of the Engineer-In-Charge shall befinal and conclusive) shall be borne and paid by the original contractor and may be deducted from any money due to him by SAIunder his contractor on any other account whatsoever from his security deposit or the proceeds of sales of unused materials, construction plants, implements temporary buildings etc. thereof or a sufficient part thereof as the case maybe. If the expenses incurred by SAI are less than the amount pay able to the contractor at his agreement rates, the difference shall not be paid to the contractor; and/ or

f) By a notice in writing to withdraw from the contractor any items or items of work as the Engineer-In-Charge may determine in his absolute discretion and get the same executed at the risk and cost of the contractor.

Any excess expenditure incurred Orto be incurred by SAI incompleting the works or part of the works or the excess loss or damages suffered or may be suffered by SAI as a fore said after allowing such credit shall without prejudice to any

other right to remedy available to SAI in law be recovered from any money due to the contractor on any account such as Performance Guarantee, Security Deposit, invoices or any other dues, and if such moneys are not sufficient the contractor shall becalled upon in writing and shall be liable to pay the same within 30 days.

If the contractor shall fail to pay the required sum within the aforesaid period of 30 days,the Engineer-In-Charge shall have the right to sell any or all of the contractor's unused materials, constructional plant, implements, temporary buildings, etc. and apply the proceeds of sale thereof towards the satisfaction of any sums due from the contractor under the contract and if thereafter there be any balance outstanding from the contractor, it shall be recovered in accordance with the provisions of the contract and law.

Any sums in excess of the amounts due to SAI and unsold materials, constructional plant etc. shall be returned to the contractor, provided always that if cost or anticipated cost of completion by SAI of the works or part of the works is less than the amount which the contractor would have been paid had he completed the works or part of the works, such benefit shall not accrue to the contractor.

In the event of anyone or more of the above courses being adopted by the Engineer-In-Charge the contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any materials or entered into any engagements or made any advances on account or with a view to the execution of the work or the performance of the contract. And incase action is taken under any of the provision aforesaid the contractor shall not be entitled to recover or be paid any sum for any work thereof or actually performed under this contract unless and until the Engineer-In-Charge has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified. Provided further that if any of the recoveries to be made, while taking action as per (d) and/or (e) above, are in excess of the security deposit forfeited, these shall be limited to the amount by which the excess cost incurred by the Department exceeds the security deposit so forfeited.

68.5 CONTRACTOR LIABLE TO PAY COMPENSATION EVEN IF ACTION IS NOT TAKEN

In any case in which any of the powers conferred upon the Engineer-In-Charge by relevant clause thereof, shall have become exercisable and the same are not exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall not withstanding be exercisable in the event of any future case of default by the contractor and the liability of the contractor for compensation shall remain unaffected. In the event of the Engineer-In-Charge putting in force all or any of the powers vested in him under the preceding clause he may, if he so desires after giving a notice in writing to the contractor, take possession of (or at the sole discretion of the Engineer-In-Charge which

shall be final and binding on the contractor) use as on hire(the amount of the hire money being also in the final determination of the Engineer-In-Charge)all or any tools, plant, materials and stores, in or upon the works, or the site thereof belonging to the contractor, or procured by the contractor and intended to the used for the execution of the work / or any part thereof, paying or allowing for the same in account at the contract rates, or in the case of these not being applicable, at current market rates to be certified by the Engineer-In-Charge, whose certificate thereof shall be final, and binding on the contractor and/or direct the contractor or his authorized agent to remove such tools, plant, materials, or stores from the premises(within a time to be specified in such notice)in the event of the contractor failing

to comply with any such requisition, the Engineer-In-Charge may remove the contractor's expense or sell the material by auction or private sale on account of the contractor and his risk in all respects and the certificate of the Engineer-In-Charge as to the expenses of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the contractor.

68.6 TIME ESSENCE OF CONTRACT & EXTENSION FOR DELAY

The time allowed for execution of the Works as specified in the terms of contract or the extended time in accordance with these conditions shall be the essence of the contract.The execution of the works shall commence from the 10$^{th}$Day or such time period as mentioned in Letter of Intent/Award after the date on which the Engineer- In-Charge issues written orders to commence the work. If the Contractor commits default in commencing the execution of the work as aforesaid, the Executing Agency shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the earnest money absolutely.

68.7Within 10 (Ten) days of Letter of Intent, the Contractor shall submit a Time and Progress Chart (CPM/ PERT/ Quantified Bar Chart) along with quarterly milestones and resources plan for man, material & machinery to achieve the milestones and get it approved by the Engineer-In-Charge. The Chart shall be prepared in direct relation to the time stated in the contract documents for completion of items of the works. Its hall indicate the forecast(milestones)of the dates of commencement and completion of various items, trades, sections of the work and may be amended as necessary by agreement between the Engineer-In-Charge and the Contractor within the limitations of time stipulated in the contract documents, and further to ensure good progress during the execution of the work.

The compensation for delay shall be leviable at intermediate stages also, in case the required progress is not achieved to meet the above time deadlines of the completion period and/ or milestones of time and progress chart, provided always that the total amount of compensation for delay to be paid under this condition shall not exceed 10% of the tendered value of work".

If the work(s)be delayed by:

i) Force-majeure, or

ii) Abnormally bad weather, or

iii) Serious loss or damage by fire, or

iv) Civil commotion of workmen, strike or lockout, affecting any of the trades employed on the work, or

v) Delay on the part of other contractors or trades men engaged by Engineer-In-Charge in executing work not forming part of the Contract, or

vi) Non-availability or breakdown of tools and plant to be supplied or supplied by SAI or, any other cause which, in

the absolute discretion of SAI, is beyond the Contractor's control,

then upon the happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the Engineer-In-Charge but shall nevertheless use constantly his best endeavors to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the Engineer-In-Charge to proceed with the works.

Request for extension of time,to be eligiblefor consideration, shall be made by the contractor in writing within fourteen days of the happening of the event causing delay on the prescribed form.

The Contractor will indicate in such a request the period for which extension is desired. In any such case SAI may give a fair and reasonable extension of time for completion of work. Such extension shall be communicated to the Contractor by the Engineer-In-Charge in writing, within 3 months of the date of receipt of such request.

68.8 QUALITY ASSURANCE AND TESTING COMPLIANCE PENALTY

Failure to comply with the approved Quality Assurance and Quality Control (QA/QC) Plan, or failure to conduct mandatory tests as specified in the contract documents, technical specifications, or as directed by the Engineer-In-Charge, shall attract a penalty of ₹25,000 (Rupees Twenty-Five Thousand only) per instance of non-compliance. Repeated defaults may lead to suspension of work, withholding of payments, or any other remedial action deemed appropriate by SAI. The Engineer-In-Charge shall have the sole authority to determine the occurrence and severity of such defaults, and his decision shall be final and binding.

**69.0 WITHHOLDING AND LIEN IN RESPECT OF SUMS DUE FROM CONTRACTOR**

69.1 Whenever any claim or claims for payment of a sum of money arises out of order the contract against the contractor, SAI shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from the security, if any, deposited by the contractor and for the purpose aforesaid, SAI shall be entitled to with hold the security deposit, if any, furnished as the case may be and also have a lien over the same pending finalization or adjudication of any such claim. In the event of the security being in sufficient to cover the claimed amount or amounts or if no security has been taken from the contractor, SAI shall be entitled to withhold and have a lien to retain to the extent of such claimed amount or amounts referred to above, from any sum or sums found payable orwhich may at any time thereafter become payable to th econtractor under the same contractor any other contract with SAI pending finalization or adjudication of any such claim.

69.2 It is an agreed term of the contract that the sum of money or money so with held or retained under the lien referred to above by the Engineer-In-Charge or SAI will be kept with held or retained as such by the Engineer-In-Charge or SAI till the claim arising out of or under the contract is determined by the competent court and that the contractor will have no claim for interest or damages whatsoever on any account in respect of such with holding or retention under the lien referred to above and duly notified as such to the contractor. For the purpose of this clause, where the contractor is a partnership firm or a limited company, the Engineer-In-Charge or SAI shall be entitled to withhold and also have a lien to retain towards such claimed amount or amounts in whole or in part from any sum found pay able to any partner/limited company, as the case may be whether in his individual capacity or otherwise.SAI shall have the right to cause an audit and technical examination of the works and the final bills of the contractor including all supporting vouchers, abstract, etc., to be made after payment of the final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any workdonebythecontractorunderthecontractoranyworkclaimedtohavebeen done by him under the contract and found not to have been executed, the contractor shall be liable to refund the amount of over-payment and it shall be lawful

for SAI to recover the same from him in the manner prescribed in clauses above or in any other manner legally permissible; and if it is found that the contractorwaspaidlessthanwhatwasduetohimunderthecontractinrespectof anyworkexecutedbyhimunderit,theamountofsuchunderpaymentshallbeduly paid by SAI to the contractor,without any interest thereonwhatsoever.

69.3 LIEN INRESPECT OF CLAIMS IN OTHER CONTRACTS

Any sum of money due and payable to the contractor (including the security deposit returnable to him) under the contract may be withheld or retained by way of lien by the Engineer-In-Charge or by SAI against any claim of the Engineer-In- Charge or SAI in respect of payment of a sum of money arising out of or under any other contract made by the contractor with the Engineer-In-Charge or SAI. It is an agreed term of the contract that the sum of money so withheld or retained under this clause by the Engineer-In-Charge or SAI will be kept withheld or retained as such by the Engineer-In-Charge or SAI or till his claim arising out of the same contract or any other contract is either mutually settled or determined by the arbitration clause or by the competent court, as the case may be, and that the contractor shall have no claim for interest or damages whatsoever on this account or on any other ground in respect of any sum of money with held or retained under this clause and duly notified as such to the contractor.

**70.0DEFECTS LIABILITY PERIOD**

The contractor shall be responsible for the rectification of defects in the works for a period of **Thirty Six months** from the date of record of completion certificate of the works by SAI Contractor shall also be liable to attend all defects for works which possess warranty period more than 36 months..Anydefectsdiscoveredandbroughttothenoticeofthecontractorforthwith shall be attended to and rectified by him at his own cost and expense. In case the contractor fails to carry out these rectifications, the same may without prejudice to any other right or remedy available, be got rectified by SAI at the cost and expense of the contractor.

**71.0 FORCE MAJEURE**

For purposes of this Clause, “Force Majeure” means an event beyond the control of the Successful bidder and not involving the Successful bidder’s fault or negligence and not foreseeable. Such events may include, but are not limited to, acts done in sovereign or contractual capacity, wars or revolutions, fires, floods, epidemics, pandemics quarantine restrictions, lockdowns and freight embargoes. The Successful Bidder shall not be liable for imposition of any such sanction so long the delay and/or failure of the Successful Bidder in fulfilling its obligations under the contract is the result of an event of Force Majeure.

If a Force Majeure situation arises, the Successful Bidder shall promptly notify Engineering Division SAI, New Delhi in writing of such conditions and the cause thereof within 7 (seven) days of occurrence of such event. Unless otherwise directed by Engineering Division SAI, New Delhi in writing, the Successful Bidder shall continue to perform its obligations under the contract as far as reasonably practical and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.

If the performance in whole or in part or any obligation under this contract is prevented or delayed by any reason of Force Majeure for a period exceeding 60 (sixty) days, SAI may at its option terminate the contract without any financial repercussion on either side.

During the period of the Successful Bidder’s inability to perform the obligations under the Agreement as a result of an event of Force Majeure and timely intimation by the Bidder, SAI shall assess the situation and then decide the application of Force Majeure. Once the duration is defined under the Force Majeure category/ situation no payments are expected to be made by the Bidder.

In case due to a Force Majeure event SAI, New Delhi is unable to fulfil its contractual commitment and responsibility, SAI, New Delhi will notify the Successful Bidder accordingly.

During the period of their inability to perform the obligations under the Agreement as a result of an event of Force Majeure and timely intimation by the Bidder, SAI shall assess the situation and then decide the application of Force Majeure. Once the duration is defined under the Force Majeure category/ situation no payments are expected to be made by the Bidder.

**GOVERNING LAWS AND JURISDICTION**

This Contract, its meaning and interpretation, and the relation between the Parties shall be governed by the Laws of India for the time being in force. The agreement shall be executed at New Delhi on non-judicial stamp paper purchased in New Delhi and the Court (s) at New Delhi alone will have jurisdiction to deal with matters arising there from, to the exclusion of all other courts.

**72.0 Dispute Resolution Mechanism**

Any dispute, controversy or claims arising out of or relating to this Agreement or the breach, termination or invalidity thereof, shall be settled through following mechanism:

a) Firstly, the aggrieved party shall write a letter to the other party detailing its grievances and calling upon the other party to amicably resolve the dispute by convening a joint meeting. Accordingly, the parties as per their convenience shall jointly convenesaid meeting(s), wherein minutes of said meeting(s) shall be prepared and counter signed by all the parties. It is mandatory to prepare minutes of meeting(s) and to be countersigned by all the parties, irrespective of the outcome of said meeting(s).

b) In the event the parties are unable to reach on any settlement in said meeting(s), then the aggrieved party shall mandatory resort to pre-litigation mediation mechanism with Delhi High Court Mediation Cell, New Delhi.

c) If any difference or disputes arises under this RFP and/or the Agreement, as the case may be, which cannot otherwise be amicable resolved between the parties through Mediation, then such dispute shall be settled by way of arbitration and either Party shall be entitled to refer the dispute to Arbitration under Arbitration & Conciliation Act, 1996 or any statutory modifications or re-enactment thereof in force. The Arbitration shall be conducted before Arbitral Tribunal comprising of a sole arbitrator to be appointed with the mutual consent of the Parties or appointed by Hon'ble High Court of Delhi while deciding an application under Section 11 of the Act. The arbitration proceedings shall be conducted as per Arbitration and Conciliation Act, 1996, or any statutory modification or re-enactment then in effect.

d) The venue for arbitration shall be India International Arbitration Center, New Delhi in accordance with the D.O. No. A-60011/50/2023-ADR dated 05.04.2024 and the courts of New Delhi shall be vested with exclusive jurisdiction and the seat/venue of arbitration shall be at New Delhi and the language of arbitration proceedings and that of all documents and communications between the parties shall be English.

e) The arbitration award shall be final, and the judgment thereupon may be entered in the courts of competent jurisdiction or application may be made to such court for a judicial acceptance of the award and an order of enforcement, as the case may be.

f) Each party shall bear the cost of preparing and presenting its case and the cost of arbitration, including fees and expenses of the arbitrator shall be shared equally by both the parties unless the award otherwise provides. It is further agreed between the parties hereto that such arbitration proceedings shall be completed within a period of eight (8) calendar months from the date of reference.

g) The parties shall continue to perform their respective obligations under this contract during the pendency of the Arbitration proceedings except in so far as such obligations are the subject matter of Arbitration proceedings.

h) SAI shall have the right to bring an action seeking injunctive or other equitable relief before the courts at New Delhi, India if it reasonably believes that damages may not be an adequate remedy for any breach by the Bidder.

i) All disputes, differences, or claims arising out of or in connection with this contract shall be resolved through **fast-track arbitration** in accordance with the provisions of **Section 29B of the Arbitration and Conciliation Act, 1996**, as amended

from time to time.

**73.0 SUSPENSION OF WORKS**

(a) The contractor shall, on receipt of the order in writing of the Engineer-In-Charge, suspend the progress of the works or any part thereof for such time and in such manner as the Engineer-In-Charge may consider necessary for any of the following reasons:

i) On account of any default on part of the contractor, or

ii) For proper execution of the works or part there off or reason other than the default of the contractor, or

iii) For safety of the works or part thereof.

The contractor shall, during such suspension, properly protect and secure the work to the extent necessary and carry out the instructions given in that behalf by the Engineer-In-Charge.

(b) If the suspension is ordered for reasons(ii)and(iii)in sub-para(a)above.

i) The contractor shall be entitled to an extension of the time equal to the period of every such suspension plus25%. No adjustment of contract price will be allowed for reasons of such suspension.

ii) In the event of the Contractor treating the suspension as an abandonment of the Contract by SAI, he shall have no claim to payment of any compensation on account of any profit or advantage which he may have derived from the execution of the work in full.

**74.0 CLARIFICATION AFTER BID SUBMISSION**

Tenderers are strictly prohibited from directly or indirectly contacting SAI, its employees, or representatives by any means regarding any matter related to the bid during the period the bids are under evaluation. Any unauthorized communication or attempt to influence the evaluation process shall result in immediate disqualification of the bidder. If clarifications are required, SAI shall reach out to the bidder in writing or through an officially designated mode of communication. Any response by the bidder must be strictly in accordance with the format and timelines prescribed by SAI. The Tender Scrutiny Committee, duly constituted and authorized by SAI, shall be solely responsible for evaluating bids and processing the award of work, seeking clarifications from bidders, if necessary, in an official capacity, and ensuring transparency and adherence to tender norms. Any attempt by a bidder to influence the decision-making process, either directly or indirectly, may result in immediate rejection of the bid, blacklisting of the bidder from future tenders and forfeiture of Earnest Money Deposit (EMD), if applicable.

**75.0 ADDENDA/ CORRIGENDA**

Addenda/Corrigenda to the tender documents may be issued prior to the date of opening of the tender to clarify or effect modification in specification and/or contract terms included in various tender documents. The tenderer shall suitably take into consideration such Addenda/Corrigenda while submitting his tender. The tenderer shall return such Addenda/ Corrigenda duly signed and stamped as confirmation of its receipt and submit along with the tender document. All addenda/Corrigenda shall be signed and stamped on each page by the tenderer and shall become part of the tender and contract documents.

**76.0 QUALITY ASSURANCE PROGRAMME**

To ensure that the services under the scope of this contractor in accordance with the specifications, the Contractor shall

adopt Quality Assurance Programme to control such activities at the necessary points. The contractor shall prepare and finalisesuchQualityAssuranceProgrammewithin15daysfromletterofintent.SAI shall also carryout quality audit and quality surveillance of systems and procedures of Contractor's quality control activities. A Quality Assurance Programme of Contractor shall generally cover the following:

a) His organization structure for the management and implementation of the proposed Quality Assurance Program.

b) Documentation control system.

c) The procedure for purpose of materials and source inspection.

d) System for site controls including process controls.

e) Control of non-conforming items and systems for corrective actions.

f) Inspection and test procedure for site activities.

g) System for indication and appraisal of inspection status.

h) System for maintenance of records.

i) System for handling, storage and delivery.

j) A quality plan detailing out quality practices and procedures, relevant standards and acceptance levels for all types of work under the scope of this contract.

The Contractors in the formats appended hereto shall submit all the quality reports. Checklist enclosed here in this document shall be followed while carrying out Construction activities (items). If any item is not covered by the Checklist/ Formats appended hereto, the Format for the same may be developed and submitted to Engineer-In-Charge for approval and the same shall be adopted. These filled in formats shall be prepared in two copies and duly signed by representatives of contractor and SAI. All the costs associate with Printing of Format sand testing of materials required as per technical specifications or by Engineer-In-Charge shall be included in the Contractor's quoted rates in the Schedule/ Bill of quantities.

**77.0 APPROVAL OF TEMPORARY / ENABLING WORKS**

The setting and nature of all offices, huts, access road to the work areas and all other temporary works as may be required for the proper execution of the works shall be subject to the approval of the Engineer-In-Charge.

All the equipment, labour, material including cement, reinforcement and the structural steel required for the enabling/temporary works associated with the entire contract shall have to be arranged by the Contractor only. Nothing extra shall be paid to the Contractor on this account and the percentage/ item rates quoted by the Contractor for various items in the Bill of Quantities shall be deemed to include the cost of enabling works.

**78.0 CONTRACT COORDINATION PROCEDURES, COORDINATION MEETINGS AND PROGRESS REPORTING**

The Contractor shall prepare and finalize in consultation with SAI, a detailed contract coordination procedure within 15 days from the date of issue of Letter of Intent for the purpose of execution of the Contract.

TheContractorshallhavetoattendallthemeetingsatanyplaceinIndiaathisown cost with SAI, Owners/ Clients or Consultants of SAI/ Owner/ Client during the currency of the Contract, as and when required and fully cooperate with such persons and agencies involved during these discussions. The Contractor shall not deal in any way directly with consultants of SAI and any dealing/ correspondence if required at any time with SAI/ Consultants shall be through SAI only.

During the execution of the work, Contractor shall submit a this own costa detailed Monthly Progress Report to the Engineer-In-Charge of SAI by 5th of every month. The format of monthly progress report shall be as approved by Engineer-In-Charge of SAI.

**79.0 CONTRACT AGREEMENT**

The Contractor shall execute and enter into a formal Contract/Agreement with the Sports Authority of India (SAI) within twenty (20) days from the date of receipt of the Letter of Intent or within such extended period as may be granted at the sole discretion of SAI. The cost of stamp papers, stamp duty, registration charges, or any other applicable expenses related to the execution of the contract shall be borne exclusively by the Contractor. In the event that the Contractor fails to sign the agreement within the stipulated period or any extended period as granted by SAI, or fails to commence the work within ten (10) days from the date of receipt of the Letter of Intent, SAI shall have the absolute right to forfeit the Earnest Money Deposit (EMD) submitted by the Contractor, and the Letter of Intent shall stand withdrawn without any further notice or liability on the part of SAI.

**80.0 MANNER OF EXECUTION OF AGREEMENT**

i. The contract agreement as per prescribed Proforma as enclosed to the tender documents shall be signed at the office of SAI within 20days from the date of receipt of Letter of Intent. The Contractor shall produce for signing of the Contract, appropriate Power of Attorney and the requisite documents/materials. Unless and until a formal contract is prepared and executed, the Letter of Intent, Letter of award read in conjunction with the Bidding Documents will constitute a binding contract.

ii. The agreement will be signed in two originals and the Contractor shall be provided with one signed original and the other signed original will be retained by SAI. Contractor has to provide 02(two)numbers of non-judicial stamp papers of requisite value (minimum Rs. 100) purchased from New Delhi.

iii. The cost of agreement between the parties shall be borne by the contractor.

**81.0 PURCHASE PREFERENCE TO PUBLIC SECTOR ENTERPRISES**

SAI reserves its right to extend Purchase Preference to Central Public Sector Enterprises ( CPSEs)as per policy of Government of India, if any, as applicable on this work. The tenderers are requested to go through latest instructions of Government of India on its preference policy for CPSU's before quoting for the tender.

**82.0 CHANGE IN FIRM'S CONSTITUTION TO BE INTIMATED**

Where the contractor is a partnership firm, the previous approval in writing of the Engineer-In-Charge shall be obtained before any change is made in the constitution of the firm. Where the contractor is an individual or a Hindu Undivided Family business concern such approval as aforesaid shall likewise be obtained before the contractor enters into any partnership agreement whereunder the partnership firm would have the right to carry out the works here by undertaken by the contractor. If previous approval as aforesaid is not obtained, the contract shall be deemed to have been assigned in contravention of the agreement hereof and SAI shall be entitled to take action.

**83.0 CORRUPT OR FRAUDULENT PRACTICE AND BLACKLISTING**

SAI mandates that all bidders, successful bidders, and stakeholders involved in the procurement and execution of

contracts adhere to the highest standards of ethics. In pursuance of this policy, SAI reserves the right to reject any proposal for award if it determines that the bidder recommended for award has engaged in corrupt, fraudulent, collusive, or coercive practices during the bidding process. Furthermore, SAI may declare a firm ineligible or blacklist it either indefinitely or for a specified period if it is found at any time to have engaged in such malpractices or exhibited gross or deliberate negligence in competing for or executing the contract.

For the purposes of this clause:

(a) "Corrupt practice" includes the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the actions of any person connected with the selection process. This also includes offering employment or engaging, directly or indirectly, any official of SAI who has been associated with the selection process, the Letter of Award (LoA), or any matters arising therefrom, within one year from the date of resignation, retirement, or cessation of service from SAI. Engaging, during or after the selection process, any person who has served as a legal, financial, or technical advisor to SAI concerning the Request for Proposal (RFP) shall also be deemed as corrupt practice.

(b) "Fraudulent practice" refers to any misrepresentation, omission, suppression, or incomplete disclosure of facts intended to influence the selection process.

(c) "Coercive practice" includes harming, threatening to harm, or impairing any person or property, directly or indirectly, to influence any participant's action or decision in the selection process.

(d) "Undesirable practice" includes establishing contact with any person connected with SAI to canvass, lobby, or influence the selection process, or engaging in activities that lead to a conflict of interest.

(e) "Restrictive practice" refers to forming cartels, arriving at arrangements, or engaging in any conduct that manipulates or restricts fair competition in the selection process.

SAI reserves the absolute and unequivocal right to terminate the contract, without prejudice to any other legal or contractual remedies available, if it is discovered at any stage that the contract was obtained through misrepresentation, concealment, or suppression of material facts, or through the submission of forged documents, false measurements, or engagement in fraudulent, corrupt, or collusive practices by the contractor.

In such an event:

- All bid security, performance guarantees, and other securities submitted by the contractor shall stand **forfeited** without any further notice.
- SAI shall initiate appropriate **legal and administrative action** against the contractor, which may include:
    - **Immediate termination** of the contract.
    - **Blacklisting** of the contractor from participating in any future tenders issued by SAI for a period of **Three (3) years**;
    - **Recovery of losses**, damages, or excess expenditure incurred by SAI due to such misconduct, from any dues payable to the contractor under this or any other contract.

The decision of SAI in this regard shall be final, binding, and conclusive.

## 13.SPECIAL CONDITIONS OF CONTRACT (SCC)

**GENERAL**

ThefollowingspecialconditionsshallbereadinconjunctionwithGeneralConditions of Contract, if there are any provisions in these Special Conditions, which are at variance with the provisions of General Conditions of Contract, the provisions in these Special Conditions shall prevail.

(1) The work in general shall be carried out as per CPWD specification updated with correction slips issued up to last date of submission of tender.

(2) For items not covered under CPWD specification, as above, the work shall be done as per latest relevant ISI /BIS Codes of practice.

**13.0 LETTEROFUNDERTAKING**

The tender shall be accompanied by Letter of Acceptance of tender conditions as per proforma given in this tender document.

**14.0** Any tender not accompanied by Letter of Acceptance in accordance with said provision of Notice Inviting Tender and Instructions to Tenderer shall be rejected.

**15.0** Once the Tenderer has given an unconditional acceptance to the tender conditions in its entirety, he is not permitted to put any remark(s)/ conditions(s)(except unconditional rebate on price, if any)in/along with the tender.

**16.0 SITE VISIT AND COLLECTING LOCAL INFORMATION**

Before tendering, the tenderer is advised to visit the site, its surrounding, access and satisfy themselves about the local conditions such as approach roads to the site, availability of water & power supply, application of taxes, duties and levies as applicable, nature of ground, soil and sub-soil condition, underground water table level, accommodations they may require, river regime, river water levels, other details of river, streams & any other relevant information required by them to execute complete scope of work. The tenderer may obtain all necessary information as to risks, contingencies & other circumstances (insurgencies etc.) which may influence or affect their tender. Tenderer shall be deemed to have considered site conditions whether he has inspected it or not and to have satisfied himself in all respect before quoting his rates and no claim or extra charges whatsoever in this regard shall be entertained / payable by SAI at a later date.

**17.0 GST & TURNOVER TAX ETC.:**

**As per GCC conditions**

**18.0 TRANSFER OF BID DOCUMENTS**

Transfer of bid documents purchased by one intending bidder to another is not permissible.

**19.0** SAI reserves the right to award the work to a single party or to split the work amongst two or more parties as deemed necessary without assigning any reason whatsoever.

**20.0 PRICEEscalation Adjustment**

10CC clause of GCC EPC 2024 CPWD shall be applicable for price escalation.

**21.0** The rates and prices to be tendered in the price schedule is for completed and finished items of works and complete in all respects. It will be deemed to include all constructional plant, labour, supervision, materials, transport, all temporary works, erection, maintenance, contractor's profit and establishment/ overheads,together with preparation of designs drawings pertaining to casting yard (if required). Staging from work, stacking yard, etc., all general risk, taxes, GST, royalty, duties, cess, octroi and other levies, insurance liabilities and obligations set out or implied in the tender documents and contract.

**22.0** The materials products used on the works shall be one of the approved makes/brands out of list of manufacturers / brands /makes given in the tender documents. The contractor shall submit samples/specimens out of approved makes of materials / products to the Engineer-In-Charge for prior approval. In exceptional circumstances Engineer-In-Charge may allow alternate equivalent makes / brands of products / materials at his sole discretion. The final choice of brand / make shall remain with the Engineer-In-Charge, whose decision in the matter shall be final and bindingand nothing extra on this account shall be payable to the contractor.

Incase single brand/make are mentioned, other equivalent makes brands maybe considered by the Engineer-In-Charge with prior approval. In case of variance in CPWD's specification from approved products makes specification, the specification of approved products make shall prevail for which nothing shall be paid extra to the contractor.

**23.0** Within10(Ten)days of issuance of Letter of Intent, the Contractor shall submit a Time and Progress Chart (CPM/ PERT/ Quantified Bar Chart) along with monthly milestones and resources plan for man, material & machinery to achieve the milestones and get it approved by the Engineer-In-Charge. The chart shall be prepared in direct relation to the time stated in the contract documents for completion of item of the works. It shall indicate the forecast (milestones) of the dates of commencement and completion of various items, trades, sections of the work and may be amended as necessary by agreement between the Engineer-In-Charge and the Contractor within the limitations of time stipulated in the Contract documents, and further to ensure good progress during the execution of the work.

**24.0** Thecontractorifrequiredshalldemolisholdstructuresontheproposedsiteproperly. The useful material shall be the property of the Owner/ SAI and these materials shall be stacked in workmanship like at the place specified by the Engineer-In- Charge.

**25.0** The contractor shall provide safety equipment and gadgets to all their workers, supervisors and technical staff engaged in the execution of the work while working. The equipment and gadgets shall also be provided to SAI by the contractor at his own cost for use of SAI officials and /or workforce.

The cost of the above equipment/gadgets shall be included in the rates quoted by the contractor for the items & works as per Bill of Quantities and contractors hall not been titled for any extra cost in this regard. The above norm is to be strictly complied with at site. In case the contractor is found to be deficient in providing safety equipment/gadgets in opinion of Engineer-In-Charge, the Engineer-In-Charge at his option can procure the same at the risk & cost of contractor and provide the same for the use at work site and shall make the recoveries from the bills of the contractor for the same. The decision of the Engineer-In-Charge shall be final and binding on contractor in this regard.

**26.0** The tenderer shall quote his rates inclusive of all taxes, GST, turn overtax/sales tax on works and Labour Cess payable to Central/ State Government along with other taxes, duties, levies etc. in conjunction with other terms and conditions.

**27.0** If required, the contractor has to do site clearance, enabling work, barricading, shifting/realignment of existing utility service set at his own cost and the contractor shall not be entitled for any extra payment what so ever in this regard.

**28.0** In case of any sort of anomalies and/or typing error in the nomenclature, rates & description etc. of the items indicated in the Price Bid / BOQ of scheduled items must be read as per respective schedule such as DSR-latest

**29.0** The agency will start work after 10 days of receiving the Letter of Intent from SAI through email or post.

**30.0** Contractor has to submit a Construction Programme within 10 days of issue of Letter of Intent. Contractor has to make provision for double shift, to complete the workin the stipulated time with lighting arrangement for nightshift.

**31.0** Unless otherwise provided in the schedule of quantity, rates tendered by the contractor shall be all inclusive and shall apply to all heights, lifts, leads, & depths of the building and nothing extra shall be paid to him on his account.

**32.0** All drawings shall at all times be properly correlated before executing any work. However, in case of any discrepancy in the item given in the scope of work/ schedule of the quantities appended with the tender and architectural drawings relating to relevant item, the former shall prevail unless and other wise given in writing by the Engineer-In-Charge.

**33.0** The contractor shall be required to produce samples of all building materials and fittings sufficiently in advance to obtain approval of the Engineer-In-Charge.

**34.0** The contractor shall comply with proper and legal orders and directions of the local or public authority or municipality and abide by their rules and regulations and pay all fees and charges which he may be liable.

**35.0** The rate of all items in which use of cement is involved inclusive of all charges for curing.

**36.0** MODEOFPAYMENT

**As per GCC Clause 44**, Contractor shall raise his invoice as per the billing milestone schedule . The payment will be made based on physical verification on completion of the milestone. Final Bill will be generated after the completion of the work (To be certified by the Engineer in charge)

**37.0** The amount quoted by the contractor shall be deemed to be inclusive of all taxes as per the laws applicable in the State/Central Government

**38.0** The contractor shall obtain all the statutory clearance / permission / licenses on behalf of SAI from different Government and civic bodies for implementation of the project.

**39.0** ThecontractorshallsubmittoSAImonthlyreportindicatingphysicalandfinancial progress by 5$^{th}$ of every month.

**40.0** The contractor shall confirm that the activities proposed under the project shall conform to all Environmental Legislations, any judicial orders in force at the site of work including the Environment and Social Safeguard measures as per the NGRBA framework.

**41.0** The contractors hall obtain the required statutory approval on behalf/in the name of SAI (if applicable).

**42.0** It shall be responsibility of the contractor to submit the 3sets of completion drawings, service drawings etc. to SAI after completion of work with the consultation of engaged architect by SAI.

**43.0** The contractor shall be responsible for obtaining connections of water, sewerage and electricity from the concerned authority to ensure their proper commissioning so that no defects in operation of connections exist, by carrying out necessary tests etc.SAI will render requisite assistance in making application etc. for the purpose.

**44.0** Operation and Maintenance (O&M) Manual shall be part of construction contracts and to be provided by the contractor wherever required.

**45.0** The contractor shall not beat liberty to release any news, information, advertisement, and propaganda etc., regarding this AGREEMENT to the Press or any other broadcasting media, except with the prior written APPROVAL from SAI.

**46.0** The contractor and their personnel shall not, either during the term or after expiration of the AGREEMENT, disclose any proprietary or confidential information relating to the network, AGREEMENT or Client's business or operations without

the prior written consent of SAI.

**47.0** The contractor shall provide all information, news and pre-post work photos/video to SAI.

**48.0** During the performance of SERVICES hereunder, the contractor shall take out/carry/maintain insurance as "Builder All Risk Insurance".

**14. SPECIFICATIONS**

**GENERAL**

The entire works shall be done as per CPWD specifications with up-to-date correction. However, in the event of any discrepancy in the description of any item as given in the Schedule of Quantities appended with the tender and the specifications relating to the relevant item as per CPWD specifications mentioned above the former shall prevail. If the specifications for any item are not available in the CPWD specifications cited above relevant IS specifications shall be followed. In case IS specifications are also not available, the decision of the Engineer-In-Charge given in written based on acceptable sound engineering practice and local usage shall be final and binding on the contractor.

1.0 The work shall be executed and measured as per metric dimensions given in the Schedule of Quantities, drawings etc. (FPS units wherever indicated are for guidance only).

2.0 The following modifications to the above specifications and some additional specifications shall however apply:

i) All stone aggregate and stone ballast shall be of hard stone variety to be obtained from approved queries at or any other source to be got approved by the Engineer- In-Charge.

ii) Sand to be used for cement concrete work, mortar for masonry and plaster work shall be of standard quality. Sand shall be obtained from any source to be got approved by the Engineer-In-Charge and screened as required. The same shall consist of hard silicious material. It shall be clean and if the sand brought to site is dirty it must be washed clean in water and should conform to Clause 3.1.5.1 of CPWDspecifications91-92orlatesteditionforfinesandandClause3.1.5.4ofCPWD specification 91-92 for coarse sand except for grading purposes.

3.0 Wherever any reference to any Indian Standard specification occurs in the documents relating to this contract the same shall be inclusive of all amendments issued their to or revisions thereof if any up to the date of receipt of tenders.

4.0 The rates for different items of works shall be for all heights and depth, leads and lifts of the building except where otherwise specified in the items of work.

The work will be carried out in accordance with the architectural drawings and structural drawings, to be issued by the Engineer-In-Charge. The structural and architectural drawings shall have to be properly noticed between architectural and structural drawings, final decision in writing of the Engineer-In-Charge shall be obtained by the contractor. For items where so required sample shall be prepared before starting the particular items of work for prior approval of the Engineer-In- Charge and nothing extra shall be payable on this account.

5.0 Articles manufactured by reputed firms and approved by the Engineer-In-Charge shall only be used. Only articles classified as "First Quality" by the manufactures shall be used unless other wise specified. Preference shall be given to those articles which bear ISI certification marks. In case articles bearing ISI certification marks are not available the quality of samples brought by the contractor shall be judged by the standards laid down in the relevant CPWD specifications. For items not covered by CPWD specifications relevant IS standards shall apply.

6.0 The contractor shall give a performance test of installations as per specification before the work is finally accepted and nothing extra whatsoever shall be payable to contractor on this account.

7.0 The work shall be carried out in a manner complying in all aspects with the requirements of relevant bye-laws of the Municipal Committee/ SAI/ DevelopmentAuthority/ImprovementTrustunderthejurisdictionofwhichtheworkis tobeexecutedorasdirectedbytheEngineer-In-Chargeandnothingextrashallbe paid on this account.

8.0 Other agencies doing work of electrification, external service other building work, horticulture work etc. for this project will also simultaneously execute the works and the contractor shall afford necessary facilities for the same. The contractor shall leave such necessary holes, openings etc. for laying/buying in the work pipes, cables, conduits, clamps, boxes and hooks for a clamp etc. as may be required for the electric and sanitary work etc. and nothing extra over the agreement rates shall be paid for the same.

9.0 Unless otherwise specified in the scope of work/ schedule of quantities the rates for all items of the work shall be considered as inclusive of pumping out or balling out water if required for which no extra payment will be made. This will include water encountered from any sources such as rains, floods, subsoil water table being high due to any other cause whatsoever.

10.0 Any cement slurry added over base surface or for continuation of concerning for better bond is added to have been in built in the item (unless otherwise/explicitly stated) and nothing extra shall be payable (or) extra cement considered with consumption on its account.

11.0 Therateforallitemsinwhichtheuseofcementisinvolvedisinclusiveofchargesfor curing.

12.0 The foundation trenches shall be kept free from water while all the works below ground level are in progress.

13.0 Thefinenessmodulusofsandtobeusedindifferentworksshallbeasfollows:

i) Coarse Sand Fineness Modulus as specified in the item like between2.5 to3.5for plain concrete, RCC work, flooring work etc.

ii) Fine Sand Fineness modulus as specified in the item like between 1.2 to 1.6 for finishing coat of cement, plaster, skirting clade etc. The coarse sand to be used at site shall be of light golden colour.

14.0 **BRICKWORKS**

Bricksshallgenerallyconformtospecificationforbrickclass7.5.Brick shall not absorb water more than 20% of their own dry weight after 24 hours immersion in cold water. Both the faces of wall of thickness more than 23 cm shall be kept in the proper plane. Wall of half bricks thickness or less shall be measured separately and paid in sqm. Half brick thickness shall be taken as 115 mm. Brick wall beyond half brick thickness shall be measured in multiple of half brick (i.e. 115 mm) which shall be deemed to be inclusive of mortar joints. When a fraction of half brick occurs due to architectural reasons or otherwise as per the requirements of the Department the same shall be measured as half brick work provided such fraction exceeds 2 cm fraction up to 2 cm thickness shall be made up in mortar and paid for as per specified thickness under brick work. Bricks shall be obtained from the source to be approved by Engineer-In-Charge and shall be of best quality, well burnt, ground moulded bricks available in the locality.

15.0 **RCCWORK**

In respect of projected balconies, projected slabs at roof level and projected verandah the payment for the RCC work shall be made under the item of RCC slabs. The payment for centering and shuttering of such items shall similarly be paid under the item of centering and shuttering of RCC slab. Nothing extras hall be paid for the side shuttering at the edges of these projected balconies and projected verandahs. All the exposed edge shall however be finished as per specifications and nothing extra shall be paid for this.

In the item of RCC walls, railings, and roofs etc. nothing extra shall be paid for making designs as per patterns given by Architects or for thickness of sections.

The rates for railing are inclusive of all the labour and the materials including of the item, portion of the railing which is embedded in the masonry or RCC shall not be included for measurements.

16.0 **PRECASTRCC**

The compaction of the concrete shall be done by vibrations, table or external vibrator as approved by Engineer-In-Charge. The rate quoted for the item shall include the element both for formwork and mechanical vibration.

The water will be tested with regard to its suitability for use in RCC work and nothing extra will be paid for on this account. The rate of item of reinforced cement in RCC work includes all operations including straightening, cutting, bending, binding with wire and placing in position at all the floors weight all leads and lifts complete.

17.0 **FLOORING**

The rate of items of flooring is inclusive of providing sunk flooring in bathrooms, kitchen etc. and nothing extra on this account is admissible.

18.0 **WATER SUPPLY SANITARY INSTALLATION**

Sanitary fittings, paints and other materials shall be obtained from one of the firms on the list of approved manufacturers of CPWD and shall bear ISI mark. The materials shall be tested as per provision in relevant IS codes. The contractor's rates for items involving the use of the above materials shall be deemed to cover the cost of samples.

The SCI pipe and G.I. pipe wherever necessary shall be fixed to RCC columns, beams etc. with raw plugs and nothing extra shall be paid for this.

G.I. pipes if stipulated for issue in the schedule of material can be issue in such sizes or its equivalent metricize is considered fit and the issue rate recoverable from the contractor will remain the same. The contractor will not be paid anything extra on this account and nothing will be deducted for using the size of G.I. pipes issued and the items will be paid as per agreement rate for the same item.

The contractor shall be responsible for the protection of the sanitary and water supply fittings and other fittings and fixtures against pilferage and breakage during the period of installation and there after until the building is handed over.

Water tanks, taps, pipes fittings and accessories should conform to byelaw and specification of the Municipal bodies SAI etc.The contractor should engage licenced plumbers for the work and got the material (fixtures fittings) tested by the municipal bodies/SAI authorities wherever required at his cost, the work shall be carried out according to the municipal by law.

19.0 **VARIATION CONSUMPTION OF MATERIALS**

The variation in consumption of material shall be governed as per CPWD specification and clauses of the contract to the extent applicable. The following specific clauses shall govern the variation in consumption of pig lead.

20.0 **VARIATION IN CONSUMPTION OF PIGLEAD**

20.1. The pig lead for caulking of joints of SCI pipes shall be issued as per theoretical consumption for SCI pipes of sizes 400mm,75mm,50mm,0.88kg at0.98kgand0.77 kg per joint respectively. Over and above the theoretical quantities of lead as marked out, variation of 5% shall be allowed for wastage etc. Any difference between the actual consumption of pig lead and theoretical consumption worked out on the above basis/c the authorized variation shall be recovered at double the issue rate. Where the pig lead is arranged by the contractor, variation of 5% will be allowed. In case variation is on higher side 5% will be allowed. In case the variation is on lower side the quantity of pig lead used less shall be recovered from the contractor at market rate to be determined by Engineer-In-Charge whose decision in the matter will be final.

20.2. The theoretical quantity of cement to be utilized in item of concrete involving use of shingle aggregate and mixed by volume batching shall be computed on the basis of the co-efficient cement to be used in different items of the work provided in DSR 2023 reducing each of the co-efficient by 5% however where the concrete is mixed by weight batching no such reduction shall be made from the theoretical co- efficient given in DSR 2023 for concrete with crushed stone aggregate.

21.0 **CONDITIONS**

The contractor shall take instructions from the Engineer-In-Charge regarding collection and stacking of materials in any place. No excavated earth or building material shall be stacked on areas where other buildings, roads, services of compound walls are to construct.

Royalty at the prevalent rates shall have to be paid by the contractor on the boulders, metal, shingle, sand and bajri etc. or any other material where royalty is payable collected by him for the execution of work direct to the revenue authority of the State Government concerned.

The contractor shall make his own arrangements for obtaining electric/water connections, If required and make necessary payments directly to the Department concerned.

The contractor must take all precautions to avoid all accidents by exhibiting necessary day and night caution boards, speed limit, red flag, red lights and providing barriers. He shall be responsible for all damages and accidents caused due to negligence on this regard. No hindrances shall be caused to traffic during the execution of work.

The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased delivery is contemplated the provisions mentioned above will apply to each phase.

No compensation shall be payable to the contractor for any damage caused by rains, lightening wind, storm, floods tornados, earthquakes, or other natural calamity during execution of work. He will make good all such damages at his own cost and no claim on this account will be entertained.

The contractor shall clear the site thoroughly of all scaffolding materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer-In-Charge before the work is considered as complete.

All material obtained from Govt. stores or other work shall be get checked from the Engineer-In-Charge or his representative on receipt of the same at site and before they are actually used.

If as per municipal rules the huts for labour are not to be erected at the site of work by the contractors.The contractor are required to provide such accommodation as is acceptable to local bodies and nothing extra shall be paid on this account.

The centering and shuttering required for RCC work will be brought to site by the contractor well in advance so that the progress of the upper floors is not hampered due to non-availability of the same. Nothing extra shall be paid for this.

The contractor must see the proposed site for the work and study specifications and conditions carefully before tendering. No claim of any sort shall be entertained on account of any site conditions or ignorance of specifications and conditions.

The site is available, and tenderer should see the approached and conditions of the same. If any approach from main road is required at site or existing approach is to be improved and maintained for cartage and materials by the contractors the same shall be provided, improved and maintained by the contractor at his own cost.

Machine made shutters shall be got approved from the Engineer-In-Charge at factory before carting the same to the site of work. The shutter damaged during the cartage shall not allow to be used in the work and shall be removed by the contractor at his own cost and no claim whatsoever shall be entertained in this regard.

22.0 **CLARIFICATION REGARDING PLINTH LEVEL**

The following works shall be treated as works relating to foundations:

a) For buildings, compound walls, plinth level (or) 1.2 meter (4feet) above ground level whichever is lower excluding items of flooring and DPC but including base concrete below the floors.

b) For abutment, piers, retaining walls of culverts and bridges, wall of water reservoirs. The floor level or where floor Is not determinate up to 1.2 metres above bedlevel.

c) For retaining walls where the floor level is not determinate up to 1.2 meters above average ground level or bed level.

d) For roads all items of excavation and filling including treatment subbase and soiling work.

e) For water supplylines, sewerlines, underground storm water drain and similar works, all items of work below ground level except items of pipework and masonry work.

f) For open storm water drain sall items of work.

23.0 **TESTING OF MATERIALS:**

a) The contractor shall produce all the materials in advance so that there is sufficient time for testing of the materials and clearance of the same before use in work.

b) Samples of various materials required for testing shall be provided free of charge by the contractor. Testing charges, if any, shall be borne by the contractor. All other expenditure required to be incurred for taking the samples, conveyance, packing etc. shall be borne by the contractor himself.

c) In case there is any discrepancy in frequency of testing as given in list of mandatory tests and that inindividual sub-heads of work as per CPWDs specifications 2019(Vol.I & II) or latest edition the higher of the two frequencies of testing shall be followed and nothing extra shall be payable to the contractor on this account.

d) The contractor shall be responsible to arrange at his own cost all necessary tool sand plants required for execution of the work.

e) With a view to avoid controversy about quality of cement concrete as revealed in the test results of 7 days cubes falling short of the prescribed standard by over 10% and 20% and pending testing of balance 3 cubes for 28 days as final confirmatory acceptance test crushed samples of cement concrete from the failed 7days cubes should be preserved in a sealed bag.

**APPLICATION FOR EXTENSION OF TIME; PART – I**

(To be completed by the Contractor)

1. Name of Contractor
2. Name of the work as given in the Agreement
3. Agreement No.
4. Estimated amount put to tender
5. Date of commencement work as per agreement
6. Period allowed for completion of work as per agreement
7. Date of completion stipulated as per agreement
8. Period for which extension of time has been given previously Extension granted
   a) First extension vide Engineer-In-Charge letter No..... date Months Days
   b) 2ndextension vide Engineer-In-Charge letterNo..... date Months Days
   c) 3rdextension vide Engineer-In-Charge letter No..... date Months Days
   d) 4thextension vide Engineer-In-Charge letter No..... date Months Days

Total extension previously given

9. Reasons for which extension have been previously given (copies of the previous application should be attached)
10. Period for which extension is applied for:
11. Hindrances on account of which extension is applied for with dates on which hindrances occurred, and the period for which these are likely to last.
    a) Serial No.
    b) Nature of hindrance
    c) Date of Occurrence
    d) Period for which it is likely to last
    e) Period for which extension required for this particular hindrance.
    f) Over lapping period, if any, with reference to item
    g) Net extension applied for
    h) Remarks, if any

Total period for which extension is now applied for on account of hindrances mentioned above ..... Month/ days.

12. Extension of time required for extra work.
13. Details of extra work and on the amount involved:
    a) Total value of extra work
    b) Proportionate period of extension of time based on estimated amount put to tender on account of extra work.
14. Total extension of time required for 11&12.

Submitted to the Engineer-In-Charge's office. SIGNATURE OF CONTRACTOR DATE

**APPLICATION FOR EXTENSION OF TIME;**
**PART–II**

1. Date of receipt of application from the Contractor in the Engineer-In-Charge's office.

2. Acknowledgement issued by Engineer-In-Charge vide his letter No. dated.

3. Engineer-In-Chargeremarksregardinghindrancesmentionedbythe Contractor.

   i) Serial No.
   ii) Nature of hindrance
   iii) Date of Occurrence
   iv) Period for which it is likely to last
   v) Extension of time period applied by the contractor.
   vi) Over lapping period, if any, with reference to item which overlap.
   vii) Net period for which extension is recommended.

   viii) Remarks as to why the hindrance occurred and justification for extension recommended.

4. Engineer-In-Charge recommendations.

(The present progress of the work should be stated and whether the work is likely to be completed by the date up to which extension has been applied for. If extension of time is not recommended, what compensation is proposed to be levied under the agreement?)

SIGNATURE OF ENGINEER-IN-CHARGE

Approval of Deputy Director

**PROFORMAFOREXTENSIONOFTIME;**
**PART–III**

To, NAME
ADDRESSOFTHECONTRACTOR SUBJECT:

Dear Sir(s)

Reference your letter No._____dated_____,in connection with the grant of extension of time for completion of the work……

The date of completion for the above-mentioned work, is.....as stipulated
In the agreement, dated……

Extension of time for completion of the above-mentioned work is granted up to_____, without prejudice to the right of SAI to recover compensation for delay in accordance with the provision made in the relevant Clause(s)of said agreement dated the_/____/_____. It is also clearly understood that SAI shall not consider anyrevisionincontractpriceoranyothercompensationwhatsoeverduetograntofthis extension.

Provided that not withstanding the extension here by granted, time is and shall still continue to be the essence of said agreement.

Yours faithfully,

FORSAI

# LIST OF Preferred Makes

This list is in addition to the list of makes already specified in DPR document/Scope of Workand BIS marked products.
However, for the specialized items/jobs for civil, Electrical, Horticultural and concurrent list of works as mentioned Annexure 6 of CPWD SOP 2024, the contractor if he doesn't possess the requisite eligibility and experience to carry out these works, specialized agencies with proven credentials shall have to be associated by the main contractor after getting approval of Engineer in charge.

| Sr. No. | ITEMS | APPROVED MAKE |
|---|---|---|
| 1. | CEMENT (OPC) /PPC | ACC, LAFARGE, AMBUJA, ULTRA TECH, AMRIT, RAMCO, DALMIA, STAR |
| 2. | WHITE CEMENT | ACC, LAFARGE, AMBUJA, BIRLA GOLD; ULTRA TECH |
| 3. | WALL PUTTY | BIRLA, J.K WHITE, ASIAN PAINTS, BERGER |
| 4. | REINFORCEMENT STEEL (SUPER DUCTILE FE-500 GRADE) | From Primary Producers: TATA / SAIL / Essar Steel / Jindal Steel / Shyam Steel/RINL / JAI BALAJI INDUSTRIES LIMITED / SRMB, RUNGTA STEEL (RC Group) |
| 5. | STRUCTURAL STEEL (FE-310) | TATA, SAIL, RINL, NEZONE, APOLLO, RUNGTA STEEL (RC Group) |
| 6. | ANTI TERMITE TREATMENT | CHLOROPYRIPHOS |
| 7. | CONSTRUCTION CHEMICALS | FOSROC, SIKA, CHOKSEY, ARDEX ENDURA, PIDILITE, BASF, PENETRON |
| 8. | PRE-LAMINATED FLUSH DOORS / SHUTTERS | GREENPLY, GREEN PANEL, ARCHIDLAM, ARCHID PLY, CENTURY, KIT PLY, STYLAM, ARYAN GOLD |
| 9. | FLUSH DOORS / SHUTTERS) (35 mm thickness) | GREENPLY, GREEN PANEL, ARCHID PLY, SANTRO, ARCHID PLY CENTURY, KIT PLY,STYLAM,RBC |
| 10. | PLYWOOD / BLOCK BOARD / SOFT BOARD | FIDEN, CENTURY, GREEN PANEL, AUSTIN PLY, GREEN PLY, ARCHIDPLY(BWR), KIT PLY, STYLAM, MERINO,OM SAI |
| 11. | PRELAMINATED PARTICLE BOARD | GREENLAM, MERINO, GREEN PANEL, ARCHIDLAM, ARCHID PLY, KITPLY, BHUTAN |
| 12. | LAMINATES (1mm thick) | GREENPLY, GREEN PANEL, CENTURY, GREENLAM, ARCHIDLAM ARCHIDPLY, KITPLY, STYLAM, MERINO |
| 13. | MDF BOARD | GREENLAM, GREEN PANEL, CENTURY, ARCDHIDLAM, ARCHID PLY, BHUTAN, STYLAM, KITPLY, MERINO, BHUTAN |

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| 14. | ADHESIVE FOR WOODWORK | DUNLOP, FEVICOL, PIDILITE |
| 15. | POLYRETHANE SEALANT | PIDILITE, FOSROC, CHOKSEY, SIKA, CICO, BASF, ARDEX ENDURA |
| 16. | POLYETHELENE BOARD / BACK UP ROD | SUPREME INDUSTRIES, FINOLEX |
| 17 | ALUMINIUM SECTIONS | JINDAL, HALCO, HINDALCO, NALCO, BACL |
| 18. | STAINLESS STEEL | JINDAL, TATA, SAIL, HINDALCO |
| 19. | STAINLESS STEEL RAILING | GODREJ, TATA, OZONE, DORMA, HALCO, JINDAL |
| 20. | EXPANSION / FASTNERS | FISHER, HILTI, RAWLPLUG/ AXEL India (Trixel),ANCHOR |
| 21. | FLOAT GLASS / TOUGHENED GLASS | SAINT GOBAIN, AIS GLASS, MODIGUARD |
| 22. | CERAMIC TILES | SOMANY, NITCO, VARMORA, JOHNSON, ORIENT, BELL, QUTONE, BONZER 7, AGL |
| 23. | VITRIFIED TILES (DOUBLE CHARGED) | SOMANY, NITCO, VARMORA, JOHNSON, ORIENT, BELL, QUTONE, BONZER 7, AGL |
| 24. | PAVER TILES | OMI, HERO TILE, MAHESHWARI INDUSTRIES, DARPAN TILES OR EQUIVALENT, OMSAI,RBC |
| 25. | EXTERIOR WALL TILES | PAVIT, ULTRA DESIGNER TILES, KAJARIA, AGL, ORIENT BELL, NITCO |
| 26. | PARKING TILES | NITCO, JOHNSON, QUTONE, OMSAI, RBC, AGL, ORIENT BELL, VARMORA, SOMANY |
| 27. | TERRAZZO TILES | SOMANY, NITCO, VARMORA, JOHNSON, ORIENT BELL, QUTONE, BONZER 7, AGL |
| 28. | CEMENT CONCRETE TILES | EUROCON, NITCO, HERO TILE, OR EQUIVALENT |
| 29. | SYNTHETIC ENAMEL PAINTS | BERGER (LUXOL GOLD), ASIAN (APCOLITE), ICI, NEROLAC, STP, DULUX |
| 30. | OIL BOUND DISTEMPER | ASIAN PAINT, BERGER (BISON), NEROLAC, DULUX |
| 31. | CEMENT BASED PAINT | SNOWCEM PLUS, BERGER (DUROCEM EXTRA), ASIAN PAINT, DULUX |
| 32. | PLASTIC EMULSION PAINT | ICI, ASIAN PAINT, BERGER, DULUX, ASIAN PAINT |
| 33. | OTHER PAINTS / PRIMERS | ICI DULUX, ASIAN, BERGER, NEROLAC, DULUX |
| 34. | PAINTS | BERGER, ASIAN PAINTS, ICI, NEROLAC., DULUX |
| 35. | SURFACE TEXTURE PAINT(EXTERIOR) | ULTRATECH, SPECTRUM, HERITAGE, DULUX OREQUIVALENT |
| 36. | SURFACE TEXTURE PAINT(INTERIOR) | ASIAN PAINT, BERGER, DULUX OR EQUIVALENT |
| 37. | DOOR HARDWARE | EBCO, GODREJ, DORMA, OZONE, DORSET, HETTICH, KICH, CLASSIC, IPSA, HARDWYN, OR EQUIVALENT |
| 38. | DOOR / WINDOWS PATCHFITTINGS | EBCO, GODREJ, DORMA, OZONE. KICH, DORSET, CLASSIC, IPSA, HARDWYN OR EQUIVALENT |
| 39. | LOCKS | EBCO, GODREJ, OZONE, HARRISON, DORSET, CLASSIC, IPSA, HARDWYN OR EQUIVALENT |
| 40. | WARDROBE/ CUBBOARDS HANDELS | EBCO, GODREJ, HETTICH, OZONE, DORMA, DORSET, CLASSIC, HARDWYN OR EQUIVALENT |
| 41. | NON-METALLIC HARDENER COMPOUND | CICO, PIDILITE, FAIRMAT, AERORITE, STP, ARDEX ENDURA, CHRYSO, ASIAN OR EQUIVALENT |
| 42. | POLYSULPHIDE SEALANT | PIDLITE, FOSROC, FAIRMATE, PENETRON, STP,CHRYSO OR |

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| | | EQUIVALENT |
| 43. | PAVEMENT TILES | PAVIT, NITCO, OMI, OMSAI,RBC, ASSAM CEMENT PIPES, MAHESHWARI INDUSTRIES OR EQUIVALENT |
| 44. | MS PIPE | TATA, SAIL, NEZONE, JINDAL, APOLLO |
| 45. | MS TUBE | TATA, NEZONE, SAIL, JINDAL, APOLLO |
| 46. | HOLLOW SECTION PIPES | TATA, NEZONE, SAIL, JINDAL, APOLLO |
| 47. | S.S. HINGES | GODREJ, HETTICH, EBCO, IPSA, DORSET,HARDWYN |
| 48 | M.S. INGES . | GODREJ, HETTICH, EBCO, IPSA, DORSET,HARDWYN |
| 49. | DOOR CLOSER | GODREJ, HETTICH, DOORSET, EBCO, IPSA,DORSET, HARDWYN, OZONE |
| 50. | METAL FALSE CEILING (ANTIBACTERIAL / ANTIFUNGAL) | FAMELINE, ARMSTONG, GRID SQUARE, SAINTGOBAIN, DEXUNE, METACIL, USG KNAUF |
| 51 | SILICON SEALANT | DOW CORNING, GE BAYER, WICKER |
| 52. | PAD LOCKS | GODREJ, HARRISON, LINK, DORSET, KICH,HARDWYN, EBCO, IPSA. |
| 53. | FIRE39. DOORS | GODREJ, NAVAIR INTERNATIONAL PVT. LIMITED, JC FIRE DOOR, SHAKTI HORMANN PVT.LTD., CS COMPONENT |
| 54. | PVC DOOR FRAMES / SHUTTERS | FENESTA, WINSTA KOMMERLING, RAJSHREE PLYWOOD, FIBREWAYS TECHNOLOGY, WINDOWS MAGIC |
| 55. | METAL (GI) SHEETROOFING | TATA BLUESCOPE, SAIL, JINDAL, PRESTAR, DURAROOF, DURACOLOR, DYNAROOF, KAMDHENU. |
| 56. | POLYCARBONATE ROOFSHEETING | FIBREWAYS TECHNOLOGY, ROOFLIGHT, UV LIGHT, ARKO BUILDING PRODUCTS PVT. LTD. OR EQUIVALENT. |
| 57. | FLOOR SPRING | DORMA, OZONE, KICH, DORSET, GODREJ, IPSA,HARDWYN. |
| 58. | AUTOCLAVED AREATEDCONCRETE(AAC) | GREEN AAC, SUPERLITE, BRICK-O-LITE,ULTRALYTE, POWERLITE |
| 59. | ROLLING SHUTTER | AS APPROVED, BENGAL ROLLING SHUTTER, PRAKASH, GANDHI AUTOMATION, NITUL SARMA |
| 60. | EXPANSION JOINT BOARD &ACCESSORIES | SUPREME INDUSTRIES, FOSROC, PIDILITE, STP, |
| 61. | ALUMINIUM COMPOSITE PANEL | EUROBOND /ALUCOBOND/ ALSTRONG/ALSTONE/ VIVA |
| 62. | TILE JOINT FILLER | DURACREATE, ROFF RAINBOW TILE MATE, ARDEX ENDURA, WINSIL 20 / SILICON SEALANTOF GE BAYER SILICON OR EQUIVALENT |
| 63. | GASKET/ RUBBER GASKET EPDM & SILICON | SCHUCO/ SAPA BUILDING SYSTEMS /EUROPEANFAÇADE PRODUCT (EPF) / RAYNERS OR EQUIVALENT |
| 64. | MELAMINE | ICI DULUX, ASIAN, MRF, BERGER |
| 65. | SILICON WATER REPELLENT SOLUTION | GE BAYER, REMMERS, ARDEX ENDURA,DUPONT, STP, ASIAN OR EQUIVALENT |
| 66. | GYPSUM BOARD FALSECEILING | INDIA GYPSUM, SAINT GOBAIN, LAFARGE, GYPROC, GYPSTEEL, USG KNAUF, METACIL, CK BIRLA |
| 67. | MINERAL FIBRE TILES CEILING | ARMSTRONG, FORBO, TARKETT, USG KNAUF, SAINT GOBAIN, DEXUNE, METACIL, CK BIRLA |
| 68. | LAMINATED WOODENFLOORING | PERGO, TARKETT, ARMSTRONG / GREENPLYOR EQUIVALENT |
| 69. | CURTAIN ROD/ DRAPERY ROD | VISTA/ MAC I, DECK, ROMA, HIGHEND OREQUIVALENT |
| 70. | VENETIAN BLINDS | VISTA, MAC I, HUNTER DOUGLAS,HIGHEND OR EQUIVALENT |
| 71. | PVC FLOORING | ARMSTRONG, FORBO, TARKETT OR EQUIVALENT |
| 72 | EXTERIOR WOOD HIGH PRESSURE LAMINATE WALL CLADDING | GREENLAM ARCHIDLAM, KIT PLY, CENTURY,GREENPANEL, STYLAM |

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| 73. | WOODEN PANELLING | ARMSTRONG, FAMELINE, ANUTONE, ALUDECOR OR EUIVALENT |
| 74. | ALUMINIUM LOUVERS | FAMELINE, DEXON, CREDANCE, DURLUM OR EQUIVALENT |
| 75. | MODULAR FURNITURE | GODREJ, FEATHERLITE, WIPRO, DURIAN, GOOD HOME OR EQUIVALENT |
| 80. | GLASS MOSAIC TILES | CORAL, BISAZZA, OPIO, ITALIA OR EQUIVALENT |
| 81 | ACCOSTICAL WALL PANELLING | ANUTONE, ARMSTRONG, ECO PHONE, CREDENCE OR EQUIVALENT |
| 82. | EPOXY FLOOR | FOSROC /BASF/ CICO/ SIKA/ PIDILITE, ARDEX ENDURA, STP CHRYSO OR EQUIVALENT |
| 83. | STRUCTURAL GLAZING | AIS / PILKINGTON / SAINT GOBAIN / MODI OR EQUIVALENT |
| 84. | WATER PROOFING | SIKA/ FOSROC/ PIDILITE/ PENETRON / ARDEX ENDURA/CHOKSEY STP / MYK ARMENT /TIKIDIN OR EUIVALENT |
| 85. | UPVC WINDOW / DOOR | WINSTA KOMMERLING/ FENESTA / DUROPLAST/WINDOW MAGIC / OKOTECH, SALAMANDER/BBW (VARDHAMAN COMPOSITES INDIA) |
| 86. | ANCHOR FASTNERS | HILTI / BOSS / RAWLPLUG/ AXEL India (Trixel) OREQUIVALENT |
| 87. | PRESSED STEEL FRAME | SANHHARVIC, RAYMUS, NITUL SARMA, BRS OR EQUIVALENT |
| 88. | ADHESIVES (Tile /stone etc.) | PIDILITE, FOSROC, ULTRACON, ARDEX ENDURA, SUPREME BITCHEM, STP, MYK LATICRETE |
| 89. | POWDER COATINGS | BERGER, NEROCOAT, OR EQUIVALENT |
| 90. | LAMINATED VENEER LUMBER (LVL) | GREENLAM, CENTURY, KIT PLY, STYLAM, GREENPANEL OR EQUIVALENT |
| 91. | COMPACT LAMINATED DOORS | GREENLAM, GREEN PLY, MERINO, FIDEN, SANTRO, STYLAM |
| 92. | SOLID SURFACE/ ACRYLIC | CORIAN /DUPONT, STARON / SAMSUNG OR EQUIVALENT |
| 93. | FIRE RESISTENT PAINTS | AKZONOBLE, PPG, JOTUN, BERGER, ASIAN OR EQUIVALENT |
| 94. | GLASS CANOPY | OZONE / DORMA / GODREJ OR EQUIVALENT |
| 95. | POLYSUPLHIDE SEALANTS | CICO, PIDILITE, BASF, SIKA, STP, CHRYSO |
| 96. | CALCIUM SILICATE BOARD | PROMATE, HILUX, ACON PAN, AEROLITE OR EQUIVALENT |
| 97. | ADMIXTURES | CICO, FORSOC, SIKA, BASF, PIDILITE, ULTRACON SUPREME BITUCHEM, PENETRON |
| 98 | TACTILE TILES N | JOHNSON OR EQUIVALENT |
| 99. | MELAMINE | ICI DULUX, TIMBERSTONE MELAMINE COATING, ASIAN PAINT, MRF OR EQUIVALENT |
| 100. | ROLLER BLINDS | HUNTER DOUGLAS / MAC/ VISTA OR EQUIVALENT |
| 101. | POP | UNITECH, JK, BIRLA, ASIAN, SAKARNI OR EQUIVALENT |
| 102. | ALUMINUM FITTINGS | ARGENT, CROWN, NULITE, IPSA, EBCO, CLASSIC OR EQUIVALENT |
| 103. | AAC MORTAR | FERROSCRETE, ULTRATECH UNITED, ARDEX ENDURA, POWERLITE, ULTRALYTE, BRIKOLITE |
| 104. | CEMENT BOARD | EVEREST, BISON PANEL, VIROC, VNEXT OR EQUIVALENT |

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| 105. | TOILET CUBICAL & URINAL PARTITION | CENTURY EXTERIA, MARINO, REST LOO, GREENLAM |
| 106. | ANY OTHER ITEMS | ON APPROVAL OF ENGINEER-IN-CHARGE |
| B. | PLUMBINGSYSTEM | |
| 1 | VITREOUSCHINASANITARYWARE | HINDWARE /ROCA / JAQUAR/KOHLER/ESSCO/PARRYWARE/CERA |
| 2 | PLASTICW.C.SEATS& COVERS | HINDWARE/ROCA/JAQUAR/KOHLER/ES SCO/PARRYWARE/CERA |
| 3 | C.P.FITTINGS: | HINDWARE/JAQUAR/GROHE/KOHLER / ROCA/CERA/ESSCO/PARRYWARE |
| 4 | AUTOMATICWATERTAPS,AUTOMATICURINALFLUSHING SYSTEM | HINDWARE/JAQUAR/GROHE/KOHLER/ ROCA/PARRYWARE, CERA/ESSCO |
| 5 | TOWELRING,TOWELROD,TOWEL RACK,COATHOOKETC.(304GRADE S.S.) | HINDWARE/JAQUAR/GROHE/KOHLER/ ROCA/ESSCO/CERA/PARRYWARE |
| 6 | STEEL / POLY VENIEL CHLORIDE GRATING | HINDWARE/JAQUAR / GROHE/KOHLER/ ROCA/CERA/PRAYAG/CAMRY/CHILLY |
| 7 | STAINLESS STEEL SINK | NIRALI/METROID ENGINEERS/NEELKANTH/AMC/PRAYAG |
| 8 | CAST IRON PIPE, HORIZONTALLY / VERTICALLY CASTED S & S AS PER IS:1729 | JINDAL / BIRLA / NECO / BIC /RIF /HEPCO/ SKF/ KAJECO OR EQUIVALENT |
| 9 | G.I. AND M.S. PIPES | TATA / JINDAL / NEZONE/ APOLLO OR EQUIVALENT |
| 10 | G.I. AND M.S. FITTINGS | ZOLOTO / DRP / UNIK /NECO OR EQUIVALENT |
| 11 | UPVC PIPES & FITTINGS | PRINCE/SUPREME / FINOLEX INDUSTRIES / SFMC/FUSION/ASTRAL OR EQUIVALENT |
| 12 | CPVC PIPES & FITTINGS | PRINCE /SUPREME/AKG /FINOLEX INDUSTRIES / SFMC/FUSION/ASTRAL OR EQUIVALENT |
| 15 | FORGED BRASS BALL VALVE | ZOLOTO /SANT/NVR/UNIK/LEADER OR EQUIVALENT |

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| 16 | F.B. MULTI UTILITY CHECK VALVE | ZOLOTO /SANT/NVR/UNIK/ LEADER OR EUIVALENT |
| 17 | F.B. AIR VENT | ZOLOTO /SANT/NVR/UNIK/ LEADER OR EQUIVALENT |
| 18 | F.B.P.R.V. | HONEY WELL/ ZOLOTO /SANT/UNIK/ LEADER OR EQUIVALENT |
| 19 | FLOAT VALVE | SANT/ZOLOTO/NVR/ LEADER OR EQUIVALENT |
| 20 | C.I, SLUICE VALVE | KIRLOSKER / ZOLOTO /SANT/ LEADER OR EQUIVALENT |
| 21 | C.I. BUTTER FLY | ZOLOTO/SANT/NVR/ LEADER OR EQUIVALENT |
| 22 | C.I.NRV REFLUX | SANT/ ZOLOTO/NVR/ LEADER OR EQUIVALENT |
| 23 | C.I. DUAL PLATE | SANT/ ZOLOTO/NVR/ LEADER OR EQUIVALENT |
| 24 | D.I. WAFER TYPE CHECK VALVE | ZOLOTO /SANT/NVR/ LEADER OR EQUIVALENT |
| 25 | C.I. Y TYPE STRAINER | EMRALD /SANT/ LEADER OR EQUIVALENT |
| 26 | C.I. DOUBLE ACTING AIR VALVE | NVR/ KIRLOSKER /SIR/ LEADER OR EQUIVALENT |
| 27 | FOOT VALVE | ZOLOTO /SANT/ LEADER OR EQUIVALENT |
| 28 | REST ALL TYPE OF VALVE | SANT/ ZOLOTO/ LEADER OR EQUIVALENT |
| 29 | C.I. MANHOLES COVER & G.I. GRATING | NECO / BIRLA/ BIC/OMI OR EUIVALENT |

| | | |
|---|---|---|
| 33 | STORAGE TYPE WATER HEATER | VENUS / RACOLD/ CROMPTON/ BAJAJ/HAVELLS/USHA/HINWARE OR EQUIVALENT |
| 34 | INSULATION | THERMAFLEX, AEROFLEX, K FLEX/LLOYD INSULATION/SAINT GOBAIN OR EQUIVALENT |
| 35 | SOLAR HOT WATER EQUIPMENT | TATA SOLAR/ SOLAHART /HONEYWELL/SOL/INTER SOLAR OR EQUIVALENT |
| 36 | ELECTRICAL HOT WATER HEATER | VENUS/ KINGSTON /CG/ HAVELLS /USHA /HINDWARE/AO SMITH/JAQUAR/ESSCO OR EQUIVALENT |
| 37 | STAINLESS STEEL PIPES | JINDAL/ TATA/ SAIL/HALCO/HINDALCO OR EUIVALENT |
| 38 | COPPER PIPES | RALCO/ LAWTON/ INDIGO OR EQUIVALENT |
| C | PUMPS AND EQUIPMENTS | |
| 1 | WATER TRANSFER PUMPS | GROUNDFOS/KIRLOSKER/CROMPTON/ PARAS OR EQUIVALENT |
| 2 | IRRIGATION PUMP | GROUNDFOS/KIRLOSKER/CROMPTON/ PARAS OR EQUIVALENT |
| 3 | SUMP PUMP | GROUNDFOS/KIRLOSKER/CROMPTON/ PARAS OR EQUIVALENT |
| 4 | WATER LEVEL INDICATOR | CIRRUS/ HONEYWELL / DANFOSS OR EQUIVALENT |
| 5 | WATER LEVEL CONTROLLER | CIRRUS/ HONEYWELL / DANFOSS OR EQUIVALENT |
| 6 | ELECTRONIC SENSING PROBE | L & T / SIEMENS OR EQUIVALENT |
| 7 | PRESSURE GAUGE | H. GURU / FIEBIG / EMRALD OR EQUIVALENT |
| 8 | ELECTRICAL PANEL | AS PER APPROVAL |

| | | |
|---|---|---|
| 9 | NON-RETURN VALVE (65MM DIA & ABOVE) | KIRLOSKAR/ ZOLOTO /SANT OR EQUIVALENT |
| 10 | BUTTERFLY VALVE (LEVER TYPE) | SANT/ ZOLOTO/NVR OR EQUIVALENT |
| 11 | BUTTERFLY VALVE (GEAR TYPE) | SANT/ ZOLOTO/NVR OR EQUIVALENT |
| 12 | FILTER AND SOFTENER | THERMAX, DOLPHIN, Ion Exchange OR EQUIVALENT |
| 13 | MOTORIZED VALVE | DANFOSS/ HONEYWELL / Belimo / Siemens / SANT OR EQUIVALENT |
| 14 | VIBRATION PAD | RESISTOFLEX/ SYNTEX OR EQUIVALENT |
| 15 | VIBRATION ELIMINATOR | RESISTOFLEX/ SYNTEX OR EQUIVALENT |
| 16 | STP / ETP / WTP | B. S. ENVIRO / THERMAX /ALDEE WATER/TOSHIBAWATER/SOMBANSI/SIMALABS OR EQUIVALENT,OMSAI |
| D. | FIRE FIGHTING SYSTEM | |
| 1 | ELECTRIC DRIVEN MOTOR AND PUMPS | GROUNDFOS/KIRLOSKER/CROMPTON OR EQUIVALENT |
| 2 | ELECTRIC DRIVEN MOTOR AND PUMPS (INDIAN STANDARD) | ROUNDFOS/KIRLOSKER/CROMPTON OR EQUIVALENT |
| 3 | DIESEL ENGINE / DIESEL FIRE PUMPS | KIRLOSKAR / EICHER/ MAHINDRA OR EQUIVALENT |
| 4 | G.I. AND M.S. PIPES | TATA / JINDAL/NEZONE OR EQUIVALENT |
| 5 | FIRE HOSE PIPES / R R.L. HOSE PIPE WITH COUPLING (GUN METAL / BRASS /SS/ ALUMINIUM) | NEWAGE / MINMAX / SAFFIRE /CEASEFIRE/NIRMAL RUBBER/ WINCO/ AAAG / ESSEL OR EQUIVALENT |

| | | |
|---|---|---|
| 6 | FIRST AID FIRE HOSE REEL WITH BRACKET, DRUM AND SHUT OFF NOZZLE | NEWAGE / MINMAX / SAFFIRE /CEASEFIRE/ NIRMAL RUBBER/ WINCO/ESSEL OR EQUIVALENT |
| 7 | G.I. AND M.S. FITTINGS | DRP / ZOLOTO / NVR OR EQUIVALENT |
| 8 | C.I. DOUBLE FLANGED SLUICE / GATE VALVE / NON-RETURN VALVES | ZOLOTO / KIRLOSKAR / SANT/LEADER/DRP OR EQUIVALENT |
| 9 | SLIM SEAL BUTTERFLY VALVES | ZOLOTO / KIRLOSKAR / SANT/ LEADER/DRP OR EQUIVALENT |
| 10 | C. I. BODY BUTTERFLY VALVE | ZOLOTO / KIRLOSKAR / SANT/ LEADER DRP OR EQUIVALENT |
| 11 | GUN METAL BODY BUTTERFLY VALVE | ZOLOTO / KIRLOSKAR / SANT/ LEADER/DRP OR EQUIVALENT |
| 12 | LANDING VALVE (GUN METAL BRASS /SS / ALUMINIUM) | ZOLOTO / KIRLOSKAR / NEWAGE / SAFEFIRE / CEASE FIRE / SANT, LEADER/ AAAG OR EQUIVALENT |
| 13 | ALARM GONG | HD / Mather & Platt / Edward OR EQUIVALENT |
| 14 | QB. SPRINKLER | TYCO / GRINNEL / KIDDE / CENTRAL/HD/ AAAG/ NEWAGE /SAFEFIRE OR EQUIVALENT |
| 15 | WRAPPING AND COATING | PYPECOAT / RUSTECH / COALTEK /STP OR EQUIVALENT |
| 16 | FABRICATED FIRE HOSE CABINET | STEELAGE / NEWAGE / SAFEFIRE / CEASE FIRE/ RKBS OR EQUIVALENT |
| 17 | BRANCH PIPE / NOZZLES (GUN METAL BRASS / SS / ALUMINIUM) | MINMAX / NEWAGE / SAFFIRE/ AAAG /CEASEFIRE/ESSEL/WINCO OR EQUIVALENT |
| 18 | FIRE EXTINGUISHERS/FIRE FIGHTING SYSTEM (ALL TYPE) | NEWAGE / MINMAX / SAFEFIRE / SAFEX /CEASEFIRE/SAFEGUARD/LIFEGUARD/ SWASTIK OR EQUIVALENT / PLY/ ANTIFIRE Make |
| 19 | FIREMANAXE | NEWAGE / MINMAX /SAFEFIRE/ SAFEX/ AAAG /CEASEFIRE OR EQUIVALENT |

| | | |
|---|---|---|
| 20 | FIRE BRIGADE CONNECTION | NEWAGE / MINMAX /SAFEFIRE/ SAFEX/AAAG /CEASEFIRE/ ESSEL/WINCO OR EQUIVALENT |
| 21 | SUCTION STRAINER | AAAG/ AS PER APPROVAL |
| 22 | VIBRATION ELIMINATOR CONNECTORS | RESISTOFLEX / D. WREN/D R P OR EQUIVALENT |
| 23 | SINGLE PHASING PREVENTOR (CURRENT OPERATED) | L & T / SIEMENS/ SCHNEIDER/ABB / LEGRAND OR EQUIVALENT |
| 24 | FLOW METER | ACCUMAX/ AS PER APPROVAL |
| 25 | ELECTRICAL SWITCHGEAR & STARTERS | L & T / SIEMENS/ABB/LEGRAND/SCHNEIDER OR EQUIVALENT/ LUMINO INDUSTRIES |
| 26 | CABLES I | K FLEX/HAVELLS / POLYCAB / RR CABLE/ KEI / GLOSTER / DELTON OR EQUIVALENT/ LUMINO INDUSTRIES |
| 27 | FLOW SWITCH | POTTER / SYSTEM SENSOR /SWITZER/ JHONSON CONTROL/ DENFORCE/ HONEYWELL OR EQUIVALENT |
| 28 | MAIN CONTROL PANEL (POWDER COATED) | PIECO / MILSTONE / TRICOLITE/ C&S / RISHA CONTROL /ADLEC/ RKBS/ SHARK OR EQUIVALENT |
| 29 | PRESSURE SWITCHES | INDFOSS / SWITZER / HONEYWELL / INDFOSS OR EQUIVALENT |
| 30 | PRESSURE GAUGE | H. GURU / FIEBIG / EMRALD OR EQUIVALENT |
| 31 | BATTERY | EXIDE / AMARON/ LUMINOUS OR EQUIVALENT |
| 32 | PAINT ENAMEL OF PIPES ETC. | As per civil make list |
| 33 | ANNUNCIATION PANEL FOR SPRINKLER SYSTEM | SAFEWAY / Ceasefire OR EQUIVALENT |

| | | |
|---|---|---|
| 34 | ALARM VALVE & HYDRAULIC ALARM WITH COVERING | MATHER & PLATT / HD / Edward MOTOR OR EQUIVALENT |
| 35 | CONTACTOR | ABB / L&T / LEGRAND/SCHNEIDER/HAGER/SIEMEN S OR EQUIVALENT |
| 36 | THIMBLES / FERRULES (TINNED COPPER) | DOWELLS / COMET / APS /PRABHAT/ 3 M /BRACO OR EQUIVALENT |
| 37 | CABLE GLANDS | DOWELLS / COMET / APS /PRABHAT/ 3 M /BRACO OR EQUIVALENT/ LUMINO INDUSTRIES |
| 38 | POWER CAPACITOR | SCHNEIDER / L&T / ABB OR EQUIVALENT |
| 39 | MEASURING METER (DIGITAL) | L&T / SIEMENS / AE / ENERCON/HPL/ BENTEX, SCHNEIDER OR EQUIVALENT |
| 40 | DASH FASTENER | HILTI / FISHER/ BOSCH/AXEL OR EQUIVALENT |
| 41 | PAINT PRIMERS | ASIAN / JHONSON NICHOLSON/BERGER/DULUX OR EQUIVALENT |
| 42 | WELDING ELECTRODES | ADVANI / ESAB / VICTOR/MANGALAM OR EQUIVALENT |
| 43 | PIPE HANGERS | CHILLY / GMGR OR EQUIVALENT |
| 44 | MCB, DBS | L&T, INDO ASIAN, SCHNEIDER, HAGER, SEIMENS, ABB / HAVELLS / C&S OR EQUIVALENT |
| 45 | 2-WAY INLET BREACHING | NEWAGE / MINMAX / NEWTECH/ SAFFIRE OR EQUIVALENT |
| 46 | 4-WAY INLET BREACHING | NEWAGE / MINMAX / NEWTECH / SAFFIRE OR EQUIVALENT |
| 47 | CONDUIT | BERILLIA/ AKG/ PRESTO PLAST |

| | | |
|---|---|---|
| 48 | WIRES | RR KABEL/ FINOLEX/ KEI/ GLOSTER/ POLYCAB/ HAVELLS/LUMINO INDUSTRIES |
| 49 | SWITCH AND SOCKET (ELECTRICAL) | CRABTREE/SCHNEIDER/LEGRAND/HON EYWELL/WIPRO/ANCHOR |
| 50 | LUMINARIES | SYSKA/PHILIPS/BAJAJ/HAVELLS/JAQUA R/WIPRO/CROMPTON |
| 51 | BLDC CEILING FAN/ EXHAUST FAN | ORIENT/CROMPTON/USHA/POLYCAB |
| 52 | AIR CONDITIONER | VOLTAS/BLUE-STAR/ DAIKIN/ CARRIER/ MITHSUBISHI |
| 53 | LIFTS / ELEVATORS | SCHINDLER/ MITSUBISHI/OTIS/KONE |
| E. | SPECIALISED ITEMS | |
| 1 | HYBRID TURF FOOTBALL FOP | GREENFIELD/GREATSPORTS/ MISCHEZO/ LANO SPORTS |
| 2 | FOOTBALL SPORTS EQUIPMENT | GREATSPORTS/ MISCHEZO/ FREEWILL |
| 3 | SPORTS LIGHTING WORKS | SIGNIFY(PHILIPS)/ BAJAJ/OSRAN/eAge Electronics Pvt Ltd |
| 4 | SEATING SYSTEM | EURO SEATING/ DAPLAST/FREEWILL |
| 5 | ITF-ACRYLIC BASED TENNIS COURT SYSTEM | CASALI/ DECOTURF/COURTSOL |
| 7 | VINYL SPORTS FLOORING | GERFLOR/ MONDO/TARKKEET |
| 8 | VINYL SKIRTING | TARKKEET/GERFLOR/ARS |

| | | |
|---|---|---|
| 9 | GYMEQUIPMENT | LIFE FITNESS/ HAMMER STRENGTH/ TECHNOGYM/ PRECOR |
| 10 | SIGNAGES | XENONSIGNAGES/121 SIGNAGES |
| 11 | TENSILE FABRIC -FAÇADE | SERGE FERRARI-MADE IN FRANCE/VERRSEIDAG INDUTEX GMBH-MADE IN GERMANY / SIOEN, MADE IN BELGIUM |
| 12 | STANDING SEAM ROOFING (ALUMINUM / METAL) | KALZIP/KINGSPAN/TATA BLUE SCOPE/JINDAL METLAC/LLOYD/ BEMO |
| 13 | STEAM GENERATOR | ASTRAL/CERTIKIN/CARMENTA |
| 14 | FILTER | HAYWARD/LEISUREPOOL/ASTRAL/CERTIKIN/CANAMAQUA |
| 15 | PUMP | IML/ASTRAL/SPECK BADU/GRUNDFOS |
| 16 | HEATPUMP | ZODIAC/CALOREX/ASTRAL/CERTIKIN |
| 17 | UV STERILISER | BIOUV/ASTRAL/VGE/CERTIKIN/TRIOGEN |
| 18 | SALT CHLORINATOR | ASTRAL/CTX/BIOUV |
| 19 | CHEMICAL DOSING | GRUNDFOS/PROMINENT/ASTRAL/CERTIKIN |
| 20 | FLOW FITTING | ASTRAL/CERTIKIN/HAYWARD/CMP |
| 21 | LIGHTS | ASTRAL/CERTIKIN/HAYWARD/CMP |
| 22 | GRATINGS & LADDERS | ASTRAL/CERTIKIN/HAYWARD/HEXAGONE |

**Note:** The Contractor shall obtain prior approval from Engineer-In-Charge before placing order for any specific material or engaging any of specialized agencies. The contractor shall make a detail submittal with catalogues and highlighted proposed specifications as well as full details of the worksexecuted by specialized agencyas specified.Wherever applicable the contractor may use approved makes of material/ items provided by CPWD/MoRTH/WA with prior approval from SAI/Engineer in Charges, provisions and guidelines issued thereof.

Any other makes are permitted to be used in the work,only after written approval from SAI.

**Volume B**

**Detailed Scope of work:-**

This document outlines the detailed Scope of Work (SoW) for the Engineering, Procurement, and Construction (EPC) Contractor responsible for the implementation of the High Performance Centre (HPC) at the Sports Authority of India (SAI) – Netaji Subhas Southern Centre (NSSC), Bengaluru, Karnataka. The Contractor shall execute the project on a complete turnkey (EPC) basis, ensuring end-to-end responsibility for design, engineering, procurement, construction, installation, testing, commissioning, and handing over of the entire facility in accordance with approved Detailed Project Reports (DPRs), drawings, and specifications.

## General Responsibilities

The EPC Contractor shall act as a single-point entity responsible for delivering the project within the stipulated time, budget, and quality standards. The Contractor shall mobilize all required resources, including manpower, equipment, and materials, to complete the project as per the approved design intent and statutory norms.
Key general responsibilities include:
• Preparation and submission of GFC (Good for Construction) drawings based on the DPR.
• Preparation of construction methodology, work breakdown structure, and resource deployment plan.
• Coordination with client, PMC, design consultants, and local authorities for approvals.
• Adherence to project timelines, quality standards, and environmental safety norms.
• Management of subcontractors and vendors.
• Regular site progress reporting and coordination meetings.

## 2. Engineering and Design Development

The EPC Contractor shall carry out all engineering activities necessary for the detailed design and execution of the project. The Contractor shall prepare coordinated engineering drawings for all disciplines ensuring integration and clash-free design.
Scope includes:
• Architectural, structural, MEP, and landscape design finalization in compliance with NBC 2016, IS codes, and Green Building guidelines.
• Preparation of design calculations, GFC drawings, and shop drawings.
• 3D BIM model coordination (if required) for design validation.
• Structural design validation based on site-specific geotechnical parameters.
• Value engineering for material optimization, constructability, and sustainability.
• Preparation of detailed BOQs, technical specifications, and as-built documentation.

## 3. Procurement and Supply Chain Management

The EPC Contractor shall be responsible for the end-to-end procurement process including sourcing, quality inspection, logistics, and storage of all materials, consumables, and equipment required for the project execution. All materials shall conform to the approved makes and specifications.
Scope includes:
• Vendor identification, technical evaluation, and approval from Client/PMC.
• Preparation of Material Submittals and Shop Drawings for approval.
• Procurement of civil, structural steel, HVAC, electrical, plumbing, and firefighting materials.
• Inspection and Factory Acceptance Tests (FAT) for MEP systems.

• Safe transport, unloading, storage, and inventory control at site.
• Maintenance of material traceability and reconciliation records.

**4. Construction and Execution**

The EPC Contractor shall execute all construction works as per approved drawings, specifications, and schedule. The works include site development, civil, structural, architectural, MEP, and external development activities necessary to deliver a complete facility.
Scope includes:
• Site preparation, leveling, excavation, and disposal of surplus material.
• Construction of shallow foundations, footings, and RCC framed superstructure (G+2 + mezzanine floors).
• Construction using AAC blocks, RMC concrete, gypsum plaster, and energy-efficient materials.
• Execution of internal finishes, flooring, painting, cladding, and ceiling works.
• Installation of MEP services including HVAC, electrical, plumbing, firefighting, ELV, and building automation systems.
• Waterproofing, façade installation, and acoustic treatments.
• External development including roads, drains, footpaths, parking areas, and landscaping.

**5. Mechanical, Electrical, and Plumbing (MEP) Systems**

The EPC Contractor shall supply, install, test, and commission all MEP systems as per the approved MEP design report. All systems must meet operational performance standards, energy efficiency norms, and NBC/IS code requirements.
MEP scope includes:
• HVAC: 12 Air-cooled modular chillers (40TR each), ducting, AHUs, FCUs, ventilation, and pressurization systems.
• Electrical: Power supply, LT panels, cable routing, earthing, lightning protection, and LED lighting.
• Plumbing: Water supply, sanitary drainage, rainwater harvesting, and STP with reuse network.
• Fire Fighting: Hydrant network, sprinklers, alarm system, pumps, and water storage tanks.
• ELV Systems: CCTV, Access Control, Public Address, and BMS integration.

**6. Testing and Commissioning**

The EPC Contractor shall carry out testing and commissioning for all systems in coordination with the Client and PMC. All equipment and installations shall be tested in accordance with IS/ASHRAE/SMACNA standards and manufacturer's guidelines.
Scope includes:
• Material inspection and pre-commissioning checks.
• Pressure testing of pipelines and joints.
• HVAC air balancing and performance validation.
• Fire detection, alarm, and sprinkler functional tests.
• Electrical continuity, insulation, and earthing resistance tests.
• Integration and demonstration of automation and ELV systems.

**7. Handover Documentation**

The Contractor shall submit complete handover documentation including As-Built Drawings, Operation & Maintenance (O&M) manuals, warranty certificates, and system performance reports. Training shall be provided to Client's operational personnel for each system.

**8. Quality Assurance and Control**

The EPC Contractor shall establish and maintain a QA/QC system compliant with ISO 9001 standards. The QA/QC plan shall define inspection stages, test frequencies, approval checklists, and documentation. The Contractor shall engage an in-house quality team to conduct daily inspections, material testing, and maintain site quality records.

**9. Health, Safety, and Environment (HSE)**

The Contractor shall implement a comprehensive HSE management plan ensuring safety of personnel, property, and environment. Compliance with the Building and Other Construction Workers (BOCW) Act, 1996 is mandatory. The Contractor shall conduct safety inductions, toolbox talks, and ensure availability of PPEs and first-aid facilities.

**10. Project Management and Reporting**

The Contractor shall employ a qualified project management team including Project Manager, Site Engineers, QA/QC Manager, Safety Officer, and MEP Coordinators. A detailed work program (Primavera/MS Project) shall be submitted within 15 days of contract award. Weekly progress reports, cash flow updates, and milestone tracking shall be provided to the Client/PMC.

**11. Performance Guarantee and Defect Liability**

The EPC Contractor shall guarantee the performance of all installed systems and structural integrity of the works for a period of 12 months post-handover. Any defects or performance shortfalls shall be rectified at the Contractor's cost. A Performance Bank Guarantee shall be maintained until successful completion of the Defect Liability Period (DLP).

**12. Deliverables Summary**

The EPC Contractor shall deliver:

- GFC and Shop Drawings
- Procurement and QA documentation
- Weekly and Monthly Progress Reports
- Test and Commissioning Reports
- As-Built Drawings and O&M Manuals
- Warranty and Guarantee Certificates
- Training Reports and Final Completion Certificate

## Payment Milestones

| Sr No | Description of work | Weightage Major Centre of Cost | Weightage Major Centre of Cost | Main Head % | Total Project Cost % | Weightage Major Centre of Cost | Main Head % | Total Project Cost % |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **1.00** | **Table 1 - Survey, Planning, Designing, Drawings & all statutory approvals** | | | | | | | |
| 1.01 | Survey ,Design & Drawings | | | | | | | 3.00% |
| | Planning, Detailed Design & Drawings and Approval from Statutory Bodies, Third party proof checking and approval of the same by the Engineer-In-Charge based on the Concept Plan, Arch Drgs, Soil Investigation & Survey provided. | | | | | | 3.00% | |
| i | On approval of All Architectural Drawings from Engineer in charge or Appointed representative by SAI. On Prorata Basis | | | | | 1.20% | | |
| ii | On approval of All Structural Drawings including steel structure and proof checking by IIT/NIT / Govt Engineering college and approval from Engineer in Charge.On Prorata Basis | | | | | 0.90% | | |
| iii | On approval of all MEP drawings & other services drawings from Engineer in charge or appointed representative.On Prorata Basis | | | | | 0.90% | | |
| | | | | | | | | |
| **2.00** | **Table 2 - High Performance Centre** | | | | | | | |
| | | | | | | | | |
| **2.01** | **CIVIL WORK (RCC, MASONARY, FINISHING & FLOORING WORKS etc.)** | | | | | | | 66.25% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| i | On Completion of R.C.C work in foundation, Column upto plinth, plinth beam, Backfilling, Brick Work etc. all work upto Plinth Lvl. | | | | | | 11.02% | |
| a. | On completion of 50 % work Upto Plinth Level | | | | | 5.51% | | |
| b. | On completion of balance 50 % work Upto Plinth Level | | | | | 5.51% | | |
| ii. | R.C.C Work of Roof Level (Inc. Slab Conduiting) | | | | | | 24.81% | |
| | On Completion of GF Roof Slab | | | | | 9.07% | | |
| | On Completion of First Floor Roof Slab | | | | | 7.10% | | |
| | On Completion of Second Floor Roof Slab | | | | | 8.53% | | |
| | On Completion of terrace floor | | | | | 0.12% | | |
| iv. | Masonary Works | | | | | | 3.82% | |
| a. | On Completion of ground floor | | | | | 1.67% | | |
| b. | On Completion of first floor | | | | | 0.92% | | |
| c. | On Completion of second floor | | | | | 1.03% | | |
| d. | On Completion of terrace floor | | | | | 0.20% | | |
| v. | Internal Wall finishes (plaster works, Painting works etc) | | | | | | 2.19% | |
| a. | On Completion of ground floor | | | | | 0.55% | | |
| b. | On Completion of first floor | | | | | 0.66% | | |
| c. | On Completion of second floor | | | | | 0.87% | | |
| d. | On Completion of terrace floor | | | | | 0.11% | | |
| vi. | External Wall finishes (plaster works, Painting works etc) | | | | | | 0.58% | |
| a. | On Completion of ground floor | | | | | 0.18% | | |
| b. | On Completion of first floor | | | | | 0.18% | | |
| c. | On Completion of second floor | | | | | 0.19% | | |
| d. | On Completion of terrace floor | | | | | 0.02% | | |
| vii. | Water proofing works and final Testing | | | | | | 1.82% | |
| a. | Below ground floor - sub structure | | | | | 0.00% | | |
| b. | On Completion of ground floor | | | | | 0.17% | | |
| c. | On Completion of first floor | | | | | 0.03% | | |
| d. | On Completion of second floor | | | | | 0.03% | | |
| e. | On Completion of terrace floor | | | | | 1.58% | | |
| viii. | Flooring and wall tiling works | | | | | | 3.82% | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| a. | On Completion of ground floor | | | | | 1.06% | | |
| b. | On Completion of first floor | | | | | 0.93% | | |
| c. | On Completion of second floor | | | | | 1.80% | | |
| d. | On Completion of terrace floor | | | | | 0.02% | | |
| ix. | Sports Flooring | | | | | | 2.68% | |
| a. | Supply of specialised flooring materials as per DBR, 60% | | | | | 1.61% | | |
| b. | Installation of specialised flooring materials as per DBR, 30% | | | | | 0.80% | | |
| c. | After Handover to client all test certificates, manuals & Training, 10% | | | | | 0.27% | | |
| x. | Fixing of door & windows | | | | | | 3.73% | |
| b. | On Completion of ground floor | | | | | 0.83% | | |
| c. | On Completion of first floor | | | | | 1.13% | | |
| d. | On Completion of second floor | | | | | 1.73% | | |
| e. | On Completion of terrace floor | | | | | 0.04% | | |
| xi. | Structural Steel fabrication & Railing Works | | | | | | 0.70% | |
| a. | On Completion of ground floor | | | | | 0.23% | | |
| b. | On Completion of first floor | | | | | 0.23% | | |
| c. | On Completion of second floor | | | | | 0.20% | | |
| d. | On Completion of terrace floor | | | | | 0.03% | | |
| xii. | False Ceiling & Acoustic Panelling | | | | | | 2.98% | |
| a. | On Completion of ground floor | | | | | 0.43% | | |
| b. | On Completion of first floor | | | | | 1.18% | | |
| c. | On Completion of second floor | | | | | 1.37% | | |
| xiii. | All miscellaneous works such as railings, structural glazing, ramps, steps, toilet cubicals etc; | | - | | | | | |
| a. | Façade work | | | | | | 4.43% | |
| | After 50% work completion | | | | | 2.22% | | |
| | After remaining 50% work completion | | | | | 2.22% | | |
| b. | Toilet cubicles & Lockers | | | | | | 0.63% | |
| | Supply | | | | | 0.38% | | |
| | Installation | | | | | 0.22% | | |
| | Handing Over | | | | | 0.03% | | |
| xiv. | Signages | | | | | | 0.85% | |
| a. | After 50% work completion | | | | | 0.43% | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| b. | After remaining 40% work completion | | | | | 0.34% | | |
| c. | After Handover to client all test certificates, manuals & Training | | | | | 0.09% | | |
| xv. | Jacuzzi | | | | | | 0.20% | |
| a. | Supplying of Equipments, 60% | | | | | 0.12% | | |
| b. | Installation of Equipments, 30% | | | | | 0.06% | | |
| c. | After Handover to client all test certificates, manuals & Training, On Completion, Testing & Commissioning of system, 10% | | | | | 0.02% | | |
| xvi. | SWIMMING POOL FILTRTION SYSTEM | | | | | 0.00% | 1.99% | |
| a. | Supplying of Equipments, 60% | | | | | 1.19% | | |
| b. | Installation of Equipments, 30% | | | | | 0.60% | | |
| c. | After Handover to client all test certificates, manuals & Training, On Completion, Testing & Commissioning of system, 10% | | | | | 0.20% | | |
| **2.02** | **SERVICES (ELECTRICAL & PLUMBING)** | | | | | | | 26.58% |
| a. | Electrical Installation | | | | | | | |
| a.1 | Supplying, installation, testing and commissioning of HT panel, transformer, HT cable, bus trunking from transformer to LT panel, i/c earthing, inter connecting power cables in substation, safety equipment's, as per scope of work, Earthing System Technical Specification & Drawings etc. complete. | | | | | | 0.56% | |
| | Design, Drawings and approvals | | | | | 0.03% | | |
| | On Supply installation and erection | | | | | 0.34% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.14% | | |
| | On CEIG Approval | | | | | 0.03% | | |
| | On Handing over | | | | | 0.03% | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| a.2 | Supplying, installation, testing and commissioning of , LT Panel, automatic power factor corrector panel, essential panel i/c earthing, inter connecting power cables in substation, safety equipment's, Substation works including DG as per scope of work, Earthing System Technical Specification & Drawings etc. complete. as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.81% | |
| | Design, Drawings and approvals | | | | | 0.04% | | |
| | On Supply installation and erection | | | | | 0.49% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.20% | | |
| | On CEIG Approval | | | | | 0.04% | | |
| | On Handing over | | | | | 0.04% | | |
| a.2 | Supplying, installation, testing and commissioning of DG SET and associated works for the entire project as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.94% | |
| | Design, Drawings and approvals | | | | | 0.05% | | |
| | On Supply installation and erection | | | | | 0.57% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.24% | | |
| | On CEIG Approval | | | | | 0.05% | | |
| | On Handing over | | | | | 0.05% | | |
| a.3 | Supplying, installation, of Lightning arrester and earthing work as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.29% | |
| | Design, Drawings and approvals | | | | | 0.01% | | |
| | On Supply installation and erection | | | | | 0.18% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.07% | | |
| | On CEIG Approval | | | | | 0.01% | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | On Handing over | | | | | 0.01% | | |
| a.4 | Supplying, installation, of **LT Cables & Cable Trays** as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 3.28% | |
| | Design, Drawings and approvals | | | | | 0.16% | | |
| | On Supply | | | | | 1.97% | | |
| | On installation and erection | | | | | 0.82% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.16% | | |
| | On Handing over | | | | | 0.16% | | |
| a.6 | On Supply and installation of **internal electrical works** which includes ceiling & wall conduiting, GI boxes fixing, PVC insulated copper wiring, Switches and sockets for light and power points, distributions board, MCB, earthing, lighting conductors, LED Light, fans fixtures supply and installation etc complete. | | | | | | 1.00% | |
| | Design, Drawings and approvals | | | | | 0.05% | | |
| | On Supply of all conduiting, boxes and wiring | | | | | 0.55% | | |
| | On Erection of conduiting and wiring with boxes | | | | | 0.23% | | |
| | On Supply of all Board fittings and light fittings & fans | | | | | 0.05% | | |
| | On Erection of all fittings | | | | | 0.02% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.05% | | |
| | On Handing over | | | | | 0.05% | | |
| a.7 | Supplying, Installation and commissioning of **UPS system** as per design load and requirement | | | | | | 0.47% | |
| | Design, Drawings and approvals | | | | | 0.02% | | |
| | On Supply | | | | | 0.28% | | |
| | On installation and erection | | | | | 0.12% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.02% | | |
| | On Handing over | | | | | 0.02% | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| a.8 | Supplying, installation testing & commissioning- **IT infrastructure** - Wifi telephony, Cabling, IT Control room ( LAN and IPBAX system), UPS, Access Control as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.34% | |
| | Design, Drawings and approvals | | | | | 0.02% | | |
| | On Supply | | | | | 0.21% | | |
| | On installation and erection | | | | | 0.09% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.02% | | |
| | On Handing over | | | | | 0.02% | | |
| a.5 | Supplying, installation, testing and commissioning of **LED lights** for the entire project as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 2.39% | |
| | Design, Drawings and approvals | | | | | 0.12% | | |
| | On Supply | | | | | 1.44% | | |
| | On installation and erection | | | | | 0.60% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.12% | | |
| | On Handing over | | | | | 0.12% | | |
| a.9 | Design, Supplying, Installation, testing and commissioning of **Passenger Lifts & Service lift** as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.96% | |
| | Design, Drawings and approvals | | | | | 0.05% | | |
| | On delivery of Lift materials at site | | | | | 0.58% | | |
| | On Erection / installation of all lifts | | | | | 0.19% | | |
| | On Completion, testing & commissioning | | | | | 0.05% | | |
| | On Approval from lift Inspector & other statutory bodies, if applicable | | | | | 0.05% | | |
| | On Handing over | | | | | 0.05% | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| a.10 | Supply, Installation, Testing and Commissioning of on grid **Solar Photovoltaic Power Plant** conforming to MNRE specifications | | | | | | 0.29% | |
| | Design, Drawings and approvals | | | | | 0.01% | | |
| | On Supply | | | | | 0.17% | | |
| | On installation and erection | | | | | 0.07% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.01% | | |
| | On Handing over | | | | | 0.01% | | |
| b. | S/I/T/C Energy efficient **(HVAC) Air conditioning system** and Split units for UPS room, IBMS room, server room, BTU metering system , Close Loop Cooling Tower, | | | | | | 9.65% | |
| | Design, Drawings and approvals | | | | | 0.48% | | |
| | On Supply of all equipments - High Side | | | | | 2.47% | | |
| | On Supply of all equipments - Low Side | | | | | 3.32% | | |
| | On Erection of all equipments & materials | | | | | 2.41% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.48% | | |
| | On Handing over | | | | | 0.48% | | |
| c. | Design, Supplying, Installation, testing and commissioning **Firefighting system** with sprinkler system or as required i/c external Ring and plant room equipments. | | | | | | 1.77% | |
| | Design, Drawings and approvals | | | | | 0.09% | | |
| | On Supply installation and erection of piping | | | | | 1.06% | | |
| | On Supply installation and erection of Pumps | | | | | 0.44% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.09% | | |
| | On Handing over | | | | | 0.09% | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| d. | Supplying, installation testing & commissioning CCTV, Fire Alarm, PA System, Access Control, etc., as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.86% | |
| | Design, Drawings and approvals | | | | | 0.04% | | |
| | On Supply of Fixtures | | | | | 0.52% | | |
| | On installation and erection | | | | | 0.22% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.04% | | |
| | On Handing over | | | | | 0.04% | | |
| f. | Plumbing Works | | | | | 0.00% | | |
| f.1 | Planning, Designing , supplying, installation of **internal plumbing works & sanitary fixtures** installation of all buildings i/c internal water supply system as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.56% | |
| i. | On designing and supplying drawings | | | | | 0.03% | | |
| ii. | On Supply of pipes, and sanitary fixtures | | | | | 0.34% | | |
| iii. | On installation of soil, waste and rain water piping at all floors | | | | | 0.08% | | |
| iv. | On installation of sanitary ware and CP fittings and other accessories | | | | | 0.06% | | |
| v. | On Completion, Testing & Commissioning of system | | | | | 0.03% | | |
| vi. | On Handing over | | | | | 0.03% | | |
| f.2 | Planning, Designing, Construction of **External Sewerage and Drainage System** as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.06% | |
| i. | On designing and supplying drawings | | | | | 0.01% | | |
| ii. | On delivery of 50% pipes / fittings materials from total requirement | | | | | 0.01% | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| iii. | On delivery of balance 50% pipes / fittings materials from total requirement | | | | | 0.01% | | |
| iv. | On completion of laying pipe work, manholes, masonary chambers, laying concrete over pipes and back filling complete | | | | | 0.01% | | |
| v. | On Completion of all sewerage & drainage works , Testing & Commissioning | | | | | 0.04% | | |
| f.3 | Planning, Designing, Construction of network for **strom drain / swales, Rain water Harvesting** as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.18% | |
| | On designing and supplying drawings | | | | | 0.00% | | |
| | On construction of 50% length of RCC drains / swales planned | | | | | 0.08% | | |
| | On construction of 50% length of RCC drains / swales planned | | | | | 0.08% | | |
| | On Completion of all works , Testing & Commissioning | | | | | 0.02% | | |
| f.4 | Design, Supplying, Installation, testing and commissioning of **Pump and Equipment's for Domestic Water Treatment system** as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.46% | |
| | On designing and supplying drawings | | | | | 0.02% | | |
| | On Supply of pipes, pumps & accessories | | | | | 0.28% | | |
| | On installation of pumps, accessories and piping network | | | | | 0.12% | | |
| | On Completion, Testing & commissioning | | | | | 0.02% | | |
| | On completion of RMO for one year | | | | | 0.02% | | |
| f.5 | Design, Supplying, Installation, testing and commissioning of **WTP &STP** as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.85% | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | On designing and supplying drawings | | | | | 0.04% | | |
| | On Supply of Equipments | | | | | 0.51% | | |
| | On installation | | | | | 0.21% | | |
| | On Completion, Testing & commissioning | | | | | 0.04% | | |
| | On completion of CTE / CTO submission | | | | | 0.04% | | |
| g. | Supplying and installation testing and commissioning of **BMS system** for building security comprising of all systems, cabling, display system and hard ware software support as per scope of work, Technical Specification & Drawings etc. complete. | | | | | | 0.86% | |
| | Design, Drawings and approvals | | | | | 0.04% | | |
| | On Progressive Supply | | | | | 0.51% | | |
| | On Progressive Installation | | | | | 0.21% | | |
| | On Completion, Testing & Commissioning of system | | | | | 0.04% | | |
| | On Handing over | | | | | 0.04% | | |
| | | | | | | | | |
| **3.00** | **SITE DEVELOPMENT WORKS** | | | | | | 4.17% | 4.17% |
| | LAND DEVELOPMENT WORKS | | | | | 4.03% | | |
| | LANDSCAPING WORKS | | | | | 0.14% | | |
| | | | | | | | | |
| | **GRAND TOTAL** | | | | | **100.00 %** | **100.00 %** | **100.00 %** |

# DETAILED PROJECT REPORT ARCHITECTURE

## HIGH PERFORMANCE CENTRE AT SPORTS AUTHORITY OF INDIA NSSC, BENGALURU, KARNATAKA

SAI
SPORTS AUTHORITY OF INDIA

HAL

collage design
Mumbai | Ahmedabad | New Delhi




REVION – R0
DATE-26-09-2025

# Contents

**1. INTRODUCTION ..... 4**
1.1 Background ..... 4
1.2 Vision ..... 4
1.3 Mission ..... 4
1.4 Goals ..... 4
1.5 Overview ..... 4
1.6 High Performance Centre ..... 5
1.7 Key infrastructure ..... 5
**2. PROJECT DESCRIPTION ..... 6**
2.1 General ..... 6
2.2 Objectives ..... 6
2.3 Project Site ..... 6
PROPOSED SITE ..... 7
PROPOSED SITE ..... 7
PROPOSED SITE ..... 7
2.4 Scope of Work ..... 8
2.4.1 Details of Building: ..... 8
2.5 Silent Features of the Design ..... 10
2.5.1 Energy Efficiency Feature for Green Building ..... 11
2.5.2 Landscape ..... 11
**3. ARCHITECTURAL REQUIREMENTS ..... 12**
3.1 Seating Area ..... 12
3.2 Architectural Design Objectives ..... 12
3.3 Concept & Façade Design ..... 13
**4. ATHLETE'S FACILITIES ..... 14**
4.1 Changing Room & Toilet facilities ..... 14
**5. ENTRANCES AND CIRCULATION ..... 14**
5.1 Entrances ..... 14
5.1.1 Access and Circulation ..... 15
5.1.2 Players & Staff Entrance ..... 15
5.1.3 Emergency Entrance ..... 15
5.2 Passenger Lifts ..... 15
5.3 Stairways and Ramps ..... 16

**6. ATHLETE FACILITIES ..... 17**
6.1 Athletes Changing Rooms ..... 17
6.2 Anti-Doping Room ..... 17
6.3 Coach Room ..... 18
6.4 Meeting cum seminar room ..... 18
**7. HIGH PERFORMANCE CENTRE ..... 18**
7.1 Sports & Conditioning Department ..... 18
7.2 Hydrotherapy & Recovery Department ..... 18
7.3 Consultation Rooms ..... 19
7.4 Bio-Chemistry Lab ..... 19
7.5 Sports Physiology ..... 19
7.6 Psychology lab ..... 19
7.7 Nutrition Department ..... 20
7.8 Anthropometry Department ..... 20
**8. HIGH PERFORMANCE CENTRE OPERATIONS FACILITIES ..... 20**
8.1 General Building Storage ..... 20
8.2 Waste management System ..... 20
8.3 Building Services ..... 20
**9. EXTERNAL DEVELOPMENT ..... 21**
9.1 Parking ..... 21
9.2 Vehicular & Pedestrian Gate ..... 21
9.3 Service Buildings ..... 21
9.3.1 The Sewage Treatment Plant (STP) ..... 21
9.3.2 The Electrical Substation ..... 21
9.4 Softscape ..... 21
**10. SIGNAGE / GRAPHICS ..... 22**
**11. GREEN BUILDING CERTIFICATION ..... 23**
11.1 Sustainable Site Planning ..... 23
11.2 Water Efficiency ..... 23
11.3 Energy Efficiency ..... 24
11.4 Material and Resources ..... 24
11.5 Indoor Environment quality ..... 24
**12. AREA STATEMENT ..... 25**
12.1 High Performance Centre Built-up Area Statement ..... 25
**13. ARCHITECTURAL FINISHES ..... 26**

**14. VIEWS ..... 34**

**15. STATUTORY APPROVALS ..... 36**

# 1. INTRODUCTION

## 1.1 Background

Netaji Subhas Southern Centre (NSSC) in Bengaluru is one of the most prominent regional centre of the Sports Authority of India (SAI)**.** The centre features a state-of-the-art sports science facility with labs for biomechanics, sports medicine, and sports psychology. A smart athletics track with sensors for stride analysis. A recovery centre, strength & conditioning zones, and modern changing rooms. A research kitchen which works with nutritionists to create customized meal plans for athletes. Offers Diploma and Certificate Courses in sports coaching and sciences. It will also contribute to the development of the sports ecosystem in the region and the nation.

## 1.2 Vision

- To promote and broaden the base of sports in India.
- To train national teams for international competitions.
- To prepare high-calibre coaches and enhance their skills.
- To identify and nurture sports talent through various promotional schemes.

## 1.3 Mission

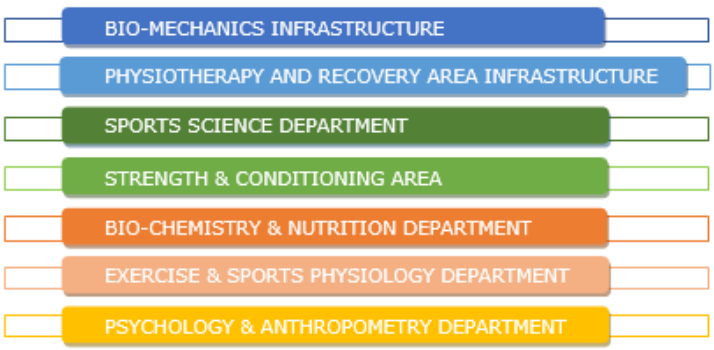
The proposed High Performance Centre in Bengaluru aims to transform India into a global sporting powerhouse by providing world-class infrastructure, training facilities, and coaching to athletes, creating opportunities for talented athletes, coaches, and administrators to excel and supporting sports science and research to enhance athlete performance.

## 1.4 Goals

To develop a state-of-the-art Sports Science Centre aimed at enhancing athletic performance and well- being by providing advanced research facilities, expert support services, and a collaborative environment for the application of multidisciplinary sports science across training, recovery, and talent development.

## 1.5 Overview

The High Performance Centre will feature:



## 1.6 High Performance Centre

- **Therapy Treatment:** biomechanics services, Cry Chambers, Jacuzzi, Ice Bath, Steam & Sauna, Massage and Physiotherapy Beds, sports medicine room, X-Ray and MRI Room.
- **Strength & Conditioning**: 55MT Indoor Track & Exercise Area.
- **Sports Science Lab:** Nutrition & Biochemistry Lab, Anthropometry & Psychology Department and Physiology Department




## 1.7 Key infrastructure

Key features of HPC include therapy treatment, strength & conditioning and sports science labs for development of athletes.



**Therapy Treatment**



**Strength & Conditioning**



**Sports Science Labs**

# 2. PROJECT DESCRIPTION

## 2.1 General

This document outlines the architectural intent and adopted design philosophy for the proposed facility. The design aims to achieve a functional, sustainable, and contextually responsive built environment. The facility will be designed and constructed in full compliance with all applicable provisions of the **National Building Code (NBC) 2016**, as well as all relevant regulations and guidelines prescribed by the local governing authorities. The architectural approach will integrate best practices in planning, accessibility, structural safety, fire protection, energy efficiency, and universal design to ensure a safe, efficient, and inclusive built form.

## 2.2 Objectives

To develop a state-of-the-art Sports Science Centre aimed at enhancing athletic performance and well-being by providing advanced research facilities, expert support services, and a collaborative environment for the application of multidisciplinary sports science across training, recovery, and talent development.




## 2.3 Project Site

The **proposed facility** is to be developed within the **existing campus of the Netaji Subhas Southern Centre, Bengaluru**. Leveraging the established infrastructure and strategic location of the

Centre, this integration aims to enhance athlete support services while maintaining proximity to core training and performance.






**PROPOSED SITE**






**PROPOSED SITE**

## 2.4 Scope of Work

### 2.4.1 Details of Building:

| A. High performance Centre (HPC) Structure (G+2) | | | |
|---|---|---|---|
| **Sr. No.** | **Building Name** | **Facilities** | **Remarks** |
| **A1** | **HPC Complex : (Ground + Ground Mezzanine + First+ First Mezzanine + Second Floor )** | | |
| **A1.1** | **GROUND FLOOR** | | |
| 1 | Bio Mechanics Department | • Multi-Disciplinary Analysis Area<br>• Badminton Court<br>• Athletic Track with force plates<br>• Instrumented Treadmill Workstation<br>• Isokinetic Workstation<br>• Staff Room & Waiting Area | |
| 2 | Recovery Area | • Hydrotherapy Pool<br>• Exercise & Rehab Area<br>• Theraband & Dumbbell station<br>• Testing & Visual Rehabilitation Area<br>• Anti-Gravity Treadmills<br>• Steam & Jacuzzi<br>• Ice Bath & Sauna<br>• Cryo Chamber<br>• Contrast Bath Facility<br>• Toilet & Athletes Changing Area<br>• Staff Room | |
| 3 | Massage Therapy | • Massage & Physiotherapy Rooms | |
| 4 | Sports Medicine Department | • Emergency & Recovery Room<br>• Sports Medicine<br>• Anti-Doping Area<br>• Consultant room<br>• X-Ray Room | |
| 5 | Spectator Area For Athletic Track | • Outdoor Viewing Area | |
| **A1.2** | **GROUND MEZZANINE FLOOR** | | |
| 1 | Service Floor | • AHU Room<br>• UPS Room | |
| | | | |

| | | | |
|---|---|---|---|
| **A1.3** | **FIRST FLOOR** | | |
| 1 | Strength & Conditioning Department | • 55MT Long Running track (including 2.5 m buffer zone at both ends)<br>• Dumbbell Area<br>• Punching Area<br>• Cardio area<br>• Suspension & Bodyweight Training<br>• Rotational Power Throw Area<br>• Performance Labs<br>• Office & Staff Area | |
| **A1.4** | **FIRST MEZZANINE FLOOR** | | |
| 1 | Service Floor | • AHU Room | |
| **A1.5** | **SECOND FLOOR** | | |
| 1 | Nutrition Services | • Reception, Waiting Area<br>• HOD Cabin & Staff Room<br>• Discussion Room<br>• Seminar Hall<br>• Counselling Room<br>• Research Kitchen | |
| 2 | Biochemistry Department | • Reception & Waiting Area<br>• Biochemistry Lab<br>• Sampling Workstation<br>• HOD Cabin & Staff Room | |
| 3 | Anthropometry Services | • Reception & Waiting Area<br>• Classroom<br>• HOD Cabin & Staff Room<br>• Assessment Rooms<br>• BOD POD room<br>• 3D Scanner Room | |
| 4 | Exercise and Sports Physiology Services | • Reception & Waiting Area<br>• HOD Cabin & Staff Room<br>• Metabolic Station<br>• Preparation & Portable Device Room<br>• Central Research & Round Workstation<br>• Genetic Lab<br>• Hypoxic Chamber<br>• Machine Room<br>• Athletic Chamber<br>• Swimming Flume | |

| | | | |
|---|---|---|---|
| 5 | Psychology Services | • Reception & Waiting Area<br>• HOD Cabin & Staff Room<br>• Relaxation Room<br>• Counselling Room<br>• Psychology Lab | |

| **B. Site Development & Utility Works** | | |
|---|---|---|
| a | Underground Water Tank | Capacity as per MEP DBR |
| b | Sewage Treatment Plant | Capacity as per MEP DBR |
| c | Electrical Sub Station Works | Please refer MEP drawings |
| e | Roads | 6.0 M wide Trimix roads |
| g | Car Parking | 20 Nos. 4 wheeler and 25 Nos. two wheeler Parking is proposed. |
| h | Storm Water Drains | 600 mm wide storm water drain |
| K | Hardscapes | |
| | (i) Roads (bituminous) | |
| | (ii) Pathways(pavers) | |
| | (iii) Stone Pitching works | |

## 2.5 Silent Features of the Design

- The goal of this project is to develop a state-of-the-art high performance centre that provides a safe, designated facility for all ages and skill levels. The complex will offer training facilities within a single, integrated location with a well-organized layout.
- Zoning: Separate zones for different programs/ departments (e.g. athletes, coaches and Support staff) are designed to streamline circulation, maintain privacy & operational effectiveness.
- Fire Safety: Includes fire alarms, and clear evacuation routes.
- Seismic Safety: Designed to withstand earthquakes.
- 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.
- Provision of maximum light and ventilation to all spaces.
- Provision of facilities for disabled persons.
- 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 per site requirement.

### 2.5.1 Energy Efficiency Feature for Green Building

- AAC Block 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.

### 2.5.2 Landscape

- 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 Area

The total minimum 300 spectator capacity is considered for outdoor viewing of athletic track events.

## 3.2 Architectural Design Objectives

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

1. **Hydrotherapy Pool:**

a. The swimming pool will measure 12.5 meters in length and 12.5 meters in width, accommodating all equipment's as per Tender drawing.

b. The pool will include setbacks of 2.5 meters at both ends and 2.25 meters on each side.

2. **Multi-Disciplinary Analysis Area:**

c. The Multi-Disciplinary Analysis Area will span 28.0 meters in length and 16.0 meters in width, accommodating activities such as hockey, volleyball, basketball, tennis, and weightlifting. It will feature a clear height of not less than 12 meters.

3. **Badminton Court:**

a. The badminton court will be 13.6 meters long and 6.1 meters wide, with a setback of 2 meters at each end and 1.5 meters on either side.

4. **Athletic Track:**

a. The athletic track in biomechanics department will feature a synthetic surface and extend 70 meters in length, comprising three lanes each 1.2 meters wide. It is designed for sprinting, jumping, and throwing mechanics, with force plate slots integrated into the layout and filled with dummy plates.

b. The athletic track in strength and conditioning department will feature both synthetic & grass surface and extend 55 meters in length, comprising three lanes each 1 meter wide.

5. **Jump Pit:**

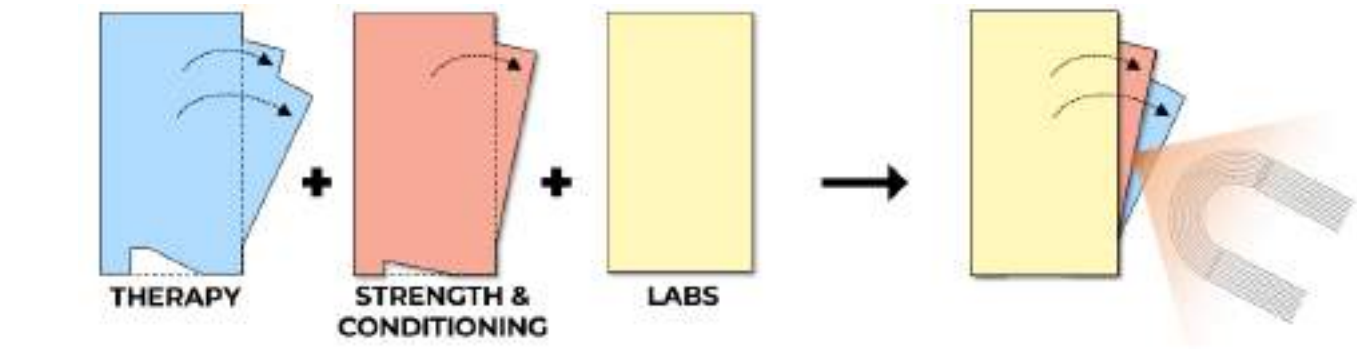
a. The jump pit will be 8.0 meters long and 4.16 meters wide, with setbacks of 3.32 meters on each side and 4 meters at the end. It is designed to accommodate long jump, high jump, triple jump, and pole vault.

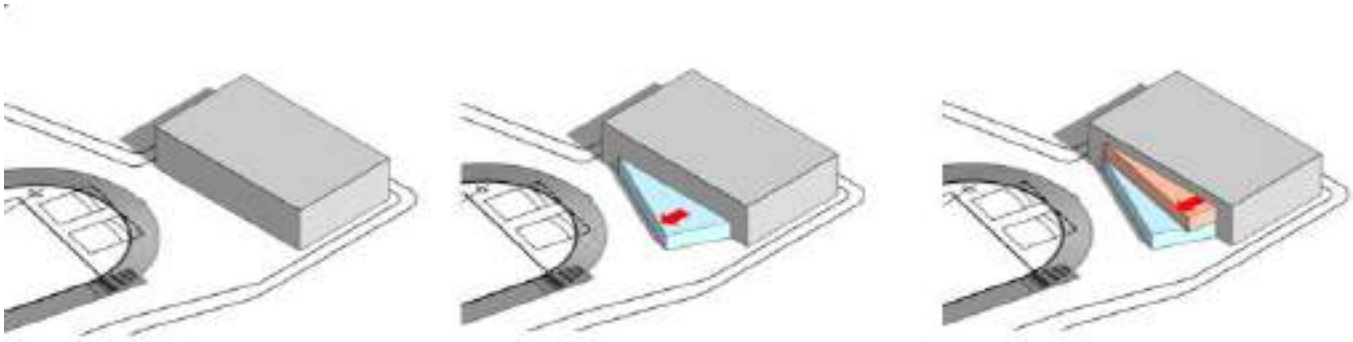
6. **Regulatory Compliance:**

a. The facility must comply with all relevant regulatory standards, NBC (2016), Green Guide (for spectator safety and comfort) and Fire Engineering standards (for safety during normal and emergency egress).

## 3.3 Concept & Façade Design

- The architectural design of the HPC should reflect its functionality and purpose with a strong and impressive visual form, enhancing the identity and presence of the facility.
- The external façade massing and form shall follow the architectural intent given in Tender drawings & documents.
- The building massing is conceived as a series of overlapping cascades, creating a dynamic, forward-thrusting form. The architecture conveys a sense of motion, orienting itself toward the athletic track as if in constant movement.
- No reflective or tinted glass shall be used on field of play site of the range. 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 facades shall be designed to achieve a comfortable level of thermal performance to the main serviced elements of the building.



INITIAL MASSING
The design process begins with a rectilinear building mass, defining the structural grid and spatial footprint.

GROUND FLOOR ARTICULATION
The ground floor slab is moved towards the Field of Play to establish a primary visual axis, simultaneously generating a usable terrace above for Level 01.

INTERMEDIATE LEVEL CASCADE
Level 02 is advanced in a stepped configuration, creating a cascading volumetric shift that enhances sightlines to the Field of Play while forming a secondary terrace for Level 02.

FORMAL INTEGRATION
A continuous upper plate is introduced, encapsulating the staggered floor plates within a unifying volumetric envelope and achieving a coherent architectural expression.

# 4. ATHLETE'S FACILITIES

## 4.1 Changing Room & Toilet facilities

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

| User Type | Min. No. of Urinals | Min. No. of WCs | Min. no. of Washbasins |
|---|---|---|---|
| Male | 1 per 50 users | 1 per 25 users | 1 per 60 users |
| Female | - | 1 per 25 users | 1 per 60 users |

- Urinals shall be provided in the male toilets in addition to WC's. Mirror, hand drying facility, soap dispensers, lavatories and toilet partitions
- Cleaner's rooms with storage shall be provided to service the toilet blocks.
- Toilet block entrances 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.
- 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.

# 5. ENTRANCES AND CIRCULATION

## 5.1 Entrances

- An efficient and effective control system for access into and exit from the complex shall be provided for all users.
- Day to day operations shall provide segregated entry points for athletes, coaches and office staff.

- Dedicated service entry points shall be provided for direct access to service floors, ensuring minimal disruption to athlete's daily routines.
- Emergency egress routes shall be considered.

### 5.1.1 Access and Circulation

- A system for the efficient and effective control of access into and out of the HPC complex and circulation around the outside and within the HPC complex 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.
- A computer-based access control system for staff and athletes.

### 5.1.2 Players & Staff Entrance

- A secure Player's & Staff's entry within the building with drop-off. This entrance shall be universal so that physically challenged can access the building with ease.
- All access and circulation areas shall be free from hazards, adequately drained where necessary, and slip resistant flooring.

### 5.1.3 Emergency Entrance

- A designated emergency entrance shall be provided to ensure rapid and unobstructed access for first responders and authorized personnel during critical situations ease.

## 5.2 Passenger Lifts

- Passenger lifts shall serve all levels of the HPC complex. All lifts shall be designed and installed in general accordance with the National Building Code and applicable safety regulations.
- Lifts shall have centre opening.
- At least one lift to be sized to accommodate wheelchair.
- At least one lift to accommodate 20 passengers or suitable for stretchers during emergency conditions to be provided.
- 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.

## 5.3 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 shall have a minimum width of 2.0 m, and the travel distance between two staircases shall not exceed 60 meters.
- Public stairs shall be generally provided with natural ventilation.
- Anti-skid flooring to be provided on stairs and ramps.
- Design for stairs directly into wide open spaces.

# 6. ATHLETE FACILITIES

Athlete changing room facilities shall be located on the ground and first floors of the High-Performance Center. These areas will be positioned in close proximity to the training zones to ensure seamless accessibility and support operational efficiency in daily athletic routines.

The athlete support facilities shall include:

- Dedicated changing areas for male and female
- Locker rooms for male and female
- Toilet and shower facilities for male and female
- Secure storage

## 6.1 Athletes Changing Rooms

The changing room must be located in close proximity to the athlete's facility for ease of access. It must include the following facilities:

- Washroom
- Shower area
- Changing area
- Locker room intended for safekeeping of individual items and athletic equipment

Adequate locker space must be provided.

Unisex disabled person's toilet to be provided for para athlete.

Filtered Drinking Water Facility shall be provided with each toilet block.

## 6.2 Anti-Doping Room

- An anti-doping room shall be incorporated within the sports medicine department on the ground floor, strategically positioned near the sports training area to ensure convenient access and operational efficiency.
- Drug testing facilities shall include the following:
- WC and hand basin.
- 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.

### 6.3 Coach Room

Coaches' rooms shall be located in close proximity to the training area, complemented by dedicated discussion spaces to facilitate effective guidance and mentoring of athletes.

### 6.4 Meeting cum seminar room

To establish a multi-purpose Meeting and Seminar Room on the second floor of the High-Performance Center to support administrative discussions, strategic planning sessions, athlete briefings, knowledge-sharing seminars, workshops, and small conferences.

## 7. HIGH PERFORMANCE CENTRE

The High-Performance Centre is a state-of-the-art facility designed to support elite-level athletes in achieving peak performance. HPC provides a controlled, athlete-focused environment where precision, preparation, and performance come together.

Equipped with advanced training tools, recovery area, and coaching support spaces. Following rooms shall be provided in HPC area:

### 7.1 Sports & Conditioning Department

High-Performance Centre (HPC) is designed to enhance the physical conditioning of athletes, supporting stability, posture, endurance, and injury prevention. Provide an air conditioned area for use by players & support staff.

- Large, robust space facilitate stretching and limbering up

The stretch area should be supplied with vinyl covered padded floor matting and wall mounted mirrors. 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)

### 7.2 Hydrotherapy & Recovery Department

Hydrotherapy is a recognized therapeutic modality that employs water in various forms such as hot, cold, steam, or ice to alleviate pain, enhance circulatory function, and facilitate physical rehabilitation. It is particularly effective in addressing conditions such as muscular discomfort, joint stiffness, inflammation, and psychological stress.

A physiotherapy room is vital for ensuring athlete longevity, performance optimization, and injury prevention and recovery. It should be located on the mezzanine floor and have direct access from the gymnasium area.

## 7.3 Consultation Rooms

A consultation room serves multiple important functions aimed at supporting athletes' performance and overall well-being.

## 7.4 Bio-Chemistry Lab

The biochemistry laboratory within a sports high performance centre plays a pivotal role in supporting athlete development through scientific evaluation and monitoring. It facilitates the assessment of biochemical and hormonal markers that reflect nutritional status, metabolic function, muscle recovery, and overall physiological adaptation to training.

## 7.5 Sports Physiology

**Sports Physiology** services are a critical component of a Sports High Performance Centre, focusing on the scientific understanding, measurement, and enhancement of athletic performance. These services are designed to assess, monitor, and improve the physical capacities of athletes through evidence-based methodologies, ensuring peak performance while minimizing the risk of injury.

The department operates in close coordination with coaches, sports scientists, medical professionals, and technical staff to deliver individualized support based on the specific needs and goals of each athlete or team.

The Sports Physiology Department will be equipped with dedicated and purpose-built spaces, including:

- Genetic Lab
- HOD Room
- Staff room
- Waiting area
- Swimming flume
- Storages and flat stations
- Neuromuscular testing zones
- Metabolic stations, preparations area
- Central research area & athletic chamber
- Hypoxic chamber with machine room storages

## 7.6 Psychology lab

The psychology laboratory within a sports high performance centre plays a vital role in enhancing athletic performance by addressing the mental and emotional dimensions of training and competition. It provides evidence-based psychological assessments and interventions aimed at optimizing focus, motivation, resilience, and stress management.

### 7.7 Nutrition Department

The Sport Nutrition Department at the HPC, arrangement is responsible for guidance, counselling and planning of sport nutrition to optimize and enhance training and competition performance, as well as to optimize recovery.

### 7.8 Anthropometry Department

The anthropometry laboratory in a sports high performance centre plays a critical role in evaluating and optimizing athlete development through precise measurement and analysis of body composition and physical structure. It supports evidence-based decision-making in talent identification, training customization, and performance enhancement.

## 8. HIGH PERFORMANCE CENTRE OPERATIONS FACILITIES

### 8.1 General Building Storage

A storage room shall be provided for miscellaneous building storage.

### 8.2 Waste management System

Waste management system and recycling policy for food service and for HPC complex 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.

### 8.3 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.

# 9. EXTERNAL DEVELOPMENT

- 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.

## 9.1 Parking

Parking distribution will be followed as per local regulations. However, the parking count does not comply with the local byelaws due to space constraints. Therefore, parking facilities shall be provided as per the directions of the Engineer-in-Charge.

## 9.2 Vehicular & Pedestrian Gate

The HPC complex shall be accessed from internal Loop Road, located within Netaji Subhas Southern Centre campus.

## 9.3 Service Buildings

The High Performance Centre complex facility shall include Sewage Treatment Plant (STP), underground tank and an Electrical Substation, both of which are integral to the operational functionality of the facility.

### 9.3.1 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 high performance centre premises. Refer MEP DBR for more details.

### 9.3.2 The Electrical Substation

It shall be constructed to provide a stable and reliable power supply to the entire complex 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.

## 9.4 Softscape

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.

- All landscape trees, shrubs, and ground cover shall be provided as specified in the architectural drawings.

# 10. 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:
- Signage within the HPC complex 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, Security and other public facilities.
- All signage to be provided including Player's facilities, Car parks, Departments, operations and services 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.

# 11. 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 the HPC complex.

## 11.1 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.

## 11.2 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.

## 11.3 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.

## 11.4 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 practises will be implemented.

## 11.5 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.

# 12. AREA STATEMENT

## 12.1 High Performance Centre Built-up Area Statement

| HIGH PERORMANCE CENTRE, KARNATAKA PROPOSED AREA STATEMENT | | |
|---|---|---|
| **S.NO.** | **NOS OF FLOOR** | **G.F+2+(INCLUDING G MEZZ+1ST MEZZ)** |
| 1 | GROUND FLOOR | 4055.0 |
| 2 | GROUND MEZZANINE FLOOR | 358.0 |
| 3 | FIRST FLOOR | 2745.0 |
| 4 | FIRST MEZZANINE FLOOR | 175.0 |
| 5 | SECOND FLOOR | 3228.0 |
| | **GRAND TOTAL BUILT-UP AREA** | **10561.0 SQM.** |

# 13. ARCHITECTURAL FINISHES

| GROUND FLOOR | | | | |
|---|---|---|---|---|
| **SR. NO.** | **SPACE** | | **CATEGORY** | **SPECIFICATION** |
| 1 | Entrance lobby / lift lobby | 1 | Flooring | Granite finish & colour as per Architects Specification in combinations |
| | | 2 | Wall | Wall panelling with combination of veneer and Granite |
| | | 3 | Ceiling | Baffle Ceiling-Combination of Gypsum+ wooden battens |
| 2 | Corridor | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 3 | X-ray room | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 4 | Sports Medicine | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 5 | Anti-Doping Control room | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 6 | Consultant room | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 7 | Recovery room | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 9 | Emergency medical room | 1 | Flooring | Vinyl Flooring on VDF |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |

| | | | | |
|---|---|---|---|---|
| 9 | Toilets | 1 | Flooring | 600MM X 600MM Anti – Skid VitrifiedTiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion+Ceramic tile 300x600 dado upto 2400mm Height |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| | | 4 | Partitions | HPL Partitioning System between Fixtures |
| 10 | Locker room | 1 | Flooring | 600MM X 600MM Anti – Skid VitrifiedTiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 11 | Shower Area | 1 | Flooring | 600MM X 600MM Anti – Skid VitrifiedTiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion+Ceramic tile 300x600 dado upto 2400mm Height |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| 12 | Meeting room | 1 | Flooring | Wooden Flooring |
| | | 2 | Wall | Wooden cladding 50 % + Acoustic paneling |
| | | 3 | Ceiling | Combination of Acoustic + Gypsum Ceiling |
| 13 | Staff Room/office Room | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt VitrifiedTiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 14 | Massage Bed rooms /Electrotherapy rooms | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt VitrifiedTiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 15 | Exercise Area/Rehab Area | 1 | Flooring | 30 mm thk Heavy Duty Rubber tiles Anti Vibration |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 16 | visual rehabilitation area | 1 | Flooring | Carpet Flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 17 | ice bath/jacuzzi/contrast | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |

| | | | | |
|---|---|---|---|---|
| | bath facility/cryo chamber | 2 | Wall | Wall Care Putty + Acrylic Emulsion+Ceramic tile 300x600 dado upto 2400mm Height |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| 18 | Steam Room | 1 | Flooring | 600 x 600 x 10 mm thick Antiskid Vitrified tilesas per approved specification |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion+Ceramic tile 300x600 dado upto 2400mm Height |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| 19 | Sauna Room | 1 | Flooring | Wooden Flooring |
| | | 2 | Wall | Wooden Cladding upto false ceiling Height |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| 20 | Balancing tank / Store room | 1 | Flooring | IPS Flooring with Epoxy Paint |
| | | 2 | Wall | Smooth Plaster + Colour Wash |
| | | 3 | Ceiling | OBD Paint |
| 21 | Hydrotherapy POOL Area | 1 | Flooring | Glass mosaic Tiles |
| | | 2 | Wall | Glass mosaic Tiles |
| | | 3 | Ceiling | Combination of Gypsum Ceiling & Acoustic ceiling(Grid & Modular) |
| 22 | Hydrotherapy Deck Area | 1 | Flooring | Anti – Skid Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum Ceiling & Acoustic ceiling(Grid & Modular) |
| | **Bio-mechanics Area** | | | |
| 23 | Track Area | 1 | Flooring | 13 mm thk Synthetic Flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 24 | Badminton Area | 1 | Flooring | 7.5mm synthetic sport flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 25 | Multi Sports Area | 1 | Flooring | 7.5mm synthetic sport flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum Ceiling & Acoustic ceiling(Grid & Modular) |
| 26 | Staircase | 1 | Flooring | Granite stone with nosing and anti-skid grooves |

| | | | | |
|---|---|---|---|---|
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | OBD Paint |
| | | 4 | Railing | Side Mounted S.S. 316 Grab Rail, Floor Mounted S.S. 316 Railing |
| 27 | Ramp | 1 | Flooring | 25mm thick Granite Stone with Nosing and anti-skid grooves |
| | | 2 | Railing | Side Mounted S.S. 316 Grab Rail, Floor Mounted S.S. 316 Railing |
| 28 | Outdoor steps at entry | 1 | Flooring | 25mm thick Granite Stone with Nosing and anti-skid grooves |
| | | 2 | Wall | Exterior Grade paint |
| | | 3 | Railing | Side Mounted S.S. 316 Grab Rail, Floor Mounted S.S. 316 Railing |
| 29 | Outdoor Spectator's seating | 1 | Flooring | IPS Flooring with Epoxy Paint |
| | | 2 | Wall | Exterior Grade paint |
| | | 3 | Railing | Ms railing |

| **FIRST FLOOR** | | | | |
|---|---|---|---|---|
| **SR. NO.** | **SPACE** | | **CATEGORY** | **SPECIFICATION** |
| 1 | Strength and conditioning area(weightlifting area ) | 1 | Flooring | 30 mm thk Heavy Duty Rubber tiles Anti Vibration |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 1a | Strength and conditioning area(Gym area) | 1 | Flooring | 20 mm thk Heavy Duty Rubber tiles Anti Vibration |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 2 | Synthetic track area | 1 | Flooring | 13 mm thk Synthetic Flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 3 | Grass Turf Track area | 1 | Flooring | Grass turf for Track |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 4 | Performance Lab Area | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 5 | Office room /Staff Room | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |

| | | | | |
|---|---|---|---|---|
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 6 | Toilets | 1 | Flooring | 600MM X 600MM Anti – Skid Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion+Ceramic tile 300x600 dado up to 2400mm Height |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| | | 4 | Partitions | HPL Partitioning System between Fixtures |
| 7 | Locker room | 1 | Flooring | 600MM X 600MM Anti – Skid Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 8 | Shower Area | 1 | Flooring | 600MM X 600MM Anti – Skid VitrifiedTiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion+Ceramic tile 300x600 dado upto 2400mm Height |
| | | 3 | Ceiling | Gypsum Calcium ciliated board grid Ceiling |
| 9 | MRI Room | 1 | Flooring | 6 mm thk Vinyl Flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 10 | Storeroom / Electrical room/AHU room | 1 | Flooring | Kota Stone flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | OBD Paint |
| 11 | Staircase | 1 | Flooring | Granite stone with nosing and anti-skid grooves |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | OBD Paint |
| | | 4 | Railing | Side Mounted S.S. 316 Grab Rail, Floor Mounted S.S. 316 Railing |
| | | | | |
| **SECOND FLOOR** | | | | |
| **SR. NO.** | **SPACE** | | **CATEGORY** | **SPECIFICATION** |
| **Biochemistry department** | | | | |

| | | | | |
|---|---|---|---|---|
| 1 | Biochemistry Lab | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 2 | HOD room | 1 | Flooring | Carpet Flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 3 | Sampling station | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 4 | Balance Area | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |

**Psychology department**

| | | | | |
|---|---|---|---|---|
| 1 | Psychology Lab | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 2 | Relaxation room | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 3 | Balance Area | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |

**Exercise and Sports Physiology Services department**

| | | | | |
|---|---|---|---|---|
| 1 | HOD room | 1 | Flooring | Carpet Flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 2 | GENETIC Lab | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 3 | Hypoxic Chamber | 1 | Flooring | Polyurethane(PU) Flooring |

| | | | | |
|---|---|---|---|---|
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| 4 | Swimming flume | 1 | Flooring | 600MM X 600MM Anti – Skid Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| 5 | NEUROMUSCULAR TESTING | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 6 | Balance Area | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |

**Nutrition department**

| | | | | |
|---|---|---|---|---|
| 1 | Research kitchen | 1 | Flooring | 600MM X 600MM Anti – Skid Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion+Ceramic tile 300x600 dado up to 2400mm Height |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| 2 | Counselling room | 1 | Flooring | Wooden Flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 3 | Balance Area | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |

**Anthropometry department**

| | | | | |
|---|---|---|---|---|
| 1 | BOD POD room | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 2 | 3D SCANNER ROOM | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |

| | | | | |
|---|---|---|---|---|
| 3 | Assessment area | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 4 | Balance Area | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |

**OTHER AREAS**

| | | | | |
|---|---|---|---|---|
| 1 | Seminar room | 1 | Flooring | Wooden Flooring |
| | | 2 | Wall | Wooden cladding 50 % + Acoustic panelling |
| | | 3 | Ceiling | Combination of Acoustic + Gypsum Ceiling |
| 2 | Coaches Area | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 3 | Toilets | 1 | Flooring | 600MM X 600MM Anti – Skid Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion+Ceramic tile 300x600 dado upto 2400mm Height |
| | | 3 | Ceiling | Gypsum+Calcium ciliated board grid Ceiling |
| | | 4 | Partitions | HPL Partitioning System between Fixtures |
| 4 | Corridor | 1 | Flooring | 600 MM X 600 MM full body Polished/Matt Vitrified Tiles |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | Combination of Gypsum & Mineral fiber Ceiling |
| 5 | Store/AHU/Electrical Room for all areas | 1 | Flooring | Kota Stone flooring |
| | | 2 | Wall | Wall Care Putty + Acrylic Emulsion |
| | | 3 | Ceiling | OBD Paint |
| **External façade** | | | | |
| 1 | External Wall | 1 | Wall | Texture paint |
| | | 2 | Glazing | Structural glazing double glazed |
| 2 | Extent portion above track area | 1 | Wall | Lightweight roof with ACP cladding |
| | | 2 | Glazing | |

# 14. VIEWS


HIGH PERFORMANCE CENTRE
SAI
adidas


HIGH PERFORMANCE CENTRE
SAI


HIGH PERFORMANCE CENTRE
SAI



# 15. STATUTORY APPROVALS

The Contractor shall include all approvals including but not limited to pre- construction, post-construction approvals, lesioning, obtaining all NoC's, CTE's, CTO's occupancy certificates, etc.,

This further includes all Statutory Approvals from Local Authorities/ Central Authorities/ Defense Authority/ Environment Authority/ Airport Authority/ Chief Fire Officer/ Pollution Control Board from inception to completion and occupation. The statutory payments or fees payable to Government/ Local Body for commencement of work and getting occupancy/completion of work, in order to obtain the NOCs/Permissions, shall be reimbursed to the Contractor by Department. Cutting/transplantation of existing trees after obtaining approval of tree cutting from concerned authority e.g. local body/forest department. The contractor shall also carry out the compensatory plantation (including maintenance of planted trees) in lieu of felled/cut trees as per stipulation of NOC/permission granted by concerned competent authority for cutting of trees. Contractor shall be responsible to adhere the terms of NOCs/Approvals granted by various statutory authorities. Tendered rates/amount of contractor is deemed to be inclusive of these conditions.

The planning, designing and engineering of all the works (Civil, electrical, mechanical, development works etc. along with services) shall be as per user requirement and architectural/structural control parameters specified in the contract document and compliant to National Building Code of India – 2016, Local Bye-laws applicable to site and subsequent amendment, Guidelines of Ministry of Environment, Forest & Climate Change, Planning for Barrier free environments (ADA & NBC), CPWD Guidelines and Space standards for barrier free built environment for disabled and elderly persons – 1998, ECBC norms – 2024, CPWD GHAR norms – 2021, GRIHA, BIS Codes, any other codes as applicable. Reference to standard/ code shall mean to their latest version/ edition.

**END OF REPORT**

**^^^^^**

# DETAILED PROJECT REPORT STRUCTURE

## HIGH PERFORMANCE CENTRE AT SPORTS AUTHORITY OF INDIA NSSC, BENGALURU, KARNATAKA

SAI
SPORTS AUTHORITY OF INDIA

HAL

collage design
Mumbai | Ahmedabad | New Delhi




REVION – R0
DATE-25-09-2025

**Table of Contents**


**1. Document Control ..... 3**

**2. INTRODUCTION ..... 4**

2.1 GENERAL ..... 4

**3. STRUCTURAL SYSTEM ..... 4**

3.1 HIGH PERFORMANCE CENTRE ..... 4

3.2 EXPANSION JOINTS: ..... 5

**Expansion joints are not provided in the respected structure. ..... 5**

**4. SOIL INVESTIGATION ..... 5**

4.1 SOIL PROFILE & SBC ..... 5

4.2 GROUND WATER TABLE ..... 5

**5. STRUCTURAL STANDARDS AND CODES: ..... 5**

**6. CONSTRUCTION MATERIAL ..... 6**

**7. DESIGN LOADS ..... 6**

7.1 DEAD LOAD ..... 7

7.2 LIVE (IMPOSED) LOAD ..... 8

7.3 SEISMIC LOAD ..... 9

7.4 WIND LOAD ..... 9

7.5 TEMPERATURE LOAD ..... 11

7.6 LOAD COMBINATION ..... 11

7.7 ORTHOGONALITY EFFECT ..... 11

**8. DESIGN CRITERIA ..... 11**

8.1 DESIGN CONCEPTS ..... 12

8.2 ANALYSIS ..... 12

8.3 ASSUMPTIONS: ..... 12

8.4 LIVE LOAD REDUCTION ..... 13

8.5 ANALYSIS SOFTWARE ..... 13

8.6 FIRE RESISTANCE ..... 13

8.7 DURABILITY ..... 14

8.8 SERVICEABILITY LIMITS ..... 14

8.1.1 DEFLECTION ..... 14

8.1.2 VIBRATIONS ..... 15

8.1.3 CRACK CONTROL ..... 15

**9. CONSTRUCTION METHODOLOGY ..... 15**

## 1. Document Control

| Revision No. | Date | Details of Revision incorporated |
|---|---|---|
| R0 | 22.09.2025 | Submitted for Review & Approval. |

# 1. INTRODUCTION

This report covers the design basis for the structural units proposed for High Performance center at SAI, NSSC, Bangalore aimed at enhancing sports infrastructure and fostering athletic talent within the region. Basically, the total area of the building in around 9935$m^{2.}$ The proposed building consists of G+2 Floors along with the Mezzanine floors.

## 1.1 GENERAL

The objective of this document is to present an abstracted view about the structural engineering aspects of the project, like structural systems, its analysis and design methodology. The document highlights the structural concept and the adopted design philosophy.

The structural design of the project has been governed by the architectural concept and the requirements for services. The design of the structure takes the following into consideration:

- Most cost-effective constructional system
- Efficient functioning of the building
- Speed of construction
- Adaptability to the local construction resources and techniques

# 2. STRUCTURAL SYSTEM

## 2.1 HIGH PERFORMANCE CENTRE

The proposed structure consists of G+2 upper floor (including ground + first floor mezzanine level) + terrace, with an area covered of 10560 SQM. The general framing arrangement of the structure is beam, column and slab.

Tabulated below is the summary of the floors with heights and primary floor usages.

| Floor Description | Floor Height (m) | Functional Usage |
|---|---|---|
| Ground | 7.2 /3.6 for mezzanine area only | Workstation, Storage room, Steam, Bio-mechanics area, Waiting area, Office room, Emergency medical room, Exercise area, Electrotherapy room, Testing area, Hydrotherapy pool, etc. |
| Mezzanine | 3.6 | AHU and UPS Room, Lift lobby, corridor. |
| First | 7.2 /3.6 for mezzanine area only | AHU Room, MRI Room, Glass track, Dumbbell area, Performance lab, Store room, Staff room, Office area, Power throwing area, Punching bag area, Terrace, lift lobby, toilet. |
| Mezzanine | 3.6 | AHU Room, Lift lobby, Terrace, Lift lobby, Corridor. |
| Second | 4.5 | Psychology lab, Office room, Relaxation room, Biochemistry room, Store room, Staff room, Service room, Waiting lobby, Lift lobby, Machine room, Toilet, Coaches area, Assessment area, Scanner room, Kitchen, Athlete chamber. |
| Terrace | | Lift Machine room, Head room |

**2.2 EXPANSION JOINTS:** Expansion joints are not provided in the respected structure.

## 3. SOIL INVESTIGATION

### 3.1 SOIL PROFILE & SBC

Bore hole plan is shared for conducting the soil investigation. Based on the Soil report, Shallow foundation is followed. From the soil report provided, Safe allowable bearing pressure is 25t/$m^2$ for 50mm permissible settlement. The support condition for columns in ETABS model is considered as fixed support. However, it is recommended to conduct a detailed soil investigation at the proposed site location before commencing the detailed design by the contractor.

### 3.2 GROUND WATER TABLE

Based on the soil report, Groundwater table is subjected to climatic changes and any changes in the surrounding area. Reconfirmation of groundwater level is proposed before any work relating to the groundwater regime.

## 4. STRUCTURAL STANDARDS AND CODES:

All structural elements are designed in accordance with the applicable requirements and recommendations of the reference codes and standards. They are regarded as minimum criteria and the values specified in this document are adopted where these prove more onerous.

| **Reference Codes & Standards (latest editions and amendments)** | |
|---|---|
| IS: 456-2000 | Plain and reinforced concrete - code of practice. |
| IS 875-Part 1- 1987 | Code of practice for design loads (other than Earthquake) for buildings and structures- dead loads — unit weights of building materials and stored materials. |
| IS 875 Part-2- 1987 | Code of practice for design loads (other than earthquake) for buildings and structures - imposed loads. |
| IS 875 Part-3- 2015 | Code of practice for design loads (other than earthquake) For buildings and structures - wind loads. |
| IS 875 Part-5- 1987 | Code of practice for design loads (other than earthquake) for buildings and structures- special loads and combinations. |
| I.S 4326 – 2013 | Code of practice for earthquake resistant design and construction of buildings. |
| I.S 13920 – 2016 | Code of practice for ductile detailing of RCC structures. |
| IS: 1893 Part-1 – 2016 | Criteria for earthquake resistant design of structures- general provisions and buildings. |
| IS: 800 – 2007 | Code of practice for general construction in steel. |
| IS: 801 – 1975 | Code of practice for Cold form Light gauge structural steel |
| IS: 1904 | Code of practice for design and construction of foundations in soils: general requirements. |
| IS: 1786 – 2008 | Specifications for high strength deformed steel bars and wires. |
| SP: 16 | Design aids for reinforced concrete to I.S: 456- 1978. |
| SP: 34 | Handbook on concrete reinforcement and Detailing. |
| SP: 7 | National Building Code of India 2016. |

## 5. CONSTRUCTION MATERIAL

The design of the concrete elements shall comply with IS 456 2000. Unless noted otherwise concrete is to be normal weight, with a typical dry density of 25 KN/$m^3$. The following list shows the 28-day cube strength (minimum) to be achieved by the concrete for some main structural members:

| Element | Concrete Grade |
|---|---|
| Footings/Pile Cap | M35/30 |
| Pedestal | M35/30 |
| Tie Beams and slabs | M35/30 |
| Columns | M35/30 |
| PCC | M15 |

Properties of steel reinforcement are to be adopted as per stipulations of the Indian standards. Only HYSD bars that are of standard sizes of 8, 10, 12, 16, 20, 25mm & 32mm diameter and with grade Fe550D with a minimum elongation index of 14.5% are to be used. All other mechanical and chemical properties are to be in accordance with the code IS: 1786- 2008.

## 6. DESIGN LOADS

The building is analyzed for the following basic load cases:

- Dead Load
- Live Load
- Seismic Load
- Wind Load
- Temperature load

The brief description of each basic load is as follows.

## 6.1 DEAD LOAD

The dead load comprises of self-weight of the structure and loading due to finishes and flooring etc. which are permanent in nature. The dead load of self-weight, partitions, ceiling, flooring, and facade etc. are applied as either area loads to slabs or line loads to beams.

The following table defines the minimum superimposed dead loads that are considered for the various elements.

Partition loads are calculated based on the final layout shown in the Architectural drawing. The loads are calculated based on the density of AAC block.

| **Super imposed Dead Loads IS 875-Part 1-1987** | |
|---|---|
| Item | Value |
| Finishes including service load | 0.2 T/m2 |
| Partition wall loads | 0.15T/m2 |
| Facade load | As per Actual |
| Concrete (RCC) | 2.5T/m3 |
| ACC masonry | 0.8 T/m3 |
| Water | 1.0 T/m3 |
| Glass | 2.6 T/m3 |
| Aluminium | 2.7 T/m3 |
| Aerated Light weight Blocks | 0.8 T/m3 |
| Plain concrete | 2.4T/m3 |
| Steel | 7.85T/m3 |
| Soil Filling | 2.0T/m3 |
| Brick Bat filling | 2.0T/m3 |

## 6.2 LIVE (IMPOSED) LOAD

Live Loads considered on floor slabs are as per IS 875 (PART II). In general, the following live loads are considered.

| **LIVE LOADS I.S. 875- Part 2- 1987** | |
|---|---|
| Floor / Item | Load |
| Assembly with fixed seats | 0.4 T/m2 |
| Assembly without fixed seats | 0.5T/m2 |
| Kitchen, Laundries | 0.3T/m2 |
| Offices, Storage room, Lab | 0.3T/m2 |
| Restaurants, Cafeteria, Dining area | 0.4T/m2 |
| Lounges, dressing, hostel rooms, | 0.2T/m2 |
| Gymnasium & Fitness Center | 0.75T/m2 |
| Corridors, hallways, stairs, concourse | 0.4T/m2 |
| Toilets | 0.2 T/m2 |
| Electrical room | 0.5T/m2 |
| Living/Dining | 0.2T/m2 |
| Balcony | 0.4T/m2 |
| Utility | 0.3T/m2 |
| Driveways and Ramps | 0.25T/m2 |
| Accessible roof | 0.15T/m2 |
| Non Accessible roof | 0.075T/m2 |

All other loads which are acting on the structure but not mentioned above will be taken and analyzed as per the governing I.S. Codes.

## 6.3 SEISMIC LOAD

IS 1893 – 2016 is used for calculating seismic load and as the basis for seismic load combinations. Pls. see the seismic zone map of India for the reference.

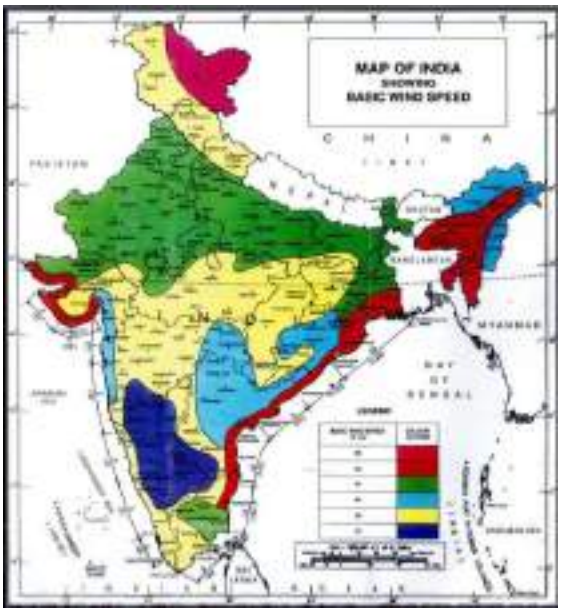



| SEISMIC LOADS I.S.1893 (PART 1):2016 | | |
|---|---|---|
| Seismic Parameters (clause 6.4.2) | Adopted Values | Remarks |
| Seismic Zone | II | (Figure 1.) |
| Zone Factor | Z = 0.1 | (Table 3) |
| Importance Factor | I = 1.5 | Important structure (Table 8) |
| Response Reduction Factor | R = 3.0 | Moment resisting frames (Table 9) |
| Structural Damping | 5% | Clause 7.2.4 |
| Time Period T | Minimum of:<br>T= 0.09H/(√d) &<br>$T=0.08H^{0.75}$ (RCC-Steel MRF without infill walls) | Clause 7.6.2 |

As the horizontal overhangs are large in this structure (IS 1893 Cl. 6.3.3.1.f), effects due to vertical earthquake shaking have been considered in the analysis.

## 6.4 WIND LOAD

Below mentioned wind parameters have been considered:




| **WIND LOADS I.S.875: 2015 (PART 3)** | | |
|---|---|---|
| Wind Parameters | Adopted Values | Remarks |
| Basic Wind Speed | Vb = 33m/s | Pls. refer the Wind map for India. |
| Probability Factor | K1=1 | Table 1 (Clause 6.3.1) |
| Terrain Factor | K2 | as Per Table 2 |
| Category | 2 | Clause 6.3.2.1 |
| Topography | K3 = 1.0 | Clause 6.3.3 |
| Importance factor for cyclonic regions | K4 = 1.0 | Clause 6.3.4 |
| Design wind speed | Vz=Vb.K1.K2. K3. K4 | |
| Design Wind Pressure | Pz= 0.6 Vz^2 | |
| Wind Force | F= Cf.Ae.Pz | Clause 6.3, where Cf is the Force Coefficient |

## 6.5 TEMPERATURE LOAD

As per IS456:2000 Clause 27.2, Temperature load is considered in the designing of structure at terrace floor level, since the length of the structure exceeds 45m.

## 6.6 LOAD COMBINATION

The following load combinations are adopted as per IS 456 and IS 1893.

| **Primary Load cases:** | | | |
|---|---|---|---|
| 1 | **Dead Load (D. L.)** | 5 | **Wx (X- dir. Wind)** |
| 2 | **Live Load (L. L.)** | 6 | **Wy (Y- dir. Wind)** |
| 3 | **Eqx (X- dir. earthquake)** | 7 | **Temperature Load (T)** |
| 4 | **Eqy (Y- dir. earthquake)** | | |

| **Basic Load combinations:** | | | | | |
|---|---|---|---|---|---|
| 1 | 1.5(D. L. + L. L.) | 12 | (0.9D. L. - 1.5Eqx) | 23 | (0.9D. L. + 1.5Wy) |
| 2 | 1.2(D. L. + L. L.+ Eqx) | 13 | (0.9D. L. - 1.5Eqy) | 24 | (0.9D. L. - 1.5Wx) |
| 3 | 1.2(D. L. + L. L.+ Eqy) | 14 | 1.2(D. L. + L. L.+ Wx) | 25 | (0.9D. L. - 1.5Wy) |
| 4 | 1.2(D. L. + L. L.- Eqx) | 15 | 1.2(D. L. + L. L.+ Wy) | 26 | 1.5(D.L +/- T) |
| 5 | 1.2(D. L. + L. L.- Eqy) | 16 | 1.2(D. L. + L. L.- Wx) | 27 | 1.1D.L+1.3 L.L +/- 1.1T |
| 6 | 1.5(D. L. + Eqx) | 17 | 1.2(D. L. + L. L.- Wy) | 28 | 1.0(D.L +/- EQ +/- T) |
| 7 | 1.5(D. L. + Eqy) | 18 | 1.5(D. L. + Wx) | 29 | 1.0(D.L + L.L +/- EQ +/-T) |
| 8 | 1.5(D. L. - Eqx) | 19 | 1.5(D. L. + Wy) | 30 | 1.0(D.L +/- W.L +/- T) |
| 9 | 1.5(D. L. - Eqy) | 20 | 1.5(D. L. – Wx) | 31 | 1.0(D.L + L.L +/- W.L +/-T) |
| 10 | (0.9D. L. + 1.5Eqx) | 21 | 1.5(D. L. – Wy) | | |
| 11 | (0.9D. L. + 1.5Eqy) | 22 | (0.9D. L. + 1.5Wx) | | |

Please note that whenever earthquake forces are included in the load combinations, the allowable bearing pressure on the soil shall be increased in accordance with Table 1 in IS:1893-2016.

## 6.7 ORTHOGONALITY EFFECT

All the columns and shear walls are orthogonal to each other in geometry. So, there is no need to check for the orthogonality effect, i.e., the 100-30% rule as per IS 1893.

# 7. DESIGN CRITERIA

The design of this structure takes into consideration various parameters that are important to ensure structural strength and rigidity. These are as prescribed by the Indian codes and as per the requirements for this particular structure considering the specific usage for which it is being constructed. These are described in detail below:

## 7.1 DESIGN CONCEPTS

All the RCC & Structural Steel members have been designed following guidelines of the codes mentioned above. Care has taken to ensure that the detailing is simpler to understand and assures proper strength. All the stability criteria as envisaged in the clause 20 of IS 456 are taken care in the analysis.

The environmental exposure condition for the structure is taken as "moderate" as per I.S.456. All the covers to the reinforcement bars are taken to suit the above-mentioned parameter.

## 7.2 ANALYSIS

Computer-aided analysis using finite element method (FEM) shall be carried out for the Analysis of structure.

## 7.3 ASSUMPTIONS:

- The structure is idealized as 3D space frame and analyzed using Etabs software package for both vertical and lateral loads.
- 
- The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and for the load combinations as given in the relevant codes.

- Temperature load is applied on the terrace floor of the buildings.

  Column : Frame Element
  RC Wall : Wall (Shell) Element
  Beam element : Frame Element
  Slab element : Membrane Element

- For 3D or 2D structural frame analysis ETABS or SAFE software shall be used, verified in-house spreadsheets will be used for the design of reinforced concrete (RC) and steel elements in consideration of flexure, shear and axial forces.

- The following are general parameters adopted in the analysis and design, Consideration of Diaphragm - Rigid Diaphragm.

**The following property modifiers are used for the structural elements.**

| Stiffness Modifier (Ultimate Limit State) | | |
|---|---|---|
| Element | Modifiers | Equivalent Stiffness Modifier |
| Walls | 0.7Ig | F11=0.7; F22=0.7; F12=0.7<br>M11=0.7, M22=0.7, M12=0.7 |
| Columns | 0.7Ig | I22=0.7; I33=0.7 |
| Reinforced Concrete Beams | 0.35Ig | I22=0.35; I33=0.35 |
| Reinforced Concrete Slabs | 0.25Ig | M11=0.25; M22=0.25; M12=0.25 |

| Stiffness Modifier (Serviceability Limit state) | | |
|---|---|---|
| Element | Modifiers | Equivalent Stiffness Modifier |
| Walls | 0.9Ig | F11=0.9; F22=0.9; F12=0.9<br>M11=0.9, M22=0.9,M12=0.9 |
| Columns | 0.9Ig | I22=0.9; I33=0.9 |
| Reinforced Concrete Beams | 0.7Ig | I22=0.7; I33=0.7 |
| Reinforced Concrete Slabs | 0.35Ig | M11=0.35; M22=0.35; M12=0.35 |

The detailing will be done in such a manner that sufficient level of ordinary detailing will be available for the main lateral load resisting elements. The lateral loads which are acting on each floor are shared by the members with respect to the floor diaphragm effects, lateral stiffness etc. The 3D Frame analysis of the structure gives the results of various parameters to be checked for the stability and serviceability of the structure like drift, deflection, torsion effects, soft story effects etc. The beams are designed for critical moments and shears out of various load combinations. Columns are designed for bi-axial moments resulting from frame moments, slenderness etc.,

### 7.4 LIVE LOAD REDUCTION

According to the Indian codes, IS 875, live load reductions can be considered in the analysis and design. So, this is considered in the analysis and design.

### 7.5 ANALYSIS SOFTWARE

A three-dimensional Finite Element Model is prepared for this structure using the software ETABS. The model incorporates all elements of the lateral and vertical load resisting system and so effectively captures the distribution of mass and stiffness along the height of the structure. Foundations are designed with some standard design tools like SAFE-16.

### 7.6 FIRE RESISTANCE

Fire rating of 2 hours has been assumed for vertical elements such as concrete and steel columns and 2 hours for beams, slabs and seating area, respectively.

### 7.7 DURABILITY

The concrete durability is affected by the concrete mix and the exposure condition it is subjected to. It can be ensured by the proper design of the concrete mix as appropriate for the Environmental Exposure condition and by providing sufficient cover to the outermost face of any reinforcement. The IS 456-2000 lists out the different environmental Exposure condition and based on it (Table 5) this structure falls into the Moderate category.

| Concrete Cover (mm) | | |
|---|---|---|
| Beams | 40 | Simply supported |
| | 30 | Continuous |
| Slabs | 35 | Simply supported |
| | 25 | Continuous |
| Ribs | 45 | Simply supported |
| | 35 | Continuous |
| Columns | 40 | 40mm to the links |
| Foundations | 75mm and 50mm | Bottom and side respectively |

Based on the requirements of the Fire rating and also for the environmental exposure condition as listed above, the concrete covers are worked out as below. (Also refer Table 16 and 16A-IS:456

### 7.8 SERVICEABILITY LIMITS

The limit states of Deflection, Vibration and cracking are studied and discussed in this section.

#### 8.1.1 DEFLECTION

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

The movements can be caused by gravity and lateral loads, long term creep and shrinkage effects, temperature stresses etc.

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

| **Global Displacements** | |
|---|---|
| Wind load | H/500 |
| Seismic Load | H/250 |

| **Element Deflections** ***(For concrete members)*** | |
|---|---|
| Vertical loads (Gravity) -Short Term | L/350 or 2cm |
| Vertical loads (Gravity) -Long Term | L/250 |

| **Element Deflections IS 800-2007** ***(For steel members)*** | |
|---|---|
| Lateral deflection for columns | H/300 |
| Vertical deflection for rafters | L/300 |

Care has been taken to ensure that for all the structural elements, Deflection values are well within the above limits.

### 8.1.2 VIBRATIONS

Floor vibrations generally make people uneasy and create concerns of structural distress. The highest vibrations are likely to arise from resonant response due to repeated footfalls at a frequency that is either the same or a multiple of the natural frequency of the floor. To provide the necessary vibration control, the structural floor system requires to be relatively rigid and of sufficient mass to reduce the acceleration.

The Steel Construction Institute (SCI) publication 076 addresses the above issue and suggests that the fundamental natural frequency of the floor system shall be kept at a minimum of 4 Hz to be within the limits prescribed for Vibration and acoustic control from human movements. The structures are provided with sufficient stiffness to the floors to cater for the above.

### 8.1.3 CRACK CONTROL

Cracking of the structural members can affect the durability and appearance of the structure and so all the codes stipulate certain guidelines to limit the crack width, depending on the environmental conditions they are exposed to or the importance/usage of the member.

IS.456 restricts the crack width to 0.3mm for similar environmental conditions. Accordingly, the rebar detailing, and designs are adopted to suit this requirement.

## 8. CONSTRUCTION METHODOLOGY

The structural design of the RCC units is so selected that it does not call for any special construction methodology with or without any specific constraints. The Foundations and other sub structure elements can be constructed by using any conventional methods. The mezzanine roofing area may require some construction sequence planning during the execution stage.

^^^^^

# DETAILED PROJECT REPORT MEP

## HIGH PERFORMANCE CENTRE AT SPORTS AUTHORITY OF INDIA NSSC, BENGALURU, KARNATAKA




REVION – R0

DATE-20-09-2025

# HIGH PERFORMANCE CENTER AT BANGALORE, KARNATAKA

## DESIGN BASIS REPORT

## FOR

## MEP SERVICES

**CLIENT**

**ARCHITECT**

**MEP CONSULTANT**

## DOCUMENT CONTROL: -

| Revision No. | Date | Details of Revision incorporated |
|---|---|---|
| R0 | 23-09-2025 | Submitted for Review & Approval. |

# CONTENTS

1) DOCUMENT CONTROL: - ..... 3
2) PREAMBLE: ..... 7
3) OUR SCOPE OF WORK: ..... 7
4) 1. HVAC SYSTEM ..... 8
5) PURPOSE: ..... 8
6) DESIGN STRATEGY & CRITERIA: ..... 8
7) Relevant Standards: ..... 8
8) BASIS OF DESIGN: ..... 9
9) BUILDING DATA ASSUMPTIONS: ..... 9
10) INDOOR AIR QUALITY- ..... 9
11) LOAD SUMMARY: ..... 11
12) SYSTEM SELECTION: - ..... 11
13) CHILLER SYSTEM: - ..... 11
14) VENTILATION SYSTEM: - ..... 12
15) AIR DISTRIBUTION SYSTEM ..... 12
16) DUCT SIZING CRITERIA ..... 12
17) 2. ELECTRICAL SYSTEM ..... 14
18) OBJECTIVE: ..... 14
19) CODES AND STANDARDS: ..... 14
20) ELECTRICAL LOAD LIST: ..... 14
21) SOURCE OF POWER SUPPLY: - ..... 15
22) GRID POWER ..... 15
23) DG SET FOR ALTERNATE POWER SOURCE ..... 15
24) ELECTRICAL DISTRIBUTION SCHEME: ..... 16
25) LIGHTING & RAW POWER DISTRIBUTION: - ..... 17
26) EXTERNAL LIGHTING: ..... 18
27) EMERGENCY LIGHTING: ..... 18
28) AUTOMATIC POWER FACTOR CONTROL: - ..... 18
29) CABLES & WIRES: ..... 18
30) EARTHING: ..... 19
31) UPS: ..... 19
32) ELECTRICAL REQUIREMENTS: ..... 19
33) LIGHTENING PROTECTION: ..... 19
34) 3. LOW VOLTAGE SYSTEM ..... 21
35) GENERAL ..... 21
36) CODES & LISTING: ..... 21
37) LOCAL CODES ..... 21
38) FIRE DETECTION AND ALARM SYSTEM ..... 21
39) BATTERY BACKUP ..... 22
40) EMERGENCY PUBLIC ADDRESS SYSTEM FOR EMERGENCY EVACUATION AND VOICE ALARM: 22
41) PA CABLE ..... 23

42) CLOSE CIRCUIT TELEVISION (CCTV) ..... 23
43) 4.BUILDING MANAGEMENT SYSTEMS ..... 24
44) INTRODUCTION ..... 24
45) SYSTEM DESCRIPTION ..... 24
46) SYSTEM ARCHITECTURE ..... 25
47) 5. PUBLIC HEALTH ENGINEERING SYSTEM ..... 26
48) PURPOSE: ..... 26
49) DESIGN STRATEGY & CRITERIA: ..... 26
50) DESIGN APPROACH ..... 26
51) WATER DEMAND ..... 26
52) WATER SUPPLY SCHEMATIC: ..... 27
53) POTABLE WATER ..... 27
54) FLUSHING WATER ..... 28
55) DAILY WATER DEMAND FOR THE PROJECT: ..... 28
56) TANK SUMMERY: ..... 29
57) WATER TREATEMENT PLANT: - ..... 29
58) SEWAGE TREATMENT PLANT: ..... 30
59) DRAINAGE SYSTEM: - ..... 30
60) STORM WATER DRAINAGE: ..... 31
61) EXTERNAL SEWER LINE CONNECTION: ..... 31
62) WATER METERING STRATEGY ..... 31
63) 6. FIRE FIGHTING SYSTEM ..... 32
64) DESIGN APPROACH: - ..... 32
65) DESIGN STRATEGY & CRITERIA ..... 32
66) BASIS OF DESIGN ..... 32
67) FIRE TANK CAPACITIES: ..... 32
68) FIRE FIGHTING RQUIREMENTS AS PER NBC: ..... 33
69) FIRE PUMPING SYSTEM: ..... 34
70) HYDRANT SYSTEM: ..... 34
71) LANDING VALVES & HOSE REELS ..... 34
72) LANDING VALVES & HOSE REELS ..... 34
73) FIRE BRIGADE CONNECTIONS ..... 34
74) SPRINKLER SYSTEM: ..... 35
75) PIPING & FITTINGS FOR SPRINKLERS ..... 35
76) TYPES OF SPRINKLERS ..... 35
77) PENDENT SPRINKLER ..... 35
78) UPRIGHT SPRINKLER ..... 35
79) FLOW SWITCHES ..... 35
80) SPRINKLER FLEXIBLE DROPS ..... 36
81) NON-RETURN VALVE. ..... 36
82) PRESSURE REDUCING VALVE. ..... 36
83) DRAIN KIT ..... 36
84) BUTTERFLY VALVE WITH TAMPER SWITCH ..... 36
85) PRESSURE GAUGE ..... 36
86) ORIFICE PLATE ..... 36

87) INSPECTION & TEST ..... 37
88) FIRE EXTINGUISHER ..... 37

## PREAMBLE:

This report outlines the preliminary design for a High performance center Consisting of G + 2 + T, located in Bangalore, Karnataka. The purpose of this design is to provide adequate accommodation and facilities for the residents, ensuring comfort, safety, and functionality, while also adhering to relevant engineering standards.

The objective of this report is to give an overview of MEP Services designed for the proposed Development.

Prior to Setting out for design following objectives have been established for the project.

- Code Compliance
- Energy Conservation
- Indoor Air Quality
- Fire Safety & Security
- Value Engineering

## OUR SCOPE OF WORK:

- Heat Ventilation Air-conditioning System
- Electrical System
- Low Voltage, Fire Alarm, Public Address
- Public Health Engineering
- Fire Fighting System

| Sr. No. | Building Type | Floors |
|---|---|---|
| 1 | HIGH PERFORMANCE CENTER AT BANGALORE, KARNATAKA | GROUND + 2 + TERRACE |

# 1. HVAC SYSTEM

## PURPOSE:

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 ASHRAE 62.1-2022 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.

## DESIGN STRATEGY & CRITERIA:

- Indian Society of Heating, Refrigerating and Air-Conditioning Engineers, an Indian national body defines the term Thermal comfort as a state of mind in humans that expresses satisfaction with the surrounding environment. Maintaining this standard of thermal comfort for occupants of buildings or other enclosures is one of the important goals of HVAC (heating, ventilation, and air conditioning) design engineers.
- The project is located in Bengaluru, Karnataka. Meteorological data was obtained from ISHRAE Weather Data book.

## Relevant Standards:

- ASHRAE 62.1-2022
- Duct construction standards as per relevant IS Codes and SMACNA
- ASHRAE Standard 55: Thermal comfort
- ISHRAE-2017/ Indian Weather Data-2014
- National Building Code of India (NBC-2016)
- ASHRAE Standard 55: Thermal comfort (2023)

## BASIS OF DESIGN:

### 1.3.1 Ambient Conditions

| | | |
|---|---|---|
| a) | Outside Condition | 34.4°C Dry Bulb (93.8° F DB)<br>20°C Wet Bulb (68.0° F WB) |
| b) | Inside Conditions | 23.0°C +/-1 Dry Bulb (73.4° F DB)<br>55% RH (No control on RH) |

## BUILDING DATA ASSUMPTIONS:

Building construction data proposed are as follows:

| | |
|---|---|
| All outer walls: | U = 0.33 Btu / Hr. Sq. Ft °F |
| Roof | U = 0.18 Btu / Hr. Sq. Ft °F |
| Floor | U = 0.15 Btu / Hr. Sq. Ft °F |
| Glass Specifications | SHGC 0.56<br>U-Value = 0.33 Btu/ Hr. Sq. Ft °F |

Above data for load calculation are assumed due to unavailability of data.

## OCCUPANCY LOAD DATA ASSUMPTIONS:

| Sr. No. | Application | Sensible | Latent |
|---|---|---|---|
| 1 | Office, Consultant, Staff Rooms, Waiting Lobby, Etc., | 245 | 205 |
| 2 | Fitness Centre | 525 | 925 |
| 3 | Research Kitchen Area | 280 | 270 |
| 4 | High Performance Centre,<br>Sports & associated rooms | 110 | 1090 |

## INDOOR AIR QUALITY-

Ventilation is the process by which fresh air is provided to occupants, and whereby concentrations of potentially harmful pollutants are diluted and removed from a space.

Ventilation is also used to passively cool a space and as a mechanism to distribute thermally conditioned air from cooling plant. Ventilation requirements for most of the spaces within the buildings have been provided equivalent to or higher than as suggested by National Building code and ASHRAE std. 62.1-2022 guidelines standards.

| | |
|---|---|
| People Outdoor Air Rate | 20 CFM/Person (Sports Area)<br>5 CFM/Person (Office/Consultant Rooms/Staff Rooms/Lobby) |

| | |
|---|---|
| Area outdoor Air Rate | 0.18 CFM/Sqft (Sports Area)<br>0.06 CFM/Sqft (Office/Consultant Rooms/Staff Rooms/Lobby) |

## LOAD SUMMARY:

Based on the architectural drawings and above considerations we have calculated the air conditioning load as follows:

| SR NO | AREA | SQFT | OCCUPANCY | FA CFM | SUMMER - TR (COOLING) | SUMMER DEH.CFM (COOLING) |
|---|---|---|---|---|---|---|
| 1 | GROUND FLOOR | 3006 | 415 | 3230 | 210 | 98373 |
| 3 | FIRST FLOOR | 2215 | 477 | 3814 | 159 | 59597 |
| 4 | SECOND FLOOR | 2497 | 709 | 5160 | 179 | 67206 |
| | TOTAL | 62533 | 1601 | 12204 | 548 | 225176 |

## SYSTEM SELECTION: -

## CHILLER SYSTEM: -

A central air conditioning system is proposed to be installed for the Sports Compels comprising of Air Cooled Non-Inverter Modular Chiller along with associated equipment like pumps, air handling units, fan coil units and ducting/piping with valves, air distribution system with grilles and diffusers, electrical panel, wiring, control wiring and earthing.

| PLANT SELECTION | | |
|---|---|---|
| **PARTICULAR** | **COOLING** | **REMARK** |
| CALCULATED LOAD | 548 (TR) | As per Calculation |
| DIVERSITY | 70% | |
| DIVERISFIED LOAD | 383 TR | |
| SELECTED | 40 TR X 12 NOS | Air Cooled Non-Invertor Modular Chiller – (10W+2S). |
| PUMPING SYSTEM | PRIMARY VARIABLE | HORIZONTAL SPLIT CASE/ END SUCTION |

## VENTILATION SYSTEM: -

The following table illustrates the type of Ventilation Systems to be used in corresponding applications.

| RECOMMENDED RATE OF AIR CIRCULATION FOR DIFFERENT AREAS | | | |
|---|---|---|---|
| **SR. No.** | **TYPE** | **ACPH** | **Remarks** |
| 1 | PUMP ROOM | 15-30 | Mechanical Ventilation |
| 2 | STORES | 03-06 | Mechanical Ventilation |
| 3 | STP AREAS | 30 MIN | Mechanical Ventilation |
| 4 | TOILETS | 06-10 | Mechanical Ventilation |
| 5 | UTILITY ROOM | 15-30 | Mechanical Ventilation |
| 6 | KITCHEN | | As Per BOH Consultant Requirement |
| 7 | STAIRCASE PRESSURIZATION | 50 PA | Mechanical Ventilation |
| 8 | LIFTWELL PRESSURIZATION | 50 PA | Mechanical Ventilation |
| 9 | SMOKE EXTRACTION | 12 | Mechanical Ventilation |

## AIR DISTRIBUTION SYSTEM

All ducts shall be factory fabricated from galvanized steel sheets (Class VII) of various thicknesses ranging from 26 Gauge (0.63mm) to 18 (1.2mm) gauge according to duct sizes and in accordance with SMACNA standards. Grilles/ diffusers shall be powder coated extruded aluminum construction and shall be provided as per the requirement of interior design.

## DUCT SIZING CRITERIA

A large part of total energy consumption within a building is attributed to the fans that move air through the ducts. The fan energy required to move the air through any duct system varies as the velocity of flow is changed. As the velocity increases, so does the static pressure that the fan needs to overcome and hence the energy usage increases. To reduce the velocity of flow, the ducts may be increased in size, however this results in larger space requirements and added cost of additional duct material, so a balance has to be established and duct sizes shall be optimized. The parameters listed in table will be used for optimal sizing of ducts.

Duct work systems are to be designed to limit the level of noise generated as indicated in the following tables, as well as to facilitate easy balancing.

Low pressure ductwork systems are to be sized by equal friction method with maximum pressure drop of 0.82 Pa/m (0.1-inch WC / 100 ft) & the velocities shall be as per the table in Duct Sizing criteria in order to minimize noise generation.

The color of exposed ducts shall be finalized based on approved specifications.

## DUCT INSULATION

Insulation material for ducts and shall be elastomeric nitrile rubber or cross-linked polyethylene. Other parameters such as thermal conductivity, density and thickness of insulation / cladding shall be indicated in tender specifications.

Ducting insulation thickness shall be as per table below.

| Ducting position | Thk. for non-coastal places | Thk. for coastal places |
|---|---|---|
| SA duct in RA path | 13 mm | 19 mm |
| Ducted return air system | SA duct: 19 mm<br>RA duct: 13 mm | SA duct: 25 mm<br>RA duct: 19 mm |
| Both SA & RA exposed | Both 25 mm | Both 25 mm |
| SA duct having open cell nitrile rubber insulation | 9 mm | 9 mm |

**Nitrile rubber Piping Insulation thickness shall be as follows:**

| Pipe nominal bore | Thk. for non-coastal places | Thk. for coastal places |
|---|---|---|
| 15 mm – 25 mm | 19 mm | 25 mm |
| 32 mm – 80 mm | 25 mm | 32 mm |
| 100 mm – 400 mm | 32 mm | 38 mm |
| Above 400 mm | 45 mm | 45 mm |

# 2. ELECTRICAL SYSTEM

## OBJECTIVE:

This section of the Design basis report covers the electrical and allied works. Purpose of design is to satisfy all requirements given by client & statutory authority guidelines. The design shall be reliable and safe electrical supply and distribution system which is important for any modern development buildings.
The salient features of design of Electrical system and provision are:

- Compliance of codes of practice and statutory requirements.
- Easy in operation, control and flexibility.
- Energy conservation measures in design.

## CODES AND STANDARDS:

- National Building Code 2016
- National Electrical Code – Bureau of Indian Standards
- Central Pollution Control Board
- National Fire Protection Association (NFPA)
- Indian Standard

## ELECTRICAL LOAD LIST:

| HPC BANGLORE - ELECTRICAL LOAD DETAILS | | | | |
|---|---|---|---|---|
| **SR. NO.** | **Description of Loads** | **Connected Load (kW)** | **Demand Factor** | **Maximum Demand (kW)** |
| 1 | Lighting Load | 28 | 0.70 | 19.35 |
| 2 | Raw Power Load | 75 | 0.30 | 22.50 |
| 3 | HPC Equipment (Assumed) | 150 | 0.70 | 105.00 |
| 4 | External & Landscape Lighting | 15 | 0.30 | 4.50 |
| 5 | HVAC | 620 | 0.70 | 434.00 |
| 6 | Ventilation | 10 | 0.50 | 5.00 |
| 7 | Emergency Ventilation | 30 | 0.00 | 0.00 |
| 8 | Lift Load | 24 | 0.40 | 9.60 |
| 9 | Fire Fighting Load | 9 | 0.10 | 0.93 |
| 10 | PHE | 47 | 0.50 | 23.30 |
| 11 | Swimming Pool Heating | 30 | 1.00 | 30.00 |
| 12 | Miscellaneous | 15 | 0.30 | 4.50 |
| | **TOTAL** | **1053** | | **659** |
| | **SUMMARY** | | | |
| | **Transformer Sizing** | | | |
| | Maximum Demand (kW) | | 658.7 | kW |
| | Considering P.F. improvement from 0.91 to 0.99 | | 665.3 | kVA |
| | Considered loading @ **80%** | | 831.7 | |
| | **Transformer Rating Recommended** | | **1 No of 1000 kVA Transformer** | |
| | **DG Sizing** | | | |

| | | | |
|---|---|---|---|
| | Maximum Demand (kW) | 658.7 | kW |
| | Considering P.F. 0.8 | 823.3 | kVA |
| | Overall Diversity 90% | 741.0 | kVA |
| | Considered 80% loading | 926.3 | kVA |
| | **DG Rating Recommended** | **2 Nos 500 kVA Radiator Cooled DG Set** | |

## SOURCE OF POWER SUPPLY: -

### GRID POWER

The principal source of electrical power shall be from Local Power Supply Company. The Incoming Power Supply for this project will be received at 11 kV from local HT power supply network.

The HT Power shall be tapped from nearest substation and HT Cable will be laid from substation to Electricity Power Supply Company HT Metering unit and then Terminated to 11kV HT Panel.

H.T meter for the connected load of 1053 KW & Demand load of 659 KW.

Based on the Electrical Demand load for entire project, it is suggested to provide Oil Cooled transformer substation & 1 No of HT panel. The panel specifications shall be complying to IEC 62271. The panel shall be motorized type VCBs, fault passage indication, communicable port for remote operation and monitoring system.

We shall provide One no. of 1000KVA Oil Cooled Transformer to cater the load of entire premises. Further LT power from this Transformer will be terminated in main LT panel in the electrical room.

The LT power shall subsequently be distributed to Sports Lighting Panel & other services such as External Lighting, PHE Pumps, Fire pumps etc. after passing through the auto changeover arrangement & safety devices providing protection to both human beings and equipment as described later in this document.

### DG SET FOR ALTERNATE POWER SOURCE

Based on the Electrical maximum demand load for the entire project, it is proposed **2 Nos. 500 kVA** prime rated Diesel Generator set. The Diesel Generator located on the Pump Room.

Following features shall be implemented on proposed DG set:

- Prime Rated
- Self-acoustic enclosure
- Engine-mounted radiator
- AMF control panel
- Integrated fuel tank with minimum of 8 hours of backup.
- Compliance:
    - Standards: Adheres to (CPCB 4+) norms & local approving authority.

- Automatic Operation:
    - Startup: Initiates automatically within 15-20 second of grid failure.
    - Shutdown: Automatically turns off when grid power is restored

- Control Integration: Monitored through main LT panel, with automatic operation managed by the AMF control panel.

- Flexibility:
  - Provision: Includes connections for a temporary external diesel generator if required.



*DG Set (Image for reference only)*

## ELECTRICAL DISTRIBUTION SCHEME:

All panel boards and their associated overcurrent devices will be sized for both the normal load current, as well as the maximum available short circuit current.
All standard panel boards will have Aluminum bus bars, a 100% rated neutral bus and a safety ground bus.

All panel boards should have at least 20% spare circuit breakers installed. Panel boards will confirm to the relevant Indian standard.

The Power panels shall be fabricated from MS sheet steel 16 gauge and shall be of compartmental design. The main supporting framework shall be of angle iron or fabricated by 14 SWG MS Sheet. The panel will be self-supporting design, dust and vermin proof, IP 42 for indoor panels and IP 55 for outdoor panels; fully inter-locked with isolating switches. The panel-mounted switches shall have Interlock defeat for testing and inspection. The board frames will be fabricated using suitable mild steel structural sections or pressed & shaped cold rolled sheet steel of thickness not less than 2.0mm & the frames be enclosed by cold rolled sheet steel of thickness not less than 1.6 mm, smoothly finished, levelled & free from flaws. Doors & covers shall be made of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary.

The panel shall be powder coated comprising of seven tank pre-treatments, degreasing and de-scaling in sulphuric acid etc. & shall be finished with powder coated paint over two coats of red oxide primer. Powder coating synthetic enamel paint for smooth finish. The color of paint shall be Siemens grey.

The panel shall be designed to facilitate inspection, cleaning and repairs. The clearance between phase to phase and phase to earth or metal parts shall be as per relevant IS standards.

The metering instruments like voltmeter, ammeter etc. shall be flush mounted and shall be of 0.5 class accuracy. All indication lamps shall be of LED type & all metering should be digital type. All energy meter will be with RS485 port & will have provision to BMS connectivity.

## LIGHTING & RAW POWER DISTRIBUTION: -

- Lighting & Power DBs will be provided depending on the electrical loads calculated based on number & type of light fixture. Each DB will have one number of FP MCB as Incomer & three numbers of DP RCCB (30 amps tripping current) as Sub incomer for each Phase. 230 Volts single phase supply will be provided to each fixture.

- Outdoor / Street lighting shall be as per architecture landscape drawing. These lights shall be controlled through times for a specific time of operation. LED Lights Fixture will be used.

**LUX LEVELS FOR DIFFERENR ROOMS:**

| Sr No | Area/Location Name | Average Lux | |
|---|---|---|---|
| 1 | Emergency Medical Room | 550 | Lux |
| 2 | Sports Shop | 350 | Lux |
| 3 | Anti Doping Rm | 600 | Lux |
| 4 | Sports Medicine | 550 | Lux |
| 5 | X Ray | 500 | Lux |
| 6 | Electrical Rm | 300 | Lux |
| 7 | Office St | 600 | Lux |
| 8 | D/W | 200 | Lux |
| 9 | Recovery Area/Entrance Lobby | 400 | Lux |
| 10 | Sauna | 400 | Lux |
| 11 | Steam | 400 | Lux |
| 12 | Waiting Area/Meeting | 500 | Lux |
| 13 | Contrast Bath Facility | 400 | Lux |
| 14 | Ice Bath | 400 | Lux |
| 15 | Cyro Chamber | 700 | Lux |
| 16 | Steam | 450 | Lux |
| 17 | Sauna | 400 | Lux |
| 18 | Ice Bath | 450 | Lux |
| 19 | Jacuzzi | 450 | Lux |
| 20 | Cryo Chamber | 400 | Lux |
| 21 | Contrast Bath Facility | 400 | Lux |
| 22 | Massager Rm Male X 5 | 500 | Lux |
| 23 | Electro Therapy Cabins X 10 | 500 | Lux |
| 24 | Balancing Tank/Filtration Equipment | 250 | Lux |
| 25 | Visual Rehabilition Area | 500 | Lux |
| 26 | Rehab Area/Exercise Area | 600 | Lux |
| 27 | Pool Area | 450 | Lux |
| 28 | Jacuzzi | 400 | Lux |
| 29 | Mri Room | 600 | Lux |
| 30 | Performance Lab | 500 | Lux |
| 31 | Play And Rack Area | 500 | Lux |

| | | | |
|---|---|---|---|
| 32 | Grass Track | 550 | Lux |
| 33 | Machine Room For Hypoxic | 550 | Lux |
| 34 | Hypoxic Chamber | 450 | Lux |
| 35 | Sampling Station | 600 | Lux |

## EXTERNAL LIGHTING:

- Area lighting, landscape lighting shall be done as per Architect's/ landscape consultant's design.
- Separate DB shall be provided for landscape lighting.
- Automatic timer controls to be installed for outdoor lights.

## EMERGENCY LIGHTING:

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

- Staircase and 20% lighting in circulation, corridor, lift lobbies, services area etc. and shall be provided through Inverter Supply having 90 minutes backup.
- Uninterpreted power supply (UPS) system for all IT, CCTV, Fire alarm, PA & USB charging points by centralized system with N configuration with 15 min battery backup.

## AUTOMATIC POWER FACTOR CONTROL: -

Capacitor banks shall be provided at substation level with the APFC Relay for control of power factor. As per regulation, all bulk users are required to maintain power factor of 0.95 lagging and above, failing which stringent penalties are imposed by the power distribution companies.

For planning purpose, the power factor correction shall be set for 0.95 lagging.

It is recommended to maintain a high-power factor of 0.95 which has the following merits:

- Utility companies insist that the power factor of the consumers' load will be maintained at 0.95 as mandatory. If power factor falls below the prescribed limit, a surcharge will be levied on the consumer.
- With a higher power factor, demand charges will be lower.
- The current flowing through the incoming main cable will get reduced which in turn will reduce the transmission losses (I2R).
- Utility Power companies will give incentive in the monthly electricity bill if the power factor higher than 0.95. Every .01 increase over & above 0.95 Power Factor will get 1% discount on the monthly consumption charges. For example, if the power factor is maintained at unity, then there will be 5% discount on the monthly consumption.

## CABLES & WIRES:

The distribution from inception of power to main panels, sub panels distribution boards, isolators of equipment will be carried out by Aluminum / Copper conductor XLPE insulated FRLS PVC sheathed armoured cables. The minimum size of Aluminum cable will be 10 sq. mm. These cable terminations will be carried by double compression brass alloy cable glands. Copper conductor cables will be terminated with copper Lugs & Aluminum conductor cables will be terminated with bimetallic lugs.

1.The system of wiring shall consist of PVC insulated FRLS copper conductor wires in metal conduits. Minimum size of copper conductor shall be 2.5 sq.mm. for lighting circuits and 4/2.5 sq.mm will be terminated with appropriate types of copper lugs for power. Color code shall be maintained for the entire wiring installation that is Red, Yellow and Blue for the three phases, Black for neutral and Green for Earthing. Besides, ferruling shall be provided for number coding and easy identification for maintenance purposes.

## EARTHING:

The earthing system for the Indoor Hall is designed to the comply with IS-3043 standard, ensure low earth resistance & complete protection in entire electrical system.

- **Earthing System Coverage**: Earthing extends across the LT distribution system using local earth pits and distributed earthing networks, effectively bonding all metallic enclosures / noncurrent carrying components, including panels, distribution boards (DBs), machinery, motors, and structural frames, as per IS 3043.
- **Materia**l: Copper / Galvanized Iron (GI) strips shall be laid over trays to connect enclosures, earthing strip size shall be as per short circuit rating.
- **Dedicated Earthing for Critical Systems:**
    - **Separate Earth Stations:** Dedicated earth pits shall be provided for critical systems such as DG & UPS Neutral, Servers and EPABX with earth resistance maintained below one ohm as recommended by IS 3043.

## UPS:

- UPS power supply locations and rating will be as IT guidelines and BOH / FOH equipment layout. These will be shown in relevant low side drawings.
- For Server/IT Room, Dedicated UPS with the N+1 configuration shall be provided. UPS backup time shall be 30 minutes for server.
- UPS Points will be provided to the Following Locations
    1. HPC Equipment's
    2. Workstations
    3. IT Racks

## ELECTRICAL REQUIREMENTS:

Following are the general provision made with the Electrical System & Electrical Rooms.

- Shock Treatment chart, first aid box & CO2 Fire extinguisher will be provided in Electrical Room.
- Mounting frames will be provided for all Electrical Panels wherever false flooring is provided.
- A minimum of 30% spare breakers will be provided on all Panels.
- Insulating Rubber Mats will be provided in Front & Back of All Electrical Panels.
- All Digital Energy Meters are with Communication protocol for Connectivity with BMS.
- Identification of Panel Feeders will be indicated on Aluminum Anodized Label.

## LIGHTENING PROTECTION:

Conventional LPS as per IEC 62305-3 is proposed to protect building from lightning strikes.

This part of IEC 62305 deals with the protection, in and around a structure, against physical damage and injury to living beings due to touch and step voltages.

The main and most effective measure for protection of structures against physical damage is considered to be the lightning protection system (LPS). It usually consists of both external and internal lightning protection systems.

An external LPS is intended to

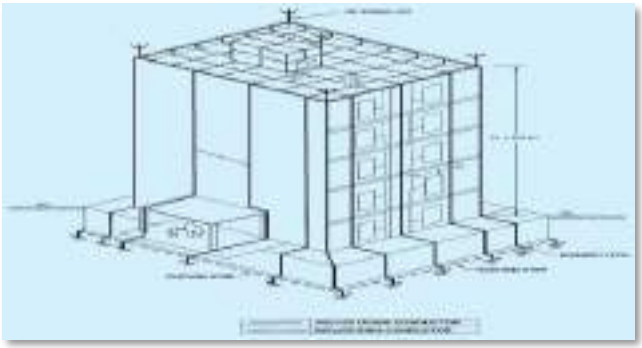
- Intercept a lightning flash to the structure (with an air-termination system),
- Conduct the lightning current safely towards earth (using a down-conductor system),
- Disperse the lightning current into the earth (using an earth-termination system). An internal LPS prevents dangerous sparking within the structure using either equipotential bonding or a separation distance (and hence electrical insulation) between the external LPS components and other electrically conducting elements internal to the structure.

Main protection measures against injury to living beings due to touch and step voltages are intended to:

- Reduce the dangerous current flowing through bodies by insulating exposed conductive parts, and/or by increasing the surface soil resistivity,
- Reduce the occurrence of dangerous touch and step voltages by physical restrictions and/or warning notices.

The Vertical air terminal is located at edge or highest point of staircase head room. Number of earth pits considered are as per Type B Earthing System.

Ring earthing to be installed at the depth of 1 meter from the protected structure and laid at the depth of 0.5 meters around the building periphery.



Following are the parts of Conventional Lightning Protection System.

- Grid of horizontal conductor above the roof.
- Down Conductors.
- Joints & connectors.
- Testing Joints.
- Earth Termination Network (Peripheral grid around the warehouse building of earth ground conductor

# 3. LOW VOLTAGE SYSTEM

The following systems shall be included in the Extra Low Voltage Systems.

- FIRE DETECTION AND ALARM SYSTEM (FAS)
- PUBLIC ADDRESS SYSTEM (PAS) FOR EMERGENCY VOICE ALARM
- CCTV

## GENERAL

- Fire detection shall be network fire detection system with distributed voice evacuation system. The network fire alarm system shall consist of all necessary hardware equipment and software programming to perform the following functions.
- Fire alarm and detection operation
- Control and monitoring of smoke control equipment and public address system etc.
- Network fire alarm control panel shall include all features for standalone FACP's and shall have network communication capabilities.
- The material appliances Equipment's and devices shall be listed by UL 864/FM/EN/54 as part of projected premises signaling system and smoke control system.

## CODES & LISTING:

The equipment and installation shall comply with the current and latest edition of the following codes and listing:

A. National Fire Protection Association (NFPA) - USA:

- NFPA 72 National Fire Alarm Code
- NFPA 76 Telecommunication Facilities
- NFPA 101 Life Safety Code
- NFPA 90A Air conditioning & ventilation system Listed

B. Underwriters Laboratories Inc. (UL) - USA:

- UL 268 Smoke Detectors for Fire Protective Signaling Systems
- UL 864 Control Units for Fire Protective Signaling Systems 9th Edition
- UL 268A Smoke Detectors for Duct Applications
- UL 521 Heat Detectors for Fire Protective Signaling Systems
- UL 346 Water flow Indicators for Fire Protective Signaling Systems
- UL 1481 Power Supply for fire protective signaling system.
- UL 1711 Amplifiers for Fire Protective Signaling Systems.

### LOCAL CODES

NATIONAL BUILDING CODES

IS-218

NFPA

## FIRE DETECTION AND ALARM SYSTEM

For buildings with a height of less than 10 meters, the National Building Code (NBC) Table 7 specifies that a Manually Operated Fire Alarm System (MOEFA) is required. Here's how the fire alarm system would be structured based on these guidelines:

Fire Detection and Alarm System for Buildings Below 10m

1. Manual Fire Alarm System (MOEFA):

- The system shall include manual call points at strategic locations.
- Audible and visual alarms shall be installed to alert occupants in case of fire.
- The fire alarm panel shall be capable of integrating with other service equipment

The system shall be of the addressable analog multiplexed type, completely supervised, such that a break in any wire (loop) shall not prevent any device from operating, with multiplexing cabinets installed in appropriate approved locations. The system shall be of the type such that each device connected to the system shall be provided with unique address and separately identified at the Main control panel (MCP). Detectors & devices shall be looped with Class A caballing.

- Common Service Areas at every floor level such as Electrical Rooms, IT/Servers rooms, Plant rooms will have Multicriteria Detectors.
- Fixed Heat Detectors to be proposed in Pantry Area.
- The monitor module shall be provided for interfacing of sprinkler flow switch, tamper switch on each level.
- Ventilation & Exhaust fans in case of fire.

## BATTERY BACKUP

Automatic battery charger, 24 volts sealed lead acid batteries sufficient for 48 hours normal working and then be capable of operating the system for 30 Minutes during an emergency condition as per NFPA-72 guidelines.

The life safety system is required to open Access Control Door in case of fire. FAS Cables LSZH armored cables with 2C X 1.5 sq.mm annealed copper conductor having Cross linkable Low smoke zero halogen insulation LSZH for inner and outer sheath. Armored cables should comply to BS 6387 & BS 7846 (latest edition). Armored cables should meet fire performance circuit integrity test as per codes.

The outer Sheath of cable should be RED in color.

## EMERGENCY PUBLIC ADDRESS SYSTEM FOR EMERGENCY EVACUATION AND VOICE ALARM:

This system shall permit one-way communication in the form of emergency announcement from the main control panel to any floor or group of floors simultaneously. The system shall be capable of manual operation or automatic operation initiated by the fire alarm system. Speakers shall be located as required to achieve acceptable audibility in all areas of the building. Communication loops will be supervised “Style 7” (Class “A”) and therefore return to the control panel.

The equipment will comprise primarily of speakers of varying types depending upon area allocation / usage.
Wherever false ceiling exists, the speakers will be of concealed mounting type with a wide bandwidth. Where false ceiling does not exist, the speakers will be surface mountable.

All PA system components should be provided with UL / EN 54 listed.

The Digital PA System is proposed for following area in entire premises,

- 6Watt Speaker Celling/Wall mounted shall be provided at Common Area such as Lobbies, Electrical Room, Toilets, and Staircase at each floor level will be in Lessor Scope.
- 6Watt Speaker Celling mounted shall be provided at complete floor common area.
- PA Call station will be at Reception.

Type of Speakers used in the Premises as following:

- 6 W Ceiling Mounted Speaker with Multi Tapping Feature.
- 6 W Wall Mounted Box Type Vandal Proof Cabinet speakers with Multi Tapping Feature.
- All speakers shall have the inbuilt facility of selectivity of the sound power produced.
- The PA rack with announcement will be placed in the Each Building Fire Control Room at ground floor level.

## PA CABLE

LSZH armored cables with 2C X 1.5 sq.mm Shielded Twin Twisted pair annealed copper conductor having Cross linkable Low smoke zero halogen insulation LSZH for inner and outer sheath. Armored cables should comply to BS 6387 & BS 7846 (latest edition).

## CLOSE CIRCUIT TELEVISION (CCTV)

The CCTV system will be provided for the following areas:

- Internal Area
  - (i) Staircase
  - (ii) Corridor/ Passage area

- External Periphery of Structure

The system will be integrated to a Network Video Recorder (NVR) with a high-capacity hard disc which stores the images in spatial format which cannot be tampered or modified. This central monitoring system for CCTV surveillance is placed in IT/Server room.

All cameras will be connected to Patch panel using Cat 6A cable.

CCTV Surveillance:

The CCTV system, will comprise of following-

1) Cameras will be of following type:

- High speed dome indoor type IP cameras: All above specified areas, entries, exists.
- High speed PTZ outdoor type IP cameras: External areas, entries & exits
- PTZ cameras – Analogue: Periphery of the building

2) Video recorder along with LCD
3) Storage system

## ACCESS CONTROL SYSTEM:

- Access system covering all the server room, HUB Room & UPS Rooms etc.
- Integration of access control will be done with fire alarm in case of fire to deactivate the Access controller.
- Wiring will be done with flexible cable and Conduits.

# 4.BUILDING MANAGEMENT SYSTEMS

## INTRODUCTION




Building management system is a centralized, robust, intelligent tool used for the management and monitoring of the electrical, mechanical and electromechanical services installed in the premises. These would include heating, cooling, ventilation, pumping, lighting, access control systems and mechanisms among others. The integration with third party devices will allow an optimum use of services thus bringing about an increase in efficiency and reduction in the energy consumption and the relevant carbon footprint.

## SYSTEM DESCRIPTION

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 running capacity
- Duty cycling of duty and standby plants and run time totalization
- Report generation, alarm, fault and change of status reporting
- Dynamic graphics 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, multiuser capability for current real time usage
- Real time event-based reporting and recording plus alarm management with relative instruction capability
- Security level access limit
- Help menu for software package to include run time totalization, time program and maintenance management

The system shall be equipped with two printers, one for printing alarm reports; another one is for trend logging.

## SYSTEM ARCHITECTURE




The system shall be logically structured into three distinctive levels which are

Management/Compute Level, Automation Level and Field Level. Each level shall be autonomous from the other. Peer to peer communication shall be possible on all system levels and the system design shall be modular in structure to allow straight forward extensions.

The following communication standards are appropriate to be used at the three levels.

- Management level: SCADA/MODBUS/BACnet, Ethernet TCP/IP
- Automation level: SCADA/MODBUS/BACnet on Lon Talk/ BACnet MSTP/ TCP/IP
- Field level: Lon Talk with Lon Mark profiles I 0-10V or 4-20 mA for sensors & field devices

# 5. PUBLIC HEALTH ENGINEERING SYSTEM

## PURPOSE:

The Section outlines Public Health Engineering system selections and extent of provisions for the project.

## DESIGN STRATEGY & CRITERIA:

Relevant Standards:

1) National building code of India 2016.
2) IS: 1742 – 1983 Code of practice for Building Drainage
3) IS :2065 -1983 Code of practice for water supply in buildings

## 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. Levels of internal roads / pavements and other services in the area will be considered while designing sewer and storm water drainage. Water Efficient Plumbing Fixtures 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 2.0 days of requirement. Both the Domestic and Flushing water supply for entire project have been through Hydro-pneumatic system. Water available at residual pressure 2.0 to 4.5 kg/cm$^2$ at fixture outlet.

## WATER DEMAND

Water demand has been arrived as per the fixture flow standards given in NBC 2016 – part 9 plumbing services, section 1 - clause 4.7.3.3. To meet the water requirement, underground tank is proposed with 2.0-day storage capacity for Domestic and flushing water storage.

**ASSUMPTION AND CONSIDERATION FOR WATER CONSUMPTION**

**Individual Spectators Watching (Per seat): -**

Gross water demand for Fixed Population = 10 LPCD (As per NBC-2016)

- Net Water Demand for Domestic Use = 04 LPCD
- Net Water Demand for Flushing Use = 06 LPCD

**Players/Staff/Guards/Utility Personnel's: -**

Gross water demand for Fixed Population = 45 LPCD

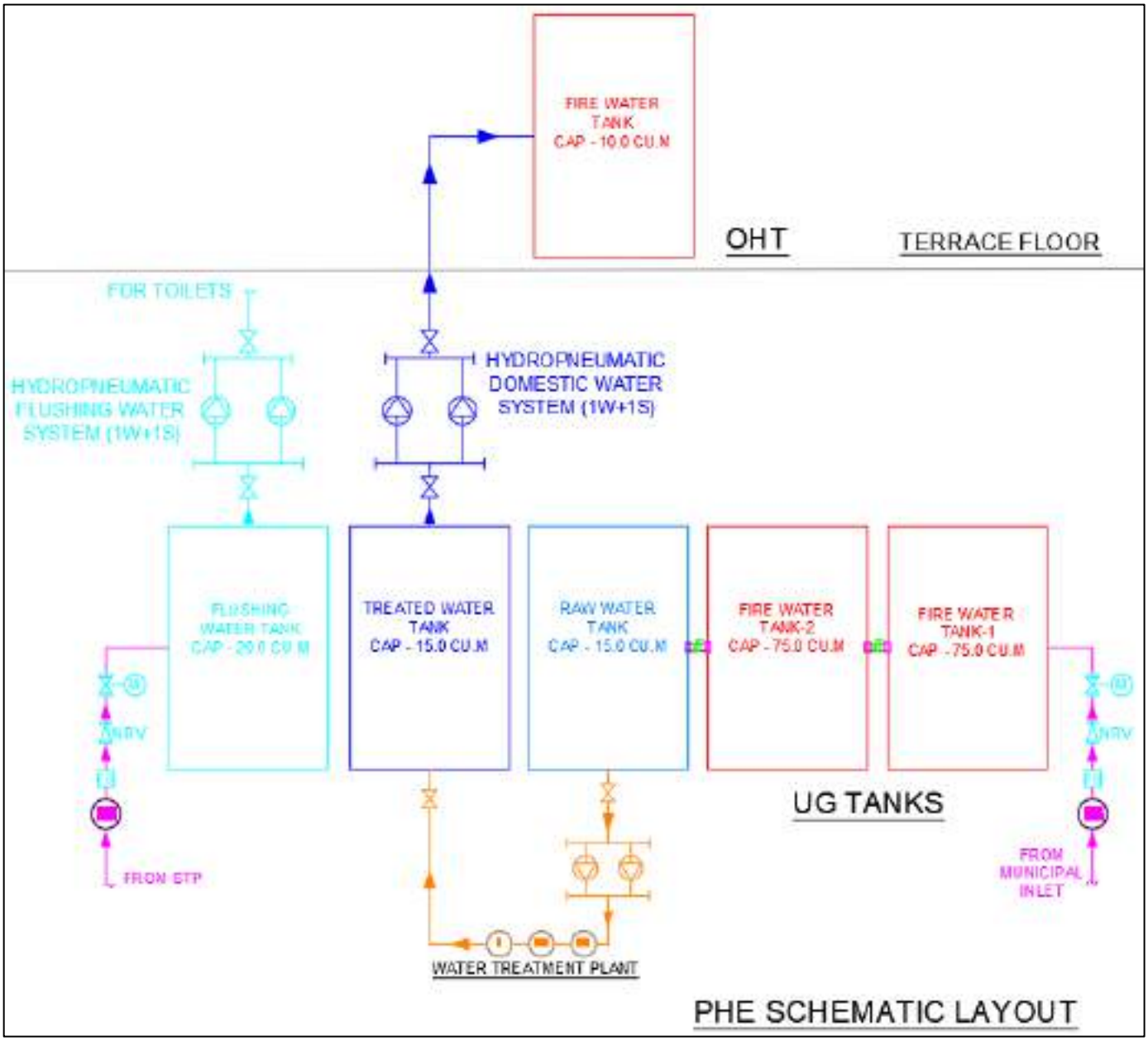
- Net Water Demand for Domestic Use = 25 LPCD
- Net Water Demand for Flushing Use = 20 LPCD

**Floating Population: -**

Gross water demand for Fixed Population = 15 LPCD

- Net Water Demand for Domestic Use = 05 LPCD
- Net Water Demand for Flushing Use = 10 LPCD

## WATER SUPPLY SCHEMATIC:




## POTABLE WATER

Daily potable domestic water requirement for the building shall be met through the Proposed Treated Water tank at

site. The incoming connection from Municipal Water Inlet shall be led into Proposed UG Fire water tank and overflow shall allowed to Raw water Tank, after treatment shall fed to Treated Water Tank. All water distribution to the building will be through hydro-pneumatic system.

## FLUSHING WATER

Flushing water for the building shall be sourced from the Proposed Treated Flushing Water Tank at STP Area. Water will feed to building by hydro-pneumatic distribution system.

## DAILY WATER DEMAND FOR THE PROJECT:

| SR No | Component /Head | Description | Total Occupancy (Nos.) | Criteria For Water Requirement (LPCD) | | Water Requirement (LPD) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Domestic Cold | Flushing | Domestic Cold | Flushing | Total |
| **A** | **POPULATION** | | | | | | | |
| 1 | Athletes | As per CDPL | 300 | 25 | 20 | 7500 | 6000 | 13500 |
| 2 | Supporting staff | As per CDPL | 100 | 25 | 20 | 2500 | 2000 | 4500 |
| 4 | Security guards | 4/shift - 3 shifts | 12 | 25 | 20 | 300 | 240 | 540 |
| 5 | Experimental kitchen | Assumed | | | | 1500 | | 1500 |
| | **Sub Total for "A" (Liters)** | | **412** | | | **11800** | **8240** | **20040** |
| | | | | | | | | |
| **B** | **FLOATING POPULATION & OTHER** | | | | | | | |
| 1 | Floating Population | 15% of total population | 41 | 5 | 10 | 206 | 412 | 618 |
| 2 | Parking | Assumed | 20 | | 20 | 0 | 400 | 400 |
| | **Sub Total for "C" (Liters)** | | **41** | | | **206** | **812** | **1018** |
| | | | | | | | | |
| **B** | **FLOATING POPULATION & OTHER** | | | | | | | |
| 1 | Landscape | Assumed | | | | | 5000 | 5000 |
| 2 | STP Backwash | | | | | | 5000 | 5000 |
| 3 | Other cleaning purposes | Assumed | | | | | 5000 | 5000 |
| 4 | Swimming Pool | | | | | | | |
| | a) Surface evaporation | 312 sqm*1.8*24 hrs. | | | | 13478 | | 13478 |
| | b) Back wash l/d | (312 sqm*1.6*1000*0.1)/6 | | | | 8320 | | 8320 |
| | **Sub Total for "C" (Liters)** | | **0** | | | **21798** | **15000** | **36798** |
| **TOTAL IN LITERS** | | | **453** | | | **33804** | **24052** | **57856** |
| **TOTAL IN CUM** | | | | | | **34.00** | **24.00** | **58.00** |

## TANK SUMMERY:

| WATER TANK SUMMARY | | | | | | |
|---|---|---|---|---|---|---|
| **Service of Tank** | **Location** | **Required Capacity (KL)** | **Selected capacity per compartment (KL)** | **No. of compartments** | **Total Capacity (KL)** | **Remark** |
| **UNDERGROUND TANKS** | | | | | | |
| Fire Fighting-UG | At proposed location | 150 | 75 | 2 | 150 | As per NBC |
| Domestic - Raw | | 24 | 15 | 1 | 15 | 2.0 Days storage |
| Domestic - Treated | | | 15 | 1 | 15 | |
| Flushing | At proposed STP Area | 19 | 20 | 1 | 20 | 1.0 Days storage |
| **OVERHEAD TANKS** | | | | | | |
| Fire - OH | At terrace | 10 | 10 | 1 | 10 | As per NBC |
| | | | | | | |

## WATER TREATEMENT PLANT: -

Water treatment process will depend on the quality of raw water from various sources viz, bore well, tanker water and municipal water. The treatment shall involve feed 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. Micron cartridge filter prevents the passage of particles to treated water tank. The Treatment system is provided with pump of suitable flow rate, head. The product water is usually taken to a tank & pumped for further use. The bypass drain will be connected to nearby drain. The treatment system is provided with adequate instrumentation & interlocks to ensure smooth operation.

All water used for domestic purpose should meet and exceed WHO portable water quality standards. Water used for domestic usage should meet the following parameters at the minimum.

TDS <200 ppm
TSS < 5 ppm
BODS < 5 ppm
Hardness < 50 ppm

Water should be colorless (< 1 NTU) and odorless.

**It is proposed to have 5 cum/hr. and 3.0 hrs. of working of WTP for the project.**

## SEWAGE TREATMENT PLANT:

The STP will be located at a location given by client. The drainage network will be proposed to take all drainage towards the STP areas.
The treated water will be of a quality suitable for external landscaping areas and flushing. Proposed STP Technology will be **MBBR Type - 25 KLD for the Project.**
Plant Components: -
a. Bar screen
b. Collection tank
c. MBBR reactor
d. Tube Settler
e. Clarified Tank
f. Filler feed pumps
g. Ultra-filtration System
h. Ultraviolet System.
i. Treated Water tank.

Typical parameters of STP before and after treatment.

| | Value | |
|---|---|---|
| Parameters | Before treatment | After treatment |
| PH | 8-6 | 6-7.5 |
| TOTAL SUSPENDED SOLIDS | 115-200 mg/lit | <30 mg/lit |
| CHEMICAL OXYGEN DEMAND | 250-400 mg/lit | <50 mg/lit |
| BIO-CHEMICAL OXYGEN DEMAND | 200-300 mg/lit | <10 mg/lit |
| OIL & GREASE | <10 | Nil |

## DRAINAGE SYSTEM: -

The soil and waste will be through individual pipes & will be carried to the Sewage Treatment plant. The drainage system will be "Two Pipe" system. Two pipe drainage system as per ASPE standards shall be connected to soil and waste fixtures separately to have redundancy during maintenance. It shall also allow trap the waste at bottom of the stack from washing basins / shower, which is likely to prevent proper flow in horizontal runs. The soil, waste & vent system shall be water tight and gas tight.

| | |
|---|---|
| Soil & Waste Stacks | UPVC - SWR Type-B |
| Rain Water Stacks | UPVC - SWR Type-B |
| Vent stacks | UPVC - SWR Type - A |

## STORM WATER DRAINAGE/RAIN WATER HARVESTING:

Storm run-off is that proportion of the precipitation which drains over the ground surface. Estimation of such run-off reaching the storm drains therefore is dependent on intensity and duration of precipitation, characteristics of the tributary area and the time required for such flow to reach the drains. The storm water flow for this purpose shall be determined by using the rational method. The characteristics of the drainage zone such as imperviousness, topography including depressions and water pockets, shape of the drainage basin and duration of the precipitation determines the fraction of total precipitation which will reach the drain. The terrace floor rainwater drain will be drained vertically through combination of UPVC A & B grade pipes & Overflow will be connected to external water drainage system. The external storm water drainage systems will be consisting of open/close drains which will be used for surface drainage as well as terrace drainage. The outlet from this drain will be discharged in the Existing/Municipal storm water connection.

## EXTERNAL SEWER LINE CONNECTION:

The sewer collected from each toilet WC shall be collected in sewer inspection chamber. Collected waste water from bathroom & kitchens shall be connected in Gully trap & then it will be connected to sewer Inspection Chambers. Minimum external sewer lines minimum pipe shall be Dia 150mm. Based on fixture calculations and pipes slope (As per NBC 2016) drainage pipe sizes shall be calculated. Collected sewer & waste drain shall be connected to STP and then the by-pass to Municipal drainage connection.

## 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/Bore well connection (Domestic) | To track water consumption | Accordingly, it can be analyzed and decided how much water will be used from each source |
| 2 | Incoming connection from Borewell/Tanker/STP (Flushing) | To track bore well consumption | |

The meters detect and display the amount of water flow in cubic liters or gallons. This data is both displayed to the user and collected by the utilities. Traditional meters mechanically detect and display use with a rotating dial in the device, while modern meters, such as ultrasonic meters, are often static and bound to remote readers, and have very high accuracy. Water utilities use the metered data to charge the consumer per unit of water consumed over a certain time. Meters generally lose sensitivity with time (especially mechanical meters), so once established, routine check-ups are required and new meters installed, when necessary.

# 6. FIRE FIGHTING SYSTEM

## DESIGN APPROACH: -

The Section outlines Fire & Life Safety system design parameters, system selections and extent of provisions for the project. Fire & Life safety system will be designed as per relevant standards.

## DESIGN STRATEGY & CRITERIA

The design and planning of Fire Fighting System shall be done keeping in view the followingcriteria:

- National Building Code of India Part IV 2016
- Local Bye-Laws
- Relevant BIS codes: Specifically, IS: 5290 and IS: 5312, IS: 908 and IS: 2190, IS:3844, IS: 15105.
- National Fire Protection Association (NFPA): - NFPA: 10, NFPA: 12, NFPA: 13,NFPA: 14, NFPA: 15 and NFPA: 20
- TAC Manual (for reference and guideline)

## BASIS OF DESIGN

- Proposed facility will be classified as in Assembly Building (D) & it indicates that contents are of comparatively Lower Combustibility & Operations conducted herein are of Low Self propagating fire to occur.
- Capacities are defined with preference given to National Building Code of India Part IV 2016 requirements.
- However, final capacities will be defined as per CFO-NOC.
- Fire Water Tanks and pump room shall be located at Proposed Location.

## FIRE TANK CAPACITIES:

| Sr. No. | Description | Total Capacity ($m^3$) per Compartment | No. of Compartments | Total Capacity ($m^3$) | Remark |
|---|---|---|---|---|---|
| **A.1** | **Overhead Water Tank** | | | | |
| 1 | Fire Tank (UG) | 75 | 2 | 150 | As per NBC |
| 2 | Fire Tank (OH) | 10 | 1 | 10 | As per NBC |
| | **Total** | | | **160 $m^3$** | |

## FIRE FIGHTING RQUIREMENTS AS PER NBC:

| FIRE FIGHTING REQUIREMENTS | | | |
|---|---|---|---|
| **BUILDING TYPE – ASSEMBLY BUILDING (D)** | | **HEIGHT OF BUILDING – 18.90 M** | |
| **SR.NO** | **TYPE OF INSTALLATION** | **AS PER NBC** | **PROPOSED** |
| 1 | **FIRE EXTINGUISHER** | **R** | ✓ |
| 2 | **FIRST AID HOSE REEL** | **R** | ✓ |
| 3 | **WET RISER** | **R** | ✓ |
| 4 | **DOWN COMER** | **NR** | X |
| 5 | **YARD HYDRANT** | **R** | ✓ |
| 6 | **AUTOMATIC SPRINKLER SYSTEM** | **R** | ✓ |
| 7 | **MANUAL OPERATED ELECTRONIC FIRE ALARM SYSTEM** | **R** | ✓ |
| 8 | **AUTOMATIC DETECTION & ALARM SYSTEM** | **R** | ✓ |
| 9 | **UNDER-GROUND TANK (LTRS)** | 1,50,000 liters. | ✓ |
| 10 | **OVER HEAD TANK (LTRS)** | 10,000 liters. | ✓ |
| 11 | **PUMPS NEAR UG TANK** | 1) One main electric pump – 2280 LPM<br>2) One jockey pump – 180 LPM<br>3) One Diesel pump – 2280 LPM | ✓ |
| 12 | **PUMPS NEAR OH TANK (LPM)** | **NR** | ✓ - (450 LPM) |

| | | | |
|---|---|---|---|
| **R- Required** | ✓ -Complied | **NR- Not Required** | X- Not Complied |

NOTE: Type of Installations will be finalized as per CFO-NOC Guidelines.

## FIRE PUMPING SYSTEM:

- One main Electric driven Pump – 2280 LPM
- One Electric driven Jockey Pump – 180 LPM
- Diesel Engine Driven Pump (Stand by) – 2280 LPM
- Booster Pump – 450 LPM

## HYDRANT SYSTEM:

- The hydrant & sprinkler piping will be of G.I. 'C' class (heavy duty) IS 1239 or Equivalent Local Code approved. The external hydrant Piping & wet riser will be 150mm dia.
- The external underground piping will be provided with anti-corrosive wrapping, the internal & exposed piping will be fire rated oil painted as per the recommendation of local authorities.
- Hydrant points with hose housing boxes having 2 Nos. Hose, 1 No. branch pipe will be located at every 30 meters distance on the hydrant main ring.
- There will be fire brigade inlet provided at strategic location as per rules in the yard hydrant ring.
- Isolation valves at appropriate locations will isolate the sections of ring main as & when required.

## LANDING VALVES & HOSE REELS

- Single headed hydrant points along with hose reels will be provided at each fire shaft.
- Hose boxes housing hoses and branch pipes will be provided with each hydrant valve.
- Hose reel will have 30-Meter-long ¾" size rubber hose with nozzle and an isolation valve.

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- Hose reel will have 30-Meter-long ¾" size rubber hose with nozzle and an isolation valve.

## FIRE BRIGADE CONNECTIONS

The following fire brigade connections will be provided to augment the facility provided.

- Fire brigade four-way breaching connection to fire UGT.
- Fire brigade street connection to external ring main
- Fire water draws out connection.

## SPRINKLER SYSTEM:

## PIPING & FITTINGS FOR SPRINKLERS

- The pipes used will be galvanized heavy ERW Pipes as per IS 1239, with heavy duty socket weld/screwed fittings.
- Supports used will be of G.I materials clamps & full thread GI stud rods (Hi–Tech). Screwed type anchor fasteners only will be used of approved quality, as shown in the layout drawings.
- Sprinkler Tap-off points will be provided with Butterfly Valve & Flow switch at every floor.

Following Is the Temperature rating of sprinkler for various areas.

| Room /Space | Sprinkler Type | Temp. rating |
|---|---|---|
| Public Areas | Quick Response | 68 Deg C |

## TYPES OF SPRINKLERS

- Type: Sprinklers will be UL / FM approved.
- Pendent / upright type 68 Deg, 5mm chrome plated.

## PENDENT SPRINKLER

- A Pendent Sprinkler designed to be installed in such a way that the water stream is directed downward against the deflector.
- 68-degree type pendant sprinkler will be provided.
- Pendent Sprinkler will be provided with SS304 with adjustable escutcheon plate.

## UPRIGHT SPRINKLER

- An Upright sprinkler designed to be installed in such a way that the water spray is directed upwards against the deflector.
- Upright sprinklers require where height between the true ceiling & false ceiling is exceeding 800mm.

## FLOW SWITCHES

- Contained in weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the Valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.
- Water flow switch will be monitored on FAS systems.

## SPRINKLER FLEXIBLE DROPS

- Flexible sprinkler drops will be of 25 mm dia. constructed out of corrugated stainless steel.
- The pipe will withstand a pressure of 16 Bar and will have female threads on one end and a reducer on the other side welded to the corrugated pipe.
- The entire assembly will be in one piece with no screwed joints. The flexi drop will connect to the branch at one end & sprinkler at the other.
- The supports will be capable to hold the sprinkler vertically down at desired height.
- The Flexible drops will be UL / FM listed.

## NON-RETURN VALVE.

- Non-Return Valves, dual Plate Type with flanges will be provided at each Sprinkler Tap-offs.

## PRESSURE REDUCING VALVE.

- Pressure Reducing Valves with flanges will be provided at lower-level piping header.

## DRAIN KIT

- 25mm Test Valve Drain kit with sight Glass, Union & required fittings etc. will be provided at the sprinkler piping at the last point of sprinkler.

## BUTTERFLY VALVE WITH TAMPER SWITCH

- Cast iron butterfly valve with Tamper Switch rated for pressure rating PN 16 kg/cm2 standard pattern (Horizontal / Vertical), with necessary flanged joints by providing necessary pair of M.S. flanges, nuts, bolts, gaskets, etc. will be provided at each Sprinkler Tap-offs.
- On / Off Position of Butterfly Valve will be monitored on FAS.

## PRESSURE GAUGE

- Pressure Gauge 0 - 30 Kg / cm2 with mounting arrangement and ball valve will be provided at each Sprinkler Tap-offs.

## ORIFICE PLATE

- SS 316 orifice plate with flanges will be provided at each Sprinkler Tap-offs.

## INSPECTION & TEST

- Hydro Testing: Complete sprinkler piping network, flexible connections and Sprinklers will be hydro-statically tested, as specified in NFPA.

## FIRE EXTINGUISHER

Portable fire extinguishers of ABC (Dry Chemical Powder), Carbon-di-oxide will be provided as first aid fire extinguishing appliances. These extinguishers will be suitably distributed in the entire public as well as service areas. The appliances will 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 will be placed or hanged on wall in a group on several suitable places. The number of extinguishers will be calculated as per NBC-2016 /NFPA. All the Extinguishers will be ISI marked only.

Carbon-dioxide of 4.5 kg and ABC Type1/2/4/6/9 Kg capacity will be provided as first aid fire extinguishing appliances. The CO2 Type Extinguisher are Provided in critical rooms whereas ABC type Extinguishers will be provided in entire building area (lobby & common corridor area).

| SR.NO | AREAS | TYPE OF EXTINGUISHER |
|---|---|---|
| 1 | PASSAGE & COMMON AREA | DRY CHEMICAL POWDER(ABC) TYPE EXTINGUISHER |
| 2 | ELECTRICAL ROOM | CO2 TYPE EXTINGUISHER |
| 3 | PUMP ROOM | FOAM TYPE EXTINGUISHER |
| 4 | ELECTRICAL SUBSTATION ROOM, PUMP ROOM & DG ROOM. | FIRE BUCKETS |

^^^^^

# NON-DSR TECHNICAL SPECIFICATIONS

# CIVIL & FINISHES

All works shall be carried out as per

PART 1 - CPWD Specifications 2019 Volume I & Volume II with latest amendments for civil works of buildings and roads, external works.

PART 2 - CPWD General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) 2017 including amendments

PART 3 - CPWD General Specifications of Electrical Works

SCHEDULE 0 - Part-I Internal 2013 including amendments

SCHEDULE 1 - Part-III-Lift & Escalators 2003

SCHEDULE 2 - Part-IV Sub Station 2013

SCHEDULE 3 - Part V Wet Riser & Sprinkler Systems 2020

SCHEDULE 4 - Part VI Fire Detection and Alarm System 2018

SCHEDULE 5 - Part VII D.G. Sets 2013

SCHEDULE 6 - Part VIII Gas Based Fire Extinguishing System 2013

PART 4 - CPWD General Specifications of Horticulture & Landscaping 2020

Refer drawings and schedules: Work shall be carried out with specifications in this document with project specific requirement and most stringent requirements shall be followed in case of discrepancy between documents such as specification, Scope of work,. DBR, drawings. The minimum standards required to be achieved are defined here in this document.

**SECTION 1**

**GENERAL REQUIREMENTS**

**PART 1**- GENERAL

## 1 Information

The General Conditions and Special Conditions of the Contract including the Drawings shall be read in conjunction with these Technical Specifications, and matters referred to, shown or described in one are not necessarily repeated in the other. These Specifications are comprehensive but may exceed the requirements of this project.

Notwithstanding the sub-division of the specification into various headings, every part of it is to be deemed supplementary to every other part and is to be read with it, so far as it may be practicable so to do, or when the context so permits.

It shall be contractual duty and responsibility of the contractor to have his own done in-depth studies by his consultants for proper details, procedure, mode of execution, use of relevant type, form and size of machineries for the works, form and extent of temporary works requirement and providing the works as specified in or necessarily to be inferred from the documents and drawings forming this contract.

The Contractor shall be required to conduct all site tests and tests from authorized testing laboratory, submit all manufacturers' test certificates as called for in the specifications.

The Contractor shall keep at site copies of all relevant standards and codes of practice referred in these specifications throughout the period of contract. These shall be the latest editions and shall include all revisions/addendums thereof.

Reference in the specifications to approved manufacturers shall be construed as establishing a standard of quality and not as limiting competition. The Contractor shall perform the contract works in proper manner and with due competency for the satisfactory completion of the same.

## 2 Codes, Regulations, Standards and Technical References

A. Regulations:

The whole of the Works and materials are to be in accordance with the Building Control Regulations, other regulations as set out by the authorities having jurisdiction over the works, and the relevant bylaws unless otherwise stated. Ensure that the requirements in the Specification are strictly adhered to when carrying out the Works, unless otherwise directed.

B. Standards and Codes of Practices:

Unless otherwise agreed by the Employer's Representative, ensure all of the Works comply with the relevant requirements of the Standards and Codes referenced in the body of the

Specification. Alternative Standards and Codes may be proposed for approval by the Employer's Representative, provided it can be demonstrated that the alternative Standards and Codes comply with the requirements of the standards specified. All Standards and Codes quoted are the current version, unless specific year references are noted.

C. Technical Reference:

Where specified, be guided by the principles and methods as set out in the technical reference when carrying out the works. Alternative methods and principles may be proposed in lieu of the referenced document, subject to acceptance by the Employer's Representative, if it can be demonstrated that the specified quality or performance of the works can be achieved.

## 3 Work Preambles

A. Ambiguity

Before commencing any works, obtain clarification or instructions in relation to any discrepancy or ambiguity, which is discovered within and between the Specification Work sections, and one or other contract documents issued by the various parties.

B. Approved Sub-contractors

All sub-contractors for the works are subject to the acceptance of the Employer's Representative. At the time of tender and before the commencement of work, submit the list of subcontractors intended to be engaged for the works. Submit with the list, details such as the relevant track records of the firms, the qualification of the personnel and details of equipment to be engaged for the works.

C. Licences, Permits and Liaison with the Authorities

Be responsible to initiate the application for all necessary licences, permits, etc and to carry out all necessary liaison with the Government Departments and Statutory Boards, etc whenever necessary, for the satisfactory completion of the Works. Be responsible for ensuring that these licences and permits are obtained in good time.

D. Safety Regulations and Temporary Works

Strictly observe all necessary safety requirements and legislation to fully comply with the provisions of the Workplace Safety and Health Regulations and/or any other requirements from the authorities having jurisdiction over the works.

E. Safeguarding Properties Adjacent to Site

Propose and adopt site procedures and methods of working such as to limit to a minimum any disturbance and vibration to the buildings around the Site. Identify and implement protective measures necessary to safeguard the adjacent properties prior to carrying out the works. Indemnify the Employer in accordance with contract conditions against all claims for loss and/or

damage to the adjoining properties by reason of the carrying out of the works or by reason of insufficiency of precautionary measures.

F. Site Supervision

Provide personnel with adequate and relevant experience to Employer's Representative's acceptance, to supervise the Work. Submit the CV of the supervisor(s) to the Employer's Representative where directed.

G. Coordination of Works

Ensure that all units, components or assemblies whether from one or different sources, are available in time for incorporation into the Works.

H. Maintenance Manual

Develop and submit for Employer's Representative's acceptance, a strategy in the form of a maintenance manual and logbook, to ensure that elements that are likely to deteriorate significantly can be replaced or rectified.

**PART 2**- PERFORMANCE REQUIREMENTS

## 1 General Requirement

Engage methods and resources that will ensure the works achieve the specified quality within the agreed programme and cost.

## 2 Environment

Ensure the carrying out of the works will not cause un-acceptable pollution, noise, erosion and vibrations to the environment as stipulated by the tender and other relevant authorities.

**PART 3-** MATERIALS

## 1 MATERIALS GENERALLY

Products are to be new unless otherwise specified. All materials are to be supplied clean, undamaged and in good condition ready to be used for the Works.

For products with a limited shelf life, ensure no parts or whole are expired. Where a choice of manufacturer or source is allowed for any particular product, supply the whole quantity required as the same type and from the same manufacture and/or source unless otherwise approved. Produce written evidence of sources of supply when requested. Ensure that the whole quantity of each product supplied is of consistent kind, size, quality and overall appearance.

Ancillary products and accessories are to be of a type recommended by the main product manufacturer, unless otherwise specified.

Unless otherwise described, all materials shall be new and in accordance with the latest Indian Standards and the Contractor shall produce all necessary Certificates to substantiate this fact if so required by the Employer's Representative. Unless otherwise described, the description of each item of measured works shall include for supplying and delivering of all materials, unloading, sorting, selecting, storing, carriage and cartage, cutting and all waste on materials, hoisting, all labour setting, fitting and fixing in position, covering up and protecting finished work, clearing away all debris and waste, return of packing, carriage paid, use of plant and equipment, supervision, establishment and overhead charges, profit and all other labour and materials necessary for the due and proper execution of each item.

Use of environmentally friendly products and materials that are certified by approved local certification body and are applicable to non-structural and architectural related building components should be adopted where appropriate or required by this Specification.

## 2 ORDERING OF MATERIALS

Unless otherwise directed, do not place orders for materials before the sources and samples of the materials have been approved and the results of any preliminary tests required by the Specification have been accepted.

## 3 CERTIFICATES FOR MATERIALS

All materials and products are to be manufactured and tested in accordance with the appropriate Standard or as specified. All materials and products delivered to the site are to bear the manufacturer's name, brand name or any other data required to verify compliance with the specified requirements. Where appropriate, provide certificates from the supplier or test agencies verifying such compliance. Include, whenever applicable, the location in the Works or the delivery or batch which the certificate represents.

Where certificates of manufacture or tests are not available for materials proposed for use in the Works, carry out independent testing to determine compliance with the specified requirements where directed by the Employer's Representative.

Where applicable or whenever requested by the Employer's Representative, the Contractor shall submit test certificates of materials to be used in the Works certifying that the materials in question comply in all respects with the Specification. The Contractor shall obtain the said certificates either from the materials manufacturers or from an approved testing laboratory. All costs incurred in obtaining the certificates shall be borne by the Contractor.

## 4 Storage of Materials

Store all materials in a manner, which is not detrimental to their use in the Works and in accordance with any specified requirements.

Ensure that the storage facilities and the loadings resulting from the storage will not adversely affect the construction, the building and other buildings/amenities nearby. Engage specialist advises if appropriate.

Do not permit the storage of materials, components or equipment on new or partially completed work without prior approval.

### 5 Rejected Materials

Immediately remove from the site, all materials which are unidentified or do not meet the requirement of the specification.

**PART 4** WORKMANSHIP

### 1 WORKMANSHIP GENERALLY

Ensure that all works are carried out:

- In accordance with the specified methods and procedures where applicable.
- In accordance with good building practice.
- In accordance with the manufacturers' instructions where applicable.
- By suitably qualified and experienced personnel.

### 2 SETTING OUT AND LEVELS

The Contractor shall appoint a licensed land surveyor to check and to confirm the existing levels, location of the existing drains and sewer inverts, existing underground services, alignment and levels of existing roads, etc. before commencing any work. The Contractor shall be deemed to have considered the time and cost to carry out the said works in this tender.

### 3 DELIVERY, STORAGE AND HANDLING

Deliver materials and products to the site with labels showing brand name, product name and manufacturers batch number.
Store materials in accordance with the manufacturer's recommendations. Use in order of delivery and before expiration of the shelf life date.

### 4 PROTECTION OF PRODUCTS AND COMPONENTS

Take measures to prevent over-stressing, distortion and other damage to the products.

Keep products and components clean and free from contamination. Prevent staining, chipping, scratching or other disfigurement, particularly of products exposed to view in the finished work.

Keep dry to prevent premature setting, moisture movement and similar defects. Where appropriate store off the ground and allow free air movement between stored products.

Prevent excessively high or low temperatures and rapid changes of temperature in the products.

Protect adequately from rain, damp, sun and other elements as appropriate. Ensure that products are at a suitable temperature and moisture content at time of use.

Ensure that sheds and covers are of ample size, in good weatherproof condition and well secured.

Keep different types and grades of products separately and adequately identified.

Keep products in their original wrappings, packings or containers until immediately before they are used. Wherever possible, retain protective wrappings after fixing until shortly before handing over to the owners.

Ensure that protective measures are fully compatible with and not prejudicial to the products and materials.

**SECTION 2**

**TECHNICAL SPECIFICATION FOR CIVIL WORKS & FINISHES**

## 2.1. ANTI -TERMITE TREATMENT:

Anti -Termite treatment shall cover measures for the total eradication and control of termites in buildings. The chemicals as well as procedure shall conform to Indian Standard code of practice for

Anti-termite measures in buildings (IS 6313 part 3).

Mode of treatment: Anti-Termite treatment shall be done for building with RCC foundations or with load bearing walled foundations. The principle of the treatment is to create a continuous chemical barrier/Zone below and around the building/structure. The stages of treatment is mentioned below:

(i) Soil Treatment: The application of chemicals (toxicant) to the soil adjacent to and under a building to form a chemical barrier which is lethal or repellent to termites.

(ii) Wood Treatment: The application of chemical termiticides to woodwork and wood-based materials to eliminate existing termite infestation and to make it resistant to termite attack for the future.

(iii) Treatment along /outside of foundations: The soil in contact with the external wall of the building shall be treated with chemical emulsion at the rate of 7.5 l/m2 of the vertical surface of the sub structure to a depth of 300 mm. To facilitate this treatment a shallow channel shall be excavated along and close to the wall at 1.75 Liters per running meter of the channel. Rodding with 12 mm diameter mild steel rods at 150mm apart shall be done in the channel if necessary for uniform dispersal of the chemical to 300 mm depth from the ground level. The balance chemical of 0.5 liter per running meter shall then be used to treat the backfill earth as it is returned to the channel directing the spray toward the wall surface. If there is a concrete or masonry apron around the building, approximately 12 mm diameter holes shall be drilled as close as possible to the plinth wall at 300 mm apart, deep enough to reach the soil below, and the chemical emulsion pumped into these holes to sock the soil below at a rate of 2.25 Liters per linear meter.

(iv) Treatment at points of contact of woodwork: All existing woodwork in the building which is in contact with the floor or walls and which is in contact with the floor or walls and which is infested by termites, shall be treated by spraying at the points of contacts with the adjoining masonry with the chemical emulsion of concentration by drilling 6 mm holes at a downward angle of about 45° at the junction of woodwork and masonry and squirting chemical emulsion into these holes till refusal or to a maximum of half a liter per hole. The treated holes shall than be sealed.

(v) Treatment of soil under floor: The points where the termites are likely to seek entry through the floor are the cracks at the following locations:

a) At the junction of the floor and walls as a result of shrinkage of the concrete;

b) At construction joints in a concrete floor, cast in sections; and expansion joints in the floor.

Chemical treatment should be provided within the plinth area of the ground floor of the structure wherever such cracks are noticed, by drilling vertically 12 mm holes at the junction of floor and walls, constructional and expansion joints mentioned above at 300 mm interval to reach the soil below. Chemical emulsion shall be squirted into these holes using a hand operated pressure pump until refusal or to a maximum of one liter per hole. The holes shall be sealed. In general, the idea is to change the soil below the floor at the locations of cracks with toxicants so that termites in the soil are denied access through such cracks and openings in the floor.

CHEMICALS: Any one of the following chemicals conforming to relevant Indian Standard in water emulsion maybe used for the soil treatment in order to protect building from termite attack.

| Chemical | Indian Standard | Concentration by weight, % |
|---|---|---|
| Chlorpyrifos 20 EC | IS 8944 | 1.0 |
| Lindane 20 EC | IS 632 | 1.0 |

Anti-Termite Treatment on wood work: - Providing, diluting & injecting chemical emulsion for POST CONSTRUCTIONAL anti-termite treatment at points of contact of wood work by chemical emulsion Chlorpyriphos/Lindane/Imidacloprid 30.5% SC (in oil or kerosene based solution) @ 0.5 Itrs. per hole by drilling 6 mm holes at downward angle of 45 degrees at 150 mm centre to centre and sealing the same.

Anti-Termite Treatment on below concrete or mansonry: - Providing, diluting & injecting chemical emulsion for POST CONSTRUCTIONAL anti-termite treatment: Along external wall below concrete or masonry apron using chemical emulsion @ 2.25 Itr. Per linear meter including plugging holes etc. With Chlorpyriphos / Lindane E.C.20% / Imidacloprid 30.5% SC with 1% concentration.

Precaution: The chemicals described in this tender are insecticides with a persistent action and is to be regarded as highly poisonous. These chemicals can have an adverse effect upon health

when absorbed through the skin, inhaled as vapours or spray-mists or swallowed. Persons carrying out chemical should know the precautions and exercise due care when handling the chemical whether in concentrate or in diluted form. The use of the chemical should be avoided where there is any risk of wells or other water supplies becoming contaminated.

Contractor is fully responsible for any eventuality occurs to his workmen during execution of work.

Dispute Resolution: Disputes, if any with regard to the interpretation, execution and /or implementation of these terms and conditions shall vest exclusively in the Director General, MP-IDSA whose decision shall be final and binding upon the parties. Disputes, if any with regard to the decision of the Director General, MP-IDSA in the regard, shall be referred to Arbitration at the hands of a sole Arbitrator to be appointed by MP-IDSA shall all proceedings in this regard shall be subject to the sole and exclusive jurisdiction of Courts of Courts of competent jurisdiction at New Delhi.

Upon acceptance of the bid, no sub-letting/transfer would be allowed by the Operator except with the prior written permission of the Director General, MP-IDSA.

Standard force-majeure conditions would apply.

## 2.2. FLOOR FINISHES

### 2.1.1 Scope

This Specification describes the general requirements for flooring finishes and rendering on projects.

Contractor shall be responsible for clean-up & Housekeeping & shall take every precaution necessary to ensure the protection of the completed works till hand over to Owners representative.

### 2.1.2 Applicable Codes

IS 269 Specification for ordinary and Low Heat Portland CementIS 383 Specification for Coarse and Fine Aggregates

IS 777 Specification for Glazed Earthenware Tiles

IS 1237 Specification for Cement Concrete Flooring Tiles

IS 1443 Code of Practice for Laying and Finishing of Cement ConcreteFlooring Tiles

IS 2571 Code of Practice for Laying In-situ Cement Concrete Flooring IS 457 Specification for Ceramic Unglazed Vitreous Acid-Resisting Tiles

### 2.1.3 General Materials

Cement shall be ordinary Portland cement conforming to IS 269 for all purposes.

Sand shall conform to IS 1542. For white and/or coloured render only quartz or silica sand shall be used.

For textured finishes and final or finishing coats sand used shall be screened through 3.35mm and 22.36mm IS sieves respectively. For torn texture a slightly larger proportion of sand screened through a 4.75mm IS sieve shall be used.

Water used for mixing and curing shall be clean, clear and free from silt, oil, alkalis, acids, salts and the like.

Colored cement shall be either ready mixed material or may be obtained by mixing pigments and cement on Site. Pigments mixed with cement shall conform to IS 2114.

Integral waterproofing compound shall conform to IS 2645.

### 2.1.4 IPS Flooring

General

The flooring shall be of specified thickness and shall consist of 1:2:4 concrete base/ M15 concrete as specified in the finishing schedule and 12mm thick wearing coat. The granolithic flooring shall be laid in alternate panels. The size of panels shall be as decided by the Employers Representatives.

Laying of 1:2:4/ M15 Concrete Base

The 1:2:4/ M15 concrete base shall be of graded course aggregate of 20mm and down size, 10mm course sand & cement. The ingredients shall be thoroughly mixed with sufficient water to obtain the required plasticity. The floor shall be completed with 1:1 cement sand mortar 12mm thick and cement slurry 2.2kg/sqm including Glass divider strips 45/50x4mm thick set in the flooring including necessary levelling, setting, etc.

The free water on the surface of the base shall be removed and a coat of cement slurry of the consistency of thick cream shall be brushed on the surface.

The prepared 1:2:4/ M15 concrete shall be laid immediately after mixing on the fresh grouted base. The concrete shall be spread evenly and levelled carefully. Low places shall be filled, humps removed and the whole surface again levelled. The layer shall be compacted by ramming and trowelled and allowed to set.

Mixing and Laying of Wearing Coat

One part of cement in dry state shall be mixed with 1.5 parts by volume of well graded/crushed granite chips of 6mm maximum size. The ingredients shall be then mixed with sufficient water as for ordinary concrete. The wearing coat shall be laid 12mm thick over 1:2:4 cement concrete base immediately after it has set compacted and levelled with a steel trowel. Just sufficient trowelling shall be made to give a level surface. The surface should not be over trowelled, as excessive trowelling will bring the cement to the surface, which shall be strictly avoided. When the initial set takes place further compaction by steel trowelling shall be done and final brushing shall be made before the topping becomes too hard.

Floor hardeners

Where specified in the drawings, floor hardeners, approved by the Employers Representative or his representative, shall be supplied and incorporated into surface finishes in accordance

with the manufacturer's recommendations.

Curing

As soon as the surface is hard enough, it shall be covered with sacking or sand and kept continuously wet for a period of at-least one week.

### 2.1.5 TECHNICAL SPECIFICATION FOR VACUUM DEWATER FLOORING

This specification covers the method and procedure to be adopted for vacuum dewatering the concrete flooring to improve the quality of concrete floors.

The vacuum dewatering process consists of levelling, compacting and vacuum dewatering the concrete flooring by using vibrating screed, vacuum pumps, suction mats, filter pads, accessories etc. The sequence of operation shall be placing of concrete, vibration, vacuum treatment and floating and the operations shall follow immediately behind each other.

The Contractor shall have persons well experienced in the vacuum dewatering process, and in the operation of all related equipments. All process equipment to be used shall be in good working condition and shall be subject to the approval of the Engineer.

The work should be planned well in advance with a view to determine areas to be concreted daily, the required number of equipment, size of vacuum mats, length of vacuum hoses, arrangement of rails, screeds etc.

The area to be concreted shall be thoroughly cleaned, reinforcement checked and got approved by the Engineer. Then the specified grade of concrete shall be placed in position without any segregation and properly vibrated.

Immediately after placement of concrete, the vibrating screed, fixed at the proper position to achieve the required specified finished level, shall be allowed to run over the concrete on a true surface to level the concrete. For better consolidation proper surcharge of concrete should be maintained infront of the leading edge of the screed and the vibrating screed shall be allowed to move forward rapidly. The concrete surface shall be screeded high by 2% of the slab's thickness to compensate for the compaction caused by the Vacuum dewatering process. (Slabs which have an aggregate hardner shall have compensation made to maintain elevation).
Immediately after levelling, the concrete shall be covered with filter pads and suction mats in strict accordance with the recommendation of the Manufacturer to have the slab fully dewatered. The suction mat shall extend 100 mm beyond the edge of the filter pad on all sides. The pads shall extend to within 100 mm of the edges of concrete slab, and the mats shall cover entire slab. Before connecting the hose on the suction mat to the vacuum pump, the edges of the mat shall be smoothed to enable an airtight seal to be created. A vacuum shall then be applied to the mat. After a minute the gauge on the vacuum pump should indicate a minimum vacuum of 0.70 atmospheres (24.0 in Hg) and if not, the mat must be checked for leakage. For concrete that dewaters readily the vacuum should then be maintained at 0.70 0.80 atmosphere (24.0 25.5 in Hg). For concrete which dewaters less efficiently (eg. air entrained concrete) the vacuum shall then be reduced to 0.50 0.60 atmospheres (15.0 18.0

in Hg). After approximately 10 minutes the vacuum can then be increased to 0.80 atmospheres. The vacuum shall be maintained for at least 3 minutes per 25 mm of concrete thickness at 0.80 atmospheres. (Where aggregate hardeners are specified, sufficient moisture shall be maintained to meet Manufacturer's requirements). The suction mats and filter pads shall then be removed and moved to the next section in a leapfrog manner.

Stop the vacuum dewatering when light foot prints only are left in the concrete when stepped upon. A suitable suction time can also be checked with a Proctor apparatus which should show 1.5 2 Kp/Sqcm.

Upon removal of the suction mats and filter pads the concrete shall be power floated without delay until all imprints from the vacuum process are removed. If crusting occurs, the floating operation must be delayed till the concrete carries the machine.

The higher speed is recommended for the floating operation. The passes with the floating disc should be made in the junction of two mats in order to avoid risk of cracking.

The waiting time after the floating operation depends on concrete temperature and humidity and varies from 10 minutes to 2 hours.

The trowelling operation cannot take place before the concrete has hardened enough to carry the machine ie. the trowelling blades will not leave any marks on the concrete. Repeated trowelling, with intervals between the passes, which are adapted to the setting of the concrete, greatly improves the surface characteristics. The surface will be more wear resistant and less dusty.

At least two passes are recommended for floors which are not to be covered.

Vacuum dewatered concrete should be cured like any quality concrete in order to achieve a good final result. Use curing compounds, plastic sheets or wet burlap.

The contractor has the responsibility for achieving the quality of concrete specified by controlling the concrete mixes, placing, vacuum process finishing and curing. The concrete technician in charge must be present at the site when work is in progress.

The contractor shall be responsible for mix adjustments, performing necessary tests, correcting deficiencies and trouble shooting in general.

The contractor shall be required to maintain control charts showing individual test results for aggregate gradation, slump, air content, cement content and compressive strength

Preparation

The surface to receive flooring shall be clean, free from dirt and free from foreign material.

Any undulations or mortar remaining on the floor shall be trimmed. Base course shall be trimmed.

The base shall be cleaned and watered before laying the floor. Work includes at all depths and heights.

The finished surface shall be kept wet for a maximum period of one week.

**Concreting (General)**

Concreting shall have a concrete base of M20 of specified thickness.Flooring shall have hardtop

on the concrete base.

Flooring shall be laid in strips, the size of which is mentioned on thedrawings.

**Materials**

| | | |
|---|---|---|
| Cement | - | Portland |
| Sand | - | River sand |
| Aggregate | - | Max. size 10 to 20mm |
| Water | - | Potable |
| Nito hardener (Optional) | - | @ 3kg/sqm |
| Polysulphide sealant | - | At all control joints of size 10mmx6mm at every 200 sqm area |

**Execution**

Mix cement, sand and aggregates in proportion 1:1.5:3 thoroughlywith water to get an appropriate consistency.
Prepared concrete shall be laid immediately after mixing.
The base shall be free from water and other foreign materials, dustand dirt.
A coat of cement slurry of the consistency of thick cream shall bebrushed on the surface of the base course.
The concrete shall then be spread over this base evenly and levelledcarefully.
Low areas shall be filled with concrete and humps removed. Devacuumization shall be done for removing the voids.
The whole concrete surface shall be levelled, compacted by rammingand trowelling. Prepared surface shall be allowed to set.Hardener screed:
Hardtop to be prepared as per the specifications with Nito hardenerand one part of dry cement.
The heard top shall be provided over concrete base immediately afterit is set, compacted and levelled with a steel trowel.
The surface shall be trowelled to bring the hardener coat to a levelledsurface.
Excessive trowelling shall be avoided.
After the initial set, further compaction shall be done by steel trowelling.
Final brushing where required (to achieve desired surface finish) shallbe made before the floor top becomes too hard.

**Curing**

Curing shall commence as soon as the surface is hard enough toreceive the water.
The surface shall be covered with sacks or sand and shall be keptcontinuously wet for a

period of at least one week.

### 2.1.6 TECHNICAL SPECIFICATION FOR VINYL FLOORING

**Product Description:**

Supply of 4.5 mm thick synthetic sports surface consisting of:

- 100% pure vinyl wear layer with a thickness of 1.5 mm.
- Upper surface treated with **Protecsol** to reduce skin burns.
- **Sanosol** treatment to prevent fungal growth.
- Double fiberglass grid for enhanced sound stability.
- Sheet width of 1.5 meters, joined with seamless hot welding.
- Laid with adhesive as per manufacturer's instructions over an existing leveled surface, including game lines marking.

**1. Surface Details:**

- **Surface Treatment**: PUR PROTECT
- **Surface Composition**: 100% PVC
- **Foam**: Closed-cell foam

**2. Dimensions:**

- **Thickness**: 4.5 mm (EN 428)
- **Weight**: 2.6 kg/$m^2$ (EN 430)

**3. Performance Metrics:**

- **Shock Absorption**: ≥ 25% (EN 14808)
- **Vertical Deformation**: ≤ 3.5 mm (EN 14809)
- **Energy Return**: ≥ 0.31 m/s (NF P 90 203)
- **Sliding Coefficient**: 80 - 110 (EN 13036-4)
- **Ball Bounce**: ≥ 90% (EN 12235)
- **Ball Speed**: 50 to 65 cm (UEFA standard)

**4. Durability:**

- **Abrasion Resistance**: ≤ 350 mg (EN ISO 5470-1)
- **Impact Resistance**: ≥ 8 N/m (EN 1517)

- **Indentation Resistance**: ≤ 0.5 mm (EN 1516)

**5. Fire Safety:**

- **Classification**: Pending (EN 13501-1)

## 2.1.7 TECHNICAL SPECIFICATION FOR SKIRTING (GYM AREA)

**Description**

This skirting is made from high-density polystyrene foam, which is 100% recyclable, and features a protective varnish. It is designed to be placed over existing skirtings in renovation projects, eliminating additional handling costs. Ideal for both aesthetic and functional purposes, it provides a neat finish and reduces installation time.

**Key Features**

- Elegant visual finish
- Ideal for renovation projects
- Reduced installation time

**Technical Information**

**Product Size (mm) 2000 length x 22 width x 110 height**

**Unit Weight (g)** 660

**Cleaning & Maintenance**

- **Installation**:

1. Ensure the surface is clean, dry, and free of grease.
2. Apply adhesive to the backside of the skirting.
3. Use polymer adhesive or acrylic glue-filler with a caulking gun.
4. A primer may be required depending on the substrate.

**Daily Cleaning**: Use standard neutral detergents (pH 7) and damp mopping for routine maintenance.

## 2.1.8 VITRIFIED TILE FLOORING / SKIRTING:

1.1 MATERIALS:

a) Vitrified Tiles: The tiles shall be of approved make and shall generally conform to the approved standards. They shall be flat and true to shape, free from cracks, crazing spots, chipped edges and corners. Unless otherwise specified, the nominal sizes of tiles shall be as under:

b) The tiles shall be square or rectangular of nominal sizes such as: 600 x 600 mm; 900 x 900 mm or as per tender schedule / drawings or as directed by the Engineer-in-Charge. Thickness shall be as per recommendations of the approved manufacturers. The tiles shall conform to the relevant standards in all respects. Samples of tiles shall be got approved from the Engineer-in-charge before bulk procurement for incorporation in the work

c) Sub grade concrete or RCC slab or side brick wall / or plastered surfaces on which tiles are to be laid shall be cleaned, wetted and mopped as specified for terrazzo tile flooring.

d) Mortar and bedding: Cement mortar for bedding shall be prepared of mix 1:4 or as specified in the schedule of items, to a consistent paste and shall conform to the specification for materials; preparations etc. as specified under cement mortar. The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in preparation of the mortar to ensure that there are no hard lumps that would interfere with even bedding of the tiles. Before spreading the mortar bed the base shall be cleaned off all dirt, scum or laitance and loose materials and well wetted without forming any pools of water on the surface. The mortar of specified proportion and thickness shall then be evenly and smoothly spread over the base by use of screed battens to proper level or slope.

e) Once the mix is prepared, no further water be added and the same shall be used within one hour of adding water. Apply on an average 20 mm thick bedding of mortar over an area of 1 sqm. at a time over surface of the area for laying tiles, in proper level and allowed to harden sufficiently to offer a fairly good cushion for the tiles to set.

1.2 LAYING OF TILES FOR FLOORING:

f) The tiling work shall be done as per the pattern shown in the drawing or as directed by the Engineer-in-Charge. As a general practice laying of tiles shall be commenced from the centre of the area and advanced towards the walls. Cut tiles, if any, shall be laid along wall with necessary border pattern as shown / directed by the Engineer-in-Charge. Tiling work shall be completed by pressing tiles firmly into place along the wall / floor. A white cement slurry to the back of the tile to be applied to ensure proper and full bedding. The tiles shall be laid on the bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles. Tiles, which are fixed on the flooring adjoining the wall, shall be so arranged that the surface on the round edge tiles shall correspond to the skirting or dado. Press gently the tile with wooden mallet for even adherence at the back of the tile. Do not use an iron hammer or some heavy material to press the tile.

g) The edges of the tiles shall be smeared with neat white cement slurry and fixed in this grout one after the other, each tile being well pressed and gently tapped with a wooden mallet till it

is properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints. The joints shall be kept as close as possible and in straight line. Unless otherwise specified, jointless tiling shall be done butting the tiles with each other. If joint is specified, the same shall not exceed 1.00 mm. in width. The joint shall be grouted with white / matching colour cement slurry. After fixing the tiles, finally in an even plane or slope, the flooring shall be covered with wet sand and allowed undisturbed for 14 days.

GROUTING OF JOINTS IN FLOOR / SKIRTING / DADO:

h) The joints, if specified, shall be cleaned off and all dust and loose particles removed. Joints shall then be filled with approved adhesive grouts. After finishing the grouting process, after 15 minute, wipe off excess grout with a damp sponge and polish the tiles with a soft & dry cloth for a clean surface. The Finished work shall not sound hollow when tapped with a wooden mallet.

MODE OF MEASUREMENT AND RATE: i) Dado / flooring / skirting shall be measured in sqm correct to two places of decimal. Length and breadth shall be measured correct to 1 cm. between the exposed surfaces of skirting or dado. No deductions shall be made nor extra paid for any opening of area upto 0.1 sqm. The rate shall include all the cost of labour and materials involved.

## 2.3. EPOXY COATINGS & FLOORINGS

**Scope**

This Specification describes the general requirements of Epoxycoatings & flooring to be executed on projects.

### 1. Concrete coating for Light duty use

Where indicated, a solvent free, self-smoothing, epoxy coating shall be applied to the concrete at a thickness of between 0.5-1.5 mm, so that it forms a hygienic surface for light to medium duty industrialuse after preparing the surface using a vacuum assisted shot blastingmachine or scarifying and priming the surface Application of coating shall only be carried out by an approved specialist applicator.

The product shall meet or exceed the following performance criteria:

Density : 1.53

Absorption (ASTM C413-80) : 0.06%

Bond strength (DIN ISO 4624) : 1.5N/mm$^2$ (concrete failure)

Abrasion resistance (DIN Taber 53754) : 98 mg

Compressive Strength (ASTM C 579-93) : > 79N/mm$^2$ @14 days

Flexural Strength (BS 6319 Part 3) : 19 N/ mm$^2$

Tensile Strength (BS 6319 Part 7) : 15 N/ mm$^2$

Slip resistance (TRRL rubber) : 104

**2. Epoxy overlay/ coating for concrete for Medium duty use**

Where indicated, a solvent free, self-smoothing, epoxy coating shall be applied to the concrete at a thickness of between 2-4 mm, so thatit forms a hygienic surface to the concrete for medium to heavy use after preparing the surface using a vacuum assisted shot blasting machine or scarifying and priming the surface Application of epoxy overlay shall only be carried out by an approved specialist applicator.The product shall meet or exceed the following performance criteria:

Density : 1.758

Bond strength (DIN ISO 4624) : 1.5N/mm$^2$ (concrete failure)

Compressive Strength (ASTM C 579-93) : 75 N/mm$^2$ @ 14days

Flexural Strength (BS 6319 Part 3) : 30 N/ mm$^2$

Tensile Strength (BS 6319 Part 7) : 17 N/ mm$^2$

Slip resistance (TRRL rubber) : 99

**3. Epoxy overlay for concrete for medium duty (4mm)**

Where indicated, an epoxy overlay shall be applied to the concrete slab so that it forms a hygienic surface for medium to heavy duty industrial use after preparing the surface using a vacuum assisted shot blasting machine or scarifying and priming the surface.

Approved epoxy screeds shall be suitable for application on damp or green concrete or concrete with moisture content greater than 5%. Application of epoxy overlay shall only be carried out by an approved specialist applicator.

The product shall meet or exceed the following performance criteria:

Density : 1.74

Bond strength (DIN ISO 4624) : Concrete failure

| | | |
|---|---|---|
| Compressive Strength (BS 6319 Pt 2) | : | 40 N/mm2 |
| Flexural Strength (BS 6319 Part 3) | : | 20 N/ mm2 |
| Water vapour permeability (DIN 52615) | : | 6,000 |
| Abrasion resistance (Taber C517 1kg/1000rpm) | : | 110 mg |

**4. Epoxy screed & overlay for concrete for heavy duty use (5mm)**

Where indicated, a solvent free, self-smoothing epoxy coating shall be applied to the concrete at a thickness of not less 5mm, so that it forms a durable surface for medium to heavy duty industrial use after preparing the surface using a vacuum assisted shot blasting machine or scarifying and priming the surface. Application of epoxy overlay shall only be carried out by an approved specialist applicator.

The product shall meet or exceed the following performance criteria: Density : 2.086

| | | |
|---|---|---|
| Compressive Strength (ASTM C 579-93) | : | 81 N/mm2 @ 14 days |
| Flexural Strength (BS 6319 Part 3) | : | 24 N/ mm2 |
| Tensile Strength (BS 6319 Part 7) | : | 14 N/ mm2 |
| Slip resistance (TRRL rubber) | : | 88 |
| Abrasion resistance (ASTM C501-84) | : | 0.50mg/cycle |

## 2.4. TOILET CUBICLES

2.6.1 SCOPE:

Providing and fixing Toilet cubical as under with door, pilaster and divider of 18mm thick board both side decorative compact laminate of required colour, shade and sizes including stainless steel accessories (SS-304 grade) like square top rail, box, knob, thumb turn and indicator, twin coat hook, door stopper, gravity hinges, and locking arrangement, SS channel etc. as desired. all complete as per drg. and direction of Engineer in charge. (Cubical size = (1050x1500) mm, Cubical Height =2100mm, External Laminate finish = Metallic)

2.6.2 APPLICABLE CODES:

IS: 2046 for Compact Laminate.

2.6.3 MATERIAL:

The Modular Toilet cubical shall be of size and shape as shown on drawings for a unit of 3/4/5 WCs, erected at locations enclosed by corner masonry walls. Division, frontal and nib panels shall be of 18 mm thick solid grade compact high pressure laminate as per IS:2046 and BS- 476 class 1 fire retardant in Suede finish, manufactured under high specific pressure > 5 MPa and temperature >120oC with bunch of kraft papers impregnated with thermosetting phenolic resin and decorative papers made of Alpha cellulose fiber impregnated with thermosetting melamine resin which provide superior scratch, abrasion, heat, chemical, impact, graffiti & moisture resistance along with anti-bacterial properties. Panels have a black core that when machined, presents a distinctive black edge. Panel is anchored to the wall with SS 304 grade U & F Channel. The top fitting should consist of SS square top rail which will get fixed with pilasters. All screws will be of SS 304 Grade in stainless steel. All pilasters are supported with Adjustable Palm Design Pedestal Footing made from Stainless steel grade 316 giving a clearance height of 150 mm from the floor. The base will be anchored to the floor. Compact laminate should be Green guard and IGBC certified.

The following stainless steel (SS 304) accessories to be used: Door Knob; coat hook with rubber stopper; self closing (gravity) hinges; privacy Thumb turn with occupancy indicator, top rail and Adjustable Palm Design Pedestal Footing SS 316 Grade Design no. as specified by Arch. / Engineer-in-charge in suede finish. Size of panels to be as per drawing.

The mock-up shall be approved by the Engineer-in-Charge before starting the installation of toilet cubicles. Vendor shall submit the certificate of warranty for aterm of 5 years on moisture related damages (partitions), 1 years for toilet cubicles workmanship and accessories. All the material supplied and installed shall be as per the description and specifications in the item. The following information shall be submitted by the contractor for obtaining approval of the Engineer-in-charge before start of work.

| | | |
|---|---|---|
| **Product Data** | : | Manufacturer's data sheets on each product to be used, including preparation instructions and recommendations. Storage and handling requirements and recommendations. Details of construction and fabrication. Installation methods. |
| **Shop Drawings** | : | Detailed plans and elevations, details of framing members,<br>anchoring methods, clearances, hardware, and accessoriesclearly shown. |

| | | |
|---|---|---|
| **Name of fabricator / installer** | : | Approved by the manufacturer, specializing in performing work of this section with minimum two years' experience. |
| **Manufacturer's Warranty** | : | Components of the toilet cubical for 5 years against breakage, corrosion, and defects in factory workmanship. |

2.6.4 DELIVERY, STORAGE, AND HANDLING:

Toilet cubical material and hardware shall be delivered and stored in manufacturer's unopened packaging until ready for fabrication and installation. It shall be protected from damage.

2.6.5 FABRICATION:

The substrates shall be prepared including but not limited to blocking and supports in walls and ceilings at points of attachment using methods recommended by the manufacturer for achieving the best result. Area shall be inspected to receive toilet cubicles for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets. Spacing of plumbing fixtures shall also be verified to assure compatibility with installation of compartment. Installations shall not be preceded until substrates have been properly prepared with blocking and supports in walls and ceilings at points of attachment and deviations from manufacturer's recommended tolerances are corrected. All the fabrication work shall be carried out as per approved shop drawings.

2.6.6 INSTALLATION:

All installation shall be carried out by the fabricator/installer approved by the PMC. Installation shall be in accordance with manufacturer's written instructions approved by the Engineer-in-charge.

Blocking and supports in walls and ceilings shall be verified that they have been installed properly at points of attachment. Location should not interfere with door swings or use of fixtures. Installation of cubical units should be rigid, straight, true to plumb, and level. Evidences of drilling, cutting, and fitting to room finish shall be concealed by capping / shoe box plate etc. U-channels and noise deafening tapes shall be provided as per drawing. All the units shall be tested for proper operation. The following fittings shall be provided in each toilet cubical.

1. Gravity hinge – 3 Nos.
2. Coat hook cum Door stopper – 1 No.
3. Door knob cum vacant / engaged position showing device – 1 No.
4. Lock set – 1 No

2.6.7 INSTALLATION:

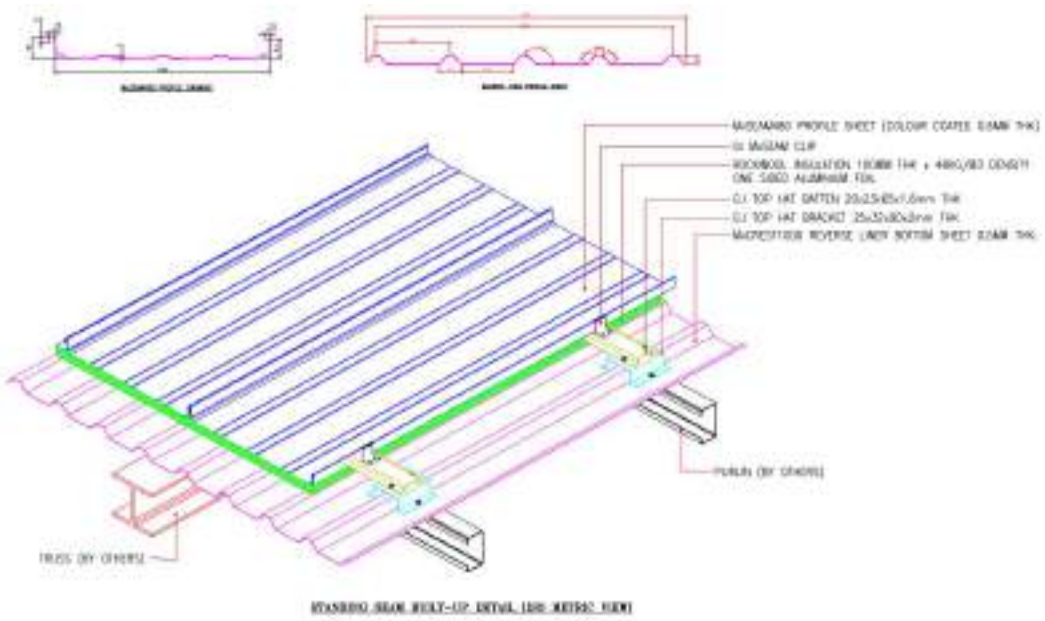
Adjustment of hardware for proper operation after installation may be permitted provided it does not damage the unit either structurally or aesthetically. Hinge cam may be set on in-swinging doors to hold doors open when unlatched and on out-swinging doors to hold unlatched doors in closed position.

Touch-up, repair or replacement of damaged products shall be done with prior approval of the Engineer-in-charge, whose decision shall be final and binding.
Exposed surfaces of compartments, hardware, and fittings shall be cleaned thoroughly.

2.6.8 TESTING:
Required numbers of tests shall be performed on Decorative Thermosetting Synthetic Resin Bonded Compact Laminated Sheets as per provision of IS: 2046. Hardware and fittings shall be of grade 304 stainless steel shall also be tested based on relevant IS codes as decided by the Engineer-in-Charge. Testing charges shall be paid by the department.

## 2.5. TECHNICAL SPECIFICATIONS FOR STANDING SEAM GALVALUME ROOFING

Top Sheet- Standing Seam Roof Sheet:



Pre-Painted Galvalume (PPGL) sheets in 480 mm effective cover width and nominal 35 mm deep ribs.

The panel side laps shall be field-Seamed in 360-degree portable seaming machine; to make it leak proof seaming process involves the male and female ribs snuggly anchored on to clip head and clip are fixed to structure member by self-drilling Screw.

The profile is weathertight and perfect roofing system for high wind prone area.

The feed material is manufactured out of nominal 0.55 mm TCT, Hi-tensile steel with minimum 245 MPa yield strength, metallic hot dipped coated with Aluminium Zinc alloy mass coating of Galvalume AZ 150 (min. 150 grams / sq. m. total on both sides, (55% Aluminium, 43.3% Zinc & 1.6% Silicon) with RMP paint coat as per AS 1397.

The paint will have a total coating thickness of 35 microns, comprising of a nominal 20-micron exterior coat on the top surface and a nominal 5- micron reverse coat on the back surface over a nominal 5-micron primer coat on both surfaces of approved colour shade by the concerned authority.

Bottom Sheet:1000 Profile Sheet:

Pre-Painted Galvalume (PPGL) Sheet in 1010 mm effective cover width and nominal 30 mm deep ribs at nominal 202 mm centre-to-centre.

In each of the pans is shaped with a small flute for making the profile much stronger & efficient for water shedding. The end rib shall be designed for ant capillary action to avoid any seepage of water through the lateral overlap.

Material is manufactured out of nomina 0.50 mm TCT, Hi-tensile steel with minimum 550 MPa yield strength, metallic hot dipped coated with Aluminium Zinc alloy mass coating of Galvalume AZ 150 (min. 150 grams / sq. m. total on both sides, (55% Aluminium, 43.3% Zinc & 1.6% Silicon) with RMP paint coat as per AS 1397.

The paint will have a total coating thickness of 35 microns, comprising of a nominal 20-micron exterior coat on the top surface and a nominal 5-micron reverse coat on the back surface over a nominal 5-micron primer coat on both surfaces of approved color shade by the concerned authority.

Sub Girth- G.I Top Hat Batten:

G.I Hat Batten in 1.6mm thick with Minimum Z80GSM and yield strength 245Mpa, to support the system- As per approved Roof Buildup System

Sub Girth- G.I Top Hat Bracket:

G.I Top Hat Bracket in 2 mm thick with Minimum Az 80GSM and yield strength 245Mpa to support the system- As per approved Roof Buildup System.

Rockwool Insulation

ROCKWOOL insulation composed of rock fibres processed from the molten state into fibrous form and bonded with a binder and Laminated with One side Aluminium Foil Free from asbestos Rockwool insulation having 48 kg/m3 density with 100 mm thickness with one Side Aluminium Foil to be laid between top sheet as per Standard Compliance: ASTM C 553

Vapour Control Barriers:

Aluminium Foil act as vapour control Barrier to prevent the penetration of moister into structure surface and to improve the airtightness of the roofing system

Barge/ Eaves/ Ridge/ Bottom Flashing:

Preprint Galvalume sheet in 0.55MM PPGL, AZ150-345Mpa flashings, Size & Shape as per the shop drawings made by us & approved by the client. Girth: up to 610 mm

GI Drip Angle:

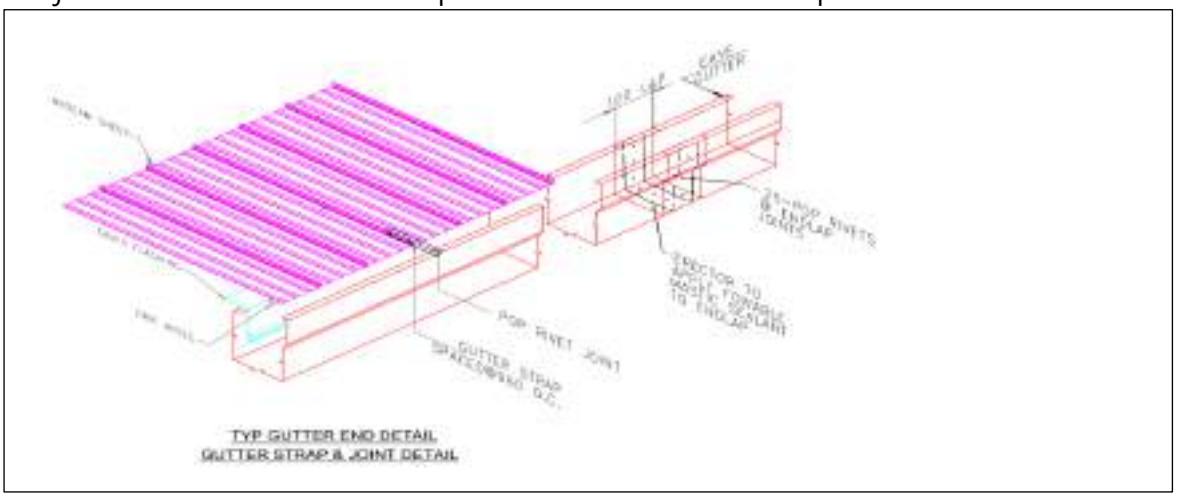
Galvanised drip Angle with 1MM thickness having zinc coating of Z120-245Mpa yield strength.

GI L Angle:

Galvanised L Angle with 1MM thickness having zinc coating of Z120-245Mpa yield strength to support the flashings and minting strength

Galvanized Gutter:

Supply of GI Gutter with 2MM thickness have Zinc of Z120Gsm- 245Mpa yeld strength and having zinc coating on both sides. Cost inclusive of Down spout at every 10MTR, END Cap 4Nos, Butt jointer at 100 mm and GI Strap for hold the Gutter. Girth upto 1220MM




## 2.6. Technical Specification –Self Supported Standing Seam Roof Liner System

### System Performance

The Self Supported Standing Seam Roof System should have the following characteristics:

Appearance

a) No external fastener fixing exceed at ridge, gable, eaves & penetration details
b) Continuous sheets with no joints. If the end laps are unavoidable due to the design or construction constraints, the detailing should be provided by manufacturer and approved by Qualify Person (Architect or Engineer) to ensure that the end laps are weather tight.
c) The height of standing seam rib should be at 65 mm.
d) The design details that provided by manufacturer should present a uniform and smooth appearance free of unsightly irregularities for overall building geometry.

**Structure**

a) The sheet should be designed & detailed to accommodate all movements of the build structure.
b) The Self Supported Standing Seam Roof sheet should support all applied loadings (e.g. snow, wind, live load, foot traffic), and transmit these loadings to spaced structural supports.
c) The structural performance of product should be approved by the independent third party, like German Institute of Building Technology / British Board of Agreement.

d) The structural calculation of roof system should be provided and approved by Professional Engineer.
e) The Self Supported Standing Seam Roof system should accommodate the following movements without any permanent deformation or reduction in the specified performance:
   i) Deflection under design loads
   ii) The effects of repeated wind and internal pressure loading.
   iii) Changes in dimension and shape of components arising from building movements, including settlement, creep, twisting and racking.
   iv) Movement of any joint whether designed to permit movement or not.
   v) Thermal movements.
   vi) Loading from maintenance personnel.

**Dead Loads**

a) The Self Supported Standing Seam Roof system should be capable of accommodating the following dead loads without any reduction in performance:
   i) The Self Supported Standing Seam Roof system's own dead load to be accommodated locally, and without causing deflections or movements in the panels.
   ii) The dead loads derived from permanent fixtures like roof hatch, wall arrest system, walkways, lightening arrestors or services attached (to be defined by architect, if required) to external surfaces of the Self Supported Standing Seam Roof system.
b) When calculating loads the worst combination should be considered, taking account of the fact that the pressure coefficients at various locations may determine more than one design criteria.

**Live Loads**

a) The Self Supported Standing Seam Roof system should be capable of accommodating the following live loads without any reduction in its performance:
   i) All loads resulting from movements of the roof support structure.
   ii) Vertically and horizontally applied loads acting on the surface of the panels arising from maintenance and cleaning operations. The Kalzip Self Supported Standing Seam Roof system should sustain safely, without reduction in performance and without permanent deformation to any component.
   iii) Impact loads, or transferred impact loads, that occur during its service life, without deterioration in its performance and without sustaining non-repairable damage.
   iv) When calculating loads, it should be ensured that the worst combination load cases have been considered, bearing in mind that the pressure coefficients at various locations may determine more than one design criteria.
   v) The Roof panel and concealed clips shall be capable of supporting a minimum uniform live load of 0.75 KN/m2.
   vi) The roof shall be designed for a wind suction of for the field area and the peripheral area / corners calculated based on IS 875 Part-3.

**Deflections**

a) All components, couplings and fixings should be capable of accommodating all of the above deflection without permanent distortion, deformation or failure.

b) The maximum allowable deflection of Self Supported Standing Seam Roof sheet when under imposed load combination shall not exceed L/200. Under wind load combination, the deflection of the standing seam roof shall not exceed L/90, where L is the clear span in a direction normal to the plane of the element.
c) The Self Supported Standing Seam Roof sheet shall not deflect under loading in any way that is detrimental to any element of the Self Supported Standing Seam Roof system or adjacent structural or building elements.

In-Plane Thermal Movement

a) The Self Supported Standing Seam Roof sheet should be designed to accommodate in-plane thermal movement resulting from the maximum and minimum ambient temperature differentials ranging 18 to 45°C. The design should cater for all temporary and permanent conditions envisaged for the works.
b) The Self Supported Standing Seam Roof sheet should be capable of accommodating changes in dimension and shape of its components resulting from the varying surface temperatures without any reduction in the specified performance criteria.

**Durability**

a) The natural finish of Self Supported Standing Seam Roof sheet has 25 years' life expectancy in aggressive marine conditions & 40 years' life expectancy in normal environment conditions as certified in British Board of Agreement (BBA).
b) The Self Supported Standing Seam Roof sheet should have an evaluation report regarding the durability performance after long-term exposure (≥ 35 years) at different locations.

**Weather & Water Penetration Resistance**

a) The Self Supported Standing Seam Roof sheet should be weather tight in accordance with:
   i. AAMA 501.1 where the roof sheet is tested at 500 Pa pressure with water sprayed at a rate of approximately 3.4 litre/min/$m^2$ for 15 minutes have no water leakage during the test duration.
   ii. Approved by independent third party, German Institute for Building Technology
   iii. Approved by independent third party, British Board of Agreement (BBA)

**Fire Resistance**

a) The Self Supported Standing Seam Roof system is classified as Ext. F AA when tested in accordance with BS 476-3: 2004 (Classification and method of test for external fire exposure to roofs).
b) The external & internal layers of Kalzip Self Supported Standing Seam Roof system should be classified as Class 0 in accordance to BS 476 Part 6 & Part 7.
c) Fire & smoke stopping: Contractor should be responsible for the provisions of all cavity barriers in the external wall and fire stopping at the junction of the external wall with other fire resisting elements of the structure.

**Thermal Performance (U-value)**

The thermal performance of U-value for completed Self Supported Standing Seam Roof system shall consider thermal bridging and should be equal or lesser than 0.6 W/m2 K. The value of U-value should be clarified either by calculations /finite element analysis.

**Acoustic Performance**

The Standing Seam Roof system should have following acoustic performance:

Sound Reduction Index (Rw) of 30 dB with +/- 2 dB tolerance in accordance with ISO 717 Part 1 & together with the independent test report.

**Warranty**

The Self Supported Standing Seam Roof system will be guaranteed for 10 years with regards to its composition, surface and tensile strength. In addition, the Roof Contractor must be fully trained and approved by the Self Supported Standing Seam Roof system's manufacturer. The trained & approved Roof Contractor should provide 5 years' warranty stating that the roof system should be weatherproof and watertight

**MATERIAL SPECIFICATION**

Roof Construction from bottom to top

The general roof construction should comprise from the bottom to top

**Internal Metal Liner Sheets**

| Steel Liner | Material Specification |
|---|---|
| Material | Pre Painted Galvalume |
| Minimum Yield Strength, N/mm$^2$ | 550 |
| Modulus of Elasticity, N/mm$^2$ | 210 000 |
| Nominal Thickness (Steel Substrate + Metallic Coating) | 0.5 |
| Metallic Coating | |
| - Material | Al Zinc |
| - Coating Thickness, µm | (20+5+5) |
| - Coating Designation | AZ150 |
| - Coating Mass at Both Surface, g/m$^2$ | 150 |
| Product Geometry | |
| - Cover Width, mm | 1000 |
| - Pitch, mm | 200 |
| - Depth, mm | 35 |
| Non-Fragile Compliance | Classified Class B in accordance to ACR(M)001: 2000 |

**Top Hat**

| Top Hat Bracket & Top Hat | Material Specification |
|---|---|
| Materials | Galvanized Steel |
| Nominal Thickness, mm | Minimum 2.0 for brackets and 1.6 mm for top hat |
| Minimum Yield Strength, N/mm$^2$ | 345 |
| Modulus of Elasticity, N/mm$^2$ | 205000 |
| Metallic Coating | |
| - Material | Zinc |
| - Coating Designation | Z275 |
| - Coating Mass at Both Surface (g/m$^2$) | 275 |
| - Coating Thickness, µm | 15 |

**Vapor Control Layer**

| VCL | Material Specification |
|---|---|
| Material | Polyethylene reinforced with mono filament scrim |
| Thickness | 250 Gsm |
| Tensile Strength- MD N/25 mm | 150 -170 |
| Moisture Vapor Transmission, $g/m^2/24hr$ as per ASTM F1249 | 0.39gms/ m2/ 24Hours |

**Insulation**

| Insulation – Rockwool (60 $kg/m^3$) | Material Specification |
|---|---|
| Density, $kg/m^3$ | 60Kgs/m3 to achieve U value and STC value |
| Fire Classification | BS 476 Part 4 |
| Thermal conductivity, W/mK at 20°C | Max 0.037 |
| Thickness, mm | 50 |

**ST-Clip**

| ST-clip | Material Specification |
|---|---|
| Material | AA6061 & Temper-T6 |
| Clip Designation | As suitable |
| Min Ultimate tensile strength | 260 MPA |
| Min Elongation at 50 mm gauge, % | 8 |
| Thermal Barrier | 5mm height black polyamide thermal barrier pad. This material shall have a minimum tensile strength of 80 MPa and maximum tensile elongation of 10% in room temperature. |
| Fasteners to fix the clip shall be of SS304 | As per structural cal minimum 2 nos per clip |

**Standing Seam profile 65/400 PVDF Coated**

| Standing Seam profile 65/400 | Material Specification |
|---|---|
| **Material** | Aluminum Alloy |
| **Aluminum Alloy Designation** | EN AW 3004 |
| **Minimum Tensile Strength, N/mm²** | 200 |
| **Minimum Yield Strength, N/mm²** | 185 |
| **Thickness, mm** | 0.9 mm |
| **Finish** | PVDF2 on exposed side and primer on rear side |
| **Thickness of PVDF, µm excluding primer & adhesive coatings** | 18-25 |
| **Product Geometry** | Straight |
| **- Cover Width, mm** | 400 |
| **- Depth, mm** | 65 |

Accessories for Self-Supported Standing Seam Roof System

a) Extruded aluminium alloy BS EN AW 6063 Gable End Channel
b) Extruded aluminium alloy BS EN AW 6063 Gable End Clip
c) Extruded aluminium alloy BS EN AW 6063 Tolerance Clip
d) Extruded aluminium alloy BS EN AW 6063 Zed Spacer
e) Extruded aluminium alloy BS EN AW 6063 Drip Angle
f) Fabricated aluminium alloy BS EN AW 3004 Ridge Closure
g) Closed cell cross-linked polyethylene ridge foam filler with tearing strength of 1.2. kg/cm
h) Closed cell cross-linked polyethylene eave foam filler with tearing strength of 1.2. kg/cm
i) Fabricated aluminium alloy flashing should be same quality, grade, and colour from the roofing elements

Fluorocarbon Coating System

a) The exterior finish coat should be PDVF paint system containing at least 70% of PVDF resin in dry paint film, as required by approved licensed coating formulations.
b) The PVDF resin should be either Kynar 500® or Hylar 5000®.
c) In order to minimise appearance differences; all requirements should be processed in one production run using the same batch of paint.
d) Gloss – standard colours will have a nominal gloss level of 20 to 35% (60o) - subject to choices of colours.
e) The coated finish of flashing and roof sheet should have the following properties:

i) Humidity Resistance tested accordance to ASTM D2247-94 (1000 Hours) with no influence.
ii) Acid Salt Spray tested accordance to ECCA T8 (1000 Hours) with creep age on scribe to bare metal maximum 2 mm.
iii) Resistance to cracking on bending tested to ECCA T7. No crack at ▪ 2T.
iv) Pencil hardness conforming to ECCA T4 with min F hardness grading.
v) Reverse Impact tested accordance to ECCA T6 with loss of adhesion index: Gt ▪ 1.
vi) Heat resistance tested accordance to ECCA T13. No influence in 0.6 hour by 60▪C continuous metal temperatures.
vii) Resistance to accelerated weathering topcoat tested accordance to ECCA T10. After 2000 hours, DE ▪ 4 & gloss retention ≥ 70% max chalk = rating of 8.

Fillers

a) The type (s) supplied by the cladding manufacturer should accurately match the sheet profile.
b) Where shown on the design drawings and wherever necessary, corrugation cavities should be closed off from the outside and inside of the building. Ensure a tight fit and leave no gaps.
c) The material should be closed cell cross-linked polyethylene with a minimum density of 0.035 g/cm3.
d) The material should have minimum compression strength and tearing strength of 0.4 kg/cm2 and 1.2 kg/cm respectively.
e) The material must be durable and will not deteriorate under heat, UV exposure and weathering conditions.

Flashing & Capping

Flashing and capping to the roof will be manufactured from the same quality grade and colour of material as the roof elements. For Openings and skylights flashings from minimum material thickness of 2.0mm and in same colour as panel, including higher density insulation for 500 mm width with 120 Kgs/ m2 and any necessary expansion profiles as required along with welding of flashing panel Dye penetration test shall be done for the length of welded areas

Accessories

General

Capping's, closure pieces, flashings, trims sills, gutters, fillers, spacers, tapes, sealant, fixing etc. where not specified should be types recommended by the manufacturer.

Gutters

a) Gutters shall be or min 2.0 mm thick aluminium in mill finish for Girths up to 1200 mm/ as calculated by the MEP consultants. The aluminium flashing is to be same specifications as the material used for the Self-supported standing seam roof top skin. The gutters located within the building shall be insulated gutter. Supply and fixing of Gutters as per detailed drawings consisting of outermost skin of Min 2

mm thick Aluminium in mill finish as per the sizes required along with welding and gutter expansion joints at every 6 mtrs based on the girth of the Gutter. Maximum 1200 mm Girth considered Aluminium gutter, GRADE AA 1100/AA1200/19000 ALLOY with EPDM Expansion joints for every 6.0mtr length, Down take spout die 150 mm at every 10 m gutter length, & other accessories and welding at joints. The final girth of gutter shall be as advised by the MEP consultants.

Sealing Laps

The Sheet Manufacturer should recommend sealant type(s) for the purpose.

a) The position of sealing laps should be in straight unbroken lines immediately below fixing positions and parallel to the edges of sheets. They should be placed into corrugation and not allowed to stretch or sag in position.

b) Ensure continuity and effectiveness of seal especially at corners of sheets. Do not over compress.

Fixing Bolts, Anchors, Brackets, Screws, Rivet and Nuts

a) Stainless steel to be grade 300 series or as approved by standing seam roofing manufacturer. Fasteners for ST to top hat batten shall be of SS 304 Only to avoid Bi-metallic corrosion.

b) Type, size and positioning of all bolts & nuts, anchors, screws and rivets should be shown on the Contractors Drawing, together with full details of their installation technique and torque settings where appropriate.

c) Where it is not possible to conceal fixings, a maximum of five-exposed bolt/stud threads should be used, subjected to approval from the Architect.

Fall Arrest System (Optional only if required –by client) Make Latchways

Supply and installation of FALL PROTECTION SYSTEM WITH Constant Force® Post suitable to the Standing Seam roofing sheets using 4 x split Aluminium clamps below 4 corners of base plate,

The Fall Protection System shall be tested to EN795: 2012(Type A & C) Personal fall protection Anchor devices one user. Evidenced by a Declaration of Conformity detailing the product, the European Standard, name of the independent Notified Body and date.

Certified with CEN/TS 16415:2013 (Type A & C)

Personal fall protection equipment - Anchor devices -Recommendations for anchor devices for use by more than one person simultaneously.

Evidenced by a Declaration of Conformity detailing the product, the European Standard, name of the independent Notified Body and date.

Certified with ACR[M]:2015 Rev02- Testing of Roof Anchors on Roof System. Evidenced by a Declaration of Conformity detailing the product, the ACR[M] test, name of the independent Notified Body and date.The system must be tested as per DIBt tests on roofing by an independent accredited laboratory. Each post will contain a stainless-steel energy absorbing coil and mechanism that enables the coil and post body assembly to

deploy in a predictable manner, in any direction and at a controlled rate in shear and not in Bending moment.

Deployment of an anchor device(s) shall occur without damage / loss of integrity of the roof and overall water tightness. The system must be tested and approved with a factor upto 11 on Beaufort scale.

Each post will be capable of absorbing 6000 Joules (J) of energy whilst within permissible limit. Each post will be able to absorb the energy of three users (300 kg) falling simultaneously in any direction. The system will be suitable for unrestricted access by up to three users at any one time and at any point along the length of the system including between two posts. The maximum span between posts shall be 10m. A pre-tension mechanism of 0.8KN to be provided in the system

The combination of the coating applied to the post elements will be compliant to EN 12206-1:2004 and have been tested to the following methods with the specified results:

1. 1,000 hours of neutral salt spray according to ASTM D1186, method B without any signs of corrosion, coating separation nor reduction in sheen.

2. 1,000 hours of acetic acid salt spray according to ISO 2360:2003 without any signs of corrosion in any finishes.

3. All steel components must be tested for minimum 6000 hours of Salt spray test Labelled according to EN 365:2004 General requirements for instructions for use, maintenance, periodic examination, repair, marking and packaging

Swaged termination manufactured from SS 316L with electropolished to include a visual swage slip indicator, system tensioning device with integral indicator.

Travelling device or trolley to be manufactured from 17/4 pH Stainless Steel.

Enabling continuous hands free operation to either side of the system without the need to detach.

The system must have anti-cold-welding mechanism. 8mm Dia with7X7 construction of stainless-steel cable with SS 316L grade must be used.

CE marked and evidenced by an EC Declaration of Conformity detailing the product, the European Standard, name of the independent Notified Body and date. Energy absorbing lanyard (by others) To be approved and or deemed suitable for use by the roofing system manufacture and maintain their roofing system warranty / guarantee.

Manufacturer to submit report of Roof Representative Testing

Installations to be undertaken by Registered Installers only.

Installation

3.1 Workmanship

a) All works should be true to detail with continuous profiles which should be free from marks, defects, flaws, steps, waves or damage of any nature.

b) All elements of framework and associated beads and strips should be stored on Site such that they will not be damaged, distorted or weathered unevenly.

c) All roof panels, sealants and gaskets should be stored on Site in accordance with the manufacturer's recommendations.

d) Dimensions and levels of the structure should be verified using total station.

e) Setting out should be such that aluminium panels are installed in the correct position, within tolerance, and in the correct relationship to the building structure.

f) All aluminium panels should be correctly mounted so that they are all consistently orientated.

g) All fixing bolts and anchors should be installed in accordance with the manufacturer's recommended procedures.

h) Materials should be carefully stored on site and remain dry until fixed.

i) Approval should be obtained from the Engineer before drilling or cutting parts of the structure, other than where shown on the approved Shop Drawings.

j) Isolating tape, plastic washers, or other suitable means to prevent bi-metallic corrosion between dissimilar metals should be used throughout the project.

k) ST Clips should be set out at evenly spaced centres, straight, parallel and truly aligned with other features, where shown on the Shop Drawings.

l) The finished work should be square, regular, true to line, level and plane, with a satisfactory fit at all junctions.

m) A Self Supported Standing Seam/ Flashings system should be laid, making due allowance for the sequencing of the whole and all interfaces. A secure free draining and completely weather tight roof should be provided.

n) The installation team should be fully trained approved and certified by the Self Supported Standing Seam Roof system manufacturer. In the event that the installation team is not approved by the manufacturer, the manufacturer reserves the right to reject the inspection for the roof and not provide any warranty for the entire roof system. All printed instructions and installation manuals and directives issued by the Self Supported Standing Seam Roof system manufacturer should be strictly adhered to.

Tolerances

a) Account should be taken of the installation tolerance requirements of the Self Supported Standing Seam Roof System.

b) The erected steel purlin top level should be suitable for installation of the roofing system and be within the allowable level difference of + / - 10 mm.

c) The Self Supported Standing Seam Roof system should be erected plumb and true in proper alignment and relation to established lines and grades as shown on the approved Shop Drawings. The erected system should present true and accurate lines and flat planes.

d) A method statement should be submitted detailing proposals for achieving the specified tolerances. This should demonstrate that a clear understanding of the construction method and the fabrication method of the panels is possessed.

e) A detailed list of tolerances to which the Self Supported Standing Seam Roof system will be installed, within the requirements of the Performance Specification

for the overall geometric requirements should be submitted before any starting any installation work. All tolerances should be submitted for review by the Engineer. As a minimum the statement of tolerances should include the following:

i) Thickness.
ii) Position on plan.
iii) Level.
iv) Alignment.
v) Joints between panels.
vi) Diagonal.
vii) Eccentricity.
viii) Inclination.

f) Allowance for sufficient analysis of the erection sequence should be made, thus ensuring and satisfying the Engineer that the installation tolerances stated above will be met.

g) At the time of handover the visual requirements of the Self Supported Standing Seam Roof system are as follows:

i) The roofing panels should be horizontal/vertical and geometrically shaped as shown on Design Drawings.
ii) All joints should be of equal size and at equal centres, unless shown otherwise on the Design Drawings.
iii) The Self Supported Standing Seam Roof sheet should present true and accurate straight lines and slat panels within the plane of the elevations and geometry.

h) Dimensional Checking: Before work begins on Site the proposed methods of dimensional setting-out and cross-checking with adjacent trades and elements, to satisfy the accuracy requirements, should be submitted to the Engineer's/ Architect's discretion, provided they are agreed in advance of the manufacture of components.

i) Work should be within the tolerances stated herein and no revisions to the tolerances allow inadequate control should be permitted.

j) The Self Supported Standing Seam Roof sheet when installed should not be subjected to warping or twisting, should be strictly rigid, firm, free from vibration, knocking rattles, squeaks and other noises when subject to the worst combination of environmental conditions and wind loads.

Quality Assurance

a) Unless accepted otherwise by the Engineer/Architect, use manufacturers and installers that employ a Quality Management System complying with the program described in BS EN ISO 9001- 2008 or similar system.

b) Installer Qualifications:

i) Engage experience installers who had complete Self Supported Standing Seam Roof system same in material, design and forming method as specified ,here in India

with five years minimum experience in application of structural site-formed concealed clip roofing systems, from same manufacturer being proposed

ii) Applicator must be an approved installer, certified by the manufacturer prior to beginning installation of the standing seam roof.

iii) Installer to submit minimum 3 project reference list completed with the same manufacturer within the last 5 years and demonstrate that they can manage projects of similar nature, size and complexity.

iv) Installer shall provide Completion certificate of projects with the same manufacturer being used for the project.

Roofing manufacturers Credential

The roofing manufacturer shall possess the following manufacturing credentials and capabilities:

a. Accredited with a Quality Management System in compliance with ISO: 9001:2008 for the Sales, Manufacturing and Supply of High-Performance Roofing System

b) References

i) British Board of Agreement for Secret Fix Roofing Systems verifable on Construction Product Certification - British Board of Agrement (bbacerts.co.uk)

ii) Deutches Institute fur Bautechnik General Building Inspectorate Approval Z-14.1-181

iii) ISO Certificate (ISO 9001)

iv) The proposed Aluminium Roofing System must have FM Approval certification

Submittals – Installer

General:

Submit listed submittals in accordance with Conditions of the Contract

Product Data:

Submit manufacturer's specifications, standard details, (and installation manual.)

Shop Drawings:

a) Show roof panel system with flashings and accessories in plan and elevation; sections and details. Include metal thicknesses and finishes, panel lengths, joining details, anchorage details, flashings and special fabrication provisions for termination and penetrations. Indicate relationships with adjacent and interfacing work.

b) Do not proceed with manufacture of roofing materials prior to review of shop drawings and field verification of all dimensions.

Samples:

a) Submit sample board consisting of panel section, 300mm long x full width panel, showing proposed metal gauge, finish and seam profile. And all accessories including panel clip and gable clip. Ridge accessories and fasteners / and end filers

Test Reports:

a) Submit copies of reports for each of the performance testing standards listed in Section 4b of this specification.

b) Test reports shall be performed by an independent, accredited testing laboratory for STC

Calculation:

Submit engineering calculations defining cladding loads for all roof areas based on design criteria

a) Calculation shall clearly indicate clip type, spacing of clips by roof zones, and fastener requirements.

b) Compute uplift loads on clip fasteners with recognition of prying forces and eccentric clip loading

c) Calculate pullout/shear strength of fasteners in accordance with test data published by the fastener manufacturer, utilizing applicable material safety factors.

d) Compute thermal calculation for expansion/contraction forces due to total temperature differential of 30 degrees C.

e) Compute panel fixed point attachment forces and required fasteners.

f) Compute in-plane clip forces and indicate required attachment fasteners

4 Miscellaneous

4.1 Preparation

Roof Installer to submit a program schedule to include (non-exhaustive)

i) Material procurement

ii) Drawing submission

iii) Method statement

iv) Material approval

4.2 Installation

Roof Installer to submit a detailed documentation to include (non exhaustive)

i) Quality Assurance and Quality Control plan
ii) Manpower allocation
iii) Method statement
iv) Safety plan pertaining to the roof installation

## 2.7. TECHNICAL SPECIFICATIONS FOR TENSILE MEMBRANE STRUCTURES (DESIGN & BUILD) GENERAL & SPECIAL CONDITIONS

- The Tensioned Fabric Structure Manufacturer (hereafter referred to as "TFS Manufacturer") shall

be responsible for the design, engineering, fabrication, supply and installation of the work specified herein. The intent of this specification is to have single source responsibility for the above functions.

- Tender specifications are intended to establish general design concept. TFS Contractor to develop a concept design for the proposed area, and design it subject to compliance with the requirements of this Specification, the Architectural approval, and Engineer's/Architect's approval.
- Performance Requirements: The TFS Manufacturer shall be responsible for the engineering design, procurement, fabrication, installation and certification (sign-off) of the tensioned membrane structure keeping in line with the architectural requirement. All materials provided shall be new and unused.
- Erection of the complete system shall be the scope of the same firm responsible for designing and manufacturing the tensile fabric Structure.
- TFS manufacturer to provide a structure suitable for the concept proposal made by them following this specification. The design of foundation for the steel framing supporting fabric shall be the responsibility TFS Manufacturer. But the construction / execution of it to the precision of 5mm (max) shall be the responsibility of Principal Contractor.

SUBMITTALS

- Data: This should include Fabric manufacturer's product data, biaxial report, including specifications and installation instructions for each component of the TFS. Include laboratory test reports and other data, wherever applicable.
- Engineering Submission: It should include Engineering drawings like GA, drawings shop and work shop drawing and design calculation reports, cutting and welding report and drawings, seam line drawings for the fabric for architectural approvals etc (Refer to the separate title mentioned as Engineering)
- Samples: For each type of the exposed finish, the TFS contractor to provide the following
  - Fabric: A4 size of pre-stretched fabric meeting all the technical parameters.
  - Seam, Edge, and Corner Condition: Not less than 300mm long section showing seam, edge, and corner treatment.
  - Exposed Hardware Finishes: Manufacturer's standard-size unit, not less than 76mm square.
  - Accessories: Manufacturer's full-size unit.

CODAL REFERENCES

| | | | |
|---|---|---|---|
| i) | IS : 2062 | - | Steel for general structures purposes – specs ( supersedes IS : 226 ) |

| | | | |
|---|---|---|---|
| ii) | IS : 1367 Part 3 | - - | Fasteners - Threaded Steel – Technical Supply conditions, Mechanical properties and Test Methods for Bolts , Screws and Studs with full load ability . |
| iii) | IS : 1363 | - | Black Hexagonal Bolts ,Nuts and Lock Nuts (diameter 6 to 39mm) and black hexagonal screw (diameter 6 to 24mm) of product Grade C |
| | IS : 1364 | - | Hexagonal head bolts, screws (M16 to M64) |
| iv) | IS : 3757 IS : 6623 | - | Specs for high strength structural bolts nuts |
| V) | IS : 2016 IS : 6639 | - - | Specs for plain washers Hexagon bolts for steel structures. |
| vi) | IS : 814 | - | Specifications for covered Electrodes metal arc welding of carbon and carbon manganese steel – specs |
| vii) | IS : 800 | - | Code of practice for general constructions in steel . |
| viii) | IS : 816 | - | Code of practice for use of metal arc welding for general constructions in mild steel specs for filler rods for gas welding. |
| ix) | IS : 1278 IS : 6419 | - - | Welding rods and bars electrodes for gas shielded are welding of structural steel |
| x) | IS : 9595 | - | Metal arc welding of carbon and carbon Manganese steel – |
| xi) | IS : 4353 | - | Recommendations for submerged arc welding of mild steel and low alloy steel |
| xii) | IS : 7280 | - | Specs for base wire electrodes for submerged arc welding of |
| xiii) | IS : 817 | - | Codes of practice for training and testing of metal arc welding |
| xiv) | IS : 7316 Part-01 | - | Approval test for welders when welding Procedure approval is not required |
| xv) | IS : 1182 | - | Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates |
| xvi) | IS : 2595 | - | Code of practice for Radiographic testing . |
| xvii) | IS : 4260 | - | Recommended practice for ultra – sonic testing for butt welds in |
| xviii) | IS : 3658 | - | Code of practice for Liquid penetrate flow detection |
| xix) | IS :1477 | - | Code of practice for painting of ferrous (Part 1 & 2 ) Metals in building |
| xx) | IS : 2074 | - | Ready mix paint , air dying ,red oxide zinc chrome, priming |
| xxi) | IS : 1852 | - | Specifications for rolling and cutting Tolerance for hot rolled steel products |
| xxii) | IS : 806 | - | Code of practice for use of steel tubes in General building constructions |
| xxiii) | IS : 1161 | - | Specifications for steel tubes for structural purposes |
| xxiv) | IS : 7215 | - | Tolerances for fabrication of steel structures |
| xxv) | IS : 822 | - | Code of procedures for inspection of welding |
| xxvi) | IS : 801 | - | Code of procedure for use of cold – ormed Light gauge steel structural members in general building constructions |
| xxvii) | IS : 1599 | - | Method for bend test |
| xxviii) | IS : 1608 | - | Mechanical testing of metals : Tensile Test |
| xxix) | IS : 7205 | - | Safety code for erection of structural steel work |

| | | | |
|---|---|---|---|
| xx) | IS :7307 | - | Approval tests for welding procedures – Fusion welding of steel |
| XXI | Fabric reference | | European design guide for surface tensile fabric structure for Cp values other references as per the shape factor for the surface. |

EN 1993 Design of steel structures –

EN 1090 Execution of steel structures and aluminum structures – EN 10204 Metallic products - Types of inspection documents – EN 10025 Hot rolled products of structural steels –

EN 10210 Hot finished structural hollow sections of non-alloy and fine grain steels –

EN 14399 High-strength structural bolting assemblies for preloading – EN 1011 Recommendations for welding of metallic materials –

EN 1337 Structural Bearings (all relevant parts)

The above list is not comprehensive, but only serves as a general guide-line.

Materials, components and systems shall be applied, installed and otherwise used in strict accordance with the recommended standards and procedures of the respective manufacturers. Use no materials, equipment or practices that may adversely affect the function, appearance or durability of the completed structure, the work or related construction.

Where requirements with respect to material grades, fabrication, tolerances, etc. specified in the Design Drawings are in contradiction with the relevant codes and standards, the higher requirement shall persist. This could be the case for example regarding the characteristic yield strength of steel plates in relation to the plate thickness.

General Specifications

1. The requirement set forth in Relevant IS Codes for the designs, fabrication and erection of structural steels for buildings shall govern this work, except as otherwise need on the drawings or as otherwise specified.
2. In cases of conflict between clauses of this specifications and those in the Indian Standards, these specifications shall govern.
3. Substitutions of sections or modifications of details or both shall be made only when approved, in writing, by the Engineer in charge. The Contractor shall be responsible for all errors of fabrications and for the correct fittings of the structural members shown on the drawings.

Materials

All materials shall be new and shall conform to their respective specifications as specified. The use of equivalent or higher grade or alternative materials shall be considered only in very special cases subject to the approval of the Engineer.

**a.** Steel

Structural steel shall conform to IS: 2062 – Grade –A (Weldable quality)
Unless specified otherwise. Carbon steel pipes shall confirm to IS: 1161 of grade YST – 240 or higher as per the requirement of structural design.

**b.** Black Bolts and Nuts

Black bolts, nuts and screws shall be in accordance with IS: 1363, 1364, 1367, 3757, 6623 ,6639- as applicable.

**c.** Washers

Washers shall confirm to IS : 2016 or any other relevant IS Codes

**d.** Welding Electrodes

Covered electrodes for metal arc welding shall confirm to IS :814, IS: 7280 for bare electrodes for submerged arc welding or IS : 1278 for filler rods and wires for gas welding or any other relevant codes .

<u>Receipt and storing of materials</u>

Storage of materials:

Approved materials confirming to IS and specifications shall be procured by the contractor as per schedule. Storing yards shall have hard grounds and should be stored on raised platform in these yards. Yards shall be maintained clean so as to avoid any contamination due to dust, mud, oil grease, etc. Scrap and full-length steel shall be stacked separately. Further each type / category of steel shall be stacked appropriately.
All sections hall be checked on receipt to ensure that they are free from surface defects as pitting, twists, racks and laminations. They shall be arranged by grade and quality and by lot. Every section shall be marked to aid identification and the manufacturers certificate for every lot giving details for chemical analysis and, mechanical characteristics shall be kept in record.
Welding wires and electrodes shall be segregated by quality and lots and stored inside a day, enclosed room as per recommendations of IS: 9595.
All cares shall be taken to keep the electrodes in perfectly dry condition to ensure weld metal soundness and satisfactory operations manufacturers certificates for electrodes shall also be made available.
Bolts and nuts washers shall be sorted out by grade, type and diameter and the manufacturers quality test certificates shall be maintained for record purposes

Quality certificate of materials

The contractor shall produce manufactures test certificate of the material. Notwithstanding, the manufacturers test certificate the EIC may ask for testing of material in approved test labs. The test result shall satisfy the requirement of relevant Indian standards.
Whenever quality certificate are missing or incomplete or when material quality differs from standard specifications, the contractor shall conduct all appropriate tests as directed by the Engineer at his own cost

.

Material Certificates

Elements, parts or assemblies, for which appropriate mill certificates and test reports cannot be presented upon request, the Client may reject the element, part or assembly and the Contractor is obliged to replace it at his own cost with an element, part or assembly for which complete and appropriate documentation exists.

Identification Markings of Components:

Each single component needs to be marked clearly with the part number, according to drawings and a defined nomenclature. Additionally, material identification batch number and all other information for complete traceability must be marked. Further the orientation of each single piece according to its assembly position needs to be indicated clearly (match marking). Marking has to be located outside of friction grip surfaces. Markings need to be permanently visible after assembly is completed. Marking is preferably to be done by adhesive labels rather than hard-stamping. Welding of markers is not permitted.

Shop/ Fabrication drawings

The contractor shall prepare all fabrications drawings on the basis of the design and submit four copies to the Engineer- in – Charge, well in advance to commencement of work for approval and comments of design consultant, if any on the same. The Contractor shall fabricate al the structural steels work strictly confirming to the specifications and approved fabrication drawings the consultant**.**

Fabrication drawings shall include the following:

- Member sizes and details
- Types and dimensions of weld and bolts
- Shapes and sizes of edge preparation or welding
- Details of shop and field joints included in the assemblers
- Bill of Materials
- Quality of structural steel, welding electrodes, bolts, nuts and washers, etc. to be used.
- Erection assemblies, identifying all transportable parts and sub-assemblies, associated with special instructions, if required showing part marks and erections marks.
- Calculations where asked for approval
- Method of erection and special precautions to be taken during erection.

Issue of fabrication and erection drawings by contractor and review of the same by the client / Design Consultant shall in no way relieve the contractor of his responsibilities for correctness in the execution of the work and the contractor shall be required to modify /rectify the structure at any stage of the work in case design consultant bring to his attention any mistake/omission in the fabrication drawing and the fabrication based on the drawing or that the work does not conform to good engineering practices, such modifications / rectification shall be made at no extra cost to the client.

The Contractor is required to update the fabrication drawings to include revisions made in design drawings during the curse of work at no extra cost. The contractor shall supply two points of as built drawings, along with their soft copies and transparencies at no extra cost.

Workmanship

The workmanship shall be equal to the standard practice followed in modem structural shop. All work shall be adequately supervised ad care shall be taken to ensure that the structural members remain in proper position. All similar parts shall be manufactures accurately so that the same could be interchanged with other parts having same identification marks. Accuracy shall be maintained during fabrication to ensure that all parts fit together during erection.

Fabrication

1. All fabrication work shall be done in full-fledged own fabrication plant or should have firm tie up with single fabrication plant owner. However, contractor to fabricate the structural element at his work shop nearby and transport the same to the site. This is to be done with prior approval of ENGINEER INCHARGE.
2. All fabrication shall be done as per specifications, IS: 800, IS: 9595 and as per "Good for Construction" fabrication drawings.
3. Fabrication shall also be understood to include building up an element either by welding plates to a rolled section, a combination of rolled sections with plates or a section/ element built up entirely with plates/ tubes/ pipes/ hollow sections, elements having sections (rolled/ tubes/ built-up box sections) fabricated to tapered profile.
4. The contractor shall prior to starting any fabrication ensures that the fabrication yard is leveled on firm ground to take weight of structures and equipment.
5. Any defective fabrication or material pointed out at any stage shall be replaced by the contractor free of cost.
6. All the fabricated and delivered item shall be suitably packed and protected from any damage during transportation and handling. Any damage caused at any times shall be made good by the contractor at his own cost
7. In general tolerance for fabrication shall be as per IS: 7215

Distortions due to weld heat must be compensated by both the shop design procedures (weld layout design) as well as the welding sequence and appropriate measures during fabrication.

Machining of connecting surfaces must be considered where high accuracy is required in order to assure the angle, length, planarity and alignment of connections. The initial plate thickness of machined parts has to allow for reduction during machining. The thickness shown in the Design Drawings gives the dimensions after machining. Welding and geometrical corrections must be done after machining.

The development, design and fabrication of any auxiliary devices such as jigs or templates for fabrication is part of the scope and must be foreseen by the Contractors without any additional remuneration.

Contact surfaces of preloaded friction bolt connections must be cleaned by wire brushing, flaming or dry blasting and protected with a blast primer. The blast primer is to be removed prior to final assembly.

Preparations of materials / Fabrications procedure Straightening

All materials shall be clean. reasonably straight and free from twists. If straightening or flattening is necessary, it shall be done by a process approved by the Consultant and in a manner that will not damage the, material. The specifications camber wherever necessary shall be provided.

Marking

Marking of material shall be made on horizontal pads, or on appropriate racks or supports in order to ensure horizontal and straight placement of such members

Clearance

The erection clearance for members having end cleats or plates shall not be more then 2mm at each end, whereas for other types of end connections it shall not be more than 3mm at each end. If for any reason a greater and clearance is required, suitable seating's, approved by the Consultant shall be provided.

Templates

Templates used shall be of steel. In case where actual parts have been used as templates for drilling similar pieces, the Engineer – in – charge shall decide whether they are fit to be used.

Cutting

**Machine cutting, flame cutting and planning:**

Machine cutting or flame cutting may be allowed to use provided, a mechanically controlled cutting torch is used for the flame -cutting and the resulting edge is reasonably clean and straight. Cut members shall be free from distortion at cut edges. When gas cutting is adopted, the flame cut edge shall be machined toa depth of 3 to 5mm depending on the thickness of

the member.
Chipping of angle flanges and edges of plates wherever necessary shall be done without damaging the parent metal. Chipped edges shall be ground to a neat finish and sharp corners and yammered rough faces shall be rounded off.
Edge preparation for welding may be done by machine controlled flame cutting with edges free of burns, clean and straight
The butting surfaces at all joints shall be planed so as to butt in close contact throughout the finished joint All flame -cut edges shall be planed, unless they are clean, square and true to shape.

Drilling / Holing

Holes for both shall be drilled. All holes, except as stated hereunder shall be drilled to the required size or sub-punched 3mm less in diameter and reamed thereafter to the required size. Thickness of the materials for sub-punching shall not be greater than 16mm. All materials holes for bolts shall register with each other so that a gauge of 0.8mm less in diameter of the hole can pass freely though the members assembled for bolting in the direction at right angle to such members. All holes for turned and fitted bolts shall be drilled undersized by ne mm and after assembly, reamed to a tolerance of +0.13mm / 0.0mm unless otherwise specified.
No holes shall be made by gas cutting process.

Bending

Cold bending of plate s, flats, tubes / pipes and sections shall be carried out on bending rolls or in process. The methodology for bending along with mockup shall be got approved from Engineer. In pipes provided cold bending is not possible.
Appropriate bending method shall be adopted, to avoid wrinkles or surface or distortion of pipe section, etc. Id required suitable filler materials shall be decided by EIC based on the mock up and good Engineering practice.
Accuracy of bending operations shall be checked by the -means of templates and the clearance between member and template shall be decided by the EIC based on the mockup and goof Engineering Practice Bend member shall not have cracks wrinkles or deep indentations from bending equipment

Assembly

All parts of bolted ad welded members shall be held firmly in position by means of jigs or clamps while bolting or welding. No drifting of holes shall be permitted except to draw the parts together and no drift shall be larger than the normal diameter of bolt. Drifting carried out during assembly shall not distort the metal or enlarge the holes
Trial assemblies shall be carried out at the fabrications stage to ensure accuracy of workmanship. These cracks shall be witnessed by the Engineer-in-charge

Bolting

Bolts shall be grade class 8.8(Class eight point eight ).All turned and fitted bolts shall be parallel throughout the barrel within the tolerance of 0.125mm unless otherwise specified and faces of heads and nuts bearing on steel work shall be machined All such bolts shall be provided with

washers not less than 3mm thick, so that when the nut is tightened it shall not bear the unthreaded body of the bolt and the threaded portion of the bolt should not be within the thickness of the parts bolted together . The threaded portion of each bolt shall project through the nut by at least one thread. Square tapered washers shall be provided for all heads and nuts bearing on levelled surface Flat washers shall be circular in shape nuts and washers etc. shall be thoroughly cleaned and dipped in linseed oil.

Preparation of member for bolting

The member shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending. Before assembly all sharp edges, rust, dirt, etc. shall be removed. Before assembly the surfaces in contact of the member shall be cleaned.

General

Welding of steel shall be in accordance with ID:800, IS: 816, IS :817, IS: 4353, IS: 1223 and IS: 9595 as applicable. Welds shall be made by qualified welders. A welder shall produce satisfactory evidence of his ability to do a given type of work and shall prove his ability to product a connection of the strength required. Evidence of welder's qualification tests shall be produced if required by the Engineer. The Engineer may reject any welder found not suitable during actual work. In general, the welder's qualification shall be carried out as per ASME- Section IX/ IS :817

Welding wire and electrodes shall be stored separately by quantities and lots inside a dry and enclosed room, and as per the instructions given by the Engineer. And perfectly dry and drawn form an electrode oven, if required.

Both the structural members and the welding operations shall be adequately protected from rain, strong winds, snow during welding. The contractor shall make all necessary infrastructures available such as requisite number of welding sets, cutting and grinding equipment's, test equipment's and all consumables as required.

Preparations of members for welding

Edge preparation of fusion faces for welding shall be carried out as per the details given in IS:9595 or as shown in drawings. All tolerances for such weld shall be as per IS: 9595

Surfaces to be welded shall be cleaned to ensure that they are free from loose scales, slag, rust, grease, paint and other foreign matter, and shall be maintained.

Pre heating of members shall be necessary when the base metal temperature (based on ambient temperature) is less than the temperature required for that welding procedure. Pre heating shall be generally be carried out for members having thickness more than 20mm. The preheating shall be done in such a manner that the part on which weld metal is to be deposited is above the specified temperature shall be measured on the face opposite to the face being heated. In case, access is limited to only the face being heated, the source of heat shall be removed and sufficient time allowed to elapse for heat equalization prior to measurement (1 minute per 25mm of plate thickness)

Column species and butt joints of compression members shall be accurately ground and close butted over the entire section to ensure full contact for load transmission. The tolerance for such works shall be maximum 0.2mm. In the case of column bases and caps the end of the section along with connected gussets, stiffeners, angles, channels, etc. shall be ground so as to

ensure a minimum contact area of 90%. The grinding of angles and channels should be sufficiently accurate to limit the reduction in thickness on account of grinding to 2mm. The ends of bearing stiffness shall be ground so as to fit tightly at top and bottom. Slab bases and cap plates shall be accurately ground over bearing surfaces to ensure minimum 90% contact area with columns.

Welding electrodes

Covered electrodes for metal arc shall confirm to IS :814, IS: 7280 for bare electrodes for submerged arc welding or IS :1278 for filler rods and wires for gas welding or other relevant codes

Welding plant

Welding plant shall be capable of maintaining the voltage and current specified by the manufacturer of the electrodes. The contractor shall supply instruments for verifying the voltage and current as and when required by the Engineer

When an automatic process of welding is adopted, the deposited metal must have mechanical properties equal to those obtained by the use of electrodes complying with IS:814 or other relevant codes

Manual Welding

Manual welding shall be carried out by qualified welders equipped with plant suitable for the purpose. All welders shall be qualified in accordance with IS :817/ASME Section IX and details of such qualification shall be submitted to the Engineer

Welding processes

Any one or more of the following welding processes may be used.

i) Manual metal arc welding process
ii) Submerged arc welding process
iii) Gas metal arc welding process

The Contractor shall submit the welding procedure and the consumables proposed to be used to the Engineer for approval combination of processes or electrodes may be permitted only with the specific approval of the Engineer

Approval and testing of welding procedures

Before welding of any of the permanent works is carried out, the contractor shall furnish details of welding procedure for each welding operation

Welding trials shall be carried out and completed on representative samples of the materials before the start of fabrication, as directed by the Engineer

Welding trials are intended to establish welding procedure prior to the commencement of fabrication and for this purpose assemblies shall be made from plate or section cuttings large enough to simulate the joints selected for trial. The trial shall be representatives of actual

fabrication conditions including:

A) Preparation and fit up
B) Preheat
C) Welding position
D) Restraint (so far as is practicable)

Welding trials on material 20m thick will be taken to include all materials under 20 mm thick. The trials shall include specimen weld details from the actual constructions, which shall be welded in a manner simulating the most unfavorable instances of fit up and preparation which it is expected will occur in the fabrication

After welding, the specimen shall be allowed to cool naturally to ambient temperature. It shall be left for 72 hours and thereafter, it shall be sectioned and examined for cracking

Testing shall be carried out in accordance with IS: 7307 PART -I as directed by the Engineer.

Approval of nay welding procedure shall not relieve the contractor of his responsibility for correct welding procedure to be followed and for minimizing the distortion in his finished structure

Sequence of welding

a) The direction of welding shall be from paints relatively fixed with respect to each other towards points having more flexibility
b) Welding shall be carried out continuously to completion with the required number of runs
c) For compound section splices, each component part shall be spliced prior to welding with other component parts
d) Welds shall progress in a sequence that will balance the applied heat so as to reduce distortion
e) Joints having more shrinkage shall be welded prior to joints having less shrinkage
f) The shrinkage causing minimum distortion or shrinkage shall be chosen

Welding Technique

The fusion faces shall be properly aligned and the gap set to the distance specified. The root pass of the butt joint shall be done such that full penetration is achieved as also complete fusion of root edges

On completing each run the weld and the parent metal shall be cleaned by wire brushing and light chipping to remove all slag and spatters. Visible defects, if any such as cracks, cavities etc shall be removed to sound metal prior to depositing subsequent run of weld

All full penetrations butt weld shall be completed by gouging /chipping the back of the joint and depositing a seal run of weld metal. Alternatively, a backing strip shall be provided

All care shall be taken to prevent any kind of movement, shock or vibration of components during welding to prevent weld cracks

Low hydrogen electrodes shall be used for all welding of girders with thickness of plates equal to or more than 20mm

Workmanship of welding

The general welding programme for shop and site welds, including particulars of the preparations of fusions faces, pre heating where required and method of making welds shall be submitted in writing to the Engineer for approval before the work is put in hand. No departure from the welding programmes shall be made without the prior approval of the Engineer

In fabrications of built-up assemblies all butt welds in each component part shall be completed before the final assembly. Wherever practicable, clamps, magnets, holding devices or other setting up fixtures shall be used in assembling parts of the structures so as to avoid tack welding as far as possible

In fit up where clamps cannot be used, spacer strips shall be used to ensure the correct root gap

Where tack welds are used, they shall be of the same quality and size as the first run of main weld. All tack welds shall be cleaned and ground to sound materials prior to welding of the root pass. The main weld shall be fuse completely with the end of the tack weld to form a regular profile.

Where preheat is required for the main welds, the tack welds shall be made under the same heat conditions. The indiscriminate use of tack welds during assembly shall be avoided

All welds shall be visually inspected. Cracked or badly formed welds shall be cut out to the approval of the Engineer before re-welding team.

As far as practicable, all welding shall be carried out in the down hand position

Where structural steel work is painted before fabrication or rection, the, metal surface within 75mm of any weld shall be coated with primer only

Weld inspection

All testing shall be as per IS:822 and the extent of inspection and testing shall be in conformity with the relevant or as directed by Engineer. The Contractor shall extend to Consultant all facility required t0 inspect all stages of fabrication and rection including welding procedure qualification. No painting of welds shall be undertaken prior to inspection and approval. All tests required to be carried out shall be paid for by the contractor

The various types of tests shall be:

i) Visual inspection

100% welds shall be visually inspected to ascertain absence of the following defects

a) Surface cracks in weld or parent metal or undercut, burning, overheating of parent metal
b) Blow holes, exposed porosity in the weld or unfused welds
c) Defects in the profile such as excessive convexity or concavity, unequal leg lengths, incompletely filled grooves excessive penetration beds, root grooves, etc.

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d) Distortion due to welding and misalignment

ii) Mechanical tests

Tensile load tests, bend tests, impact tests, etc shall be carried out as per the standard

iii) Radiographic testing

Such testing shall be carried out on 5% of butt joints. The tests shall be carried out as per relevant codes. The contractor shall fulfil all necessary statutory safety requirements while handling x-ray and gamma ray equipment and provide the Consultant viewing facilities

All welds shall be of radiographic quality, Frequency of radiographic tests to be carried out shall be decided by Engineer in Charge. Evaluation and interpretation of the results of the testing shall be carried out by independent expert agency approved by CIDCO

iv) Magnetic particle /Dye penetration /Ultrasonic tests

At least 10% welds shall be checked by any one of these methods. For fillet welds, ultrasonic testing of 1 in 20 positions decreased to 1 in 50, if failures are less than 10. Such test shall be carried out only when directed by the Engineer. These shall be carried out to the procedure specified IS: 822

All charges incurred due to testing, arrangements for testing, conveyance charges for CIDCO officials for outdoor testing including lodging, boarding charges etc shall be borne by the Contractor

Weld tests have to be carried out as per BS EN 1090-2 Cl.12.4 and corresponding to the execution class (EXC) and related assessment group (see BS EN 1090-2 Cl.7.6) The minimum volume of non-destructive testing is as per BS EN 1090-2 Table 24

In addition to the requirements for weld testing as per BS EN 1090-2, NDT shall be carried out for all site welds as follows:

a) Full and partial penetrations butt welds :100% MPI and 1005UT 48 hours after completion of welding
b) Fillet welds :100% MPI 48 hours after completion of welding

Repair of welds

Welds do not meet the requirement of the specifications and IS codes shall be removed and replaced. Repairs to defective welds shall be carried out only after the repair procedure submitted is approved by the Engineer -in – charge

Splicing

In compound sections, splicing of components shall be staggered with respect to each other by a minimum of 500mm. When two parts of a component are not welded to each other, the opposing ends at a joint shall be ground flush for bearing and suitable flange and web splice plates shall be designed to cater for the full strength of the flange/web of the sections

In case full strength butt weld is used to connect opposing ends at a joint, additional flange and web splice plate shall be provided capable of carrying 20% strength of the flange and web

Shop section

The steel work shall be temporarily erected in the shop to determine the accuracy of the fit.

The extent of erection shall be either complete or as directed by Engineer -in- charge

General inspections and testing of structures

Materials and workmanship at all times shall be subject to inspection by the Consultant. All inspection as far as possible shall be made at the place of fabrication and the contractor shall co-operate with the Consultant Inspector and permit access for inspection to all places where work is being done. The contractor shall supply free to the Consultant all necessary gauges and templates necessary for inspection. However, such inspection shall not relieve the contractor of his responsibility to furnish satisfactory work
Materials of workmanship, not conforming to provisions of the specifications may be rejected any time when defects are found during the progress of work.
The contractor shall obtain approval from the Engineer in charge of all fabricated items prior to commencement of their erection. However, any such approval shall not absolve the contractor from his responsibility of correctness and workmanship of the entire work

Packaging and transportation

Loading and transportation shall be done in accordance with transport rules prevailing at that location. Items shall be packed to protect them from damage /distortion. Small parts shall be wired to their main members. Loose item such as bolts, nuts and washers shall be packed in crates/bags .

Erection general

Erection of structural steel works shall be carried out in accordance with the relevant IS code in conformity with the drawings and specifications in an expeditious manner
The suitably and capacity of al plants, equipment,etc. ,used for erection shall be the satisfaction of the Engineer

Scope of erection work

The contractor shall provide all construction material and equipment, transport facilities, tools, consumables, labours, supervision for erection, including carrying out the following:
Receiving, unloading, checking and moving into the storage facility at site, as outlined under General conditions of contract inclusive of attending to all insurance matters in respect of materials arriving at site.
Transporting from site, storage, handling, rigging, assembling, riveting, bolting, welding and installation of all fabricated materials in proper location according to drawings or as directed by the Engineer Checking centre lines, levels of all foundations blocks including checking line and level, position and plumb of all bolts and pockets. Any defects observed in the foundation shall be brought to the notice of engineer. The contractor shall satisfy himself regarding the correctness of the foundations before installing the fabricated structures on the foundation blocks. Aligning, levelling, riveting, bolting, welding, fixing in position fabricated materials in accordance with drawings or as directed by the Engineer
Supply of all required consumables, constructions and erection materials, including but not limited gauges, welding /brazing, rods, electrodes and wires, oxygen, acetylene, fuel, bolts,

nuts, shims and temporary supports, etc. as required for the incidental works and for the completion of erection. Erection shall also include the following work:

a) All minor modification such as:
   i) Removal of bends, kinks, twists, etc. of parts damaged during transport and handling
   ii) Cutting, chipping, filling, grinding, etc. for preparation and finishing of site connections
   iii) Reaming for use of the next higher size of rivet or bolt for holes which do not register or which are found to be damaged
   iv) Welding of connections in place of riveting or bolting for which holes are either not drilled or wrongly drilled during fabrication

The following shall be considered as a legitimate part of erection work

   i) Re-fabrication work in respect of parts damaged beyond repair during transport and handling or in respect of those that are incorrectly fabricated
   ii) Fabrication of parts omitted during fabrication due to an error, or subsequently found to be essential
   iii) Plug- welding and re -drilling of holes which do not register and which cannot be reamed for the use of next size of rivet or bolt
   iv) Drilling of holes which are either not drilled at all or are drilled in incorrect positions during fabrication

Erection drawings

The approved erection drawings and any approved arrangements drawings, specifications or instructions accompanying them shall be followed while erecting the structural steel work. Erection drawings for structural steel work shall be prepared by the contractor and shall consist of line -diagrams showing every member in position with the respective erection mark
Erection marks shall appear on the structural steel members as detailed and all steel work shall be erected with the marks in the same relative position as shown on the plan or elevation
Any discrepancy between and specifications shall be brought to the attention of the Engineer -in-charge for obtaining his decision

Storing and handling of materials

The fabricated material shall be carefully unloaded at site, examined for defects, checked, sorted out and stacked properly above the ground level, to be kept clean and properly drained. The handling and storing of the component parts of a structure shall involve the use of method and alliances not likely to produce injury by twisting, bending or otherwise deforming the metal.
No member slightly bent or twisted shall be put in place until the defects are corrected.
All small bends or twists detected in members shall be rectified before such members are out in place
Any serious bends or defects shall be reported at once to the Engineer. The straightening of bent edges of plates, angles, and other shape shall be done by methods not likely to produce fracture or other injury. Following the completion of the straightening of abend or buckle, the

surface of the metal shall be carefully inspected by the contractor for evidence of incipient or any other type of fractures. The contractor shall report to the Engineer about the presence of such evidence and act according to his instructions

Setting out

The contractor shall be responsible for checking the alignment and levels of foundations, correctness of foundation bolt centres, their projected height above the foundation tops, the length of threading provided and the provision and fitment of nuts for the foundations bolts. There shall be checked well in advance of starting the rection work and the contractor shall be checked well in advance of starting the rection work and the contractor shall be responsible for any consequences for non-compliance thereof. Discrepancies, if any, shall immediately be brought to the notice of the Engineer for his advice

One set of reference axes and one bench mark level will be furnished to the contractor. These shall be used by him for the setting out operation

The contractor shall assume full responsibility for the correctly setting out for all steelwork and erecting it correctly as per the alignment and levels shown in the drawings and for the vertically of members.

Notwithstanding any assistance rendered to the contractor by the Engineer, if at any time during the progress of the work any error should appear or arise therein, the contractor shall remove and amend the work to the satisfaction of the Engineer, at his own cost

Assembly and Erection

Before the commencement of structural steelwork, the contractor shall submit a schedule of operations, detailing the erection procedures to be followed. The scheduled shall include provisions for any temporary bracing that may be considered necessary during the erection

During the rection of a structure, the steelwork shall be securely bolted or otherwise fastened and if necessary temporarily braced, so as to make adequate provisions for all erection stresses and conditions, including those due to erection equipment and its operation. Such temporary bracing shall be maintained in position until the erection work is sufficiently advanced and it is ascertained that the bracing provided is no longer required

Connections for temporary bracing and additional habit holes, members or cheats used to facilitate handling or erection, shall be provided in a manner which does not weaken the steelwork already erected The alignment of each position of the structure shall be carried out progressively, soon after that portion is erected. Permanent connections shall not be made until proper alignment has been obtained and a sufficiently large portion of the structure has been erected and temporarily connected so as to ensure that the members thus connected shall not be overdressed or displaced during the progressive alignment of the remainder of the structure

Tolerances

Erection tolerances shall be provided strictly in accordance with the requirements of IS: 7215

Field connections

Field bolting

This shall be carried out with the same care as shop bolting.

Field welding

Field welding after field assembly shall follow the same requirements as laid down for shop assembly and shop welding.

Grouting

Prior to erecting the steelwork over concrete pedestals, columns or brackets, the top of the concrete shall be cleared with wire brushes, chipping and compressed air to remove all laitance and loose materials and made thoroughly wet. The structural member shall then be erected aligned and plumbed with the base plates, maintained at specified levels using shims/picks plates or wedges

After the structure is erected, formwork shall be done all around and the joints sealed to be water tight. The grout under the bas plates, including in pockets and sleeves shall be non-shrink grout, as specified in schedule of quantities. Non-shrink grout shall be of premix type and shall be prepared as per manufactures instructions, Non shrink grout shall be of quality and type approved by Engineer-in- charge The grout shall be poured in by grout pumps continuously from one side till the intervening space is filled completely and the grout is carried to the far side of base plate. The grout shall be spread with flexible steel strips and rammed with rods to ensure the gaps is filled completed

After the grout has sufficiently hardened the shims/packs/ wedges which are accessible may be removed and anchor bolts tightened. The alignment of the structure shall be rechecked and the voids left by removal of the shims/pack plates /wedges shall be filled with a similar mix of grout. In case the structures is not properly aligned the grout shall be removed, the structure re-aligned and grouting operation repeated

Painting of steel elements

Structural steel components which shall remain exposed without concrete encasing shall have painting on exposed outer surface as stated hereinafter. Prior to painting, for protection of steel against corrosion, the essential element is removal of all mill scales/residues, which are formed on the surface of plates and section to prepare the surface for receiving the specified paint system.

Surface preparation

All surfaces to be painted shall be blast cleaned in the shop to Sa 2 ½ standard i.e. blast cleaning to White metal cleanliness, until at least 95% of each element of surface areas is free of all visible residues. The abrasive to be used shall be either set up a system for blasting by mechanical means by using centrifugal impellers or by using compressed air (manual/hand blasting) with appropriate arrangement for recycling of frit/ shots.

For any surface preparation, if required at site, manual blasting as specified above shall be carried out using expendable abrasive such as crushed slag, non-metallic silica free compounds, etc.

Application of coating

Unless otherwise specified, the paint system shall be applied by airless spray /air spray/ roller /brush method or a combination of these methods. All coatings in the shop should be done by the airless spray method.

Paint Thickness

To determine conformance to dry film thickness specified by means of magnetic gages, five separate spot measurements shall be taken spaced evenly over an area of say 10 m2, or other area as may have specified.

The average of the 5 spot measurements should not less than the specified thickness, no single spot measurements should not be less than 80%of specified thickness. Occasionally if unusually high or low readings occur, such single gauge readings, which are not repeated consistently can be ignored and not used in the determination of spot measurements. In shop painting, wet film thickness measurements may also be used , as they have the advantage of providing an immediate indication of thickness at a time when inadequacies can be corrected , usually without the need of an additional costs cannot be applied to correct the deficient thickness

The wet fil thickness readings should be taken within a few seconds after the application , the approximate expected dry film thickness can then be calculated by simply multiplying the wet thickness by the Volume Percent Solids ( Vs)/100m(taking into account any thinning of the paint for application) Most dry film thickness gages using magnetic particles indicate at best only the distance from the top of the paint surface to all magnetic steel surface , other films under the paint ( such as rust, mill scale, existing paint , or a rough surface profile) also increase the gage readings. Such gage measurements shall be then corrected by either:

i) Measuring a known shim of similar thickness in the same substrate Or

ii) Subtracting a "blank" reading of the same substrate without paint.

Paint repair

Touching up of areas damaged by handling is the responsibility of the contractor, damaged shop coated areas should be cleaned of damaged paint, re-prepared and then repainted with the same paint system as the damaged areas. The paint manufacturer should specify the maximum time gap between the shop and the field costs, so as to avoid excessive weathering and touching of shop paints. Contractor shall schedule the shop coats, erection and final costs accordingly. Shop painted steel which is stored in the filed pending erection, should be kept free from ground and positioned as to minimize water holding pockets, dust, mud and other contamination of the paint film. Any damage to paint due to improper storage shall be rectified as specified above.

Inspection and testing of paint

i) All painting material shall be procured from the reputed manufactures. Quality test certificate s must accompany the supply. Engineer-in-charge at his discretion may ask for additional tests to satisfy himself regarding the quality of paint including batch wise test of wet paints for physical and chemical analysis. The costs of all such testing shall be borne by the Contractor

ii) The various stage wise inspection shall be at the following stages:

1. Surface preparation
2. Primer application
3. Each subsequent coat

The contractor shall make available all facility and equipment such as Elko meter necessary for inspection free of cost. Measurement /tests shall be performed at as many locations as desired by Engineer -in- charge. The contractor shall make good / rectify any defects pointed out prior to proceeding with next stage or work. Irrespective of any intermediate inspections and approvals the contractor shall be responsible for rectifying any defect liability period.

Hot Dipped Galvanizing (for the bolts, corner plates and other accessories)

i) Hot dipped galvanizing shall be carried out in accordance with IS: 802 (Part II), IS: 5358 and IS: 4759

ii) The steel work prior to delivery, shall be cleaned for scale, rust, dirt, grease, etc. by means of chipping, scraping, wire brushing, mechanical buffing using skilled operators and dipping in caustic soda bath and then in a bath containing dilute solution of hydrochloric acid

iii) The steel shall then be fluxed with ammonium chloride by impression in a pre-flexing bath or other approved means

iv) After pre-flexing, the steel shall be dipped into the pure (98.5%) molten zinc held at a temperature between 440 degrees centigrade to 470 degrees centigrade. Proper arrangements shall be made to support the member. The size of bath shall be such that it shall accommodate the individual member in its entirely.

v) The thickness of hot dipped galvanized coating shall be between 610 to 765 g/m2

vi) Immediately after the steel has been removed from the bath, it shall be wiped, centrifuged to remove excess zinc and eliminate irregularities.

vii) Proper vents of approved diameter shall be provided for all box members for proper venting of the closed space.

viii) Care shall be taken to avoid the distortion of the steel member

Avoidance of contact corrosion

Appropriate measures have to be foreseen to permanently avoid contact corrosion between different types of metal (e.g. aluminum and steel, carbon steel and stainless steel)

Mode of measurement Steel work

Payment of structural steel shall be paid on the basis of admissible weight (in metric tons) of the structure accepted by the Engineer-in-charge. The rate shall include , supply ,fabrication, erection in position (at all locations and levels as mentioned in schedule of items) , testing and examining of bolted and / or welded structural steelwork of all types (including all types of built up and compound sections made up from rolled sections and plates ) including all transporting , preheating, welding or bolting of joints ( bolts , nuts , etc. will be paid separately in weight basis ) including continuously seal welding of box/ hollow sections, grinding , fixing in line and level with temporary staging , bracing , guying , temporary fasteners , temporary supports, temporary anchor bolts etc. and the removal of the same after erection

including preparations of fabrication drawings and erection drawings, erection schedules including all necessary submissions for review, preparing the surface for painting, surface cleaning, removal of mill scale, dust, rust, oil or grease.

The weight shall be determined from the fabrication drawings and bill of materials prepared by the contractor and approved by CIDCO. The weights shall be calculated on the basis of IS handbook / IS: 1161/ IS:806, wherever applicable and from manufactures handbook for other cases. In the case of imported section, the weights chargeable shall be the weight according to the relative standards of the country of origin. No allowance in weight shall be made for rolling tolerance. The price shall include allowance for wastage, caused by shape or profile of elements

Weight of erection pack plates, shims, wedges and weld shall not be measured. The quoted rate shall be deemed to include the same. In calculating wights of gusset plates, payments will be made for the least enclosing parellogram or triangle. For structural sections, the weight will be calculated on lengths actually used, with no deductions for splay cut or mitred end.

Bolting

All foundations bolts, connections bolts including nuts, washers, will be payable separately on weight basis on the basis of Indian Standard codes.

Grouting

Grout shall be paid on cu. m. basis based on volume area calculated to fill the pockets and the gap of pedestal and underside of base plate

Painting of structural steelwork

Payment for the painting of structural steelwork shall be done on the basis of weight in metric tons of the painted structure accepted by the Engineer -in -charge

The rate shall include storage, surface preparation, degreasing, cleaning, drying , touching up, rectification of damaged points as mentioned in Schedule 'A' as per the methodology approved by the Engineer -in- charge

WARRANTY

- General Defect liability period is one year from date of completion and handing over.
- Warranty for Steel Structure materials and workmanship against defects for a period of 5 years from date of completion of the work and handing over
- 15-year warranty for the 902 S2 series of Fabric material from serge Ferrari (conditional warranty from manufacturer)

DESIGN

- The structural design shall comply with applicable codes and regulations of Indian Standard/ BS/ AISE.

- Engineering Design documentation of the complete tensioned membrane structure shall meet all applicable codes of AISE /Euro Code III or equivalent.
- The structure shall be designed for loads in accordance with the IS:875 with the basic wind speed applicable to the site as per IS:875 Part-03
- Design of structural steel shall be done as per the Limit State Design using IS:800 / EN 10219-2
- Reference to other international codes / standards can be made at times when necessary guidelines are not available within Indian Standards.

ENGINEERING

- This part of the specification document covers the basic engineering requirements for this structure
- Engineering calculation: It should include primarily the following items
  - Design basis & criterion clearly mentioning the parameters and characteristics for all the materials that are being used for this tensile fabric structure
  - Basic data used for generating wind loads and pressures along with loading diagrams
  - Large deflection numerical shape generation that will ensure a stable, uniformly stressed, three dimensionally curved shape that is in static equilibrium with the internal pre-stress forces and is suitable to resist all applied loads.
  - Analysis of the fabric (using the stable form) for all applicable external forces / loads.
  - Confirmation of fabric strength – contractor to confirm that the fabric specified in this document is satisfying the technical requirement based on fabric analysis.
  - Finite element structural analysis of the support frame system. Member sizing calculations of all primary structural members.
  - Connection design including bolt, weld and ancillary member sizing.

- Engineering drawings: In general, all submissions shall be made in minimum A3 size. All drawings shall include critical dimensions, specification, grades of materials, connections, anchoring and foundation details necessary to understand the submission. The engineering submission to include primarily (but not limited to) the following drawings
  - GA drawing of the structure with the pre- stressed fabric – to include the plans and elevations
  - Structural framing drawings – to include plans and elevations along with the basic sizes of the primary structural members
  - Layout and details of foundation and anchoring
  - Details of connection between structural members, fabric connection to structural framing, specific connections critical to the structure, etc.
  - A General Seam layout of the fabric, typical seam joining details, fabric reinforcing details, etc.
- Contractor shall be experienced enough to understand Biaxial Fabric test results, interpret and finalize the fabric compensation values. Using these results, the engineer to find out the final two- dimensional compensated fabric templates required to generate the three-dimensional equilibrium shapes.
- Structural Authenticity: All drawings and calculations shall be signed and sealed by a specialized engineer mastered in membrane structures from any European University. This engineer is responsible for this authenticity shall hold the following minimum basic requirement.

- An overall minimum experience of 15 years in tensile membrane engineering is required.
- The contractor will help the client to get the design vetted by IIT /NIT or equivalent, if required.

QUALITY ASSURANCE

**Acceptable Manufacturers:**

Tensile fabric contractor must provide proof of the following certifications:

- Have been in continuous operation as a professional fabric Tension Structure manufacturer for a minimum of 15 years prior to this contract.
- Should have the following software's in-house for design engineering calculation, beam analysis, member size optimization, cutting pattern generations etc.
- Should have the following Machineries in house for design engineering calculation, beam analysis, member size optimization, cutting pattern generations etc.

➢ Zund Conveyor Type Automatic Plotter cutting machine for the cutting accuracy of membrane panels – (Made in Switcher land) – No manual cut or table type cutting machines allowed due to the accuracy matters for cutting of membrane panels

➢ Forsrom High Frequency welding machines 12 and 20 KW Stationary and Travelling machine of minimum table size of 30 meters for the welding adequacy and reliability – No Indian Chinese machines stationary machines allowed for the accuracy and workmanship perfection matters.

Fabric cutting welding ISO report formalities should be followed for cutting, welding, testing, packing procedures.

FABIRC MATERIALS

1. FT 381 perforated mesh fabric and GI-coated base Structure and special aluminum Profile frames, Complete as per the approved design concept and shop drawing. 10-year warranty with following Characteristics.

| | |
|---|---|
| Front Face | Metallic or pearl finish |
| Back Face | Matt |
| Weight | 550g/m2 |
| Standard format length | 50lm |
| Thickness | 0.95mm |
| Tensile Strength(Wrap/Weft) | 330/330daN/5cm |
| Tear Strength(Wrap/Weft) | 80/90daN |

| | |
|---|---|
| Extreme Usage temperature | -30degree C/+70degreeC |
| Openess factor | 28% |
| Warranty | 10 Years |
| MOQ | 3500lm |

2. 202 S2 Type-III 1050 GSM PVDF coated PVC Fabric from Serge Ferrari -Made in France- 15-year warranty with following Characteristics.

| | |
|---|---|
| Weight | 1050g/m2 |
| Standard format length | 175lm |
| Thickness | 0.95mm |
| Tensile Strength(Wrap/Weft) | 560/560daN/5cm |
| Tear Strength(Wrap/Weft) | 80/90daN |
| Extreme Usage temperature | -30degree C/+70degreeC |
| Warranty | 15 Years |
| MOQ | 1500lm for 180cm width-3500lm for 267cm width |

STRUCTURAL STEEL FRAMING AND COATINGS

- Structural frame shall be fabricated using structural steel of standard shapes as per the architect's requirement.
- The steel shall be of IS or ASTM for standard profiles and ASTM A500 / ASTM A53 / IS:1161 for structural tubes & Pipes
- The fabrication of the steel shall be in accordance with guidelines set forth in the AISC steel design manual and the AWS code of structural welding. The fabrication activity shall be performed at the factory only – Not at site. All welds shall be in accordance with manufacturers design and performed prior shipping. No welding shall be performed in the field / site unless authorized in writing to by the Client or Client's representative.
- The structural members shall be fabricated in as large segments as possible thereby reducing the number of joints.
- All segments of the assembly will be welded or stamped with the appropriate part number in a manner that will still be visible after painting is applied.
- Fabricator to grind all corners and sharp edges in order to avoid damage of fabric.
- The fabricated structural steel framing shall be applied with the following painting finish (200 microns) using spray (Air / Airless) system.
  - The surface of the fabricated steel framing shall be cleaned using abrasive blasting to SA2.5 o Apply base primer pigmented with metallic elements anodic to steel (60 microns)
  - Apply intermediate coat to build the thickness (100 microns)
  - Apply weather resistant re-paintable polyurethane finish coat (40 microns)

CABLES AND END FITTINGS

- This part of the specification is applicable wherever there are requirements of cables and associated fittings.
- All structural wire rope shall be made from Wire Rope conforming to AISI Steel Cable Manual requirements with a Class A galvanized coating or approved substitute. The cable should be IWRC improved plow steel. All cable terminations and connectors shall be Stainless steel (SS316). Cables should be designed with a minimum safety factor of 2 on breaking strength.
- All cables and end fittings shall be delivered clean and thy.
- All swaged fittings shall be designed and attached to develop the full breaking strength of the cable. Thimble end fittings shall develop a minimum of 110% of the cable breaking strength.
- Attach a tag indicating the cable length and mark number to each cable assembly.

BOLTS AND RELATED FASTENERS

- Fasteners and hardware accessories shall be of types and sizes best suited for the purpose as recommended by the specialized membrane structure engineer.
- Fasteners used on main structural members shall be hot-dipped galvanized (HDG) high-strength bolts including nuts and washers and conforming to Gr.8.8 minimum as applicable. All other fasteners shall be adequately sized and treated for corrosion protection.
- Concrete anchor bolts shall be Gr.8.8 or equivalent and be Hot-dipped Galvanized Straight type bolts with stopper plates and nuts in the bottom part of the bolts with 150mm threads in both ends.

ROOM LAYOUT

## 2.8. Technical Specification – Badminton & Multipurpose Flooring

**Item:** Providing and fixing of European Make or Equivalent Synthetic Sports Flooring
**Thickness:** Overall **7.5 mm**

---

**1. Material Composition**

- **Vinyl Wear Layer:** 2.0 mm calendared and grained vinyl surface layer.
- **Surface Treatment:** Patented **Triple-Action Protecsol®** for slip resistance, reduced maintenance, and durability.
- **Base Layer:** Double density **CXP-HD™ closed-cell foam** for shock absorption and comfort.
- **Reinforcement: D-Max™ fiberglass grid** for dimensional stability.
- **Sanitation: Sanosol® treatment** for fungistatic and bacteriostatic protection.
- **Bio-content:** Minimum **24%**, sourced from plant residue.
- **Weight:** Approx. **4.7 kg/m²**.

---

**2. Performance Characteristics**

- **Impact Resistance (EN 1517):** ≥ 8 N/m²
- **Abrasion Resistance (EN ISO 5470-1):** ≤ 350 mg
- **Impact Protection Index (IPI):** 76%
- **Shock Absorption (EN 14808, Class P1):** ≥ 25% (Labosport tested value = 31%)
- **Indentation Resistance (EN 1516):** ≤ 0.5 mm
- **Ball Bounce (EN 12235):** ≥ 90%
- **Vertical Deformation (EN 14809):** ≤ 2 mm
- **Sliding Coefficient (EN 13036-4):** 80–110
- **Fire Classification (EN 13501-1):** Cfl-s1
- **Anti-Viral (ISO 21702):** 99.37% reduction of Human Coronavirus 229E after 2h
- **Anti-Bacterial (ISO 22196):** > 99% growth inhibition

---

**3. Certifications & Compliance**

- **CE Marking:** For indoor multi-sports surfaces (EN 14904).
- **REACH Compliant** (European Union regulation).
- **Singapore Green Label Certified.**
- **EPD (Environmental Product Declaration):** Must be available.
- Product must have been used in the **last 3 Olympic Games**.
- Must be **homologated and certified** by the following international sports bodies:
    - **FIVB, AVC, IHF, AHF, EHF, AFC, FIBA, IFF, WPV, BWF**.

---

**4. Installation**

- Subfloor preparation with self-leveling screed (±2 mm tolerance in 3 m straight edge).
- Approved adhesive as per manufacturer's recommendation.
- Sheet joining by heat welding with matching welding rods for seamless finish.

- Perimeter finishing with skirting and edge trims.
- Line marking in contrasting colors as per respective federation standards.

---

**5. Warranty**

- Minimum **15 years manufacturer's product warranty** for wear resistance and performance.
- OEM compliance and certification documents must be submitted before installation.

## 2.9. Technical Specification – Athletics Track Flooring (Sandwich System)

**Item:** Providing and laying **13 mm World Athletics Federation Approved Sandwich System** synthetic surface
**Application:** Running Track & Multipurpose Athletic Surfaces

---

**1. System Composition (13 mm total thickness)**

1. **Base Layer (10 mm SBR Rubber Base Mat):**
    - Material: Recycled SBR rubber granules, 1–4 mm size.
    - Mixing: Thoroughly mix granules with polyurethane (PU) binder in a mechanical mixer until each granule is fully coated.
    - Installation: Apply the mixture over primed asphalt base using a mechanical spreader.
    - Curing: Leave to harden; curing time depends on ambient temperature and humidity.
2. **Sealing Coat:**
    - Material: PU Components A & B mixed to form a uniform mass.
    - Application: Spread a thin sealing layer evenly over the cured base mat.
3. **Top Layer (3 mm EPDM Broadcast):**
    - Material: PU components mixed in ratio 100:65 (Comp. A : Comp. B).
    - Application: Spread evenly over the sealed base mat; when self-leveled, broadcast with UV-stable EPDM granules (excess quantity to ensure complete coverage).
    - Hardening: Leave for approx. 24 hours for curing, then remove excess loose granules.
4. **Line Marking:**
    - Method: Paint application after surface hardening.
    - Standard: As per **World Athletics Federation line marking specifications** (lane width, event markings).

---

**2. Performance Standards**

The system shall comply with the latest **World Athletics Federation Certification Standards** for track surfaces, including but not limited to:

- Shock Absorption: 35–50% (EN 14808)
- Vertical Deformation: ≤ 2.0 mm (EN 14809)
- Tensile Strength & Elongation: As per EN 12230
- Resistance to Spikes: ≥ 5,000 cycles without damage
- Slip Resistance: Meets EN 13036-4
- Weather Resistance: UV-stable, all-weather, porous system

---

**3. Sub-Base Requirement**

- Sub-base: Asphalt concrete base, compacted and finished to required level, tolerance ±3 mm in 3 m straight edge.
- Priming: Apply polyurethane primer to the asphalt base prior to base mat installation for enhanced adhesion.

---

**4.** World Athletics Federation **Certificate of Product Compliance** to be submitted.

## 2.10. Technical Specification – Gym Flooring (Rubber Tiles)

**Item:** Supply and Installation of Rubber Tiles for Gym & Fitness Areas
**Application:** CrossFit Zones, Heavy Weight Training Zones, Free-Weight Areas

---

**1. Material & Dimensions**

- **Tile Size:** 500 mm × 500 mm (±1%)
- **Thickness:** 20 mm (±2 mm)
- **Weight:** Approx. 6.2 kg per tile
- **Material:** High-density vulcanized rubber, free from harmful chemicals, recyclable.
- **Hardness:** Shore A **60 ± 5**
- **Sound Insulation:** Approx. 24 dB (impact noise reduction).
- **Resistance:** Excellent resistance to static loads, dumbbells, and heavy equipment.

---

**2. Performance Characteristics**

- **Shock Absorption:** High impact resistance, reducing stress on joints during weight training.
- **Slip Resistance:** Anti-slip surface, even under wet conditions.
- **Durability:** Resistant to indentation, cracking, and deformation.
- **Maintenance:** Easy to clean, moisture-resistant, and hygienic surface.

- **Safety Compliance:** Non-toxic, low VOC, and conforms to relevant fire-safety standards.

---

**3. Installation**

- **Subfloor Preparation:** Ensure the subfloor is clean, dry, level, and free of dust or oil.
- **Fixing System:** Use **special plastic connectors** for tile-to-tile locking, ensuring stability.
- **Alignment:** Precise alignment with **minimal visible joints** and neatly finished edges.
- **Surface Finishing:** After laying, the entire surface shall be rolled with a heavy-duty roller to ensure proper bonding and levelling.

---

**4. Contractor's Responsibility**

- Provide **technical datasheets** and **installation methodology** for approval prior to execution.
- Supply all adhesives, connectors, rollers, and required tools for installation.
- Ensure workmanship meets international gym flooring standards.

---

**5. Warranty**

- Minimum **5-year material warranty** covering wear, tear, and structural performance under normal gym usage.

## 2.11. Technical Specification – Heavy Weight Training Zones (Rubber Tiles)

**Item:** Supply and Installation of Rubber Tiles for Heavy Weight Training Zones
**Application:** Free-weight zones, CrossFit areas, Olympic lifting platforms, and dumbbell sections.

---

**1. Material & Dimensions**

- **Tile Size:** 500 mm × 500 mm (±1%)
- **Thickness:** 30 mm (±2 mm)
- **Weight:** Approx. 6.2 kg per tile
- **Material:** High-density vulcanized rubber tiles, eco-friendly, free from harmful chemicals.
- **Hardness:** Shore A **60 ± 5**
- **Shock Absorption:** ≥ **49%**, tested as per relevant international standards.
- **Slip Resistance:** Minimum **R9 rating** or equivalent (anti-slip under dry and wet conditions).

- **Sound Insulation:** Approx. **24 dB** impact noise reduction.
- **Load Resistance:** Highly resistant to static loads, heavy barbells, and free weights.

---

**2. Performance Characteristics**

- Provides **high impact protection** for both users and subfloor.
- Hygienic, non-toxic, and low VOC emissions.
- Easy maintenance – surface washable and resistant to moisture and sweat.

---

**3. Installation**

- **Subfloor Preparation:** Subfloor must be clean, dry, and level (tolerance ±2 mm over 2 m straightedge).
- **Fixing System:** Interconnected using **special plastic connectors** to ensure stability and prevent movement.
- **Alignment:** Precise alignment with minimal visible joints and neat edge finishing.
- **Finishing:** Entire laid surface to be rolled with a heavy-duty roller for proper bonding and leveling.

---

**4. Contractor's Responsibility**

- Submit **technical datasheets** and **installation methodology** for approval prior to installation.
- Provide all necessary connectors, adhesives, rollers, and tools.
- Ensure installation is executed by trained personnel with prior experience in gym flooring.

---

**5. Warranty**

- Minimum **5-year manufacturer's warranty** covering material defects, wear resistance, and structural integrity under heavy weight usage.

## 2.12. Technical Specification -Synthetic Artificial Turf System

**Item:** Supply and Installation of JUTA Make Synthetic Artificial Turf with Shock pad
**Application:** Multipurpose sports turf (training, recreational, and indoor/outdoor sports use).

---

**1. Turf System Composition**

- **Pile Height:** Minimum **11 mm**.
- **Shockpad:** Minimum **15 mm shockpad** installed on the existing surface.
- **Yarn Type:** 100% **Polyethylene (PE) monofilament, texturized** (not fibrillated).
- **Filaments:** 8 pcs, individually extruded monofilaments.
- **Pile Fineness:** ≥ **8,800/8 dtex** (per bunch).
- **UV & Heat Stability:** Turf shall be **UV-stabilized and heat-resistant** to withstand outdoor exposure.
- **Backing:** Secondary backing of **SBR latex** for dimensional stability.

- **Color:** Dual-tone green/blue for play area with **integrated white line marking** for field boundaries (tufted lines, not painted).

---

**2. Technical Characteristics**

- **Total Weight:** ≥ **3.1 kg/m²**.
- **Number of Tufts:** ≥ **69,000/m²**.
- **Number of Piles:** ≥ **1,100/m²**.
- **Stitch Rate:** 21–22 stitches per 10 cm.
- **Gauge:** 3/8".
- **Infill (if required):** Manufacturer's recommended infill material to be used as per system design.
- **Durability:** Resistant to wear, heavy foot traffic, and environmental conditions.
- **Performance:** Turf must provide consistent ball roll, bounce, and player comfort suitable for multipurpose sports use.

---

**3. Installation**

- **Sub-Base Preparation:** Ensure existing surface is clean, level, and free from cracks or loose particles.
- **Shockpad Installation:** shockpad tile (15 mm) installed over the prepared surface.
- **Turf Laying:** Turf rolls laid, seamed with PU adhesive tape, and secured as per manufacturer's guidelines.
- **Line Marking:** Factory-integrated tufted lines in white for boundary and game markings. Painted lines shall not be accepted.
- **Finishing:** Surface brushed and infilled (if applicable) for uniform appearance.

---

**4. Certifications & Standards**

- Product must comply with **EN 15330-1** (Synthetic turf systems for sports).
- Must be **REACH compliant** and free from heavy metals.
- Laboratory test results (UV stability, tensile strength, pile recovery) to be submitted for approval.

---

**5. Warranty**

- Minimum **7-year manufacturer's warranty** for material and performance.
- Warranty to cover UV degradation, pile detachment, and shockpad resilience

## 2.13. Specification - Locker Room Flooring

**Item:** Supply and Installation of Rubber Tiles / Rolls for Locker Room Areas
**Application:** Locker rooms, changing areas, walkways, and wet-access zones adjoining showers/pools.

---

**1. Material & Dimensions**

- **Tile/Roll Size:** Tiles (500 mm × 500 mm ±1%) or Rolls (custom lengths, 1.2–1.5 m wide).
- **Thickness:** Minimum **8–10 mm** (±1 mm).
- **Weight:** Approx. 4.5–5.0 kg/m$^2$.
- **Material:** High-density vulcanized rubber or homogeneous rubber flooring, non-porous and anti-microbial.
- **Hardness:** Shore A **65 ± 5** for stability and resistance to indentation.
- **Color/Finish:** Non-glare, matte surface with anti-slip texture, available in solid or speckled designs.

---

**2. Performance Characteristics**

- **Slip Resistance:** R10 or higher (DIN 51130 / EN 13893) to prevent slipping in wet/dry conditions.
- **Water Resistance:** Impermeable surface, resistant to water absorption, sweat, and cleaning agents.
- **Sound Insulation:** Approx. 18–20 dB.
- **Durability:** Resistant to indentation from lockers, benches, and heavy foot traffic.
- **Hygiene:** Anti-bacterial and anti-fungal treatment; easy to clean and maintain.
- **Fire Safety:** Compliant with **EN 13501-1 (Cfl-s1 or better)**.

---

**3. Installation**

- **Subfloor Preparation:** Smooth, clean, dry, and level subfloor; moisture barrier if required.
- **Adhesive:** Manufacturer-approved PU adhesive for full-surface bonding (no hollow sounds, no moisture seepage).
- **Jointing:** Heat-welded joints with matching welding rods to ensure a seamless, watertight finish.
- **Edge Finishing:** Skirting and coved profiles at wall junctions for hygiene and easy cleaning.

---

**4. Contractor's Responsibility**

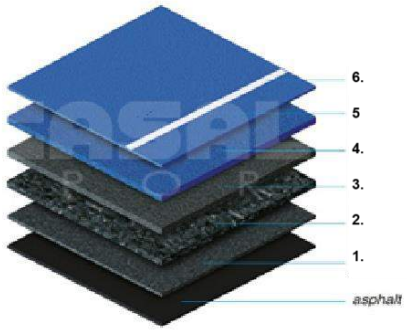
- Provide **technical datasheets** and certifications prior to approval.
- Submit **sample tiles/rolls** for client's color and texture selection.
- Ensure experienced installation team and compliance with manufacturer's guidelines.

---

**5. Warranty**

Minimum **7-year warranty** against surface wear, cracking, and microbial degradation.

## 2.14. TECHNICAL SPECIFICATIONS FOR ACRYLIC BASE TENNIS COURT SYSTEM




The provided content is an exhaustive specification for the Synthetic **Tennis Court System**, which is a specialized acrylic-based sports surface

**System Overview**

- **Application**: Tennis and Pickleball (Indoor/Outdoor)
- **Court Type**: Acrylic
- **Features**:

o Optimal ball bounce, comfort, and speed.

o High resistance to UV rays and weather.

o Certified for environmental and indoor air quality standards.

**Components & Layers**

1. **SOFTBASE**

o **Purpose**: Acts as a primer and sealing layer for asphalt or cement surfaces.

o **Composition**: Acrylic resin, select sands, water emulsion.

o **Application**: Applied on asphalt (cured 3-4 weeks) or smoothed cement decks.

o **Technical Data**:

- Specific Weight: 1.7 ± 0.1 Kg/dm$^3$
- Viscosity: 240,000 ± 12,000 mPa·s

o **Coverage**: 1.8–2 kg/m$^2$ in two crossed coats.

2. **SUPERSOFT EVOLUTION**

o **Purpose**: First elastic layer, providing base elasticity and resistance.

o **Composition**: Rubber granules and special binders.

o **Technical Data**:

- Specific Weight: 1.04 ± 0.05 Kg/dm$^3$

- Viscosity: 78,000 ± 2,000 mPa·s

o **Application**:

- Diluted with water and additive SE.
- Minimum coverage: 1.8–2 kg/m² in two crossed coatings.

3. **SUPERSOFT EVOLUTION HD**

o **Purpose**: Second elastic layer for enhanced flexibility and smoothness.

o **Composition**: Rubber granules and quartz sand.

o **Technical Data**:

- Specific Weight: 1.47 ± 0.05 Kg/dm³
- Viscosity: 160,000 ± 20,000 mPa·s

o **Application**:

- Applied on top of Supersoft Evolution.
- Coverage: At least 1.5 kg/m² in two coats.
- Environmental Conditions: 10–40°C, <90% humidity.

4. **SUPERSOFT PRO**

o **Purpose**: First colored layer, adding flexibility and durability.

o **Compliance**: Meets EN 1297 standards for UV, heat, and water resistance.

o **Technical Data**:

- Specific Weight: 1.64 ± 0.05 Kg/dm³
- Viscosity: 90,000 ± 9,000 mPa·s

o **Application**: Smoothed with a rubber spatula over Supersoft Evolution HD.

5. **SUPERSOFT COLOR**

o **Purpose**: Final finishing layer providing grip, ball bounce, and aesthetic appeal.

o **Composition**: Acrylic resin, select sands, and fine quartz.

o **Technical Data**:

- Specific Weight: 1.5 ± 0.1 Kg/dm³
- Viscosity: 76,600 ± 2,000 mPa·s

o **Drying Times** (at 23°C, 50% R.H.):

- Surface: 1 hour

- To Touch: 2 hours
- Between Coatings: 4 hours

- **Colors**: Available in various shades (e.g., Red, Green, Blue, Violet).
- **Packaging**: 45 kg drums.

**Key Certifications**

- **Performance**:
- ITF Speed Class 3 (Medium)
- EN ISO 16000-9 Certified (Indoor Air Quality)
- Compliant with Green Public Procurement (GPP).
- **Durability**: Tested per EN 1297 for UV, temperature, and water resistance.

**Environmental & Storage Notes**

- Storage: 3–40°C, stable for 12 months in original packaging.
- Application Conditions:
- Ambient Temp: 10–40°C
- Surface Temp: 5–50°C
- Humidity: <90%

## 2.15. SEATING SYSTEM

General Requirements for Specialist Subcontractor

1) It should also have sufficient expertise and experience in manufacture, supply and installation of Stadium Chairs.

2) It should have satisfactorily completed supply & installation of minimum 10,000 chairs of similar nature in last 5 years for a stadium hosting International Matches, Common Wealth Games, Asian Games and any other International Sporting Event in India. The company must provide documentary proof for the same.

3) The applicant should provide mockup of proposed Chair including installation on site.

4) It should have its own manufacturing facility and shall arrange visit of Employer/Engineer to its Manufacturing Facility and of their completed works.

5) It should provide Names of Technical Experts to be deployed by the Company to supervise the execution of the work

6) It should provide guarantee to Employer against any manufacturing & installation defect for a period of 5 years

7) The specialist subcontractor shall provide detailed Company Profile in soft and hard copy, it should also include but not limited to following details about the company

a. Details of Production Capacity

b. Details of Manufacturing Facility

c. Company Financial Details

d. Details of Stock Inventory of last three months of each type of chair for which the bid is submitted

e. Credentials of Completed works

f. Pert Chart defining the schedule of completion from start date, if awarded the work.

g. Certificate / Compliance for seating meeting FIH Guidelines

h. Certificate / Compliance for seating meeting Indian Standards of Fire, Safety, etc

Minimum Technical Requirement of Chairs as below:

| | | |
|---|---|---|
| 1 | Moulded | Double-wall hollow blow mold bucket type seat, From HDPE |
| 2 | SIZE | Seat Dimensions: -<br>Seat depth: - Not less than 465 mm.<br>Seat width: - Not less than 440 mm.<br>Rare height: -Not less than 392 mm. |
| 3 | Fastening | Tempered proof Fastening |
| 4 | Strength & Durability | The seat has been design to pass the most demanding standards and comes with warranty of 2 years against significant color fading and 5year against breakage. |
| 5 | Ergonomic | Seat conforms to the preferred posture and supports movement as supported by ergonomic design. |

| | | |
|---|---|---|
| 6 | Standards | Chair Plastic Part tested with xenon –Arc exposure Test as per ISO 4892-2:2013. Cycle-1. The seat pass BSEN 12520 : 2015 TEST. |
| 7 | Fixing | Seat should be fixed with Metal Inserts molded inside seat to connect seat with Galvanized pipes 25 Nominal Bore and 2 mm thickness running under the chairs. The pipes are resting above Aluminum bracket at c/c distance from 1.0 to 1.5 mtr and all open ends of all pipes are to be closed by PVC cap. The Seat center to center distance is 480-500mm. |

## 2.16. TECHNICAL SPECIFICATION OF FILTER AND FILTER ACCESSORIES

### 2.10.1. BOBBIN WOUND FILTER

TOTALLY ANTI-CORROSIVE Bobbin Wound SideMounted filter, 750mm diameter.
Max. working pressure: 2.5 kg/cm$^2$. Flow rate = 21m$^3$/hr. Filter Connection Size – 2".

**FEATURES**

Filters manufactured by spraying up on layers of polyester resin and fiber glass.
Excellent finish. Colour: RAL 6027. Transparent top lid with V-clamp system. Water and air drain of ¼". Maximum pressure: 2.5 bar. Maximum temperature: 50ºC



### 2.10.2. MULTIPORT VALVE

Manual multiport valves with six channels to carry out different functions in an hydraulic circuit.

- Connection to filter through a sweep elbow instead of a 90° elbow and new design to offer a reduced pressure loss.
- Diverter gasket placed in the diverter instead of the body to improve performance and maintenance.

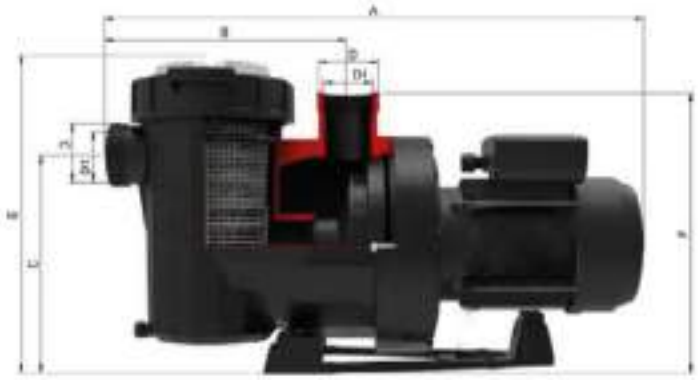
### 2.10.3. VICTORIA PLUS SILENT PUMP

The filtration pump is the most important component for the good performance of any pool. It

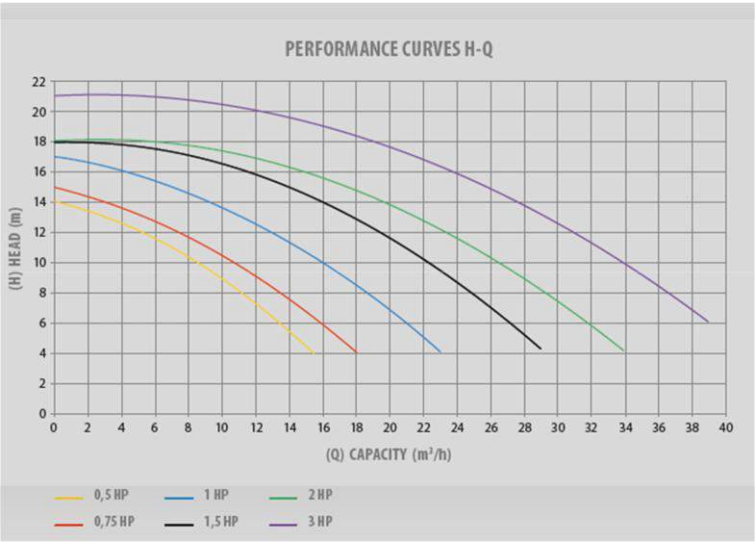
is core to the way a pool works as it performs several functions, all of which are essential for running and maintaining it. Advantages of Victoria Plus Silent

- A longer service life thanks to its state-of-the-art thermoplastic materials and motors with IP-55 protection rating that have been prepared to withstand hot environments and high levels of humidity.
- Easy to use and maintain as it has a built-in prefilter with two levers and better protection to prevent foreign bodies from getting in that could damage the pump's hydraulic parts.
- For all pools as it comes in a wide range of singlephase and three-phase motors from 1/2 to 3 cv. Victoria Plus Silent is self-priming.

  Sound level below 70 dBa.





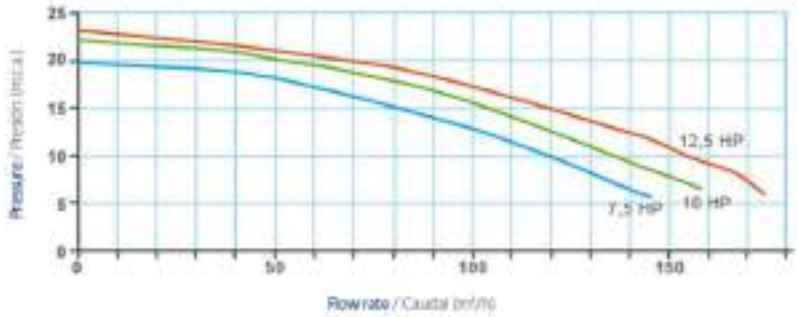



TECHNICAL FEATURES

| Code | Power CV/HP | Voltage V | Max. H m | RPM | Nom. Q m³/h | Nom. H m | Weight kg | Volume m³ |
|---|---|---|---|---|---|---|---|---|
| 92692 | 1 CV/HP | 230/400V | 30 | 3000 | 5.5 | 18 | 7 | 0.07 |
| 92693 | 2 CV/HP | 230V | 21 | 2827 | 14 | 18 | | |



PERFORMANCE CURVES




### 2.10.4. HYDROCYCLONE PRE-FILTER

Hydrocyclone pre-filters can be fitted to filtration systems in both new and old installations. Hydrospin is able to treat flows up to 30 m2/h with a maximum working pressure of 2.5 bars. It is fitted between the pump and the filter and separates out solids of up to 40 micra, thus reducing by half the amount of water consumed for cleaning the filtration system.

HydroSpin has a device for collecting solids with three separate areas (settling, clarifying and clouding). It can be cleaned using just five litres of water without having to stop the pump.

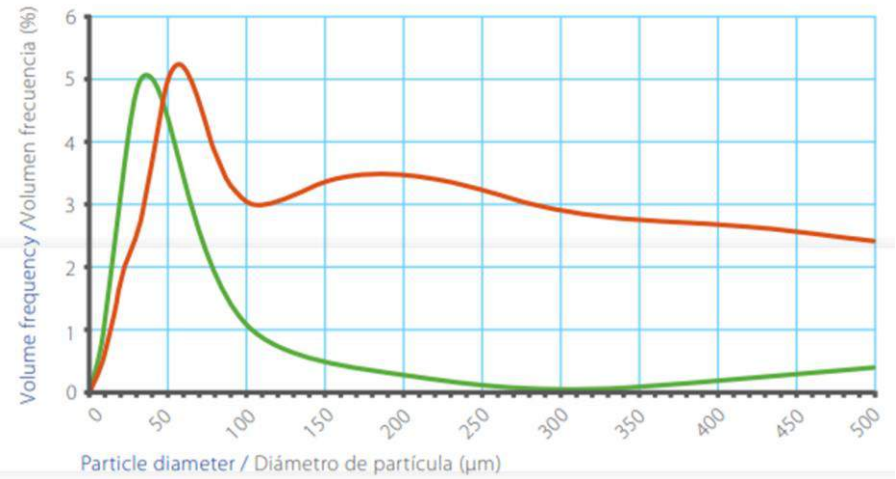
- Considerable reduction in filter cleaning operations.
- Low head pressure losses that make it possible to install it without the need to change the existing pump.
- Can be fitted to the ground with the accessories provided or the wall with DN300 flanges.
- Standard Ø63 mm connections for water inflow and outflow and Ø32 mm for the evacuation of dirt.



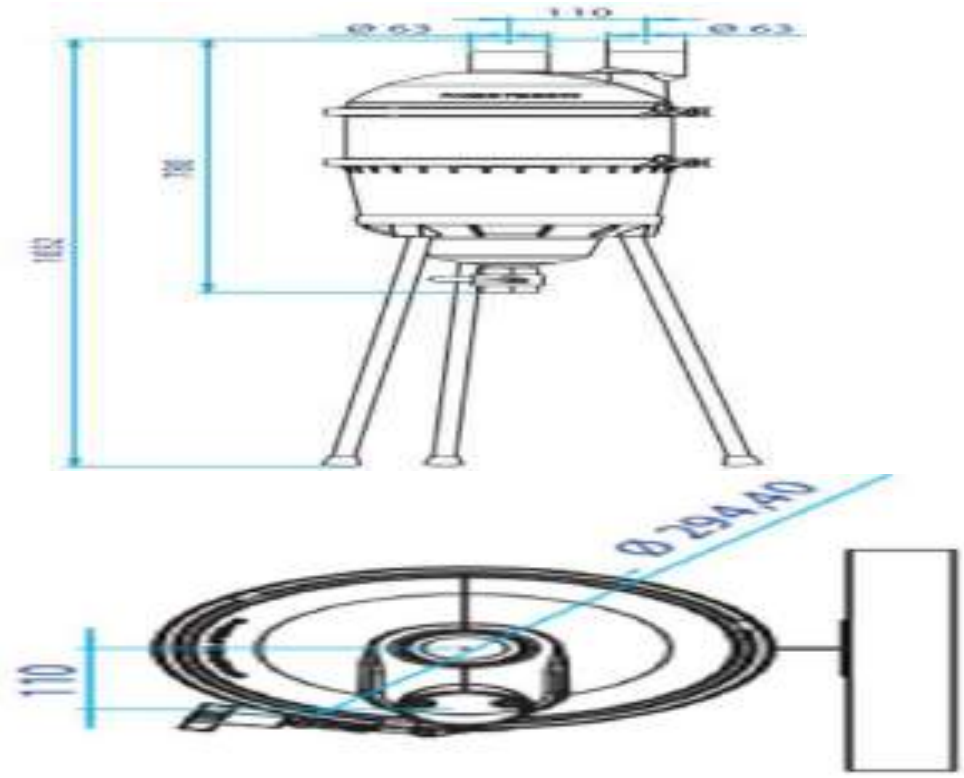
TECHNICAL FEATURES

| | |
|---|---|
| Code<br>Código | 45289 |
| Dimensions<br>Dimensiones | 820 x Ø300 mm. |
| Included elements<br>Elementos incluidos | HydroSpin, hanging bracket, support structure, purge valve 1"<br>HydroSpin, anillo soporte, estructura de soporte, válvula de purga de 1" |
| Maximum working pressure<br>Presión máxima de trabajo | 2,5 bar |
| Connections<br>Conexiones | Ø63 mm |
| Minimum flow rate<br>Caudal mínimo | $5m^3/h$ |
| Maximum flow rate<br>Caudal máximo | $30m^3/h$ |

PERFORMANCE CURVE




DIMENSIONS (MM)




## 2.10.5. DOSING PUMP

The Acqua Dos series digital dosing pump with pH/Redox control meter built in and adds to the functionality the capacity to dialogue with a PLC using the Modbus protocol. The dosing pump is supplied without measuring probes.

Other features are:

- constant or proportional dosing according the measured pH or Redox value
- PT100 probe input for thermal compensation
- Repetition alarm relay • Input On-Off for remote control
- 4÷20 mA output for measure transmission

TECHNICAL FEATURES

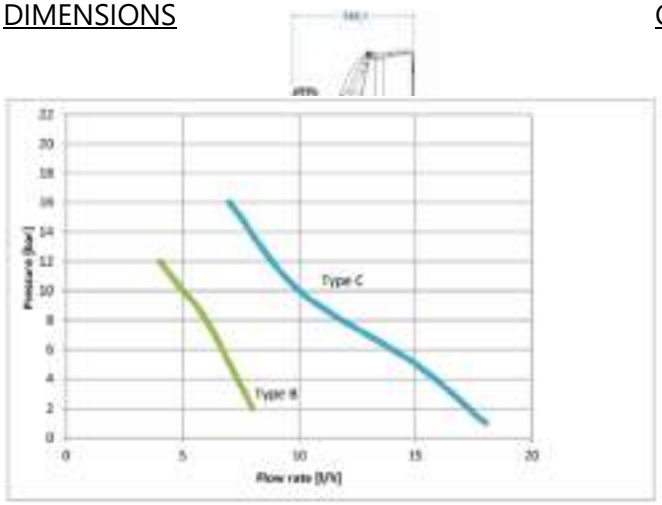
- Flow rates: from 4 to 110 l/h
- Max back pressure: up to 16 bar • Power supply: 100÷240 Vac - 50/60 Hz
- Stroke rate: from 160 to 300 strokes/minute
- Pump head: PVDF
- Diaphragm: PTFE
- External Enclosure: PP reinforced with fiberglass
- Protection degree: IP65
- Manually priming valve

With only 3 sizes, is possible to cover a wide range of performances, having a flow rate range from 4 to 110 l/h and a back pressure up to 16 bar. The power supply is 100÷240 Vac – 50/60 Hz therefore the same pump can operate with different supply voltage. The pump head is in PVDF, therefore high chemical compatibility with several liquids. All Acqua Dos series are equipped with a manually priming pump for the start up. The pump is furnished with a complete standard installation kit, which includes: PVDF foot filter and injection valve, PVC suction tube, PE delivery tube

HYDRAULIC FEATURES

| Code | Type | Pressure [bar] | Flow [l/h] | strokelmin | cc/imp | Connections | | Power supply | Consmption | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Suction | Delivery | | Min | Max |
| 75080 | Type C | 16<br>10<br>5<br>1 | 7,0<br>10,0<br>15,0<br>18,0 | 300 | 0,39<br>0,56<br>0,83<br>1,00 | 4/6 | 4/6 | 100÷240 Vac | 22,0 | 33,0 |

DIMENSIONS



CURVES




## 2.10.6. SUCTION NOZZLE

Outer 2" thread, Ø 50 mm inner wall. Maximum pressure: 6 bar. Made of white ABS with 11/2" threaded plug.



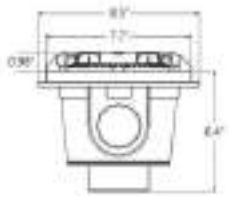
| Código / Code | A | A1 | A2 | ØB | ØC | D |
|---|---|---|---|---|---|---|
| 00301 | 66 | 57 | 9 | 119 | 50 | 2" BSP |



## 2.10.7. VGB DRAIN GRILLE

8" Gunite Pool Main Drain

- • Extra Deep Threads for Easier Pressure Testing
- 2" FPT Port Size
- IAPMO Listed VGBA Suction: Compliant to ANSI/APSP - 16 2017 & CPSC Requirements DIMENSIONS



## 2.10.8. FLOOR INLET

White ABS plastic adjustable bottom inlet for concrete with S.S. screws. Maximum recommended flow rate 12m3/hr.
Standard - Compliant with standard EN 13451-1-3 and EN 16582-1, EN-16713-2

### Application:

The bottom inlets are placed in the floor of the pool, returning water at floor level. They prevent dirt from settling by carrying it towards the surface.
Bottom: The adjustable inlet allows perfect adjustment to the ground at the time of installation. It is particularly recommended when overflow channels are used.

Dimension:

2″ external thread, Ø 50 mm t internal and NPT outlets. Outer
Diameter – 120mm
Height – 43.15mm

### 2.10.9. OVER FLOW DRAIN CHANNEL

To be glued to a Ø 63 mm pipe. Body and grille in ABS plastic, screws in stainless steel. Application on wall. Its characteristics make this nozzle particularly suitable for overflow channels. Maximum flow rate: 4.5 m3 /h.

### 2.10.10. SALT CHLORINATOR

- Self-cleaning salt electrolysis systems
- Cover status input.
- Salinity alarms: High/Low. Salt Production: 17-21 gr Cl2/hr Power Consumption: 0.2A
- Input Voltage: 230V AC 50/60 Hz

### 2.10.11. UV STERILISER

STAINLESS STEEL UV-C 130 WATT AMALGAM WITH FLOWSWITCH
Works with 1 Amalgam lamp (130 watt) with a radiation output of 50 Watt. UV-C output after 12000 hours is at least 80%. Suited for ponds up to 130$m^3$. Pump speed max. 30$m^3$/h. Incl. 50/63mm solvent fittings. Max. pressure: 2 bar. Flow switch (amalgam version) will switch off the lamp when there is insufficient flow

### 2.10.12. UNDER WATER LED LIGHT

- Lumiplus Essential PAR 56 Projector. Colour: Warm White Consumption: 14.5W
- Luminous Flux: 1485 Lumens Color Temperature: 3000K Frequency: 50/60 Hz

### 2.10.13. HEAT PUMP

Full Inverter with R32 refrigerant

- High-end compressor
- DC Inverter fan motor

- High efficiency COP
- Built in WiFi function Heating Capacity: 70kW Input: 10.03kW
- COP: 6.9
- Water Flow: 20m3/hr Working Temperature: -15~43 Refrigerant: R32
- Heat Exchanger: Titanium

## 2.17. STEAM CABIN

Steam cabins with straight lines, sober and elegant design. Size: 3m x2.5m x2.2m

- Wall modules: Manufactured with double high density expanded polystyrene panel on an anodized aluminum structure.
- Ceiling: Vaulted ceiling made in white methacrylate modules of 3 mm, standing on anodized aluminium support, and tightenup with multicoated layers of polyester resin.
- Ceiling & underbench perimetral LED included.
- Diffuser in black lacquered.
- Lower and upper ring: Anodized aluminum.
- Handle: Tubular stainless steel matt black.
- Frontal finishing: laminated glass (5+5) of 10 mm.
- Benches coated with large format porcelain in Kairos
- Walls coated with white solid surface.
- Door: Made of tempered glass of 8 mm, hinges of anodized aluminium. Width 90 cm appx.
- Control panel: Ecotouch
- Heating: 12kW
- Aromatherapy one essence included



**Technical Specifications for Swimming Pool:**

| 1.00 | FILTRATION EQUIPMENTS |
|---|---|
| 1.01 | SAND FILTER |
| | Supply of 1200mm dia bobbinwound fibreglass and polyester resin anti corrosive sand filter with 2.5" connections, The filter shall be fitted with easy acess top lid with manual air purge, flat clamp for cover tightening, FRP Foot base and necessary accessories such as glycerin filled pressure gauge, combination of manual sand and water drain etc., Filtration Velocity 35 to 40 $m^3/hr/m^2$, Flow rate = 45 $m^3/hr$, Maximum working pressure : 2.5 Bar<br>MAKE: AQVASTAR/ASTRAL/ PROCOPI |
| 1.02 | MULTIPORT VALVE |
| | Supply of 6 way side mount multiport valve of 2.5" dia connection with Body in ABS & fibre glass, handle in ABS, distributer with EPDM gaskets, metallic elements in Stainless Steel and watertight shaft system with low head loss. Maximum working Pressure 3.5 kg/cm2.<br>MAKE: AQVASTAR/ASTRAL/ PROCOPI |
| 1.03 | FILTER MEDIA |
| a | Supply of Bio Resistant filter media with 1-micron filtration rate, Grade # 1, 0.4-0.8 mm bags of 25 Kg. |
| b | Supply of Bio Resistant filter media with 1-micron filtration rate Grade # 2, 0.7-2.0 mm bags of 25 Kg. |
| c | Supply of Bio Resistant filter media with 1-micron filtration rate Grade # 3, 2.0-4.0 mm bags of 25 Kg. |
| | MAKE : Make – DRYDEN AQUA, SCOTLAND/ EQUIVALENT |
| 1.04 | Recirculation Pump(2 Duty+1 Standby) |

| | |
|---|---|
| | Supply of centrifugal self priming pump with high hydraulic efficiency, chemical resistant and ultra quiet operation. Each pump integrated along with IP-55 protection- class F continuous rating. Pump shall be of one piece body made in fibreglass and reinforced polypropylene, integrated prefilter with strainer basket,fast opening translucent transperant polypropylene lid, easy opening knob system, 316 SS Shaft and mechanical seal.Self priming at 1m, Impeller : Plastic impeller, 90mm suction & 90mm return union connections, Horse power : 4.0 HP,4Kw, Phase : III phase 415v, Flowrate = 45 $m^3$/hr at 12 mtr water head.<br>MAKE: AQVASTAR/ASTRAL/HAYWARD |
| | |
| **2.00** | **MAIN POOL BASIN FITTINGS** |
| 2.01 | Main Drain |
| | Supply of'Supply of Square Main Drain Frame & Grille in SS 450x450mm for a FLOW of 80m3/hr.<br>MAKE: AQVASTAR/ASTRAL/HAYWARD |
| 2.02 | Vacuum Point |
| | Supply of Vacuum Point in ABS 63mm solvent connections,<br>MAKE: AQVASTAR/ASTRAL/HAYWARD |
| 2.03 | Return Inlet |
| | Supply of Adjustable floor inlet in ABS Standard design 63mm solvent connections 9m3/hr - 12 m3/hr<br>MAKE: AQVASTAR/ASTRAL/HAYWARD |
| 2.04 | Wall conduit |
| | Supply of Wall Conduit for vacuum point with 2" threaded fitting<br>MAKE: AQVASTAR/ASTRAL/HAYWARD |
| 2.05 | Overflow Fitting |
| | Supply of Square Main Drain- Frame & Grille in ABS 225 x 225mm 20 cu Mtr/hr.<br>CODE: AQVASTAR/ASTRAL/HAYWARD |
| 2.06 | Overflow Grating |
| | Supply of Overflow gratings 300mm PPG - in metre<br>MAKE: AQVASTAR/ASTRAL/HAYWARD |
| | |
| **3.00** | **LIGHTING FOR MAIN POOL** |
| 3.01 | Supply of Stainless Steel 316 Wall mounted LED light 18W-12V, Warm White MAKE: AQVASTAR/HAYWARD/ASTRAL/CERTIKIN |
| 3.02 | Deck Box |
| 3.03 | Supply of ABS deck box for connecting the cables between the U/W light and transformer. IP68 protection. ( 3/4" Threaded inlet & 1/2" gland connection x 2/4 nos)<br>MAKE: AQVASTAR/ASTRAL/CERTIKIN |
| 3.04 | Supply of SMPS LED driver 150W/12V<br>MAKE: AQVASTAR/ASTRAL/MEANWELL |
| | |
| **4.00** | **CHEMICAL EQUIPMENT** |
| | Chemical dosing pump |

| | |
|---|---|
| 4.01 | Supply and Installation of Solenoid Metering Pump 05LT/HR @ 5 Bar for chlorine and alum dosing. Supplied with IP65 anti acid casing. Power supply: 230 v a.c. 50 HZ MAKE:AQVASTAR PRO /ASTRAL/ CERTIKIN |
| 4.02 | Chemical Holding Tank<br>Supply of chemical holding tank 100 liters<br>MAKE: AQVASTAR/ASTRAL/HAYWARD |
| 4.03 | Manual Agitator<br>Supply of Manual agitator 600mm<br>MAKE: AQVASTAR/ASTRAL/HAYWARD |
| | |
| **5.00** | **LADDER** |
| 5.01 | Supply of stainless steel ladder 4 step made of SS316 with non slip surface, 500mm wide with hand rails. Over flow type<br>MAKE: AQVASTAR/ASTRAL/CERTIKIN |
| 5.02 | Supply of stainless steel ladder 4 step made of SS316 with non slip surface, 500mm wide with hand rails. Over flow type<br>MAKE: AQVASTAR/ASTRAL/CERTIKIN |
| | |
| **6.00** | **COMMERICAL UV** |
| 6.01 | Commerical UV System |
| | VGE UV system Model VGE pro 400-204 is designed to work at Medium pressure capable to dose UV at a rate of 400J/m2. The unit shall be made of SS316L body with U shape irradiation reactor chamber with 6 BAR maximum pressure rating. The unit shall be capable to work around 92 cumtr/ hr flow with a 100mm connection. The unit shall used AOP , Advanced oxidation processes . The UV comes with control panel and monitor with sensors to check UV & temperature. The units UV Lamp shall be placed to perpendicular to the direction of flow. The Lamp base shall be equipped with SMART PIN TECHNOLOGY where the lamp shall be removed when the system is pressurised. The UV lamp expected life time shall be 16000 hrs. The end connections shall be of 100mm dia SS flanges.<br>MAKE: BLUE LAGOON/ASTRAL/AQVASTAR |
| | |
| **7.00** | **SALT CHLORINATOR** |
| 7.01 | Supply of Commercial Salt Chlorinator suitable upto 180 g/h (250kpa & psi 2.5bar)<br>MAKE: INNO WATER/ASTRAL/AQVASTAR |
| | |
| **8.00** | **INVERTOR HEAT PUMP** |
| 8.01 | Supply of Invertor Heat Pump Commercial, 115KW Output<br>MAKE : - AQVASTAR /ASTRAL/HAYWARD |
| | |
| **9.00** | **CONTROL AND REGULATORY VALVES** |
| | All valves shall be in PVC with PN10 rating and EPDM seat. |
| 9.01 | Butterfly Valve with Flange Adapters dia 160mm<br>MAKE: AQVASTAR/COMER/CEPEX/PIMTAS |

| | |
|---|---|
| 9.02 | Butterfly Valve with Flange Adapters dia 110mm MAKE:AQVASTAR/COMER/CEPEX/PIMTAS |
| 9.03 | Ball Valve Double union dia 90mm MAKE: AQVASTAR/COMER/CEPEX/PIMTAS |
| 9.04 | Ball Valve Double union dia 75mm MAKE: AQVASTAR/COMER/CEPEX/PIMTAS |
| 9.05 | Ball Valve Double union dia 63mm MAKE: AQVASTAR/COMER/CEPEX/PIMTAS |
| 9.06 | Wafer check Valve with Flange Adapters dia 90mm MAKE: AQVASTAR/COMER/CEPEX/PIMTAS |
| | |
| **10.00** | **PIPES AND FITTINGS** |
| | Supply, Install, Testing & commissioning UPVC 10KG/CM2 Piping including necessary fitting such as Elbows, Bends, Sockets, Tees, Collars, Nipples, Reducers, Stub Ends, diminishing pieces, Solvent Cement, etc. for Swimming Pool Inlet & Drain & Suction piping, Swimming Pool filtration plant piping, drain pipe along the pipe periphery including all fittings, fixtures and Ceiling/ Wall Support System suitable for following uPVC pipe as specified and directed. MAKE: SUPREME/FINOLEX/PRINCE |
| 10.01 | 63mm dia pipe |
| 10.02 | 75mm dia pipe |
| 10.03 | 90mm dia pipe |
| 10.04 | 110mm dia pipe |
| 10.05 | 160mm pipe |
| | |
| **11.00** | **LIGHT CABELING** |
| 11.01 | Supplying of copper cable with PVC conduits from junction boxes to transformer & transformer to control panel. ( length in mters as per drawing); Make : POLYCAB /FINOLEX/PRINCE/AKG/KEI |
| a | 2.5mmsq x 3 core |
| b | 4mm Sq x 4 core |
| c | 6mm Sq x 5 core |
| d | PVC electrical conduit pipe of 25 mm dia |
| e | Cable tray works inside pump room |
| | |
| **12.00** | **CONTROL PANEL** |
| 12.01 | Supply of Control panel for controlling pumps, lights.Body shall be powder coated sheet metal cabinet for indoor installation, wall mounted, dust proof and shall be with hinged doors with rubber gasket. Panel shall read and display pump status, light status,voltage, current. Panel shall come with single phase prevention, phase reversal protection. (in case of 3-phase pumps). MAKE: All Product uses of L&T/Schneider |
| | |
| **13.00** | **CLEANING & MAINTENANCE** |

| | |
|---|---|
| 13.01 | Vacuum Hose<br>Supply of 1.5" (38mm) Flexible floating Hose with end swivels-15 Metre MAKE: AQVASTAR |
| 13.02 | Wall Brush<br>Supply of 18" (450mm) Heavy duty wall brush with poly bristle - Dark blue colour MAKE: AQVASTAR |
| 13.03 | Algae brush<br>Supply of 10"(250mm) Algae brush- SS bristle, clip in fastening- Dark Blue MAKE: AQVASTAR |
| 13.04 | Flat Net<br>Supply of Heavy duty Flat net with 5 Micron net, clip in fastening- Dark Blue MAKE: AQVASTAR |
| 13.05 | Deep Net<br>Supply of Heavy duty 15" deep net with 5 Micron mesh, clip in fastening- Dark Blue MAKE: AQVASTAR |
| 13.06 | Telescopic Pole<br>Supply of 8-16' Telescopic pole with handgrip & clip-in fastening- Corrugated- Silver colour<br>MAKE: AQVASTAR |
| 13.07 | Vacuum Head<br>Supply of 450mm Anodised Aluminium VAC head- clip in fastening-Silver MAKE: AQVASTAR |
| 13.08 | Test Kit<br>Supply of 3 way Test kit ( PH/ CL/BR) ; MAKE: AQVASTAR |
| 13.9 | Test Kit<br>Supply of 3 way Test strips ; MAKE: AQVASTAR |

**Technical specifications for Hydrotherapy pool:**

| **1.00** | **ARCHED CURTAIN** |
|---|---|
| 1.01 | Supply of Arched curtain pool surround cascade to give intense deep relaxing massage with curtain of water, made of mirror - polished ASIS 316 stainless steel with approx 881 mm height and approx 864 mm width (or as per OEM standards ) 75mm dia connection with assembly plate in SS316 pump with inbuilt pre -filter basket having minimum flow 34 cu mtr @ 10 mtr head ,3 HP/2.2KW ,Single phase,noryl impeller , necessary suction drain , pneumatic equipment and valves to complete the system complete etc as required . |

| | |
|---|---|
| 1.02 | Supply of centrifugal self priming pump with high hydraulic efficiency, chemical resistant and ultra quiet operation. Each pump integrated along with IP-55 protection- class F continuous rating. Pump shall be of one piece body made in fibreglass and reinforced polypropylene, integrated prefilter with strainer basket, fast opening translucent transparent polypropylene lid, easy opening knob system, 316 SS Shaft and mechanical seal. Self priming at 1m, Impeller : Plastic impeller, 63mm suction & 63mm return union connections, Horse power :3.0HP, 2.2 Kw, Phase : I phase 240v, Flow rate = 34$m^3$/hr @ 10 m water head. Flow Rate : 34 Cum/Hr @ 10 Mtr head |
| 1.03 | Supply of the SS 316 box with the push button |
| 1.04 | Supply, Install, Testing & commissioning UPVC 10KG/CM2 Piping including necessary fitting such as Elbows, Bends, Sockets, Tees, Collars, Nipples, Reducers, Stub Ends, diminishing pieces, Solvent Cement, etc. |
| 1.05 | Supplying of copper cable with PVC conduits from junction boxes to transformer & transformer to control panel. |
| 1.06 | Supply of Control panel for controlling pumps, lights.Body shall be powder coated sheet metal cabinet for indoor installation, wall mounted, dust proof and shall be with hinged doors with rubber gasket. Panel shall read and display pump status, light status,voltage, current. Panel shall come with single phase prevention, phase reversal protection. (in case of 3-phase pumps). |
| | |
| **2.00** | **CANNON JET** |
| 2.01 | Supply of Cannon pool surround water jet for pool surround , with swans - neck shaped cylindrical section , providing a high pressure jet of water for a relaxing massage 979mm heights/as per OEM standards , Anchoring fixture accessory made of polished AISI 316 stainless steel and uniform pressure nozzle, pump with inbuilt pre -filter basket having minimum flow of 26 m3/hr @ 10 mtr head 2.0HP / 1.5 KW Single phase noryl impeller , necessary suction drain , pneumatic equipment and valves to complete the system etc .as required . |
| 2.02 | Supply of centrifugal self priming pump with high hydraulic efficiency, chemical resistant and ultra quiet operation. Each pump integrated along with IP-55 protection- class F continuous rating. Pump shall be of one piece body made in fibreglass and reinforced polypropylene, integrated prefilter with strainer basket, fast opening translucent transparent polypropylene lid, easy opening knob system, 316 SS Shaft and mechanical seal. Self priming at 1m, Impeller : Plastic impeller, 63mm suction & 63mm return union connections, Horse power :2.0HP, 1.5 Kw, Phase : I phase 240v, Flow rate = 26$m^3$/hr @ 10 m water head. |
| 2.03 | Supply of the SS 316 box with the push button |
| 2.04 | Supply, Install, Testing & commissioning UPVC 10KG/CM2 Piping including necessary fitting such as Elbows, Bends, Sockets, Tees, Collars, Nipples, Reducers, Stub Ends, diminishing pieces, Solvent Cement, etc. |
| 2.05 | Supplying of copper cable with PVC conduits from junction boxes to transformer & transformer to control panel. |

| | |
|---|---|
| 2.06 | Supply of Control panel for controlling pumps, lights.Body shall be powder coated sheet metal cabinet for indoor installation, wall mounted, dust proof and shall be with hinged doors with rubber gasket. Panel shall read and display pump status, light status,voltage, current. Panel shall come with single phase prevention, phase reversal protection. (in case of 3-phase pumps). |
| | |
| **3.00** | **SS AIR PAD** |
| 3.01 | Supply of 300x300 mm Hydromassage grill in SS316 with turbo blower 1.1 kw necessary suction drain , pneumatic equipment and valves to complete the system complete etc as required |
| 3.02 | Supply of Air Blower 1100W, 1.5HP Single Phase |
| 3.03 | Supply, Install, Testing & commissioning UPVC 10KG/CM2 Piping including necessary fitting such as Elbows, Bends, Sockets, Tees, Collars, Nipples, Reducers, Stub Ends, diminishing pieces, Solvent Cement, etc. |
| 3.04 | Supplying of copper cable with PVC conduits from junction boxes to transformer & transformer to control panel. |
| 3.05 | Supply of Control panel for controlling pumps, lights.Body shall be powder coated sheet metal cabinet for indoor installation, wall mounted, dust proof and shall be with hinged doors with rubber gasket. Panel shall read and display pump status, light status,voltage, current. Panel shall come with single phase prevention, phase reversal protection. (in case of 3-phase pumps). |
| | |
| **4.00** | **CIRCULAR MASSAGE** |
| 4.01 | Supply of massage jet that regulates proportion of air/water outlet 50mm diameter water inlet and 32mm air inlet flow with plastic pump 2.2 kw/3 phase, plastic impeller 2850 rpm motor with IP55 protection , flow 30m3/hr @ 10 mtr head , necessary suction drain , pneumatic equipment and valves to complete the system complete etc as required |
| 4.02 | Supply of centrifugal self priming pump with high hydraulic efficiency, chemical resistant and ultra quiet operation. Each pump integrated along with IP-55 protection- class F continuous rating. Pump shall be of one piece body made in fibreglass and reinforced polypropylene, integrated prefilter with strainer basket, fast opening translucent transparent polypropylene lid, easy opening knob system, 316 SS Shaft and mechanical seal. Self priming at 1m, Impeller : Plastic impeller, 63mm suction & 63mm return union connections, Horse power :3.0HP, 2.2 Kw, Phase : I phase 240v, Flow rate = 34$m^3$/hr @ 10 m water head. |
| 4.03 | Supply of the SS 316 box with the push button |
| 4.04 | Supply, Install, Testing & commissioning UPVC 10KG/CM2 Piping including necessary fitting such as Elbows, Bends, Sockets, Tees, Collars, Nipples, Reducers, Stub Ends, diminishing pieces, Solvent Cement, etc. |
| 4.05 | Supplying of copper cable with PVC conduits from junction boxes to transformer & transformer to control panel. |

| | |
|---|---|
| 4.06 | Supply of Control panel for controlling pumps, lights.Body shall be powder coated sheet metal cabinet for indoor installation, wall mounted, dust proof and shall be with hinged doors with rubber gasket. Panel shall read and display pump status, light status,voltage, current. Panel shall come with single phase prevention, phase reversal protection. (in case of 3-phase pumps). |
| | |
| **5.00** | **WALL MASSAGE JETS** |
| 5.01 | Supply of Wall Massage nozzle made in ABS with internal venturi arrangement & finished with SS316 FACIA suitable with flow of 22 Cu mtr / hr - Concrete / Tile |
| 5.02 | Supplying of Centrifugal self priming pump with high hydraulic efficiency, chemical resistant and ultra quiet operation. Integrated along with IP-55 protection- class F continuous rating. Pump shall be of one piece body made in fibreglass and reinforced polypropylene, WITHOUT prefilter, 316 SS Shaft and mechanical seal. Plastic impeller, 90mm suction & 90mm return union connections, Horse power :5.5 HP, 4.0 Kw, III phase 415v, Flow rate = 50$m^3$/hr @13.8 m water head. |
| 5.03 | Supply of the SS 316 box with the push button with the Air volume control |
| 5.04 | Supply, Install, Testing & commissioning UPVC 10KG/CM2 Piping including necessary fitting such as Elbows, Bends, Sockets, Tees, Collars, Nipples, Reducers, Stub Ends, diminishing pieces, Solvent Cement, etc. |
| 5.05 | Supplying of copper cable with PVC conduits from junction boxes to transformer & transformer to control panel. |
| 5.06 | Supply of Control panel for controlling pumps, lights.Body shall be powder coated sheet metal cabinet for indoor installation, wall mounted, dust proof and shall be with hinged doors with rubber gasket. Panel shall read and display pump status, light status,voltage, current. Panel shall come with single phase prevention, phase reversal protection. (in case of 3-phase pumps). |
| | |
| **6.00** | **NECK MASSAGE JETS** |
| 6.01 | Supply of Neck massage jets made in stainless steel |
| 6.02 | Supply of centrifugal self priming pump with high hydraulic efficiency, chemical resistant and ultra quiet operation. Each pump integrated along with IP-55 protection- class F continuous rating. Pump shall be of one piece body made in fibreglass and reinforced polypropylene, integrated prefilter with strainer basket, fast opening translucent transparent polypropylene lid, easy opening knob system, 316 SS Shaft and mechanical seal. Self priming at 1m, Impeller : Plastic impeller, 63mm suction & 63mm return union connections, Horse power :1.0HP, 0.75Kw, Phase : I phase 240v, Flow rate = 15$m^3$/hr @ 12 m water head. |
| 6.03 | Supply of the SS 316 box with the push button |
| 6.04 | Supply, Install, Testing & commissioning UPVC 10KG/CM2 Piping including necessary fitting such as Elbows, Bends, Sockets, Tees, Collars, Nipples, Reducers, Stub Ends, diminishing pieces, Solvent Cement, etc. |
| 6.05 | Supplying of copper cable with PVC conduits from junction boxes to transformer & transformer to control panel. |

| | |
|---|---|
| 6.06 | Supply of Control panel for controlling pumps, lights.Body shall be powder coated sheet metal cabinet for indoor installation, wall mounted, dust proof and shall be with hinged doors with rubber gasket. Panel shall read and display pump status, light status,voltage, current. Panel shall come with single phase prevention, phase reversal protection. (in case of 3-phase pumps). |
| | |
| **7.00** | **STAINLESS STEEL LOUNGER** |
| 7.01 | Supply of Embedded lounger built -in Hydromassage Lounger with Turbo blower 1.1 Kw necessary suction drain , pneumatic equipment and valves to complete the system complete etc as required. |
| 7.02 | Supply of Air Blower 1100W, 1.5HP Single Phase |
| 7.03 | Supply of Supply of Pneumatic Push Button in SS 316 Box |
| 7.04 | Supply, Install, Testing & commissioning UPVC 10KG/CM2 Piping including necessary fitting such as Elbows, Bends, Sockets, Tees, Collars, Nipples, Reducers, Stub Ends, diminishing pieces, Solvent Cement, etc. |
| 7.05 | Supplying of copper cable with PVC conduits from junction boxes to transformer & transformer to control panel. |
| 7.06 | Supply of Control panel for controlling pumps, lights.Body shall be powder coated sheet metal cabinet for indoor installation, wall mounted, dust proof and shall be with hinged doors with rubber gasket. Panel shall read and display pump status, light status,voltage, current. Panel shall come with single phase prevention, phase reversal protection. (in case of 3-phase pumps). |

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**NON-DSR TECHNICAL SPECIFICATIONS**
**ELECTRICAL WORKS**

# Main Low Voltage Switchboard

## Enclosure

This section covers the detailed requirements of Main Low Voltage Switchboard for 415 volts, 3 phase, 50 Hz, 4 wire system.

## STANDARDS AND CODES

The equipment proposed in this offer to be designed, manufactured, and tested according to the relevant IEC recommendations:

- IEC 61439-1/2 Low voltage switchgear & controlgear assemblies – Part 2 Power switchgear and controlgear assemblies
- IEC60529 Degrees of protection provided by enclosures
- IEC60947-2 Low voltage switchgear & controlgear – part 2 Circuit breakers
- IEC60947-3 Low voltage switchgear & controlgear – Part 3 Switches, disconnectors, switch-disconnectors & fuse combination units
- IEC60 947-4-1 Contactors and motor starters
- IEC60044-1 Current transformers
- IEC60186 Voltage transformers
- IEEE693 Environmental testing/ Seismic Withstand Level
- IEC61140 Protection against electric shock – Common aspects for installation and equipment – Basic safety publication
- IEC61641 TR Internal Arc Test report

### General

LV Switchboards shall be certified by 3rd party Certification body as per IEC 61439-1 & 2. Test reports without certificate shall not be considered admissible proof of compliance. The Certifying Authority shall be qualified under ISO/IEC 17065 as per IEC 61439-1.

IEC 61439-1&2 compliance certificate to be submitted for all ratings of LV Switchboards as mentioned in Schedule of Quantities or Single Line Diagram for this project along with the tender.

The LV switchboards and the associated equipment including switchgear, control gear, Busbar supports, Busbar orientation, Busbar links etc shall be identical in construction to the assembly which has undergone certification as per IEC61439-1 & 2.

Certified design of switchboards shall be proven design from OEM (Original Equipment/ Switchgear Manufacturer). OEM name should be mentioned on top of each column of switchboard. Also, OEM Partnership Certificate shall be furnished by Panel builder.

To ensure installation consistency during switchboard life cycle, installation system, switchgears, motor starter components and metering devices must be supplied by the same Manufacturer (OEM).

Switchboards shall have a short circuit level withstand as per Schedule of Quantities and drawings. The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions.

Switchboards shall have Rated Impulse withstand voltage (Uimp) of 12kV for withstanding against transient Overvoltages, for which the values of clearances are referred applicable for ACB, horizontal & vertical busbars.

All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 42 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 42 is retained.

Switchboards shall be tested for Internal arc. The test should be performed for arc starting place - at Horizontal busbar, Vertical busbar and in outgoing cable compartments.

As Aluminium busbar are recommended for switchboard - Internal arc test to be performed on switchboards having Aluminium busbar. Reports with Cu busbar design shall not be accepted as proof of compliance.

To ensure right performance on Seismic risk, Switchboards shall be validated design for Seismic withstand for Ground Acceleration level of 2g. Test shall be performed in accordance with standard IEEE 693 : 2018.

Switchboards must have mechanical impact IK10 tested.

In order to facilitate access within the switchboard for maintenance, its covering panels must be dismountable on all surfaces for all IP degrees

To ensure maximum protection of people around the electrical installation, front plates must be installed in front of all control and protection equipment in order to avoid direct access without a tool to the devices and consequently to the live parts.

For safety reasons and especially when the door is open during switchboard operation, all busbars must be covered by Metallic barriers over whole perimeter of the busbar zone. IP2X (touch proof) protection shall be available.

As specified in the BOM the switchboard shall be form 3b. For forms of separation to be achieved, only metallic covers shall be used. Hylem/ PVC sheets shall not be allowed.

To enhance Sustainability, LV Switchboards shall have Green Premium Certification, with eco production, with product design in accordance with RoHS & REACh directives and with End of Life Instructions.

The switchboard shall be supplied with a smartphone/web-based maintenance tracking system. A unique identifier(like QR code) shall be employed for each switchboard to enable quick access to switchboard details including but not limited to switchboard drawings, wiring diagrams, list of spares, Switchboard BOM etc. A maintenance schedule shall be provided by the manufacturer for switchboard and major components inside. There should be a provision to enable alerts for upcoming maintenance activities for the switchboard and components. The alerts shall be automated and provided to the maintenance staff appointed by the End-user in the form of smartphone notifications.

## Switchboard Configuration

The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MCB's, Motor Starter components, Metering devices and other equipment as called for in the schedule of quantities.

The MCCBs shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single tier or Two-Tier formation to facilitate operation and maintenance.

The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

## Constructional Features

The Switchboards shall be metal clad totally enclosed; floor mounted free-standing type of modular extensible design suitable for indoor installations. Switchboards, panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness, same as that of tested assembly according to IEC61439-1 & 2. Sheet thickness for Load bearing frame structures shall not be less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. Also, the doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 1.6 mm.

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

Panel shall be supplied with a double door arrangement. Global Door/ Front Door shall be fitted with transparent Glass to allow maintenance staff to visually access device status, meter readings, indicating lamp status without opening the door. IP level & Mechanical impact performance of the panel shall not be compromised in any scenario and shall remain at IP42/54 and IK10 level respectively, in all conditions.

Global door shall be provided with Ergonomic handles with locking (key RONIS n° 405).

Switchboards construction shall employ the principle of compartmentalized and segregation for each circuit.

Incomer and bus section panels or sections shall be separate and independent and shall not accommodate any outgoing feeder. The incomer panel shall be suitable for receiving bus trunking or LV cable of size specified.

Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous switchboards.

Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers.

The switchboards shall be designed for use in high ambient temperature upto 45 degree centigrade and humid tropical conditions suitable for pollution degree 3.

Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

Special care to be taken to ensure effective earthing of the frame and doors of the switchboards.

Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability of space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contract with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables.

Some switchboards may be required to be installed against the wall, for such applications, documented designs shall be available.

The painting of the sheet metal shall be done by electrostatic spraying of epoxy resin powder to give smooth finish to the equipment. Color used shall be RAL 7047 for the enclosure and RAL 9022 for the functional unit.

Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness, same as that of tested assembly according to IEC61439-1 & 2.

All the devices must be installed onto dedicated mounting plate designed for one or several switchgears of the same type. The objective of this point is to group protection equipment of the same type, as well as distinguish inside the switchboard the function of each device or group of devices and avoid identification mistakes.

Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as stipulated in schedule of quantities. The unused openings within the switchboards shall be closed using suitable grommets.

### Switchboard Dimensional Limitations

The overall height of the switchboard shall be limited to 2000 mm for all the Busbar ratings and type of switchboards. Panel should have integral base frame of 75/100mm, The height of the operating handle push buttons etc shall be restricted between 300 mm and 1800 mm from finished floor level.

Other dimensional limits if any are specified separately.

## Switchboard Compartmentalization

Switchboard design shall be completely compartmentalised with separate compartments for horizontal busbars, vertical busbars, Cable alleys and functional units consisting of ACBs, MCCBs, & MCB's.

Earthed metal or insulated shutters shall be provided between drawout and fixed portion of the switchgear such that no lives parts are accessible with equipment drawn out. Degree of protection within compartments shall be atleast IP 2X.

For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.

Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be in front of switchgear only.

Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables.

Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.

## Switchboard Bus Bars

Busbars shall be made of high conductivity, and high strength Aluminum E91E or high strength Copper of ETP grade.

Busbars shall be of rectangular cross sections better suitable for full load current for phase bus bars and half/ full rated current for neutral bus bar or as stipulated in schedule of quantities. Busbar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities.

The maximum temperature of the busbars shall not exceed 90 degree Centigrade.

The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar Chamber on either side of Switchgear chamber, so that busbars could be accessed with front access itself.

Design of LV Switchboard shall be such that, Phase and Neutral busbars should be together in same compartment. Also, the Neutral busbar shall always be in front to ensure safety, even when covers are open.

For ratings up to 1600A, design of LV Switchboards shall be such that Main Horizontal Busbar can be assembled at Top or at Bottom of Switchboard, to achieve less footprint, depending on site conditions viz. Cable Entry from Top/ Cable Entry from bottom etc.

The bus bars carrying full current of Switchboard shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fiber reinforced polymer insulated supports that are Thermoset in nature, so as to able to withstand high operating temperature of 135 deg C and mechanical forces, arising from a severe fault level as stipulated in schedule of quantities.

To ensure ability to resist ignition & to self-extinguish when ignited, Insulated supports shall be supplied from OEM only & confirm to Glow Wire Test The Busbar Support and the spacing should be same as per the type tested assembly.

Clearances & Creepage distances between phases should be in line with IEC.

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to site earth at two ends of Switchboard.

### Switchboard Interconnection

All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

For unit ratings up to 160 Amps, PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all rating of 200 Amps & above.

All connections, tappings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints.

All screws, bolts, washers shall be zinc plated. Only 8.8 grade nuts and bolts shall be used for Assembly of panels & also busbar connections.

### Drawout Features for ACB

Air Circuit Breakers shall be provided in fully drawout cubicles, unless otherwise stated. These cubicles shall be such that drawout is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

## Instrument Accommodation/Meters

All voltmeter and ammeter and other instruments shall be flushed mounted type of size 96 sq. mm conforming to class 1.5 to IS 1248 for accuracy. All voltmeter shall be protected with MPCBs.

Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided, and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.

For MCCBs, instruments and indicating lamps can be provided on the internal compartment doors.

The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.

On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All lamps shall be protected by MCBs.

## Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall be used at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

## Space Heaters

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 5O C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a rule, the heaters shall be placed at the bottom of the cubicle.

## Sheet Steel Treatment and Painting

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50-micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.

### Testing at Works

Copies of Routine test carried out at the Panel Builder's Workshop shall be furnished along with the delivery of the switchboards. Engineer-in-Charge reserves the right to get the switchboard inspected by their representative at Panel Builder's works prior to dispatch to site to witness the followings.

1. Physical variation and dimensional check
2. Verification of bill of material
3. Functional check
4. HV test
5. IR test

## Smart Wireless Sensors (Cable Heating Detection)

Switchboards, non-forced air ventilated, shall be enabled with a DIN rail wireless sensor capable of monitoring the system and generate three-levels of alerts on overheating wire connections or overheating cables depending on the severity of the detected situation.

Each column of the electrical switchboard shall include one wireless sensor at the top, to help user to prevent electrical switchboards from being damaged, by analyzing gas and particles in the air and sending alerts before any smoke or insulator browning occurs.

Sensor shall be able to analyze gases and microparticles inside the switchboard, by concentrating air into the sensor (with the help of an aspiration fan), applying a smart algorithm to sort internal cable issues from overheating, and sending alerts via email or notification to a smart phone application, enabling the switchboard's digital management.

Temperature and humidity inside the switchboard should be measured by the wireless sensor and values to be communicated through the network. Wireless sensor for early detection of overheating wire connections or overheating cables, should fulfill ISO 14025 PEP ecopassport® program requirements.

Sensor device should not replace any fire protection device of the installation.

## HT Panel Specifications – 11kV

This Specification covers the design, Testing, packaging & forwarding & supply of HT Panel Set having Incomer and Outgoing, Indoor Type, Metal Clad Floor Mounted of 11 KV, incorporating Vacuum Circuit Breaker, Panels along with remote control & equipped with all specified accessories i.e. CTs, PTs (Indoor Type), metering and protection system including termination etc.

## Common VCB Panel Description:

12 KV, 630 Amps, 40KA/3sec, MV indoor Air insulated draw out type folded metal clad switchgear panels. Power frequency withstand voltage: 28 KV rms for 60 sec, Rated lightning impulse withstand voltage (peak):1.2/50 micro sec: 75 KV, Rated short circuit breaking current (rms): 40 KA for 3sec., Rated short circuit making current (peak): 63 KA, **Internal Arc fault withstand capacity: 40 KA for 1 sec**. Panel enclosure shall be self-supporting floor mounted, indoor, dust and vermin proof, totally enclosed as per IEC 62271-200. Special attention must be given so that all the apparatus shall be designed to obviate the risk of accidental short circuit due to insects, mites, rodents or microorganisms. The inspection window on the VCB door shall be made of toughened glass. As per IEC 62271-200, it should bear the same mechanical strength as that of the enclosure. Circuit breaker shall be mounted on a withdrawable truck which shall be horizontally draw out from service position to isolated position i.e. **"Complete Roll on floor type of design"**. Cassette type VCB design is not acceptable. Switchgear shall be fully type tested for extended mechanical endurance of M2 class as per IEC 62271. Switchgear shall be E2 and C2 electrical parameter compliance.

Each unit of VCB Panel Board should be divided into functional individual compartment such as Bus Bar, Instrument/relay & LT control, Circuit breaker, Cable termination and Instrument transformers (CT, PT). There shall be metallic partitions between individual compartments. All these compartments should have proper access for maintenance & should be segregated from each other by means of earthed metallic sheet steel/safety shutters. Safety shutters should be fully automatic and mechanically interlocked with the movement of the truck assembly having danger plates and pad locking arrangements. It shall have both electrical and mechanical flag indication for Isolate/Test/Service position. The switchgear shall be of high quality galvanized sheet steel construction with sheet not less than 2.5 mm thickness (front door, load bearing/structural members/gland plate) and not less than 2 mm thickness for non-load bearing section & shall totally enclosed dust and vermin proof, free standing and floor mounting type. Front door hinges shall be of heavy duty type. **Half Moulded SMC 40 % Glass housing between phases should be provided. Bakelite, Lamtuf sheet or any other phase separation sheet is not acceptable between phases.**

## Interlocks:

The following interlocks shall be available between panel and breaker:

- A breaker in closed condition cannot be inserted into a panel in the Service position or cannot be taken out from panel when in SERVICE position.
- A breaker cannot be operated in between TEST & SERVICE position.
- The breaker shall not be moved either test to service or vice versa in ON position.
- The breaker shall not be switched ON in any position other than test or service.
- A breaker cannot be inserted into a panel in the SERVICE position or cannot be taken out from a panel when in SERVICE position without connecting the control circuit.
- Mechanical interlocking of the breaker with panel doors are required so that panel door shall not be opened with breaker in ON position. It shall be FOOLPROOF.
- VCB's circuits should have provisions for remote operations for closing & tripping of VCB's.

- The bus shutters shall be of self-closing type which shall close automatically when the truck is withdrawn.
- The cradle shall have proper design and construction so as to permit smooth withdrawal and

insertion of the breaker. The movements shall be free of jerks, easy to operate and shall be on steel
balls /rollers. The cradle shall have the markings for the two distinct and separate positions viz., Service and Test of the circuit breaker.

## SECONDARY DISCONNECTING SWITCH (SDS) INTERLOCKS

• VCB cannot be racked in unless the SDS plug is inserted
• SDS plug cannot be removed when VCB is in service or intermediate position
• SDS plug can be removed only when the VCB is in test or isolated position

A spacious cable chamber shall be located at the rear of the panel capable to accommodate 11 KV XLPE cable. Cable chamber should be accessible through removable rear cover backed by a framed wire mesh cover for additional safety. There should be 600 mm minimum vertical clearance in cable compartment between bottom gland plate and cable connection terminal. Bottom plate in cable compartment should be detachable type and cut into two halves to facilitate easy entry of cable for future use. Arrangement has to be done for proper sealing of gland plate.

The panel front access shall be single stroke opening type with pad lockable arrangement to ensure operator safety and rear access shall be with folded frame bolted covers with handles. **It should be possible to open/close the door of the VCB compartment in a single latch action. A special provision should be provided so that rear door cover should be interlocked with same panel front door**. Switchgear panel shall be with horizontal isolation and horizontal draw out type Vacuum Circuit Breaker. The panel shall be possible to extend the switchgear in either direction in the future date. There shall be detachable side covers.

As per site condition, there is moisture condensation problem during rainy season and high humidity condition. Hence Special provisions should be made for anti-condensation/moisture proof to eliminate high voltage tracking phenomenon, corrosion effect and improve insulation life. Design each feeder with additional space heater arrangement. Parts such as hangers, supports shall be hot dip galvanized as per IS: 2629 (latest edition) & IS: 4826 with zinc plating and olive green passivation. The material for springs of shutter mechanism etc. shall be rust proof. All metal bolts and nuts to be used in busbars, panels and earthing work shall be made of stainless steel (SS) with heavy duty double flat washer (SS) and locking spring washer. Each individual feeder panel shall be provided with metal enclosure on all sides and shall be sent as individual panel but shall be suitable for assembly at site to form three/four set of switchboards as per existing site constraints. Loss of service continuity shall be of LSC2B category with compartments segregated from each other by metallic partitions (PM).

**Degree of protection**: High voltage Compartment: IP4X, Relay and Metering Compartment: IP52 as per IEC 60529. All components inside the cubicle shall be provided with traffolite material labels for identification.

**Internal arc classification:** IAC AFLR Each power compartments should be fitted with individual pressure relief flaps on its top surface. Switchgears shall be equipped with all safety interlocks for upmost safety of personnel and equipment. Special Deflector/Gas duct type of arrangement should be provided at top of every breaker confirming to IAC test for 1 sec. i.e. as per IEC 62271-200 ensuring full safety. Type test certificate from NABL accredited lab should be submitted by Manufacturer at the time of Inspection.

**Accessibility to compartments:** Busbar compartment (tool based), Switching device compartment (Interlock controlled), Connection compartment (tool based) Lateral metallic wiring ducts for laying Control cables shall be used wherever it is passing through HV compartment. Whereas in LV compartment control wire to be carried through PVC wire duct, having comb arrangement and in such a way that while putting the cover, all combs should align automatically.

## CURRENT TRANSFORMER

The current transformer shall comply with IS: 2705 part I,II and III with all latest amendments.

- All Current transformers supplied shall be of dry type epoxy resin insulated.
- The accuracy class of the current transformer used for metering shall be class 0.5 and class 5P10 for protection as per latest relevant Indian standards.
- The current transformer shall have the required VA capacity to supply connected meters and relays without exceeding the accuracy limits specified above. They shall have a rated secondary current of 1A as per the metering / relay requirements.
- All meters supplied shall be suitable for operation from current transformers having nominal secondary rating of 1A.
- All CTs shall have undergone routine tests as specified in relevant Indian standards.

## POTENTIAL TRANSFORMER

This shall be Draw out type (Ratio: 11KV/v3/110V/v3 Volts), epoxy resin cast moulded. The High voltage winding of PT transformer shall be protected by current limiting HT fuses duly encapsulate by cast resin barrel i.e. fully insulated with spring loaded tip

**Installation of Line Potential Transformer of Cast resin insulated draw out type with HT primary fuses at below of VCB panel only with bushings and shutters to the connection compartment**. Line PT shall be mounted on VCB truck, however rack in rack out operation of PT, inside the panel, shall be independent of racking operation of VCB. Racking operation of the PT shall be possible only in closed door condition similar to VCB. The complete switchgear panel surfaces inside as well as outside should be powder coated with epoxy resin, standard colour RAL 7035 with 7 tanks pre-treatment process, after application of anti-rusting paint.

## Auxiliary wiring & Terminals:

All wiring for control, signalling, protection and instrument circuit should be of 1100 volts grade FRLS insulated multistranded copper conductors. The wiring in the panel should be laid through

proper cable trays with proper identification ferules. The CT wiring shall be of 4.0sq. mm and all other controls as well as PT wiring shall be of 1.5sq. mm multistrand copper. All inter panel control wiring within each shipping section shall be through pre terminated plugin type terminals so as to reduce the time/mistake during commissioning.

Each panel shall be provided with transparent acrylic type labels of 40mm Height, nut bolted on front and rear of a non-removable part, clearly indicating the panel number and name. Details of name plate shall be given after installation of panels. Suitable danger/warning stickers should be provided wherever access to live parts from outside is possible. Labels indicating the function of internal devices and terminal block numbers and wire groups shall be provided. The same numbers or letters as used in the schematic and wiring diagrams shall identify all internal devices such as relays, fuses, MCBs, switches.

Instructions shall be screen printed on the VCB door, instead of Stickers/ plates. Indication Lamps: Each circuit Breaker panel should be provided with indication lamps for Breaker ON/OFF, Auto trip, Spring charged, trip circuit healthy, DC fail, VCB position i.e. Service, Test etc. All indication lamps should be properly labelled and LED type only. All indicating lamp labels should be mounted such that they are tilt free. Each feeder of the panel should be provided with panel illumination lamp LED type only 230V AC with door switch & fuse, 2 Nos. space heaters 100 watts (230 Volt AC) continuously rated tubular/strip type with manual ON/OFF switch & thermostat cut off, spring charging motor ON/OFF switch, local/remote switch and TNC switch. Each feeder should be provided with modular five pin 5/15 Amp, 230 V AC socket and switch baked by MCB.

## Terminal blocks

For Current transformer secondary lead wires shall be heavy duty, stud type disconnecting terminals and provided with external plug type shorting link and earthing facility. Low voltage compartment front cover shall house a terminal block with screwed cover arrangement duly CT and PT connection with plug shorting facility for safe external testing/calibration purpose. Each terminal block should not have more than one incoming and outgoing wire termination. Terminals for AC circuit and DC circuit shall be separately mounted in different DIN rails. The number of terminals making up a terminal block shall include at least six spare terminals. Totally 20% spare terminals shall be provided in each panel. All wiring from external connections shall be brought out to terminal on a readily accessible terminal block.

## BUS BAR AND CONNECTORS:

Air insulated, Electrolytic grade tinned copper flat rectangular bus bar of 800 Amp. Continuous rating. The main Busbars and Jumpers are of Copper material and grade of ETP. Busbar shall have smooth surfaces free from burrs, sharp edges to minimise dielectric stress concentration. Bus bar shall be mounted on integral seal off bushing and interconnection with electrolytic grade copper with joints silver plated. Bus bar size of 65x10 mm with insulator sleeves & supporting insulator capable for 630A carrying capacity.

## Cable Termination:

There shall be a clear space allowed between the terminal block and cable entry for the spreading and terminations of external conductors. Positioning of cable termination shall avoid obstruction of other cable terminations, removable covers etc., and provide easy access for terminating cables. System for verification of safe isolation from supply for feeder and Busbar by means of capacitive voltage detecting system with panel front closed. All Hinged doors/ frames and movable parts shall be earthed through adequately sized (10 Sq.mm minimum) flexible tinned copper braids to the fixed frame to the switch board.

Separate holes with rubber grommet shall be provided on LV compartments for interpanel wiring & communication wiring. Mechanical door stopper arrangement to be provided for LV door such that door does not open beyond 95 Degrees. Single actuating mechanism shall be provided for electrical and mechanical indication of VCB position status. Firm shall supply 2 sets of all special tools i.e. (racking handle, spring charging handle etc.) required for day to day operation in a separate package. Manufacturer should provide separate instruction label for torque tightening of Busbar coupling.

## EARTHING:

There shall be a continuous copper earth bus as per relevant standards running at the bottom of the panel. Earth bus shall be robust and shall be capable of carrying full short circuit current for 1 second. Doors, covers and all non-current carrying metallic parts shall be earthed through flexible copper wires. This also includes instrument casting and cable armour which are also connected to the earth bus. Earth bus must be type tested for STC at 40KA for 1 sec. Earth bus bar of size as per statutory requirement shall be provided throughout the full length of the panel at the bottom and projected outside on both ends of the panel so as to facilitate termination of earth conductors from earth pits.

## ERECTION & COMMISSIONING:

Complete erection & commissioning work shall be executed by Licensed Electrical Contractor. Firm must submit the license certificate and details of above contractor through which they intent to execute the work. The erection & commissioning work must be carried out under the supervision of OEM. Commissioning will only be carried out by the firm after erection and successfully carried out pre commissioning checks. After complete installation of switchgears and insulation of high voltage system, firm shall arrange high voltage test kit to check the power frequency insulation level (28KV), secondary injection test kit for checking CT, protection & metering system. All functional tests like Auto/ Local/ Remote operations, relay testing, finishing of wirings/ terminations and painting, etc. Practical trial will start after ensuring that all statutory/ mandatory requirements are met. A commissioning manual will be prepared by the firm and produced with detailed commissioning activities. Once the equipment has been installed and commissioned, site acceptance tests will be performed by the firm to confirm the systems operation and compliance with the requirements specifications. Recorded documentation confirming that the testing has been successfully executed duly checked and signed by both Firm and representative and will be available for review /inspection prior to the commencement of the system hand over.

## SWITCHBOARD WISE DESCRIPTION

The Switchboard as complete consist of 1 Nos. of Incomer + Outgoing Panel .

### A) 11kV 630A Incomer Panel

- **BREAKER:** 11kV, 630A, 40kA, 110V DC TC CC, 230V AC motor spring charged mechanism type Vacuum Circuit breaker.
- Acceptable make: L&T/Siemens/Schneider/ABB only.
- **CURRENT TRANSFORMER:** 200/1-1A, Acc. Class - 0.5, 5P10. Acceptable make: ECS/Pragati/Kappa/ Kapco electric
- **POTENTIAL TRANSFORMER:** Ratio: 11KV/v3/110V/v3 Volts, Accuracy class is 0.5. Rated Burden 50VA. Acceptable make: ECS/Pragati/Kappa/Kapco electric.
- **Meters:** Demand controller of Accuracy class 0.5 monitoring all electrical parameters like per phase, voltage, current, demand, W, VA, VAR, all instantaneous, integrated and demand parameters, Neutral current, Frequency, PF, % load, Phase angle, THD working on MODBUS protocol. Acceptable make: L&T /Schneider/ABB/Secure.
- **Digital Ammeter** with Selector switch – 1 no. Acceptable make: L&T / Schneider/ABB/Secure.
- **Digital Voltmeter** with Selector switch – 1 no. Acceptable make: L&T / Schneider/ABB/Secure.
- **RELAYS:** The offered relays shall be multifunction numerical type. All Numerical relays Relay shall have minimum following features:
  - Relay shall be suitable for 1A CT secondary.
  - Relay shall be draw out type
  - Relay shall be provided with rear RS485 port for connection to remote operation.
  - The communication protocol of the relay shall be MODBUS only.
  - Relay setting change.
  - Relay Fault, Event & Disturbance recorder extraction.
  - Reading the measurement values.
  - Relay shall be provided with an alpha numeric LCD display and keypad for navigation and setting. Acceptable make: L&T /Schneider/ABB/Siemens.
- **High speed master trip relay** – 1 No. Acceptable make: ABB/Ashida/Schneider/Siemens.
- **Trip circuit supervision relay** – 1 No. Acceptable make: ABB/Ashida/Schneider/Siemens.
- **Under/Over voltage relay** – 1 No. Acceptable make: ABB/Ashida/Schneider/Siemens/L&T.
- **Phase sequence Indication arrangement to be provided**.
- Accessories like local remote selector switch, TNC switch, Space heater with thermostat – 2 nos., DC & AC control circuit through MCB, Indicating LED lamps, Spring Charged indication, DC supply healthy, Breaker ON/OFF, in service, test, disconnected position etc. should be provided.

## CABLES:

Cables shall confirm to latest IS 1554-1988. Cables shall be heavy duty, armored, all cables

to be FR grade, XLPE insulated & PVC sheathed 1.1 KV grade aluminum or copper. Type test certificate of the cables from manufacturers for that particular drum shall be provided. Cable shall be fixed with G.I spacers & saddles at an interval of 45 cms and on every side of bends. The bending radii of cables shall be as per manufacturers instructions and in no case it shall be less than 12 times the overall diameter of the cable. Cable shall be so installed that they are not subject to mechanical damage. If there is a bend in the cable enclosed in a conduit, care has to be taken to prevent undue compression of insulation. This applies also to the top of vertical runs of longer than 5 meters where there could be compression caused by the weight of unsupported vertical cables. The cables run in cable trays shall be fixed with cable ties at intervals of not more than 30 cms. No joints in the cables shall be permitted unless otherwise approved by Client or consultant. Termination of the cables shall be done with heavy duty copper/Aluminum lugs and brass cable glands.

Cables laid under ground shall be to a minimum depth of 750 mm. It shall be ensured that cables laid underground are free of water lines, sewage lines etc. The trenches shall be at least 30 cm wide & filled with 10 cms thick of layer of dry sand on which the cable shall be laid. Further, 10 cms thick river sand layer shall be put on the cable over which a brick layer shall be kept. The trench shall than be back filled with soft earth, rammed and consolidated to original level. Cable route indicators made up of CI shall be laid at intervals of 20 meters and at all change in directions. Any cable slab to be provided on top of the cable before sand fill to prevent accidental excavation damage in future.

For cables laid on walls aluminum tags shall be fixed showing the size of the cable and the feeder number of the cable. These tags shall be at each ends and at least one or two places at intermediate positions.

Straight through joints to be avoided as far as possible. prior cable schedule to be submitted by Vendor. Heavy duty brass type compression glands to be used for all types of terminations. All LT cable joints in outdoor and humid atmospheres shall be done with double compression glands only / if done by Single compression Gland should be accommodated by PVC HOOD of Appropriate size.

1. Earth continuity.
2. Insulation resistance.
3. 1000 Volt megger shall be used for testing 3 phase 415volt system.

Cables shall be meggered as soon as they are brought to site. Insulation resistance shall also be tested.

4. After cutting.
5. After laying and preparing the joint.

The mode of measurement of the cables shall be as follows:

i) For top entry of the cable, the measurement shall be taken up to the bottom of that switch-gear.

ii) For bottom entry of the cable, the measurement shall be taken up to the top of that switch board. No wastage shall be allowed for measurements.

## CORE IDENTIFICATIONS

Cores of the cables shall be provided with following colour scheme of PVC insulations.

| | |
|---|---|
| 1. Single Core | : Green, Yellow for earthing |
| 2. Two Cores | : Red & Black, Blue & Black, Yellow & Black |
| 3. Three Cores | : Red, Yellow & Blue |
| 4. Four Cores | : Red, Yellow, Blue & Black |

# Surge Protection Devices

## Impulse Discharge Current (I-imp)

In case of a LPS being fitted to the building hosting the electrical installation, there is a need to recall the rules given in IEC 62305 series to calculate the sharing of current and thus the current withstands I-imp of the SPD located at the entrance. According to the IEC 62305 series, there is a need to use an equipotential SPD at the entrance of the installation as soon as an LPS is present on the building. This SPD is tested with Class I tests and is defined mainly by a 10/350 withstand I-imp.

## Maximum Continuous Operating Voltage (Uc)

Maximum rms voltage which may be applied to the SPD's mode of protection.

It is selected depending on

- Nominal Operating Voltage (Uo)
- Low Voltage Distribution System (TN,TT,IT)
- Required modes of protection (L-N, L-PE, N-PE)
- The TOV to be expected and its withstand requirements

Uc: 1.45x Uo: 1.45x230V: 333.5V ac (335V ac)

Immunity against commonly temporary overvoltage for 230/400V guaranteed by selection of the following Uc Values (tested for TOV of 1200V for 200ms).

Case A: The SPD is completely immune if Uc ≥ 335 V, it operates only if there are lightning overvoltage.

Case B: With Uc ≤ 335V, the SPD reaches its end of life, in case of TOV.

## Nominal Discharge Current (8/20µs) (Uc)

The Nominal Discharge Current is the peak value of surge current conducted through SPD. It has 8/20us impulse current waveform. The SPD must function after 15 applied surges. This current discharge parameter (In) should be selected in accordance with impulse withstand voltage of the equipment to be protected, if not then SPD will survive such a stress but the equipment will not be protected.

## Maximum Discharge Current (8/20µs

The Maximum Discharge Current is the peak value of surge current conducted through SPD. It also has 8/20us impulse current waveform but after one applied surges, SPD no longer functions (SPD reached its end of life).

## Short Circuit Withstand Capability (Without Back fuse and With Backup fuse)

During the normal operation of surge protective devices, the SPD provides a high impedance at nominal system voltage and rated frequency. In case an SPD reaches its end of life in low impedance state, the resulting short circuit current must be interrupted. This interruption may be provided by and SPD internal disconnector or in conjunction with an external disconnector for e.g. fuse.

## Voltage Protection Level

The surge withstand of the equipment (or impulse immunity of critical equipment) to be protected and the nominal voltage of the system shall be considered in choosing the preferred voltage protection level value of the SPD. It's a drop across SPD terminals during discharge. The lower the value the better the protection.

| Panel/Board Description | SLD Specification | Backup Fuse |
|---|---|---|
| Main Control Panel/PCC | Type I and II<br>Uc = 335V<br>Iimp = 25KA & In= 60KA<br>Ut= 440V/120min (Withstand)<br>Isccr= 5KA without fuse/ 50KA with backup fuse<br>Up ≤ 1.25 kV at 25KA<br>3 color progressive indication<br>PD/IP 3/20 (built in), KEMA-KEUR, ZOTUP Make | 250 A gG fuse |
| Sub Control Panel/Floor Panels/Secondary Distribution Panel | Type I and II<br>Uc = 335V<br>Iimp = 13 KA & In= 35KA<br>Ut= 440V/120min (Withstand)<br>Isccr= 5KA without fuse/ 50KA to 100 KA with backup fuse<br>Up ≤ 1.25 kV at 20 KA<br>3 color progressive indication | 160A gG fuse |

| | | |
|---|---|---|
| | PD/IP 3/20 (built in), KEMA-KEUR, ZOTUP Make | |
| Distribution Boards/Sub Distribution Boards | Type II<br>Uc = 335V<br>In= 30KA<br>Ut= 440V/120min (Withstand)<br>Isccr= 5KA without fuse/ 50KA with backup fuse<br>Up ≤ 1.00 kV at 5 KA<br>3 color progressive indication<br>PD/IP 3/20 (built in), KEMA-KEUR, ZOTUP Make | 125 A gG fuse |

# NON-DSR TECHNICAL SPECIFICATIONS
# EXTRA LOW VOLTAGE

## GENERAL

### 1. CONTRACTORS RESPONSIBILITIES

The Contractor is responsible for the quality and the satisfactory operation of the installations entrusted to him, as well as for compliance with the performance stipulated in this document.

Consequently, for his own account and under his own responsibility, he must carry out all calculations and select the necessary materials and equipment.

Apart from the required performance definitions, this document and the relevant drawings also provide many indications resulting from the studies carried out by the Engineer.

The Contractor shall review these studies and check the corresponding indications.

The same applies to equipment selection, for which the information given in this document must be deemed as indicative and defines only the minimum requirements.

### 2. SCOPE DESCRIPTION

The contractor shall furnish all labor, materials, tools, supplies, equipment, transportation, supervision, technical, professional, and other services, and shall perform all operations necessary and required to satisfactorily complete all the necessary engineering, procurement services, construction work and commissioning for the systems and equipments for the project.

### 3. BASIC DESIGN CRITERIA

Refer tender Drawings and Documents.

### 4. GENERAL CONDITIONS

4.1. The schedules, tender drawings, contract documents provided for reference design intent. It is the scope of contractor to verify, design, manufacture, supply, transport , install, test , commission, handover the complete ELV system including all necessary services, accessories, material, equipment , Tools & tackles, labor , and any other type of service or material as required.

4.2. It is not the intent to specify completely herein all details of design and construction of system/ plant/ equipment to be supplied / erected. However, the system/ plant/ equipment supplied shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation in a manner acceptable to the Client who will interpret the meaning of drawings and specifications and shall I have the power to reject any work or material which in his judgement are not in full accordance therewith.

4.3. In case of discrepancy and / or disparity between these general and special conditions of contract and any other sections enclosed here in, the most stringent shall apply and the decisions of the Client/consultant shall be final.

4.4. Entire works which are part of this contract shall be completed in all respects and handed over in the timeline defined by the client the award of contract. However final timeline will be decided based on mutual agreement during finalization.

## 5. NS-1: Dome Camera

### 5.1. Technical Specifications:

**1. Image Sensor:**

- **Sensor Type:** 5MP CMOS
- **Optical Format:** 1/2.7"
- **Pixel Array:** 2880 x 1620 (5MP resolution)

**2. Lens:**

- **Lens Type:** Fixed Lens
- **Focal Length:** 2.8mm
- **Aperture:** F1.6
- **Field of View (FoV):**
  - Horizontal: 91°
  - Vertical: 46°
  - Diagonal: 110°

**3. Minimum Illumination:**

- **Color:** 0.004 Lux @ F1.6
- **Infrared (IR) Support:** IR illumination for 0 Lux visibility up to 30 meters

**4. Shutter Speed:**

- Range: 1/5s to 1/20000s

**5. WDR (Wide Dynamic Range):**

- **Support:** 120dB WDR

**6. Image Enhancement Features:**

- **IR Cut Filter:** Automatic (Day/Night switching)
- **Image Adjustments:** Brightness, Contrast, 3D DNR (Digital Noise Reduction)

**7. Intelligent Video Analytics:**

- **Event Detection:**
  - Face Detection
  - Human Detection
  - Vehicle Detection
  - Perimeter Intrusion Detection
  - Line Crossing Detection
  - Rare Sound Detection

**8. Video Compression & Streaming:**

- **Video Compression Formats:**
  - H.265
  - H.264
- **Resolution Streams:**
  - 5MP at 30fps (Primary Stream)
  - Multiple Resolution Support

**9. Audio:**

- **Audio Input:** Built-in Microphone for Audio Recording

**10. Network and Storage:**

- **Network Protocols Supported:**
  - TCP/IP
  - HTTP
  - ONVIF G/S/T
- **Ethernet Port:** 10/100M RJ45
- **Storage:** Supports up to 256GB microSD Card

**11. Power Supply:**

- **Power Options:**
  - PoE (Power over Ethernet)
  - 12V DC

NS-2: Bullet Camera

**Technical Specifications:**

**1. Image Sensor:**

- **Sensor Type:** 2MP CMOS
- **Optical Format:** 1/2.7"
- **Pixel Array:** 2880 x 1620 (2MP resolution)

**2. Lens:**

- **Lens Type:** Fixed Lens
- **Focal Length:** 2.8mm
- **Aperture:** F1.6
- **Field of View (FoV):**
    - Horizontal: 91°
    - Vertical: 46°
    - Diagonal: 110°

**3. Minimum Illumination:**

- **Color:** 0.004 Lux @ F1.6
- **Infrared (IR) Support:** IR illumination for 0 Lux visibility up to 30 meters

**4. Shutter Speed:**

- Range: 1/5s to 1/20000s

**5. WDR (Wide Dynamic Range):**

- **Support:** 120dB WDR

**6. Image Enhancement Features:**

- **IR Cut Filter:** Automatic (Day/Night switching)
- **Image Adjustments:** Brightness, Contrast, 3D DNR (Digital Noise Reduction)

**7. Intelligent Video Analytics:**

- **Event Detection:**
    - Face Detection
    - Human Detection
    - Vehicle Detection
    - Perimeter Intrusion Detection
    - Line Crossing Detection
    - Rare Sound Detection

**8. Video Compression & Streaming:**

- **Video Compression Formats:**
    - H.265
    - H.264
- **Resolution Streams:**
    - 5MP at 30fps (Primary Stream)
    - Multiple Resolution Support

**9. Audio:**

- **Audio Input:** Built-in Microphone for Audio Recording

**10. Network and Storage:**

- **Network Protocols Supported:**
  - TCP/IP
  - HTTP
  - ONVIF G/S/T
- **Ethernet Port:** 10/100M RJ45
- **Storage:** Supports up to 256GB microSD Card

NS-3 :- PTZ Camera

**Technical Specifications:**

**1. Image Sensor:**

- **Sensor Type:** 2MP CMOS
- **Optical Format:** 1/2.7"
- **Minimum Illumination:**
  - Color: 0.003 Lux
  - Black & White (IR mode): 0 Lux

**2. Lens:**

- **Lens Type:** 33X Optical Zoom Lens
- **Focal Length:** 4.3mm to 142mm
- **Optical Zoom:** 33X
- **IR Range:** Up to 200m

**3. Shutter Speed:**

- **Range:** 1/5s to 1/20,000s (Automatic)

**4. Dynamic Range & Image Settings:**

- **Backlight Compensation:** Supported
- **Wide Dynamic Range (WDR):** Supported
- **Anti-Flicker:** Supported

**5. PTZ (Pan-Tilt-Zoom) Functionality:**

- **Pan/Tilt Speed:** Configurable
- **Presets:** Multiple presets supported
- **Scanning Patterns:** Supported

**6. Intelligent Video Analytics:**

- **Analysis Functions:**
  - Face Recognition
  - Human & Vehicle Detection
  - Perimeter Intrusion Detection
  - Line Crossing Detection
  - Cross Counting
  - Stationary Object Detection
  - Heat Map

**7. Video Compression & Streaming:**

- **Video Compression Formats:**
  - H.265
  - H.264
- **Multiple Resolution Streams:** Supported

**8. Audio:**

- **Audio Input:** Built-in Microphone for Audio Recording

**9. Network and Storage:**

- **Network Protocols Supported:**
  - TCP/IP
  - HTTP
  - ONVIF (Compliance with G/S/T profiles)
- **Ethernet Port:** 10M/100M RJ45
- **Storage Support:** Up to 256GB microSD Card

**10. Power Supply:**

- **Power Options:**
  - PoE (Power over Ethernet)
  - 12V DC (Max Power Consumption: 25W)

NS-4 :- 64 Channel NVR

**Technical Specifications:**

**1. System Overview:**

- **Operating System:** Embedded Linux
- **Channels Supported:** Up to 64 Video Inputs
- **Video Throughput:**
  - Incoming Bandwidth: 640 Mbps (or better)
  - Outgoing Bandwidth: 640 Mbps (or better)

- **Video Outputs:**
  - 2 HDMI Video Outputs

**2. Video Inputs & Resolution:**

- **Live View, Storage & Playback Resolution:** 1MP to 12MP
- **Supported Video Streams:**
  - Simultaneous recording of multiple streams in any combination of:
    - H.264, H.265, H.264+, H.265+
  - **Stream Functions:** Start, stop, normal play, back play, frame-by-frame forward, fast forward (2x, 4x, 8x, 16x), slow forward (1/2x, 1/4x, 1/8x, 1/16x)

**3. Storage:**

- **SATA Interface:** 8 SATA Ports
- **Storage Capacity:**
  - Up to 18TB per HDD slot (Enterprise Class HDD)
  - **Supports Net HDD** and Cloud Storage (Google Drive, Dropbox) for video and snapshots
- **RAID Support:** RAID 0, 1, 5, 6, 10
- **E-SATA Port:** 1 port

**4. Audio:**

- **Audio Codec Support:** G.711A, G.711U

**5. Networking & Connectivity:**

- **Ethernet Ports:** 2x RJ45 10M/100M/1000M ports
- **USB Ports:**
  - 2x Rear USB 3.0 ports
  - 1x Front USB 2.0 port
- **Alarm Inputs:** 16 Channels
- **Alarm Outputs:** 4 Channels
- **RS485 Port:** 1 Port

**6. Display & Playback Features:**

- **Live-View Display:**
  - VCA (Video Content Analytics) metadata display on live view and playback
- **Playback Features:**
  - Digital Zoom
  - Video Clip
  - Sub-stream/Main-stream playback
  - Playback video bar
  - Add custom/default tag for events during playback
  - Full-screen playback
- **Event Actions:**

- Pre/Post recording actions: Send email, FTP upload video/screenshot, Cloud upload video/screenshot
- Alarm output trigger, PTZ linkage on events
- Voice prompts for events

**7. Video Compression & Storage:**

- **Compression Support:**
  - H.264, H.265, H.264+, H.265+
- **Multi-stream Recording:** Supports multiple streams from different cameras with various resolutions and compression formats

NS-5:- 6TB 3.5" SATA HDD

**Technical Specifications:**

**1. General Overview:**

- **Type:** Internal 3.5" SATA Hard Disk Drive (HDD)
- **Capacity:** 6TB
- **Form Factor:** 3.5-inch
- **Interface:** SATA III (6.0 Gbps)
- **Data Transfer Rate:** Up to 180 MB/s (depending on the model)

**2. Performance Specifications:**

- **Rotational Speed:** 7200 RPM (Revolutions Per Minute)
- **Cache Memory:** 128MB (typically for enterprise-level performance)
- **Average Seek Time:** Approximately 8-9ms
- **Workload Rate:** Designed for heavy-duty, 24/7 operational workloads

**3. Power Consumption:**

- **Idle Power Consumption:** Around 6-7W
- **Operating Power Consumption:** Around 8-10W
- **Standby Power Consumption:** Typically 3W or lower

**4. Compatibility:**

- **Compatibility with NVR Systems:** Compatible with enterprise-level network video recorders (NVR) and servers
- **Operating Systems Supported:** Compatible with most operating systems supporting SATA drives, including Windows, Linux, and MacOS

NS-6:-24 port

**Technical Specifications:**

**1. General Overview:**

- **Type:** Managed Layer 3 Switch
- **Total Ports:**
  - 24 x 10/100/1000BASE-T POE Ports
  - 4 x GbE/10GbE SFP/SFP+ Uplink Ports
- **Layer:** Layer 3 (Supports static routing, RIP)
- **Stacking Support:** Up to 10 switches (Stackable for high scalability)
- **Redundant Power Supply:** Support for external redundant power supply for reliability
- **Power-over-Ethernet (PoE):** Yes, on all 24 Ethernet ports

**2. Ethernet Ports:**

- **10/100/1000BASE-T Ports:**
  - 24 x Ports (PoE+ support on all)
  - Supports IEEE 802.3af/at PoE for powering connected devices (e.g., IP cameras, phones, wireless access points)
- **Uplink Ports:**
  - 4 x GbE/10GbE SFP/SFP+ (for high-speed uplink connections)
  - Can be used for stacking or connecting to higher-end network infrastructure

**3. Layer 3 Routing & Protocols:**

- **Static Routing:** Support for manual IP routing configuration
- **Routing Information Protocol (RIP):** Support for RIP (v1 & v2) for dynamic routing
- **VLAN Support:** Supports VLANs for network segmentation
- **ACL (Access Control Lists):** Ability to configure network access control for security
- **Routing Features:** Inter-VLAN routing, multicast routing, and other advanced routing features

**4. Power-over-Ethernet (PoE) Support:**

- **PoE Power Budget:** Sufficient PoE power for all 24 ports (depends on switch model, usually 370W-1000W+ depending on PoE+ or PoE++ support)
- **IEEE 802.3af/at Compliant PoE:** Supports both standards for efficient power delivery over Ethernet cables

**5. Stacking & Scalability:**

- **Stackable:** Up to 10 switches can be stacked for higher port density and easier management
- **Stacking Ports/Cables:** Each switch should be provided with the required stacking ports/cables for linking multiple switches in a stack

NS-7:- VMS Workstation

**VMS Workstation Minimum Hardware Specifications:**

**1. Operating System:**

- **Supported OS:**
  - Windows 7 (64-bit)
  - Windows 10 (64-bit)
  - Windows 11 (64-bit)
  - macOS 11.6 and later

**2. Processor (CPU):**

- **Minimum Processor:** Intel® Core™ i5-4590 @ 3.3 GHz or higher
- **Recommended:** Intel® Core™ i7 or AMD Ryzen™ series for higher performance, especially for large camera counts

**3. Memory (RAM):**

- **Minimum RAM:** 8 GB
- **Recommended for High Camera Counts:** 16 GB or more (for systems with many cameras or higher resolution feeds)

**4. Graphics Card (GPU):**

- **Minimum Graphics Card:** NVIDIA GT 730 with 4 GB or higher
- **Recommended:** A higher-performance GPU (such as NVIDIA GTX series) for better video decoding and display, especially when handling multiple high-definition video streams

**5. Storage:**

- **Hard Drive:** SSD (Solid State Drive) for OS and application storage for better performance
- **Storage Capacity:** At least 500 GB (higher capacity if storing video locally or working with large video files)
- **Additional Storage:** HDD or NAS/SAN for video storage (depending on your recording needs)

**6. Network:**

- **Ethernet:** Gigabit Ethernet (1 Gbps) or higher for networked video data transfer
- **Wi-Fi (optional):** Only if the workstation is connected via wireless; wired connection is preferred for stability and speed

**7. Ports and Connectivity:**

- **USB Ports:** Minimum of 3 USB 3.0 or higher for peripherals and external storage devices

- **Video Output:** HDMI or DisplayPort for connecting to monitors (supports multi-monitor setups for surveillance purposes)

**8. Monitor:**

- **Resolution:** At least Full HD (1920x1080), but 4K or higher resolution recommended for optimal monitoring, especially in large multi-camera layouts
- **Multi-monitor Setup:** For better surveillance experience, especially for monitoring many cameras at once

**9. Power Supply:**

- **Power Supply Rating:** Sufficient power to support all components, especially if using high-performance GPUs and multiple monitors (typically 500W or higher)

NS-8:- VMS Client Software

**VMS Client Software Specifications:**

1. **Core Features:**

- **Live Camera View:**
  - Capable of displaying live views from multiple cameras simultaneously
  - Supports high-definition video streams (up to 4K or higher resolution)
- **Multi-user Access:**
  - Supports simultaneous access by multiple users with configurable permissions and roles
- **Password Management:**
  - Allows for user password resetting and management
- **Device Addition:**
  - Ability to add devices individually or in batches (import/export device lists)
  - Supports automatic device discovery and manual IP/domain configurations

2. **Protocols & Device Integration:**

- **Protocol Support:**
  - Supports various protocols such as ONVIF, RTSP, HTTP, HTTPS, etc.
  - Compatibility with IP cameras, NVRs, and other network devices
- **IP/Domain Configuration:**
  - Allows manual or automatic configuration of devices using IP addresses or domain names
- **Remote Device Configuration:**
  - Remote management and configuration of connected devices (e.g., cameras, NVRs) through the client software

3. **Remote Viewing & Playback:**

- **Real-time Video Viewing:**
  - Remote viewing of live video from multiple devices on various endpoints (e.g., desktop, mobile devices)
- **Video Playback:**
  - Playback of recorded videos from local or remote storage (supports timeline navigation, frame-by-frame, and fast-forward/rewind)
- **Remote Image and Video Playback:**
  - Access recorded videos or images remotely, with the ability to download and view them
- **Cruise View:**
  - Automated camera patrolling (cruise mode) to display a series of cameras at regular intervals
- **Alarm Configuration:**
  - Allows for configuring and managing alarms based on motion detection, sensor triggers, or other events
  - Push notifications and email alerts for alarm triggers

NS-9:- CAT 6A cable in existing conduit

**Specification for Giga Speed Category 6A Non-Plenum U/UTP Cable:**

**1. General Overview:**

- **Cable Type:** Category 6A (Cat 6A) Unshielded Twisted Pair (U/UTP) Cable
- **Conductor Type:** Copper (Solid or Stranded, depending on application)
- **Color:** Standard color (typically blue, but other colors can be specified as required)
- **Standards Compliance:**
  - **ISO/IEC 11801** (International Standard for cabling)
  - **TIA/EIA 568-C.2** (Telecommunications Industry Association/Electronic Industries Alliance)
  - **ANSI/TIA-568-C.2** (Category 6A specifications)
  - **UL Listed** (Underwriters Laboratories for safety and performance)
  - **RoHS Compliant** (Restriction of Hazardous Substances)

**2. Cable Specifications:**

- **Performance Rating:**
  - **Data Transmission Speed:** Up to 10 Gigabit Ethernet (10GbE) at 500 MHz
  - **Bandwidth:** Supports 10Gbps speeds over distances up to 100 meters (328 feet)
- **Impedance:** 100 Ohms nominal
- **Wire Gauge:** Typically 23 AWG (American Wire Gauge) for solid conductor
- **Insulation Material:** High-density polyethylene (HDPE) or equivalent for insulation
- **Conductor Material:** Solid copper for improved signal integrity and better performance over long distances
- **Jacket Material:** PVC (Polyvinyl Chloride) or LSZH (Low Smoke Zero Halogen) for non-plenum rated applications

- **Cable Diameter:** Standard cable diameter for Cat 6A cables (typically 6.3-7.0mm, depending on insulation thickness)

NS-10:- CAT6A patch panel

**Specification for 24-Port Loaded CAT6A Patch Panel:**

**1. General Overview:**

- **Type:** 24-Port Loaded Patch Panel (CAT6A)
- **Category:** CAT6A (Category 6A) for 10 Gigabit Ethernet support
- **Function:** The patch panel will be used for organizing and managing CAT6A cables, connecting them to network devices, and providing a reliable patching solution for high-speed networking.
- **Ports:** 24 ports (RJ45 for network connections)
- **Mounting:** 19-inch rack-mounted
- **Form Factor:** Standard 1U (rack unit) or as required

**2. Cable & Network Standards Compliance:**

- **Standard Compliance:**
  - **TIA/EIA-568-C.2** for Cat 6A performance standards
  - **ISO/IEC 11801** for international cabling standards
  - **UL Listed** for safety and performance
  - **RoHS Compliant** (Restriction of Hazardous Substances)
- **Supported Speeds:** Up to 10 Gigabit Ethernet (10GbE) over distances up to 100 meters (328 feet)
- **Performance Rating:** CAT6A, supporting frequencies up to 500 MHz and 10Gbps speeds

NS-11:- 9U Rack

**Specification for 9U Network Rack:**

**1. General Overview:**

- **Type:** 9U Rack for mounting network switches, patch panels, and other network equipment.
- **Form Factor:** 9U (Rack Units) tall, designed to be installed in a standard 19-inch rack system.
- **Function:** Used to house and organize network equipment, ensuring efficient airflow, cable management, and secure mounting of devices.
- **Mounting Compatibility:** Standard 19-inch EIA (Electronic Industries Alliance) mounting to accommodate various network equipment such as switches, patch panels, and routers.

**2. Rack Design and Features:**

- **Material:** Constructed from high-quality steel or metal with a corrosion-resistant powder-coated finish (typically black or grey).
- **Load Capacity:** Designed to support up to 50-80 kg (depending on the design and manufacturer) of mounted equipment.
- **Front and Rear Doors:** The rack should feature lockable mesh or perforated front and rear doors to ensure security and proper ventilation.
- **Side Panels:** Removable or lockable side panels to facilitate easy access and improve security.
- **Ventilation:** Adequate ventilation with mesh or perforated sections on the doors and side panels to ensure airflow for cooling.
- **Rack Mounting:** Rack should include adjustable vertical rails to accommodate various equipment depths and ensure proper alignment.
- **Dimensions:** Standard 9U height (approximately 15.8 inches or 400 mm), with a width of 19 inches and a depth that accommodates typical network equipment (usually 600 mm to 800 mm deep).

**3. Accessories Included:**

- **Spike Protector:**
  - A surge protector or spike arrestor for electrical safety, designed to protect sensitive network equipment from power surges and spikes.
- **Fan Tray:**
  - A fan tray with one or more fans (usually 2 or 3) for active cooling to ensure that equipment inside the rack does not overheat.
  - The fan tray should be easily removable for maintenance and feature a filter to prevent dust accumulation.
- **Cable Manager:**
  - Integrated cable management solutions, such as vertical or horizontal cable managers, to neatly organize and secure network cables.
  - These should allow for easy routing of cables and prevent tangling or strain on the cables.
  - Cable tie-down points, Velcro straps, or other cable retention mechanisms should be included to maintain a clean and organized rack setup.

**4. Installation and Mounting:**

- **Mounting the Rack:**
  - The rack will be securely installed in the designated location, ensuring the rack is level and stable.
  - Mounting of the rack should be performed on a concrete, wood, or other solid surfaces, with appropriate mounting hardware included (e.g., wall or floor-mounted brackets if required).
- **Device Installation:**
  - Proper mounting of network equipment such as switches, patch panels, or other devices on the adjustable 19-inch rails.

  - Ensure that all equipment is securely fixed, using screws or rack-mount brackets as needed.
- **Cable Management:**
  - All network cables should be neatly routed and organized within the cable management system to ensure no obstruction to airflow.
  - Cables should be appropriately labeled for easy identification.

NS-12:- 27U Rack

**Specification for 27U Network Rack:**

**1. General Overview:**

- **Type:** 27U Network Rack designed for mounting network switches, patch panels, servers, and other network equipment.
- **Form Factor:** 27U (Rack Units) tall, designed to fit in standard 19-inch rack systems.
- **Function:** Provides a secure and organized solution for housing and managing network equipment, allowing efficient airflow and cable management.
- **Mounting Compatibility:** Standard 19-inch EIA (Electronic Industries Alliance) mounting to accommodate a wide range of network equipment.

**2. Rack Design and Features:**

- **Material:** High-quality steel or metal construction with a powder-coated finish (typically black, gray, or customizable).
- **Load Capacity:** Designed to support up to 150-200 kg (depending on design and manufacturer) of mounted equipment.
- **Doors:**
  - **Front Door:** Lockable perforated mesh or tempered glass front door for security and ventilation.
  - **Rear Door:** Lockable perforated or solid rear door for security and ventilation.
- **Side Panels:** Removable or lockable side panels to provide easy access to the rack while ensuring security.
- **Ventilation:** Mesh or perforated panels on front and rear doors, and side panels to allow adequate airflow and prevent overheating of equipment.
- **Rack Mounting:** Adjustable vertical rails to accommodate a range of equipment depths, ensuring proper alignment.
- **Dimensions:**
  - **Height:** 27U (approximately 47.25 inches or 1200mm)
  - **Width:** Standard 19 inches for EIA compliance
  - **Depth:** Typically 800mm to 1000mm, ensuring sufficient space for large network devices, servers, and other equipment.

NS-13:- CAT 6A 1 Meter patch cord

**Specification for CAT 6A 1-Meter Patch Cord:**

**1. General Overview:**

- **Type:** CAT 6A 1-Meter Patch Cord
- **Function:** Used for connecting network devices (such as switches, routers, patch panels, and computers) in a structured cabling system for high-speed data transmission.
- **Length:** 1 meter (3.28 feet)
- **Category:** CAT 6A (Category 6A) – Supports 10 Gigabit Ethernet and is backward compatible with lower category cables.
- **Connector Type:** RJ45 (8P8C) connectors on both ends
- **Cable Construction:** Solid copper or stranded copper conductors for high performance and reliability.

**2. Cable and Connector Standards Compliance:**

- **Cable Standard Compliance:**
  - **TIA/EIA-568-C.2** (Telecommunications Industry Association/Electronic Industries Alliance) for Cat 6A performance standards.
  - **ISO/IEC 11801** (International Organization for Standardization / International Electrotechnical Commission) for international cabling standards.
  - **UL Listed** (Underwriters Laboratories) for safety compliance.
  - **RoHS Compliant** (Restriction of Hazardous Substances) to meet environmental standards.
- **Performance:**
  - **Data Rate:** Supports up to 10 Gbps Ethernet (10 Gigabit Ethernet) at distances up to 100 meters (328 feet).
  - **Bandwidth:** Supports bandwidth frequencies up to 500 MHz for reliable high-speed performance.
  - **Crosstalk:** Designed to minimize crosstalk and maintain high signal integrity.
  - **Insulation:** Each conductor is insulated with high-quality dielectric material to maintain signal quality.

**3. Construction Features:**

- **Cable Type:** Unshielded Twisted Pair (UTP) construction
- **Conductor Type:** Solid or stranded copper wire (depending on application; solid for permanent connections and stranded for patch cords).
- **Jacket Material:** Flexible PVC (Polyvinyl Chloride) outer jacket, designed for durability and flexibility, allowing easy installation in tight spaces.
- **Length:** 1 meter (3.28 feet) – custom lengths available upon request.
- **Connector Construction:**

- **Gold-Plated Contacts:** 50 µm gold-plated contacts for better conductivity and reduced risk of oxidation.
- **Strain Relief Boot:** A flexible, protective boot to reduce strain at the connector and cable entry point, preventing damage from bending or pulling.
- **Snagless Design:** To prevent damage during installation by allowing easy insertion and removal from network devices.

NS-14:- 4 Loop Panel

**Specification for Microprocessor-Based Intelligent Addressable Main Fire Alarm Panel:**

***1. General Overview:***

- **Type:** Intelligent, addressable, microprocessor-based Fire Alarm Control Panel.
- **Capacity:** Capable of supporting **not less than 240 devices** (including detectors), with **minimum 120 detectors per loop**.
- **Loop Length:** Each loop can support up to **2 kilometers** of cabling.
- **Communication Protocol:** Compatible with open protocols such as **BACnet** and **Modbus over IP**, enabling seamless integration with the **Integrated Building Management System (IBMS)**.
- **Power Supply Unit:**
  - **Input:** 230 ± 5%, 50 Hz AC power supply.
  - **Backup:** 48 hours of backup using **24-volt sealed maintenance-free batteries** with an automatic battery charger.
- **Integration:** The panel shall have the ability to seamlessly integrate with the **analog/digital voice evacuation system** and any other required subsystems (such as HVAC, lighting, etc.).

***2. Panel Features:***

- **CPU (Central Processing Unit):**
  - The panel shall include a **microprocessor-based CPU** for real-time processing and decision-making.
  - The CPU shall process all fire alarm signals and manage the communication between the control panel and connected devices.
- **Loop Modules:**
  - The panel shall include multiple **loop modules** that allow for easy connection of addressable devices such as smoke detectors, heat detectors, manual call points, and other monitoring devices.
  - The system shall support **a minimum of 120 detectors per loop** and shall be capable of managing up to **240 total devices**.
- **Display & User Interface:**
  - The panel shall have a **320-character graphics or LCD display** for real-time status display and diagnostics.
  - The user interface shall include a **touch screen** or **keypad** for user interaction and ease of use.
  - The system shall support **event history logs** of up to **4000 events** stored in **non-volatile memory (EPROM)**.

- **Control and Monitoring:**
  - The system shall allow remote monitoring and control via a network communication card.
  - The panel shall allow configuration of alarm thresholds, device testing, and configuration changes through the keypad or touch screen interface.

***3. Features and Functions:***

- **Event Log:**
  - The panel shall maintain a history log of at least **4000 events** in the **non-volatile memory** (EPROM).
  - The event log shall include details such as the type of alarm, date/time of the event, and the location of the triggered devices.
- **Printer Interface:**
  - The panel shall include a **facility to connect an external printer** for printout of event logs, fault logs, and system status.
- **Power Supply and Battery Backup:**
  - The panel shall have an integrated **power supply** capable of providing the necessary power for the fire alarm system.
  - It must be capable of running for a minimum of **48 hours** on **24V sealed maintenance-free batteries** with automatic recharging capability.

NS-15:- Addressable multicriterion detectors

**Specification for Intelligent and Electronically Addressable Multicriterion Detectors:**

***1. General Overview:***

- **Type:** Intelligent and electronically addressable multi criterion detector.
- **Detection Types:** Combines **photoelectric smoke detection** and **thermal detection** (both fixed temperature and rate-of-rise).
- **Microprocessor-based:** The detector shall be equipped with an integrated microprocessor for advanced processing of detection signals.
- **Mounting Base:** Includes a mounting base with an integrated **LED indicator** for visual status display.
- **Compatibility:** Designed to work seamlessly with intelligent fire alarm systems (addressable) and communicate with the central fire alarm control panel.

***2. Detector Features:***

- **Detection Technology:**
  - **Photoelectric Smoke Detection:** Uses light scattering to detect smoke particles, ideal for smouldering fires.
  - **Thermal Detection:**
    - **Fixed Temperature:** Detects a predefined temperature threshold to signal the presence of fire.

        - **Rate of Rise:** Detects rapid increases in temperature, providing an additional level of detection for fast-growing fires.
- **Microprocessor in Head:**
    - The detector shall have an onboard microprocessor to intelligently process data from both the smoke and thermal sensors.
    - The microprocessor shall enable adaptive sensitivity and logic to reduce false alarms and optimize performance in various environmental conditions.
- **LED Indicator:**
    - Each detector shall include an integrated **LED indicator** that provides visual feedback (e.g., normal operation, alarm condition, fault status).
    - The LED shall be **visible from a distance** and easily discernible, with color-coded status indicators (e.g., green for normal, red for alarm).
- **Addressable:**
    - The detector shall be **electronically addressable**, meaning it can be individually identified by the fire alarm control panel.
    - It shall communicate the status of the device (e.g., normal, alarm, trouble) to the control panel, enabling pinpoint location of the event.

***3. Performance Specifications:***

- **Photoelectric Smoke Detection:**
    - **Sensitivity:** Designed for optimal smoke sensitivity in both residential and commercial environments.
    - **Detection Range:** Effective in detecting smoke at varying distances, as per applicable standards.
- **Thermal Detection (Fixed and Rate of Rise):**
    - **Fixed Temperature:** The fixed temperature threshold shall be pre-configured and set (e.g., 57°C or 135°F).
    - **Rate of Rise:** The detector shall detect significant temperature increases (e.g., more than 8°C per minute) as an indication of a fire's rapid development.
- **Environmental Conditions:**
    - **Temperature Range:** The detector shall operate effectively in a temperature range of **-10°C to +50°C** (or as per specific application needs).
    - **Humidity Range:** The detector shall function in environments with relative humidity levels from **0 to 95%** (non-condensing).
- **Response Time:**
    - The detector shall provide a fast response time for both smoke and thermal detection to ensure early detection of fires.

***4. Electrical Specifications:***

- **Power Supply:**
    - The detector shall operate on a **standard 24V DC power supply**, as per industry standards.
    - The power consumption shall be low, ensuring minimal load on the fire alarm control panel.
- **Current Consumption:**

- The detector shall have a current draw in the range of **< 10 mA** in standby mode and up to **30 mA** during alarm conditions (depending on specific model).

NS-16:- Call station

**Specification for Call Station with Zone Selection Keys, PTT Key, and Speech Enhancement Features:**

***1. General Overview:***

- **Type:** Call Station with Six Zone Selection Keys, All-Call Key, and Momentary PTT Key.
- **Functionality:** The call station is designed to facilitate audio communication in emergency and public address systems, with zone selection, emergency calling, and adjustable audio parameters to enhance speech intelligibility.
- **Features:** The call station will include LED indications for zone selection, fault, and emergency state, providing clear and intuitive status information to the operator.

***2. Key Features:***

- **Zone Selection:**
  - The call station shall feature **six zone selection keys**, allowing the operator to select and communicate with different zones or areas in the facility.
  - **All-Call Key:** An additional **all-call key** shall allow communication with all zones simultaneously.
- **PTT (Push-to-Talk) Key:**
  - A **momentary PTT key** shall allow the operator to initiate communication to the selected zone or all-call system, ensuring hands-free operation when needed.
- **Audio Enhancement:**
  - The call station shall be equipped with **selectable gain**, **speech filter**, **limiter**, and **output level** control to ensure optimal audio clarity and intelligibility even in noisy environments.
- **LED Indications:**
  - **Zone Selection LEDs:** Visual indicators (LEDs) for each zone selection key to indicate active zones.
  - **Fault Indicators:** LEDs to show fault status, allowing operators to easily detect any issues in the system.
  - **Emergency State Indicators:** LEDs to indicate the emergency status of the call station (e.g., during alarm events or emergency calls).

***3. Electrical Specifications:***

- **Voltage Range:** The call station shall operate with a **24V DC** power supply, ensuring compatibility with standard public address or emergency systems.
- **Current Consumption:** The call station shall have a **current consumption of less than 30 mA**, ensuring low power usage while maintaining full functionality.
- **Nominal Sensitivity:** The nominal sensitivity shall be **85 dB SPL**, providing clear audio output for the operator in normal conditions.

- **Nominal Output Level:** The call station shall have a **nominal output level of 700 mV**, ensuring that audio signals are sufficiently loud and clear for all listeners.
- **Input Sound Level (Max):** The system shall handle an **input sound level of up to 110 dB SPL**, ensuring the call station can operate in high-noise environments without distortion or failure.
- **Distortion:** The call station shall maintain **less than 0.6% distortion** at full operating capacity to ensure high-fidelity, intelligible audio communication.

NS-17:- 4 Door/4 Reader access control system

**Specification for Microprocessor-Based 4 Door/4 Reader Access Control System**

***1. General Overview:***

- **System Type:** Microprocessor-based access control system for **4 doors and 4 readers**.
- **CPU:** Engineered with a **32-bit CPU** to provide robust performance and handle multiple readers and locations.
- **Expandability:** The system shall be **expandable**, capable of scaling to accommodate more doors, readers, and locations as required.
- **Distributed Intelligence:** The system shall support **distributed intelligence**, ensuring that decision-making is decentralized for enhanced reliability and fault tolerance.
- **Protocol Compatibility:** The system shall be compatible with **TCP/IP protocols**, ensuring seamless network connectivity for remote access, monitoring, and control.
- **Integration:** Capable of integrating with **third-party systems** (e.g., alarm systems, CCTV) for enhanced security features.

***2. Core Features:***

- **Reader Support:**
  - Supports **up to 4 readers** for 4 doors, with each reader being capable of handling multiple credential types (e.g., RFID, biometric, PIN).
  - System shall be designed to support **two readers per door** for entry and exit management, ensuring full control of all access points.
- **Card Database:**
  - The system shall support an expandable **card database of up to 100,000 cards**, allowing it to accommodate large-scale installations.
- **Transaction Buffer:**
  - The system shall have a **transaction buffer of up to 100,000 transactions**, storing event logs such as door access and alarms, with the ability to retrieve this data in real-time or historically.
- **Access Levels:**
  - The system shall support **128 access levels**, enabling granular control over who can access which areas and at what times.
  - **Time Zone Levels:** The system shall support **127 time zone levels**, allowing access to be controlled based on time of day, days of the week, holidays, etc.
- **Supervised Inputs:**
  - The system shall include **8 supervised inputs** for monitoring devices such as door contacts, push buttons, motion sensors, or other security peripherals.

- **Relay Outputs:**
  - The system shall include **4 relay outputs** for easy and reliable interface with third-party systems such as alarms, elevators, or other automation systems.

***3. Performance Specifications:***

- **Processing Power:**
  - Powered by a **32-bit CPU**, ensuring that the system can handle real-time processing for multiple readers and large databases efficiently.
- **Flash Memory:**
  - The system shall have **flash memory** to ensure reliable storage of configurations and data, with **easy upgradeability** for firmware or software.
- **User Capacity:**
  - The system shall support up to **100,000 cardholders**, providing flexibility for a variety of environments, from small offices to large campuses.
- **Transaction Capacity:**
  - The system shall have a transaction buffer that can hold **100,000 transactions**, which ensures comprehensive data logging and enables real-time query retrieval from the database.
- **Connectivity:**
  - The system shall use **TCP/IP communication** for connecting with other systems, remote management, and system monitoring over a network.
  - It shall also support **LAN/WAN** connectivity for integration with existing IT infrastructure.

***4. Input/Output Specifications:***

- **Inputs:**
  - **8 Supervised Inputs** for integrating with peripheral devices like door sensors, panic buttons, alarm systems, etc.
  - Inputs shall be fully supervised to ensure that any faults (e.g., disconnections or failures) are reported in real time.
- **Outputs:**
  - **4 Relay Outputs** for controlling other equipment such as door strikes, gates, or other automation systems.
  - Each output shall be configurable for **NO/NC (Normally Open/Normally Closed)** contacts, ensuring compatibility with a wide range of devices.

***5. Power Supply:***

- **Digital Power Supply:**
  - The system shall be powered by a **digital power supply** capable of delivering stable and efficient power for all connected devices, including readers and relays.
  - The power supply shall support **24V DC** output and include features like **overcurrent protection** and **battery backup** for continuous operation during power failures.

NS-18:- Controller Enclosure

**Specification for Controller Enclosure with Power Supply Unit for Controllers & Magnetic Locks with Battery Charger and Backup**

- **System Type:** Controller Enclosure with Power Supply Unit designed for use with **access control systems** and **magnetic locks**.
- **Purpose:** The unit is designed to provide reliable power to controllers and magnetic locks, ensuring that the system continues to function during power failures for at least **10 minutes** using the battery backup.

NS-19:- HID multi class readers with bluetooth

**Specification for HID Multi-Class Readers with Bluetooth and NFC Interface**

***1. General Overview:***

- **Type of Reader: HID Multi-Class Reader** with **Bluetooth and NFC interface**.
- **Compatibility:** The reader should be compatible with a wide range of access control technologies including **smart cards**, **mobile credentials**, **Bluetooth**, and **NFC** (Near Field Communication).
- **Mounting Options:** The reader must be **suitable for mounting on metal surfaces**, **metal frames**, **wooden frames**, or any surface as required based on the specific site conditions.
- **Purpose:** Designed for seamless integration with an **access control system** and capable of reading multiple credential types for flexibility and security.

***2. Key Features:***

- **Multi-Class Compatibility:**
  - The reader shall support multiple credential formats including:
    - **HID Prox Cards** (125 kHz)
    - **iCLASS® Cards** (13.56 MHz)
    - **Mobile Access (Bluetooth)**, allowing smartphones or other mobile devices to act as credentials.
    - **NFC (Near Field Communication)** support for mobile-based credentials.
    - **MIFARE® and DESFire®** smart cards (if applicable), supporting both **ISO 14443 A/B** standards.
- **Bluetooth Interface:**
  - The reader shall support **Bluetooth Low Energy (BLE)**, enabling **mobile access** from smartphones or tablets, allowing users to unlock doors via Bluetooth with their mobile devices.
  - **Mobile credentialing** through BLE for a contactless user experience.
- **NFC Interface:**
  - The reader shall support **NFC technology**, enabling smartphones or smart cards with NFC capability to communicate with the reader for access.
- **Wiegand and OSDP Communication:**

  - The reader shall support standard communication protocols such as **Wiegand** and **OSDP (Open Supervised Device Protocol)** for secure, encrypted communication with access control panels.
- **Multi-Technology Operation:**
  - The reader shall be capable of reading different card technologies simultaneously or within a flexible configuration, enabling the use of various types of credentials as required by the site.
- **Status Indicators:**
  - The reader shall feature clear visual indicators, including **LEDs** for status (Green for valid access, Red for invalid access).
  - **Audible Feedback** such as beeps for access granted or denied.

***3. Mounting and Installation:***

- **Mounting Surface Compatibility:**
  - The reader shall be **suitable for mounting on metal surfaces** (e.g., metal doors, frames, or metal enclosures) and **wooden surfaces** (e.g., wooden frames or walls), ensuring easy installation on a wide range of mounting surfaces.
  - The reader shall include the necessary **mounting hardware** for both metal and wood installations, including **screw holes** and optional **adhesive backing** for easy mounting.
- **Weather Resistance:**
  - The reader shall be **weather-resistant** with an **IP65 or higher rating**, making it suitable for both indoor and outdoor installations, withstanding exposure to dust and moisture.
- **Design Considerations:**
  - The reader shall have a **compact, sleek design**, suitable for installation in both **commercial and residential settings**, maintaining a modern aesthetic while being functional.

NS-20:- Double Leaf Door.

**Specification for Electromagnet Door Holder (Fail-Safe Type)**

***1. General Overview:***

- **Type of Door Holder: Electromagnet Door Holder** (Fail-Safe Type) designed to provide **15 lb holding force**.
- **Application:** Suitable for use with doors where the fail-safe mechanism is required (doors that release in the event of power failure or emergency).
- **Purpose:** Designed to hold the door open during normal operation and automatically release it in the event of power failure or emergency alarm, ensuring the door closes when needed for fire safety or security purposes.

***2. Key Features:***

- **Holding Force:**

  - The door holder shall provide a **15 lb (6.8 kg)** holding force to securely hold doors in the open position.
  - **Fail-Safe Design:** The holder will release the door in the event of **power loss**, **fire alarm activation**, or emergency conditions, allowing the door to close automatically.
- **Magnetic Force:**
  - The electromagnet shall provide sufficient holding force to ensure that the door remains open under normal operation, but will disengage under the fail-safe conditions.
  - **Magnetic Strength:** The magnet shall be strong enough to securely hold the door open but weak enough to release when triggered.
- **Voltage and Power Requirements:**
  - **Operating Voltage:** Typically **24V DC** or **12V DC** depending on the system design.
  - **Current Consumption:** The holder should have a low current draw (usually around **100mA to 200mA** depending on the specific model).
- **Construction Material:**
  - The electromagnet shall be made of **high-strength materials** designed for durability and reliability.
  - **Housing Material:** The housing shall be made of corrosion-resistant materials such as **steel or stainless steel** to ensure long-lasting performance even in challenging environments.
- **Size and Mounting:**
  - The electromagnet door holder shall be **compact and easily mountable** to various door frames.
  - **Mounting Type:** Suitable for **surface mounting** or **flush mounting** to ensure compatibility with different door configurations.
- **Safety and Compliance:**
  - The device shall meet **UL** or equivalent safety standards, ensuring compliance with **fire and safety regulations**.
  - **Fire and Smoke Control:** Designed to be integrated into fire control systems to ensure that the door will close automatically in the event of an emergency such as a fire or smoke detection.

***3. Technical Specifications:***

- **Holding Force:** 15 lbs (6.8 kg)
- **Fail-Safe Type:** The electromagnet shall be a **fail-safe** design that **releases the door when power is lost** or in the event of an emergency.
- **Mounting Options:** Compatible with a wide range of doors, including **fire-rated doors, wooden doors, and metal doors**.
- **Operating Voltage:** 24V DC or 12V DC (please specify as per system requirements).
- **Current Draw:** Typically **100mA-200mA**.
- **Magnetic Strength:** Strong enough to hold a door securely ope
- n, but designed to disengage in emergency situations.
- **Temperature Range:** The electromagnet should operate reliably within a temperature range of **-20°C to 50°C**.

- **Humidity Range:** 0-95% non-condensing.
- **Compliance:** The product should comply with relevant **fire safety standards**, **building codes**, and **access control regulations** (e.g., UL 10C, UL 294, NFPA 101).

***4. Operation Features:***

- **Fail-Safe Mechanism:**
  - In the event of a **power failure**, the magnet will release, allowing the door to close automatically (as per fire safety regulations).
  - The electromagnet will engage when the system is powered, holding the door in the open position.
- **Triggering Mechanism:**
  - Can be triggered by a **fire alarm system** or **smoke detector** to automatically release the door.
  - Can also be integrated into **access control systems** for automatic release based on security requirements.
- **Manual Release:** In case of failure or emergency, the system may also feature a manual release option to disengage the door holder.

NS-21:- Single Leaf Door.

**Specification for Electromagnet Door Holder (Fail-Safe Type) – 15 lb Holding Force**

***1. General Overview:***

- **Type of Door Holder:** Electromagnetic door holder, **fail-safe** design.
- **Holding Force: 15 lbs** (6.8 kg).
- **Operation:** The electromagnet holds the door open during regular use and automatically releases it during a power failure or emergency situation (e.g., fire alarm).
- **Installation Compatibility:** Suitable for **wooden doors**, **metal doors**, and **fire-rated doors**.

***2. Key Features:***

- **Holding Force:** 15 lbs (6.8 kg), providing adequate force to hold doors open under normal operation.
- **Fail-Safe Mechanism:** The door holder will **release the door** in the event of **power failure** or **activation of an emergency alarm** (such as a fire alarm).
- **Voltage:** Typically **24V DC** (for standard systems) or **12V DC** (based on system requirements).
- **Current Consumption:** Low, typically between **100mA to 200mA** (depending on the exact model and load).
- **Magnetic Strength:** Strong enough to securely hold the door open during normal operation, but designed to disengage under emergency conditions.

***3. Performance Specifications:***

- **Power Supply:**
  - **Voltage:** 24V DC or 12V DC.
  - **Current Draw:** Approx. **100mA-200mA** depending on the model.
- **Holding Force:** 15 lbs (6.8 kg) ensures secure holding while being easy to release during an emergency.
- **Magnet Type:** Permanent magnet with electromagnet design for **fail-safe** release under emergency conditions.
- **Temperature Range:** The unit shall operate within the temperature range of **-20°C to +50°C**.
- **Humidity:** Designed to work in environments with **0-95% humidity** (non-condensing).
- **Safety Compliance:** Complies with necessary fire and safety standards (e.g., **UL 10C**, **NFPA 101**, and other relevant codes).

***4. Mounting and Installation:***

- **Mounting Options:**
  - **Surface Mount**: The electromagnet should be suitable for **surface mounting** or **flush mounting** onto the doorframe.
  - **Universal Mounting:** Should be adaptable to different door materials (metal, wood, or fire-rated doors) with the necessary mounting accessories.
- **Accessories:**
  - The holder shall come with **mounting screws** and **installation hardware** suitable for various door types.
  - **Optional:** Adjustable mounting brackets for customized door frame fitment.

NS-22:- Door Magnetic Contact

Double door and single door magnetic contact to be provided.

NS-23:- Contactless smart card

**Specification for Contactless Smart Card with Mutual Authentication Protocol**

***1. General Overview:***

- **Type:** Contactless Smart Card.
- **Frequency: 13.56 MHz** operating frequency.
- **Standards Compliance:**
  - Meets **ISO/IEC 14443 Type A**.
  - Supports **ISO/IEC 7810** (Physical Characteristics).
  - Supports **ISO/IEC 7816** (Integrated Circuit Cards with Contacts).

- **Security Protocol:** Card shall implement a **Mutual Authentication Protocol** to generate a **diversified session key** to protect each card session, ensuring enhanced security.

***2. Key Features:***

- **Mutual Authentication Protocol:**
  - The card shall support **mutual authentication** with the reader to ensure secure and verified communication between the card and the reader.
  - A **diversified session key** will be generated during each authentication process, which ensures that each card session is encrypted and protected independently.
- **Frequency & Standards Compliance:**
  - Operating on **13.56 MHz** for contactless communication.
  - Fully compliant with **ISO/IEC 14443 Type A** for proximity cards and **ISO/IEC 7810** for card physical characteristics.
  - Supports **ISO/IEC 7816** for integrated circuit cards with contacts, ensuring compatibility with both contact and contactless readers.
- **Security Features:**
  - **Data Encryption:** The card shall support **AES encryption** or equivalent for the secure transmission of data.
  - **Session Protection:** Each transaction or session shall use a **unique, diversified session key** to prevent session replay attacks or key compromise.
  - **Authentication:** Strong mutual authentication ensures both the card and the reader verify each other's identity before allowing communication or transactions.
- **Memory and Data Storage:**
  - The card shall have sufficient **EEPROM** or **Flash memory** to store multiple applications, cryptographic keys, and user data.
  - The memory shall support secure data storage and prevent unauthorized read or write access.
- **Card Dimensions:**
  - The card shall conform to the standard dimensions defined by **ISO/IEC 7810 ID-1** (85.6mm x 53.98mm), ensuring compatibility with card readers, wallets, and card management systems.

NS-24:- Egress push button switch

**Specification for Egress Push Button Switch for Individual Access Control Door**

***General Overview:***

- **Type:** Egress Push Button Switch for individual access control doors.
- **Functionality:** Provides a secure and reliable means for users to exit a secured area by unlocking the door from the inside, complying with safety and fire exit regulations.
- **Activation:** The push button is used to activate the **door release mechanism** to allow the door to be opened from the inside, typically used in access control systems.

- **Mounting:** Suitable for installation on walls or door frames for easy access and operation.

***Key Features:***

- **Single Button Operation:**
  - The egress button shall feature a **single press-to-release mechanism** to allow individuals to exit the door securely.
  - The button shall be **spring-loaded** or **momentary** type, ensuring that it resets automatically once released.
- **Compliance with Regulations:**
  - The button must comply with **NFPA 101 (Life Safety Code)**, **Building Codes**, and other relevant local or international codes for emergency egress systems.
  - It should ensure that in the event of an emergency, individuals can **quickly and easily exit** the area without being impeded by the access control system.
- **Interface with Access Control System:**
  - The egress button shall interface directly with the **access control panel**, signaling the system to release the door lock and allow egress.
  - The button may also support a **time delay function**, which would release the door lock after a set period for additional security.

***3. Performance Specifications:***

- **Electrical Rating:**
  - **Voltage Rating:** 12V DC or 24V DC, depending on the system requirements.
  - **Current Rating:** Typically less than **100mA** when activated, suitable for low-power door release circuits.
- **Mechanical Specifications:**
  - **Button Type:** Momentary (push-to-release).
  - **Construction:** The button should be constructed of durable **plastic or metal** materials, designed to withstand repeated use and physical stress.
  - **Button Colour: Green**, typically indicating the "Exit" or "Release" function, but may also have other colors depending on local regulations and system design.
  - **Dimensions:** Compact design, typically around **2-3 inches** (50-75mm) in diameter for easy user access.
- **Activation Mechanism:**
  - The button shall be easy to press with a minimal force, ensuring that users can exit without difficulty, especially in emergencies.
  - The button shall include tactile feedback (audible or mechanical) to confirm activation.

NS-25:- Emergency Release Switch

**Specification for Emergency Release Switch in Green Polycarbonate Housing (Push to Break Glass Type)**

***1. General Overview:***

- **Type:** Emergency Release Switch.
- **Housing Material: Green Polycarbonate** housing, designed for easy identification and durability.
- **Functionality:** Push-to-break glass type, used for emergency situations where immediate unlocking of doors or other access control points is required. The glass cover must be broken by pressing the switch to activate the release mechanism.
- **Activation:** The switch is activated by breaking the glass cover, which is typically done in an emergency situation, to ensure quick and easy access to the exit or security system release.

***2. Key Features:***

- **Push-to-Break Glass Design:**
  - The switch operates by **breaking the glass cover** with a **push** or a **forceful press** to activate the door release or emergency function.
  - Once the glass is broken, the switch activates the **door unlocking mechanism** or triggers an emergency response.
  - The switch shall be equipped with a **replaceable glass** or a **plastic cover** to prevent unnecessary damage and ensure quick restoration of functionality after activation.
- **Emergency Activation:**
  - **Emergency Egress:** The button allows users to manually trigger an emergency unlock or access release for doors, gates, or other controlled access systems.
  - Ideal for environments requiring **quick release** or **immediate exit** during emergencies such as **fire alarms**, **power failure**, or **evacuations**.
- **Green Polycarbonate Housing:**
  - The switch shall come housed in a **green polycarbonate** enclosure, ensuring visibility and durability in emergency situations.
  - Polycarbonate is a high-impact resistant material, ensuring the unit remains intact and operational in case of accidental contact or vandalism.

***Performance Specifications:***

- **Electrical Rating:**
  - **Voltage Rating:** Typically **12V DC** or **24V DC** to match standard access control systems.
  - **Current Rating:** Typically less than **100mA** for the switch circuit.
- **Mechanical Specifications:**
  - **Button Type:** Push-to-breakglass, spring-loaded.

  - **Glass:** The switch will have a **breakable glass cover** (usually tempered glass) that protects the button from accidental activation, but can be easily broken when emergency use is required.
  - **Housing:** The polycarbonate housing shall be rugged and resistant to impact, dust, and moisture, ensuring the switch performs in harsh conditions.
  - **Size:** Standard dimensions, approximately **4.5" x 4.5"** (115mm x 115mm), depending on installation requirements.
- **Glass Type:**
  - Typically made of **tempered glass** for easy breakage during emergency use.
  - **Replaceable Glass:** The design shall allow for quick replacement of the broken glass after activation, ensuring minimal downtime.

NS-26:- Multi class technology Card readers

**Specification for Multi-Class Technology Card Readers with Necessary Accessories (Including Back Box for Installation)**

***General Overview:***

- **Type:** Multi-Class Technology Card Reader.
- **Functionality:** The card reader shall support **multiple card technologies** (e.g., **smart cards, RFID cards, proximity cards**) and shall provide secure access control for door entry systems.
- **Compatibility:** The card reader should be compatible with multiple credential types such as **MIFARE**, **HID Prox**, **13.56 MHz**, **125 kHz RFID**, and **Bluetooth/NFC** as per the system requirements.
- **Installation:** Includes all necessary accessories for mounting, including **back box** for secure installation of the reader on a wall or door frame.

***Key Features:***

- **Multi-Class Technology:**
  - The reader shall be able to read and authenticate **multiple types of cards** including:
    - **13.56 MHz Smart Cards** (e.g., **MIFARE** or **DesFire**).
    - **125 kHz RFID Proximity Cards** (e.g., **HID Prox**).
    - **Bluetooth/NFC** cards or devices for mobile-based authentication.
  - The reader shall allow users to use different card technologies without the need for multiple types of readers in a single installation.
- **Access Control Security:**
  - Supports secure **card authentication** for access control systems, ensuring only authorized users can enter secure areas.
  - The reader shall support **encryption** for secure communication between the card and the reader.
  - The reader should have a built-in **anti-tampering feature** to detect physical tampering attempts and raise alerts to the control system.
- **User Interface:**

    - The reader shall provide a **visible indicator** (LED) to show operational status, such as:
        - **Green LED** for access granted.
        - **Red LED** for access denied or invalid card.
    - **Audible Indicators:** The reader shall emit **beep tones** for events such as **card accepted**, **card rejected**, or **error** (optional).
- **Mobile Access:** If supporting **Bluetooth/NFC**, the reader should also be capable of allowing mobile-based authentication for users with smartphones or other NFC-enabled devices.
- **Mounting and Design:**
    - The reader shall come with a **back box** for installation, providing secure and easy mounting on walls or door frames.
    - **Weatherproof and Vandal-Resistant:** The card reader shall be designed for both **indoor** and **outdoor** use with an **IP65** or better rating for dust and water resistance. The housing shall be **vandal-resistant** (IK10 rated), ensuring durability in high-risk environments.
- **Form Factor:**
    - **Slim and compact design** to integrate easily with standard door entry panels or standalone installations.
    - Suitable for mounting on metal, wood, or concrete surfaces without affecting performance.

***Technical Specifications:***

- **Operating Frequency:**
    - **125 kHz** for RFID proximity cards.
    - **13.56 MHz** for smart cards (e.g., **MIFARE**, **DesFire**).
    - **NFC/Bluetooth** for mobile-based access (optional).
- **Power Supply:**
    - **12V DC** (or as required by the system).
    - **Power consumption** should not exceed **100 mA** during normal operation.
- **Connection Type:**
    - **Wired connection** (RS485, Wiegand 26/34, or TCP/IP) depending on the access control system requirements.
    - Optional **Wi-Fi/Bluetooth** for wireless communication.
- **Reader Range:**
    - **RFID Proximity Card Range:** Typically **3-10 cm**.
    - **Smart Card (13.56 MHz) Range:** Typically **3-10 cm** (varies based on card technology).
    - **Bluetooth/NFC Range (Optional):** Typically **up to 10 meters** for mobile access.
- **Operating Temperature:**
    - **-20°C to +60°C** for use in a wide range of environmental conditions.
- **Humidity:**
    - **0-95% Relative Humidity** (non-condensing).
- **Indicators:**
    - **LED Status Indicators:** Green, Red, and Amber for status display.
    - **Audible Beep:** For successful authentication, failure, or error notifications.

- **Communication Protocols:**
  - **Wiegand 26/34**, **RS485**, **TCP/IP** (depending on the access control system specifications).
  - Supports **ONVIF**, **Modbus**, or other open protocols for integration with third-party systems.

NS-27:- PVC sheathed 4c x 0.5 Sq.mm Cable

**Specification for Shielded, Multi-Stranded Copper Conductor, PVC Sheathed 4c x 0.5 Sq.mm Cable**

***1. General Overview:***

- **Type:** Shielded Multi-Stranded Copper Conductor Cable.
- **Conductor Material: Copper** (multi-stranded for flexibility).
- **Sheath Material: PVC (Polyvinyl Chloride)**.
- **Configuration:** 4 cores, each with a cross-sectional area of **0.5 sq.mm**.
- **Shielding: Shielded** to protect the signal integrity from external interference and noise.

***Key Features:***

- **Conductor:**
  - **Material:** The conductors are made from high-quality **copper** to ensure excellent conductivity and reduced resistance, especially in long-distance cable runs.
  - **Stranding:** The cable features **multi-stranded conductors** for improved flexibility and durability, making it ideal for installations where the cable might be subject to movement or bending.
- **Shielding:**
  - The cable is **shielded** to prevent electromagnetic interference (EMI) and radio-frequency interference (RFI), ensuring the integrity of the transmitted signal. The shielding can be made of materials like **aluminium foil**, **braided copper**, or a combination of both for enhanced protection.
  - **Shielding Type:** Typically, **Aluminum Foil and Braided Copper Shielding** or a **Copper Tape Shield** to ensure minimal signal loss and immunity to external interference.
  - **Shielding Effectiveness:** Typically ensures protection against external noise or signal degradation over long distances.
- **Insulation:**
  - **PVC Insulation** around each conductor ensures **electrical insulation** and provides protection against external environmental factors like moisture, abrasions, and temperature variations.
  - **Insulation Material:** The PVC used should comply with **UL** and **IEC standards**, ensuring good dielectric properties and stability under operational conditions.
- **Number of Cores:**
  - The cable has **4 cores** (wires) which can be used for various purposes such as data transmission, control, or signal transfer across different systems.
- **Core Cross-Sectional Area:**

  - The cable features a **0.5 sq.mm** cross-sectional area per conductor, suitable for low-voltage and signal transmission tasks such as in **control systems**, **communication lines**, **alarm systems**, or **audio/video systems**.
- **Outer Sheath:**
  - **PVC Outer Sheath:** Provides **mechanical protection** against external environmental factors like moisture, oil, UV exposure, and other harsh conditions.
  - The sheath is designed to provide high **abrasion resistance**, **chemical resistance**, and **flame retardancy**, ensuring safe operation even in tough environments.

***3. Technical Specifications:***

- **Conductor Material:** Multi-Stranded **Copper**.
- **Conductor Size: 0.5 sq.mm** per core.
- **Number of Cores: 4 Cores**.
- **Cable Construction:**
  - Multi-stranded copper conductors.
  - Each core is individually insulated with **PVC**.
  - Overall cable is **shielded** to protect from EMI and RFI.
  - **PVC Sheath** surrounds the entire cable for protection.
- **Voltage Rating:** Suitable for **low-voltage applications**, typically **300V** or **500V**.
- **Temperature Range:** Typically **-10°C to 70°C** (subject to the PVC insulation type).
- **Impedance (if applicable):** Typically **50Ω** or **75Ω** for signal integrity.
- **Shielding Type:** Combination of **Aluminum Foil** and **Braided Copper** or **Copper Tape Shielding**.
- **Cable Diameter:** Varies depending on construction, but typically around **4-6 mm** (depending on insulation and shielding layers).

NS-28:- PVC sheathed 8c x 0.5 Sq.mm Cable

**Specification for Shielded, Multi-Stranded Copper Conductor, PVC Sheathed 8c x 0.5 Sq.mm Cable**

***1. General Overview:***

- **Type:** Shielded Multi-Stranded Copper Conductor Cable.
- **Conductor Material: Copper** (multi-stranded for flexibility).
- **Sheath Material: PVC (Polyvinyl Chloride)**.
- **Configuration:** 8 cores, each with a cross-sectional area of **0.5 sq.mm**.
- **Shielding: Shielded** to protect the signal integrity from external interference and noise.

***2. Key Features:***

- **Conductor:**
  - **Material:** The conductors are made from high-quality **copper** to ensure excellent conductivity and reduced resistance, making them ideal for data transmission and control systems.

  - **Stranding:** The conductors are **multi-stranded**, which improves flexibility, making it suitable for installations where the cable may need to be bent or twisted.
- **Shielding:**
  - The cable is **shielded** to minimize electromagnetic interference (EMI) and radio-frequency interference (RFI). This helps ensure the integrity of signals, especially in environments with a lot of electrical noise.
  - **Shielding Type:** Typically **Aluminum Foil and Braided Copper Shielding** or a **Copper Tape Shield**, which provides excellent shielding against external interference.
  - **Shielding Effectiveness:** Ensures minimal signal loss and protects against external electrical noise, making the cable ideal for sensitive applications.
- **Insulation:**
  - **PVC Insulation** surrounds each individual conductor. PVC offers high dielectric strength, providing electrical insulation and protection against environmental factors.
  - The **PVC insulation** also adds durability and resistance to environmental stresses such as UV rays, abrasion, and chemical exposure.
- **Number of Cores:**
  - The cable has **8 cores** (wires), making it suitable for applications that require multiple signal paths, such as data transmission, control, and communication systems.
- **Core Cross-Sectional Area:**
  - The cable features a **0.5 sq.mm** cross-sectional area per conductor, which is ideal for low-voltage, signal transmission, and data communication tasks.
- **Outer Sheath:**
  - **PVC Outer Sheath:** Provides **mechanical protection** for the cable against external damage, such as abrasion or minor chemical exposure.
  - The PVC outer sheath is designed for easy handling and installation in various environments.

***Technical Specifications:***

- **Conductor Material:** Multi-Stranded **Copper**.
- **Conductor Size: 0.5 sq.mm** per core.
- **Number of Cores: 8 Cores**.
- **Cable Construction:**
  - Multi-stranded copper conductors.
  - Each core is individually insulated with **PVC**.
  - Overall cable is **shielded** to prevent electromagnetic interference.
  - **PVC Sheath** surrounds the entire cable for protection.
- **Voltage Rating:** Suitable for **low-voltage applications**, typically **300V** or **500V**.
- **Temperature Range:** Typically **-10°C to 70°C** (subject to the PVC insulation type).
- **Impedance (if applicable):** Typically **50Ω** or **75Ω** for signal integrity.
- **Shielding Type:** Combination of **Aluminum Foil** and **Braided Copper Shielding** or **Copper Tape Shielding**.

- **Cable Diameter:** Typically around **5-7 mm**, depending on insulation and shielding layers.

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# NON-DSR TECHNICAL SPECIFICATIONS
# HVAC WORKS

## CONTRACTORS RESPONSIBILITIES

The Contractor is responsible for the quality and the satisfactory operation of the installations entrusted to him, as well as for compliance with the performance stipulated in this document.
Consequently, for his own account and under his own responsibility, he must carry out all calculations and select the necessary materials and equipment.
Apart from the required performance definitions, this document and the relevant drawings also provide many indications resulting from the studies carried out by the Engineer.
The Contractor shall review these studies and check the corresponding indications.
The same applies to equipment selection, for which the information given in this document must be deemed as indicative and defines only the minimum requirements.

## SCOPE DESCRIPTION

The contractor shall furnish all labor, materials, tools, supplies, equipment, transportation, supervision, technical, professional, and other services, and shall perform all operations necessary and required to satisfactorily complete all the necessary engineering, procurement services, construction work and commissioning for the systems and equipments for the project.

## BASIC DESIGN CRITERIA

Refer tender Drawings and Documents.

## CODES AND STANDARDS

All the systems shall be designed and installed in accordance with the requirement of International Codes and Standards and Local Authority having Jurisdiction. They shall be particularly in accordance with the following NBC 2016 / ECBC 2017 /NFPA /ASHRAE standards:

- NBC 2016
- ISHARE DESIGN DATABOOK 2017
- ECBC 2017
- RELEVANT IS STANDARDS
- ASHRAE – 62.1 (2019) Ventilation for acceptable indoor air quantity
- ASHRAE – 90.1 (2022) Energy standard for buildings except low-rise residential buildings
- ASHRAE -55 (2020) for thermal comforts
- NFPA – 90A Installation of Air Conditioning and Ventilation Systems.
- SMACNA (2005) – 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)
- ISEER TESTING GUIDELINES

## GENERAL CONDITIONS

1.1 The schedules, tender drawings, contract documents provided for reference design intent. It is the scope of contractor to verify, design, manufacture, supply, transport, install, test , commission, handover the complete HVAC system including all necessary services, accessories,

material, equipment , Tools & tackles, labor , and any other type of service or material as required.

1.2 It is not the intent to specify completely herein all details of design and construction of system/ plant/ equipment to be supplied / erected. However, the system/ plant/ equipment supplied shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation in a manner acceptable to the Client who will interpret the meaning of drawings and specifications and shall l have the power to reject any work or material which in his judgement are not in full accordance therewith.

1.3 In case of discrepancy and / or disparity between these general and special conditions of contract and any other sections enclosed here in, the most stringent shall apply and the decisions of the Client/consultant shall be final.

1.4 Entire works which are part of this contract shall be completed in all respects and handed over in the timeline defined by the client the award of contract. However final timeline will be decided based on mutual agreement during finalization.

## OTHER INSTRUCTIONS

Vendor to prepare following documents at required stages as and when asked by client/client engineer.

- ✓ Design Verification
- ✓ Design calculations
- ✓ Shop Drawings
- ✓ Technical document preparation
- ✓ Conduct witness Testing of Materials or Equipments as Specified in design documentation.
- ✓ SITC of complete system as per approvals by Client/Architect/consultants.
- ✓ Testing & commissioning of system
- ✓ As built drawings
- ✓ Handover the system
- ✓ Execution of Maintenance work for said warranty periods.

All safety precaution is the responsibility of Contractor. Vendor to follow local norms and guidelines defined by local Authority. It is also the responsibility of vendor to comply with Local Authority norms in all involved activities.

Contractor shall be responsible for getting necessary approvals on technical documentation, drawings and other documents as asked by the consultant / client timely before delivering any kind of material. The approvals have to be signed by following teams in order.

1. Consultant
2. Architect
3. Project management Agency wherever applicable
4. Client Representative

It is the sole responsibility of contractor to execute the work in satisfactory manner and with due regard to documentation.

## WARRANTY PERIOD

The warranty period for all BOQ / Tender items is defined to be 36 Months from the date of Commissioning and no separate cost shall be paid towards the maintenance and rectification works as asked by client / consultant in case of any failure / breakdown of system happens. Warranty shall be applicable for complete system including Equipments, materials, Low side works , accessories , support work , ancillary work , Electrical and harness components , etc. Each and every item and its accessories will be covered in warranty scope.

## SECTION-1 MODULAR AIR COOLED FIXED SPEED CHILLER

### GENERAL REQUIRMENTS

The requirements of the General Conditions, Supplementary Conditions, Division 1, and Drawings apply to all work herein.

### SCOPE

Provide scroll compressors, air-cooled chillers of the scheduled capacities as shown and indicated on the Drawings, including but not limited to:

Single or modular package

1. Electrical power and control connections
2. Chilled liquid connections
3. Charge of refrigerant and oil

### QUALITY ASSUARNCE

Product shall be Designed, Tested, Rated and Certified in accordance with, and Installed in compliance with applicable sections of the following as per AHRI Standard:

1. Performance and testing in accordance with AHRI 550/590.
2. Equipment safety code
3. Mechanical safety code
4. Manufactured in facility registered to ISO 9001.
5. OHSAS - Occupational Health and Safety Assessment Series

Factory Run Test: Air-cooled chiller shall be pressure-tested, evacuated and fully charged with refrigerant and oil, and shall be factory operational run tested with water flowing through the vessel.

### DELIVERY AND HANDLING

Warranty: Manufacturer shall warrant all equipment and material of its manufacture against defects in workmanship and material for a period of one year from date of initial start-up or eighteen (18) months from date of shipment, whichever occurs first.

Unit shall be delivered to job site fully assembled and charged with refrigerant and oil by the Manufacturer.

Unit shall be stored and handled per Manufacturer's instructions.

Protect the unit and its accessories from the weather and dirt exposure during shipment.

### PRODUCTS

### CHILLER MATERIALS AND COMPONENTS

A. General: Install and commission, as shown on the schedules and plans, factory assembled, charged, and operational run tested air-cooled scroll compressor chiller(s) as specified herein. Unit shall include but is not limited to: a complete system with 2

refrigerant circuits, fix speed 4 nos scroll compressors, brazed plate heat exchanger, air-cooled heat exchanger, refrigerant, operating controls including capacity controller, controller, compressors starting components, special features as specified herein or required for safe and automatic operation

B. Operation Characteristics
    1. Unit operation should be stepless (25% 50%, 75% & 100%).
    2. Cabinet: Unit panels, structural elements, control boxes and heavy gauge structural base shall be constructed of painted galvanized steel. All exposed sheet metal shall be coated with baked on power paint to meet 500-hour salt spray in accordance with the ASTM B117 standard.
    3. Shipping: Unit shall ship in one piece and shall require installer to provide only a single evaporator inlet and outlet pipe connection.

## COMPRESSORS

A. Fix speed scroll compressors: including
    1. Compliant design for axial and radial sealing.
    2. Refrigerant flow through the compressor with 100% suction cooled motor.
    3. Large suction side free volume and oil sump to provide liquid handling capability.
    4. Compressor crankcase heaters to provide extra liquid migration protection.
    5. Annular discharge check valve and reverse vent assembly to provide low-pressure drop, silent shutdown and reverse rotation protection.
    6. Initial oil charge.
    7. Vibration isolator mounts for compressors.
    8. Brazed-type connections for fully hermetic refrigerant circuits.
    9. Compressor Motor overloads capable of monitoring compressor motor current. Provides extra protection against compressor reverse rotation, phase-loss and phase-imbalance.
B. Compressor motor shall be direct driven, cooled by suction refrigerant and protected by discharge temperature sensors.
C. Motor overheat protection will be provided to ensure the motor reliability

## REFRIGERANT CIRCUIT COMPONENTS

A. Compressor crankcase heaters are also included for extra protection against liquid migration. Heat the compressor in the case of the standby when power on.
B. Each refrigerant circuit shall include: a discharge service ball type isolation valve, dual high side pressure relief valves, liquid line shutoff valve with charging port, dual low side pressure relief valves, solenoid valve, sight glass with moisture indicator, electronic expansion valves, and flexible, closed-cell foam insulated suction line and suction pressure transducer, refrigerant receiver, discharge liquid separator and R410A refrigerant.

## HEAT EXCHANGERS

A. WATER SIDE HEAT EXCHANGER:
    1. Water side heat exchanger shall be brazed-plate stainless steel construction capable of refrigerant working pressure of 4.5 MPa and liquid side pressure of 1.0 MPa. Brazed plate heat exchangers shall be 2014/68/EU listed.
    2. Exterior surfaces shall be covered with 38mm, flexible, closed cell insulation.
    3. Water nozzles shall be provided with grooves and factory offered mechanical couplings.
    4. Water side heat exchanger shall include vent and drain fittings and thermostatically controlled heaters to protect in off-cycle.
    5. A 50-mesh, serviceable wye-strainer and mechanical couplings shall be provided for field installation on inlet prior to startup.
    6. Paddle type flow switch shall be factory installed in water side heat exchanger outlet pipe.

B. Air side heat exchanger:
    1. Four-side air inlet, structured with "U" shaped heat exchanger, exclusively designed for minimum footprint per area
    2. Coils shall be internally enhanced 7mm tube and hydrophilic pre-coated aluminum fins type condenser coils. Coils shall be designed for 4.5 MPa or higher working pressure.
C. Fans assembly kits shall be composed of following components with their feature:
    1. Impeller: constructed with aluminum material blade
    2. Fan motors: Dual speed, high efficiency, direct drive, 3-phase, insulation class "F", current protected, IP55.
    3. Fan housing: resistant, corrosion resistant, galvanized and coated sheet steel
    4. Guard grill: metal coated with black plastic color

## INSULATION

A. Material: Closed-cell, flexible, UV protected, thermal insulation for preformed flexible elastomeric cellular thermal insulation in sheet and tubular form.
B. Thickness: Standard 25mm.
C. Factory-applied insulation over cold surfaces of liquid chiller components including brazed plat heat exchanger, water pipe on chiller, and suction line.

## POWER AND ELECTRICAL REQUIREMENTS

A. Power/Control Panel:
B. Factory installed and wired IP54 rain/dust tight, powder painted steel cabinets with tool lockable, hinged, latched, and gasket sealed outer doors. Provide main power connection(s), compressor starters and fan motor contactors, current overloads, and factory wiring.
C. Terminal Block:

1. Provide single point power connection to chiller, shall be 3 phase of scheduled voltage.
2. Terminal Block connections shall be provided at the point of incoming single point connection for field connection and incoming power wiring, which must comply with local codes.

D. Control Transformer: None. 220V control power from phase and "neutral line".
E. Short Circuit Withstand Rating of the chiller electrical enclosure shall be (380V: 5,000 Amps). Rating shall be published in accordance with GB5226.1.
F. All exposed power wiring shall be routed through liquid-tight, UV-stabilized, non-metallic conduit.
G. Supplied equipment shall not exceed scheduled Minimum Circuit Ampacity (MCA.) The mechanical Contractor shall be responsible for any additional costs associated with equipment deviation.

## CONTROLS

A. General:
   1. Provide automatic control of chiller and waterside economizer operation including compressor start/stop and load/unload, anti-recycle timers, condenser fans, evaporator pump, evaporator heater, waterside economizer bypass value, unit alarm contacts and run signal contacts.
   2. Chiller shall automatically reset to normal chiller operation after power failure.
   3. Unit operating software shall be stored in non-volatile memory. Field programmed set points shall be retained in memory for minimum 5 years.
   4. Alarm contacts shall be provided to remote alert for any unit or system safety fault.

B. Single system Safeties:
   1. Automatic reset required, includes:
      a) Fins temperature
      b) Low unit leaving water temperature in cooling mode
      c) High unit leaving water temperature in heating mode
   2. Manual reset required, includes:
      a) Accumulator inlet temperature
      b) Discharge temperature
      c) Low pressure switch
      d) High pressure switch
      e) Fan motor protector
      f) Power fault
      g) Braze Plate Heat Exchanger freeze fault
      h) Low leaving water temp in heating mode
   3. After the twice trips by automatically reset and third trip by manual reset within 30 minutes:
      a) High pressure at high pressure side

b) Low pressure at low pressure side
c) Water flow
d) High discharge temperature
e) Communication fault with fan
f) Communication fault with unit
g) DC driver fault
h) Module Safeties:

4. Automatic reset
   a) Ambient temperature
   b) Low system leaving water temperature in cooling mode
   c) High system leaving water temperature in heating mode
   d) Low air inlet temperature in cooling mode
   e) High air inlet temperature in heating mode
   f) Communication fault with HMI controller
5. Manual reset
   a) System return water temperature
   b) System leaving water temperature
   c) Water flow fault
   d) External linkage fault
   e) Over limit operation time

C. BAS Communications:

Modbus connectivity as standard.

## EXECUTION

## INSTALLATION

A. Permission Power Supply: 342-420V/50HZ/3Ph+N+PE
B. General: Rig and Install in full accordance with manufacturer's requirements, project drawings, and contract documents.
C. Location: Locate unit as indicated on drawings, including cleaning and service maintenance clearance per Manufacturer instructions. Adjust and level unit on support structure. If equipment provided exceeds height of scheduled chiller, installing contractor is responsible for additional costs associated with extending the height of parapet or screening walls/enclosures.
D. Components: Installing Contractor shall provide and install all auxiliary devices and accessories for fully operational chiller.
E. Electrical: Coordinate electrical requirements and connections for all power feeds.
F. Controls: Coordinate all control requirements and connections with Controls Contractor.

## SECTION-2 PRIMARY VARIABLE PUMPING SYSTEM

## END SUCTION PUMPS

### SCOPE

This specification covers the design, materials of construction, features, performance and testing of long coupled End suction pumps. Pump shall be suitable for the purpose they are intended.

### CODES AND STANDARDS:

The design, material, construction, manufacture, inspection, testing and performance of end suction pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. The Equipment supplied complies with the latest applicable Indian, American or equivalent Standards.

### GENERAL:

The pumps shall be flexible coupled with spacer, single stage, centrifugal, volute type radial split casing, end suction with back-pull out design. Hence, the rotating unit can be removed and serviced without disconnecting the suction, discharge piping and electrical motor. The pump, electric motor, base frame, coupling and coupling guard shall be factory assembled at the pump manufacturer's facility. Installation instructions shall be included with pump at time of shipment. The pump manufacturer shall have complete unit responsibility.

### FEATURES OF CONSTRUCTION:

### PUMP CASING:

Pump casing shall be of robust construction with integrally-cast pedestal support feet in order to transmit pipe load to the base and foundation. Liquid passages in the casing shall be smooth finish to ensure high Efficiency.

Pump casing shall capable of withstanding 1.5 times the maximum working pressure.

Pump casing shall be close-grained Cast Iron / Ductile Iron according to ASTM A48-Class 30 and capable of withstanding to the maximum pressure developed by the pump.

Flange dimensions are in accordance with ANSI Class 125# standards and be machined flat face.

Pump casing shall be fitted with bronze wear ring.

Pump casing shall have tapped hole provision for priming and draining.

### IMPELLER:

The impeller shall be of SS / Silicon Bronze, ASTM B584 C87600, enclosed single suction type with smooth surface finish for minimum frictional loss. This ensures high Efficiency. Impeller shall be keyed to the shaft and secured by impeller lock nut. All impellers are dynamically balanced to ISO 1940-1: Grade G6.3. The thrust balancing can be of balancing holes or back vanes.

The direction of rotation of the impeller is clockwise when viewed from the motor.

### SHAFT:

Shaft shall be martensitic stainless steels according to EN1.4021/AISI 420, ground and polished to final dimensions and be adequately sized to withstand all stresses, hydraulic loads, vibrations and torques coming in during operation.

Shaft run-out shall be limited at the seal face and at the impeller to 0.05 mm.

Shaft shall be provided with Mechanical seal as default fitment to provide leak free operation.

### WEAR RINGS:

A renewable type bronze wearing ring shall be provided in the pump casing to maintain close running clearance and to minimize leakage and recirculation losses.

### MECHANICAL SEALS:

The liquid cavity shall be sealed off at the pump shaft by an internally flushed mechanical seal with carbon seal seat and ceramic / Silicon carbide seal head. The mechanical seal shall be capable of being inspected and easily replaced without removing the piping or volute.

### BEARINGS:

Bearing shall be heavy-duty, single row, antifriction, grease lubricated ball as a standard type and shall meet long and trouble-free operation. These shall be factory filled lubrication. Bearing shall meet minimum L-10 rating life up to 20000 hrs.

Bearing of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

### COUPLING:

Pumps shall be provided with flexible type, centre drop-out (Spacer) design coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor.

Coupling guard shall be bolted to the base plate shall be furnished for all coupled pumps and it shall be rigid and free of vibration.

### MOTORS:

Motor shall be a horizontal, foot mounted, totally enclosed fan-cooled, standard squirrel cage induction motors with main dimensions according to IEC standards. Electrical tolerances are to IEC 60034. Motor shall be IE 3 class, energy efficient type.

Motor shall be to with IP 55 enclosure. The class of insulation shall be F with temperature rise limited to Class B.

Motor shall be suitable for operation on a 415 V (± 10% variation), 50Hz ± 5%, 3phase, or 240V-1phase AC supply. Motor shall be suitable for both DOL and / or STAR/DELTA starting. Pump and motor shall be factory aligned and shall be realigned by the contractor as per factory recommendations after installation.

## BASE PLATES:

Base plate shall be of fabricated steel and securely welded cross members. Grouting area shall be fully open. The combined pump and motor base plate shall be sufficiently stiff as to limit the susceptibility of vibration. The base plate should be provided with lifting holes.

## NAME PLATES:

Each pump shall be provided with a name plate indicating the following details:

1. Pump type designation

2. Pump Model

3. Rated flow

4. Rated head

5. Pressure rating/max temperature

6. Rated speed

Revision:

Working pressure:

Maximum allowable working pressure (MAWP) for all the pressure containing parts shall in no case be less than the maximum discharge pressure produced by the pump at shut off (including tolerances), at the max suction pressure, for the maximum impeller diameter and the maximum continuous speed. Pump shall be rated for minimum of 10bar working pressure.

## VIBRATION:

The pump(s) vibration test standard as per ISO 5199.

## SOUND LEVEL:

Sound pressure level of the pump driver shall be min 68 to max 96 dbA* measured at 1.0m distance from pump for the duty points.

## PAINTING:

The equipment shall be thoroughly cleaned and greased. All rust sharp edges and scales shall be removed. All external and exposed cast iron parts of pumps shall be painted with one coat of high-quality factory approved paint and name-plated before shipment from the factory.

The pump shaft shall not be painted.

## PUMP & MOTOR SELECTION:

The pump(s) selection shall be in Preferred Operating Region (POR) unless otherwise approved by the engineer. The pumps shall be factory manufactured, assembled and hydrostatically tested as per Hydraulic Institute standards in an ISO 9001 approved facility.

Motor should be selected as non-over-loading type.

Note: The motor nameplate rating for pumps under parallel operation shall not be less than the max BKW indicated on the pump data sheet (the power at the END of the curve for the rated impeller) or shall have the specified margin as per this clause whichever is greater. The pump motors shall also be suitable for Start-up under open discharge valve condition.

## INSPECTION & TESTING OF VARIOUS ITEMS:

Before effecting delivery of the equipment, following inspections and tests as per relevant IS standards shall be carried out.

For Pumps:

1. Hydrostatic Testing

2. Performance Test

3. Dynamic balancing for pump impeller.

## TENDER DRAWINGS:

The following drawings shall be submitted by the Contractor / Vendor along with their Bids.

1. Preliminary outline dimensional drawing of pump and motor (Suction and discharge connections and foundation details shall also be indicated).

2. Performance curves (capacity Vs total head, efficiency, NPSH and KW requirement) ranging from zero to maximum capacity.

# SECTION-3 PUMP LOGIC CONTROLLER PACKAGE

## APPROVED MANUFACTURERS

The following manufacturers shall be acceptable subject to compliance with the stated specifications

1. GRUNDFOS
2. ARMSTRONG
3. XYLUM

## COMPONENTS OF PUMP LOGIC CONTROL PANEL

a) To supply and install Multi Pump Controller as per the design
b) The control system should include the Pump logic controller, Variable frequency drive(s) and Differential pressure transmitters as indicated in the design
c) Pump logic control panel should house dedicated Multi Pump Controller, Variable frequency drive(s) and associated switchgears
d) Pump logic controller, Variable frequency drive(s), Differential pressure transmitters and related equipment shall be installed by the mechanical contractor as shown in the design
e) Input power wiring to the pump logic control panel and the output wiring to the motors shall be the scope of electrical contractor and to be done as indicated in the electrical drawings submitted for the specific project

f) Low voltage wiring for the Building Management System to be done by the BMS contractor from the pump logic control panel to the IBMS system

## SPECIFICATIONS

### PUMP LOGIC CONTROLLER

a) Multi Pump Controller shall be listed by and bear the label of Underwriter's Laboratory Inc (UL). The controller shall be specifically designed for variable speed pumping applications
b) Pump logic controller in built in Variable frequency drives are not accepted. Logic controller should be external to the drives used in the system
c) Multi Pump Controller shall have programs to safeguard the system against the following conditions

    i. Pump flow surges System
    ii. Hunting End of curve protection

d) Multi Pump Controller shall be capable of receiving multiple analog input signals from zone differential pressure transmitters as indicated in the design. Multi Pump Controller will then select the analogue signal that has deviated most from its set point. The selected signal will then be used as the process input value for the hydraulic stabilization function.
e) Multi Pump Controller shall be capable of controlling up to six pumps in parallel
f) Multi Pump Controller shall be capable of accepting an additional analog input signal from a flow sensor. This input shall be used for the end of curve protection. Instantaneous Flow value should be displayed in the front page. Cumulative Flow data's should be logged into Multi pump controller.
g) Multi Pump Controller shall be capable of accepting 7 different set points activated through either clock program or individual digital inputs
h) Multi Pump Controller shall be capable of accepting additional analog input as external set point influential signal to vary the primary analog input signal. This external set point influential signal shall be user selectable from various types of signals like ambient temperature signal or like
i) Multi Pump Controller shall have program function to accept the pump curve data for optimizing the system performance in terms of energy consumption for the pump being controlled
j) The hydraulic stabilization program shall utilize a proportional-integral control function. The proportional-integral values shall be user adjustable in the Multi Pump Controller over a finite range
k) Multi Pump Controller shall be self-prompting and all alarm messages shall be displayed in plain English. The operator panel shall have the following features:

    i. Multi fault memory and recall of last 24 faults with time stamping
    ii. Red fault light with related alarm message on default screen with graphical representation of the fault
    iii. Soft touch membrane keypad switches

l) Multi Pump Controller shall have a display screen size of minimum 320 pixels X 240 pixels VGA display with backlight. Current status of settings and measured values are to be displayed in the default screen
m) Multi Pump Controller shall have an installation wizard to enable the user to configure the system with minimum assistance
n) Multi Pump Controller shall have minimum 2 level password protection to safeguard the settings against unwanted / unauthorized changes
o) Display should have menu driven function for the operation easiness
p) Multi Pump Controller shall be capable of performing the following pressure boosting function:

    i. Low suction pressure cut out to protect the pumps against operating with insufficient suction pressure
    ii. High system pressure cutout to protect the piping system against high-pressure conditions

q) The following communication features shall be provided to the BMS

    i. Remote start/stop of the VSPS through potential free contact from BMS
    ii. Individual pump start/stop/trip status from VSPS through potential free contact to BMS

r) The following communication features shall be provided to BMS system via RS-485 port utilizing Modbus protocol

    i. Individual analog input
    ii. Individual pump/VFD on/off status
    iii. System percent reference
    iv. System start/stop command
    v. System operating mode Individual
    vi. Pump kW consumption Individual pump operating hours
    vii. Individual pump running speed in Hz/percentage reference
    viii. System flow, when optional flow sensor is provided

s) Multi Pump Controller shall have on board Ethernet port for connecting the VSPS to BMS. If given static IP address, Multi Pump Controller should be accessible over Intranet or Internet.
t) The pump logic controller shall be - Multi Pump Controller or approved equal housed in a NEMA 1 enclosure

## VARIABLE FREQUENCY DRIVE:

a) The variable frequency drive(s) shall be pulse width modulation (PWM) type, microprocessor controlled design.
b) VFD, including all factory-installed options, is tested to UL standard 508. VFD shall also meet C-UL and be CE marked and built to ISO 9001:2000 standards.

c) VFD shall comply EMC directives as per IEC 61800-3:2004, category C1 with 50 meter motor cable (for power less than or equal to 90 Kw) & category C2 with 50 meter motor cable (for power more than 90 Kw).
d) VFD shall be housed in IP21 enclosures for indoor applications. Wall mounted/VFDs with plastic enclosures shall not be acceptable. For outdoor applications, VFDs shall be housed in IP 54 enclosure.
e) VFD shall employ an advanced sine wave approximation and voltage vector control to allow operation at rated motor shaft output speed with no derating. This voltage vector control shall minimize harmonics to the motor to increase motor efficiency and life. Power factor shall be near unity regardless of speed or load.
f) VFD shall have balanced DC link chokes to minimize power line harmonics. VFDs without a DC link choke shall provide a 3% impedance line reactor
g) Automatic motor adaptation (AMA) algorithm shall be available in the VFD. This feature shall allow for automatic adaptation of drive to meet the characteristics of the motor to have increased efficiency leading to additional energy savings. AMA feature should be able to configure without disconnecting the motor from the VFD.
h) Output power switching shall be done without interlocks or damage to VFD
i) The following user adjustable parameters shall be provided in the VFD Acceleration time
    i. Deceleration time
    ii. Minimum frequency Maximum frequency
j) VFD shall be compatible for Modbus protocol as standard
k) VFD shall have Automatic Energy Optimization (AEO) function. This feature shall reduce voltages when the drive is lightly loaded to provide a 3% to 10% additional energy savings
l) VFD shall be suitable for elevations to 1000 meters above sea level without derating. Maximum operating ambient temperature shall not be less than 40 Deg Celsius. VFD shall be suitable for operation in environments up to 95% non-condensing relative humidity
m) VFD shall be capable of displaying the following data in plain English via 40 character alphanumeric display:
    i. Frequency
    ii. Voltage
    iii. Current
    iv. Kw per hour consumption
    v. Running hours
    vi. Run mode (remote/local)
    vii. Active power
    viii. RPM
n) VFD(s) shall be warranted for a period of 12 / 18 months

## DIFFERENTIAL PRESSURE TRANSMITTERS

Differential pressure transmitters shall be field mounted and shall transmit an isolated 4-20mA DC signal indicative of process variable to the pump logic controller via standard three wire 24 DC system with Emission/Immunity confirming to EN61000-6-2/3.

Unit shall have stainless steel wetted parts with two 7/16" process connections. It shall be protected against radio frequency interference and shall have water tight, IP 55 electrical enclosure. Sensor should be capable of withstanding a burst pressure of 25 bar. Accuracy shall be within 2.5% BFSL (Best Fit Straight Line)

## SEQUENCE OF OPERATION

a) The system shall consist of Multi Pump Controller (MPC), multiple pump/VFD sets, with manual and automatic alternation and pump staging
b) The pumping system shall start upon the start command from the BMS when the Multi Pump Controller (MPC) is configured in "Remote" mode
c) If the Multi Pump Controller (MPC) is configured in "Local" mode, the system is started via the "Control Unit" at the panel and the pumping system shall operate automatically
d) Differential pressure transmitters shall be provided as indicated in the design
e) Each DPT shall send a 4-20 mA signal to the pump logic controller, indicative of the field condition
f) Multi Pump Controller shall compare each DPT signal against the set point and consider the most deviated signal for engineering the VFD/Pumps speed
g) Multi Pump Controller shall continuously scan the DPT signals and compare with the set point to control the most deviated zone
h) If the actual process variable (PV) is not met by the lead pump, Multi Pump Controller shall initiate a timed sequence to bring in a lag pump into operation
i) The lag pumps shall accelerate in tandem with the lead pump decelerating until both the pumps settle at same speed to meet the set point. (Process Variable PV = Set Point SP)
j) Further if the Process Variable (PV) changes, both the pump(s) speed should change together
k) During normal running sequence, Multi Pump Controller should attempt to destage pumps so that optimum number of pumps is always running in terms of energy consumption
l) In the event of lead pump/VFD fault, Multi Pump Controller automatically initiates a timed sequence to start the standby pump/VFD set in the variable speed mode. The standby variable speed pump shall be controlled by the Multi Pump Controller
m) VFD fault indication shall be continuously displayed on the display screen graphically until the fault is rectified and the controller has been manually reset
n) In the event of failure of zone differential pressure transmitter, its process variable signal shall be removed from the scan/compare sequence. Alternative zone differential pressure transmitter if available, shall remain in the scan/compare sequence
o) Upon differential pressure transmitter failure a plain English warning message shall be displayed on the Control Unit of Multi Pump Controller screen with a fault code
p) In the event of failure to receive all zone differential pressure transmitter signals, a user selectable number of VFD/Pump sets shall run at a user adjustable speed. Same shall be reset upon correction of the zone failure.

## SECTION-4 HORIZONTAL /VERTICAL FLOOR MOUNTED AIR HANDLING UNITS

### SCOPE

The Scope of this section comprises the supply, erection, testing and commissioning of air handling units conforming to these Specifications and in accordance with requirements.

### TYPE

The air handling units shall be double skin modular, draw through type comprising of various sections such as mixing chamber (wherever R .AIR and F.AIR are ducted.), pre filter section, chilled water coil section, fan section supply air plenum as per details given in Drawings and design requirement.

### CAPACITY

The air handling capacities, maximum motor HP, static pressure shall be as shown on Drawings and as per design requirements.

### CASING

Double skinned panels shall be 40+/-2 mm thick Double Skin Panels with thermal break profile, shall be made of 0.8mm Pre-coated GSS on outside and 0.8mm Galvanized sheet inside with 275 GSM galvanized coating for corrosion resistance and with CFC – FREE P.U. insulation of 42 (+/- 5%) kg/Cu M injected in between with an internal gasket between the skins to interrupt the thermal bridge of the panel. Outer sheet of panels shall be made of galvanized pre-coated sheet of 0.8 mm thickness to ensure mechanical strength as per class D1 of EN 1886, air leakage as per class L1 of EN 1886,thermal bridging of minimum TB3 class and thermal transmittance of minimum T3 class as per EN 1886.

Manufacturer shall submit test certificate of conformity for Class D1, Class L1, Class TB3 & Class T3 issued by internationally recognized Independent Laboratory should be submitted along with type test report.

The entire framework shall be mounted on an aluminium alloy or galvanized steel or heavy duty engineering composite material (depending on size) channel base as per manufacturer's recommendation. Panels shall be assembled together to form an enclosure that is capable of low air leakage potential, conforming to class A of EN 1886:2007. Handles shall be made of hard nylon and all access panels should be openable with Allen key arrangement. Units supplied with various sections shall be suitable for on site assembly with continuous foam gasket. All fixing and gaskets shall be concealed.

### Mixing Box

AHU's requiring mixing boxes as specified in drawings shall be complete with fresh and return air dampers.

### Damper

Dampers shall be opposed to the type of blade. Blades shall be made of double-skinned aero-foil aluminium sections with integral gasket and assembled within a rigid extruded aluminium

alloy frame. All linkages and supporting spindles shall be made of aluminium or nylon, turning in Teflon bushes. Manual dampers shall be provided with a Bakelite knob for locking the damper blades in position. Linkages shall be extended wherever specified for motorized operation. Damper frames shall be sectionalized to minimize blade warping. Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure.

### Motor and Drive

Fan motors shall be energy efficient (IE-3) and shall be 415±10% volts, 50 cycles, three phase, totally enclosed fan-cooled class F, with IP-55 protection. Motors shall be especially designed for quiet operation. Drive to fan shall be provided through direct-drive arrangement.

### Fan

Fans shall be direct driven plug fan with aerofoil design blades for Floor Mounted AHU/TFA units and Ceiling Suspended unit with Forward Curved Direct Driven Fan with three phase motor so as to give maximum efficiency for given duty condition. All direct driven Plug fan with casing will be certified by a reputed 3rd party internationally acclaimed certifying body like Eurovent, or AHRI or AMCA, and the entire Fan + Motor assembly will be balanced at supplier's works before despatch. Fans driven by variable frequency drive shall be backward inclined irrespective of static pressure value. Fans shall be selected for minimum efficiency of 70%. Fan wheels shall be made of galvanised steel in case of forward curved, MS epoxy coated in case of backward curved DIDW fans and MS epoxy coated/composite material for direct driven plug fans. Fan array with multiple fans should be used for capacities more than 15000 CMH. Plug fans in fan array shall have individual VFDs for every motor fan set. For DIDW Fan shaft shall be grounded C40 carbon steel and supported in self-aligning Plummer block operating less than 75% of first critical speed, grease lubricated bearings. Fan wheels and pulleys shall be individually tested and precision balanced dynamically. Fan motor assembly shall be statically and dynamically balanced to G6.3 grade as per relevant ISO/AMCA standard. Certified Computerized selection for AHU shall be with fan selection and sound level spectrum. Complete AHU sound level should be given in computerized selection sheet instead of sound level of bare fan.

Motors shall be mounted inside the AHU casing on rigid frame/ slide rails for alignment, and be totally enclosed, fan cooled, to be class `F' insulation.

Heavy duty anti-vibration mounts shall be provided for isolating the unit casing. Fire retardant, waterproof silicone rubber impregnated flexible connection shall be provided at the fan inlet/ discharge.

### Cooling/Heating Coils

### Chilled Water Cooing/Heat Coil

Chilled water coils shall have 12.5mm (1/2") to 15mm (5/8") dia. tubes minimum 0.41 mm thick with aluminium fins firmly bonded to copper tubes assembled in a zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory tested at 21 Kg./Sq.cm air pressure

under water. Tube shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Fins spacing shall be 11 to 13 fins per inch (4 to 5 fins per centimetre).

SPECIAL NOTE: CONTRACTOR TO CHECK TENDER DETAILS FOR CONNECTIONS OF VRF ODU WITH TFA OR AHU UNIT. COIL RD TO BE STUDIED. CONTRACTOR TO CONSIDER THE NECESSARY COST OF EXPANSION KITS OR ADDITIONAL CAPACITIES AS REQURIED FOR CONNECTION OF VRF SYSTEM WITH ASKED AIR HANDLING UNIT OR TREATED FRESH AIR HANDLING UNIT WITH MENTIONED COIL RD. IT WILL BE DSITC SCOPE OF CONTRACTOR FOR MENTIONED SYSTEM. NO EXTRA COST SHALL BE PAID TOWARDS ANY SUCH MODIFICATIONS.

## SECTION-5 CEILING SUSPENDED AIR HANDLING UNITS

### SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of ceiling mounted air handling units, conforming to these specifications and in accordance with requirements of drawings and as per design requirement.

### TYPE

The air-handling units shall be double skin ceiling suspended, draw through type comprising of various sections such as pre-filter section, chilled water coil section, fan section, as per details given in drawings and as per design requirement.

### CAPACITY

The air moving and coil capacities shall be As per DPR/Detailed Design and as per design requirement.

### UNIT CONSTRUCTION

The unit shall be ceiling suspended type. The housing/casing of the air handling unit shall be double skin construction. The framework shall be of extruded aluminium hollow sections. All the frame shall be assembled using pressure die cast aluminium joints to make a sturdy, strong & self-supporting frame work for various sections.

40mm thick double skin panels shall be made of 0.8 mm pre-plasticized GSS sheet on outside and 0.8 mm galvanized sheet inside with PUF insulation injected in between. These panels shall be screwed on to the framework with soft rubber gasket on aluminium frame to make the joints air tight. Insulation material shall be of 40 Kg./m3 density (minimum). Detachable steel insulated drain pan with necessary slope to facilitate fast removal of condensate shall be provided. Necessary outlet from the drain pan shall be provided. The unit shall be suitably insulated from inside to avoid condensation on outer surface. Necessary provision for ceiling suspension shall be provided. The drain pan shall be insulated with 12mm thick closed cell Nitrile rubber or as per manufacturer's specifications.

Manufacturer shall submit test certificate of conformity for Class D1, Class L1, Class TB3 & Class T3 issued by internationally recognized Independent Laboratory should be submitted along with type test report.

### FAN AND MOTOR

Plug Fans:-Fans shall be backward curved plug fan with aerofoil design blades so as to give maximum efficiency for given duty condition. The fan shall be AMCA certified and the entire Fan + Motor assembly shall be balanced before dispatch. Multiple fans/ single fan shall be used in AHU to suit available AHU Room at site & as per approved shop drawing. The supply air fan shall be as per requirements. The fan impeller shall be supported to housing with angle iron frame & pillow block heavy duty ball bearing. The fan housing with TEFC Sq. Cage motor shall be mounted on a common adjustable base frame on vibration isolators/ rubber turret mounts vibration isolators. The fan motor shall be installed inside the housing of air handling unit to keep low noise level. The fan & motor assembly shall be of aluminium extruded section only.

## COIL

The chilled water coil shall be of seamless copper tubes not less than 0.4 mm thick and 12mm OD. Coil face areas shall be such as to ensure rated capacity from each unit and such that air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of airflow. The fins shall be uniformly bonded to the tubes by mechanical expansion of the tube for minimum thermal contact resistance with fins. Coil size shall be selected for a max. Face velocity of 500 FPM.

Fin spacing shall be 11to 12 FPI & shall be 0.17 to 0.2 mm thick. The coils shall be tested against leaks at a hydraulic pressure of 21 kg/sq.cm. This pressure shall be maintained for period of at least 2 hours.

No drop should be observed indicating any leaks .the water headers shall be completed with water in/out connections, vent plug on top and drain at bottom and designed to provide water velocity between 2 to 6 FPS. The coils exceeding 6 rows depth should be in two equal parts.

## FILTER

Shall be done as per specification given under Electronic Air Filter System.

## ACCESSORIES

Each air-handling unit shall be provided with manual air vent at highest point in the cooling coil. In addition; following accessories may be required at air handling units.

a. Stem type thermometer at inlet and outlet of each coil with tubing and gauge cocks and as per applicable specifications.
b. Pressure gauge with globe valves at inlet and outlet of each coil with tubing and as per applicable specifications.
c. Butterfly valves at inlet and outlet of each coil.
d. Y Strainer at inlet of each coil.
e. Union and condensate drain piping from the unit up to the drain trap as described in section piping.
f. PIB Control Valve located in chilled water lines connected to the coil. This valve shall be operated through the cooling/heating thermostat and shall control the flow of chilled/hot water and as per applicable specifications.
g. Cooling /heating thermostat as per section
h. 'Automatic Controls and Instruments' shall be located in return air stream.
i. Double Flexible connection of fire retardant Hessian between the fan outlet and duct.
j. Vibration isolators of minimum 90% efficiency.
k. Motor & drive package
l. Air purge valve on top of coil header and drain valve at bottom.

## DESIGN DATA FOR AIR HANDLING UNITS

i. Fan outlet velocity shall not exceed 550 MPM.
ii. The air velocity across coil shall not exceed 150 MPM.

iii. The air velocity across air pre filter shall not exceed 150 MPM.

Motor rating is tentative only and shall be suitable for the duty but not less than the specified HP. Motors shall be selected considering at least 20% margin over the break power.

The AHU fan shall be selected for a total static pressure as indicated under Technical Schedule for Equipment'.

## INSTALLATION

Unit shall be installed above the false ceiling in a manner so as to permit the removal of all the parts of AHU for any maintenance work without dismantling other equipment such as plenum, pipes, ducts etc. Air handling unit installation shall be carried out as per manufacturer's recommendation. Rubber in shear type suspension hangers shall be provided for vibration isolation.

## PERFORMANCE DATA

Air handling unit shall be selected for the lowest operating noise level. Fan performance rating and power consumption data with operating points clearly indicated shall be submitted and verified at the time of testing & commissioning of the installation.

## TESTING

Cooling/heating capacity of various air-handling unit models shall be computed from the measurements of airflow and dry and wet bulb temperatures of air entering and leaving the coil.

## SECTION-6 VARIABLE FREQUENCY DRIVES FOR HVAC SYSTEMS

### GENERAL REQUIREMENTS –

Specifically, HVAC Drives from MAKES mentioned in make list.

a. This specification covers complete variable frequency drives (VFDs) designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD.
b. The frequency converter shall not be a general purpose product, but a dedicated HVAC engineered product.
c. The VFD and its options shall be factory mounted and tested as a single unit under full load before dispatch.
d. The VFD shall be tested to UL 508C. The appropriate UL label shall be applied.
e. The VFD shall be CE marked and conform to the European Union Electro Magnetic Compatibility directive.
f. The VFD shall be UL listed for a short circuit current rating of 100 Ka and 23nstall23 with this rating.

### TECHNICAL REQUIREMENTS

1. The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor derating.
2. When properly sized, the VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
3. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.
4. The VFD shall have a dual 5% impedance DC link reactor (harmonic filters) on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable.
5. VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.
6. IEEE519, 1992 recommendations shall be used for the basis of calculation of total harmonic distortion (THD) at the point of common coupling (PCC). On request VFD manufacturer shall provide THD figures for the total connected load. The contractor shall provide details of supply transformer rating, impedance, short circuit current, short circuit impedance etc. to allow this calculation to be made.
7. All VFDs shall contain integral EMC Filters to attenuate Radio Frequency Interference conducted to the AC power line. The VFDs shall comply with the

emission and immunity requirements of IEC 61800-3 : 2004, Category C1 with 50m motor cable (unrestricted distribution). The suppliers of VFDs shall include additional EMC filters if required to meet compliance to this requirement.

8. The VFD's full load output current rating shall meet or exceed the normal rated currents of standard IEC induction motors. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 second while starting.
9. The VFD shall provide full motor torque at any selected frequency from 20 Hz to base speed while providing a variable torque V/Hz output at reduced speed. This is to allow driving direct drive fans without high speed derating or low speed excessive magnetization, as would occur if a constant torque V/Hz curve was used at reduced speeds. Breakaway current of 160% shall be available.
10. A programmable automatic energy optimization selection feature shall be provided as standard in the VFD. This feature shall automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings.
11. The VFD must be able to produce full torque at low speed to operate direct driven fans.
12. Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.
13. An Automatic Motor Adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.
14. Galvanic isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete digital I/O shall include additional isolation modules.
15. VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.
16. The VFD shall allow up to at least 100 meters of SWA (Single Wire Armour) cable to be used between the FC and the motor and allow the use of MICS (Mineral Insulated Copper Sheath) cable in the motor circuit for fire locations.
17. Overload protection in VFD shall automatically compensate for changes in motor speed.
18. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable.
19. Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.

20. Protect from under voltage. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output, without faulting, with an input voltage as low as 70% of the nominal voltage.
21. VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.
22. If the temperature of the VFD's heat sink rises to 80C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. It shall also be possible to program the VFD so that it reduces its output current limit value if the VFD's temperature becomes too high.
23. In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.
24. The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.
25. Protect from output switching: The VFD shall be fully protected from switching a contactor/ isolator at the output without causing tripping e.g.: for switching on/off the isolators of the AHU/ ventilation fans/ pumps near the motor with VFD in ON mode.
26. The VFD shall store in memory the last 10 alarms. A description of the alarm, and the date and time of the alarm shall be recorded.
27. When used with a pumping system, the VFD shall be able to detect no-flow situations, dry pump conditions, and operation off the end of the pump curve. It shall be programmable to take appropriate protective action when one of the above situations is detected.

## INTERFACE FEATURES

1. Auto keys shall be provided on the control panel to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation.
2. There shall be an "Info" key on the keypad. The Info key shall include "on-line" context sensitive assistance for programming and troubleshooting.
3. The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Manual or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.
4. Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes.
5. All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.
6. To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup

parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters. Keypad shall provide visual indication of copy status.

7. Display shall be programmable to communicate in multiple languages including English, Chinese, Korean, Japanese, Thai and Indonesian.
8. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
9. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD. The VFD shall also have individual Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.
10. A three-feedback PID controller to control the speed of the VFD shall be standard.
11. This controller shall accept up to three feedback signals. It shall be programmable to compare the feedback signals to a common set point or to individual set points and to automatically select either the maximum or minimum deviating signal as the controlling signal. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals.
12. The VFD shall be able to apply individual scaling to each feedback signal.
13. For fan flow tracking applications, the VFD shall be able to calculate the square root of any or all individual feedback signals so that a pressure sensor can be used to measure air flow.
14. The VFD's PID controller shall be able to actively adjust its setpoint based on flow. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system.
15. The VFD shall have three additional PID controllers which can be used to control damper and valve positioners in the system and to provide setpoint reset.
16. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
17. Five simultaneous meter displays shall be available. They shall be selectable from (at a minimum), frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, feedback signals in their own units, among others.
18. Programmable Sleep Mode shall be able to stop the VFD. When its output frequency drops below set "sleep" level for a specified time, when an external contact commands that the VFD go into Sleep Mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop. When the VFD's speed is being controlled by its PID controller, it shall be possible to program a "wake-up" feedback value that will cause the VFD to start. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD.
19. A run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of initiating an output "run request" signal to indicate to the external equipment that the VFD has received a request to run.
20. VFD shall be programmable to display feedback signals in appropriate units, such

as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F). Examples can be room temperature in 0C, return air temperature in 0C, supply air temperature in 0C, CO2 concentration in ppm, pressure in bar, differential pressure in PSI etc.

21. VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.
22. Standard Control and Monitoring Inputs and Outputs

a. Four dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

b. Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.

c. Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status.

d. Each relay shall have an adjustable on delay/ off delay time.

e. Two programmable analog inputs shall be provided that can be either direct-orreverse acting.

f. Each shall be independently selectable to be used with either an analog voltage or current signal.

g. The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 Ma.

h. A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.

i. The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,

j. One programmable analog current output (0/4 to 20 Ma) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.

a. It shall be possible to read the status of all analog and digital inputs of the VFD through serial bus communications.
b. It shall be possible to command all digital and analog output through the serial communication bus.

Optional Control and Monitoring Inputs and Outputs

a. It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.
b. These modules shall use rigid connectors to plug into the VFD's control card.
c. The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module.
d. Modules may include such items as:
e. Additional digital outputs, including relay outputs
f. Additional digital inputs
g. Additional analog outputs
h. Additional analog inputs, including Ni or Pt temperature sensor inputs

i. It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.

1. Standard programmable firefighter's override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display FIREMODE whenever in firefighter's override mode. Fire mode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.
2. A real-time clock shall be an integral part of the VFD.

a. It shall be possible to use this to display the current date and time on the VFD's display.
b. Ten programmable time periods, with individually selectable ON and OFF functions shall be available. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. Is shall be possible to program unique events that occur only during normal work days, others that occur only on non-work days, and others that occur on specific days or dates. The manufacturer shall provide free PC-based software to set up the calendar for this schedule.
c. All VFD faults shall be time stamped to aid troubleshooting.
d. It shall be possible to program maintenance reminders based on date and time, VFD running hours, or VFD operating hours.
e. The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log.
f. The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time.

i. The VFD shall include a sequential logic controller to provide advanced control interface capabilities. This shall include:
ii. Comparators for comparing VFD analog values to programmed trigger values.
iii. Logic operators to combine up to three logic expressions using Boolean algebra
iv. Delay timers
v. A 20-step programmable structure

The VFD shall include a Cascade Controller which allows the VFD to operate in closed loop set point (PID) control mode for one motor at a controlled speed and control the operation of 3 additional constant speed motor starters.

## SERIAL COMMUNICATIONS

1. The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:

a.Metasys N2

b.Modbus RTU

2. VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide at no-charge- PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.
3. The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD's control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

## ADJUSTMENTS

The VFD shall have a manually adjustable carrier frequency that can be adjusted in 0.5 kHz increments to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.

1. Four independent setups shall be provided.
2. Four preset speeds per setup shall be provided for a total of 16.
3. Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.

Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period.

If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

An automatic "start delay" may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.

Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

## SERVICE CONDITIONS

7.1 Ambient temperature at full speed, full load operation with continuous drive rated output current:

a. -10 to 45°C for ratings upto 90 Kw without derating
b. -10 to 40°C for ratings 110 Kw and higher without derating
c. Relative Humidity : 0 to 95%, non-condensing.

d. Elevation : Up to 3,300 feet without derating.
e. AC line voltage variation : + 10% of nominal with full output.
f. VFD Enclosure protection : IP 55, integral, with no additional cabinets.
g. Side Clearances : No side clearance shall be required for cooling.
h. All power and control wiring shall be done from the bottom.
i. All VFDs shall be plenum rated.

## QUALITY ASSURANCE

To ensure quality, the complete VFD shall be tested by the manufacturer. The VFD shall drive a motor connected to a dynamometer at full load and speed and shall be cycled during the automated test procedure.

All optional features shall be functionally tested at the factory for proper operation.

## SECTION-7 FAN COIL UNIT

### SCOPE

This section covers the technical requirements for manufacture, testing at works, and delivering at site, testing after installation, commissioning of fan coil units conforming to these specifications and in accordance with the requirement of the drawings and 'Schedule of Quantities'.

### TYPE

The fan coil unit shall be horizontal type to be mounted within ceiling space blow through type, complete with finned coil, fan with EC/ Brushless DC motor, pre-insulated drain pan, one or more centrifugal fans and motors, cleanable air filters & fan speed regulator & other controls as described. Horizontal fan coil units shall be provided with auxiliary secondary condensate drain pan. Fan coil units shall be with EUROVENT certified performance & quality standard and be 'type' tested. The Contractor shall submit the make and type of each fan together with the 'type' test certificate for the Client/ Consultant's approval.

### Capacity

The air moving and coil capacities shall be as shown on Drawings and indicated in Schedule of Quantities.

### Cabinets

Cabinets shall be constructed of 18 gauge die-formed cold-rolled galvanized sheet steel, bowdlerized and painted with approved shade of powder coating or galvanized coating finish and shall have access doors to piping and controls. Access panels shall have positive locking fasteners for easy removal. Horizontal furred-in type units mounted within ceiling space shall be provided with a cabinet housing, the coil and fan section with provision to mount filters within the fan section.

### Interior Chassis

The interior chassis shall be constructed of not less than 16 gauge cold rolled galvanized sheet steel bowdlerized and painted with approved shade of powder coating or galvanized coating finish. All ceiling suspended fan coil units shall be securely mounted from the building structure with top panel set dead level in both directions. In case of ceiling suspended horizontal units, fan deck and cooling coil shall be easily removable from FCU without lowering down of the FCU or disturbing the other installation.

### Fan Section

This shall consist of two lightweight aluminum/ ABS impellers of forward curved type, both statically and dynamically balanced.

The two impellers shall be directly mounted on to a double shaft, single phase multiple winding motor capable of running at three speeds A GI plenum shall connect fan outlet to the coil

### Cooling Coil

The coil shall be of seamless copper tube of minimum 9.52 mm OD and wall thickness shall be minimum 0.4 mm. All bends and joints shall be enclosed within insulated end sections of the base unit for protection against sweating. Each coil shall be provided with air vent. All coils shall be factory tested at 21 kg per sq.cm. (300psig) air pressure when submerged in water. Fin spacing shall be minimum 5 fins per cm. Tubes shall be mechanically/ hydraulically expanded for minimum thermal contact resistance with fins. Air vent shall be provided in headers at a level higher than coils. The cooling coil shall be easily removable from backside of FCU without disturbing the other installations. The copper tube or pipe should not be manufactured from reprocessed or recycled copper. The units shall have provision for both LHS and RHS type coil design, preferably reversible at site.

### Drain Pans

Primary drain pan shall be of single skin construction fabricated from 22G stainless steel with all corners enclosed. The pan shall be insulated with minimum 6mm thick flexible closed cell elastomeric insulation to prevent condensation. The pan shall be of sufficient size to accommodate cooling coil supply and return water header and bends and control valves.

The auxiliary condensate drain pan shall be similar in construction to primary drain pan and size larger than primary drain pan to catch all overflows in case primary drain pan gets choked. Drain from auxiliary drain pan shall be connected to drain from primary drain pan through a tee connection and piped to vertical risers.

### Motor

Motor shall be 240 ± 10% volts, 50 Hz, single phase, six poles, rpm not exceeding 1000 at maximum airflow. The motor shall be either EC or Brushless DC type, with permanent magnets for reduced friction, lower power input and quiet running and have sleeve or ball bearings factory lubricated for extended life, with multi-speed (minimum 3 speeds) and preferably option to select operating static pressure at site, as per requirement. The EC/ BLDC motor shall be provided with its compatible variable speed drive card for air side modulation, mounted on the unit itself. Motor shall be factory wired to a terminal block mounted within the fan section. Motors shall have extended shaft on both sides. A sturdy switch shall be provided with the unit complete with wiring, for ON/OFF operation & with minimum three speed control of the fan.

All fan coil units capacity and air flow rate shall be selected based on the performance of the units at high fan speed. In selecting the fan coil units, allowance shall he made for the actual resistance imposed on the air flow of the units due to ducts and grilles. The added resistance is to be applied to all fan coil units whether shown to have ducts connected or not and shall be taken as not less than 12Pa external to the unit. The units shall have option to select between static pressure options at site to accommodate for variable duct lengths.

### AIR FILTER

The filter shall be cleanable type 12mm thick with minimum 90% down to 20 micron rating with either MERV 8 rating AL wire mesh or synthetic woven fabric on metal rod frame and mounted behind the pan in a filter plenum of GI sheet.

## PAINTING

The fan coil units shall be powder coated in approved colour or galvanized coating finish.

## CONTROLS

All units shall be complete with following controls

PIB Control Valve in water lines

Wall mounted thermostat containing three speed and on/off control for fan, speed and temperature control for summer/ winter air conditioning

'Y' strainer, ball valve and globe valve as shown on drawings and 'schedule of quantities'

## PERFORMANCE DATA

Fan coil units shall be selected for the lowest operating noise level having standard sound level rating of NC 30 at low speed and NC 35 at medium/ high speed. Fan performance rating and power consumption data, with operating points clearly indicated, shall be submitted by the Contractor and verified at the time of testing and commissioning of the installation.

The thermal, volumetric and acoustic performance of fan coil units shall meet the requirements indicated and testing and rating shall be verified by third party testing and certification by Eurovent.

## TESTING

Cooling capacity of various fan coil unit models shall be computed from the measurements of airflow and dry and wet bulb temperatures of entering and leaving the coil. Flow measurements shall be by anemometer and temperature measurements by accurately calibrated mercury -in-glass thermometers. Computed ratings shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

## SECTION-8 CHILLED WATER CASSETTE UNIT

### GENERAL CONSTRUCTION

a) Units shall be necessarily with Eurovent/AHRI Certified Performance
b) The units shall be 4-way directional flow Chilled Water Cassettes.
c) The units shall comprise of multi-row chilled water coil section, 4 speed motor, 3-dimension screw fan forward curve type, circuit box, decorative panel, thermostatic controls, drain pump assembly, all relevant sensors for protection and control, galvanized sheet steel casing with GI coated finish.
d) The Drain pump should be ideally suited to lift water up to a height of 500mm. The pump shall be inter-locked with the unit's functioning in such a way that if the drain pump mal-functions, then the unit should stop functioning and give a warning signal.
e) The indoor unit should be fabricated from 18 Gauge G.I. sheets & decorative panel with ABS plastic.
f) The fan should be statically & dynamically balanced and with directly driven forward curved blades. The fan should be able to deliver air @ 400 CFM / TR at the highest speed.

g) Fan motor should be power saving single phase suitable for 220 V, 50Hz; Brushless DC type with its drive card also inbuilt.
h) Cooling coil should be minimum of 7mm O.D. and minimum wall thickness minimum of 0.3mm.
i) Coil should be minimum 2 rows deep. The coil should be suitable for operation on chilled water and accordingly return headers should be provided. The coil sizes and capacity should be adequate for desired refrigeration performance.
j) The coil inlet/ outlet distributors should be of brass and of size 20mm. The coils should have hydrophilic aluminum type of fins for prolonged life of equipment. Minimum fins per inch should be 14.
k) The units should be available with a cordless remote controller. The remote should be able to control set temperature, change modes, change fan speed and preferably with timer on/ off function.
l) There should be a provision for wired controller with digital display as well.

### INSTALLATION

a) The Chilled Water Cassette should be suspended from the ceiling, using anchor fasteners for robust fitting.
b) The unit should be hung using threaded hangers for height and level adjustment. These hanging accessories shall be factory provided. The minimum height of the adjustable hanging rods should be 15 inches.
c) An auxiliary drain tray arrangement should be provided to house the ball valves, strainer and on/off control valve assembly. Water from this aux. tray arrangement shall go back into the Cassette main drain tray and no additional drain pipe outlet should be required.
d) The ball valves fitted should be of appropriate sizes. However, only a factory prepared valve station should be provided at site.

e) A onetime riser should be provided by the installer for the drain flow to ensure no return of the drain water under any circumstances. A natural gravity slope should be provided after the riser by the installer. This "N" trap arrangement is mandatory for all Chilled Water Cassettes instalment.

### CONTROLS

a) Water side inlet & outlet of the FCU should be provided with Brass ball valves suitable for connection. The inlet value should also be provided with a built-in Y – Type strainer.
b) A two/ three way on/off valve should be provided to facilitate regulation of temperature in the conditioned area. The value shall be suitable for 220 V, 50 Hz operation. The valve will be on/ off type valve. No modulating function type valves are suited for the Cassettes.
c) Units should be compatible with BMS systems. If any extra items or conditions prevail for connectivity with BMS, the same should be highlighted in advance.

## SECTION-9 DX TYPE HI WALL SPLIT UNITS

The purpose of this tender is to supply and install DX Type Hi-Wall Air Conditioning Units for ensuring reliable, energy-efficient cooling and heating solutions. The units should meet the performance, quality, and operational standards as outlined in this specification

## SECTION-10 SHEET METAL WORKS AND ACCESSORIES:

### SCOPE

The scope of this section includes supply, fabrication, installation & testing of all sheet metal ducts, supply, installation, testing & balancing of all grills & diffusers as per specifications & drawings.

Except as otherwise specified all ductwork and related items shall be in accordance with these specifications.

Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners, hangers & all accessories.

### DUCT MATERIALS

The ducts shall be fabricated from galvanized steel sheets class VIII - Light coating of Zinc conforming to ISS: 277-1962 (REVISED) and with a galvanizing thickness of nominal 120 gm. per SQM surface area.

Only new, fresh, clean (unsoiled) and bright GI/Aluminum sheets shall be used. The CLIENT/ DESIGN CONSULTANT reserve the right to summarily reject the sheets not meeting these requirements. Fabrication of ducts shall be through Lock forming machines.

All duct work, sheet metal fabrication unless otherwise directed, shall strictly meet requirements, as described in IS:655-1963 with Amendment-I (1971 Edition)

| Long er size of Duct | Sheet thickness GI(MM) | Type of Joints | Bracing |
|---|---|---|---|
| Up to 750 | 0.63 | GI Flange | - |
| 751-1000 | 0.8 | 25x25x3 mm angle iron frame with 8 mm Dia nuts & bolts | 25X25X3 MM @ 1M |
| 1001-1500 | 0.8 | 40x40x5 mm angle iron frame with 8 mm Dia nuts & bolts | 40x40x5 MM @1M |
| 1501-2250 | 0.1 | 50x50x5 mm angle iron frame with 10 mm Dia nuts & bolts at 125 mm center | 40x40x3 mm @ 1.2m to be braced diagonally. |
| 2251 & above | 1.25 | 50x50x6 mm angle iron frame with 10 mm Dia nuts & bolts at 125 mm center | 40x40x3 mm @ 1.6m diagonally braced |

Ducts larger than 450 mm shall be cross broken, duct sections up to 1200 mm length may be used with bracing angles omitted.

Changes in section of ductwork shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 Deg. Angle from the axis of the main duct unless otherwise approved by the Engineer-in-Charge.

All ducts shall be supported from the ceiling/slab by means of M.S. rods of 10 MM Dia with M.S. angle at the bottom of size 40 mm x 40 mm x 6 mm for sizes up to 1500 mm at 3 m intervals. Above size 1500 mm upto 2250, support shall be provided with 10 mm dia. MS rod and MS angle size 50 mm x 50 mm at bottom at 2.5 m intervals. Above size 2250 mm support shall be provided with 12 mm dia MS rod and MS angle size 50 mm x 50 mm at bottom

## INSTALLATION

1. All ducts shall be fabricated and installed in workman like manner, generally conforming to relevant BIS codes. Round exposed ducts shall be die formed for achieving perfect circle configuration
    a) Ducts so identified on the drawing shall be acoustically lined and thermally insulated as described in the section 'Insulation' and as indicated in 'Schedule of Quantities. Duct dimensions shown in drawings are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in 'Schedule of Quantities'.
    b) Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made airtight.
    c) All exposed ducts upto 60 cm width within conditioned spaces shall have slip joints. The internal ends of the slip joints shall be in the direction of airflow. Ducts and accessories within ceiling spaces visible from air-conditioned areas shall be provided with two coats of matt black finish paint.

d) Change in dimensions and shape of ducts shall be gradual. Air turns shall be installed in all vanes arranged to permit the air to make the turn without appreciable turbulence.
e) Ducts shall be fabricated as per details shown on drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees of ample size to keep the ducts true to shape and to prevent buckling, vibration or breaking.
f) All sheets metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans shall be constructed of 18 Gauge GSS thoroughly stiffened with 25mm x 25mm x 3mm angle iron braces and fitted with all necessary inspection doors as required to give access to all parts of the apparatus. Doors shall be not less than 45cm X 45cm in size.
g) Plenums shall be panel type and assembled at site. Fixing of MS angle iron flanges of duct pieces shall be with rivet heads inside i.e. Towards G.S. sheet and riveting shall be done from outside.
h) Rubber gasket 3 mm thick shall be used between duct flanges and between duct and duct supports instead of felt in all ducting installation for complete sealing.

2. During the construction, the Contractor shall temporarily close duct openings with sheet metal covers to prevent debris-entering ducts and to maintain opening straight and square, as per direction of Engineer-in-Charge.
   a) Great care should be taken to ensure that the ductwork does not extend outside and beyond height limits as noted on the drawings.
   b) All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be tight and shall be made in the direction of airflow.
   c) The ducts shall be reinforced where necessary, and must be secured in place so as to avoid vibration of the duct on its support.
   d) All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration. All ducts shall be fabricated and installed in accordance with modern design practice. The sheet metal gauges and fabrication procedures as given in I.S. specifications shall be adhered to and shall be considered as an integral part of these specifications.
   e) The ductwork shall be varied in shape and position to fit actual conditions at building. All changes shall be in accordance with accepted duct design and subject to the approval of the engineer-in- charge. The Contractor shall verify all measurements at building and shall notify the Engineer-in- Charge of any difficulty in carrying out his work before fabrication.
   f) Sponge rubber or approved equal gaskets shall be installed between all connections of sheet metal ducts to walls. Sheet metal connections shall be made to walls and floors by means of galvanized steel angles anchored to the building structure with anchor bolts and with the sheet bolted to the angles.

Sheet metal connections shall be as shown in the drawings or as directed by Engineer-in-Charge.

g) All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angel/channel under ducts. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods and angles/ channels shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/ anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats.

h) Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick TF quality thermo Cole around the duct prior to sealing of the opening.

i) All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 100 mm long but not more than 200 mm, securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

j) Flanges and supports are to be black, mild steel and are to be primer coated on all surfaces before erection and painted with aluminum thereafter. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.

k) The ductwork should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling Contractors.

## DAMPERS

At the junction of each branch duct with main duct and split of main duct, volume control dampers must be provided. Dampers shall be rigid in construction to the passage of air.

The volume dampers shall be of an approved type, lever operated and complete with suitable level links & quadrants, locking devices, which will permit the dampers to be adjusted and locked in any position.

The dampers shall be of opposed blade or louver type. The damper blade shall not be less than

1.25 mm (18) gauge and shall not be over 225 mm wide. Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Damper frames shall be constructed of 16 gauge steel

After completion of the ductwork, dampers are to be adjusted and set to deliver the required amount of air as specified in the drawings.

## ACCESS PANEL

A hinged and gasket access panel shall be provided on ductwork before each control device that may be located inside the ductwork. Doors shall be provided with neoprene rubber gaskets. Angle joints shall be provided with neoprene rubber gaskets for leak tightness of the joints. Access door/panels shall be provided: - Near each smoke sensor Any other place specifically mentioned in the drawing or if asked by CLIENT/ DESIGN CONSULTANT during execution stage.

## MISCELLANEOUS

a) Sponge rubber gaskets also to be provided behind the flange of all grills.
b) Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.
c) Inspection doors measuring at least 450 mm x 450 mm are to be provided in each system at an appropriate location, as directed by Engineer-in-Charge.
d) Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.
e) Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Engineer-in-Charge.
f) All duct supports, flanges, hangers and damper boxes etc. Shall be given 2 coats of red oxide paint before installation and one coat of aluminum paint after the erection, at no extra cost.
g) All angle iron flanges are to be welded electrically and holes to be drilled.
h) All the angle iron flanges are to be connected to the GSS ducts by rivets at 100 mm centers.

## SECTION-11 SHEET METAL WORKS (FACTORY FABRICATED)

### GENERAL

The work under this part shall consist of furnishing labour materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, and exhaust system ready for operation as per drawings.

Except as otherwise specified all duct work and related items shall be in accordance with these specifications.

Ductwork shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers

### DUCT MATERIALS

The ducts shall be fabricated from galvanized steel sheets class VIII conforming to ISS:277-1962 (revised) or aluminium sheets conforming to ISS:737-1955 (wherever aluminium ducts are specified).

All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in IS:655-1963 with amendment-I (1971 edition)

GOVERNING STANDARDS:- Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and FlexibleSecond Edition-1995" SMACNA)

### RAW MATERIAL

1. Ducting
    a) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. row material furnished with accompanying Mill test Certificates.
    b) Galvanizing shall be of 120gms/sq.m. (total coating on both sides).
    c) In addition, if deemed necessary, samples of raw material, selected at random by CLIENT/ DESIGN CONSULTANT's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.
    d) The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross section dimensions.
2. Duct Connectors and Accessories

All transverse duct connectors (flanges/cleats) and accessories/related hardware are such as support system shall be zinc-coated (galvanized)/ FABRICATION STANDARDS

a) All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces to provide the requisite quality of ducts and speed of supply.
b) Coil lines to ensure location of longitudinal seams at comes/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.

c) All ducts, transformation pieces and fittings to be made on CNC profile cutlers for required accuracy of dimensions, location and dimensions of notches at the folding lines.
d) All edges to be machine treated using lock formers, flanges and roller for fuming up edges.
e) Sealant dispensing equipment for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified.

## SELECTION OF G.I. GAUGE AND TRANSVERSE CONNECTORS

Duct Construction shall be in compliance with 1" (250 Pa) w.g. static norms as per SMACNA.

All transverse connectors shall be the Rolamate 4-bolt slip-on flange system or Techno Fabriduct imported makes of similar 4-bolt systems with built-in sealant if any to avoid any leakage additional sealant to be used.

The specific class of transverse connector and duct gauge for a given duct dimensions will be

1" (250 Pa) pressure class.

Non-toxic, AC-applications grade P.E. or PVC Casketing is required between all mating flanged

Joints. Gasket sizes should conform to flange manufacturer's specification.

## DUCT CONSTRUCTION

The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.

## DIMENSIONAL TOLERANCES:

a) All fabricated dimensions will be within +/- 1.0 mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be +/- 1.0 mm per meter.
b) Each and every duct pieces should be identified by color coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge.
c) Ducts shall be straight and smooth on the inside Longitudinal seams shall be airtight and at comers only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness.
d) Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the tum without appreciable turbulence.
e) Plenums shall be shop/factory fabricated panel type and assembled at site.
f) Factory Fabricated ducts shall have the thickness of the sheet shall be as follows.

| size of Duct | Types of joints | | Bracing with hanger tie rods of following sizes |
|---|---|---|---|
| Up to 750 | Fabricated out of G.I. sheet of 24 gauge at every 1.2 m internal. | The flanges shall be made out of the same duct sheet | Cross tie rods to be fitted of suitable dai GI |

| | | | |
|---|---|---|---|
| 751-1000 | E-24 type flange, shall be fabricated out of 24G sheet at every 1.2 m internal | and all the four corner shall be fitted for fitting the bolt | rod for each piece of duct. |
| 1001-1500 | E-22 type flange, shall be fabricated out of 22G sheet at every 1.2 m internal | The flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt | Cross tie rods to be fitted of suitable dai GI rod for each piece of duct. |
| 1501-2250 | J-16 type flange, shall be fabricated out of 16G sheet at every 1.2 m internal | | |
| 2251 & above | J-16 type flange, shall be fabricated out of 16G sheet at every 1.2 m internal | | |

g) The gauges, joints and bracings for sheet metal duct work shall further conform to the provisions As per DPR/Detailed Design.
h) Ducts larger than 600 MM shall be cross broken, duct sections upto 1200 MM length may be used with bracing angles omitted.
i) Changes in section of ductwork shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer-In-Charge.
j) All ducts shall be supported from the ceiling/slab by means of M.S. Rods of 10 MM (3/8") DIA with M.S. Angle at the bottom. The rods shall be anchored to R.C. Slab using metallic expansion fasteners.

## INSTALLATIONS

a) During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of Engineer-In-Charge.
b) Great care shall be taken to ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.
c) All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow.
d) The ducts shall be re-inforced with structured members where necessary, and must be secured in place so as to avoid vibration of the duct on its support.
e) All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration

f) The duct work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the Engineer-In-Charge. The contractor shall verify all measurements at site and shall notify the Engineer-In-Charge of any difficulty in carrying out his work before fabrication.
g) Sponge rubber or approved equal gaskets of 6 MM maximum thickness shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. Sheet metal connections shall be made to walls and floors by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.
h) Flanges bracings and supports are to be Rolamate or Techno Fabriduct. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.
i) Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineer-In-Charge.
j) Joints requiring bolting or riveting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. All jointing material must have a finish such as cadmium plating or Galvanized as appropriate.
k) Fire retarding flexible joints are to be fitted to the suction and delivery of all fans. The material is to be normally double heavy canvass or as directed by Engineer-In-Charge. On all circular spigots the flexible materials are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.
l) The flexible joints are to be not less than 75 MM and not more than 250 MM between faces.
m) The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.
n) Duct passing through brick or masonary, wooden frame work shall be provided within the opening. Crossing duct shall have heavy flanges, collars on each side of wooden frame to make the duct leak proof.

## DOCUMENTATION TO MEASUREMENTS

For each drawing, all supply of ductwork must be accompanied by computer-generated detailed bill of material indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct areas by gauge and duct size range as applicable.

Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge wise.

All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

### TESTING

After duct installation, a part of duct section (approximately 5% of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA- "HVAC Air Duct Leakage Test Manual: (First Edition).

## SECTION-12 INSULATION:

### GENERAL

WORK INCLUDED

a) Comply with the schedule of Quantity, General Requirements and all documents referred to therein.
b) Provide all labour, materials, products, equipment and services to supply and install thermal insulation, vapour barriers and finishes for mechanical work as indicated on the Tender drawings and specified in this Section of these Specifications.

### SUBMITTALS

a) Submit samples and specification sheets of all types of insulation materials specified in this Section of the Specifications.

### MATERIALS - GENERAL

a) All insulation works shall be carried out by one firm specializing in insulation work.

b) Provide insulation and covers in strict accordance with authorities governing combustibility and fireproofing of materials and in accordance with manufacturer's recommendations.

The materials shall comply with following standards.

BS 476: Part 4 – Non Combustible

BS 476: Part 5 – Not easily Ignitable (Class P)

BS 476: Part 6 – Fire propagation Index (I<12)

BS 476: Part 7 - Surface spread of flame (Class 1)

The material should comply to Class'O' fire rating as per BS 476 part 6&7.

The product shall be able to work effectively at ambient temperature range of -100ºC to 150 ºC

## THERMAL INSULATION MATERIALS

### FIBER GLASS (FOR DUCT):

Insulation material of Duct shall be factory laminated Polypropylene 'Toughguard' facing with fiberglass wool. The Thermal conductivity of the insulation material shall not exceed 0.034 W/m K at 25 deg C mean temperature. The thickness of insulation shall be so selected as to prevent any condensation and should be able to meet R-Value requirements.

The minimum thermal resistance (R-Values) for insulation of ducts (as per Ashrae 90.1-2004) shall be as described below:

Supply Air Ducts R= 1.4 m2 deg. /W (Thickness requirement for glass wool 50MM)

Return Air Ducts R= 0.6 m2 deg. /W (Thickness requirement for glass wool 25MM)

The nominal density of Resin Bonded Fiberglas insulation shall be 24 kg/m3

### RESIN BONDED FIBER GLASS WOOL FOR DUCT ACOUSTIC LINING

Insulation material for Duct Acoustic Lining shall be resin bounded fiberglass wool with one side factory laminated either Black Glass Oven Cloth or Black Glass Tissue. The Thermal conductivity of the fiberglass for air-conditioning application shall not exceed 0.034 W/m K at 25 deg C mean temperature and average Noise Reduction Coefficient (NRC=0.7, frequency range from100 Hz to 4000Hz ) .The density of insulation material shall be either 32 Kg./m3 and thickness of insulation material shall not less 25mm.

The installation guideline for glass wool in Duct Acoustic Lining:

The inside duct surface should be cleaned with suitable solvents and rendered free from all physical and chemical impurities.

Fix 22 gauge G.I. channels & angle frame work 25mm wide x depth equal to thickness of insulation at 600mm centre, screwed to the sheet metal by means of brass metal screws.

Cut the panels of fiberglass wool insulation material & fix in framed work using two coats of cold applied bitumen/CPRX or any other equivalent approved product.

The inner most surface of insulation material shall be covered with factory laminated either Black Glass Oven Cloth or Black Glass Tissue.

Finally cover the insulation with 0.5 mm thick perforated Aluminum sheet having 20% perforation with joints overlapped and screwed to the frame by means of brass metal screws, to produce an even surface.

With fibre glass external thermal insulation shall be provided as follows:

Duct surfaces shall be cleaned, adhesive shall be applied on all sides and 50 mm thick resin bonded fiberglass insulation panels shall be wrapped before adhesive dries out. All longitudinal and transverse joints shall be sealed by covering with fiberglass tissue paper

overlapped y minimum 100 mm to cover all joints. PVC straps at 600 mm centre shall be used to hold insulation in position. Cladding shall be provided with 28 gauge GI sheet cladding.

All longitudinal and transverse joints in outer cladding shall have minimum overlap of 50 mm duly beaded and grooved and shall be sealed with elastomeric metal sealant 95-66 of Benjamin Foster USA or equivalent. Self-tapping screws/pop rivets spots shall be sealed with above sealant. The cladding shall be done in a neat & clean manner to give true surface.

Alternatively Nitrile Rubber or XLPE or PIR Pre-insulated Ducts Can be used In Compliance with Thermal Conductivity & Fire Rating.

### NITRILE RUBBER:

The minimum thickness of material used for duct thermal insulation shall be 19mm

Closed cell Elastomeric Nitrile Rubber: Thermal insulation material for Duct & pipe shall be closed cell Elastomeric Nitrile Rubber of Thermal conductivity of the insulation material shall not exceed 0.032 W/moK or 0.212 BTU / (Hr-ft2-oF/inch) at an average temperature of 30oC(The thermal conductivity shell be as per ECBC Code). Density of the nitrile rubber shall be 40-60 Kg/m3. The product shall have temperature range of –40 oC to 105oC. The insulation material shall be fire rated for Class 0 as per BS 476 Part 6 : 1989 for fire propagation test and for Class 1 as per BS 476 Part 7, 1987 for surface spread of flame test. Water vapour permeability shall be not less than 0.024 perm inch (2.48 x 10-14 Kg/ms Pa i.e. μ>7000: Water vapour diffusion resistance

The manufacturer shall have to provide the test report for insulation which will shall include minimum of the following parameters like density, Temperature range, Water absorption, Puncture resistance, Fire rating, etc.

Attain a complete and continuous vapour barrier over insulation applied to cold and dual temperature piping, sheet metal and equipment. Use either factory applied vapour barrier jacket or field applied Reinforced Foil Flame Resistant Kraft vapour barrier jacket. Apply to piping, fittings, valves and inline components, sheet metal and fittings and equipment. Seal longitudinal and circumferential laps. If vapour barrier jacket is not lapped, seal joints with self-adhering 100mm wide plain aluminium foil tape, or adhere 100mm wide aluminium foil tape with adhesive. Jacketing with self-adhesive laps and self-adhesive vapour barrier tape will be an acceptable alternative closure system.

### CLOSED CELL CROSS LINKED POLYETHYLENE INSULATION

Closed Cell Chemically Cross Linked Polyethylene thermal insulation sheet of nominal density of the material shall be 33 kg/m3, having a thermal conductivity of 0.032 W/m ok at 23 oC, mean temperature.

The material shall conform to BS 476 Part 7 Class 1 category. Water Vapour Resistance factor, μ, of bare material shall be > 11000 and with Al foil > 14000.

Tube: Aluminium foil faced insulation tube, an FR Closed Cell Chemically Cross Linked Polyethylene thermal insulating pre-formed tubing material. The material conforms to BS 476

Part 7, Class 1 category. Water Vapour Resistance factor,μ, of bare material is > 11000 and with Al foil > 14000.

Insulation tube could be supplied in the required ID to match with the type of pipe – whether MS or Copper in required thickness in single or multilayer, suitable for the location and conditions prevalent with a vapour barrier as aluminium foil on the outermost side.

Chilled water pipes shall be insulated with XPLE insulation of mentioned thickness as per BOQ

## SPECIAL NOTE ON MATERIAL SELECTION:

The type of material shall be as Mentioned in Schedule of Quantities only.

## SECTION-13 KITCHEN DUCTING:

Mild steel ducts (MS Ducts) are fabricated from hot rolled or cold rolled black steel sheets with fully welded construction to achieve leak proofing.

MS ducting is made from the high-quality mild steel which contains 0.16–0.29% carbon. This composition ensures that the material is neither ductile nor brittle. MS ducts are mainly used for the kitchen exhaust because of its inherently fire-resistant characteristics. The fire resistance characteristics of MS ducts can be further enhanced by Fire Rated Spray Coat or painted with multiple coats of Red Oxide along with Rock wool insulation conforming to NFPA 96 Standards.

Where total 'grease tightness' is required within the kitchen fire zone, all ductwork (min. 1.5 mm thick) shall be of fully welded construction with welded angle iron flanges and use full faced gaskets. Gaskets shall be non-porous, impervious to grease and cooking oils and capable of withstanding the higher temperatures experienced in kitchen extract systems. Mild steel ductwork should also be painted externally with 2 coats of protective paint before leaving the manufacturers works. Duct velocities shall be as per latest Ashrae standards and DW172.

Ducts shall not pass-through fire walls. Ducts shall be installed with not less than 2 percent slope on horizontal runs up to 75 feet and not less than 8 percent slope on horizontal runs more than 75 feet. Factory-built grease ducts shall be permitted to be installed in accordance with the listing and the manufacturer's installation direction. Ducts shall be installed without forming dips or traps.

## SECTION-14 PREINSULATED PANELS:

Factory Pre-cut SMART Pre-Insulated INDUS PIR Panels complete CFC & HCFC Free 17mm thick with 80 micron Embossed Aluminium foil (Anti-microbial, Anti-fungal, Anti corrosion and UV Protection coating) on outer sides and FSK foil in internal sides with close cell not less than 95% Rigid Cellular foam insulation of thickness as specified below and material shall be Class O as

per BS 476 Part 6 & Part 7 with 2 hours fire rating, with Density of 45 ± 3 kg/m3 and should have Thermal Conductivity 0.023 W/Mk , Water absorption shall be not more than 0.03% as per EN 13403 standard and panel should be GreenPro , GRIHA & EPD 48nstall48d. The ductwork should be capable of handling pressures upto 2000 Pascals. The joint between the ducts shall be with Polymer slide in type joint between the ducts and all other polymer accessories to be of the same manufacturer. Measurement would be done on outer to outer. Supporting of Threaded Rod (6mm) & C Channel/ Wire supporting of reputed make recommended by Manufacturer to be provided. Manufacturer to have experience of more than 10 years of producing the same material in India.

## SECTION-15 LOUVERS:

A louver is a ventilation product that allows air to pass through it while keeping out unwanted elements such as water, dirt, and debris. Several fixed or operable blades mounted in a frame can provide this functionality. The louvers will be used for Fresh air suction application as well as exhaust air applications.

The Opening should be minimum 60% that of total area including frame area. The construction should be such that lower pressure drop will occur during applications. Flange construction should be low leakage type when connected to ducts. Louvers should be constructed in extruded aluminium type. The frame should be with Bird screen. Blades should be inclined to 45 Deg, to avoid ingress of rainwater during applications. Powder coated finishing is required.

## SECTION-16 EXHAUST DISC VALVE:

The disk valve is simple solution extraction of Air. It consists of Installation frame, Central disk, valve Ring. It will have adjustable settings to match required airflow. These are ideal for Toilets, restrooms, Kitchen, and other application, it is also suitable for supply air applications.

The construction should be Aluminium extruded type.

Designed for installation in ceilings

Quick & easy installation type

Airflow adjustment provision should be there by rotating central disk.

Product design should be such that it will create low noise.

Powder coated finish is required with required colour code.

## SECTION-17 DAMPERS

i. Dampers: All duct dampers shall be opposed blade louver dampers of robust 16 G GSS construction and tight fitting. The design, method of handling and control shall be suitable for the location and service required.

b. Dampers shall be provided with suitable links levers and quadrants as required for their proper operation. Control or setting device shall be made robust, easily operable and accessible through suitable access door in the duct. Every damper shall have an indicating device clearly showing the damper position at all times.

c. Dampers shall be placed in ducts at every branch supply or return air duct connection, whether or not indicated on the Drawings, for the proper volume control and balancing of the air distribution system.

d. Pressure relief dampers: Pressure relief dampers shall be constructed with 18G Aluminum construction with parallel blade construction. Leafs shall be 100% air tight upon closure. Leafs shall be loaded with spring pressure of stiffness (k value) corresponding to set point pressure.

e. Non return damper (Back draft damper): Non return damper shall be constructed out of 16G GSS. Blades shall ensure 100% air leak proof performance on closure. Design shall ensure that no rattling noise is produced at design duty.

## SECTION-18 CONSTANT AIR FLOW REGULATOR:

Constant Air Flow Regulators (CAR) shall be used to obtain constant air volume at a given pressure range.

The Constant Air Flow Regulators (CAR) shall be of the circular type for high pressures and to be inserted into ductwork and suitable for vertical as well as horizontal mounting and it should be placed at a minimum distance of 3x the duct diameter from air supply grilles and minimum distance of 1x the duct diameter from air exhaust grilles

Constant Air Flow Regulators (CAR) body, valve and piston shall be made out of flame retardant PVC, fire classification M1. They shall contain a self-regulating PVC valve, piston, rubber strip for air tightness inside the duct and stainless steel calibrated spring and shall have preset air volume.

Constant volume regulator shall be made of PVC. The range covers an air flow range from 15 up to 1200 $m^3/h$ within a pressure range from 50 up to 600 Pa.

## SECTION-19 GRILLS/DIFFUSERS:

### SUPPLY AND RETURN AIR DIFFUSERS

Supply and return air diffusers shall be made of extruded aluminum section. The diffusers shall be powder coated in finish. Supply air diffusers shall be provided with screw operated opposed blade volume control devices of extruded aluminum in black anodized finish. The diffusers shall be suitable for concealed fixing arrangement and as approved by Engineer-in-charge/DESIGN CONSULTANT.

The diffusers shall be provided with removable central core.

All diffusers shall be selected as per selection curves and in consultation with Engineerin-charge/ DESIGN CONSULTANT. All diffusers shall have soft continuous rubber/foam gasket between the periphery of the diffusers and the surface on which it has to be mounted.

### LINEAR GRILLS:

Linear continuous supply or return air grills shall be extruded aluminum construction with fixed horizontal bars at 15 0 inclination with flanges on both sides. The thickness of fixed bar louvers shall be 5mm in front and the flange shall be 20mm wide with round edges. The grille shall be suitable for concealed fixing and horizontal bars of the grille shall be mechanically crimped from the back to hold them.

Volume control device of extruded aluminum construction in black anodized finish shall be provided in S.A. duct collars.

### DOUBLE ADJUSTABLE LOUVERED SUPPLY/ RETURN AIR GRILLS WITH HORIZONTAL /VERTICAL OR VERTICAL/ HORIZONTAL LOUVER ARRANGEMENT:

The grille shall be adjustable as each louver shall be pivoted to provide pattern with 00 to plus or minus 150 ARC upto 300 deflection down towards. The louvers shall hold deflection settings under all conditions of velocity and pressure. The rear louver of the register shall be in black shade. Volume control device of extruded aluminum construction with black anodized finish shall be provided in S.A. grills.

### MULTI SLOT CEILING DIFFUSERS:

Multi slot ceiling diffuser shall be made of extruded aluminum with various slot width and air pattern deflectors. Deflectors in each slot provide an adjustable air pattern of 180 degree full. A special plenum shall be provided for each supply air diffuser. The linear diffuser shall have alignment strips to give straight look while installation.

Hit & miss type volume control damper of extruded aluminum construction with mill finish shall be with multi-slot supply air diffuser.

### LINEAR CEILING MOUNTED DIFFUSERS:

Linear ceiling mounted air terminals shall be made of extruded aluminum surface mounted one way or two way pattern. The linear terminal shall have alignment strips to give straight look while installation. Volume control device of extruded aluminum construction in mill finish shall be provided in S.A. diffuser.

## MOTORIZED COMBINED SMOKE & FIRE DAMPERS – SPRING RETURN

All supply and return air ducts at AHU room crossings and at all floor crossings or as indicated in the drawings shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating.

These shall be of multi leaf type and provided with Spring Return electrical actuator having its own thermal trip for ambient air temperature outside the duct and air temperature inside the duct.

Actuator shall have Form fit type of mounting, metal enclosure and guaranteed long life span. The dampers shall meet the requirements of NFPA90A, 92A and 92B. Dampers shall have a fire rating of 1.5 Hrs. in accordance with latest edition of UL555 and shall be classified as Leakage Class 1 smoke damper in accordance with latest edition of UL555S. Each fire/smoke damper shall be AMCA licensed and bear the AMCA seal for air Performance. Actuators used shall be UL listed.

Each damper shall be supplied with factory mounted sleeve of galvanized steel of thickness as per SMACNA and of minimum 400mm long or as specified in schedule of quantities depending up on the wall thickness. The damper shall be fitted in to sleeve either using welding or self-tapping screws. All welded joints shall be finished using heat resistance steel paint, UL listed and approved Silicon sealant shall be applied at all corners as well as at joints between damper frame and sleeve.

Damper Frame shall be a roll formed structural hat channel, reinforced at corners, formed from a single piece of 1.5mm galvanized steel. Damper blades shall be aerofoil shaped (equivalent to 2.0mm thickness strength) roll formed using 1.0mm thick single piece of galvanized sheet. Bearings shall be of stainless steel fitted in an extruded hole in the damper frame. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Side Jam seals of stainless steel and Top and bottom seals of galvanized steel shall be provided. All galvanized steel used shall be with minimum 275 gm/ Sq.m Zinc coating. Bigger size Dampers shall be supplied in multiple modules of sizes not exceeding in dimensions of certified module, jack shafted together. Multiple actuators shall be provided for large dampers with higher torque requirements as prescribed in UL.

The electric actuator shall be energized either upon receiving a signal from smoke detector installed in AHU room supply air duct/ return air duct. Electric Actuator of suitable Torque and as approved by UL shall be factory mounted and tested. The actuator shall be suitable for 230V AC supply. In addition actuator shall have elevated temperature rating of 350 deg. F. Electric Actuator shall have been energized hold open tested for a period of at least one year with no spring return failure. Each fire/smoke damper shall be equipped with a heat actuated release device which shall allow controlled closure of damper rather than instantaneous to prevent accident (Electrical fusible link). The damper shall be equipped with a device to indicate OPEN and CLOSE position of Damper blades through a link mounted on the damper blade.

Each damper shall be provided with its own control panel, mounted on the wall and suitable for 230 VAC supply. This control panel shall be suitable for spring return actuator and shall have at least the following features:

a) Potential free contacts for AHU fan ON/ OFF and remote alarm indication.
b) Accept signal from external smoke / fire detection system for tripping the electrical actuator.
c) Test and reset facility.

Indicating lights/ contacts to indicate the following status:

a) Power Supply On
b) Alarm
c) Damper open and close position.

Actuators shall be mounted on the sleeve by the damper supplier in his shop and shall furnish test certificate for satisfactory operation of each Motor Operated Damper in conjunction with its control panel. Control panel shall be wall mounted type.

It shall be HVAC Contractor's responsibility to co-ordinate with the Fire Alarm System Contractor for correctly hooking up the Motor Operated Damper to Fire Detection/ Fire Management System. All necessary materials for hooking up shall be supplied and installed by HVAC Contractor under close co- ordination with the fire protection system contractor.

HVAC Contractor shall demonstrate the testing of all Dampers and its control panel after necessary hook up with the fire protection/ fire management system is carried out by energizing all the smoke detectors with the help of smoke.

HVAC Contractor shall provide Fire retardant cables wherever required for satisfactory operation and control of the Damper.

HVAC Contractor shall strictly follow the instructions of the Damper Supplier or avail his services at site before carrying out testing and installation at site.

Fire/smoke damper shall be provided with factory fitted sleeves; however, access doors shall be provided in the ducts within AHU room in accordance with the manufacturer's recommendations.

The Contractor shall also furnish to the Owner, the necessary additional spare actuators and temperature sensor (a minimum of 5% of the total number installed) at the time of commissioning of the installation.

## PAINTING

All grilles, and diffusers shall be powder coated in color as approved by Engineer-incharge/DESIGN CONSULTANT before installation.

All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in Matt finish.

## TESTING

After completion, all duct system shall be tested for air leakage.

The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final balance of air quantity through each outlet shall be submitted to the engineer-in- charge for approval. Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5% in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time.

# SECTION-20 PIPING AND FITTINGS

## SCOPE

The scope of this section comprises the supply and laying of pipes required for chilled water; condenser water & drain water conforming to these specifications and in accordance with the requirement of the 'Technical Schedule of Equipments' and 'Schedule of Quantities'

## WATER PIPING

## MATERIAL

Water piping fittings and valves shall be of the following makes or approved equal make and shall conform to IS standards as indicated below.

a) PIPES UPTO150MM :- MS, Class C (Heavy Class) as per BS – 1387 / 1985/ Equivalent
b) 200MM & ABOVE: - Welded Black Steel Pipe Class 2 (6.35 MM Thickness). As per BS 1387/1935

Pipe/Grooved: Carbon Steel/ MS- Roll grooved-ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. The Grooving Machine used shall be of the same manufacturer as Grooved Couplings & Fittings. Groove Measuring Tape shall be used to check the Groove in the pipe

NOTE – GRROVED FITTINGS SHALL BE USED FOR PIPES IN PLANT ROOM ONLY FOR PIPES ABOVE 50MM

Standard Mechanical Couplings, 2 inch (DN50) through 12 inch (DN300): Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. (Gaskets used for potable water applications shall be UL classified in accordance with ANSI/NSF-61 for potable water service.) Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A- 183, minimum tensile strength 110,000 psi (758450 kPa).

Grooved Couplings requiring Torque to tighten as a part of their installation shall not be allowed till 12".

Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13.

c) 2" (DN50) through 8" (DN200): Installation ready rigid coupling Style 107 for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C)
d) b. 10" (DN250) through 12" (DN300): Standard rigid coupling Style 07- Gasket shall be Grade "E" EPDM compound with green color code designed for operating temperatures from -30 deg F (-34 deg C) to +230 deg F (+110 deg C)

Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three couplings, for each connector, shall be placed in close proximity to the vibration source.

Flange Adapters: For use with grooved end pipe and fittings, flat faced, for mating to ANSI Class 125/ 150 flanges/ PN 10/ PN 16

Grooved couplings shall meet the requirements of ASTM F-1476.

Gasket: Synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D- 2000.

Grooved AGS Mechanical Couplings - 14 inch (DN350) & above: Couplings shall consist of two ASTM A-536 ductile iron housing segments, a wide elastomer pressure responsive gasket, and zinc electroplated carbon steel track head bolts and nuts conforming to the physical and chemical requirements of ASTM A-449 and the physical requirements of ASTM A-183.

Coupling housings designed with the wedge-shaped AGS key profile to engage the mating pipe(s)/component(s) wedge-shaped AGS grooves. Housings include lead-in chamfer to accommodate a wider range of initial pipe positions. Housings shall be coated with orange enamel

Grooved End Fittings:

Standard fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, forged steel conforming to ASTM A-234, Grade WPB 0.375" wall (9,53 mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish. Zinc electroplated fittings and couplings conform to ASTM B633.

AGS Fittings shall be supplied with factory AGS grooved ends. Fittings shall be manufactured of ductile iron conforming to ASTM A-536, forged carbon steel conforming to ASTM A-234, or factory fabricated from carbon steel pipe conforming to ASTM A-53. Fittings shall be manufactured to the dimensional standards ASME B16.9. Orange enamel coated - for use with Grooved AGS Product

Hole-Cut Branch Outlets:

Bolted Branch Outlet: Branch reductions on 2"(DN50) through 8"(DN200) header piping. Bolted branch outlets shall be manufactured from ductile iron conforming to ASTM A-536, Grade 65-

45-12, with synthetic rubber gasket, and heat treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183

All grooved components shall conform to local code approval and/or as listed by ANSI-B-31.1, B-31.3, B-31.9, ASME, UL/ULC, FM, IAPMO or BOCA.

Installation Ready Couplings shall be installed directly in the pipe without disassembling the Gasket.

Grooved end product manufacturer to be ISO-9001 certified.

Welding if any shall be done by qualified welders and shall strictly conform to Standard Code of practice for manual metal arc, welding of Mild Steel.

PIPING INSTALLED INSIDE BUILDING & BURRIED LINE WLL BE IN WELDED TYPE CONSTRUCTION

## VALVES

### GATE & GLOBE VALVES

Make: As approved shall be heavy duty non rising spindles and flanges as per is 1536 and factory tested for PN16.

Compliance - API 600 / BS 1873 / BS 1868 / ASME B16.34

### BALANCING VALVES

The balancing valves control and shut off valves with built in pressure drop and flow measuring facility shall be provided in the water outlet pipes of condensers and chillers, AHUs or wherever shown in tender drawings.

a) 15-50 mm Size: Gunmetal ASTM B-6 2 Screwed ends conforming to BS 5154
b) 65mm and above: Cast iron, flanged ends with stainless steel trim.

The valves shall have PTFE/SS disc with special erosion/corrosion proof sealing. The valves shall have temper proof adjustable and lockage arrangement for required water quantity after commissioning. The valves shall be complete with pressure test cock and drain cocks.

| Size | Construction | Ends |
|---|---|---|
| 15 To 50 MM | Gun metal body | Screwed |
| 65 MM and above | Cast Iron Body & spindle valve, seat wedge etc., of Brass or Gun Metal | Flanged |

To enable accurate and practical operation, measurement of flow and differential pressure shall be made with a computerized balancing instrument which shall enable the operator to read the flow directly without the use of diagrams or tables. In addition to measuring flow rate, differential pressure and temperature, computerized balancing instrument shall have a computer programs to provide the following functions:-

To balance the HVAC installation and calculate the necessary valve settings, based on system measurements.

To store the results of balancing.

To log measured values from a valve (differential pressure, flow rate or temperature)

To printout saved data in computerized measurement protocol (CMP) consisting of:-

- Name and size of Balancing Valve (BV)
- Presetting position of BV
- AP at BV
- Flow at BV
- Design Flow

Flanges shall be of approved make. The supply of flanges shall form part of piping (not separately identified in Schedule of Quantities) and shall also include supply of bolts, washers, nuts and suitable rubber insertion gaskets (minimum 3 mm thick).

Valves must be duly insulated with closed cell Polyurethane Foam (PUF) with not less than 70 Kg/m3 density.

The PUF insulation shall be protected by Cladding of HDPE or Aluminum to ensure Life of PUF and prevent it from Peeling and damage.

Insulation shall be done such that mounting bolts for the valve are fully enclosed by valve insulation.

Standard flanges and bolts can be used with no change in flange insulation method. Flange bolts shall be tightened directly on metal surface of flange and not on top of insulation.

### BUTTERFLY VALVES –

The butterfly valve shall consist of cast iron / Die Cast Aluminum , Disc – Stainless Steel 316 , Shaft – SS 410 or Equiv, Seat - EPDM Rubber. The valves shall be PN 16 / PN 10 rating & gear/ hand lever operated. Valves up to 150 mm size shall be with detachable hand lever operation whereas valves above 150 mm size shall have worm gear operation with hand wheel. The flanges, counter flanges, gasket, fasteners etc. required for installation of valve shall be in the scope of contractor. On/off type valve actuator of make Siemens/ Johnson Control/Equivalent to be provided for Motorized Butterfly valve. The actuator shall be intelligent type which incorporates motor, integral reversing starter, local / remote control facilities, terminals for remote control and indication connections housed within self-contained sealed enclosure. Actuator shall have 2 NO & 2 NC potential free auxiliary contacts for torque and limit switch. The actuator motor shall be suitable for 415V or 230V, 50Hz AC supply. Motor protection shall be provided in case of jamming of valve, single phasing, overheating, over travel etc. The actuator gearing shall be totally enclosed in an oil/grease filled gear case. There shall be manual wheel for operation in case of actuator/ power failure.

Compliance- CSN EN ISO 593 (13 3901)/ BS EN 593:2004/ DIN 3354/ ISO 10631:2021

## BALL VALVES

All ball valves and ball valves with Y strainer shall be bronze forged body construction with chrome plated bronze ball and handle of stainless steel constructions. These are separately identified in Schedule of Quantities.

Compliance: BSEN ISO 17292 (replaces BS: 5351)

## NON RETURN VALVES

Non return valves shall be dual plate check valve provided As per DPR/Detailed Design, and identified in Schedule of Quantities conforming to relevant Codes and in accordance with the following Specifications.

| Size | Construction | Ends |
|---|---|---|
| 50 to 150 mm | Body cast iron, plate stainless steel | Wafer |
| 200 to 450 mm | Body cast iron, plate stainless steel | Wafer |

The spring and hinge/ stop pin shall be SS304 and bearing PTFE material. Valves shall be suitable for not less than 10 Kg per sq. cm. gage working pressure.

Valves must be duly insulated with closed cell Polyurethane Foam (PUF) with not less than 70 Kg/m3 density.

The PUF insulation shall be protected by Cladding of HDPE or Aluminium to ensure Life of PUF and prevent it from Peeling and damage.

Insulation shall be done such that mounting bolts for the valve are fully enclosed by valve insulation.

Standard flanges and bolts can be used with no change in flange insulation method. Flange bolts shall be tightened directly on metal surface of flange and not on top of insulation.

## STRAINERS

Strainers shall be 'Y' type or Pot type Strainers as shown on drawings and as per requirements. 'Y' Strainer shall be fabricated out of MS 'C' class pipe two sizes higher than that of Strainer pipe size. Flanges as per B.S. 10 shall be provided at inlet and outlet connectors. The body shall be pressure tested at 10 kg/cm2 and shall be hot dip galvanized. Permanent magnet shall be provided in the body of the Strainer to arrest MS particles. Filter element shall be of non-magnetic 20 gauge SS sheet with 3 mm perforation. Strainers shall be provided at in let of each Air Handling Unit and Pump as shown in drawings and as per requirements.

Pot Strainers body shall be fabricated out of MS plate S235JR (1.0038(dubl))/IS 226/ E235B / Fe360B. Thickness of sheet shall be as per size of the strainer chamfered pipes with flanges shall be provided at inlet/ outlet connections of the strainer. The tangential entry of water shall create a centrifugal action and due to velocity shall separate sediments and deposit on the inner surface of Filter Element and at bottom of the Strainer. Butterfly valves shall be provided at inlet/outlet connections as shown in drawing and as per requirements. The strainer body shall have two separate chambers properly sealed to avoid mixing of filtered and unfiltered

water. A powerful magnet shall be provided in the body to arrest MS particles. Filter element of Pot Strainer shall be of non-magnetic 18 gauge SS sheet properly reinforced to avoid damage of the element. A cone with sufficiently to flush out foreign particles. This arrangement shall avoid frequent opening of Pot Strainer for cleaning of filter element. Gage connection shall be provided at inlet and outlet connection. A set of MS flanges with tongue and groove arrangement and neoprene rubber gasket shall be provided on the top cover and Pot Strainer flange with sufficient bolts and nuts to make the joint watertight. Bearing loaded top cover lifting and swinging arrangement shall be provided. The Pot strainer body shall be properly de-rusted and epoxy coated from inside and outside. Manufacturers Test Certificate shall be provided with each Pot Strainer.

Size of various Pot Strainer, Filter Element and Thickness of MS sheet shall be as detailed below:-

| Size (mm) | Pot Dia. (mm) | Pot HT (mm) | Element Dia. (mm) | Element HT (mm) | MS Plate Thickness (mm) |
|---|---|---|---|---|---|
| 50 | 300 | 400 | 200 | 240 | 6 |
| 80 | 350 | 450 | 250 | 250 | 6 |
| 100 | 450 | 500 | 300 | 280 | 6 |
| 125 | 500 | 600 | 330 | 340 | 8 |
| 150 | 540 | 700 | 360 | 390 | 8 |
| 200 | 610 | 815 | 400 | 470 | 8 |
| 250 | 800 | 955 | 550 | 510 | 8 |
| 300 | 1000 | 1105 | 750 | 580 | 8 |
| 350 | 1190 | 1300 | 895 | 678 | 12 |
| 400 | 1350 | 1500 | 1020 | 785 | 12 |
| 450 | 1518 | 1700 | 1060 | 890 | 12 |
| 500 | 1690 | 1800 | 1100 | 900 | 12 |
| 600 | 2000 | 2200 | 1500 | 1160 | 12 |

The Y-Strainer & Pot Strainer confirming to SSPL 107 & SSPL 106 shall have cast iron body and factory tested at works at 16 Kg/sq.cm pressure. The screen shall be made out of 3 mm perforated stainless steel sheet. It should be easily removable when required to be cleaned.

Isolating butterfly valves at either end of the pot strainer shall be provided.

Each pot strainer shall be provided with a Test Certificate.

All chilled water piping and fittings shall be pressure tested, painted and then insulated as described under the section "Insulation".

## AIR & DIRT SEPARATOR

Air and dirt separator for air, micro bubbles, sand, rust and other ferrous or non-ferrous impurities in closed loop circuits. Epoxy resin coated steel body. Complete with a set of concentric metal mesh surfaces (in stainless steel AISI 302) to create the swirling motion

required to facilitate the release of air to the top air vent and dirt to settle on the bottom of the body. Top automatic air vent in CW617N brass body, with CW614N brass special long guide and stem to prevent any impurities in the water from reaching the seal seat, float lever and spring in stainless steel and hydraulic seals in EPDM. A drain top cock in CW617 brass to draw floating impurities and allow fast filling operation. Flanged connections (PN16 for DN50-150 and PN10 for DN200-300), complete with CW617N Brass drain valve 1" F (from DN 50 to DN 150), 2" F (from DN 200 to DN 300). DN200 to 300 have a probe older of 1/2''F on both inlet and outlet of the separator. An insulation shell to prevent thermal losses and condensation is available for models from DN50 to 150. Main inner part made out of closed cell expanded PE-X, with 60 mm of thickness (for DN50 to 100) and 50 mm for DN 125 and 150, a double layer density of 30 kg/m3 on the inner part and 80 kg/m3 on the outer part, with thermal conductivity (ISO 2581) of 0,038 W/(m·K) at 0°C and 0,045 W/(m·K) at 40°C, a coefficient of resistance to water vapour (DIN 52615) over 1300, a working temperature range of 0–100°C and a class B2 reaction to fire (DIN 4102). The main shell is covered with a 0, 7 mm thickness of embossed unfinished aluminium with a class 1 reaction to fire (DIN 4102).

Medium water and non-hazardous glycol solutions excluded from the guidelines of EC directive 67/548; maximum percentage of glycol 50%. Maximum working pressure 10 bar. Working temperature range 0–100°C. Particle separation rating down to 5 µ.

Floor brackets for sizes DN 200 (from DN 200 to DN 300).

The third party TNO certification is required for the separation of air and dirt with given limits.

### AUTO AIR VENT VALVES

Air vent valves shall be provided at all higher points in piping system for venting and of following sizes:-

a) Up to 100 mm dia pipes: 25 mm dia.

Air vent valves shall be Gun metal and tested up to pressure of Class I pressure rating.

FITTINGS

The dimensions of the fittings shall conform to mentioned pipe standard (as per latest amendment) unless otherwise specified in specification.

All bends in sizes up to and including 150 mm dia shall be readymade of heavy-duty, wrought steel of appropriate class.

All fittings such as branches, reducers etc. in all sizes shall be fabricated from pipes of same dia and thickness and length at least twice the dia of pipe.

The branches may be welded straight to main line.

Blank ends are to be formed with flanged joints and 1 mm thick blank insertion of rubber gasket between flange pair for 150 mm and over in case where a future extension is to be made otherwise blank end discs of 6 mm thickness are to be welded on with additional cross stiffeners.

The tender drawings show schematically the size and location of pipes but this is for contractor's guidance only. Pipe runs may be changed to meet the site conditions.

## PIPIING SUPPORTS

All piping work shall be carried out in workman like manner causing minimum disturbance to the existing services.

Piping shall be of steel, primer coated with rust preventive paint and finished with approved shade. Pipe supports shall not exceed the following spacing: -

Maximum Spacing of Pipe Supports

| Pipe Size (MM) | Spacing (Mtr.) | Rod Size |
|---|---|---|
| 25 | 2 | 10 mm |
| 30 to 75 | 2.5 | 10 mm |
| 100 and above | 3.0 | 12.5 mm |
| 150 and above | 3.0 | 16/20 mm |

Pipe hangers shall be fixed on walls and ceiling by means of metallic Raw bolts or approved shear fasteners.

Note – It will be responsibility of vendor to design & provide required supporting accessories for proper long lasting rigid support.

Piping shall be properly supported on, or suspended from, stands, clamps, and hangers as specified and as required. The contractor shall adequately design all the brackets, saddle, anchors, clamps and hangers and be responsible for their structural sufficiency.

Vertical risers shall be parallel to walls and columns. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 10 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall also have a duck foot elbow or steel support welded to the pipe at the lowest point. On risers drain valves shall be provided at heels.

Pipe sleeve of 50 mm larger than the pipe diameter shall be provided wherever pipes pass through walls and the annular space filled with felt and finished with retaining rings. In case of an insulated pipe the diameter shall be inclusive of insulation.

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. Metal sheet shall be provided between the insulation and clamp, saddle or roller extending at least 150 mm on both sides of clamp, saddle or roller.

## PRESSURE GAUGES AND THERMOMETERS

One pressure gauge each shall be provided to measure pressure at the inlet and outlet of each cooling coil, shall be not less than 100 mm Dia and shall be complete with shut off (globe)

valve. Care shall be taken to protect pressure gauge during pressure testing, range shall not exceed 50% above normal measurement.

Thermometer shall be stem type and shall be provided at inlet and outlet of each cooling coil.

## TESTING

a) All water piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure but not less than 16 kg/sq cm for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the DESIGN CONSULTANT.
b) Pipes repaired subsequent to above pressure shall be retested in same manner.
c) Piping may be tested in section and such sections shall be securely capped.
d) The Contractor shall ensure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipments in the system concerned. If proper circulation is not achieved due to air bound connections, the 'Contractor' shall rectify the defective connections. He shall bear all the expenses for carrying out above rectifications involving tearing up and refinishing of floor walls etc. as required.
e) The Contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by Engineer in- charge at site.
f) The contractor shall provide temporary pipe connections to initially by-pass condenser/chiller and circulate water through condenser/ chilled water pipe lines for minimum 8 hours. Water should be drained out from the lowest point. The temporary lines shall be removed and blanked with dead flanges. Pot strainers and Y strainers shall be cleaned and fresh water filled in the circuits.
g) After the piping has been installed, tested and run for at least three days of eight hours each, all un-insulated exposed piping in plant room shall be given two finish coats, 3 mills each of approved colour, conforming to relevant BIS Codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows. For painting of insulated and clad pipes refer to insulation section.
h) After testing, all systems shall be chemically cleaned. After cleaning, the pipe work should be rinsed multiples times until the system is neutral. The contractor shall make a report conforming the above to Engineer in charge for records.
i) The Contractor shall provide all materials tools equipments, services and labour required to perform the test and to remove water resulting from cleaning and testing.

## BALANCING

a) After completion of the installation, all water systems shall be adjusted and balanced to deliver water quantities as specified.
b) Instruments required for the water balancing (computerized balancing instrument) shall be accurately calibrated in an approved manner before taking any measurements. Calibrated orifices and portable flow meters shall be used to balance the water flow. Orifices used for testing and balancing shall be installed with straight length upstream and downstream as recommended by the manufactures and shall be left permanently installed in the system.
c) Automatic control valve and three way valves shall be set for full flow conditions during balance by procedure. Water circuit shall be adjustable by balancing cocks provided for

balancing. These shall be permanently marked after balancing is completed so that they can be restored to their correct positions of disturbed.

## PAINTING

In case of pipes to be insulated after thorough anti grease and rust removal treatment, clean the pipe and then apply two coats of epoxy primer before applying in insulation treatment as specified elsewhere. All uninsulated pipes after de rusting will be provided with two coats of epoxy primer followed by epoxy paint of approved shade.

## FIRE BREAKS INSULATION

Firebreaks shall be provided in all ducts for internal lining/external thermal insulation after a run of 10 m center to center. There shall be a discontinuity of the insulating material in the form of MS angle of a minimum of 50 mm x 50 mm x 3 mm size. At the interface of the MS angle and insulating material, proper care of tucking in of the insulating material shall be taken so as to prevent erosion.

## SECTION-21 MIXED FLOW FANS:

**GENERAL**

a) Base fan performance at standard conditions (density 0.075 Lb/ft3).
b) Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.
c) Fans are to be equipped with lifting lugs.
d) After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be industrial gray. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.
e) Fan shall be listed for UL Standard-705.
f) Fan shall be UL listed as "Power Ventilators for Smoke Control Systems" for a minimum rating of 250˚C temperature for a minimum of 2 hours of operation. The UL certified sticker shall be fixed to the fan housing.
g) All fans shall bear the AMCA Certified Ratings Seal for air performance.
h) The Fan shall be selected for the best efficiency & lowest noise level.

**FAN HOUSING AND OUTLET**

a) Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
b) Tubular fan housing shall be completely welded and coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be gray. No uncoated metal fan parts will be allowed.
c) Housing and bearing support shall be constructed of welded structural steel members

to prevent vibration and rigidly support the shaft and bearings.

d) All mixed flow housings shall include welded steel vanes to straighten airflow prior to exiting the fan discharge.
e) An access door shall be supplied for impeller inspection and service.
f) OSHA compliant belt guard or motor cover to be included to completely cover the motor pulley and belt(s).

**FAN IMPELLER**

a) Fan impeller shall be mixed flow design. The impeller shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.
b) Fan impeller shall be manufactured with continuously welded steel airfoil and coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be industrial gray.
c) The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

**FAN MOTOR & DRIVE**

a) Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor.
b) Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.
c) Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.
d) Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or roller pillow block type.
e) Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to ensure the inner race diameter is within tolerance to prevent vibration.
f) Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class.
g) Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed.
h) Bearings shall have extended lube lines with Zerk fittings to allow for lubrication.

## SECTION- 22 FANS

### SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of centrifugal, in-line and propeller type fans and roof mounted units conforming to these

Specifications and in accordance with the requirement of Drawings and Schedule of Quantities.

## TYPE

Centrifugal, in-line propeller fans and roof mounted units shall be of the type as indicated on Drawings and identified in Schedule of Quantities.

## CAPACITY

The air-moving capacity of fans shall be as shown on Drawings and in Schedule of Quantities.

## CENTRIFUGAL FAN

Centrifugal fan shall be DWDI / SWSI Class I construction arrangement 3 (i.e. bearings on both the sides) for DWDI fans complete with access door, squirrel-cage induction motor, V-belt drive, belt guard and vibration isolators, direction of discharge / rotation, and motor position shall be as per the Approved-for-Construction shop drawings.

A. Housing shall be constructed of 14-gauge sheet steel welded construction. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans, however neoprene / asbestos packing should be provided throughout split joints to make it airtight.

18-gauge galvanized wire mesh inlet guards of 5 cm sieves shall be provided on both inlets. Housing shall be provided with standard cleanout door with handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

b. Fan Wheel shall be backward-curved non-over loading type. Fan wheel and housing shall be statically and dynamically balanced. For fans up to 450 mm dia, fan outlet velocity shall not exceed 550 meter/minute and maximum fan speed shall not exceed 1450 rpm. For fans above 450 mm dia, the outlet velocity shall be within 700 meter/minute and maximum fan speed shall not exceed 1000 RPM. High static pressure fan speed shall be as per manufacturer.

c. Shaft shall be constructed of steel, turned, ground and polished.

d. Bearings: shall be of the sleeve / ball-bearing type mounted directly on the fan housing. Bearings shall be designed especially for quiet operation and shall be of the self-aligning, oil / grease pack pillow block type.

e. Motor: Fan motor shall be energy efficient and suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, squirrel-cage, totally enclosed, fan-cooled motor, provided with class F insulation, and of approved make. Motor name plate horsepower shall exceed brake horsepower by a minimum of 10%. Motor shall

be designed especially for quiet operation and motor speed shall not exceed 1440 rpm. The fan and motor combination selected for the particular required performance shall be of the most efficient (smallest horse power), so that sound level is lowest.
000

| HP | POWER FACTOR | | | EFFICIENCY | | |
|---|---|---|---|---|---|---|
| | FL | ¾L | ½L | FL | ¾L | ½L |
| 0.50 | 0.71 | 0.62 | 0.50 | 73.00 | 73.00 | 68.00 |
| 0.75 | 0.74 | 0.64 | 0.50 | 78.00 | 78.00 | 70.00 |
| 1.00 | 0.76 | 0.67 | 0.55 | 82.50 | 82.50 | 77.00 |
| 1.50 | 0.77 | 0.70 | 0.57 | 83.80 | 83.80 | 80.00 |
| 2.00 | 0.77 | 0.70 | 0.57 | 85.00 | 85.00 | 81.00 |
| 3.00 | 0.82 | 0.74 | 0.60 | 86.40 | 86.40 | 84.00 |
| 5.00 | 0.82 | 0.78 | 0.63 | 88.30 | 88.30 | 86.00 |
| 7.50 | 0.85 | 0.80 | 0.71 | 89.50 | 88.50 | 88.00 |
| 10.00 | 0.86 | 0.83 | 0.76 | 90.30 | 90.30 | 89.00 |
| 12.50 | 0.84 | 0.82 | 0.73 | 90.50 | 90.50 | 88.00 |
| 15.00 | 0.85 | 0.83 | 0.76 | 91.50 | 91.50 | 89.50 |
| 20.00 | 0.85 | 0.83 | 0.76 | 92.20 | 92.20 | 91.00 |
| 25.00 | 0.85 | 0.82 | 0.76 | 92.40 | 92.40 | 91.00 |
| 30.00 | 0.85 | 0.80 | 0.72 | 92.80 | 92.80 | 92.00 |
| 40.00 | 0.86 | 0.85 | 0.80 | 93.20 | 93.20 | 91.00 |
| 50.00 | 0.87 | 0.85 | 0.77 | 93.60 | 93.60 | 91.60 |
| 60.00 | 0.88 | 0.86 | 0.78 | 93.90 | 93.90 | 91.90 |
| 75.00 | 0.87 | 0.85 | 0.78 | 94.20 | 94.20 | 92.80 |

f. Drive to fan shall be provided through belt with adjustable motor sheave and a standard belt guard. Belts shall be of the oil-resistant type.

g. Vibration Isolation: MS base shall be provided for both fan and motor, built as an integral part, and shall be mounted on a concrete foundation through resistoflex vibration isolators. The concrete foundation shall be at least 15 cm above the finished floor level, or as shown in approved-for-construction shop drawings.

a. Centrifugal fans for smoke extract application shall have external belt drive and motor. Fan & casing shall be internally rated for 300°C for 2 hours.

## AXIAL FLOW FAN

### Axial Flow Fan (Standard)

Fan shall be complete with motor, motor mount, belt driven (or direct driven) and vibration isolation type, suspension arrangement as per approved for construction shop drawings.

ii. Casing: shall be constructed of heavy gage sheet steel. Fan casing, motor mount and straightening vane shall be of welded steel construction. Motor mounting plate shall be minimum 15 mm thick and machined to receive motor flange.

An inspection door with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Fan casing are with internal punched inlet and outlet flanges to prevent air leakage, for size up to 1600 mm dia and shall be constructed of rolled steel with a continuous seam welded. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be bonderized, primed (minimum 2 coats of rust-proof primer) and finish coated with enamel paint or powder coated after phosphating process.

iii. Rotor: hub and blades shall be cast aluminium alloy or cast steel construction. Blades shall be die-formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Rotor shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually readjusted at site upon installation, for obtaining actual air flow values, as specified and quoted. Taper lock bushing shall be used to mount the propeller to the motor shaft. The impeller and fan casing shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

c. Motor: shall be energy efficient squirrel-cage, totally-enclosed, fan cooled, standard frame, constant speed, continuous duty, single winding, suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, provided with class `F' insulation. Motor shall be specially designed for quiet operation. The speed of the fans shall not exceed 1000 RPM for fans with impeller diameter above 450

mm, and 1440 RPM for fans with impeller diameter 450 mm and less. For lowest sound level, fan shall be selected for maximum efficiency or minimum horsepower. Motor conduit box shall be mounted on exterior of fan casing, and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit.

| HP | POWER FACTOR | | | EFFICIENCY | | |
|---|---|---|---|---|---|---|
| | FL | ¾L | ½L | FL | ¾L | ½L |
| 0.50 | 0.71 | 0.62 | 0.50 | 73.00 | 73.00 | 68.00 |
| 0.75 | 0.74 | 0.64 | 0.50 | 78.00 | 78.00 | 70.00 |
| 1.00 | 0.76 | 0.67 | 0.55 | 82.50 | 82.50 | 77.00 |
| 1.50 | 0.77 | 0.70 | 0.57 | 83.80 | 83.80 | 80.00 |
| 2.00 | 0.77 | 0.70 | 0.57 | 85.00 | 85.00 | 81.00 |
| 3.00 | 0.82 | 0.74 | 0.60 | 86.40 | 86.40 | 84.00 |
| 5.00 | 0.82 | 0.78 | 0.63 | 88.30 | 88.30 | 86.00 |
| 7.50 | 0.85 | 0.80 | 0.71 | 89.50 | 88.50 | 88.00 |
| 10.00 | 0.86 | 0.83 | 0.76 | 90.30 | 90.30 | 89.00 |
| 12.50 | 0.84 | 0.82 | 0.73 | 90.50 | 90.50 | 88.00 |
| 15.00 | 0.85 | 0.83 | 0.76 | 91.50 | 91.50 | 89.50 |
| 20.00 | 0.85 | 0.83 | 0.76 | 92.20 | 92.20 | 91.00 |
| 25.00 | 0.85 | 0.82 | 0.76 | 92.40 | 92.40 | 91.00 |
| 30.00 | 0.85 | 0.80 | 0.72 | 92.80 | 92.80 | 92.00 |
| 40.00 | 0.86 | 0.85 | 0.80 | 93.20 | 93.20 | 91.00 |
| 50.00 | 0.87 | 0.85 | 0.77 | 93.60 | 93.60 | 91.60 |
| 60.00 | 0.88 | 0.86 | 0.78 | 93.90 | 93.90 | 91.90 |
| 75.00 | 0.87 | 0.85 | 0.78 | 94.20 | 94.20 | 92.80 |

d. Drive: to fan shall be provided through belt drive with adjustable motor sheave and standard sheet steel belt guard with vented front for heat dissipation. Belts shall be of oil-resistant type.

e. Vibration Isolation: The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of heavy duty spring isolators type.

iv. Accessories: The following accessories shall be provided with all fans:

v. Outlet cone for static pressure regain.

ii. Inlet cone.

Fan silencers may be provided where specifically called for in Schedule of Quantities. Fans shall be factory assembled and shipped with all accessories factory-mounted.

**Axial Flow Fan shall be AMCA certified for Air and Sound performance in accordance to AMCA 210 and AMCA 300. Fan shall be suitable for both indoor and outdoor application with all accessories. Base fan performance shall be at standard conditions (density 1.2 Kg/Cu.mt.)**

### Axial Flow Fan (UL Listed/ CE Certified)

Fan shall be suitable for mounting in duct or wall / floor / slab as required. Fan shall be complete with motor, motor mount, belt driven (or direct driven) and vibration isolation type, suspension arrangement as per approved for construction shop drawings.

vi. Casing: shall be constructed of heavy gage sheet steel. Fan casing, motor mount and straightening vane shall be of welded steel construction. Bolt construction is not acceptable. Motor mounting plate shall be of structural steel with minimum 15 mm thick and suitable to handle the weight of the motor and propeller, machined to receive motor flange.

An inspection door with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Fan casing are with internal punched inlet and outlet flanges to prevent air leakage, for size upto 1600 mm dia and shall be constructed of rolled steel with a continuous seam welded confirming to UL standards. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be bonderized, primed (minimum 2 coats of rust-proof primer) and finish coated with enamel paint or powder coated after phosphating process as prescribed in UL-705.

vii. Rotor: hub and blades shall be cast aluminum alloy or cast steel construction. Blades shall be die-formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Rotor shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually readjusted at site upon installation, for obtaining actual

air flow values, as specified and quoted. Taper lock bushing shall be used to mount the propeller to the motor shaft. The impeller and fan casing shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

c. Motor: shall be energy efficient squirrel-cage, totally-enclosed, fan cooled, standard frame, constant speed, continuous duty, single winding, suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, provided with class `F' insulation. Motor shall be specially designed for quiet operation. The speed of the fans shall not exceed 1000 RPM for fans with impeller diameter above 450 mm, and 1440 RPM for fans with impeller diameter 450 mm and less. For lowest sound level, fan shall be selected for maximum efficiency or minimum horsepower. Motor shall pass elevated temperature test and other tests as per UL standards and shall be UL listed. Motor conduit box shall be mounted on exterior of fan casing, and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible liquid tight PVC conduit confirming to UL standards.

| **HP** | **POWER FACTOR** | | | **EFFICIENCY** | | |
|---|---|---|---|---|---|---|
| | **FL** | **¾L** | **½L** | **FL** | **¾L** | **½L** |
| 0.50 | 0.71 | 0.62 | 0.50 | 73.00 | 73.00 | 68.00 |
| 0.75 | 0.74 | 0.64 | 0.50 | 78.00 | 78.00 | 70.00 |
| 1.00 | 0.76 | 0.67 | 0.55 | 82.50 | 82.50 | 77.00 |
| 1.50 | 0.77 | 0.70 | 0.57 | 83.80 | 83.80 | 80.00 |
| 2.00 | 0.77 | 0.70 | 0.57 | 85.00 | 85.00 | 81.00 |
| 3.00 | 0.82 | 0.74 | 0.60 | 86.40 | 86.40 | 84.00 |
| 5.00 | 0.82 | 0.78 | 0.63 | 88.30 | 88.30 | 86.00 |
| 7.50 | 0.85 | 0.80 | 0.71 | 89.50 | 88.50 | 88.00 |
| 10.00 | 0.86 | 0.83 | 0.76 | 90.30 | 90.30 | 89.00 |
| 12.50 | 0.84 | 0.82 | 0.73 | 90.50 | 90.50 | 88.00 |
| 15.00 | 0.85 | 0.83 | 0.76 | 91.50 | 91.50 | 89.50 |
| 20.00 | 0.85 | 0.83 | 0.76 | 92.20 | 92.20 | 91.00 |
| 25.00 | 0.85 | 0.82 | 0.76 | 92.40 | 92.40 | 91.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 30.00 | 0.85 | 0.80 | 0.72 | 92.80 | 92.80 | 92.00 |
| 40.00 | 0.86 | 0.85 | 0.80 | 93.20 | 93.20 | 91.00 |
| **HP** | **POWER FACTOR** | | | **EFFICIENCY** | | |
| | **FL** | **¾L** | **½L** | **FL** | **¾L** | **½L** |
| 50.00 | 0.87 | 0.85 | 0.77 | 93.60 | 93.60 | 91.60 |
| 60.00 | 0.88 | 0.86 | 0.78 | 93.90 | 93.90 | 91.90 |
| 75.00 | 0.87 | 0.85 | 0.78 | 94.20 | 94.20 | 92.80 |

d. Drive: Fan shall be provided through direct / belt drive with adjustable motor sheave and standard sheet steel belt guard with vented front for heat dissipation. Belts shall be of oil-resistant type.

e. Vibration Isolation: The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of heavy duty spring isolators type.

viii. Accessories: The following accessories shall be provided with all fans:

ix. Outlet cone for static pressure regain.
ii. Inlet cone.

Fan silencers may be provided where specifically called for in Schedule of Quantities. Fans shall be factory assembled and shipped with all accessories factory-mounted confirming to UL standards.

*Complete fan assembly (fan, impeller, fan casing, motor base frame along with motor) shall be ensure mechanical, electrical, water safety as per UL standards.*

**Axial Flow Fan shall be AMCA certified for Air and Sound performance in accordance to AMCA 210 & AMCA 300 and shall be UL listed in accordance with UL 705 for both indoor and outdoor application with all accessories. Base fan performance shall be at standard conditions (density 1.2 Kg/Cu.mt.)**

## PROPELLER FAN

Propeller fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring.

x. Mounting Plate shall be of steel construction, square with streamlined venturi inlet (reversed for supply applications) coated with baked enamel paint.

Mounting plate shall be of standard size, constructed of 12 to 16 gauge sheet steel depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

xi. Fan Blades shall be constructed of aluminium or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works.

xii. Shaft shall be of steel, accurately ground and shall be of ample size for the load transmitted and shall not pass through first critical speed thru the full range of specified fan speeds.

d. Motor shall be standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed with prelubricated sleeve or ball bearings, designed for quiet operation with a maximum speed of 1000 rpm for fans 60 cm dia or larger and 1440 rpm for fans 45 cm dia and smaller. Motors for larger fans shall be suitable for 415±6% volts, 50 cycles 3 phase power supply, and for smaller fans shall be suitable for 220 ± 6% volts, 50 cycles single phase power supply. Motors shall be suitable for either horizontal or vertical service as indicated on Drawings and in Schedule of Quantities.

e. Accessories: The following accessories shall be provided with propeller fans:

xiii. Wire guard on inlet side and bird-screen at the outlet.
ii. Fixed or gravity louvers built into a steel frame at the outlet.
xiv. Regulator for controlling fan speed for single phase fan motor.
xv. Single phase preventers for 3 phase fans.

### PERFORMANCE DATA

All fans shall be selected for the lowest operating noise level. Capacity ratings, power consumption, with operating points clearly indicated, shall be submitted and verified at the time of testing and commissioning of the installation.

### TESTING

Capacity of all fans shall be measured by an anemometer. Measured air flow capacities shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

## COMMISSIONING & HANDOVER:

CONTRACTOR SHALL PROVIDE ALL THE DOCUMENTS ASKED BY CONSULTANT/CLINT/ARCHTECT

## AIR DISTRIBUTION

(FOR DUCTS FABRICATED IN FACTORY AS PER "SMACNA" STANDARDS)

## SCOPE

The scope of this section comprises supply fabrication, installation and testing of all sheet metal / aluminum ducts, supply, installation, testing and balancing of all grilles, registers and diffusers. All to be in accordance with these specifications and the general arrangement shown on the Drawings.

## DUCT MATERIALS

### Raw Materials

Galvanized steel sheets with Class – VII Galvanizing – light coating of zinc (Zinc coating shall be Lead free), nominal 120gm/sq.m surface area and Lock Forming Quality prime material along with mill test certificates. In addition, if deemed necessary, samples of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

### Gauges, Bracing By Size Of Ducts

All ducts shall be factory fabricated from galvanized steel / aluminum of the following thickness, as indicated below:

For Ducts with External SP upto 250 Pa

**To be used for Hotels & Commercial Projects**

| **Rectangular Ducts G. S.** | **External Pressure 250 Pa** | | |
|---|---|---|---|
| | **Duct Section Length 1.2 m (4 ft)** | | |
| **Maximum Duct Size** | **Gauge** | **Joint Type** | **Bracing Spacing** |
| 1–500 mm | 26 | C&S Connector | Nil |
| 501 – 750 mm | 26 | TDF Flange | Nil |
| 751 – 900 mm | 24 | TDF Flange | Nil |
| 901 – 1200 mm | 24 | TDF Flange | Nil |
| 1201 – 1500 mm | 22 | TDF Flange | Nil |
| 1501 – 1800 mm | 20 | TDF Flange | JTR or ZEE BAR |
| 1801 – 2100 mm | 20 | TDF Flange | JTR or ZEE BAR |
| 2101 – above | 18 | TDF Flange | JTR or ZEE BAR |

**OR**

For Ducts with External SP upto 500 Pa

**For Hospital & Clean room jobs, where AHU SP is specified as 75 mm and above.**

**<u>Not Suitable for Ots</u>**

| **Rectangular Ducts G. S.** | **External Pressure 500 Pa** | | |
|---|---|---|---|
| | **Duct Section Length1.2 m (4 ft)** | | |
| **Maximum Duct Size** | **Gauge** | **Joint Type** | **Bracing Spacing** |
| 1–400 mm | 26 | C&S Connector | Nil |
| 401-700 mm | 24 | TDF Flange | Nil |
| 701-900 mm | 24 | TDF Flange | Nil |
| 901-1000 mm | 22 | TDF Flange | Nil |
| 1001-1200 mm | 22 | TDF Flange | JTR or ZEE BAR |
| 1201-2100 mm | 20 | TDF Flange | JTR or ZEE BAR |
| 2101-above | 18 | TDF Flange | JTR or ZEE BAR |

*Distance of reinforcement/bracing from each joint. Bracing material to be same as of material used for joining of duct sections.

FOR ALUMINUM DUCTS MATERIAL SHALL BE ONE COMMERCIAL GAUGE HIGHER WITH 22 G AS MINIMUM

4.2.3 For Round Ducts

| Duct diameter mm | Upto 50 mm Wg static pressure (+ve) | | 51 – 250 mm Wg static pressure (+ve) | | Upto 50 mm Wg static pressure (-ve) | |
|---|---|---|---|---|---|---|
| | Spiral seam gauge | Longitudinal seam gauge | Spiral seam gauge | Longitudinal seam gauge | Spiral seam gauge | Longitudinal seam gauge |
| Upto 650 | 26 | 24 | 24 | 22 | 24 | 22 |
| 651-900 | 24 | 22 | 22 | 20 | 22 | 20 |
| 901 – 1250 | 22 | 20 | 20 | 20 | 20 | 18 |
| 1251 – 1500 | 20 | 18 | 18 | 18 | 18 | 16 |
| 1501 – 2100 | 18 | 16 | 18 | 16 | 16 | 14 |

FABRICATION STANDARDS & EQUIPMENT

All duct construction and installation shall be in accordance with SMACNA standards. In addition, ducts shall be factory fabricated utilizing the following machines to provide the requisite quality of ducts.

1. Coil (Sheet metal in Roll Form) lines to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.

xvi. All ducts, transformation pieces and fittings to be made on CNC profile cutter for requisite accuracy of dimensions, location and dimensions of notches at the folding lines.

xvii. All edges to be machine treated using lock formers, flangers and rollers for turning up edges.

xviii. Kitchen exhaust ducting shall be with 16 G MS welded construction. Suitable access doors shall be provided at every 3m. Provision shall be made for firefighting agency to install duct mounted sprinklers at every 3m. Generally, exhaust ducts shall have slope towards kitchen hood. Spot Welded M.S Stuck-up pins shall be provided facilitating insulation of the Duct.

Laundry and dish washer extract duct shall be air and water tight construction manufactured from Aluminium sheets in accordance to BS 1470

## DUCT CONSTRUCTION

All ducts shall be fabricated and installed in workmanlike manner, conforming to relevant SMACNA codes.

a) Ducts so identified on the Drawings shall be acoustically lined and insulated from outside as described in the section "Insulation" and as indicated in schedule of Quantities. Duct dimensions shown on drawings, are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in Schedule of quantities. The fabricated duct dimensions should be as per approved drawings and care should be taken to ensure that all connecting sections are dimensionally matched to avoid any gaps.

b) Ducts shall be straight and smooth on the inside with longitudinal seams shall be airtight and at corners only which shall be either Pittsburgh or snap button as per SMACNA practice, to ensure air tightness.

c) All ducts up to 75cms width within conditioned spaces shall have C&S connector. The internal ends of slip joints shall be in the direction of airflow. Care should be taken to ensure that Cleats are mounted on the longer side of the duct and Cleats on the shorter side. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint.

d) Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Air-turns (vanes) shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

e) Ducts shall be fabricated as per details shown on Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing

seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

f) All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans, shall be constructed of 18 gauge GSS / 16gauge aluminum, thoroughly stiffened with 25mm x 25mm x 3mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Access doors shall be not less than 45cm x 45cm in size.

g) Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside.

h) Self-adhesive Neoprene rubber / UV resistant PVC foam lining 5mm nominal thickness instead of felt, shall be used between duct flanges and between duct supports in all ducting installation.

i) All fire rated duct, smoke exhaust ducts shall be quoted with flame bar BWII or equivalent to achieve the required fire rating also all the related accessories gaskets shall be suitable for the required fire rating.

## INSTALLATION PRACTICE

All ducts shall be installed generally as per tender drawings, and in strict accordance with approved shop drawings to be prepared by the Contractor:

a) The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these Specifications and Drawings. The work shall meet with the approval of Owner's site representative in all its parts and details

xix. All necessary allowances and provisions shall be made by the Contractor for ducts, pipes, or other obstructions in the building, whether the same are shown on the drawings. Where necessary to avoid beams or other structural work, copper or other pipes, and ducts, the ducts shall be rerouted, divided or resized to one side (the required area being maintained) all as per the site requirements.

xx. If a duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available in accordance with other services and as per approval of owner's site representative.

xxi. All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with hangers formed of galvanized steel wire ropes (as per clause 20.12) and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel wire hangers under ducts, rigid supports may be provided at certain interval if need be. The spacing between supports should be not greater than 2.4 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates or Toggle end wire fixing left in slab at the time of slab casting.

Galvanized steel cleat with a hole for passing the wire rope hanger shall be welded to the plates. Trapeze hanger formed of galvanized steel wire rope using Gripple shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Wire rope supports shall hang through the cleats or wire rope threaded studs can be screwed into the anchor fasteners.

b) Alternatively, if mentioned in the SOQ, all ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel rod under ducts**.** The spacing between supports should be not greater than 2.0 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats or fully threaded galvanized rods can be screwed into the anchor fasteners.

c) Ducting over furred ceiling shall be supported from the slab above, or from beams after obtaining approval of Owner's site representative. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false

ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

d) Where ducts pass through brick or masonry openings, it shall be provided with 25mm thick TF quality expanded polystyrene around the duct and totally covered with fire barrier mortar for complete sealing.

e) All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 10cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

f) Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top.

## STEEL WIRE ROPE HANGERS & SUPPORTS:

Wire Hangers shall be used to suspend all static HVAC Air Distribution services.

Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10) stud, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturers recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a Hanger self-locking grip (double channel lock) at the other end. Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key and should not be an integral part of the self-locking grip. Only wire and/or supports supplied and/or approved, shall be used with the system.

- Wire Hangers should have been independently tested by Lloyds Register. APAVE, TUV, UL NEBS, CSA, Chiltern International fire, ADCAS, Intertek, ECA, and SMACNA, approved by ULC and CSA and comply with the requirements of DW/144 and BSRIA – wire Rope Suspension systems. Wire rope should be manufactured to BSEN 12385: 2002

- The contractor shall select the correct specification of wire hanger to use for supporting each particular service from Table 1 below. Each size is designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).

The correct specification of wire hanger required is determined using the following formula.

**Weight per meter of object suspended (kg) X distance between suspension points (m) = weight loading per Hanger suspension point (kg).**

Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations give in the manufacturer's handbook.

The contractor shall select the correct length of wire rope required to support the service. Lengths from 1-10m lengths. Specials can be made, check with manufacturer. No in–line joints should be made in the rope.

Table. 1

| Wire Hanger Safe Working Loads | | |
|---|---|---|
| **Hanger size** | **minimum breaking load of Wire Rope (Kg / lbs)** | **working load limit (kg/lbs)** |
| No. 1 | 80kg/176 lbs | 0-10 kg / 0-22 lbs |
| No. 2 | 260kg/572 lbs | 10-45 kg / 23-100 lbs |
| No. 3 | 580kg/1276 lbs | 45-90 kg / 101-200 lbs |
| No. 4 | 1500kg/3300 lbs | 90-225 kg / 210-495 lbs |
| No. 5 | 2160kg/4752 lbs | 225-325 kg / 496-715 lbs |
| No. 6 | 2500kg/5500 lbs | 325-500 kg / 715-1100 lbs |

The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless-steel wire rope as per the application, the minimum specification is as above and should be manufactured to BS 302 (1987), BSEN12385. **Comply with manufacturer's load ratings and recommended installation procedures.**

## A HVAC Supports

Gripple Hanger Supports are suitable for: Rectangular duct, Spiral Duct, Oval Duct, Fabric Duct, Diffusers, plenum boxes

## B Ducting Supports:

a. All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with hangers formed of galvanized steel wire ropes and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel wire hangers under ducts, rigid supports may be provided at certain interval if need be. The spacing between supports should be not greater than 2.4 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates or Toggle end wire fixing left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the wire rope hanger shall be welded to the plates. Trapeze hanger formed of galvanized steel wire rope using Gripple shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Wire rope supports shall hang through the cleats or wire rope threaded studs can be screwed into the anchor fasteners. In case of PEB structure Loop and Catenary system can be used based on the site conditions as per approved suspension system drawings.

b. All horizontal ducts shall be adequately secured and supported. In an approved manner, with trapeze Hangers formed of galvanized steel wire rope in a cradle support method (refer to typical drawings) under ducts at no greater than 3000mm centre, for 3001mm-above appropriate size angle along with neoprene pad in between the duct & MS angle should be used with prior approval. All vertical duct work shall be supported by structural members on each floor slab. Duct support shall be through dash / anchor fastener driven into the concrete slab by electrically operated gun. Hanger wires shall then hang around the ducting. Rigid supports shall be used in conjunction with wire rope hangers to assist with alignment of services where recommended for by the manufacturer. Rigid support must also be used in conjunction with wire rope hangers with duct work at each change of direction or connection or as per approved drawings. Support ducting in accordance with Schedule I specified below. Any other Gripple solution can be used based on manufacturer's recommendation on site conditions after prior approval. In cases of Spiral ducting the wire can be wrapped directly around the ducting without the need for a spiral ducting clamp for sizes above 1100 a cradle support should be provided, refer to manufacturer's recommendations.

c. Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Construction manager/consultant. In no case shall any duct be supported from false ceiling Hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other Contractor's work in the building. All supports of pipe shall be taken from structural slab/wall by means of fastener.

d. Stainless Steel Supports should be provided for food, chemical and High Corrosion areas near coastlines.

For further technical information, refer to manufacturers catalogue and installation guide. **Comply with manufacturer's load ratings and recommended installation procedures.**

**Schedule I: Duct Hanger Schedule**

| Maximum Duct Size (mm) | Gauge | Wire Hanger size | Maximum Duct Size (mm) | Gauge | Wire Hanger size |
|---|---|---|---|---|---|
| 1 - 500 | 26 | No. 1 or 2 | 1–400 mm | 26 | No. 2 |
| 501 - 750 | 26 | No. 1 or 2 | 401-700 mm | 24 | No. 2 or 3 |
| 751 - 900 | 26 | No. 2 | 701-900 mm | 24 | No. 2 or 3 |
| 901 - 1200 | 24 | No. 2 or 3 | 901-1000 mm | 22 | No. 3 or 4 |
| 1201 - 1500 | 22 | No. 3 | 1001-1200 mm | 22 | No. 3 or 4 |
| 1501 - 1800 | 22 | No. 3 or 4 | 1201-2100 mm | 22 | No. 3 or 4 |
| 1801-2100 | 20 | No. 3 or 4 | 2101 - 3000mm | 18 | No. 4 |
| 2101-3000 | 18 | No. 4 | 3001 - above (Trapeze type support Arrangement) | 18 | No. 3 or 4 |
| 3001 - above (Trapeze type support Arrangement) | 18 | No. 3 or 4 | | | |

**Notes: All supports are considered at 2400 mm interval in above table and may vary as per the design but should not be greater than 2400mm.**

All units shall be adequately secured and supported in an approved manner using wire hanger suspension Y fit solution as per manufacturers' recommendation with prior approval.

**Rigid Supports to be used in conjunction with wire supports:**

Rigid supports if required in conjunction with wire hangers shall be of steel, adjustable for height and Zinc chromate primer coated and finish coated black. Where supports and clamps are of dissimilar materials, a gasket shall be provided in between. If the MS angle at the bottom if required as per design should be as per following table:

| **Longer size of Duct (mm)** | **Type of Joints** |
|---|---|
| Up to 750 | 25x25x3 mm L angle with M8 nuts & bolts |
| 751-1000 | 25x25x3 mm L angle with M8 nuts & bolts |
| 1001-1500 | 40x40x5 mm L angle with M8 nuts & bolts |
| 1501-2250 | 50x50x5 mm L angle with M10 nuts & bolts |
| 2251 & above | 50x50x6 mm L angle with M10 nuts & bolts |

All the supporting system should be supplied from the same manufacturer.

## DOCUMENTATION & MEASUREMENTS FOR DUCTING

All ducts fabricated and installed should be accompanied and supported by proper documentation viz:

xxii. Bill of material/Packing list for every duct section supplied.

Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

Each and every duct piece to have a tag number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement and verification.

Unless otherwise specified, measurements for ducting for the project shall be on the basis of centerline measurements described herewith:

Ductwork shall be measured on the basis of external surface area of ducts. Duct measurements shall be taken before application of the insulation. The external surface area shall be calculated by measuring the perimeter comprising overall width and depth, including the corner joints, in the center of each duct section, multiplying with the overall length from flange face to flange face of each duct section and adding up areas of all duct sections. Plenums shall also be measured in a similar manner.

For tapered rectangular ducts, the average width and depth shall be considered for perimeter, whereas for tapered circular ducts, the diameter of the section midway between large and small diameter shall be adopted, the length of tapered duct section shall be the centerline distance between the flanges of the duct section.

For special pieces like bends, tees, reducers, branches and collars, mode of measurement shall be identical to that described above using the length along the centerline.

The quoted unit rate for external surface of ducts shall include all wastage allowances, flanges and gaskets for joints, nuts and bolts, hangers and angles with double nuts for supports, rubber strip 5mm thick between duct and support, vibration isolator suspension where specified or required, inspection chamber/access panel, splitter damper with quadrant and lever for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall NOT be separately measured nor paid for.

xxiii. Special Items for Air Distribution shall be measured by the cross-section area perpendicular to air flow, as identified herewith:

xxiv. Grilles and registers – width multiplied by height, excluding flanges. Volume control dampers shall form part of the unit rate for registers and shall not be separately accounted.

ii. Diffusers - cross section area for air flow at discharge area, excluding flanges. Volume control dampers shall form part of unit rate for supply air diffusers and shall not be separately accounted.

iii. Linear diffusers – shall be measured by cross-sectional areas and shall exclude flanges for mounting of linear diffusers. The supply air plenum for linear diffusers shall be measured with ducting as described earlier.

xxv. Fire dampers – shall be measured by their cross sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary collars and flanges for mounting, inspection pieces with access door, electrical actuators and panel. No special allowance shall be payable for extension of cross section outside the air stream.

v. Flexible connection – shall be measured by their cross sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary mounting arrangement, flanges, nuts and bolts and treated-for-fire requisite length of canvas cloth.

xxvi. Kitchen Hoods – shall be measured by their cross sectional area at the capture point of fumes, parallel to the surface of kitchen equipment. Quoted rates shall include the grease filters, provision for hood light, suspension arrangement for the hood, profile to direct the air to ventilation ducts and provision for removable drip tray.

## FLEXIBLE DUCT

Insulated flexible duct should be UL 181 CLASS I AIR DUCT LISTED AND LABELLED WITH NFPA 90A & 90B AND SEAL OF AIR DIFFUSION COUNCIL with double lamination of tough polyester which encapsulates steel helix wire forms the air tight inner core, double layer core wrapped in a multiple thickness of fiberglass wool with R Value 4.2, Green guard certification of fiberglass wool must. Reinforced and sheathed in a rugged and durable tridirectionally reinforced matlized polyester jacket.

Flexible duct connections should be made as per UL181 listing procedure with proper flexible right forming brace connection allowing right connections for flexible duct into energy efficient. And Strapping the flexible duct connections with flexible duct strap ties.

### TESTING AND BALANCING

After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks by visual inspection.

The entire air distribution system shall be balanced using an anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less/excess than 5 percent of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval, and four copies of the approved balance report shall be provided with completion documents.

## SECTION- 23 ECOLOGY UNIT

### SCOPE

The scope includes Design, Supply, Fabricate, Install, Test & Commission the complete product as per site requirement.

### DESCRIPTION

Unit Shall Be Double Skin Type Self Contained Factory Assembled Capable Of Significantly Reducing Smoke, Grease & Odor From The Exhaust Air Stream. Unit Shall Have UL 762 Certified Mixed Flow Fan Suitable for Kitchen Exhaust Application & Electrostatic Precipitator Having Efficiency Not Less Than 90% For 1 Micron Particle Size At Operating Condition (Airflow).

### HOUSING

Unit Housing Shall Be 23 Mm +/- 2 Mm Thick Puf Insulated Double Skin Panel With 0.6 Mm Thick Precoated Gi Sheet Outer Skin & 0.6 Mm Thick Plain Inner Gi Sheet With Casing Constructed Of Extruded Aluminum Profile.

### BASE

Unit Base Shall Be Bolted Construction Made Of Heavy Gaue Gi & Complete Unit Supported On Base.

### FAN SPECIFICATIONS

Fan Type-Fan Shall Be Mixed Flow Inline Fan Suitable For Kitchen Exhaust Application, Low Noise Level & Energy Efficient. Motor Must Be Outside Airpath.

## CERTIFICATION

Fan Must Be AMCA Certified For Air & Sound Performance.
Fan Must Be UL 762 Certified. (UL 762 Is Concerned With Fans Designed For Removal Of Smoke & Grease Laden Vapors With Air Stream Temperature Up To 400 Degrees Fahrenheit.)

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# NON-DSR TECHNICAL SPECIFICATIONS

# FIRE FIGHTING WORKS

## GENERAL

### CONTRACTORS RESPONSIBILITIES

The Contractor is responsible for the quality and the satisfactory operation of the installations entrusted to him, as well as for compliance with the performance stipulated in this document.
Consequently, for his own account and under his own responsibility, he must carry out all calculations and select the necessary materials and equipment.
Apart from the required performance definitions, this document and the relevant drawings also provide many indications resulting from the studies carried out by the Engineer.
The Contractor shall review these studies and check the corresponding indications.
The same applies to equipment selection, for which the information given in this document must be deemed as indicative and defines only the minimum requirements.

### SCOPE DESCRIPTION

The contractor shall furnish all labor, materials, tools, supplies, equipment, transportation, supervision, technical, professional, and other services, and shall perform all operations necessary and required to satisfactorily complete all the necessary engineering, procurement services, construction work and commissioning for the systems and equipment for the project.

### BASIC DESIGN CRITERIA

Refer tender Drawings and Documents.

### CODES AND STANDARDS

All the systems shall be designed and installed in accordance with the requirement of International Codes and Standards and Local Authority having Jurisdiction. They shall be particularly in accordance with the following standards:

| Serial No. | Code No. | Code |
|---|---|---|
| 1 | NBC Part – IV | National Building Code of India; Part IV Fire & Life Safety |
| 2 | TAC | Tariff Advisory Committee fire protection manual Part-I. |
| 3 | IS-1239 / IS 3589 | Specification for MS / GI Pipes |
| 4 | IS 778 | Specifications for Gun Metal gate, globe & check Valves for water supply |
| 5 | IS 4927 | Specifications for Canvas Hose Pipes. |
| 6 | IS 903 | Specifications for Branch pipes Fire hose |

| | | |
|---|---|---|
| | | couplings and auxiliary equipment's |
| 7 | IS-5290 | Specifications for hydrant landing valves. |
| 8 | IS-4853 | Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes |
| 9 | IS-636 | Specifications for no-percolating flexible firefighting hose pipes. |
| 10 | IS 9137 | Specification for horizontal end suction centrifugal pump. |
| 11 | BS 1965 Part I | Specification for butt-welded Pipe Fittings. |
| 12 | IS 8423 | Controlled percolating hose for firefighting. |
| 13 | IS 2871 | Branch pipe, universal for firefighting purposes |
| 14 | IS 884 | First aid hose reel for fire fighting |
| 15 | IS 5131 | Dividing Breeching with Control for Fire Brigade Use |
| 16 | IS 2002 | Steel plates for pressure vessels for intermediate and high temperature service including boilers |
| 17 | IS: 6392 | Steel pipe flanges |
| 18 | IS 908 | Specification for fire hydrant, stand post type |
| 19 | IS:8432 | Tubes, Tracheotomy (rubber or plastics) |
| 20 | IS 903 | Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner. |
| 21 | IS 11149 | Rubber Gaskets |
| 22 | IS 6912 | Copper and copper alloy forging stock and forgings |
| 23 | IS 210 | Grey Iron Castings |
| 24 | IS 1367 | Technical Supply Conditions for Threaded Steel Fasteners |
| 25 | IS 5312 | Swing Check Type Reflux (Non-Return] Valves for Water Works |
| 26 | IS 10221 | Coating and wrapping of underground mild steel pipelines - Code of practice |

## GENERAL CONDITIONS

1.1 The schedules, tender drawings, and contract documents provided for reference design intent. It is the scope of contractor to verify, design, manufacture, supply, transport, install, test , commission, handover the complete FIREFIGHTING system including all necessary services, accessories, material, equipment , Tools & tackles, labor , and any other type of service or material as required.

1.2 It is not the intent to specify completely herein all details of design and construction of system/ plant/ equipment to be supplied / erected. However, the system/ plant/ equipment supplied shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation in a manner acceptable to the Client who will interpret the meaning of drawings and specifications and shall l have the power to reject any work or material which in his judgement are not in full accordance therewith.

1.3 In case of discrepancy and / or disparity between these general and special conditions of contract and any other sections enclosed here in, the most stringent shall apply and the decisions of the Client/consultant shall be final.

1.4 Entire works which are part of this contract shall be completed in all respects and handed over in the timeline defined by the client with the award of contract. However final timeline will be decided based on mutual agreement during finalization.

## NSR-51 & 52 :- 'C' class heavy duty MS Pipe

1. Underground/Outside pipes shall be Galvanized Steel conforming to IS: 1239
2. (heavy class) duly wrapped and coated as per IS: 10221 with welded joints. The coating / wrapping protection shall be tested.
3. Pipes for risers, Basements, headers and floor branches inside the building shall be Galvanized Steel conforming to IS:1239 (heavy class) up to 150 mm dia. Pipes 200mm dia. and above shall conform to IS 3589 with 6 mm thick walls.
4. Electro resistant welded pipe to be use pressure exceeding 16kg/cm2.
5. Joints in risers- All risers shall. be installed with grooved couplings with necessary fittings. Horizontal & branch floor piping shall be screwed up to 50mm dia. and grooved joints for Higher pipe sizes shall be used.
6. All pipes above ground and in exposed locations shall be painted with two coat of Etching type primer and two or more coats (each of 75 microns) of synthetic enamel paint of approved shade.
7. Pipes shall be initially brushed to remove all foreign matter before applying paint / primer.

8. Pipes (buried) shall be initially brushed to remove all foreign matter and apply 2 coats of primer over the pipe. Primer shall be allowed to dry until the solvent
9. evaporates and surface becomes tacky. Tape 4mm thick and 150/250mm wide shall then be wound in a spiral fashion and bonded completely to pipe by thermo fusion process. Overlap shall be maintained at 15mm.

Following pressure rating criteria to be followed while selecting the pipes

TABLE: PRESSURE RATING TABLE FOR PIPE, VALVES AND ACCESSORIES

| Sr. No. | Description | Pressure Rating |
|---|---|---|
| 1 | Pipes in pump room | PN 25 |
| 2 | Riser | PN 20 |
| 3 | All horizontal pipe work after orifice (on each floor level) | PN 10 |

## NSR-53:- M.S. hose cabinet

A. Cabinets shall be concealed type made of masonry construction, sized to accommodate valve(s), hose reel assembly, hoses, multipurpose dry chemical extinguisher and fire accessories.

B. External cabinets shall be primer-coated, cold-rolled sheet steel, or anodized extruded Aluminum construction.

C. All fire cabinets shall be painted stove enameled fire red paint (shade No. 536 of IS:5). The inside of the cabinet shall be white baked enamel.

D. Fire shaft shall have shutter fabricated by M.S/S.S (as per SOQ) powder coated sheet or fully welded construction of 16 gauge with glass-fronted door (glass shall be 2mm thick) with locking arrangement.

E. Cabinet shall have "FIRE HOSE" written on it prominently (size as given in the schedule of quantities).

F. Door shall be in two leaves with necessary stiffeners. Shutter shall be powder coated finish of `Red' out side and `White' inside and on the glass label of "FIRE" shall be stuck. The letter size shall be min. 75 mm height. There shall be built in breakable glass type feature to keep key.

G. Cabinet surfaces in contact with the walls shall not be powder coated but instead given two coats of anti-corrosive bitumastic paint.

H. External Hose Cabinet: The hose cabinet shall be of size to accommodate the following:
   1. Single headed yard hydrant valve
   2. Hose pipe (2 lengths of 15 m)
   3. Branch pipes, nozzles
   4. Fire man's axe

### NSR-54:- Single/double hung lockable shutter

25mm dia uPVC pipes, 40mm dia uPVC headers & fittings shall be used for condensate, from Evaporator Unit to drain point. The joints shall be properly sealed so that there is no water leakage. U-trap shall be provided at the end. Additional insulation drain tray shall be provided below the Evaporator Unit, if required.

**Mounting**

All indoor units shall be mounted with Brackets, Hangers etc. With proper size anchor Fasteners.

### NSR-55:- dial type pressure gauge

Pressure gauge shall be provided near all individual connections of the hydrant system with isolation valves and near each flow switch assembly of the sprinkler system. Pressure gauge shall be 100 mm dia gunmetal bourdon type with gunmetal isolation ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate height for easy readability.

### NSR-64:- MS Class 'C' for diesel engine exhaust pipe

Pipe Work - All pipe lines with fittings and accessories required shall be provided for fuel oil, lub. oil and exhaust systems, copper piping of adequate sizes, shall be used for Lub, oil and fuel oil. M.S. piping will be permitted for exhaust.

### NSR-65:- Gun metal fire Brigade Suction Hose coupling (Draw-out Connection)

A. Fire brigade connection shall be as per IS: 5131.
B. Provide four numbers of 63mm NB gunmetal Fire Brigade type instantaneous inlets with built in check valves and 150 mm dia. flanged outlet connection with butterfly and check valves.
C. The collecting heads shall be connected to fire water wet risers for the use of local Fire Brigade. Fire brigade connection shall be enclosed in a suitably sized glass fronted box mounted at a suitable position.
D. It shall be connected to the storage tank with a 150 mm fire brigade pumping connection.
E. This connection shall not be taken directly into the side of the storage tank, but arranged to discharge not less than 150 mm above the top edge of the tank such that the water flow can be seen.
F. The connection shall be fitted with stop valve in a position approved by the Employer's Representative.
G. An overflow connection discharging to a drain point shall be provided from the storage tank.

H. The fire brigade connection shall be located as to make the inlets accessible from the outside of the building.

I. The size of the wall box kept beside the inlet shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken.

J. Each box shall have fall of 25mm towards the front at its base and shall be glassed with wired glass with "FIRE BRIGADE INLET" painted on the inner face of the glass in 50 mm size block letter.

K. Each such box shall be provided with a steel hammer with chain for breaking the glass.

L. In addition to the emergency fire brigade connection to the storage tank, a 150mm common connection shall be taken from the four 63mm instantaneous inlets direct to hydrant main so that the fire brigade may pump to the hydrants in the even of the hydrant pumps being out of commission.

M. The connection shall be fitted with a sluice valve and reflux valve. Location of these valves shall be as per the approval of the Employer's Representative.

N. Two way collecting head with two numbers 63 mm instantaneous type inlets shall be connected to the sprinkler header.

## NSR-66:- inspecting & testing assembly

A. 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 as per approved drawing.

## NSR-67:- carbon-di-oxide type fire extinguishers

A. The Carbon Dioxide Extinguisher shall be as per IS: 2878

B. The body shall be constructed of seamless tube conforming to IS: 7285 and having a convex dome and flat base. Its dia shall be maximum 140 mm, and the overall height shall not exceed 720 mm.

C. The discharge mechanism shall be through a control valve conforming to IS:3224. The internal siphon tube shall be of copper aluminum conforming to relevant specifications.

D. Hose Pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 Kg/cm2 and shall be approximately 1.0 meter in length having internal dia of 10

E. The discharge horn shall be of high-quality unbreakable plastic with gradually expanding shape, to convert liquid carbon dioxide into gas form.

F. The handgrip of Discharge horn shall be insulated with Rubber of appropriate thickness.

G. The gas shall be conforming to IS: 307 and shall be stored at about 85 Kg/cm2. The expansion ratio between stored liquid carbon dioxide to expanded gas shall

be 1:9 times, the total discharge time (effective) shall be minimum 10 secs, and maximum 25-secs.

H. The extinguisher shall fulfill the following test pressures:
   a. Cylinder: 236 Kg/cm2
   b. Control Valve: 125 Kg/cm2
   c. Burst Pressure of Hose: 140 Kg/cm2 minimum

I. It shall be an Upright type. The cylinder, including the control valve and high-pressure Discharge Hose must comply with relevant Statutory Regulations, and be approved by Chief Controller of Explosives, Nagpur and also bear IS marking. The Extinguisher including components shall be IS marked.

## NSR-68:- mechanical foam type fire extinguishers

a. The construction of body shall be welded and the requirement of thickness of sheet and details of the construction shall be as per IS-2825-1960 code for pressure vessels. CO2 gas cylinder used for propelling foam solution shall have necessary statutory approvals. The extinguisher shall have furnished with all accessories as needed such as filling orifice with removable S.S strainer, S.S drain plug, pressure vacuum vent,(breather valve) pressure reducer , safety valve, level indicator etc.

b. The charge shall be of mechanical foam compound as per IS-4989-1974 (part-11

c. AFFF) for producing foam for firefighting. The fire extinguisher shall be painted ' FIRE RED ' conforming to shade No 536 of IS- 5-1961.Each fire extinguisher shall be clearly marked with necessary information in English.

Technical Details

1. Tank capacity-50LTR
2. Gas (co2)- 2 kg in gas cylinder with control valve
3. Charge-AFFF (4) Foam expansion 6-8 times
4. Discharge jet length-8 to 10 mtr
5. Hose length-5 mtr
6. Tank shall be epoxy coated inside and outside the tank
7. Trolly wheel- 300mm dia solid rubber
8. Discharge Nozzle (specially designed self-aspirating branch pipe)- S.S-304.
9. Syphon tube-S.S-304.

Stored Pressure Mechanical Foam (AFFF)

| | | |
|---|---|---|
| a. | Capacity | 9 liters |
| b. | Code | BIS: 15397 |
| c. | Jet range | < 6 meters |

| | | |
|---|---|---|
| d. | Discharge Time | 25-60 Seconds |
| e. | Minimum discharge | 90% |
| f. | Test Pressure | 30 Kg/cm$^2$ |

## NSR-70:- ABC Powder type fire extinguishers

A. The Extinguisher shall be filled with ABC grade 40, Mono Ammonium Phosphate 40% from any approved manufacturer.
B. The capacity of the extinguisher when filled with Dry Chemical Powder (First filling) as per IS 4308, Part II, shall be 5 Kg +/-2% or 10 Kg +/- 3%.
C. The distribution of fire extinguishers to be as per IS 2190 – 1992.It shall be operated upright, with a squeeze grip valve to control discharge.
D. The plunger neck shall have a safety clip, fitted with a pin, to prevent accidental discharge. It shall be pressurized with Dry Nitrogen, as expellant.
E. The Nitrogen to be charged at a pressure of 15 Kg/cm2.Body shall be of mild steel conforming to relevant IS Standards.
F. The neck ring shall be also mild steel and welded to the body. The discharge valve body shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be of brass.
G. The nozzle shall be of brass, while the hose shall be braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it.
H. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.
I. The Neck Ring shall be externally threaded - the threading portion being 1.6 cm. The filler opening in the neck ring shall not less than 50 mm.
J. Discharge nozzles shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85% of contents upto a throw of 4 mtr, continuously, at least for 15 seconds.
K. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 5 Kg capacity and 12 mm for 10 Kg capacity.
L. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside.
M. The extinguisher shall be treated with anti-corrosive paint, and it shall be labeled with words ABC 2.5 cm long, within a triangle of 5 cm on each face.
N. The extinguisher body and valve assembly shall withstand internal pressure of 30 Kg/cm2 for a minimum period of 2 minutes.
O. The pressure gauge shall be imported and suited for the purpose.

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# NON-DSR TECHNICAL SPECIFICATIONS
# PUBLIC HEALTH ENGINEERING

## PART 1 - GENERAL

### CONTRACTORS RESPONSIBILITIES

The Contractor is responsible for the quality and the satisfactory operation of the installations entrusted to him, as well as for compliance with the performance stipulated in this document.
Consequently, for his own account and under his own responsibility, he must carry out all calculations and select the necessary materials and equipment.
Apart from the required performance definitions, this document and the relevant drawings also provide many indications resulting from the studies carried out by the Engineer.
The Contractor shall review these studies and check the corresponding indications.
The same applies to equipment selection, for which the information given in this document must be deemed as indicative and defines only the minimum requirements.

### SCOPE DESCRIPTION

The contractor shall furnish all labor, materials, tools, supplies, equipment, transportation, supervision, technical, professional, and other services, and shall perform all operations necessary and required to satisfactorily complete all the necessary engineering, procurement services, construction work and commissioning for the systems and equipment's for the project.

### BASIC DESIGN CRITERIA

Refer tender Drawings and Documents.

### CODES AND STANDARDS

All the systems shall be designed and installed in accordance with the requirement of International Codes and Standards and Local Authority having Jurisdiction. They shall be particularly in accordance with the following standards:

A. National building code of India 2016.
B. IS: 1742 – 1983 Code of practice for Building Drainage
C. IS :2065 -1983 Code of practice for water supply in buildings
D. CPHEEO Manual on Water Supply and treatment
E. Chartered Institution of Building Services Engineers UK Guide G. PHE. ▪ American Society of Plumbing Engineers (ASPE), Design Data Book Volume I to IV
F. Uniform Plumbing code (UPC)-2008

## GENERAL CONDITIONS

1.1 The schedules, tender drawings, contract documents provided for reference design intent. It is the scope of contractor to verify, design, manufacture, supply, transport , install, test , commission, handover the complete PLUMBING system including all necessary services, accessories, material, equipment , Tools & tackles, labor , and any other type of service or material as required.

1.2 It is not the intent to specify completely herein all details of design and construction of system/ plant/ equipment to be supplied / erected. However, the system/ plant/ equipment supplied shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation in a manner acceptable to the Client who will interpret the meaning of drawings and specifications and shall l have the power to reject any work or material which in his judgement are not in full accordance therewith.

1.3 In case of discrepancy and / or disparity between these general and special conditions of contract and any other sections enclosed here in, the most stringent shall apply and the decisions of the Client/consultant shall be final.

1.4 Entire works which are part of this contract shall be completed in all respects and handed over in the timeline defined by the client the award of contract. However final timeline will be decided based on mutual agreement during finalization.

**SECTION 1- GENERAL-DUTY VALVES FOR PLUMBING PIPING**

## PART 1 - GENERAL

## RELATED DOCUMENTS

1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

## SUMMARY

A. Section Includes:

1. Butterfly valves.
2. Ball valves.
3. Air release valve
4. Non -Return valves.
5. Gunmetal Gate valve.
6. Pipe Line Strainer

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 water distribution piping Sections for general-duty and specialty valves for site construction piping.

## SUBMITTALS

Product Data: For each type of valve indicated.

## QUALITY ASSURANCE

1.1 Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

## DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

1. Aboveground and Under-building slab domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Flexible connectors.
4. Bore well / Municipal / Tanker Water supply – Underground Piping.
5. Drinking Water Supply.
6. Flushing Water Supply.
7. External water supply to cater for Horticulture and Cooling Towers drawn from the Treated Sewage Water Tank through an independent pumping System (as required).
8. Connection to various mechanical equipment to be supplied and installed by the other specialist contractors.

## PART 2 - PRODUCTS

## GENERAL REQUIREMENTS FOR VALVES

All valves (gate, globe, check, safety) shall be of gun metal suitable for the particular service as specified. All valves shall be of the particular duty and design as specified. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Gate, globe and check valves shall conform to Indian Standard IS:776 and non-return valves and swing check type reflux to IS:5312

A. Butterfly valve:

1. The butterfly valve shall be suitable for waterworks and rated Pressure requirement as mentioned in the Schedule of quantities.
2. The body shall be of cast iron to IS:210 in circular shape and of high strength to take the water pressure. The disc shall be heavy duty cast iron with anti corrosive epoxy or nickel coating.
3. The valve seat shall be of high grade elastomer or nitrile rubber. The valve is closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be EN 8 grade carbon steel.
4. The valve shall be fitted between two flanges on either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

B. Ball valve:

1. The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.
2. The ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.
3. The handle shall be provided with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping.
4. The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

| Sr.No | Type of Valve | Size | Construction | Ends |
|---|---|---|---|---|
| A. | G.M. non-return valve | 15 mm to 50 mm<br>65 mm above | Gun Metal<br>Gun Metal | Screwed<br>Flanged |

All valves shall be suitable for the working pressure involved.

Table -1 Bonnet Joint Bolt Size

| Nominal Pressure Rating (Lbs). | Valve size (in nom) |
|---|---|
| 400 | 10 or over |
| 600, 900, 1500, 2500 | 6 or over |

Table -2 Minimum Shell Wall Thickness and Minimum Stem dia, in Inches

| Valve Size Nom In | 150 lbs | | 300 lbs | | 400 lbs | | 600 lbs | |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.25 | 5/8 | 0.25 | 5/8 | Use 600 lbs valves in these sizes | | | |
| 1 ¼ | 0.25 | 5/8 | 0.25 | 5/8 | | | 0.310 | 5/8 |
| 1 ½ | 0.25 | 11/16 | 0.310 | ¾ | | | 0.340 | 5/8 |
| 2 | 0.344 | ¾ | 0.375 | ¾ | | | 0.365 | ¾ |
| 2 ½ | 0.375 | ¾ | 0.438 | ¾ | | | 0.438 | 7/8 |
| 3 | 0.406 | 7/8 | 0.469 | 7/8 | | | 0.469 | 1 |
| 4 | 0.438 | 1 | 0.500 | 1 | 0.500 | 1 1/8 | 0.500 | 1 1/8 |
| 6 | 0.469 | 1 1/8 | 0.625 | 1 ¼ | 0.656 | 1 3/8 | 0.625 | 1 ½ |
| 8 | 0.500 | 1 ¼ | 0.688 | 1 3/8 | 0.750 | 1 ½ | 0.750 | 1 5/8 |
| 10 | 0.563 | 1 3/8 | 0.750 | 1½ | 0.844 | 1 ¾ | 1.000 | 1 7/8 |
| 12 | 0.625 | 1 ½ | 0.812 | 1 5/8 | 0.938 | 1 7/8 | 1.125 | 2 |
| 14 | 0.656 | 1 5/8 | 0.875 | 1 ¾ | 1.062 | 1 7/8 | 1.250 | 2 ¼ |
| 16 | 0.688 | 1 ¾ | 0.937 | 1 7/8 | 1.125 | 2 | 1.375 | 2 3/8 |
| 18 | 0.718 | 1 7/8 | 1.000 | 2 | 1.187 | 2 ¼ | 1.500 | 2 ½ |
| 20 | 0.750 | 2 | 1.062 | 2 1/8 | 1.312 | 2 ½ | 1.625 | 2 ¾ |
| 24 | 0.812 | 2 ¼ | 1.187 | 2 ½ | 1.437 | 2 ¾ | 1.750 | 3 |
| 900 lbs | | | 1500 lbs | | 2500 lbs | | | |
| 1 | Use 1500 lbs | | 0.500 | ¾ | 0.594 | ¾ | | |
| 1 ¼ | | | 0.560 | ¾ | 0.688 | ¾ | | |
| 1 ½ | | | 0.590 | 7/8 | 0.750 | 7/8 | | |
| 2 | | | 0.750 | 1 | 0.875 | 1 | | |
| 2 ½ | | | 0.875 | 1 1/8 | 1.000 | 1 1/8 | | |
| 2 ½ | | | 0.875 | 1 1/8 | 1.000 | 1 1/8 | | |
| 3 | 0.750 | 1 1/8 | 0.938 | 1 ¼ | 1.188 | 1 ¼ | | |
| 4 | 0.844 | 1 ¼ | 1.125 | 1 3/8 | 1.406 | 1 3/8 | | |
| 6 | 1.031 | 1 5/8 | 1.500 | 1 ¾ | 1.906 | 1 7/8 | | |
| 8 | 1.250 | 1 7/8 | 1.875 | 2 1/8 | 2.438 | 2 3/8 | | |
| 10 | 1.438 | 2 1/8 | 2.250 | 2 ½ | 2.656 | 2 7/8 | | |

Table-2 (Continued) Minimum Shell Wall Thickness and Minimum Stem dia, in Inches
Nominal Pressure Rating

| 900 lbs | | | 1500 lbs | | 2500 lbs | |
|---|---|---|---|---|---|---|
| 12 | 1.656 | 2¼ | 2.625 | 2 ¾ | 3.406 | 3 ¼ |
| 14 | 1.812 | 2 3/8 | 2.750 | 3 | - | - |
| 16 | 2.062 | 2 ½ | 3.125 | 3 | - | - |
| 18 | 2.250 | 3 | 3.500 | - | - | - |
| 20 | 2.500 | - | 3.875 | - | - | - |
| 24 | 2.875 | - | 4500 | - | - | - |

Note: Shell comprises the body and the bonnet.

5. Requirements: The Contractor shall submit the following:
    a. If chain wheel operation is required, the type of chain wheel shall be specified.
    b. If gear operation is required, the type of gears and their arrangement and the design maximum pressure differential across the valve shall be specified.
    c. If power operation is required, the type of power and power unit and the design of maximum pressure differential across the valve shall be so specified in the purchase order.
6. By Pass: A by-pass shall not be furnished unless specified in the purchase order.
    a. Any by-pass furnished shall be of the valve external type, of a size corresponding to the valve size specified by series 'A' of MSS SP45. It shall be connected on the side of the valve in accordance with 'Regular Practice' as specified in MSS SP 45. The bypass valve shall be a globe type, rising stem with a flanged bonnet.
7. Inspection and Test: If inspection by the purchaser specified in API 598. If inspection is not specified, the valve shall meet the requirements for visual examination described in API 598.
8. Pressure Test: Each valve shall be pressure tested as specified in API 598. The tests made are the following:
    a. Body: Leakage test on body & bonnet including body bonnet connection.
    b. Seat: Leakage test on disc wedge.
    c. Back Seat: Leakage test
    d. Stuffing Box: Leakage test
9. Body Test:
    a. With fully open wedge or disc without packing in the stuffing box, the test pressure are the following:

        Class: 150 300 600 900 1500
        Kg/cm2: 30 77 152 228 378

    b. No visible leakage allowed.
10. Seat Test:
    a. With substitute packing in the stuffing box, the test pressure is equal to maximum working pressure. If the value has been equipped with an actuator, the test pressure is set by the specified maximum differential pressure across the wedge. The actuator is selected for the maximum differential pressure. Leakage accepted is 2 cc per hour per inch dia of seat diameter. Gate valves to be tested alternately with pressure on one side, the opposite side open for inspection.

b. Hydraulic test certificates and material certificate for pressure containing parts will be supplied.

11. Coating: Unmachined exterior surface of the shell shall be painted aluminum.

a. The flanges shall be blanked with bolted or steel strapped wood, wood fibre or metal covers, not smaller than the outside diameter of the valve ends.

API Standard 600
ANSI B – 16.5, Flanged Ends.
ANSI B – 16.34, Welding Ends.

b. The pressure ratings of cast steel valves of API 600 specification to class ASA 150, 300, 400, 600, 900, 1500 and 2500 Lbs nominal are as shown in ANSI B 16.5 as indicated in table -5. Each pressure rating is the maximum allowable sustained non-shock pressure at the corresponding tabulated temperature. Pressure rating may be interpolated between temperatures tabulated. Specification of valve parts is given in table-6.

C. Air Valves (Air release valve)

1. Air release valve shall be installed as per specifications provided in BOQ.

Table -Commonly Adopted Size of Air Valves

| Size of Main mm | Type of Valve | Size of Air Valve mm |
|---|---|---|
| 80 | Single air valve | 20 |
| 100 | Double air valve | 40 |
| 125-200 | Double air valve | 50 |
| 250-350 | Double air valve | 80 |
| 400-500 | Double air valve | 100 |
| 600-900 | Double air valve | 150 |
| 1000-1200 | Double air valve | 200 |

D. Non-Return or Reflux Valves:

Like sluice valves these are manufactured in three types. (a) Swing check type cast iron reflux valves for general duty conditions, (b) Gunmetal non return (check) valves and (c) Cast steel reflux valves for severe duty conditions.

1. (a) Swing check-type Reflux Valves (Cast Iron) single door pattern, conforming to IS 5312 (Part I) and for (b) Swing Check Valves, cast carbon steel conforming to BS 1868 or ASA Standard are added below for ready reference.

a. Swing Check-Type Reflux Valves (Cast Iron): (Non-return valves) Single Door Pattern (IS 5312 (Part I)

- General: The body, door, cover and hinge shall be of cast iron to IS 1210 Gr 20. Body ring, door faces, bearing bushed are of gun metal, hinge pins, door pins and door suspension pins shall be of high tensile brass or chromium steel (minimum 12 % chrom) and air release plugs galvanized cast iron. Reflux valves shall be designated by nominal pressure (PN) defined as maximum permissible gauge pressure.

Table -1 Test Pressures and Working Pressures of Reflux Valves

| Size of valve, mm | Test Pressure MPa | | Nominal Pressure (PN) MPa |
|---|---|---|---|
| | Body | Seat | |
| 50 to 125 (PN 1.6) | 2.4 | 1.6 | 1.6 |
| 150 to 300 (PN 1.0) | 1.5 | 1.0 | 1.0 |
| 350 to 600 (PN 0.6) | 0.9 | 0.6 | 0.6 |

Table-2 Weight of C.I.D.F. Reflux Valves

| Size in-mm | Wt. in-Kg (Approx.) |
|---|---|
| 80 | 34 |
| 100 | 49 |
| 125 | 70 |
| 150 | 83 |
| 200 | 136 |
| 250 | 253 |
| 300 | 309 |
| 350 | 422 |
| 400 | 558 |

Table-3 Dimensions of Reflux Valves (mm)

| Valve Size | Length of by Pass | Size of by Pass | Valve Size | Length of By Pass | Size by pass |
|---|---|---|---|---|---|
| 50 | 200 | 10 | 250 | 600 | 25 |
| 65 | 240 | 10 | 300 | 700 | 40 |
| 80 | 260 | 10 | 350 | 800 | 40 |
| 100 | 300 | 10 | 400 | 900 | 40 |
| 125 | 350 | 15 | 450 | 1000 | 50 |
| 150 | 400 | 15 | 500 | 1100 | 50 |
| 200 | 500 | 25 | 600 | 1300 | 65 |

Note: By pass valves up to 40 mm size shall be of gun metal to IS 778 and sizes above 40mm shall be cast iron to IS 780, flanges faced and drilled to IS 780, flanges faced and drilled to IS 1538, unless specified otherwise.

b. Gun Metal Non-Return (Check) Valves

- For use in mild steel pipes, gun metal non-return valves are available in two designs, Lift type and Swing type. Swing type check valves are for application in horizontal or vertical upward flow whereas vertical life check valves are used in vertical upward flow. Gun metal vertical check valves, manufactured to IS 778 are tested hydraulically to 20 Kg/cm2 for body and 17.5 Kg/cm2 for seat. (Also refer Clause 19.10(5) for weights and other details).

E. Gunmetal Gate Valves IS 778:

1. Gun metal gate valves shall be of solid wedge type screwed bonnet, integral seat, inside screw, nonrising stem, provided with a sturdy hand wheel for operation. These shall conform to Indian Standard 778. The gate valves to this Indian Standard shall be used in three classes of IS 778, both screwed female and flanged ends as per requirement.
2. The testing of these vales shall be done as per clause 10 of IS 778 for hydraulic test
3. pressures as indicated in table 281.

Table - Hydraulic Test Pressures of G.M. Gate Valves with Screwed or flanged Ends (IS778)

| Class of Valve | Max Non-shock service pressure rating at 450C, Kg/cm2 | Test Pressure in Kg/cm2 | |
|---|---|---|---|
| | | Body | Seat |
| 1 | 12 | 20 | 17.5 |
| 2 | 14 | 30 | 20.0 |
| 3 | 28 | 50 | 40.0 |

F. Pipe Line Strainer:

1. Pipe line strainers shall be either(1) Basket / Bucket type, or (2) Y-type. Basket / Bucket type strainers shall be supplied with flanged end connection and Y-strainers with screwed, socket welding or flanged ends. The strainers shall have the aggregate area which should be atleast 3 times the area of the pipe. The strainers shall be with drain plugs to blow-off the accumulated foreign particles.
2. Generally manufactured flanges in case of C.I strainers shall conform to ANSI B 16.1 Class 125 or ASA 150, for gun metal table H of BS 10 and for cast steel ANSI B 16.5 (with raised face). The G.M or Brass strainers shall be tested to maximum non-shock hydraulic test pressure of 16 Kg/cm2, C.I strainers for 300 mm dia and less to 12 Kg/cm2 and higher sizes to 10 Kg/cm2.
3. The screen shall SS 316 material. The pore / hole size of the screen shall be 0.8 mm or less.
4. Alternatively, Dirt Boxes may be provided at the inlet of water meters as an additional safe guard and protection of the meter mechanism. These shall conform to any flanges specification and are available in sizes 50 mm to 600 mm.

## PART 3 - EXECUTION

## EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

## VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chain wheels on operators for valves DN 100 and larger and more than 2400 mm above floor. Extend chains to 1520 mm above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

## ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

## SECTION 2 - DOMESTIC WATER PIPING

1. GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2. SUMMARY

A. Section Includes: The scope of this section comprises the supply, installation, testing and commissioning of piping network for water supply for internal & external services as follows

1. Bore well / Municipal / Tanker Water supply – Underground Piping.
2. Drinking Water Supply.
3. Flushing Water Supply.
4. External water supply to cater for Horticulture and Cooling Towers drawn from the Treated Sewage Water Tank through an independent pumping System (as required).
5. Connection to various mechanical equipment to be supplied and installed by the other specialist contractors.

A. The Contractor shall make all necessary application and arrangements for his work to be inspected by the Local Authorities.

B. The Contractor shall be solely responsible for obtaining the Authorities approval of his works prior to the handing over of the complete water supply / distribution installation to the Owner.

1.3. PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to NBC.

1.4. SUBMITTALS

A. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which all services are shown and coordinated with each other, using input from Installers of the items involved:

D. Field quality-control reports.

1.5. QUALITY ASSURANCE

A. Piping materials shall be label, stamp, or other markings of specified testing agency.

2. PRODUCTS

2.1. PIPING MATERIALS

A. Polypropylene Random (PP-R) pipes and fittings conforming to EN ISO- 15874 /DIN 16962 & DIN 8077 / DIN 8078: 1999-70 for Hot & Cold water.

B. Medium Heavy class Galvanized Iron pipes and fittings conforming to IS:1239.

**Note: The sizes are specified in the Schedule of Quantities and the makes are specified in List of Makes**

2.1.1. GALVANISED IRON PIPES & FITTINGS

A. The pipes shall be galvanised mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of IS:1239.

B. The pipes under this standard are designated by their nominal bore and are further classified as Light, Medium and Heavy depending upon their wall thickness and shall be used as per required suitable pressure. Sockets of these pipes are designated by respective nominal bore of the pipe.

C. Joints: The threads of all screwed and socket pipes shall conform to IS-554. The minimum length of thread in 'Light' pipe shall be 80 percent of specified in IS-554. Each tube shall be supplied with one socket.

D. Length: The tubes shall be supplied in random lengths of 3 to 6 m.

E. Galvanizing: When tubes are required to be galvanized, the Zinc coating shall conform to IS 4736. (Hot dip zinc coatings on steel tubes).

F. Manufacturing Process: Tubes are made from tested quality of steel manufactured by any approved process Electric Resistance Welded (ERW),

G. The Galvanizing shall conform to IS:4736, the hot dip zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the pipe.

H. The fittings shall be malleable iron and comply with all the requirements of the pipes. The sizes of pipes and fitting is specified in the schedule of quantities.

I. Hydraulic test: Each pipe shall be hydraulically tested at manufacturer's work to withstand a test of Pressure of 5 Mpa.

J. Marking: The different classes of pipes shall have 75mm colour bands when arrived on site.

K. The following color bands shall be provided.

Light ---------- Yellow

Medium ---------- Blue

Heavy ---------- Red

L. Fittings: The fittings shall be malleable iron screwed fittings and shall conform to IS:1879.

M. The fittings are classified as Light, Medium and Heavy. The sizes of pipes and fitting is specified in the schedule of quantities.

N. Hydraulic Test: Each tube shall be hydraulically tested at manufacturer's works to withstand a test pressure of 5 Mpa.

O. Marking: The different classes of tubes shall have 75 mm colour bands before leaving the manufacture's works.

Medium tube ..... Blue

Table Dimensions and Nominal Weights of Black Steel Tubes (MEDIUM) (IS 1239)

| N.B mm 1 | Outside dia | | Thickness mm 4 | Weight of Black Tube | | Calculated nominal Wt. of Galvanised Tubes | |
|---|---|---|---|---|---|---|---|
| | Max mm 2 | Min mm 3 | | Plain end Kg/m 5 | Screwed and socketed Kg/m 6 | Plain end Kg/m 7 | Screwed and socketed Kg/m 8 |
| 15 | 21.8 | 21.0 | 2.65 | 1.22 | 1.23 | 1.28 | 1.29 |
| 20 | 27.3 | 26.5 | 2.65 | 1.58 | 1.59 | 1.66 | 1.67 |
| 25 | 34.2 | 33.3 | 3.25 | 2.44 | 2.46 | 2.54 | 2.56 |
| 32 | 42.9 | 42.0 | 3.45 | 3.14 | 3.17 | 3.26 | 3.29 |
| 40 | 48.8 | 47.9 | 3.25 | 3.61 | 3.65 | 3.75 | 3.79 |
| 50 | 60.8 | 59.7 | 3.65 | 5.10 | 5.17 | 5.28 | 5.35 |
| 65 | 76.6 | 75.3 | 3.65 | 6.51 | 6.63 | 6.72 | 6.84 |
| 80 | 89.9 | 88.0 | 4.05 | 8.47 | 8.64 | 8.72 | 8.89 |
| 100 | 115.0 | 113.10 | 4.50 | 12.10 | 12.40 | 12.42 | 12.72 |
| 125 | 140.8 | 138.50 | 4.85 | 16.2 | 16.7 | 16.59 | 17.09 |
| 150 | 166.5 | 163.9 | 4.85 | 19.2 | 19.8 | 19.27 | 20.27 |

Permissible Working Pressure for Mild Steel Tubes

| N.B. of pipe mm | Working Pressure | | | | | |
|---|---|---|---|---|---|---|
| | Light | | Medium | | Heavy | |
| | Ibs/sq.in | Kg.cm2 | Ibs/sq.in | Kg.cm2 | Lbs/sq.in | Kg.cm2 |
| 15 | 150 | 10.55 | 300 | 21.09 | 350 | 24.61 |
| 20 | 150 | 10.55 | 300 | 21.09 | 350 | 24.61 |
| 25 | 150 | 10.55 | 300 | 21.09 | 350 | 24.61 |
| 32 | 125 | 8.80 | 250 | 17.58 | 300 | 21.09 |
| 40 | 125 | 8.80 | 250 | 17.58 | 300 | 21.09 |
| 50 | 100 | 7.03 | 200 | 14.06 | 250 | 17.58 |
| 65 | 100 | 7.03 | 200 | 14.06 | 250 | 17.58 |
| 80 | 100 | 7.03 | 200 | 14.06 | 250 | 17.58 |
| 100 | 100 | 7.03 | 171 | 12.02 | 228 | 16.03 |
| 125 | - | - | 171 | 12.02 | 213 | 14.79 |
| 150 | - | - | 142 | 9.98 | 171 | 12.02 |

P. Pipe Flanges: - Pipe Flanges shall conform to British Standards 10 (Specification for flanges and bolting for pipes, valves and fittings). Following table gives specification of Pipe Flanges and Sleeves.

TABLE: SCHEDULE OF SLEEVES

| SR. NO | M S SLEEVE | | | M. S. FLANGE | | BOLTING | | | | | M.S. PUDDLE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SLEEVE NOS | N.B. OF PIPE | THICKNESS OF PIPE | DIAMETER mm | THICKNESS mm | PCD mm | DIA OF BOLT | NO. OF BOLT | INSIDE | OUTSIDE | SIZE mm | THICKNESS mm |
| 1 | S1 | 15 DIA | 3.25 mm | 100 | 10 | 70 | 15 | 4 | -- | -- | 50 x 50 | 6 |
| 2 | S2 | 20 DIA | 3.25 mm | 100 | 10 | 75 | 15 | 4 | -- | -- | 50 x 50 | 6 |
| 3 | S3 | 25 DIA | 4.05 mm | 120 | 10 | 90 | 15 | 4 | -- | -- | 50 x 50 | 6 |
| 4 | S4 | 32 DIA | 4.05 mm | 135 | 10 | 100 | 15 | 4 | -- | -- | 100 x 100 | 6 |
| 5 | S5 | 40 DIA | 4.05 mm | 140 | 15 | 125 | 15 | 4 | -- | -- | 100 x 100 | 6 |
| 6 | S6 | 50 DIA | 4.05 mm | 165 | 15 | 105 | 15 | 4 | -- | -- | 150 x 150 | 6 |
| 7 | S7 | 65 DIA | 4.05 mm | 185 | 15 | 150 | 15 | 8 | -- | -- | 150 x 150 | 6 |
| 8 | S8 | 80 DIA | 4.85 mm | 200 | 15 | 165 | 15 | 8 | -- | -- | 200 x 200 | 6 |
| 9 | S9 | 100 DIA | 5.4 mm | 225 | 20 | 200 | 15 | 8 | -- | -- | 200 x 200 | 6 |
| 10 | S10 | 150 DIA | 5.4 mm | 300 | 25 | 260 | 20 | 12 | -- | -- | 300 x 300 | 6 |
| 11 | S11 | 200 DIA | 6.0 mm | 370 | 25 | 325 | 20 | 12 | -- | -- | 350 x 350 | 6 |
| 12 | S12 | 250 DIA | 6.0 mm | 435 | 32 | 380 | 25 | 12 | -- | -- | 400 x 400 | 6 |
| 13 | S13 | 300 DIA | 6.0 mm | 500 | 32 | 450 | 25 | 16 | -- | -- | 400 x 400 | 6 |
| 14 | S14 | 350 DIA | 6.0 mm | 550 | 40 | 500 | 25 | 16 | -- | -- | 500 x 500 | 6 |

Q. LAYING AND JOINTING OF GI PIPES

1. The galvanized pipes and fittings shall run in wall chase or ceiling or as specified. The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5 cm clear of the wall where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted for pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes may be buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Owner's Site Representative, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in walls or floors it shall be painted with anticorrosive bitumastic paints of approved quality. Under the floors the pipes shall be laid in layer of sand filling.
2. Galvanised iron pipes shall be jointed with threaded and socket joints, using threaded fittings. Care shall be taken to remove any burr from the end of the pipes after threading. Teflon tape, White lead or an equivalent jointing compound of proprietary make shall be used, according to the manufacturer's instructions, with a grommet of a few strands of fine yarn while tightening. Compounds containing red lead shall not be used because of the danger of contamination of water. Any threads exposed after jointing shall be painted with bituminous paint to prevent corrosion.
3. Electric Welded steel pipes conforming to IS:3589 for 150mm to 2000mm Nominal Diameter:
4. The pipes shall be made from Steel plates or strips by butt welding longitudinally or spirally. The pipes shall be butt welded by employing any of the methods such as a) Electric Resistance Welding and b) Electric Fusion Arc welding.
5. Joints: The Joints shall be a) Plain or bevelled ends for field butt welding and b) Joints with sleeve joints or swelled and plain ends for welding.

2.1.2. POLYPROPYLENE PIPING SPECIFICATION

R. Specification

1. This specification covers requirements for the Polypropylene Piping System intended for the hot and cold water. The components of the polypropylene pipe system are in accordance with the following standards.

S. Polypropylene Pipe (PP-R)

1. Polypropylene pipes and fittings shall be made up of polypropylene Random UV stabilized and Anti Micro bid and arumicrobial fusion welded 3 layer in accordance with the requirements of DIN 8077 / 8078 type 1 and related ISO recommendation and draft resolutions. It shall be suitable for a working pressure 20 kg/sqcm at a temperature of 70°C.

T. Polypropylene Fittings

1. All polypropylene fittings shall be metric sizes conforming to EN ISO 15874 or equal and shall be socket or butt fusion type suitable for heat fusion. All socket fusion fittings shall exhibit an interference fit prior to jointing with dimensions and tolerances in accordance with ISO 7279 and DIN 16962 Parts 1 to 12 and related ISO Recommendations and Draft Resolutions. All butt fusion fittings shall also be manufactured in accordance with DIN 16962 Parts 1 to 12 and related ISO Recommendations and Draft Resolutions. All threaded connections shall have pipe threads in accordance with the requirements of ISO 7-1:1994.

U. Polypropylene Valves

1. All polypropylene valves shall be metric sizes manufactured by George Fischer or equal in accordance with DIN 3442 Parts 1 to 3.

V. Jointing Tools and Jointing

1. Jointing tools and the procedure for heat fusion jointing described are as per recommendations of the German Institute of Welding Technology's Codes of Practice DVS 2208 and DVS 2207

respectively, and with related ISO Recommendations and Draft Resolutions. Jointing & Installation shall be as per Manufacture's requirement.

2.1.3. PIPING INSTALLATION SUPPORT (VALID FOR GI PIPING ONLY)

A. Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

B. Piping shall be properly supported on, or suspended from, on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

C. Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. All accessories and ancillaries of support system such as brackets, saddles, clamps, hangers etc. shall be hot dip galvanized after fabrication. Further to permit free movement of common piping, support shall be from a common hanger bar, fabricated from galvanised steel sections.

D. Pipe hangers shall be provided at the following maximum spacings:

| Pipe Dia (mm) | Hanger Rod Dia (mm) | Spacing between Supports (m) |
|---|---|---|
| Up to 25 | 6 | 2 |
| 32 to 50 | 10 8 | 2.7 |
| 65 | 10 | 2.7 |
| 80 to 100 | 12 10 | 2.7 |
| 125 to 150 | 16 10 | 3.6 |
| 200 to 300 | 19 | 5.3 |

E. Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14-gauge metal sheet shall be provided between the insulation and the clamp, saddle or roller, extending at least 15 cm. on both sides of the clamps, saddles or roller.

F. All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

G. Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

H. Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fiberglass and finished with retainer rings.

I. The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

J. All pipes shall be accurately cut by pipe cutting machine to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as

the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

K. All buried pipes for CWS shall be cleaned and coated with two coats of bitumen and then wrapped with two layers of 400 micron polythene sheet coating.

L. Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size isolation ball valve. Automatic air valves shall also be provided on hot water risers.

M. Discharge from the air valves shall be piped through a galvanized steel pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

N. Pressure gauges shall be provided as shown on the approved drawings and include in Bill of Quantities. Care shall be taken to protect pressure gauges during pressure testing.

O. Temperature gauge as specified shall be provided at the hot water supply and return and as shown on drawings and included in Bill of Quantities

3. EXECUTION.

3.1. PIPING INSTALLATION

A. See "Writing Guide" Article in the Evaluations for a discussion of how this Section is organized and the most efficient way to edit this Section.

B. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.

C. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

D. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

E. Provide for the expansion and contraction of all pipes. Install expansion joints to have sufficient flexibility to prevent end thrust and movements caused by thermal expansion and contraction causing damage to piping and joints. For all PVC piping, provide expansion joints as required to absorb all movements in piping systems.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. Provide fire stops and or sleeves where combustible piping penetrates fire walls and or Provide fire stops and or sleeves where combustible piping penetrates fire walls and or barriers. These fire stops and sleeves shall have the same rating as the penetration

H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping adjacent to equipment and specialties to allow service and maintenance.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

O. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping.

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."n first paragraph below if hot-water circulation pumps are controlled by thermostats.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.2. PIPING INSTALLATION SUPPORT (VALID FOR GI / COPPER PIPING ONLY)

A. Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

B. Piping shall be properly supported on, or suspended from, on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

C. Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. All accessories and ancillaries of support system such as brackets, saddles, clamps, hangers etc. shall be hot dip galvanized after fabrication. Further to permit free movement of common piping, support shall be from a common hanger bar, fabricated from galvanised steel sections.

D. Pipe hangers shall be provided at the following maximum spacings:

| Pipe Dia (mm) | Hanger Rod Dia (mm) | Spacing between Supports (m) |
|---|---|---|
| Up to 25 | 6 | 2 |
| 32 to 50 | 10 8 | 2.7 |
| 65 | 10 | 2.7 |
| 80 to 100 | 12 10 | 2.7 |
| 125 to 150 | 16 10 | 3.6 |

| | | |
|---|---|---|
| 200 to 300 | 19 | 5.3 |

E. Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge metal sheet shall be provided between the insulation and the clamp, saddle or roller, extending at least 15 cm. on both sides of the clamps, saddles or roller.

F. All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

G. Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

H. Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fiberglass and finished with retainer rings.

I. The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

J. All pipes shall be accurately cut by pipe cutting machine to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

3.3. JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

3.4. TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.5. DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.6. FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

A. Install bronze-hose flexible connectors in copper domestic water tubing.

B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7. IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.8. FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Test

1. Retain first paragraph below to describe tests and inspections to be performed. Portions of testing and inspecting requirements in this article are taken from model plumbing codes. Verify requirements are applicable to location of this Project.
2. The pipes shall be jointed, plugged and shall have been in position for at least 24 hours, before the tests are carried out.
3. The piping shall be tested for line, gradient and water tightness. The Contractor shall furnish all labour, and necessary testing instruments such as gauges, pumps etc. as directed by the Engineer. A minimum of two (2) nos identical pressure gauges shall be installed at extremities of the piping circuit to be tested.
4. Fill the piping with clean fresh water, leaving all high points open to allow for purging of air. Allow a soaking period of at least 24 hours for cement lined or concrete pipes.
5. Pressurize the system using manual pumps in increments of 25 percent of the test pressure. Allow a standing period of 10 minutes after each pressure increment. Pressure testing using motor driven pump is not permitted.
6. Do not over pressurize the system under any circumstance. If the test pressure is close to the maximum permissible pressure of any of the system components, install calibrated pressure relief valves in the tested circuit.
7. Prior to testing keep all valves and control devices in open position. After completion of pressure test, close each valve one at a time starting from the pressure release end, so as to ensure tightness of the valve.
8. The piping shall be hydrostatically tested at a pressure of 690 Kpa (100 psig) or 1.5 times the system working pressure, whichever is greater, The pressure shall be maintained for at least 4 hours. In metallic piping, allow for pressure fluctuations due to ambient temperature variations. Record the circuit temperature along with the pressure readings.
9. Check for leaks by swabbing with a dry tissue. Drop in pressure to the order of 10 Kpa (1.5 psig) per hour shall be considered as acceptable.
10. Do not subject sanitary fixture chrome fittings to the test pressure.
11. Piping shall be tested in segments during the progress of the work. Maintain an official log book for recording the tests carried out on sections of piping, including test pressure, date of test and approval signature of Engineer's representative witnessing the test.

C. Domestic water piping will be considered defective if it does not pass tests and inspections.

D. Prepare Test and Inspection reports.

3.9. ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.

    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10. CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

    b. Fill and isolate system according to either of the following:

    - Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.

    - Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

**SECTION 3 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS (HYDROPNEUMATIC PUMP)**

## PART 1 - GENERAL

## RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

## SUMMARY

A. Section Includes:

1. Constant-speed booster pumps.
2. Variable-speed booster pumps.

B. Related Sections:

1. Division 22 Section "Domestic Water Pumps" for domestic-water circulation pumps.
2. Division 22 Section "Facility Indoor Potable-Water Storage Tanks" for separate hydro pneumatic domestic-water tanks for multiplex booster pumps.

## DEFINITIONS

A. VFC: Variable-frequency controller(s).

## PERFORMANCE REQUIREMENTS

A. Seismic Performance: Booster pumps shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7].

1. The term "withstand" means "the booster pump will remain in place without separation of any parts from the booster pump when subjected to the seismic forces specified and the booster pump will be fully operational after the seismic event]."

## SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For booster pumps. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Seismic Qualification Certificates: For booster pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

## DELIVERY, STORAGE, AND HANDLING

A. Retain protective coatings and flange's protective covers during storage.

## COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## PART 2 - PRODUCTS

## VARIABLE-SPEED BOOSTER PUMPS

A. Variable speed Hydropneumatics pumping units shall be provided for supply of domestic water, flushing water supply for the project. The units shall be selected so as to provide at minimum of 2 bar pressure at the highest/farthest fitting in each plumbing system, the unit serves. The hydropneumatic pumping units shall have the following features;

Pumps:

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

b. The Contractor shall supply and install pumps of the type and performance as shown on the drawings. All duties of pumps given in the Tender Drawings shall be checked

and where necessary corrected before ordering. All the parts of the pumps that are in contact with water e.g. shaft, impeller etc. shall be of stainless steel construction.

c. Pumps shall be so selected that the design duty point is within 5% of the maximum efficiency point. The pump casing so selected shall have ample space to take an impeller one size larger than that capable of performing the design duty.

d. The pump shall have a speed of not more than 1500 rpm. However pumps of 2900 rpm with high efficiency and low noise motor can be selected and noise data submitted for approval. All pumps and motors shall be of minimum vibration and noise level during operation. Vibration isolators shall be provided for all pump sets.

e. Facilities shall be provided to prevent starting of pumps when the water tank is at low water level. An indicator for this low water level alarm shall be provided.

f. Facilities to select which pump to be duty pump and standby pump shall be provided and be interchangeable.

g. Leakage from pump gland shall be drained to the nearest floor waste. Pump curves for all pumps offered shall be submitted. All curve indicating excessive shut-off head will not be approved.

h. Each pump shall be provided with a gate valve at suction and discharge, approved check valve at discharge, approved strainer at suction, flexible connections at pump suction and discharge, eccentric reducer at suction, concentric reducer at discharge, pressure gauges at suction and discharge, circulation relief valve and automatic air relief valve.

i. Appropriate neoprene vibration isolation mountings shall be provided for each pump sets.

2. Vertical Multi-Stage Pumps:

a. Multi-stage pumps shall be of centrifugal type and arranged with shafts vertically installed. The impellers shall be of stainless steel mechanically balanced and keyed to shaft. Renewable guide rings are to be provided in the casting, keyed to prevent rotation.

b. Pumps shall be driven by elevated in-line TEFC squirrel cage motors via extended vertical shafted complete with universal couplings.

c. The shafts shall be stainless steel. Stainless steel sleeves shall be provided to protect the shaft in the water space and through the sealing glands. The sleeves shall be keyed to prevent rotation and secured against axial movement.

d. The bearings shall be of ball or roller type protected against ingress of water, dirt and other matter.

e. Vertical multistage pumps shall have universal flanges. Intermediate bearing, support bearing shall be provided in the pump. The shaft seal shall be easily serviceable and shall allow for correct adjustment and loading of the seal.. Pump motors above 7.5 kW shall be equipped with a spacer coupling which allows changing of shaft seals without removing the motor. The pump motors shall be of Class "F" insulation and IP55 rating and shall be provided with built-in thermistors for protection against over heating.

3. System Description

a. The system shall be supplied as complete sets including suction and discharge common manifolds, non-return valves, isolating valves, pressure transmitter on the discharge side and electrode at the suction tank.

b. The system operation will be such that the initial small water demand shall be met by the charged diaphragm pressure vessel. Should the water demand continue the system pressure will dip to a preset pump cut-in point when the lead pump starts to operate at reduced speed through the variable speed drive? However, should the system pressure be still below the preset value, the controller continuously increases pump speed to meet the system demand. When the lead pump is not able to meet the system pressure at full speed, the second pump also starts to operate.

c. At peak demand all the pumps operate, similarly, if there is a drop in water demand the duty pump speed starts to reduce, then standby pumps cuts-off, followed by stopping of the duty pump.

d. The closed diaphragm pressure vessel shall be of polyethylene material with a pressure gauge and isolating valve. The interior shall be of non-toxic lining suitable for use with potable water. The vessel shall be manufactured to conform to ASME pressure vessel code/standards.

e. The system shall be under the control of an electronic microprocessor unit (EMU).

f. A pressure transmitter shall detect the pressure at the delivery manifold and feedback to the microprocessor control panel via control circuit.

g. The system shall incorporate a frequency converter or frequency converter motors on the pumps and the pressure transmitter shall register the actual pressure on the discharge side.

h. The variable speed drive pumping system shall maintain a constant pressure regardless of the system demand. If there is a drop in pressure outside the preset point, the Variable Speed Drive (VSD) pump shall start to run until the pressure increases to the preset limit, or it will continue to increase the pump speeds to the upper limit of the frequency. If the water system demand still cannot be met, the second pump shall be called in to run, the VSD will then alter the pump speed to meet the preset pressure point. If the set point is still unable to be met, the third pump is then activated to run (in case of 3 pumps units).

i. This shall be achieved by continuously varying the motor speed of the duty pump according to the demand up to a maximum designed capacity.

j. Under decreasing hydraulic demand the reverse sequence to the above description shall apply.

k. The EMU shall ensure alternation of all the duty and standby pumps for even running hours for all the pumps.

l. The frequency converter shall be linked to the motor of the duty pump for continuous speed adjustment and ultimately the water delivery shall be maintained at constant pressure at the preset value.

4. System Features

a. The required performance features of each Hydropneumatics pumping unit shall be as follows:

b. System Configuration

c. Variable speed pumps with pressure vessels.

d. Control panel consisting of the following components:

- Pump Functional Unit (PFU) - control unit c/w pre-programmed microprocessor chip. This unit shall control all pumping unit operations through electronic controller.

- Pumping Monitoring Unit (PMU) - monitor the operation of the pump sets. This unit shall allow for monitoring and setting of all control parameter.
- Variable Speed Drive
- Circuit Breakers
- Fusses
- Pressure Transmitter

e. Set Point

Ten separate pressure "set points" shall be able to be programmed into the PMU and switching between set points is timed by a real time clock when a lower pressure is acceptable during certain periods, for instance after hours or weekends, the set point shall be lowered to minimise power consumption.

An external input shall also be used to switch between set points, or manually adjust a set point at any time.

f. Friction Loss Compensation

It shall be possible to allow for the friction loss component of the system, calculated at full flow and set as a percentage of the set point which will reduce the working pressure of the pump set depending on the actual no. of pumps in operation. A linear approximation of system resistance curve can therefore be allowed for, and pressure will automatically increase as system flow and subsequent frictional losses increase. As such power consumption shall reduce which is required for the pumping system.

g. Displays

Through the PMU keypad all variable parameters shall be adjustable, current status of settings and measured values shall be able to display on the 2 line x 24 character liquid crystal display.

Individual menus shall be available for monitoring individual pumps, zones, settings, alarms and ON/OFF functions.

h. Pump Status

Running hours of each pump

Actual pump status (running, not available, standby, allocated to zone, fault)

Maximum head of pump at zero flow.

i. Zone Status

This menu shall be the main operating menu where at the setting and operating parameters can be viewed,

- Current operating set point
- Measured values in the system
- Operating capacity in terms of total output
- Mode of operation for the zone
- Clock programs (relating to set point pressures)

- Standby pumps
- Pump change over time
- Zone configuration
- Pressure transducer scaling
- Friction loss compensation
- Pump priority
- Inlet pressure measuring (if required)
- System response times
- Allowable number of starts per hour for the pumps
- Minimum limit (loss of water, burst mains protection)

j. Setting Menu (Set)

In this menu all parameters for the operation of the pump set shall be able to be adjusted as required.

- Set points (up to 10)
- On/Off function (used to prevent unnecessary cycling at low demands)
- Displayed pressure units (Bar, PSI, mBar, kPa)
- Real time clock programming for any time of the day, week, or weekend
- Zone configuration
- Friction loss compensation

k. Alarm

The alarm menu shall display all faults that occur during operation, logging the time and date of when the fault occurred and when it was corrected, or whether it is still an actual fault, up to 10 faults can be maintained as history in the controller. The following type of faults shall be diagnosed by the controller.

- Mains failure
- Frequency converter fault
- Analogue input (pressure transducer) fault
- High discharge pressure fault
- Low discharge pressure fault
- Motor thermal overload fault

l. Variable Frequency Drive

Variable frequency drive shall be of a reputable make acceptable to Project Manager and shall be complete with RFI filter and harmonic dampers.

m. Enclosure

An IP 54 powder coated steel enclosure shall house all the electrical components.

The enclosure can be supplied loose for remote mounting, or mounted on a common base with the pumps, it shall be adequately ventilated for use in conditions up to a maximum ambient temperature of 45 degrees Celsius.

n. Electrical Component

All circuit breakers, thermal overloads and contactors shall be of reputable make acceptable to the architect. Electrical supply to the pump controller shall be protected using an isolating circuit breaker.

o. Method of Starting

The panel shall be built to start the pumps in suitable starting modes, i.e. D.O.L., Star/Delta, or using Soft Starters.

p. Quality and Testing

Manufacture of the pumps, plus design and assembly of the complete packaged Hydropneumatic pumping system shall be factory assembled and the pump station shall be fully tested hydraulically and electrically prior to dispatch to site. Test reports etc. shall be submitted for review before dispatch.

## PART 3 - EXECUTION

## EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

## INSTALLATION

A. Equipment Mounting: Install booster pumps on concrete base using restrained spring isolators as per manufactures instruction/GA drawings.

B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

## CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge piping.

1. Install shutoff valves on piping connections to booster-pump suction and discharge piping. Install ball, butterfly, or gate valves same size as suction and discharge piping.
2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to domestic-water piping.
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers.
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge piping.
5. Install piping adjacent to booster pumps to allow service and maintenance.

## FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform visual and mechanical inspection.
2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

## STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

## ADJUSTING

A. Adjust booster pumps to function smoothly and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested, provide on-site assistance in adjusting booster pump to suit actual occupied conditions.

## DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

**SECTION 4 - SANITARY WASTE AND VENT PIPING**

# PART 1 - GENERAL

## RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

## SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of internal drainage services.

Work under this section shall consist of furnishing all labor, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings and given in the schedule of quantities.

## SUMMARY

This Section includes the following for soil, waste, and vent piping inside the building:

Pipe, and fittings.
Special pipe fittings.

Related Sections include the following:

Division 22 Section "Sanitary Sewerage Pumps."

## DEFINITIONS

A. uPVC Pipe (IS:13592 / IS 4985-1981)

B. Low Noise Polypropylene pipe (DIN EN 1451-Part 1-6, DIN EN 1986-100 & EN 12056 Part 1-5)

## PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

Soil, Waste, and Vent Piping: 10-foot head of water (0.3 bar).

Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to relavant IS code.

## SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

Drainage System: Include plans, elevations, sections, and details.

C. Field quality-control inspection and test reports.

## QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency. All pipes to be kite mark certified.

A. Comply with relevant Indian standard (IS) for plastic & CI piping components. Include marking for plastic drain, waste, and vent piping.

B. All components and fittings of each pipe work shall be from same supplier.

C. Store fittings in their delivery bags or within protective containers. Do not expose to direct sunlight.

D. Store pipe clear of ground. Do not stack pipes more than 7 layers high. Do not expose to direct sunlight.

## PART 2 - PRODUCTS

## UPVC Pipes and Fittings

A. The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from groovings and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter and shall conform to IS:4985-1981 or IS:13592. The pipes shall be of Class-III; 6 Kg/sq.cm pressure rating.or type B.

B. Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to IS:14735.

C. Laying and Jointing

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively, plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring for vertical line. The type of joint shall be used as per site conditions / direction of the Owner's site representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with GI adopter for insertion in the RCC slab for a water proof joint complete as directed by Owner's site representative.

D. Supports

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

E. Repairs

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs shall be made by replacement of the damaged section. If any split or chip out occur in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

## LOW NOISE POLYPROPYLENE PIPING SYSTEM

A. Socket Pipes

Three Layered, low noise sound insulated Polypropylene piping (PP) system as per DIN EN 1451-Part 1-6, DIN EN 1986-100 & EN 12056 Part 1-5 with push-fit joints, food gradeand mineral

reinforced material with a density of 1.9 gm/cm3, coefficient of expansion 0.04 mm/m0K, tensile strength 13 N/mm2, having high impact and stiffness, sound transmission levels of 13dB as per DIN 4109 at a flowrate of 4 l/s and having pipe ring rigidity as per 1S0/DIS 9969 and tightness as per EN 1277/B and C and DIN 19560, with all necessary fittings fitted with factory fitted lip ring, having 3 layers, pipes to be painted with ordinary cement paint for external installation:

B. Internal Layer:

Of PP-C, hot water resistant to 97 degree C, tested in accordance to ON EN 1451-1 and DIN 19560, good heat and corrosion ageing stability as well as high chemical resistance and a smooth pipe inner-surface.

C. Intermediate Layer:

Of PP-MV compound reinforced with mineral aggregate, which guarantees greater stiffness and stability.

D. External Layer:

Of PP-C. With high impact resistance and good weathering resistance.

E. Pipe Ring Stiffness:

Pipe ring stiffness would be in accordance with IS0/DIS 9969 and TIGHTNESS as per EN 1277/B and C and DIN 19560.

F. Markings:

All pipes shall carry the following markings: Batch number; year and week of manufacture; company name; dimension application class; stiffness class, test mark and material details.

G. Fittings:

Single- Layered fitting reinforced with mineral aggregate, made of a Halogen free PP-C-KV synthetic material, a reinforced wall and factory fitted lip ring, hot water resistant upto 95 degree c in accordance to ON EN 1451-PART 1-6 EN 12056 PART 1-5.

H. Fire Resistance And Heat Resistance:

The Pipes and fittings shall have a B2 fire classification according to EN 4102 and shall be hot water resistant up to 95ºC short term loading (90ºC long term loading).

I. Chemical Resistance:

The pipes and fittings shall have chemical resistance of pH 2-12 and be resistant to organic and inorganic acids.

J. Installation:

The piping system must be clamped properly as required, pipes passing through walls, beams, slabs, columns should pass through sleeves which are padded with insulation material internally (between pipe and sleeve) covering the pipe to avoid transfer of body and structural borne sounds (refer manufacturer's installation guide lines). The piping must not touch any wall, structure, paneling, false ceiling etc.

## PART 3 - EXECUTION

## GENERAL

A. Install seismic restraints on piping.

B. All pipe work, fittings and accessories shall be installed as per IS: 13592, IS: 4985, to give water tight pipe work installation.

C. Pipe route shall be the shortest possible, with as few bends as possible.

D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

E. Plastic pipe work and fittings jointing shall generally be solvent welded with ring seal joints to accommodate expansion

F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

Building Sanitary Drain: 2 percent downward in direction of flow for piping DN 80 and smaller; 1 percent downward in direction of flow for piping DN 100 and larger.

Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

H. Install uPVC soil and waste drainage and vent piping according to IS: 13592, IS:4985.

I. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

J. Install piping to allow for expansion and contraction without stressing pipe joints or connected equipment.

K. Base of stack shall be formed using 2 nos 45 degree bends connected together by an appropriates length of pipe or a 90 degree large radius support bend to ensure that the formed bend is minimum of 2 times the OD of the stack.

L. All branches to be swept in the direction of flow at all times.

M. Cross vent connections shall be made by a branch pipe being at 45 degrees. All cross connections shall be made above the flood level of any appliance at each floor level.

N. Install exposed piping parallel or at right angles to the building walls, except where otherwise shown on the Contract Drawings.

O. Where changes in pipe sizes occur, install tapered reducer fittings. Use of bushings is not permitted. Install eccentric reducer fittings with level crown.

P. Where changes in pipe direction occur install factory manufactured fittings. Bending or forming of piping is not permitted without Engineer's written permission.

Q. Install test-tees in soil, waste, vent and rainwater pipe risers at locations shown on the contract drawings.

R. Provide minimum clearances between piping covered by this Section and other services.

S. Expansion joints shall be anchored; the anchor points shall be made utilizing the groove provided on fittings the matching engineered bracket. If it is not possible to anchor at the expansion joint, it shall be provided directly onto the pipe; must be within one meter of the proposed point of anchorage.

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

## INSTALLATION OF SOIL, WASTE & VENT PIPES

A. Soil, waste & vent pipes in shafts under the floors / suspended below slab shall consist of cast iron pipes as described earlier. Waste pipes from bottle trap to floor/urinal traps for wash basin, urinal and sink shall be GI pipes and fittings.

B. All Horizontal pipes running below the slab and along the ceiling, shall be fixed on structural adjustable clamps, sturdy hangers of the design as called for in the drawings. The pipes shall be laid in uniform slope and proper levels. All vertical pipes shall be truly vertical fixed by means of stout clamps in two sections, bolted together, built into the walls, wedged and neatly jointed. The branch pipes shall be connected to the stack at the same angle as that of fittings. All connections between soil, waste and ventilating pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts. Where the horizontal run off the pipe is long or where the pipes cross over building expansion joints etc. suitable allowance shall be provided for any movements in the pipes by means of expansion joint etc. such that any such movement does not damage the installation in any way.

C. Before jointing, the interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right up to the back of the socket and carefully centered by two or three laps of threaded spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required levels and alignment. The reminder of the socket is left for the lead caulking. Where the gasket has been tightly held, a jointing ring shall be placed round the barrel against the face of the socket. Molten Lead shall be poured to the remainder of the socket.

D. The joint shall not be covered till the pipe line has been tested under pressure. Rest of pipe line shall be covered so as to prevent the expansion and contraction due to variation in temperature.

E. Rainwater Pipes

All open terraces shall be drained by rain water down takes.

Rainwater down takes are separate and independent of the soil and waste system and will discharge into the underground storm water drainage system of the complex.

Rainwater in open courtyards shall be collected in catch basins and connected to the Storm Water Drains.

Any dry weather flow from waste appliances, e.g. AHU's pump rooms, waste water sumps shall connected to sewers after traps and not in the storm water drainage systems.

F. Balcony / Planter drainage

Wherever required, all balconies, terraces, planters and other frontal landscape areas will be drained by vertical down takes or other type of drainage system shown on the drawings and directed by the Project Manager.

## PIPE SLEEVES

Pipe sleeves, next larger diameter than pipes shall be provided wherever pipes pass through walls & slabs and annular space filled with fiberglass & finished with retainer rings. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matter.

## PIPE PROTECTION

Cast iron soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate of 12 mm size) 10 cm bed and around. When pipes are running well above the structural slabs, the encased pipes shall be supported with suitable cement concrete pillars of required height and size at intervals directed by the Project Manager.

## CUTTING AND MAKING GOOD

Pipes shall be fixed and tested as building proceeds. The contractor shall provide all necessary holes, cutouts and chases in structural members as building work proceeds. Wherever holes are cut or left originally they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement : 2 coarse sand). Cured and the surface restored to original condition.

## TESTING

A. Testing shall be done in accordance with IS:1172 and IS:5329 except as may be modified herein under.

B. Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber bellow plugs, manometers, smoke testing machines, pipe and fitting work tests,

C. All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

D. Soil and waste pipes shall be tested in sections after installation, by filling up the stack with water. All openings and connections shall be suitably plugged as approved by the Project Manager. The total head in the stack shall be 4.5 m at the highest point of the section under test. The period of test shall be minimum for 30 minutes or as directed by the Project Manager. If any leakage is visible, the defective part of the work shall be cut out and made good.

E. On completion of the work the entire installation shall be tested by smoke testing machine. The test shall be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging the outlets with bellow plugs. Apply dense smoke keeping the top of stack open and observe for leakages. Rectify or replace defective sections.

F. After the installation is fully complete, it should be tested by flushing the toilets, running atleast 20% of all taps simultaneously and ensuring that the entire system is self-draining, has no leakages, blockages etc. rectify and replace where required.

G. A test register shall be maintained and all entries shall be signed and dated by the Contractor and the Project Manager or his representative.

H. All pipes in wall chase or meant to be encased or burried shall be hydro tested before the chase in plastered or the pipe encased or burried.

**SECTION 5 - SANITARY WASTE PIPING SPECIALTIES**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
Floor Traps.
Cleanout Plugs

1.3 DEFINITIONS

A. Retain acronyms and abbreviations that remain after this Section has been edited.

B. ABS: Acrylonitrile-butadiene-styrene plastic.

C. FOG: Fats, oils, and greases.

D. FRP: Fiberglass-reinforced plastic.

E. HDPE: High-density polyethylene plastic.

F. PE: Polyethylene plastic.

G. PP: Polypropylene plastic.

H. PVC: Polyvinyl chloride plastic.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

1.1 TRAPS

A. Floor Traps

Floor traps where specified shall be siphon type full before P or S type Cast Iron / uPVC / PP / HDPE having a minimum 50 mm deep seal. The trap and main waste pipes in toilets having no Sunken floor shall run below slab and shall be supported from the ceiling below. The trap and waste pipes in sunken area (where required) shall be set in cement concrete blocks firmly supported on the structural floor.

The trap and waste pipes when buried below ground shall be set and encased in cement concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1: 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level.

Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30 x 30 cms of the required depth.

1.2 CLEANOUT PLUGS

A. Floor Clean Out Plug

Clean out plug for soil, waste or rain water pipes laid under floors shall be provided near pipe junctions bends, tees, "Y" and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor level. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be cast brass suitable for the pipe dia. With screwed to a GI socket. The socket shall be drip seal joined/ Lead Caulked to the drain pipes.

B. Cleanout on Drainage Pipes

Cleanout plugs shall be provided on head of each drain and in between at locations indicated on plans or directed by Owner's site representative. Cleanout plugs shall be of size matching the full bore of the pipe but no exceeding 150 mm dia CO plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.

Floor cleanout plugs shall be cast brass.

Cleanouts provided at ceiling level pipe shall be fixed to a CI flanged tail piece. The cleanout doors shall be specially fabricated from light weight galvanized sheets and angles with hinged type doors with fly nuts, gasket etc. as per drawing.

Waste pipe from appliances

Waste pipe from appliances e.g. wash basins, sinks and urinals shall be of uPVC pipes 32, 40, 50 mm OD conforming to IS:4985 class III (6 kg/cm2 or as given in the schedule of Quantities or shown on the drawings.

All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps.

PART 3 - EXECUTION

1.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

Size same as drainage piping up to 100mm. Use 100mm for larger drainage piping unless larger cleanout is indicated.
Locate at each change in direction of piping greater than 45 degrees.
Locate at minimum intervals of 50 feet (15 m) for piping 100mm and smaller and 100 feet (30 m) for larger piping.
Locate at base of each vertical soil and waste stack.

For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

Install vent caps on each vent pipe passing through roof.

Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

1.2 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

Tests and Inspections:

Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

1.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

Place plugs in ends of uncompleted piping at end of each day or when work stops.

**SECTION 6 - EXTERNAL DRAINAGE (SEWAGE & STORM WATER DISPOSAL)**

# PART 1 - GENERAL

1.1 SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of external drainage & sewage disposal services.

1.2 General Scheme

The contractor shall install a drainage system to effectively collect; drain and dispose all soil and waste water from various parts of the buildings, appurtenances and equipment. The piping system shall finally terminate and discharge into the STP. The piping work mainly consists of laying of Salt glazed stoneware pipes, reinforced cement concrete pipes and cast iron soil pipes as called for on the drawings. All piping shall be installed at depth greater than 80 cm below finished ground level. The disposal system shall include construction of gully traps, manholes, intercepting chambers as indicated. The piping system shall be vented suitably at the starting point of all branch drains, main drains, the highest/lowest point of drain and at intervals as shown. All ventilating arrangements shall be unobstructive and concealed. The work shall be executed strictly in accordance with IS: 1742. The sewage system shall be subject to smoke test for its soundness as directed by the Project Manager. Wherever the sewerage pipes run above water supply lines, same shall be completely encased in cement concrete 1:2:4 all round with the prior approval of the Project Manager.

Without restricting to the generality of the foregoing, the drainage system shall inter-alia include:

a. Sewer lines including earth work for excavation, disposal, back filling and compaction, pipe lines, manholes, drop connections and connections to the municipal or existing sewer.

b. Storm water drainage, earth works for excavation, disposal, backfilling and compaction, pipe lines, manholes, catch basins and connections to the existing municipal storm water drain or connected as indicated by the Project Manager.

1.3 General Requirements

All materials shall be new and of quality conforming to specifications and subject to the approval of the Owner's site representative. Wherever particular makes are mentioned, the choice of selection shall remain with the Architect / Consultant / Owner's site representative.

Drainage lines and open drains shall be laid to the required gradients and profiles.

All drainage work shall be done in accordance with the local municipal bye-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.

Location of all manholes, etc shall be got confirmed by the Project Manager before the actual execution of work at site. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Project Manager in writing.

All materials shall be rust proofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

## PART 2 - TRENCHING FOR PIPES AND DRAINS

1.1 General

All the material shall be new of best quality conforming to specifications and subject to the approval of the Architects. Drainage lines shall be laid to the required gradients and profiles. All drainage work shall be done in accordance with the local municipal by-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority. Location of all manholes, catch basins etc. shall be finalized and shown in approved shop drawings before the actual execution of work at site. All work shall be executed as directed by the Project Manager.

1.2 Alignment & Grade

The sewer and storm water drainage pipes shall be carefully laid to levels and gradients shown in the plans and sections but subject to modifications as shall be ordered by the Architects from time to time to meet the requirements of the works. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in straight lines without vertical or horizontal undulations. The body of the pipes shall rest on an even bed in the trench for its length and places shall be excavated to receive collar for the purpose of jointing. No deviations from the lines, depths of cuttings or gradients as called for on the drawings shall be permitted without the written approval of the Architect. All pipes shall be laid at least 60cms below the finished ground level or as called for on the drawings.

1.3 Setting out Trenches

The contractor shall set out all trenches, manholes, chambers and such other works to true grades and alignments as called for. He shall provide the necessary instruments for setting out and verification for the same. All trenches shall be laid to true grade and in straight lines and as shown on the drawings. The trenches shall be laid to proper levels by the assistance of boning rods and sight rails which shall be fixed at intervals not exceeding 10 meters or as directed by the Project Manager.

1.4 Trench Excavation

The trenches for the pipes shall be excavated with bottoms formed to level and gradients as shown on the drawings or as directed by the Project Manager. In soft and filled in ground, the Project Manager may require the trenches to be excavated to a greater depth than the shown on the drawings and to fill up such additional excavation with concrete (1:4:8) consolidated to bring the excavation to the required levels as shown on the drawings.

All excavations shall be properly protected where necessary by suitable timbering, piling and sheeting as approved by the Project Manager. All timbering and sheeting when withdrawn shall be done gradually to avoid falls. All cavities be adequately filled and consolidated. No blasting shall be allowed without prior approval in writing from the Architect. It shall be carried out under thorough and competent supervision, with the written permission of the appropriate authorities

taking full precautions connected with the blasting operations. All excavated earth shall be kept clear of the trenches to a distance equal to 75 cms.

1.5 Timbering of Sewer and Trenches

The Contractor shall at all times support efficiently and effectively the sides of all the trenches and other excavations by suitable timbering, piling and sheeting and they shall be close timbered in loose or sandy starta and below the surface of the sub soil water level.

All timbering, sheeting and piling with their wallings and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

The Contractor shall be held responsible and shall be accountable for the sufficiency of all timbering, bracings, sheeting and piling used and also for, all damage to persons and property resulting from improper quality strength placing, maintaining or removing of the same.

1.6 Shoring of Buildings

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

1.7 Obstruction Road

The contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit. He shall remove the materials excavated and bring them back again when the trench is required to be refilled. The contractor shall obtain the consent of the Project Manager in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

1.8 Protection of Pipes etc.

All pipes, water mains, cables etc. met in the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the cables, the removal of which shall be arranged by the contractor with the written consent from the Project Manager.

1.9 Trench Back Filling

Refilling of the trenches shall not be commenced until the length of pipes therein has been tested and approved. All timbering which may be withdrawn safely shall be removed as filling proceeds. Where the pipes are unprotected by concrete hunching, selected fine material shall be carefully hand-packed around the lower half of the pipes so as to buttress them to the sides of the trench.

The refilling shall then be continued to 150mm over the top of the pipe using selected fine hand packed material, watered and rammed on both sides of the pipes with a wooden hammer. The process of filling and tamping shall proceed evenly in layers not exceeding 150mm thickness, each layer being watered and consolidated so as to maintain an equal pressure on both sides of the pipe line. In gardens and fields the top solid and turf if any, shall be carefully replaced.

1.10 Contractor to restore settlement and Damages

The contractor shall at his own costs and expenses, make good promptly during the whole period for the works in hand if any settlement occurs in the surfaces of roads, beams, footpaths, gardens, open spaces etc. in the public or private areas caused by his trenches or by his other excavations and he shall be liable for any accident caused thereby. He shall also, at his own expense and charges, repair (and make good) any damage done to building and other property. If in the opinion of the Project Manager he fails to make good such works with all practicable dispatch, the Project Manager shall be at his liberty to get the work done by other means and the expenses thereof shall be paid by the contractor or deducted from any money that may be or become due to him or recovered from him by any other manner according to the laws of land.

The contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled, surplus soil shall be immediately removed, the surface shall be properly restored and roadways and sides shall be left clear.

1.11 Removal of Water from Sewer, Trench etc.

The contractor shall at all times during the progress of work keep the excavations free from water which shall be disposed by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any road or streets, nor cause any interference with the use of the same by the public.

If any excavation is carried out at any point or points to a greater width of the specified cross section of the sewer with its cover, the full width of the trench shall be filled with concrete by the contractor at his own expense and charges to the requirements of the Project Manager.

1.12 Removal of Filth

All night soil, filth or any other offensive mater met with during the execution of the works, shall not be deposited on the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be immediately, after it is taken out of any trench, sewer or cess pool, put into the carts and removed to a suitable place to be provided by the Contractor.

1.13 Width of Trench

The Project Manager shall have power by giving an order in writing to the Contractor to increase the maximum width/depth for excavation and backfilling in trenches for various classes of sewer, manholes and other works in certain length to be specifically laid down by him, where on account of bad ground on other unusual conditions, he considers that such increased width/depths are necessary in view of the site conditions.

# PART 3 - PRODUCT

## PIPING MATERIAL

a. UPVC Pipes and Fittings

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from groovings and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter.

A. Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

B. Laying in Trenches

UPVC pipes shall be laid on cement concrete bed of width 300mm over the outside diameter of pipe, and 100 mm thickness. Fine sand shall be carefully filled around the lower half of the pipes so as to buttress them to the sides of the trench.

The filling shall then be continued to 150mm over the top of the pipe using fine sand, watered and rammed on both sides of the pipes. The process of filling and ramming with fine hand picked material shall proceed evenly in layers not exceeding 150mm thickness, each layer being watered and consolidated so as to maintain an equal pressure on both sides of the pipe line.

A. Dimensions

**Dimension or Pipes**

a. Mean Outside Diameter

The mean outside diameter, outside diameter at any point and tolerances shall be as given in Table 1 and shall be measured according to the method given in IS 12235(Part 1).

**Table 1 Outside Diameters and Tolerances**
**(Clause 6.1.1)**
**All dimensions in millimeters**

| Sl. No. | Nominal Outside diameter, da | Mean Outside Diameter, dem | | Outside Diameter at Any Point, de | |
|---|---|---|---|---|---|
| | | Min | Max | Min | Max |
| (1) | (2) | (3) | (4) | (5) | (6) |
| i) | 110 | 110.0 | 110.4 | 108.6 | 111.4 |
| ii) | 125 | 125.0 | 125.4 | 123.5 | 126.5 |
| iii) | 160 | 160.0 | 160.5 | 158.0 | 162.0 |
| iv) | 200 | 200.0 | 200.6 | 197.6 | 202.4 |
| v) | 250 | 250.0 | 250.8 | 247.0 | 253.0 |
| vi) | 315 | 315.0 | 316.0 | 311.2 | 318.8 |

b. Length of Pipe

The lengths may be supplied as agreed to between the purchaser and the manufacturer.

c. Dimensions of Integral Sockets and Spigots Ends

The basic dimensions shall be in accordance with Tables 3 and 4, and Fig. 2, 3, 4 and 5.

d. Wall Thickness of Sockets

e2min =0.9e and e3 min = 0.75e

e3 min applies only to those parts of the sealing ring zone where the fluid contained within the pipe comes into contact with the fluid, that is beyond the designated ring seal point, walls thinner than e3 are permitted.

If retaining caps or rings are- provided, they can be made to other designs or from polymers other than unplasticized polyvinyl chloride, provided that the finished joint conforms to the same functional test requirements.

When a sealing ring is retained by means of a retaining ring or cap, the wall thickness of the area shall be calculated by addition of the wall thickness at the corresponding places of the socket and the retaining ring or cap (see Fig. 3). In all cases, the components shall meet the functional test requirements.

**Table 3 Dimensions of Elastomeric Sealing Ring Sockets and Spigot Ends**
**(Clause 6.1.4)**
**All dimensions in millimeters**

| Sl. No. | Nominal diameter, dn | Socket | | | Spigot End | |
|---|---|---|---|---|---|---|
| | | dsm | A | C | l1 | H1 |
| | | Min | Min | Max | Min | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| i) | 110 | 110.4 | 32 | 26 | 60 | 6 |
| ii) | 125 | 125.4 | 35 | 26 | 67 | 6 |
| iii) | 160 | 160.5 | 42 | 32 | 81 | 7 |
| iv) | 200 | 200.6 | 50 | 40 | 99 | 9 |
| v) | 250 | 250.8 | 55 | 70 | 125 | 9 |
| vi) | 315 | 316.0 | 62 | 70 | 132 | 12 |

NOTES

1. A MIN for dn ≤ 200 mm, shall be 0.2 dn + 10 mm

2. A MIN for dn ≤ 250 mm, shall be 0.1 dn + 30 mm

3. Values for B may be smaller for constructions with sealing rings firmly fixed in the groove of the socket. Where sealing rings are firmly and have multiple sealing zones, the dimensions Amin and C max should be measured to the effective sealing point as specified by the manufacturer (see Fig.4)

B. Physical Characteristics

a. Appearance

When viewed without magnification, the internal and external surfaces of the pipe shall be smooth, clean and tree from grooving, blistering and any other surface irregularity, which is likely to prevent conformance of the pipe with this standard. Slight shallow longitudinal grooves or irregularities in the pipe shall be permissible, provided the wall thickness remains within permissible limits. The pipe wall shall not contain impurities or pores. The pipe ends shall be cleanly cut and reasonably square to the axis of the pipe.

b. Colour

The colour of the pipes shall be dark (any shade of brown). The pipe shall be uniformly coloured throughout the entire wall. Slight variations in the appearance of the colour are permitted.

C. Joints

a. Elastomeric Sealing Rings

Elastomeric sealing rings shall be free from substances (for example, plasticizers) that can have a detrimental effect on the polyvinyl chloride of the pipes or fittings used in conjunction with the pipes.

The design of the profile and dimensions of the sealing ring is left to the manufacturer, as long as the pipe with the sealing ring meets the requirements of this standard. Where the design of the

socket is such that the sealing ring is not firmly fixed in position, the housing for the ring shall be so designed as to minimize the possibility of the ring being dislodged during insertion of the pipe ( or spigot of a fitting) to complete the joint.

Elastomeric sealing rings shall be in accordance with one of the types (Type 1 to Type 6) of IS 5382. The manufacturer has to, however, specify the type of sealing ring (namely Type 1, 2, 3, 4, 5 or 6) that is being offered.

b. Solvent Cement

The solvent cement used shall conform to the requirements laid down in IS 14182.

D. Performance Requirements

a. Elastomeric Sealing Ring Joints

i. Internal Hydrostatic Pressure

When tested according to the method described in Annex D, the joint, when assembled according to the manufacturer's instructions and subjected to an angular deflection,$\alpha$, of minimum 2°as well as a diametric deflection (distortion) of 5 percent of the outer diameter, shall withstand an internal pressure of up to and including 0.05 MPa (0.5 bar) fora minimum of 15 min without leakage.

ii. Internal Negative Hydrostatic Pressure (Internal Vacuum)

When tested according to the method described in Annex E, the joint, when assembled according to the manufacturer's instructions and subjected to an angular deflection,$\alpha$, of minimum 2° as well as a diametric deflection (distortion) of 5percent of the outer diameter, shall withstand an internal negative pressure (internal vacuum) of up to and including 0.03 MPa ( 0.3 bar) for a minimum of 15 min without leakage.

b. Solvent Cemented Joints

i. Internal Hydrostatic Pressure

When assembled according to the manufacturer's instructions, the joint shall withstand an internal pressure of up to and including 0.05 MPa (0.5 bar) - for a minimum period of 15 min without leakage.

ii. Internal Negative Hydrostatic Pressure (Internal Vacuum)

When assembled according to the manufacturer's instructions, the joint shall withstand an internal negative pressure (internal vacuum) of up to and including 0.03 MPa (0.3 bar) for a minimum period of 15 min without leakage.

E. Marking

a. Each pipe shall be clearly and indelibly marked in ink / paint or hot embossed on white base at intervals of not more than 3 m, but at least once per pipe, in the colour indicated in 12.3. The marking shall be legible without magnification. The marking shall not initiate cracks or other types of defects which adversely influence the performance of the pipe. Marking by indentation reducing the wall thickness not more than 0.15 mm shall be

deemed to conform to this clause without infringing the requirements for the wall thickness given in 2.1.2.

b. The marking shall show the following:

i. Identification of the source of manufacture,

ii. Outside diameter, -

iii. Stiffness class, and

iv. Batch or Lot number.

c. The colour of the marking shall be such that it differs from the basic colour of the pipe.

d. BIS Certification Marking

i. Each pipe may also be marked with the ISI Standard Mark.

ii. The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the rules and regulations made thereunder. Details of conditions under which a license for the use of the Standard Mark may be granted to the manufacturers or the producers may be obtained from the Bureau of Indian Standards.

**Table 6 Requirement of Pipes for Internal Hydrostatic Pressure Test (Clause 8.3)**

| Sl. No. | Test | Test Temperature | Test Duration |
|---|---|---|---|
| | | °C | (Minimum Holding Time) |
| (1) | (2) | (3) | (4) |
| i) | Acceptance test | 27 | 1 |
| ii) | Type test | 60 | 1000 |

a. Masonry Drains

Brick masonry drains shall be of a minimum width of 30cms for depth upto 45cm and a maximum width of drains shall be 45cms for depths beyond 45cms. However, in special cases where the depth is very high, the width of drain shall be in proportion of 1:5 with the depth. Brick masonry drains shall be constructed in brick masonry in cement mortar 1:5 in cement concrete foundations as specified in the schedule of quantities. Whereever specified, masonry drains shall be plastered with cement mortar inside. The outer surface shall be flush pointed without additional charge.

All brick masonry covered drains shall be provided with Cast Iron perforated cover with frame or cast in situ or precast RCC slabs as specified in drawings. All drains shall be plastered with cement mortar 1:4, 12mm thick with a coat of neat cement. All finished work shall afford specified gradient to ensure free and efficient discharge.

Payment for masonry drains shall be made under individual items of masonry, cement concrete and plaster by volume of area as given in the drawings and schedule of quantities.

A. Making Connections

Contractor shall connect the new sewer line to the existing manhole by cutting the walls benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

b. EXECUTION

c. TESTING

All rights of the sewer and drain shall be carefully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subject to a test pressure of 1.5 meter head of water. The test pressure will however, not exceed 6 meters head at any point. The pipes shall be plugged preferably with standard design plugs or with rubber plugs on both sides, the upper end shall, however, be connected to a pipe for filling with water and getting the required head poured at one time.

Sewer lines shall be tested for straightness by :

A. Inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball shall roll down the invert of the pipe and emerge at the lower end.

B. means of a mirror at one end a lamp at the other end. If the pipe is straight the full circle of light will be seen otherwise obstructions or deviations will be apparent.

C. The contractor shall give a smoke test to the drain and sewer at his own expense and charges, if directed by the Owner's site representative.

D. A test register shall be maintained which shall be signed and dated by contractor and Owner's site representative.

**SECTION 7 - SUMP PUMPS**

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

Submersible sump pumps.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Provide from the list of approved manufacturer's.

Wiring Diagrams: For power, signal, and control wiring.

Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined by a qualified testing agency, and marked for intended location and application.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

Protect bearings and couplings against damage.

Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

1.1 Submersible Sump Pump

A. These shall be fully submersible with a fully submersible motor. The pumps shall be provided with an automatic level controller and all interconnecting power and control

cabling which shall cause the pumps to operate when the water level in the sump rises to a preset level and stop when the preset low level is reached.

B. Pumps for drainage shall be single stage, single entry.

C. Pump shall be C.I. casing and C.I. two vane open type with a dynamically balanced impeller connected to a common shaft of the motor. The vane for sewage pump will be open type, while for drainage pump, etc. it will be of semi open type. The MOC of the sump shall be in accordance to schedule of quantity.

D. Stuffing box shall be provided with mechanical seals.

E. Each pump shall be provided with a suitably rated induction motor suitable for 415 volts, 3 phase, 50 Hz A.C. power supply.

F. Each pump shall be provided with in built liquid level controller for operating the pump between predetermined levels.

G. The pumping set shall be for stationary application and shall be provided with pump connector unit. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation.

H. Pump shall be provided with all accessories and devices necessary and required for the pump to make it a complete working system.

I. Sump pump shall be complete with level controllers, power and control switch gear, Auto/off/Manual switches, pumps priority selections and control and power cabling upto motor and controller/probes etc. (Including earthing). Level control shall be such that one pump starts on required level, 2nd pump cuts in at high level and alarms is given at extra high level. All level controllers shall be provided with remote level indications.

1.2 Motor Design

A. The pump motor shall be a squirrel cage induction, housed in air filled water-tight enclosure. Oil filled motors are not acceptable. The stator windings shall be Class "F" insulation (155 degree C or 311 degree F) for general usage and class `H' insulation (180 degree C or 317-8 grade 2) for submersible type.

B. The stator shall be heat shrunk fitted into the enclosure and shall not use bolts, pins or other fasteners that penetrate through the stator enclosure. The starter shall be equipped with a thermal switch embedded in series in the coils of the stator windings to protect the stator from wheel.

C. The motors shall be designed for continuous running duty type at 415 volts, 3 phase, 50 Hz power supply and capable of sustaining a minimum of 20 starts/stops per hour.

D. Between stator housing and pump, a tandem seal arrangement will be provided with an oil barrier. Both seals run in oil, allowing dry running without seal damage. Both seals shall be of the rubber bellows or metallic bellow type with positive drive between shaft and rotating seal face.

PART 3 - EXECUTION

1.1 EARTHWORK

Excavation and filling are specified in Division 31 Section "Earth Moving."

1.2 EXAMINATION

Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

1.3 INSTALLATION

Pump Installation Standards: Comply with relevant standard for installation of sump pumps.

1.4 CONNECTIONS

Comply with requirements for piping specified in Division 22 Section "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

Install piping adjacent to equipment to allow service and maintenance.

1.5 FIELD QUALITY CONTROL

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

Perform tests and inspections.

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

Tests and Inspections:

1. Perform each visual and mechanical inspection.
   Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

Pumps and controls will be considered defective if they do not pass tests and inspections.

Prepare test and inspection reports.

1.6 STARTUP SERVICE

Engage a factory-authorized service representative to perform startup service.

2. Complete installation and startup checks according to manufacturer's written instructions.

1.7 ADJUSTING

Adjust pumps to function smoothly and lubricate as recommended by manufacturer.

Adjust control set points.

**SECTION 8 - SANITARY FIXTURES & C.P FITTINGS**

PART – 1 : GENERAL

This section covers Sanitary Fixtures and Chromium plated fittings required for Plumbing works.

## RELATED DOCUMENTS

E. The Plumbing fixtures shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, Specifications, relevant Standard Specifications and manufacturer's instruction.

F. Sanitary Fixtures and C.P Fittings shall be in line with the requirements of approved drawings, schedule of quantities & municipal authorities requirement they shall be:

1. Sanitary appliances and fixtures for toilets as per requirements of Tender documents.
2. Chromium plated brass fittings as per requirements of Tender documents.
3. Stainless steel sinks as per requirements of Tender documents.
4. Accessories as per requirements.

1.8 SECTION INCLUDES

A. Sanitary appliances and fixtures for toilets.

B. Chromium plated brass fittings

C. Stainless steel sinks

D. Accessories e.g. towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails, coat hooks etc.

E. Hand driers, drinking water fountains etc.

1.9 RELATED REQUIREMENTS

A. Section 07 9216 - Joint Sealers: Seal fixtures to walls and floors.

1.10 SCOPE OF WORK

The scope of this section consists of but is not necessarily limited to supply, installation, testing and commissioning of following items:

A. Sanitary appliances and fixtures for toilets.

B. Chromium plated brass fittings

C. Stainless steel sinks

D. Accessories e.g. towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails, coat hooks etc.

E. Hand driers, drinking water fountains etc.

Whether specifically mentioned or not the Contractor shall provide for all appliances and fixtures all fixing devices, nuts, bolts, screws, hangers as required. All appliances, fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, specifications, and drawings. Accessories shall include proper fixing arrangements, brackets, nuts, bolts, washers, screws and required connection pieces. Sanitary wares & fitting if supplied free of cost by the Owner's site representative it would be listed and mentioned in the relevant Schedule of Quantities or drawing. All exposed pipes within toilets and near appliances/fixtures shall be of chromium plated brass or copper unless otherwise specified.

## 1.11 REFERENCE STANDARDS

| Serial no | Code no | Code |
|---|---|---|
| 1 | IS : 4346 | washers for use with fittings for water services |
| 2 | IS:110221 | |
| 3 | IS : 771 (Part 1 ) | Glazed Fire-Clay Sanitary Appliances: Part-1 General Requirements |
| 4 | IS : 771 (Part 2) | Glazed Fire-Clay Sanitary Appliances: Part-2 Specific Requirements of Kitchen And Laboratory Sinks |
| 5 | IS : 771 (Part 3) | Glazed Fire Clay Sanitary Appliances : Part-3 Specific Requirements of Urinals, Section 1 Slab Urinals |
| 6 | IS : 774 | Flushing Cistern for Water Closets and Urinals (Other Than Plastic Cisterns) - |
| 7 | IS : 775 | cast iron brackets and supports for wash basins and sinks |
| 8 | IS : 781 | Cast Copper Alloy Screw Down Bib Taps And Stop Valves for Water Services |
| 9 | IS : 1700 | drinking fountains |
| 10 | IS : 2548 (Part 1) | Plastic seats and covers for water-closets: Part 1 Thermoset seats and covers |
| 11 | IS : 2548 (Part 2) | Plastic seats and covers for water-closets: Part 2 Thermo plastic seats and covers |
| 12 | IS : 2556 (Part 1) | vitreous sanitary appliances (vitreous china): Part 1 General requirements |
| 13 | IS : 2556 (Part 2) | Vitreous Sanitary Appliances (Vitreous China) - Part 2: Specific Requirements of Washdown Water Closets |

| | | |
|---|---|---|
| 14 | IS : 2556 (Part 3) | Vitreous Sanitary Appliances (Vitreous China) - Part 3: Specific Requirements of Squatting Pans |

| Serial no | Code no | Code |
|---|---|---|
| 15 | IS : 2556 (Part 4) | Vitreous Sanitary Appliances (Vitreous China) - Part 4: Specific Requirements of Wash Basins |
| 16 | IS : 2556 (Part 6 section 2) | Vitreous sanitary appliances (vitreous china) : part 6 Specific requirements of urinals, section 2 half stall urinals. |
| 17 | IS : 2556 (Part 6 section 4) | Vitreous sanitary appliances (vitreous china) : Part 6 specific requirements of urinals, section 4 partition slabs. |
| 18 | IS : 2556 (Part 6 section 5) | Vitreous sanitary appliances (vitreous china): Part 6 Specific requirements of urinals, section 5 waste fittings. |
| 19 | IS : 2556 (Part 6 section 6) | Vitreous sanitary appliances (vitreous china) : Part 6 Specific requirements of urinals, section 6 water spreaders for half stall urinals. |
| 20 | IS : 2556 (Part 7) | Vitreous Sanitary Appliances (vitreous china) - - Part 7 : Specific Requirements of Accessories for Sanitary Appliances |
| 21 | IS : 2556 (Part 8) | Vitreous Sanitary Appliances (Vitreous China) - - Part 8 : Specific Requirements of Pedestal Close Coupled Washdown and Syphonic Water Closets |
| 22 | IS : 2556 (Part 11) | Vitreous sanitary appliances (vitreous china): Part 11 Specific requirements for shower rose |
| 23 | IS : 2556 (Part 12) | Vitreous sanitary appliances (vitreous china): Part 12 Specific requirements of floor traps |
| 24 | IS : 2556 (Part 15) | Vitreous Sanitary Appliances (Vitreous China) - - Part 15 : Specific Requirements of Universal Water Closets |
| 25 | IS : 2717 | Glossary of terms relating to vitreous enamelware and ceramic-metal systems |
| 26 | IS : 2963 | Copper Alloy Waste Fittings and Waste Plug for Wash Basin and Sinks |
| 27 | IS : 3311 | waste plug and its accessories for sinks and wash-basins |
| 28 | IS : 6249 | Point Hooks with Shank (for Capacities 63 Tones to 160 Tones) |

| Serial no | Code no | Code |
|---|---|---|
| 29 | IS : 6411 | gel-coated glass fiber reinforced polyester resin bath tubs |
| 30 | IS : 8931 | copper alloy fancy single taps, combination tap assembly and stop valves for water services |

| | | |
|---|---|---|
| 31 | IS : 9758 | flush valves and fittings for water closets and urinals |
| 32 | National Building Code of India 2005 Part IV and Part IX | Uniform Plumbing Code of India 2008 |
| 33. | IS : 1068 | Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium |
| 34. | IS : 1367 (Part 1) | Technical Supply Conditions for Threaded Steel Fasteners Part 1 General Requirements for Bolts, Screws, Studs and Nuts |
| 35. | IS : 1367 (Part 2) | Technical Supply Conditions for Threaded Steel Fasteners - Part 2 : Tolerances for Fasteners - Bolts, Screws, Studs and Nuts - Product Grades A, B and C |
| 36 | IS : 2064 | Code of practice for selection, installation and maintenance of sanitary appliances |
| 37 | IS : 8321 | Glossary of terms applicable to plumbing work |
| 38 | IS : 11149 | Rubber Gaskets |
| 39 | BSEN : 274 | Sanitary tap were, waste fittings for basins, bidets and baths. General technical specifications. |
| 40 | ANSI Z124.1.2 | American National Standard for Plastic Bathtub and Shower Units; 2005. |
| 41 | ANSI Z358.1 | American National Standard for Emergency Eyewash and Shower Equipment; 2009. |
| 42 | ASHRAE Std. 18 | Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008. |
| 43 | ASME A112.6.1M | Supports for Off-the-Floor Plumbing Fixtures for Public Use; The American Society of Mechanical Engineers; 1997 (Reaffirmed 2002). |

| **Serial no** | **Code no** | **Code** |
|---|---|---|
| 44 | ASME A112.18.1 | Plumbing Supply Fittings; The American Society of Mechanical Engineers; 2012. |
| 45 | ASME A112.19.1M | Enameled Cast Iron Plumbing Fixtures; The American Society of Mechanical Engineers; 2008 (R2011). |
| 46 | ASME A112.19.2 | Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals; The American Society of Mechanical Engineers; 2008. |

| | | |
|---|---|---|
| 47 | ASME A112.19.3 | Stainless Steel Plumbing Fixtures (Designed for Residential Use); The American Society of Mechanical Engineers; 2008. |
| 48 | ASME A112.19.4M | Porcelain Enameled Formed Steel Plumbing Fixtures; The American Society of Mechanical Engineers; 1994 (R2004). |
| 49 | ASME A112.19.5 | Trim for Water-Closet Bowls, Tanks and Urinals; The American Society of Mechanical Engineers; 2011. |
| 50 | ASME A112.19.14 | Six Liter Water Closets Equipped with Dual Flushing Device; 2006. |
| 51. | ASME A112.19.15 | Bathtub/Whirlpool Bathtubs with Pressure Sealed Doors; 2012. |

1.12 SUBMITTALS

A. See Section 10 3000 - Administrative Requirements, for submittal procedures.

B. Samples: Submit two lavatory supply fittings.

C. Manufacturer's Instructions: Indicate installation methods and procedures.

1.13 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Perform work in accordance with applicable codes.

1.14 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.15 MOCK-UP

A. The installation of the sanitary fixtures and fittings shall be as per the shop drawings approved by the Architect/Consultant.

B. The contractor shall have to assemble at least one set of each type of sanitary fixtures and fittings in order to determine precisely the required supply and disposal connections.

C. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes, holding devices etc. which will be required for final installation of all sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Architect / Interior Designer.

D. The fixtures in the trial assembly can be re-used for final installation without any additional payments for fixing or dismantling of the fixtures.

1.16 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. All sanitary fixtures and fittings shall receive from the Owner's Site Representative and thereafter be stored under covered roof and handled carefully to prevent any damage by the Contractor.

C. Factory packaging to be in place to protect fixtures and prevent use.

1.17 WARRANTY

A. See Section SCC - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for electric water cooler.

1.18 TOILETS FOR THE DISABLED

A. Where specified, in washroom facilities designed to accommodate physically disabled, accessories shall be provided as directed by the Owner's Site Representative.

B. Stainless steel garb brass of required size suitable for concealed or exposed mounting and opened non-slip gripping surface shall be provided in all washroom. The flushing cistern/valve shall be provided with chromium plated long handles.

PART 2 - PRODUCTS

## TOWEL RAIL

A. Towel rail shall be chromium plated brass or of stainless steel or powder coated brass of size, shape and type specified in the Schedule of Quantities.

B. Towel rail shall be fixed with screws/capping having finish similar to the towel rail in wall with Rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by the Owner's Site Representative.

## LIQUID SOAP DISPENSER

A. Liquid Soap Dispenser shall be wall/counter mounted suitable for dispensing liquid soaps, lotions, detergents. The cover shall lock to body with concealed locking arrangement, opened only be key provided.

B. Liquid soap dispenser body and shank shall be of high impact resistance material. The piston and spout shall be stainless steel with 1 liter capacity polyethylene container.

C. The valve shall operate with less than 2.27 Kg (5 lbs) of force.

## HAND DRIER

A. The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.

B. The hand drier shall be fully hygienic, rated for continuous repeat use (CRU).

C. The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds.

D. The hand drier shall be of wall mounting type suitable for 230 V, single phase, 50 Hz, AC power supply.

PART 3 - EXECUTION

## EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

## PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

## INSTALLATION

A. The contractor shall install all sanitary fixtures and fittings in their final position in accordance with approved trial assemblies and as shown on drawings. The installation shall be complete with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal/replacement of sanitary fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

B. Fixtures shall be mounted rigid, plumb and to alignment. The outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. It shall be ensured that the receiving pipes are clear of obstruction. When fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

C. Install each fixture with trap, easily removable for servicing and cleaning.

D. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers,

and escutcheons.

E. Install components level and plumb.

F. Install and secure fixtures in place with wall supports and bolts.

G. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 9005, color to match fixture.

H. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

I. The sanitary fixtures and fittings shall be installed at the correct assigned position as shown on the drawings and as directed by the Architect / Owner's Site Representative and shall fully meet with the aesthetic and symmetrical requirements as demanded by the Architect / Interior Designer

J. All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architect requirements. Wherever necessary, the fittings shall be centered to dimensions and pattern as called for.

K. All appliances, fittings and fixtures shall be fixed in a neat workmanlike manner true to level and to heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions.

L. The appliances shall be placed in correct position or marked out in order that pipe work can be fixed or partially fixed first.

M. The appliance shall be fixed in a manner such that it will facilitate subsequent removal if necessary.

N. The appliance shall be securely fixed. Manufacturer's brackets and fixing methods shall be used wherever possible. Compatible rust-proofed fixings shall be used. Fixing shall be done in manners that minimize noise transmission.

O. Pipe connections shall be made with demountable unions. Pipe work shall not be fixed in a manner that it supports or partially supports and appliance.

P. Appliances shall be fixed true to level firmly fixed to anchor or supports provided by the manufacturer and additional anchors or supports where necessary.

Q. Sizes of sanitary fixtures given in the Specifications or in the Schedule of Quantities are for identification with reference to the catalogues of make considered. Dimensions of similar models of other makes may very within + 10% and the same shall be provided and no claim for extra payment shall be entertained NOR shall any payment be deducted on this account.

R. Joints / gaps between all sanitary appliances / fixtures and the floor / walls shall be caulked with an approved mildew resistant sealant, having antifungal properties, of colour and shade to match that of the appliances / fixture and the floor / wall to the extent possible.

## INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

## ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

## CLEANING

A. Clean plumbing fixtures and equipment.

## PROTECTION

A. The contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation. At the time of handing over, the contractor shall clean, disinfect and polish all the fixtures and fittings. Any fixtures and fittings found damaged, cracked chipped stained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

B. Protect installed products from damage due to subsequent construction operations.

C. Do not permit use of fixtures by construction personnel.

D. Repair or replace damaged products before Date of Substantial Completion.

E. Contractor shall, during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection so as to absolutely prevent any damage to the appliances until handing over (The original protective wrapping shall be left in position for as long as possible).

## SCHEDULES

F. Fixture Heights: Install fixtures to heights above finished floor as indicated.

1. Towel Rail: As shown in drawings
2. Liquid Soap Dispenser: As shown in drawings
3. Hand Drier: As shown in drawings

## TESTING AND ACCEPTANCE

G. All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested. The contractor shall block the ends of waste and ventilation pipes and shall conduct an air test.

1. The sanitary fixtures form the final terminal units of the water supply and drainage system and shall meet the performance needs as a terminal unit. Each fixture shall be inspected for scratches or chippings and alignment before acceptance.
2. The following design flows shall be verified and validated for acceptance.

H. All tests shall be conducted at each and every fixture except for flush valves which shall be at the lowest and highest test connections to be made on each riser/downtake. The

contractor shall make the temporary valve connections which shall be plugged with a brass plug after validation.

I. Note: The above specification subject to change wherever applicable with respect to model selection by Architect / Interior designer.

## MEASUREMENT

A. Rate for fixing only of sanitary fixtures accessories, CP fittings shall etc. include all items, and operations stated in the respective specifications and bill of quantities and nothing extra is payable.

B. Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same, CP screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning and making good to the satisfaction of the Owner's Site Representative

**ANNEXURE II**

**Project Works :** **:**

**Status of Shop Drawings for (PHE System)**

**Date:**

**Contractor:**

| Sr. No. | Dwg. No. | Drawing Title | Scheduled Date of Submission | Submission & Approval of Shop Drawings | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1st Submission | Receipt of comments | 2nd Submission | Receipt of comments | Final Submission | Final Approval | |
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(a) Total no. of drawings = … Nos.; (b) Drawings Approved = … Nos.; (c) Approval Awaited = … Nos.; (d) Drawings Under Hold = … Nos.; (e) Drawings to be Submitted = … Nos.

Note: (a) All drawings in A1 size; (b) Floor plans - 1 : 100 (number of sheets as per project); (c) Section - 1 : 50; (d) Plant Room - 1 : 50 or 1 : 100 as per project)

**ANNEXURE III**
**Status of Technical Submittals (PHE)**

**Date:**

**Contractor:**

| Sr. No. | Submittals | Scheduled Date of Submission | Date of Submission | Date of Approval | Inspection | | Samples for Approval |
|---|---|---|---|---|---|---|---|
| | | | | | At Site | At Works | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**ANNEXURE IV**
**Technical (Product) Submittal**

| | | | |
|---|---|---|---|
| CLIENT | : | | |
| PROJECT | : | | |
| SERVICE | : | PHE SYSTEM | |
| SUBMITTAL REF NO. | : | | |
| DESCRIPTION OF ITEM | : | | |
| B.O.Q. REF. NO. | : | | |
| SPECIFICATION REF. NO. | : | | |
| CLAUSE NO. | : | | |
| PROPOSED MAKE | : | | |
| ENCLOSURES | : | | |
| CONTRACTOR | : | | |
| SIGNATURE | : | | DATE: |
| CONSULTANTS | : | | |
| APPROVED BY | : | | DATE: |
| PROJECT MANAGEMENT CONSULTANT | : | | |
| APPROVED BY | : | | DATE: |
| CLIENT | : | | |
| APPROVED BY | : | | DATE: |




# HIGH PERFORMANCE CENTRE AT SPORTS AUTHORITY OF INDIA NSSC, BENGALURU, KARNATAKA

## R1-ARCHITECTURAL DRAWINGS

collage design
Mumbai | Ahmedabad | New Delhi

Collage Design Pvt Ltd
300, Sai Sampanna, Station Rd,
Vikhroli East, Mumbai, 400 083
+91 22 25740844 / 45
-
S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| | |
|---|---|
| **PROJECT :** | **PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE** |
| **PROJECT NO.** | **25-P388** |
| **TITLE :** | DRAWING LIST |
| **CLIENT :** | SPORTS AUTHORITY OF INDIA (SAI) |

## HIGH PERFORMANCE CENTR

| SR.NO. | DRAWING NO. | DESCRIPTION | REVISION |
|---|---|---|---|
| | **ARCHITECTURE** | | |
| | **SITE** | | |
| 1 | AR-HPC-A0.001 | SURVEY PLAN | R0 |
| 2 | AR-HPC-A0.002 | SITE PLAN | R1 |
| 3 | AR-HPC-A0.003 | LANDSCPE PLAN | R1 |
| 4 | AR-HPC-A0.004 | LANDSCPE FINISHES PLAN | R1 |
| 5 | AR-HPC-A0.005 | LANDSCAPE SECTIONS | R1 |
| | **FLOOR PLANS** | | |
| 1 | AR-HPC-A1.01 | GROUND FLOOR PLAN | R1 |
| 2 | AR-HPC-A1.02 | GROUND MEZZANINE FLOOR PLAN | R1 |
| 3 | AR-HPC-A1.03 | FIRST FLOOR PLAN | R1 |
| 4 | AR-HPC-A1.04 | FIRST MEZZANINE FLOOR PLAN | R1 |
| 5 | AR-HPC-A1.05 | SECOND FLOOR PLAN | R1 |
| | **ELEVATIONS,SECTION & DETAILS** | | |
| 1 | AR-HPC-A2.01 | ELEVATIONS -01 | R1 |
| 2 | AR-HPC-A2.02 | ELEVATIONS -02 | R1 |
| 3 | AR-HPC-A3.01 | SECTIONS | R1 |
| 4 | AR-HPC-A3.02 | SECTIONS | R1 |
| 5 | AR-HPC-A4.01 | TYPICAL TOILET DETAILS | R0 |

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**REVISIONS**

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |
| R1 | UPDATED DRAWING LIST | 29-10-2025 |

**KEY PLAN**

**CLIENT**

LOGO.png

Sports Authority Of India, Karnataka ,India.

**ARCHITECT**

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Collage Design Pvt Ltd
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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

**PROJECT TITLE**

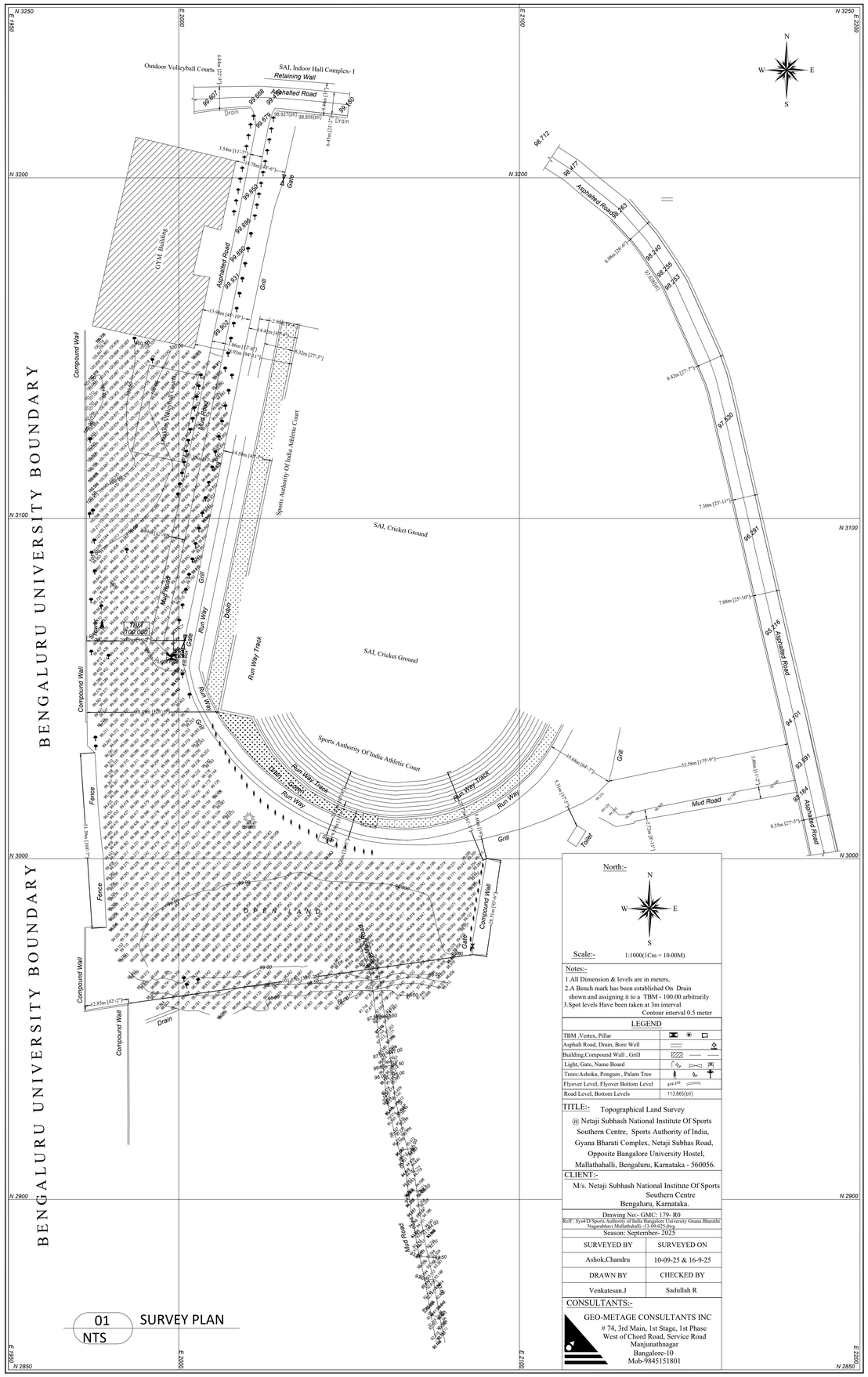
HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

**DRAWING TITLE**

ARCHITECTURE DRAWING LIST

| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A1.01 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1st ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
| DRAWN BY | TK | |

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N 3250
E 1950
E 2000
E 2100
E 2200
N 3200
N 3100
N 3000
N 2900
N 2850
BENGALURU UNIVERSITY BOUNDARY
Outdoor Volleyball Courts
SAI Indoor Hall Complex- I
Retaining Wall
Asphalted Road
Drain
GYM Building
Compound Wall
Gate
Grill
Run Way
Run Way Track
Sports Authority Of India Athletic Court
SAI, Cricket Ground
Mud Road
Fence
Toilet
Asphalted Road
Drain

EXISTING TOWER

MUD RUN WAY

EB Box

Gate

100.000 TBM

2 WHEELER PARKING

6.0 M WIDE DRIVEWAY

EXISTING FENCING

4 WHEELER PARKING

Fence

EXISTING ATHLETIC TRACK

MUD RUN WAY

EXISTING BORE WELL

Existing Stage

EXISTING FENCING

EXISTING TOILET TO BE DEMOLISHED

Compound Wall

EXISTING STRUCTURE

Gate

4 WHEELER PARKING-10NOS

6.0 M WIDE DRIVEWAY STAFF PARKING

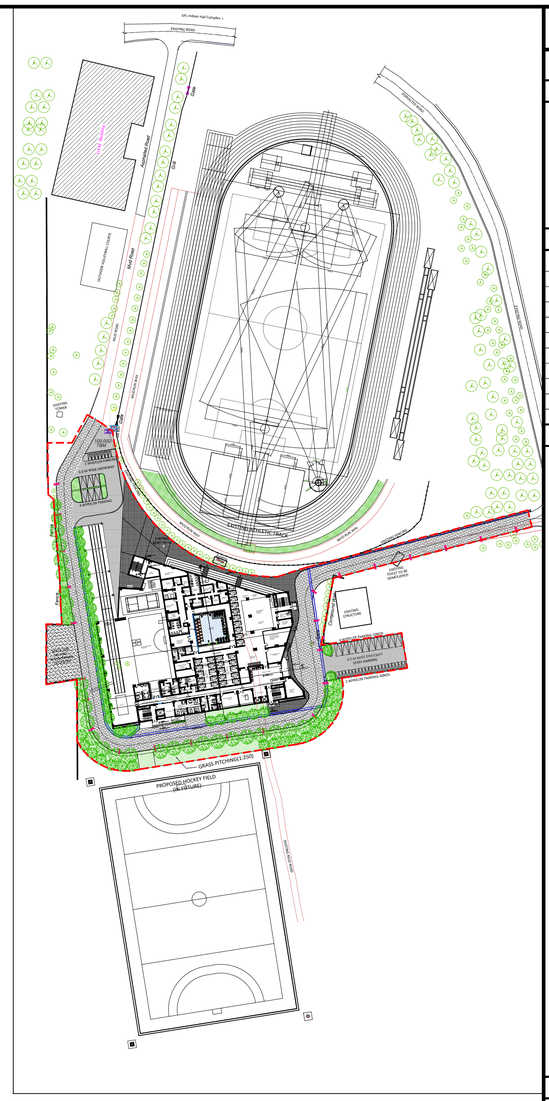
2 WHEELER PARKING-20NOS

SPACE FOR DG AND TRANSFORMER ,ESS ROOM

GRASS PITCHING(1:250)

PROPOSED HOCKEY FIELD (IN FUTURE)

01 SITE PLAN
1:750



01 KEY PLAN
1:750

## LEGEND

| | |
|---|---|
| | EXISTING TREES |
| | PROPOSED TREES |
| | 6M WIDE ROAD TRIMIX |
| | PAVER 1 |
| | PAVER 2 |
| | STORM WATER DRAIN |
| | DEVELOPMENT SITE AREA |

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |
| R1 | UPDATED DRAWING | 29-10-2025 |

## KEY PLAN

**CLIENT**

SAI SPORTS AUTHORITY OF INDIA

**ARCHITECT**

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

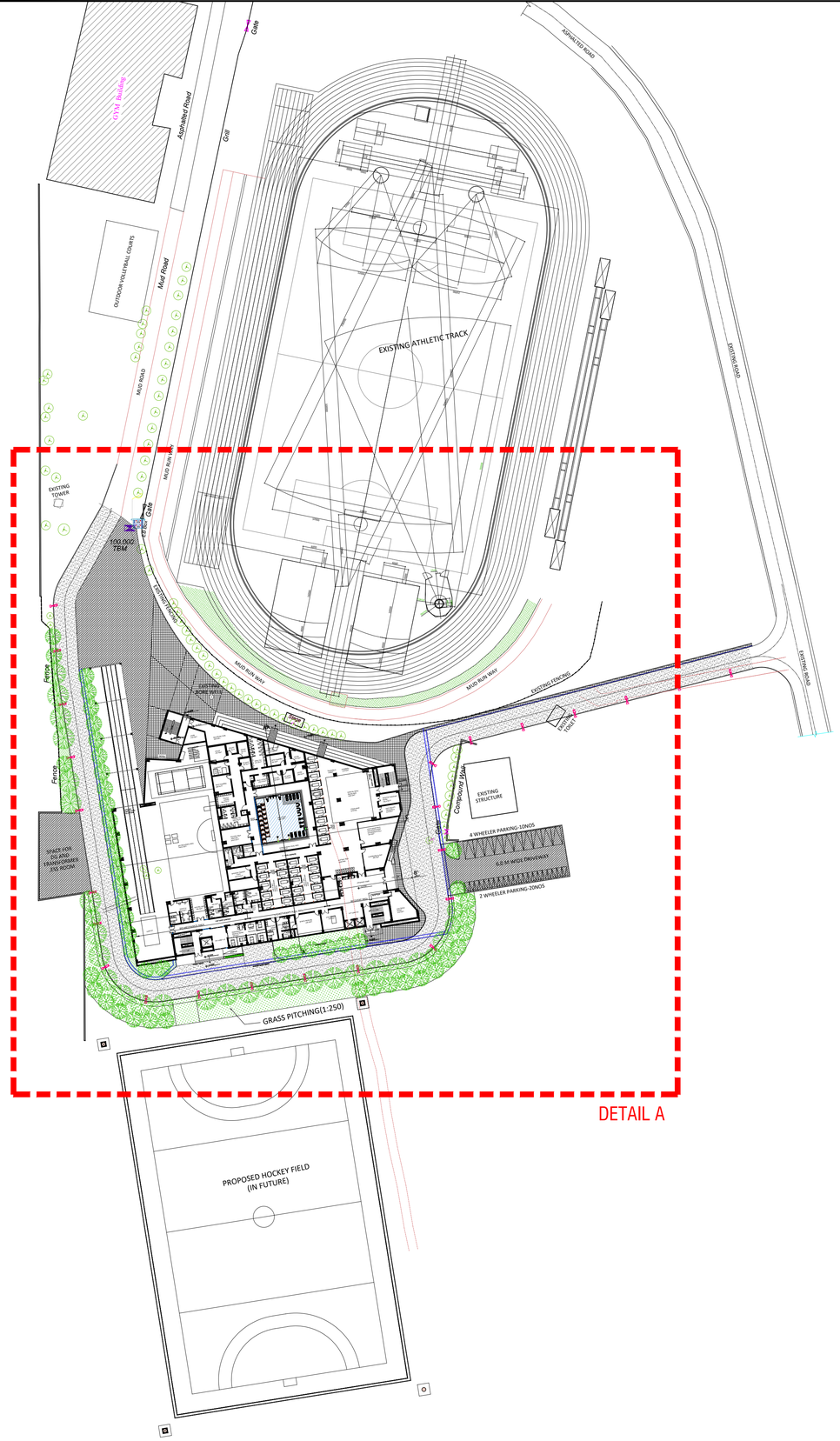
**PROJECT TITLE**

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

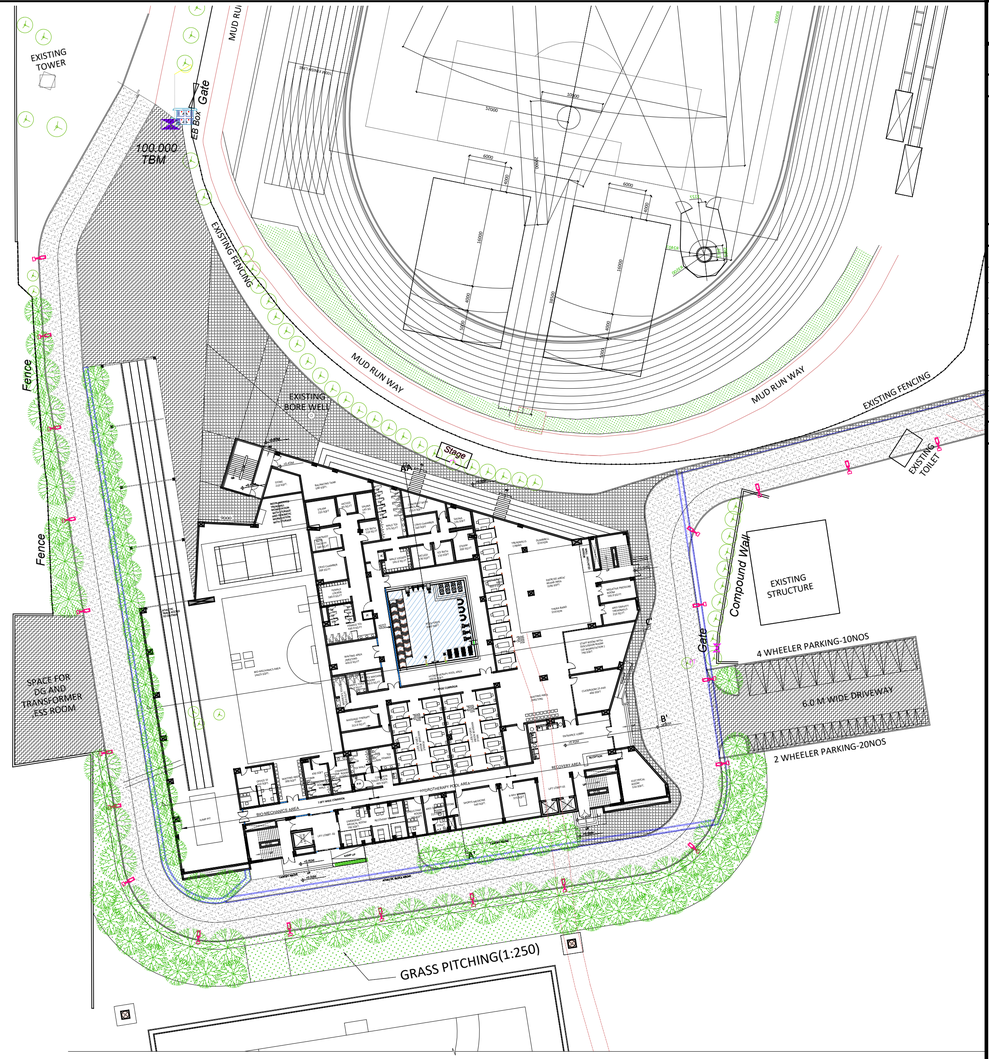
SITE PLAN

| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A0.002 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:500 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | |
| APPROVED | ---- | |
| CHECKED BY | AS | |
| DRAWN BY | BD | |




DETAIL A

01 KEY PLAN
1:750




01 LANDSCAPE PLAN(DETAIL A)
1:500

| LEGEND | |
|---|---|
| | EXISTING TREES |
| | PROPOSED TREES |

LIST OF TREES,SHRUBS,PALMS AND GROUNDCOVERS

| S.NO | CODE | BOTANICAL NAME | C/C | NOS |
|---|---|---|---|---|
| | **TREES (T)** | | | |
| 1 | Bau pur | *Bauhinia purpurea* | 4500 | 15 |
| 2 | Cas fis | *Cassia fistula (Amaltash)* | 6000 | 20 |
| 3 | Cas Sia | *Cassia siamea* | 6000 | 5 |
| 4 | Del Reg | *Delonix regia (Gulmohar)* | 6000 | 12 |
| 5 | Plu Alb | *Plumeria alba* | 3500 | 10 |
| 6 | Ter Spe | *Terminalia sp* | 4500 | 15 |
| 7 | Fic Ben | *Ficus benjamina (green)* | 6000 | 5 |
| 8 | Fic Lyr | *Ficus lyrata* | 3500 | 15 |
| 9 | Mic Cha | *Michelia champa (Golden Champa)* | 4500 | 10 |
| 10 | Lag Tho | *Lagerstroemia thorelli* | 4500 | 10 |
| | | | | **117** |
| | **PALMS (P)** | | | |
| 1 | Fis Pal | *Fishtail palm* | 5000 | 5 |
| 2 | Phe Roe | *Phoenix roebelenii* | 5000 | 5 |
| | | | | **10** |
| | **SHRUBS (S)** | | | |
| 1 | Alp Var | Alpinia Variegated | 600MM | 150 |
| 2 | Ham pat | Hamelia patens | 600MM | 150 |
| 3 | Tec gaud | Tecoma gaudichaudi | 600MM | 100 |
| 4 | Dra Son | Dracaena 'Song of India' | 600MM | 100 |
| 5 | Dur Gol | Duranta Golden | 600MM | 100 |
| 6 | Fic reg | Ficus reginald | 600MM | 200 |
| 7 | Bir of | Bird of Paradise | 600MM | 100 |
| 8 | Jat mul | Jatropha multifida (Red) | 600MM | 200 |
| 9 | Lag ind | Lagerstroemia indica | 600MM | 40 |
| 10 | Sch Var | Scheffera Variegated | 600MM | 100 |
| 11 | Spa | Spathiphyllum | 450MM | 100 |
| 12 | The ner | Thevetia nerifolia | 1200MM | 50 |
| 13 | Cae pul | Caesalpinia pulcherrima | 600MM | 20 |
| 14 | Aca Dif | Acalypha (Different Colours) | 600MM | 100 |
| | | | | **1510** |
| | **GROUND COVER (Gr )** | | | |
| 1 | Dur Gol | Duranta Golden | 600MM | 1800 |
| 2 | Fic Lon | Ficus long island | 450MM | 1500 |
| 3 | Syn Var | Syngonium variegate | 150MM | 2200 |
| 4 | Wed Tri | Wedelia trilobata | 150MM | 800 |
| 5 | Alt Spe | Alternanthera specie | 300MM | 800 |
| 6 | Asp Spr | Asparagus sprenger | 150MM | 300 |
| 7 | Ire Her | Iresine herbstii | 150MM | 500 |
| 8 | Oph Jab | Ophiopogon jaburan (variegated) | 150MM | 500 |
| 9 | Pet Hyb | Petunia hybrid | 300MM | 200 |
| 10 | Phi Moo | Philodendron moonlight | 300MM | 500 |
| | | | | **9100** |
| | **CREEPERS (cr )** | | | |
| 1 | Bou | Bougainvillea | | 50 |
| 2 | Ipo Pur | Ipomea purpurea | | 50 |
| 3 | Cle Spl | Clerodendrum splendens | | 50 |
| | | | | **150** |
| | **LAWN (L) & GRASS PAVERS (GP)** | | | |
| 1 | | *selection No. 1 grass* | | 650 SQM |

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |
| R1 | UPDATED DRAWING | 29-10-2025 |

## KEY PLAN

## CLIENT

SAI SPORTS AUTHORITY OF INDIA

## ARCHITECT

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| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

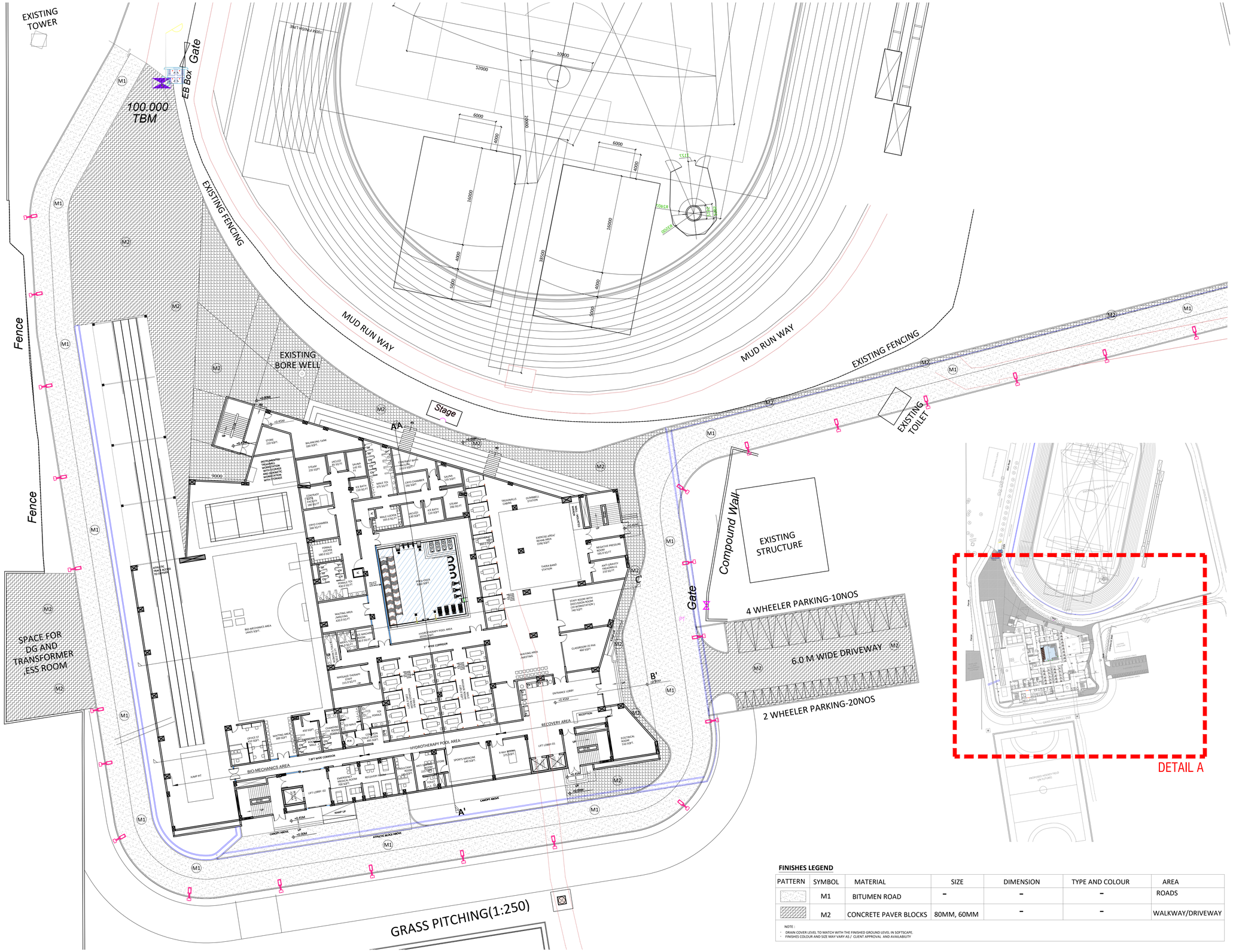
**PROJECT TITLE**

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LANDSCAPE PLAN

| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A0.003 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:500 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
| DRAWN BY | BD | |




01 FINISHES PLAN
1:500

**FINISHES LEGEND**

| PATTERN | SYMBOL | MATERIAL | SIZE | DIMENSION | TYPE AND COLOUR | AREA |
|---|---|---|---|---|---|---|
| | M1 | BITUMEN ROAD | - | - | - | ROADS |
| | M2 | CONCRETE PAVER BLOCKS | 80MM, 60MM | - | - | WALKWAY/DRIVEWAY |

NOTE :
- DRAIN COVER LEVEL TO MATCH WITH THE FINISHED GROUND LEVEL IN SOFTSCAPE.
- FINISHES COLOUR AND SIZE MAY VARY AS/ CLIENT APPROVAL AND AVAILABILITY

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## REVISIONS

| | DESCRIPTION | DATE |
|---|---|---|
| | FIRST ISSUE | 26-09-2025 |
| R1 | UPDATED DRAWING | 29-10-2025 |

## KEY PLAN



## CLIENT

SAI SPORTS AUTHORITY OF INDIA

## ARCHITECT

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| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

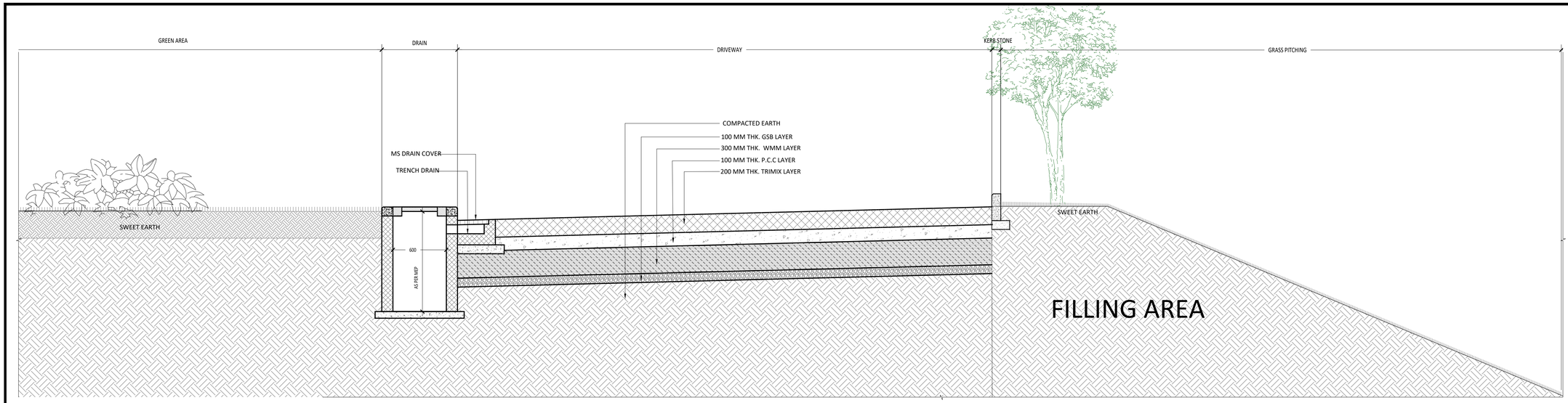
**PROJECT TITLE**

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

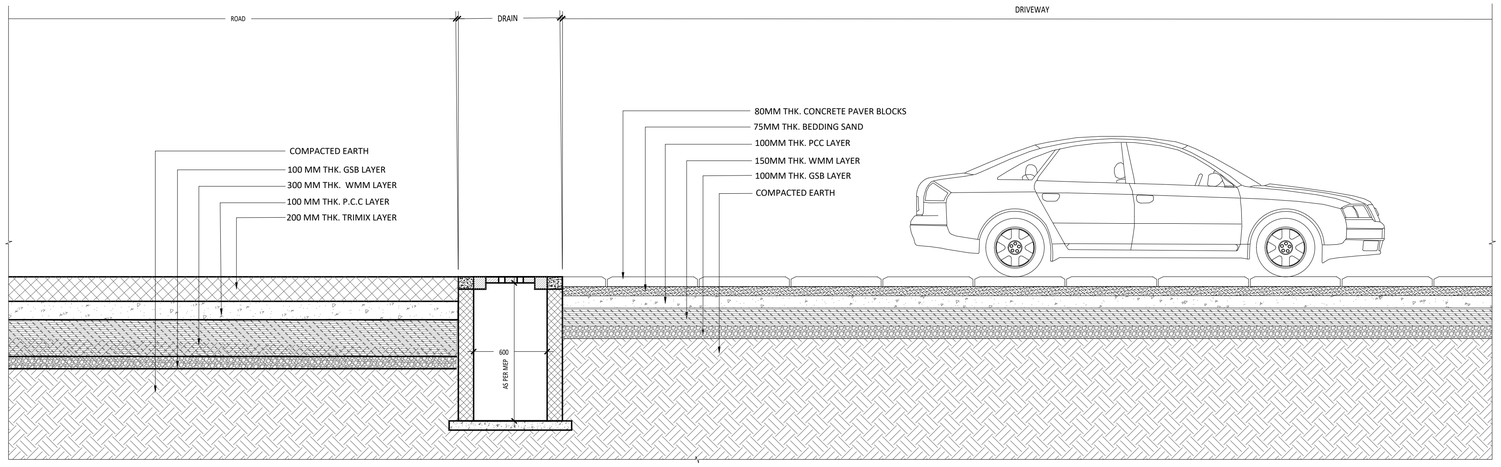
**DRAWING TITLE**

FINISHES PLAN

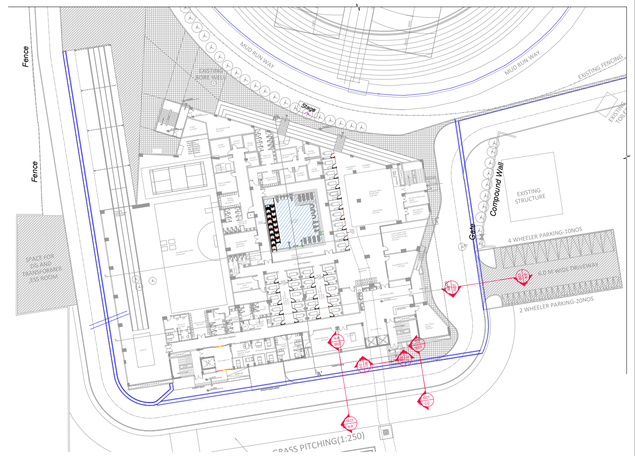
| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A0.004 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:500 (A1) | NORTH |
| 1 ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
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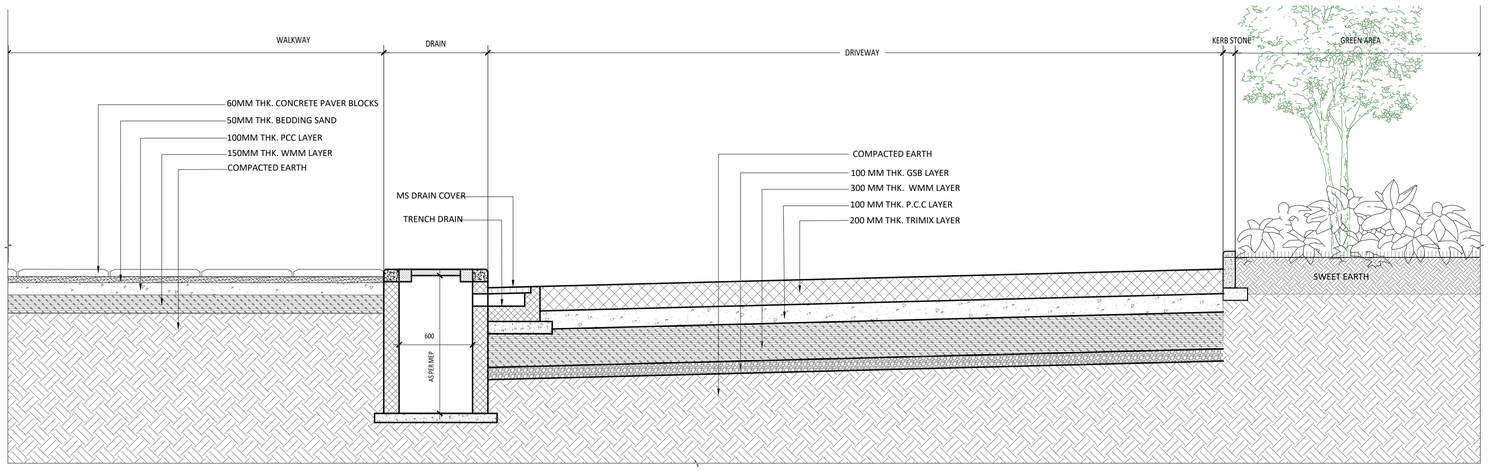

01 SECTION A-A'
1:30 (ROAD-DRAIN-GREEN)



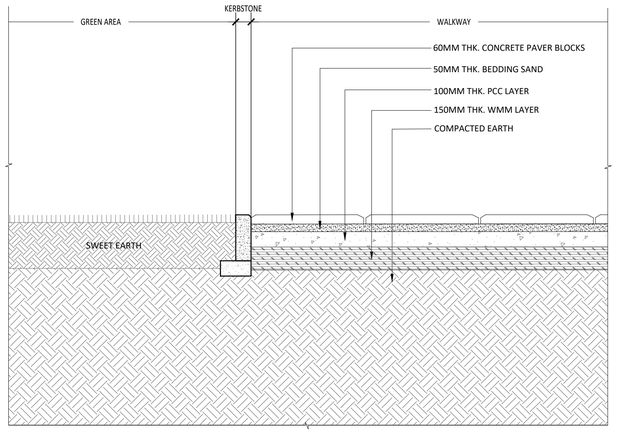

02 SECTION B-B'
1:30 DRIVEWAY AND DRAIN




03 KEY PLAN
1:750




05 SECTION C-C'
1:25 ROAD AND WALKWAY DETAIL




05 SECTION D-D'
1:20 GREEN AREA AND WALKWAY DETAIL

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## REVISIONS

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|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |
| R1 | UPDATED DRAWING | 29-10-2025 |

## KEY PLAN

**CLIENT**

SPORTS AUTHORITY OF INDIA

**ARCHITECT**

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300, Sai Sampanna, Station Rd,
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| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

**PROJECT TITLE**

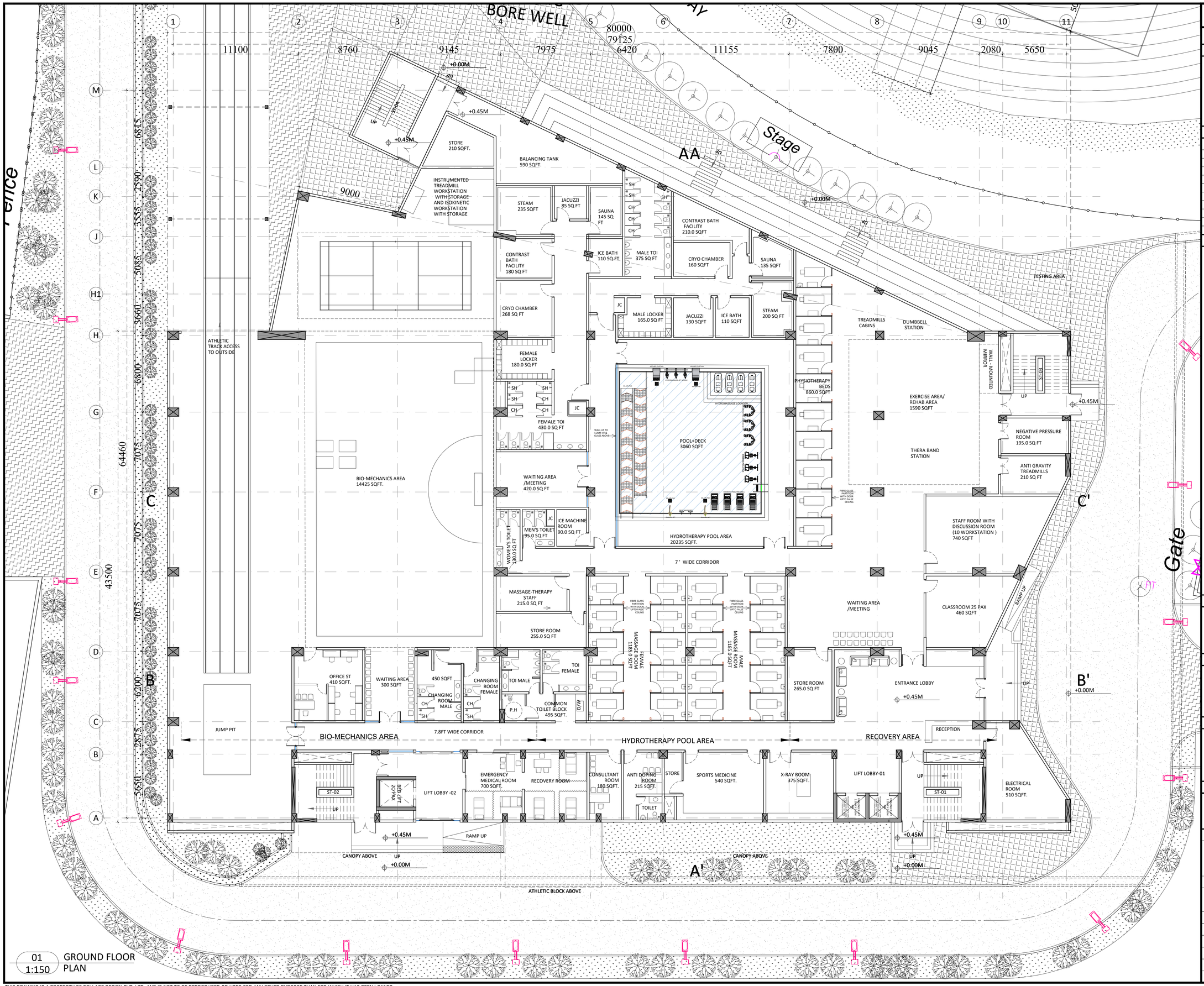
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LANDSCAPE SECTIONS

| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A0.005 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | AS SHOWN(A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
| DRAWN BY | BD | |

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01 GROUND FLOOR PLAN
1:150

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |
| R1 | TENDER DRAWING | 29-10-2025 |

## KEY PLAN

## CLIENT

Sports Authority Of India, Karnataka ,India.

## ARCHITECT

collage design
Mumbai | Ahmedabad | New Delhi
Collage Design Pvt Ltd
300, Sai Sampanna, Station Rd,
Vikhroli East, Mumbai, 400 083
+91 22 25740844 / 45
S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

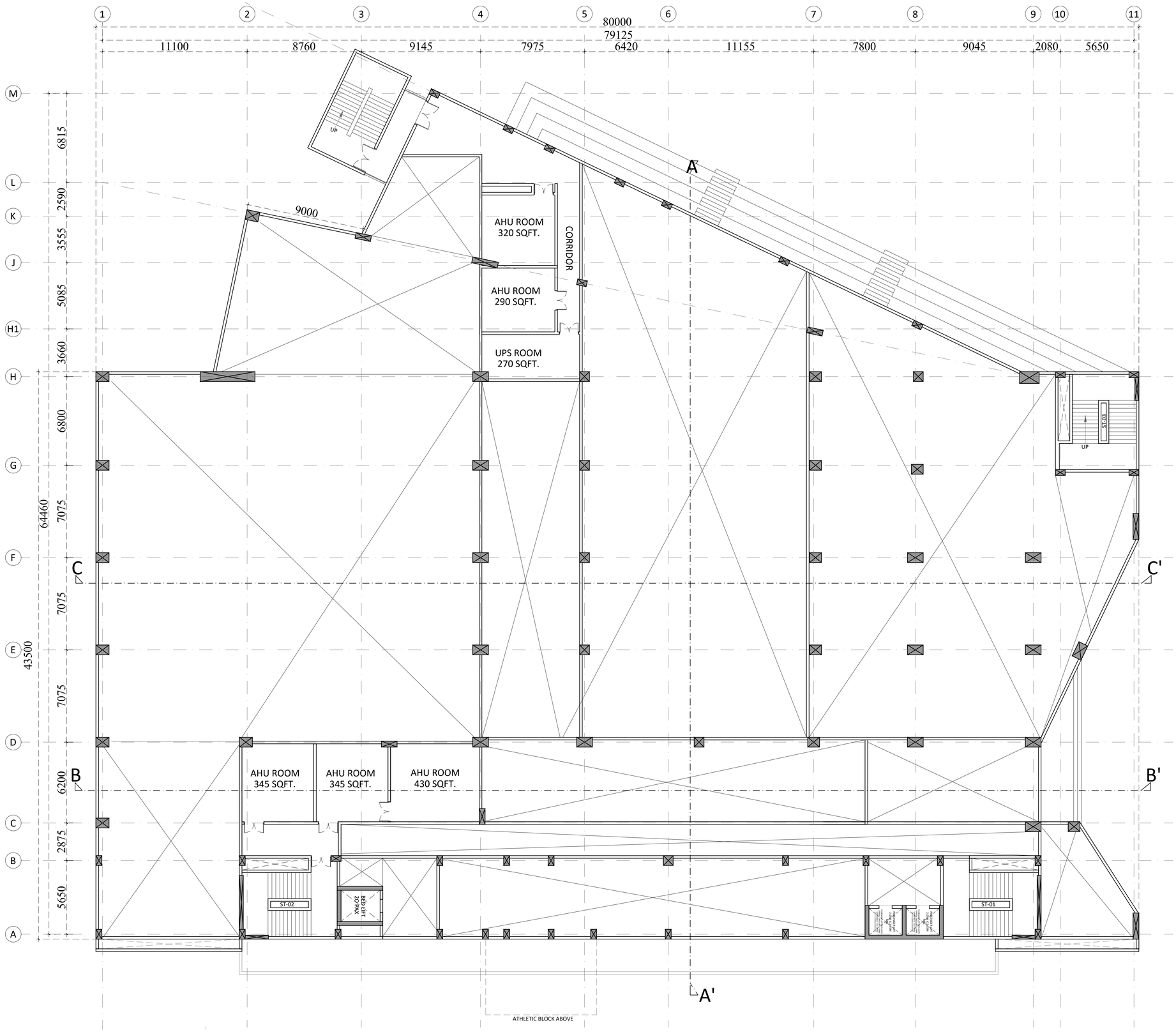
HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

## DRAWING TITLE

GROUND FLOOR PLAN

| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A1.01 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | |
| APPROVED | AM | |
| CHECKED BY | AS | |
| DRAWN BY | TK | |

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01 GROUND FLOOR MEZZANINE PLAN
1:150

# TENDER DRAWINGS

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|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |
| R1 | TENDER DRAWING | 29-10-2025 |

## KEY PLAN

## CLIENT

Sports Authority Of India, Karnataka ,India.

## ARCHITECT

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506,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

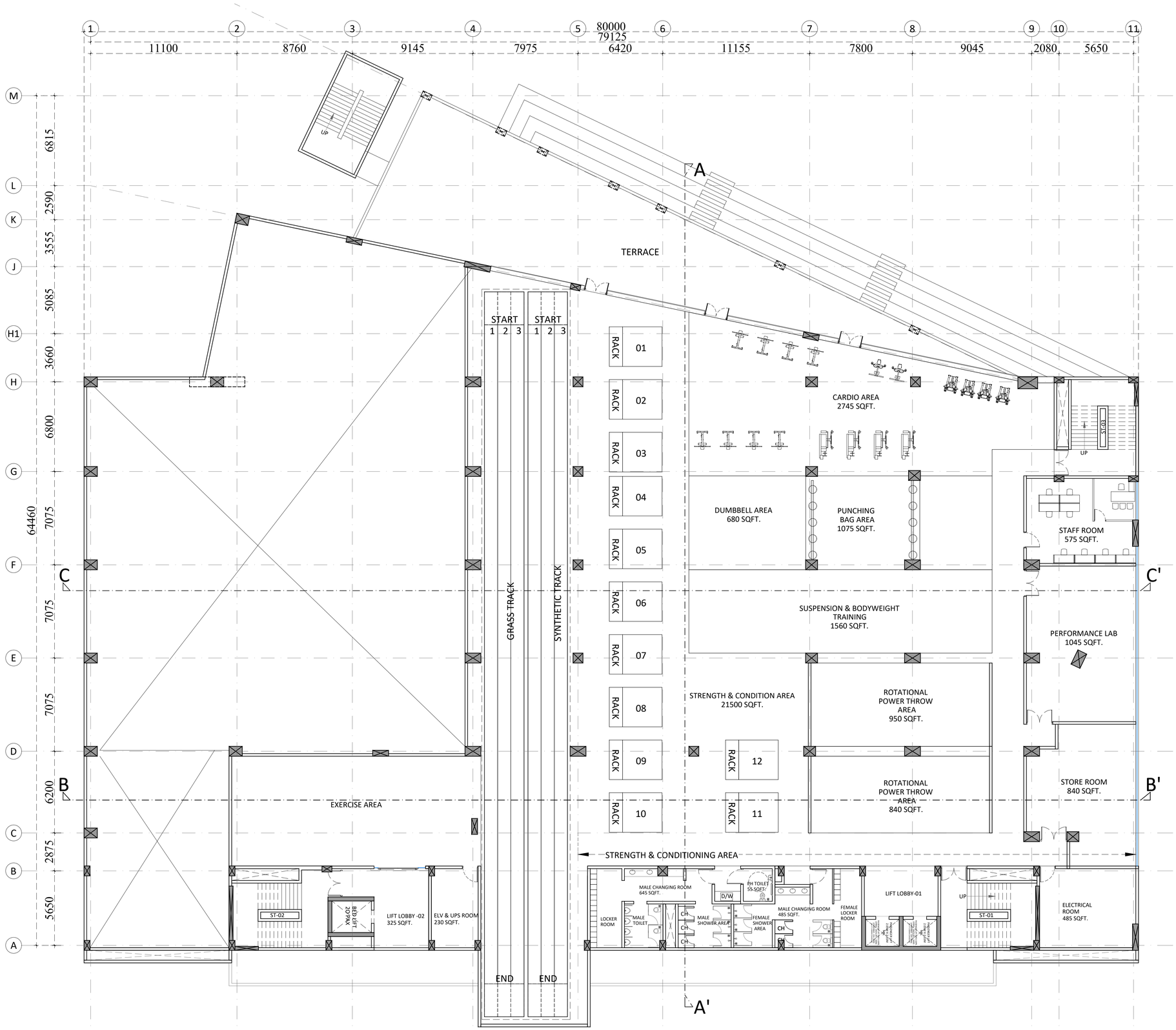
HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

## DRAWING TITLE

GROUND MEZZANINE FLOOR PLAN

| DWG. NO. | | REV. NO. |
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| AR-HPC-A1.02 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
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| CHECKED BY | AS | |
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01 FIRST FLOOR PLAN
1:150

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# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |
| R1 | TENDER DRAWING | 29-10-2025 |

## KEY PLAN

## CLIENT

Sports Authority Of India, Karnataka ,India.

## ARCHITECT

collage design
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300, Sai Sampanna, Station Rd,
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506,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
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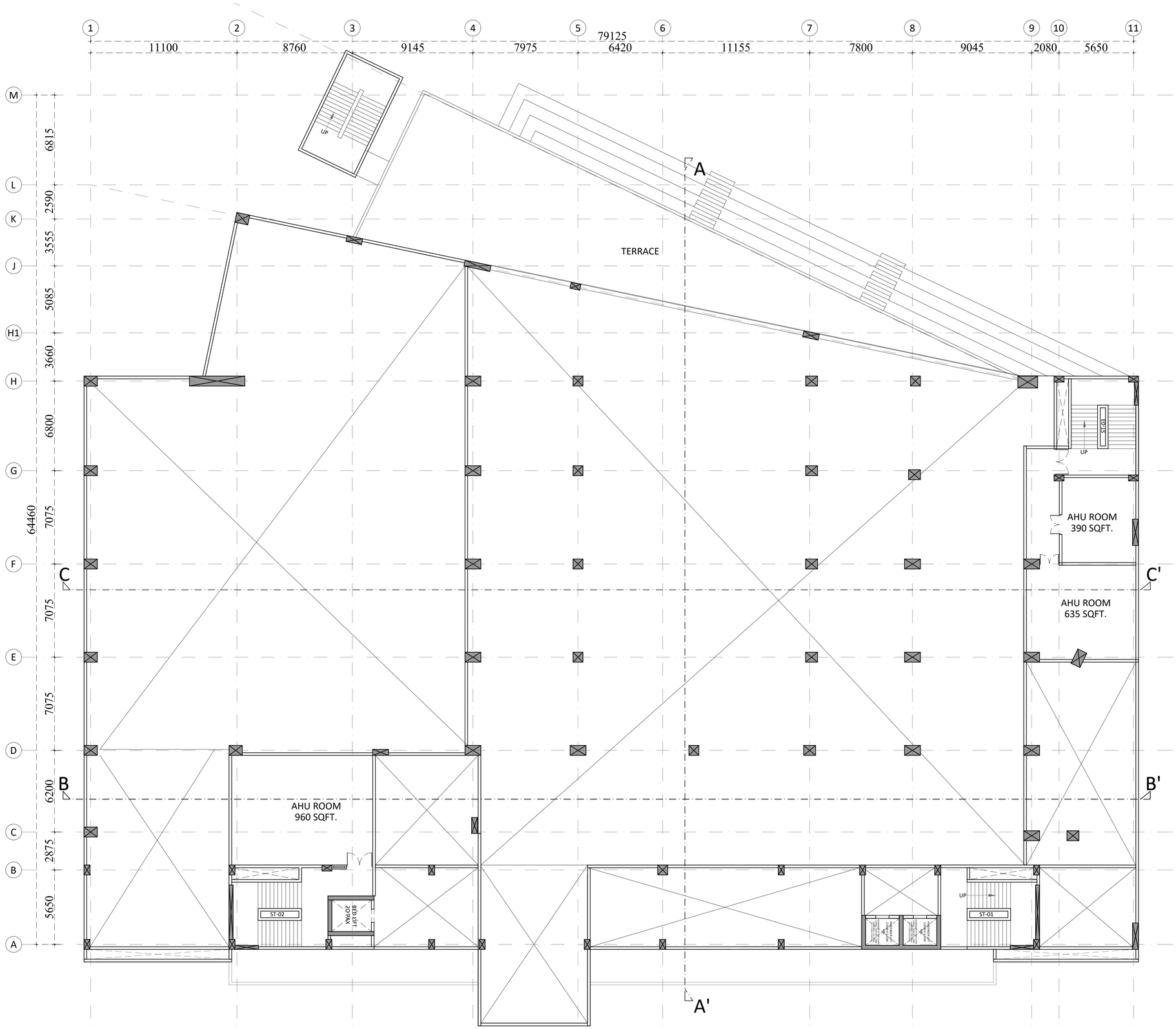
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HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

## DRAWING TITLE

FIRST FLOOR PLAN

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| AR-HPC-A1.03 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
| DRAWN BY | TK | |




01 FIRST FLOOR MEZZANINE PLAN
1:150

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |
| R1 | TENDER DRAWING | 29-10-2025 |

## KEY PLAN

## CLIENT

Sports Authority Of India, Karnataka ,India.

## ARCHITECT

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
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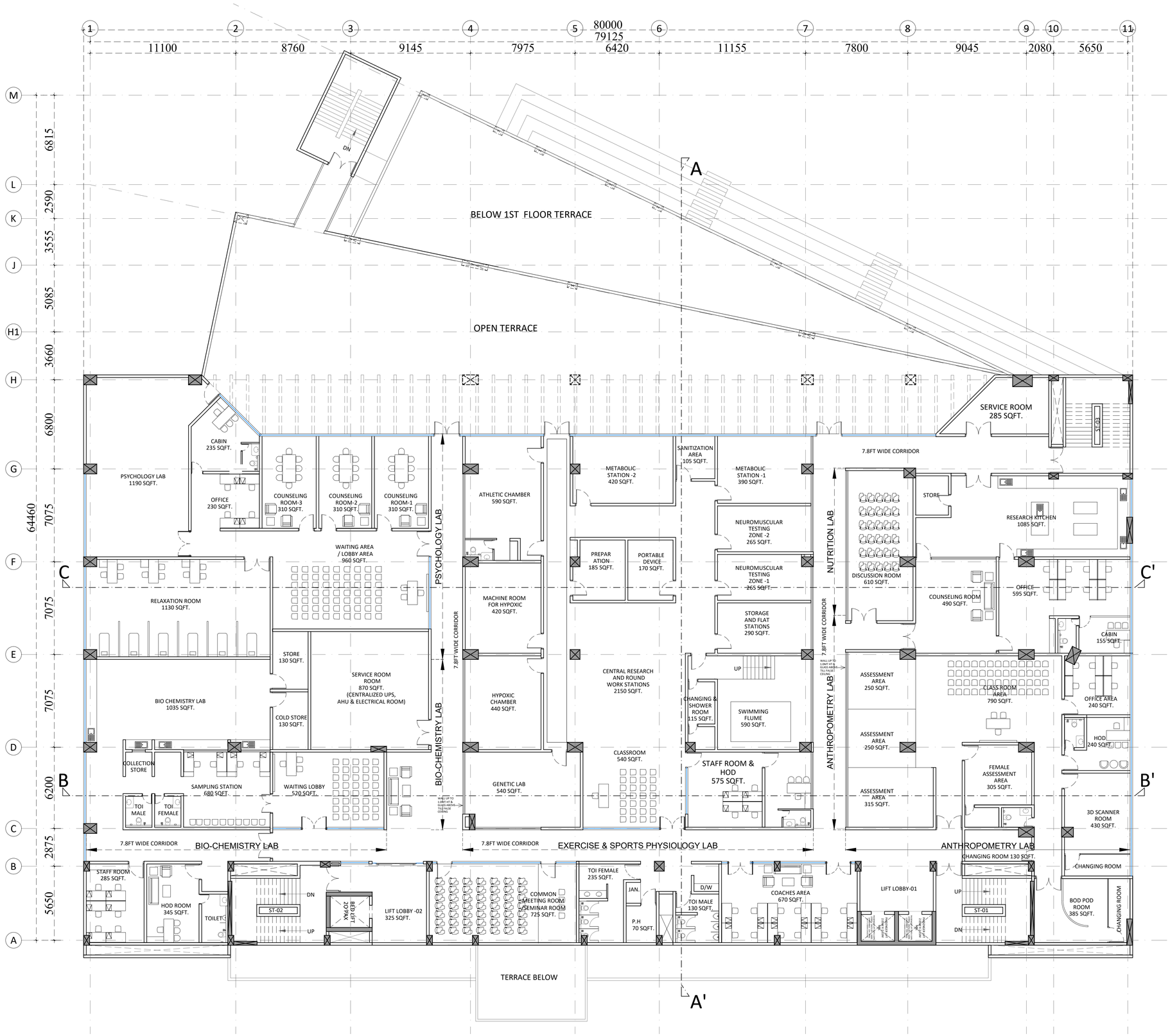
## PROJECT TITLE

HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

## DRAWING TITLE

FIRST MEZZANINE FLOOR PLAN

| DWG. NO. | | REV. NO. |
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| AR-HPC-A1.04 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
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01
1:150
SECOND FLOOR
PLAN

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| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |
| R1 | TENDER DRAWING | 29-10-2025 |

## KEY PLAN

## CLIENT

Sports Authority Of India, Karnataka ,India.

## ARCHITECT

collage design
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S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

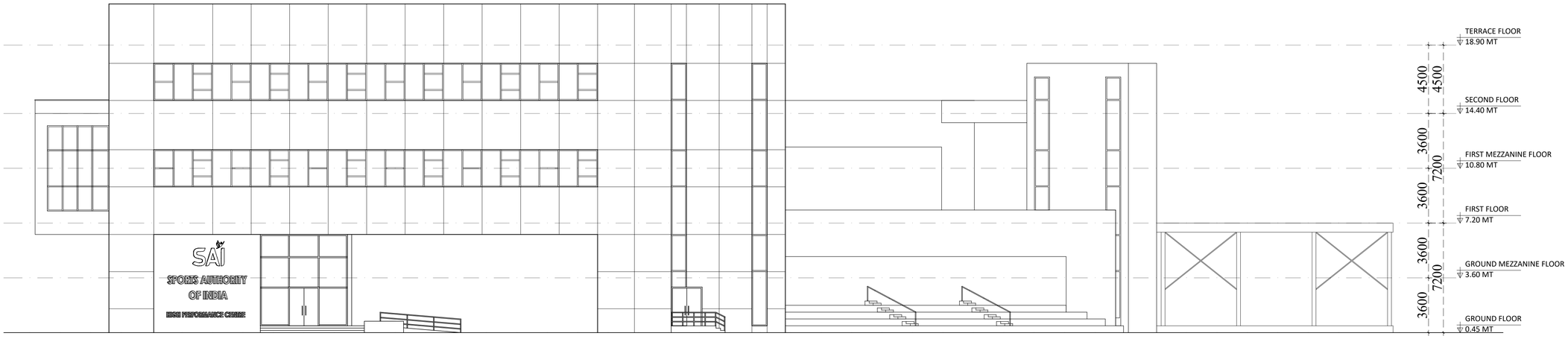
HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

## DRAWING TITLE

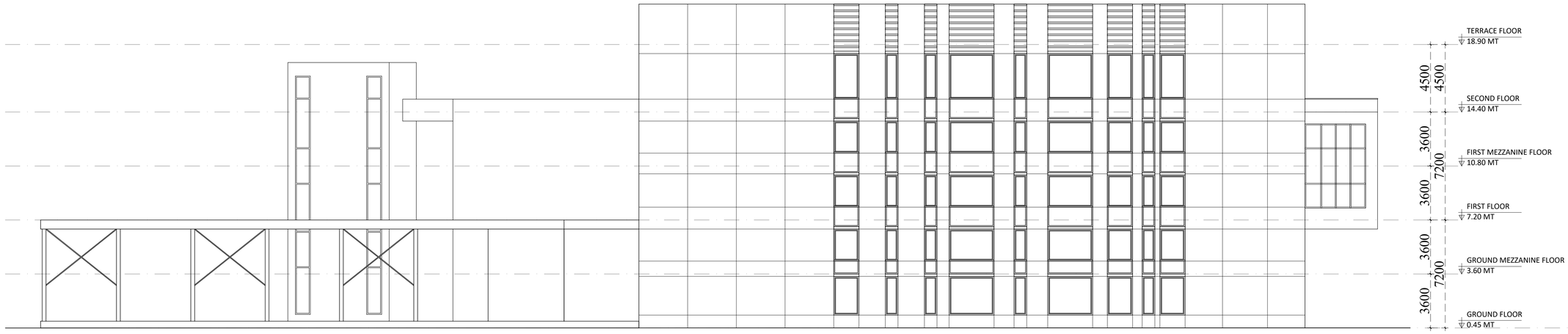
SECOND FLOOR PLAN

| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A1.05 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
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01
1:150
EAST FACING
ELEVATION




02
1:150
WEST FACING
ELEVATION

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |
| R1 | TENDER DRAWING | 29-10-2025 |

## KEY PLAN

## CLIENT

Sports Authority Of India, Karnataka ,India.

## ARCHITECT

collage design
Mumbai | Ahmedabad | New Delhi
Collage Design Pvt Ltd
300, Sai Sampanna, Station Rd,
Vikhroli East, Mumbai, 400 083
+91 22 25740844 / 45
506,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

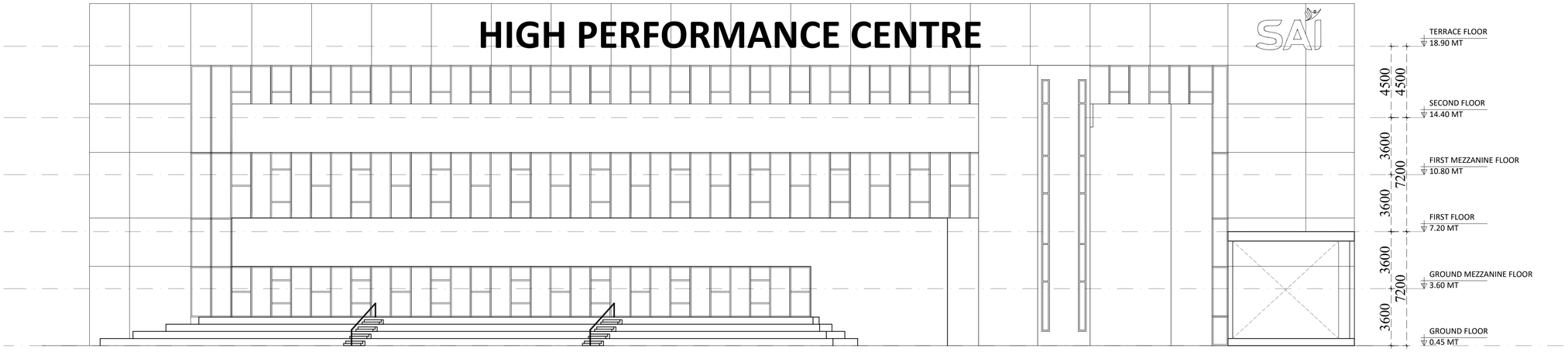
## DRAWING TITLE

BUILDING ELEVATION-2

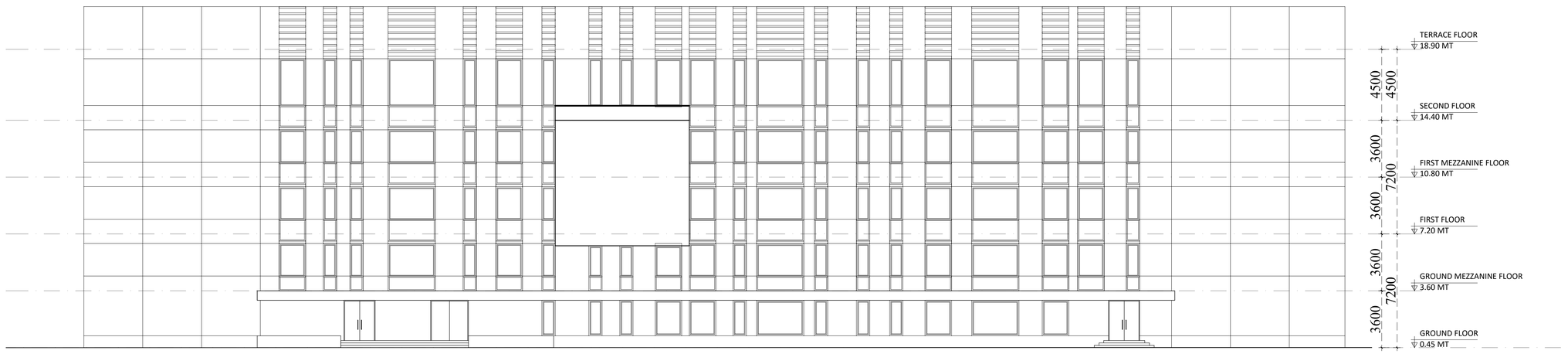
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|---|---|---|
| AR-HPC-A2.01 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
| DRAWN BY | TK | |

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# HIGH PERFORMANCE CENTRE




01 1:150 SOUTH FACING ELEVATION




02 1:150 NORTH FACING ELEVATION

## TENDER DRAWINGS

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### REVISIONS

| REV | DESCRIPTION | DATE |
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| R0 | TENDER DRAWING | 26-09-2025 |
| R1 | TENDER DRAWING | 29-10-2025 |

### KEY PLAN

### CLIENT

Sports Authority Of India, Karnataka ,India.

### ARCHITECT

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300, Sai Sampanna, Station Rd,
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506,6th FLOOR,ORCHID METROPOLIS,
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+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
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| | | |

### PROJECT TITLE

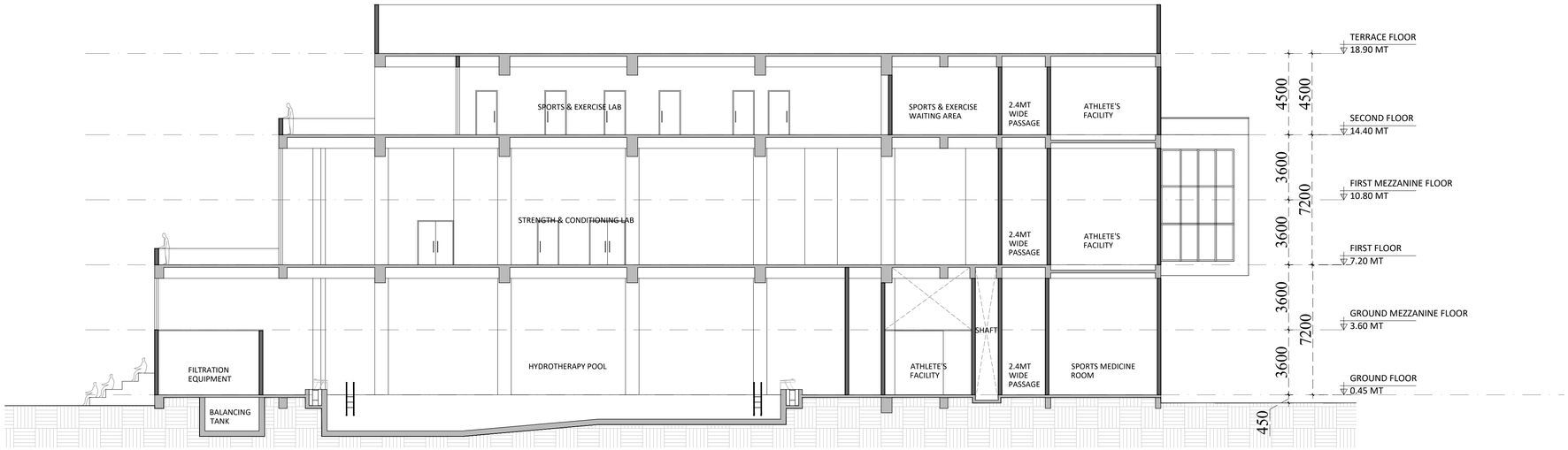
HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

### DRAWING TITLE

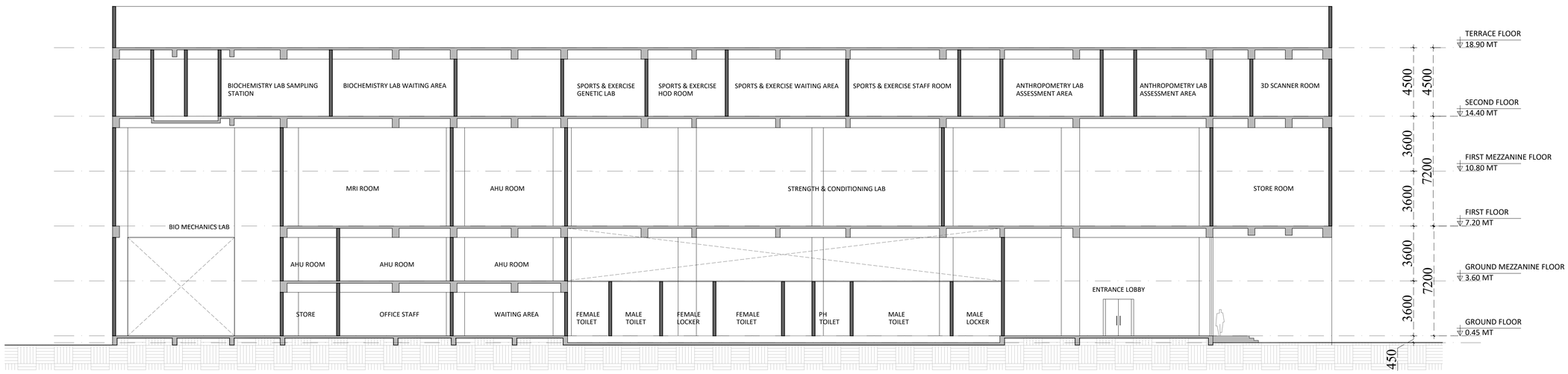
BUILDING ELEVATION-1

| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A2.01 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
| DRAWN BY | TK | |

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01 SECTION AA
1:150




02 SECTION BB
1:150

# TENDER DRAWINGS

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| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |
| R1 | TENDER DRAWING | 29-10-2025 |

## KEY PLAN

## CLIENT

Sports Authority Of India, Karnataka ,India.

## ARCHITECT

collage design
Mumbai | Ahmedabad | New Delhi
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300, Sai Sampanna, Station Rd,
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506,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

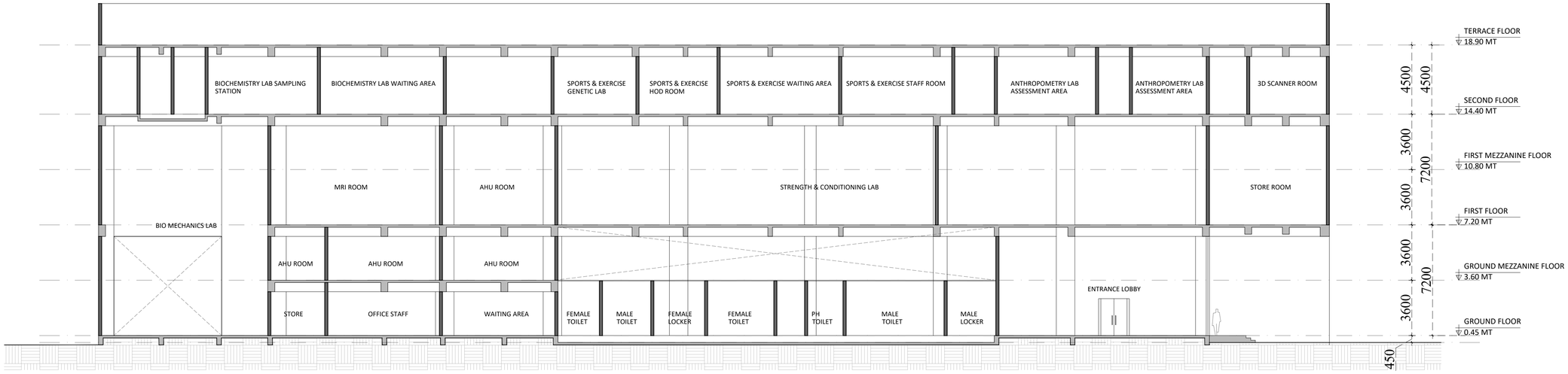
HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

## DRAWING TITLE

BUILDING SECTION-1

| DWG. NO. | | REV. NO. |
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| AR-HPC-A3.01 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
| DRAWN BY | TK | |

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01 SECTION CC
1:150

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| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

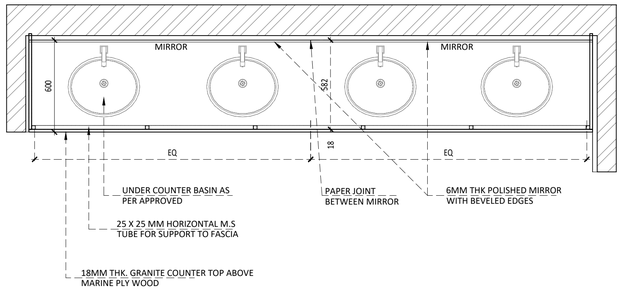
HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

## DRAWING TITLE

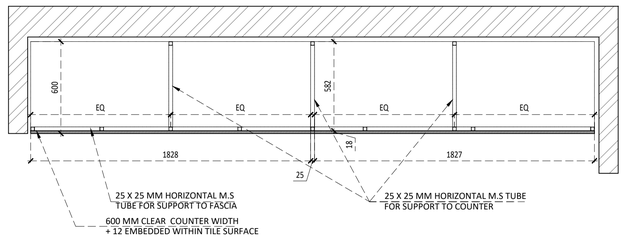
BUILDING SECTION-1

| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A3.02 | | R1 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
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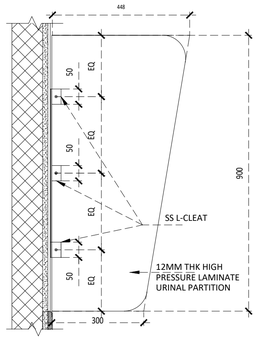
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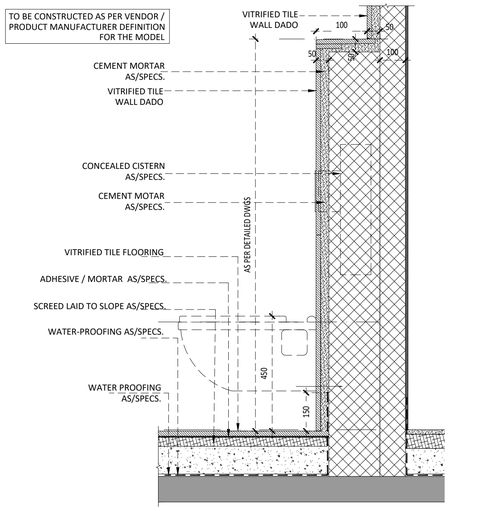

01 1:20 TYPICAL WASH BASIN COUNTER DETAIL PLAN



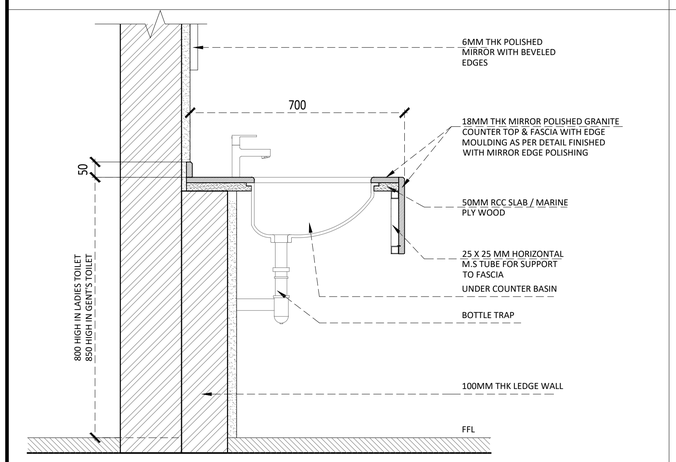

02 1:20 TYPICAL WASH BASIN BELOW COUNTER DETAIL PLAN



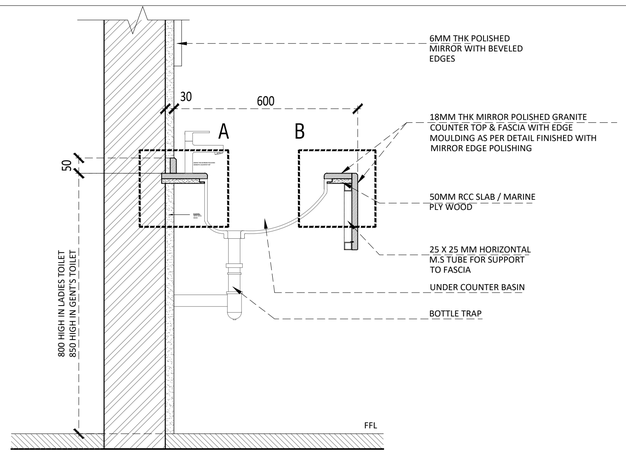

03 1:10 TYPICAL URINAL PARTITION DETAILS



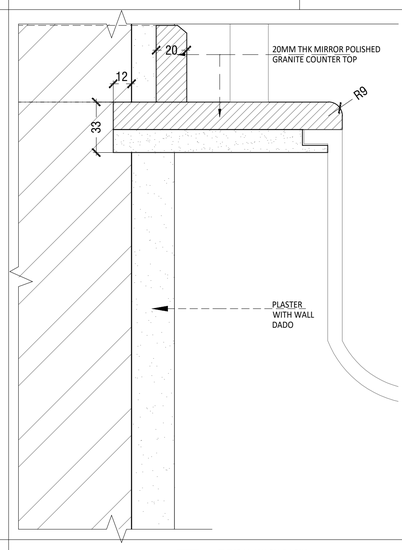

04 1:10 TYPICAL W.C DETAILS



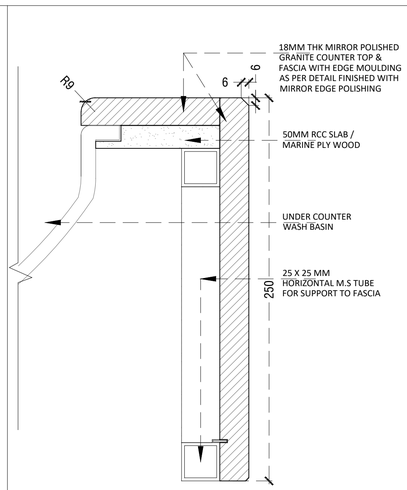

05 1:10 TYPICAL WASH BASIN SECTION COUNTER DETAIL WITH LEDGE WALL



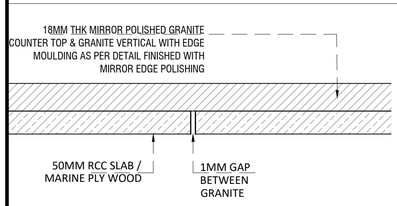

06 1:10 TYPICAL WASH BASIN COUNTER DETAIL SECTION-1

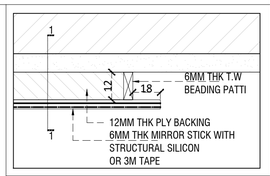



07 1:5 TYPICAL WASH BASIN COUNTER DETAIL-A

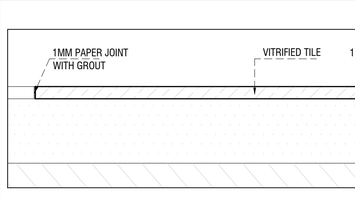



08 1:5 TYPICAL WASH BASIN COUNTER DETAIL-B

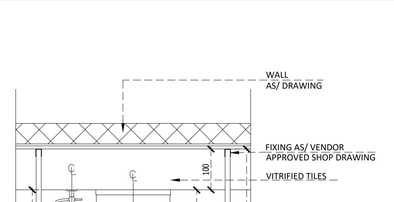


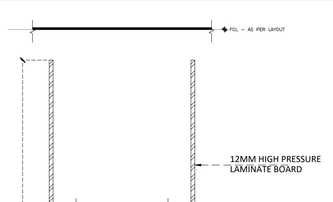

11 1:2 TYPICAL MIRROR PANELING DETAIL



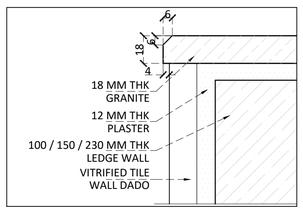

13 1:2 THRESHOLD WITH SAME FLOOR LVL ON BOTH SIDE



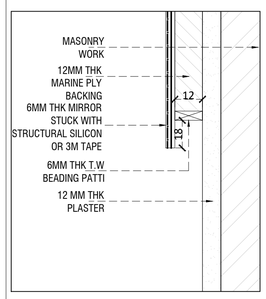

15 1:20 TYPICAL W.C DETAIL PLAN DETAILS



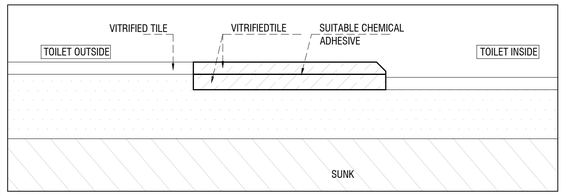

16 1:20 TYPICAL W.C DETAIL ELEVATION




10 1:2 TYPICAL LEDGE WALL DETAIL




12 1:2 SECTION 2-2 TYPICAL MIRROR PANELING DETAIL




14 1:2 THRESHOLD WITH DIFFERENT FLOOR LEVELS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |

## KEY PLAN

## CLIENT

Sports Authority Of India, Karnataka ,India.

## ARCHITECT

Collage Design Pvt Ltd
300, Sai Sampanna, Station Rd,
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+91 11 35537736

Mumbai | Ahmedabad | New Delhi

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

## DRAWING TITLE

TYPICAL TOILET DETAILS

| DWG. NO. | | REV. NO. |
|---|---|---|
| AR-HPC-A4.01 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | |
| APPROVED | AM | |
| CHECKED BY | AS | |
| DRAWN BY | TK | |

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# HIGH PERFORMANCE CENTRE AT SPORTS AUTHORITY OF INDIA NSSC, BENGALURU, KARNATAKA

## STRUCTURAL DRAWINGS

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Mumbai | Ahmedabad | New Delhi

Collage Design Pvt Ltd
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-
S06,6th FLOOR,ORCHID METROPOLIS,
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| | |
|---|---|
| **PROJECT :** | **PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE** |
| **PROJECT NO.** | **25-P388** |
| **TITLE :** | DRAWING LIST |
| **CLIENT :** | SPORTS AUTHORITY OF INDIA (SAI) |

## HIGH PERFORMANCE CENTR

| SR.NO. | DRAWING NO. | DESCRIPTION | REVISION |
|---|---|---|---|
| | | **STRUCTURE** | |
| 1 | STR-HPC-A1-01 | LAYOUT OF FOUNDATION DETAILS | R0 |
| 2 | STR-HPC-A1-02 | LAYOUT OF COLUMN DETAILS | R0 |
| 3 | STR-HPC-A1-03 | LAYOUT OF PLINTH BEAM & SLAB | R0 |
| 4 | STR-HPC-A1-04 | LAYOUT OF GROUND FLOOR ROOF BEAM & SLAB | R0 |
| 5 | STR-HPC-A1-05 | LAYOUT OF GROUND MEZZANINEFLOOR ROOF BEAM & SLAB | R0 |
| 6 | STR-HPC-A1-06 | LAYOUT OF FIRST FLOOR ROOF BEAM & SLAB | R0 |
| 7 | STR-HPC-A1-07 | LAYOUT OF FIRST MEZZANINEFLOOR ROOF BEAM & SLAB | R0 |
| 8 | STR-HPC-A1-08 | LAYOUT OF SECOND FLOOR ROOF BEAM & SLAB | R0 |
| 9 | STR-HPC-A1-09 | DETAILS OF LIGHT ROOF STRUCTURE | R0 |
| 10 | STR-HPC-A1-10 | LAYOUT & SECTION OF SWIMMING POOL AND EXTERNAL STAIRCASE | R0 |

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**REVISIONS**

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | TENDER DRAWING | 26-09-2025 |

**KEY PLAN**

**CLIENT**

Sports Authority Of India, Karnataka ,India.

**ARCHITECT**

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

**PROJECT TITLE**

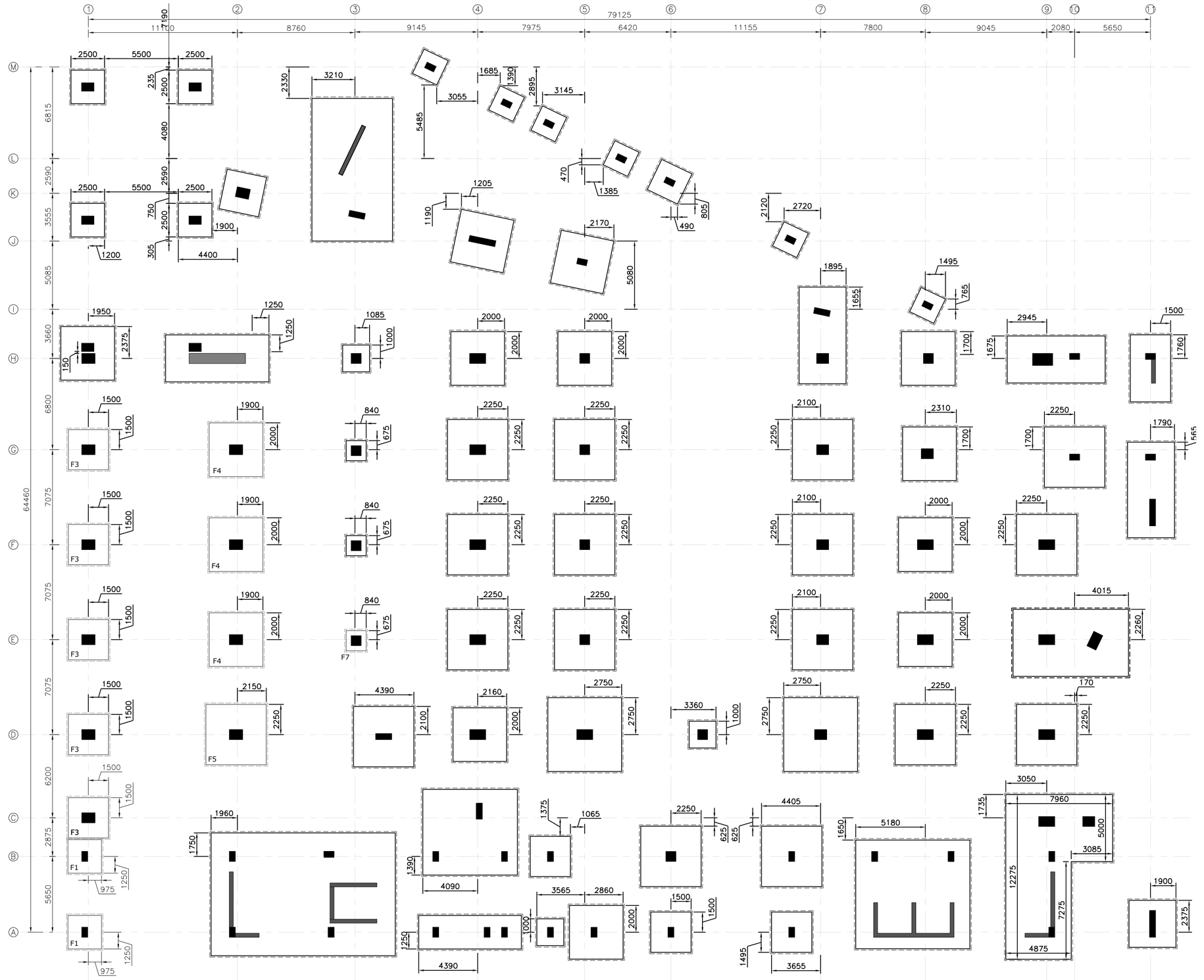
HIGH PERFORMANCE CENTRE, BENGALURU, KARNATAKA

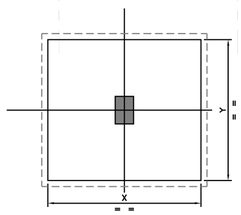
**DRAWING TITLE**

STRUCTURE DRAWING LIST

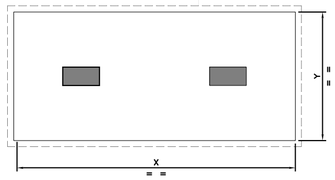
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| | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | (A1) | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | AM | |
| CHECKED BY | AS | |
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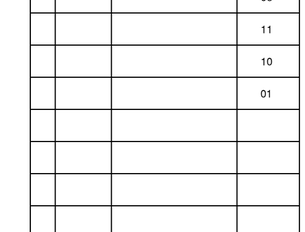


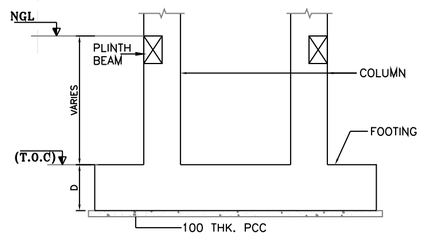

TYP. PLAN OF ISOLATED FOOTING
(SCALE 1:50)




TYP. PLAN OF COMBINED FOOTING
(SCALE 1:50)




TYP. SECTION OF ISOLATED FOOTING
(SCALE 1:50)




TYP. SECTION OF COMBINED FOOTING
(SCALE 1:50)

| | FOOTING NAME | | |
|---|---|---|---|
| | | | 03 |
| | | | 08 |
| | | | 06 |
| | | | 11 |
| | | | 10 |
| | | | 01 |
| | | | 01 |

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 24-09-2025 |

## KEY PLAN

NOTES:

1. IN ADDITION PLINTH BEAM,TIE BEAMS TO BE PROVIDED WHERE EVER REQUIRED TO MATCH DESIGN REQUIREMENTS BASED ON SITE TOPO LEVELS AND VARIABLE FOUNADTION LEVEL.
2. DISTANCE BETWEEN N.G.L AND FOUNDATION TOP VARIES AND MINIMUN LENGTH REQUIRED IS 2100mm.
3. SW1– 300 THK STRUCTURAL WALL
   SW2– 750 THK STRUCTURAL WALL

SPORTS AUTHORITY OF INDIA

Collage Design Pvt Ltd
300, Sai Sampanna, Station Rd,
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Hauz Khas, New Delhi 110 016
+91 11 35537736

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Structural Consultants

**PROJECT TITLE**

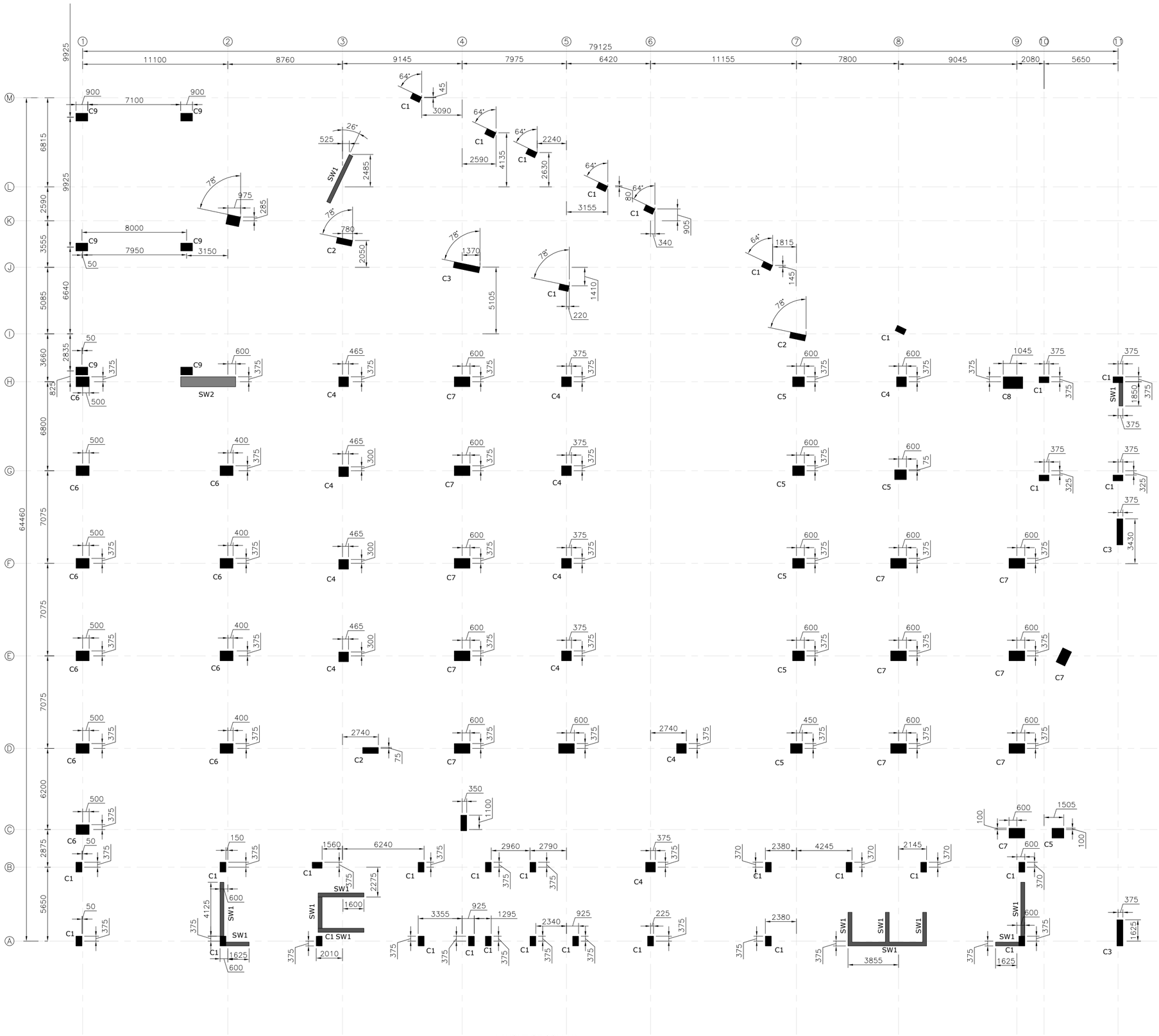
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LAYOUT OF FOUNDATION DETAILS

| | | REV. NO. |
|---|---|---|
| STR-HPC-A1-01 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:100 (A1) | NORTH |
| 1ST ISSUED ON | 24-09-2025 | |
| APPROVED | KK | |
| CHECKED BY | MM | |
| DRAWN BY | JR | |

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LAYOUT OF COLUMN
(SCALE 1:150)

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 24-09-2025 |

## KEY PLAN

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2. DISTANCE BETWEEN N.G.L AND FOUNDATION TOP VARIES AND MINIMUN LENGTH REQUIRED IS 2100mm.
3. SW1– 300 THK STRUCTURAL WALL
   SW2– 750 THK STRUCTURAL WALL

| Sl. NO | NAME | SIZE |
|---|---|---|
| 1 | C1 | 450X750 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

SPORTS AUTHORITY OF INDIA

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**PROJECT TITLE**

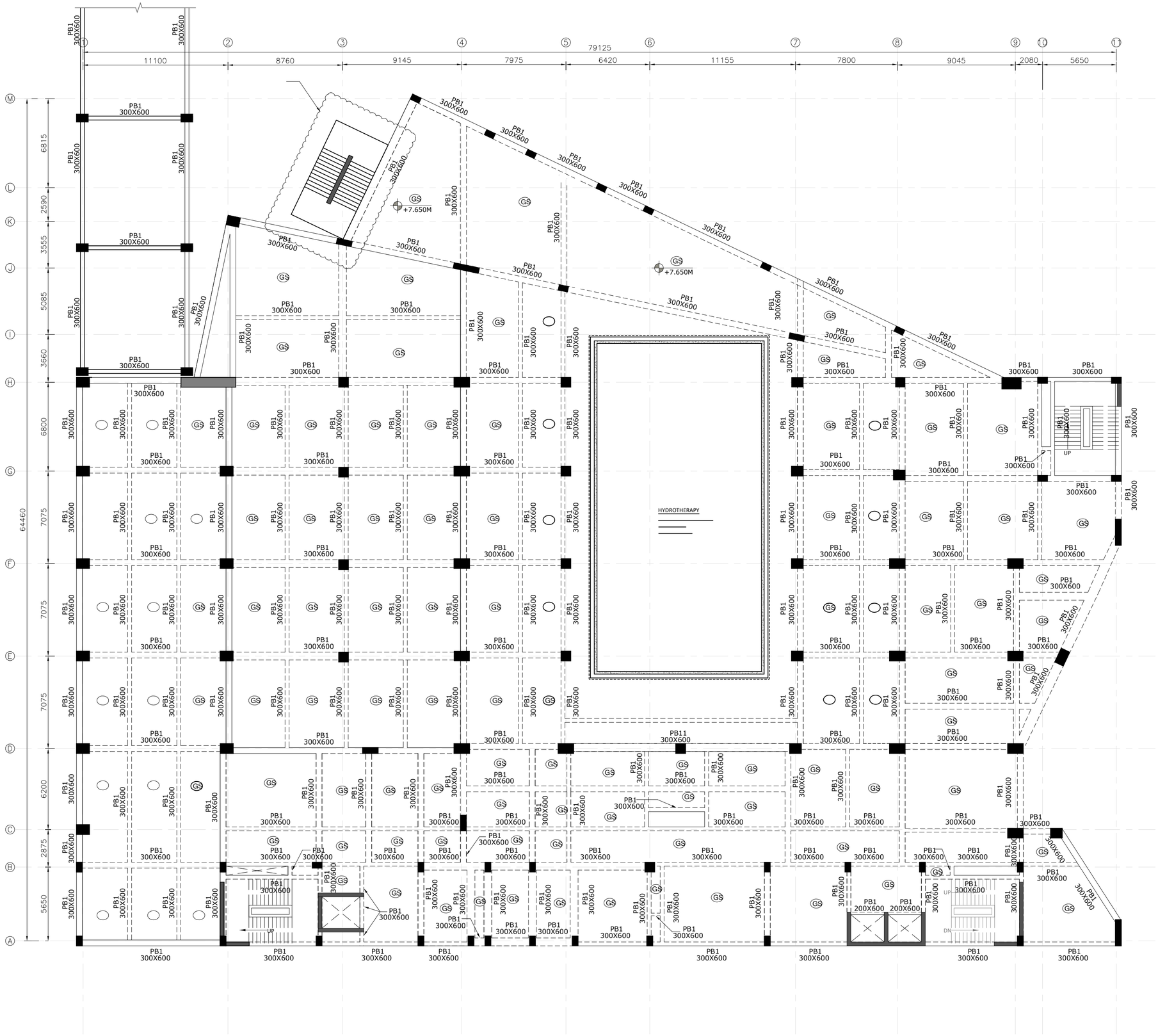
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LAYOUT OF COLUMN DETAILS

| | | REV. NO. |
|---|---|---|
| STR-HPC-A1-02 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:100 (A1) | NORTH |
| 1ST ISSUED ON | 24-09-2025 | |
| APPROVED | KK | |
| CHECKED BY | MM | |
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LAYOUT OF PLINTH BEAM & SLAB (+0.450M)
(SCALE 1:150)

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 24-09-2025 |

## KEY PLAN

NOTES;

■ – STRUCTURAL COLUMN

SPORTS AUTHORITY OF INDIA

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Hauz Khas, New Delhi 110 016
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Structural Consultants

**PROJECT TITLE**

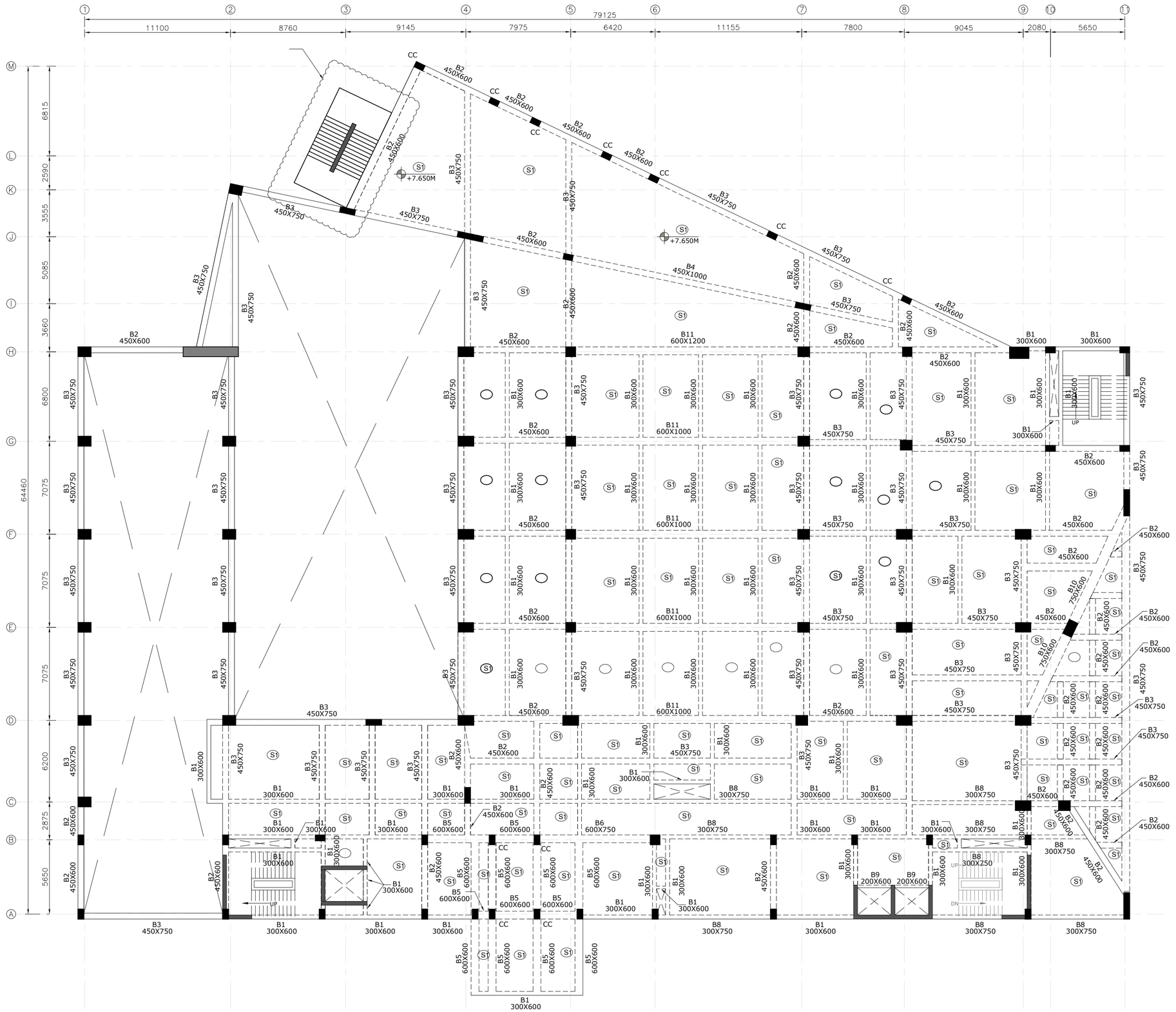
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LAYOUT OF PLINTH BEAM & SLAB (+0.450M)

| | | REV. NO. |
|---|---|---|
| STR-HPC-A1-03 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:100 (A1) | NORTH |
| 1ST ISSUED ON | 24-09-2025 | N |
| APPROVED | KK | |
| CHECKED BY | MM | |
| DRAWN BY | JR | |

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LAYOUT OF GROUND FLOOR ROOF BEAM & SLAB (+7.650M)
(SCALE 1:150)

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## KEY PLAN

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+91 11 35537736

Mumbai | Ahmedabad | New Delhi

ENXGE
Structural Consultants

**PROJECT TITLE**

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LAYOUT OF GROUND FLOOR ROOF BEAM & SLAB (+7.650M)

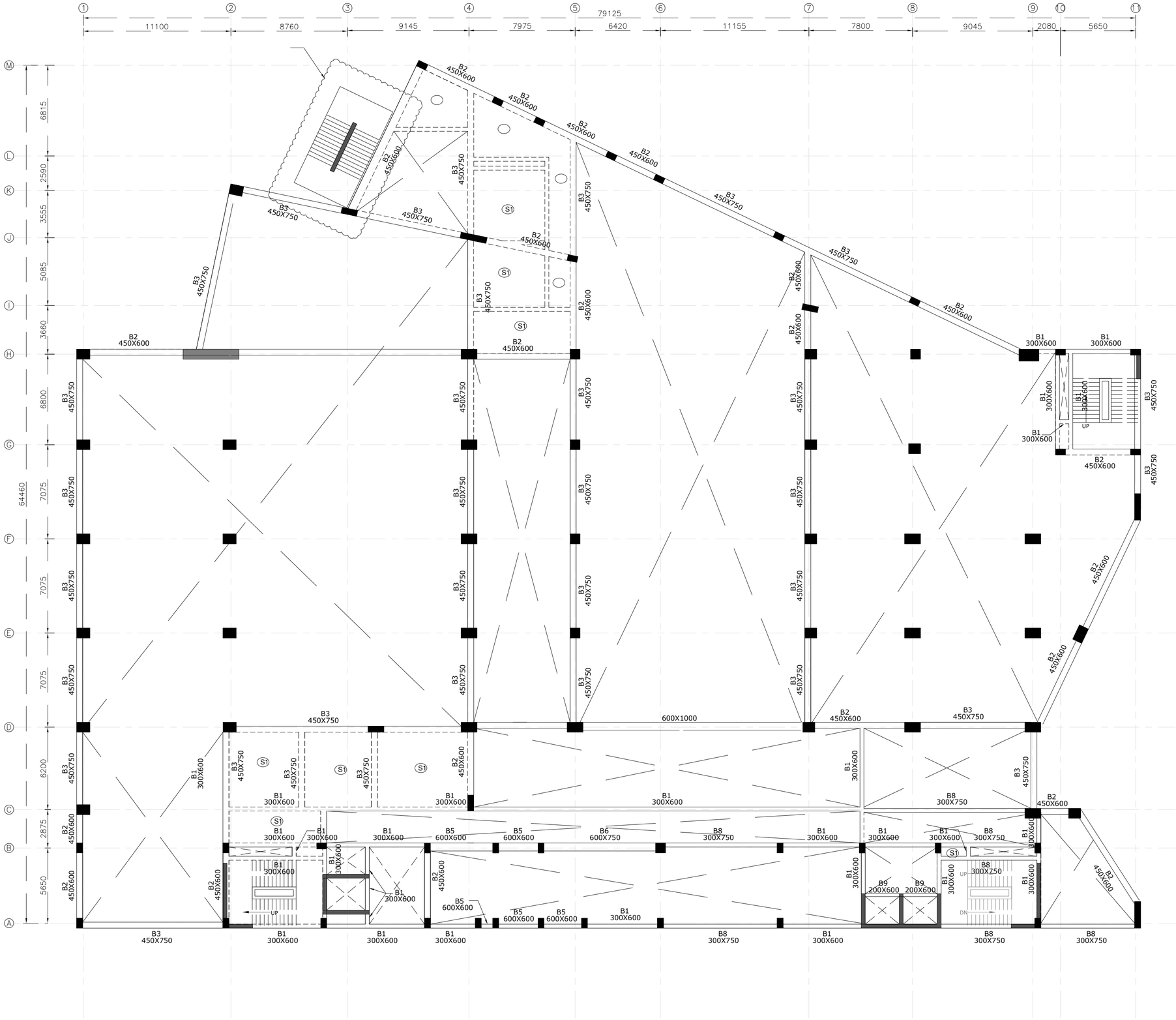
| | REV. NO. |
|---|---|
| STR-HPC-A1-04 | R0 |

| | |
|---|---|
| PROJECT NO. | 25-P388 |
| SCALE | 1:100 (A1) |
| 1ST ISSUED ON | 24-09-2025 |
| APPROVED | KK |
| CHECKED BY | MM |
| DRAWN BY | JR |

NORTH

N

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LAYOUT OF GROUND FLOOR MEZZANINE BEAM & SLAB (+4.050M)
(SCALE 1:150)

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 24-09-2025 |

## KEY PLAN

NOTES;

■ – STRUCTURAL COLUMN

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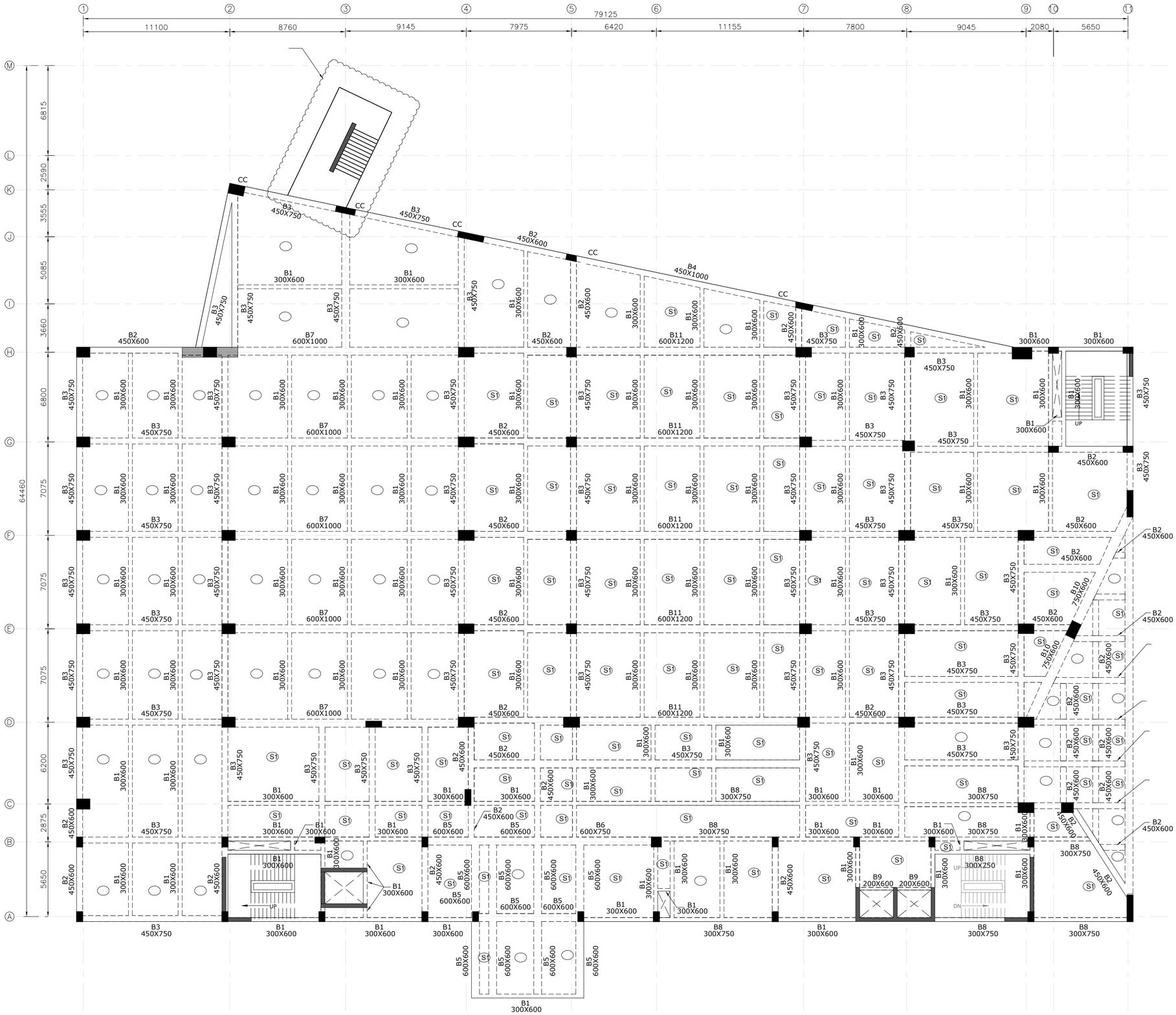
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LAYOUT OF GROUND FLOOR MEZZANINE BEAM & SLAB (+4.050M)

| | | |
|---|---|---|
| | | REV. NO. |
| STR-HPC-A1-05 | | R0 |
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LAYOUT OF FIRST FLOOR ROOF BEAM & SLAB (+14.850M)
(SCALE 1:150)

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| R0 | FIRST ISSUE | 24-09-2025 |

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**PROJECT TITLE**

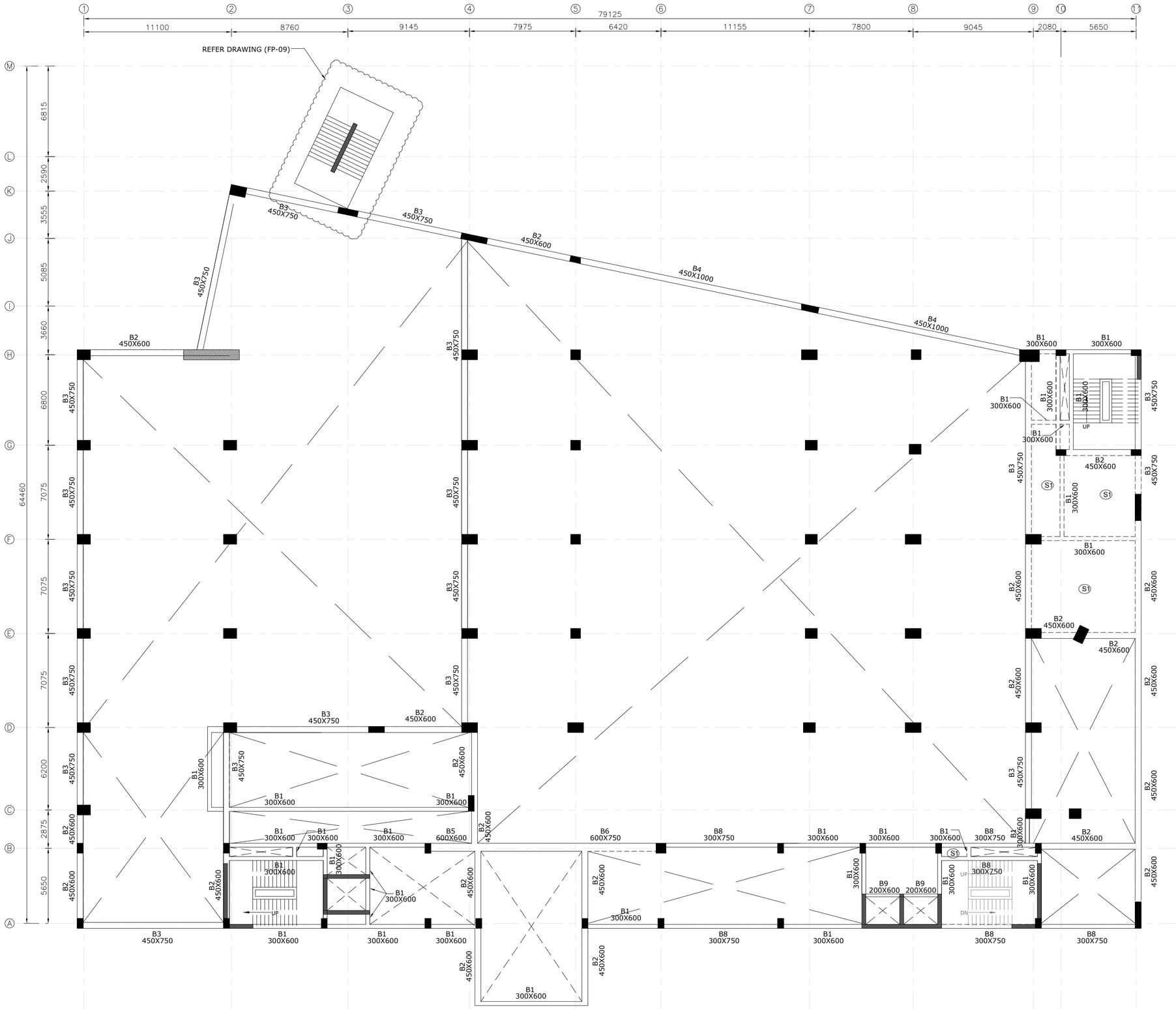
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LAYOUT OF FIRST FLOOR ROOF BEAM & SLAB (+14.850M)

| | | REV. NO. |
|---|---|---|
| STR-HPC-A1-06 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:100 (A1) | NORTH |
| 1ST ISSUED ON | 24-09-2025 | N |
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| CHECKED BY | MM | |
| DRAWN BY | JR | |

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LAYOUT OF FIRST FLOOR MEZZANINE BEAM & SLAB (+11.250M)
(SCALE 1:150)

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**PROJECT TITLE**

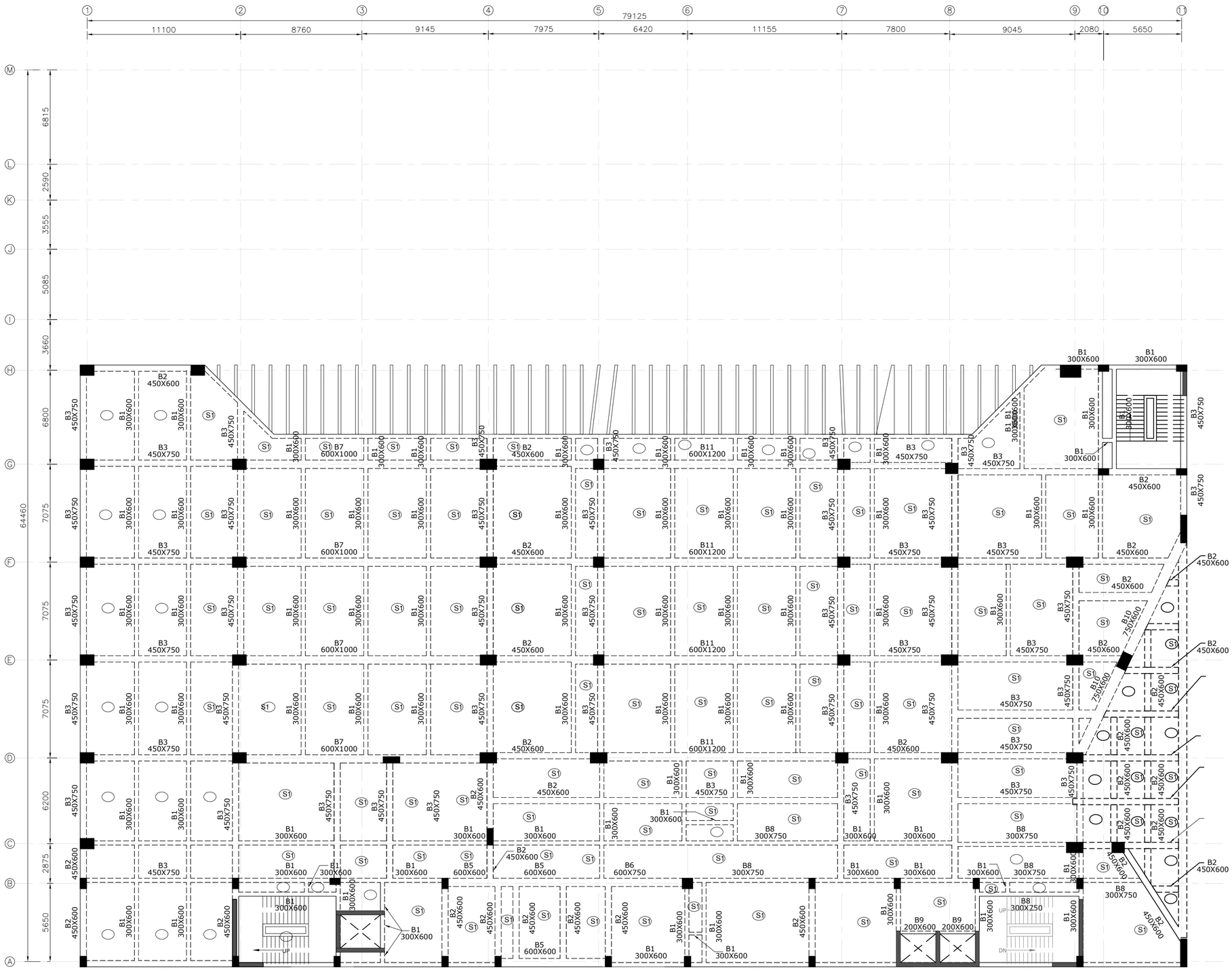
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LAYOUT OF FIRST FLOOR MEZZANINE BEAM & SLAB (+11.250M)

| | | REV. NO. |
|---|---|---|
| STR-HPC-A1-07 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:100 (A1) | NORTH |
| 1ST ISSUED ON | 24-09-2025 | N |
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| CHECKED BY | MM | |
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LAYOUT OF SECOND FLOOR ROOF BEAM & SLAB (+19.350M)
(SCALE 1:150)

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**PROJECT TITLE**

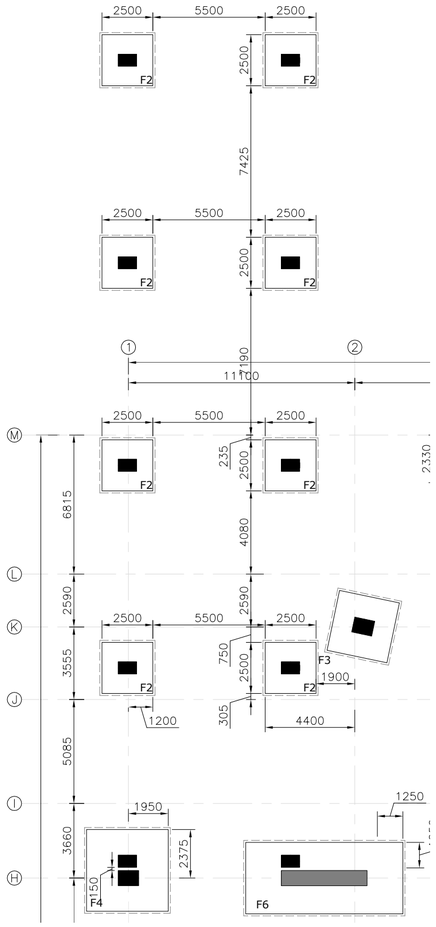
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

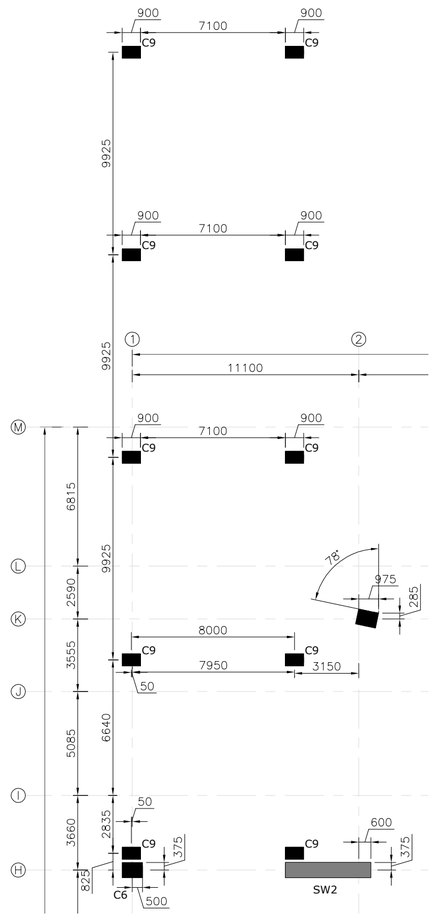
LAYOUT OF SECOND FLOOR ROOF BEAM & SLAB (+19.350M)

| | | REV. NO. |
|---|---|---|
| STR-HPC-A1-08 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:100 (A1) | NORTH |
| 1ST ISSUED ON | 24-09-2025 | N |
| APPROVED | KK | |
| CHECKED BY | MM | |
| DRAWN BY | JR | |

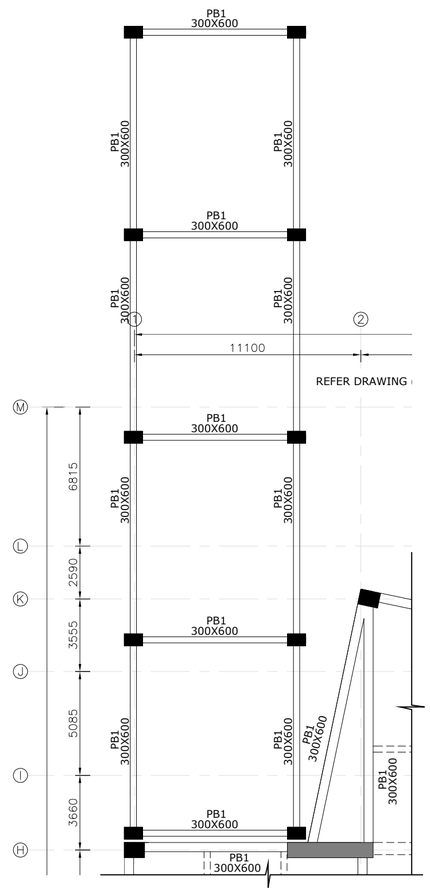
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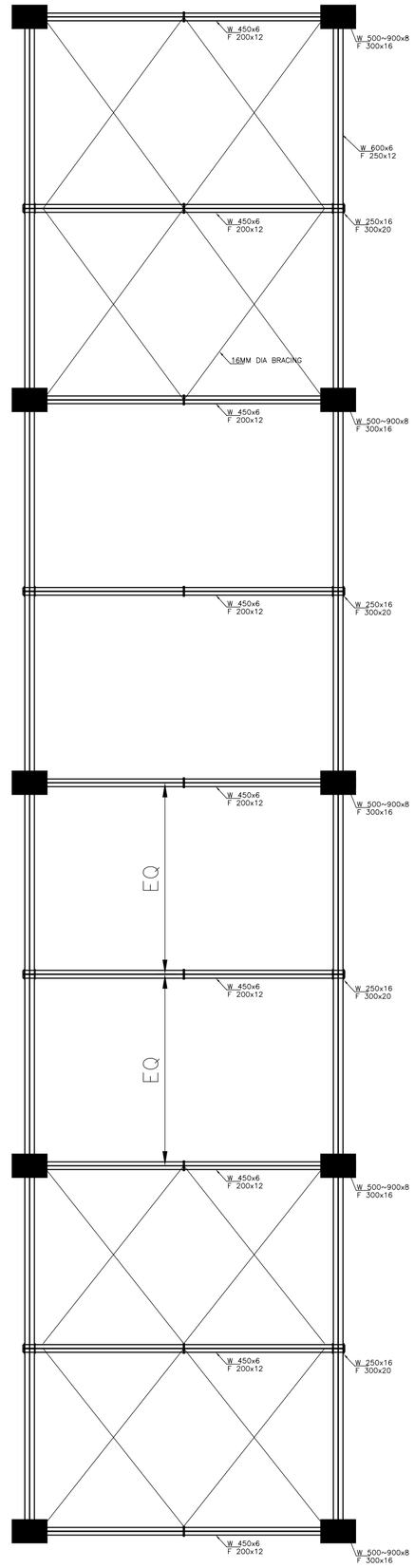

LAYOUT OF SHED FOUNDATION




LAYOUT OF SHED PEDESTALS




LAYOUT OF SHED PLINTH BEAM




COLUMN SCHEDULE:

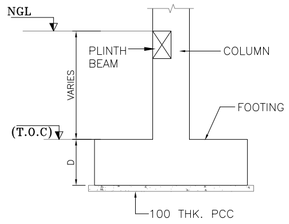
| Sl. NO | NAME | SIZE |
|---|---|---|
| 1 | C9 | 900X600 |

FOOTING SCHEDULE:-

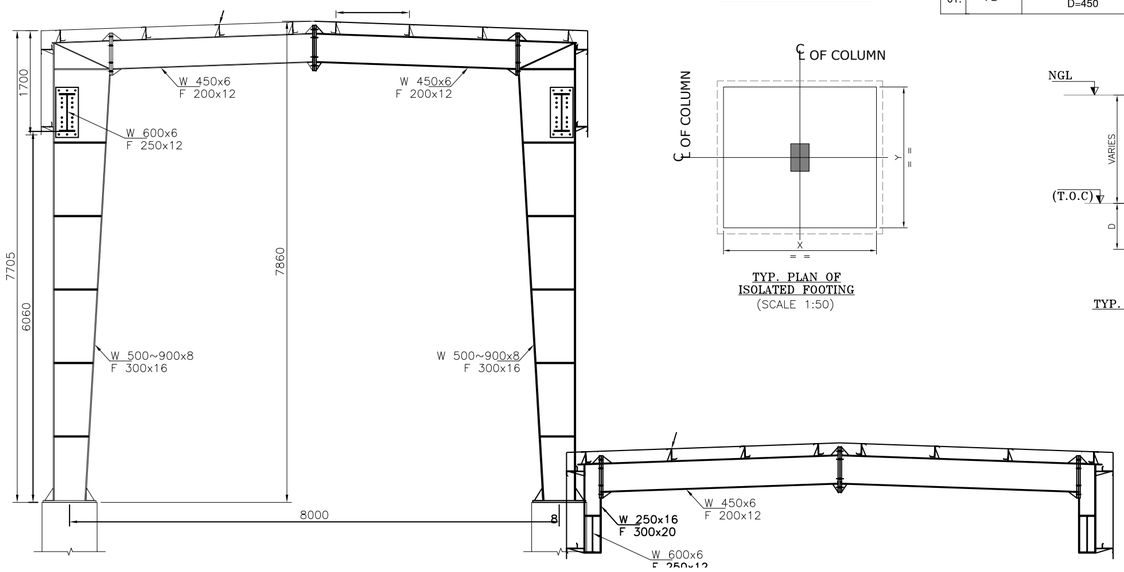
| Sl. NO. | FOOTING NAME | FOOTING SIZE (LXB) | NO OF FOOTING |
|---|---|---|---|
| 01. | F2 | 2500X2500 D=450 | 08 |




TYP. PLAN OF ISOLATED FOOTING
(SCALE 1:50)




TYP. SECTION OF ISOLATED FOOTING
(SCALE 1:50)




FRAMING DETAIL @ COLUMN LOCATION

FRAMING DETAIL @ SECONDARY BEAM LOCATION

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 24-09-2025 |

## KEY PLAN

NOTES:

1. IN ADDITION PLINTH BEAM,TIE BEAMS TO BE PROVIDED WHERE EVER REQUIRED TO MATCH DESIGN REQUIREMENTS BASED ON SITE TOPO LEVELS AND VARIABLE FOUNADTION LEVEL.
2. DISTANCE BETWEEN N.G.L AND FOUNDATION TOP VARIES AND MINIMUN LENGTH REQUIRED IS 2100mm.
3. SW1– 300 THK STRUCTURAL WALL
   SW2– 750 THK STRUCTURAL WALL

NOTE : ALL STRUCTURAL STEEL ARE FE350 GRADE & BOLTS 8.6GRADE

SPORTS AUTHORITY OF INDIA

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**PROJECT TITLE**

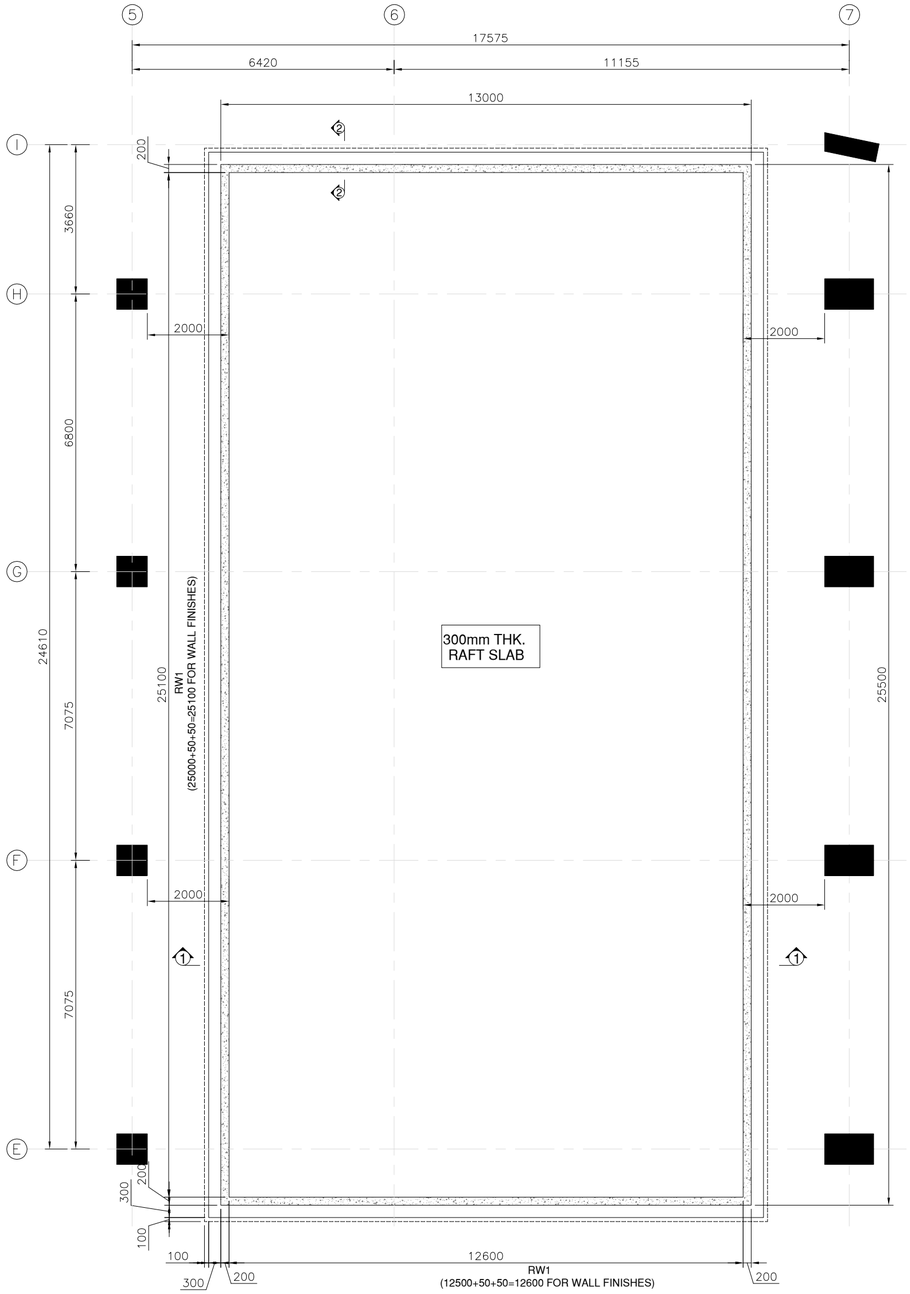
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

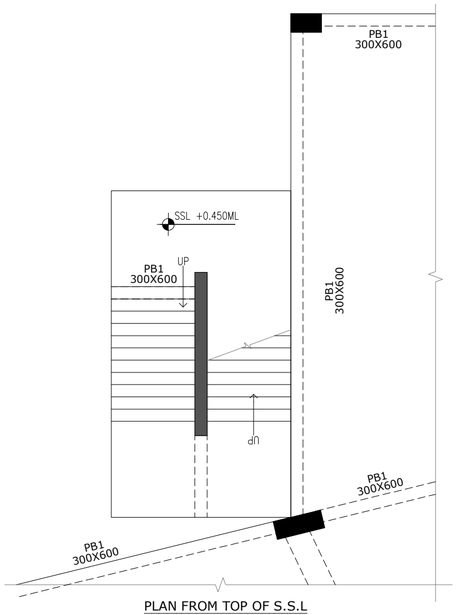
DETAILS OF LIGHT ROOF STRUCTURE

| | | REV. NO. |
|---|---|---|
| STR-HPC-A1-09 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:100 (A1) | NORTH |
| 1ST ISSUED ON | 24-09-2025 | N |
| APPROVED | KK | |
| CHECKED BY | MM | |
| DRAWN BY | JR | |

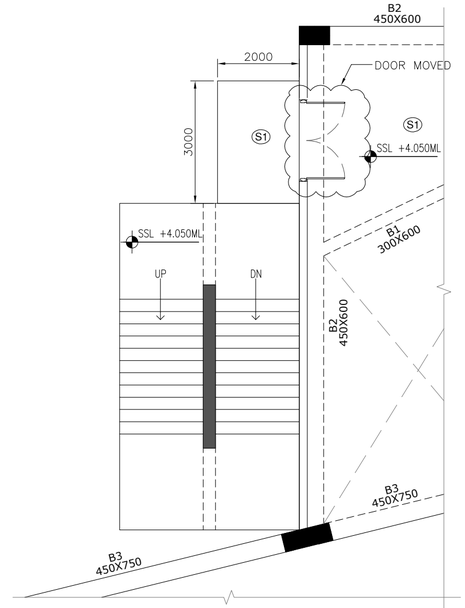
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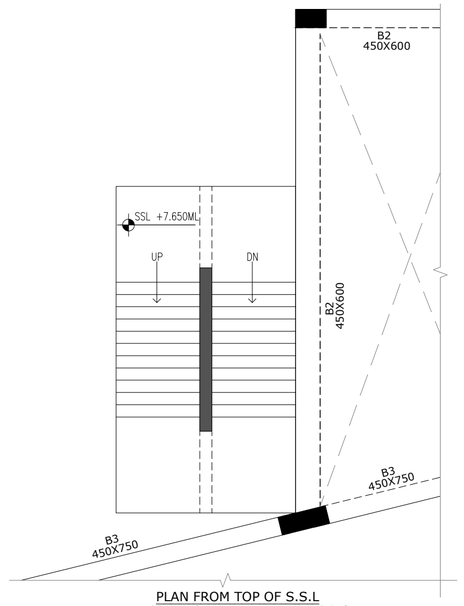

LAYOUT OF SWIMMING POOL
(SCALE 1:75)



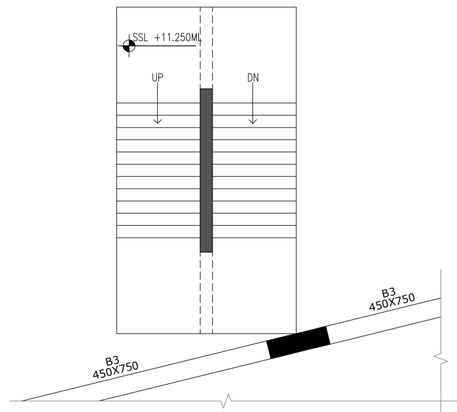

PLAN FROM TOP OF S.S.L
+0.450ML (PLINTH)
(SCALE 1:75)



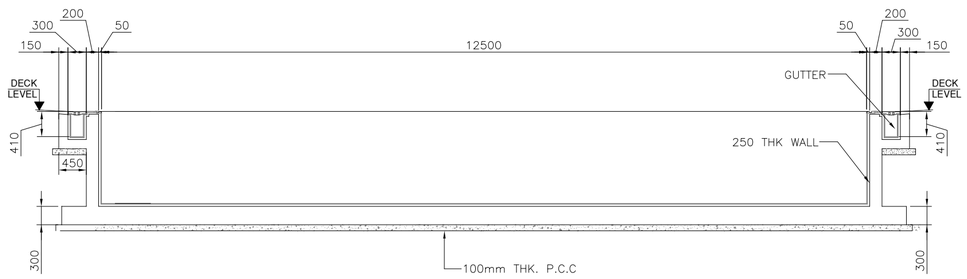

PLAN FROM TOP OF S.S.L
+4.050ML (GROUND FLOOR MEZZANINE)
(SCALE 1:75)



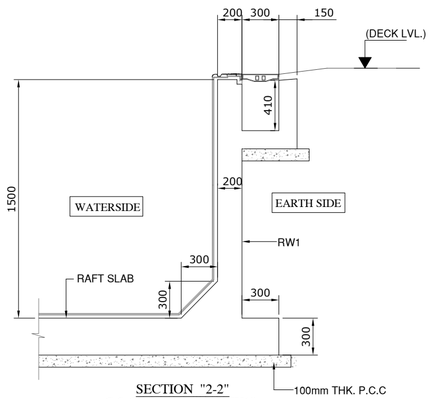

PLAN FROM TOP OF S.S.L
+7.650ML (GROUND FLOOR ROOF)
(SCALE 1:75)



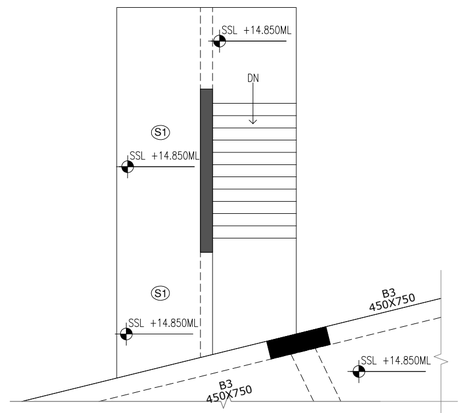

PLAN FROM TOP OF S.S.L
+11.250ML (FIRST FLOOR MEZZANINE)
(SCALE 1:75)




SECTION "1-1"
SCALE-1:50




SECTION "2-2"
C.S OF R.C WALL "RW1"
(250mm THK.)




PLAN FROM TOP OF S.S.L
+14.850ML (FIRST FLOOR ROOF)
(SCALE 1:75)

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
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| | | |
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| | | |

## KEY PLAN

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**ARCHITECT**

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+91 11 35537736

Mumbai | Ahmedabad | New Delhi

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | ENXGE Structural Consultants |

**PROJECT TITLE**

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

LAYOUT & SECTION OF SWIMING POOL AND EXTERNAL STAIRCASE

| DWG. NO. | | REV. NO. |
|---|---|---|
| STR-HPC-A1-10 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:100 (A1) | NORTH |
| 1ST ISSUED ON | 24-09-2025 | N |
| APPROVED | KK | |
| CHECKED BY | MM | |
| DRAWN BY | JR | |

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| LEGENDS:-LIGHTING | |
|---|---|
| SYMBOL | DESCRIPTION |
| | 600X600MM SQUARE LIGHT |
| | 18W LED DOWN LIGHT |
| | 15W DOWN LIGHT |
| | 9W LED SPOT LIGHT |
| | 1200MM CEILING FAN |
| | EXHAUST FAN |
| | MIRROR LIGHT |
| | 28W TUBE LIGHT FITTING |
| | BULK HEAD LIGHT |
| | 72W LED HIGH BAY LIGHT |

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| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

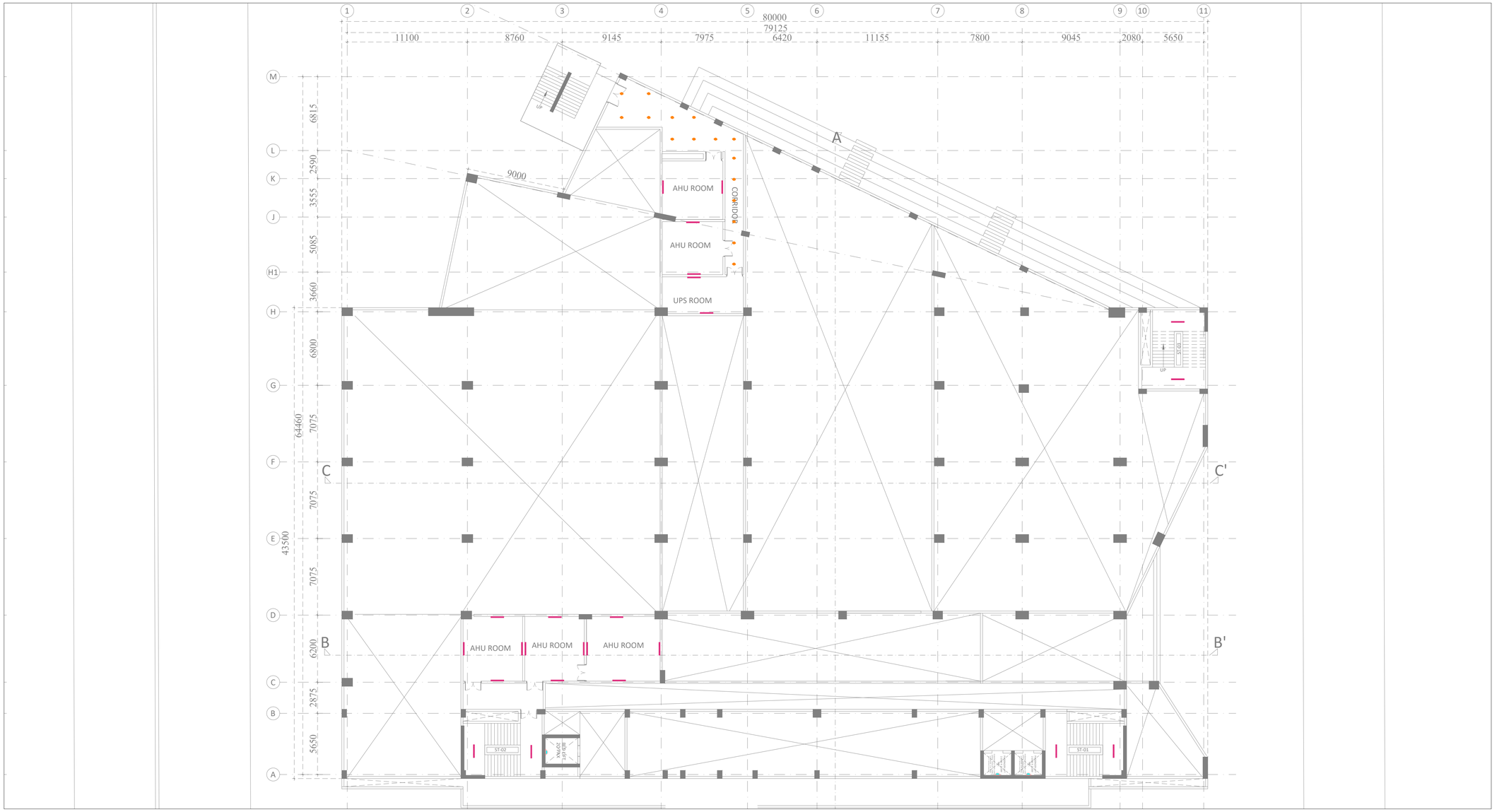
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

GROUND FLOOR LIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-GR-LL-1001 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:200 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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| LEGENDS:-LIGHTING | |
|---|---|
| SYMBOL | DESCRIPTION |
| | 600X600MM SQUARE LIGHT |
| | 18W LED DOWN LIGHT |
| | 15W DOWN LIGHT |
| | 9W LED SPOT LIGHT |
| | 1200MM CEILING FAN |
| | EXHAUST FAN |
| | MIRROR LIGHT |
| | 28W TUBE LIGHT FITTING |
| | BULK HEAD LIGHT |
| | 72W LED HIGH BAY LIGHT |

# TENDER DRAWINGS

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4. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE RELEVANT SERVICES AND STRUCTURAL DRAWINGS.

## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

**CLIENT**

SPORTS AUTHORITY OF INDIA

**ARCHITECT**

Collage Design Pvt Ltd
300, Sai Sampanna, Station Rd,
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+91 22 25740844 / 45

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+91 11 35537736

Mumbai | Ahmedabad | New Delhi

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

**PROJECT TITLE**

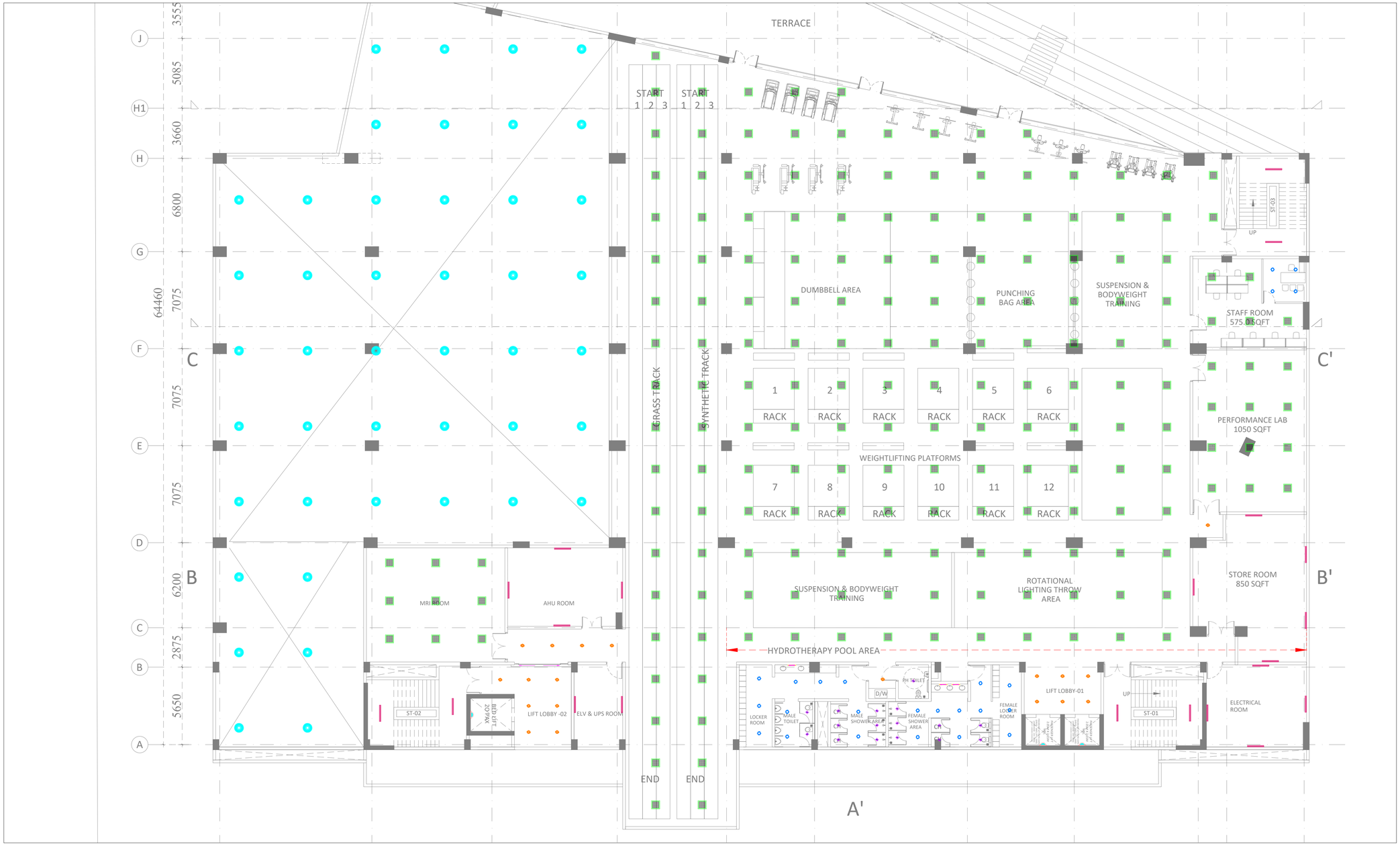
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

GROUND MEZZANINE FLOOR LIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-GR-MEZZ-LL-1002 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:75 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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| LEGENDS:-LIGHTING | |
|---|---|
| SYMBOL | DESCRIPTION |
| | 600X600MM SQUARE LIGHT |
| | 18W LED DOWN LIGHT |
| | 15W DOWN LIGHT |
| | 9W LED SPOT LIGHT |
| | 1200MM CEILING FAN |
| | EXHAUST FAN |
| | MIRROR LIGHT |
| | 28W TUBE LIGHT FITTING |
| | BULK HEAD LIGHT |
| | 72W LED HIGH BAY LIGHT |

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# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

**CLIENT**

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**ARCHITECT**

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

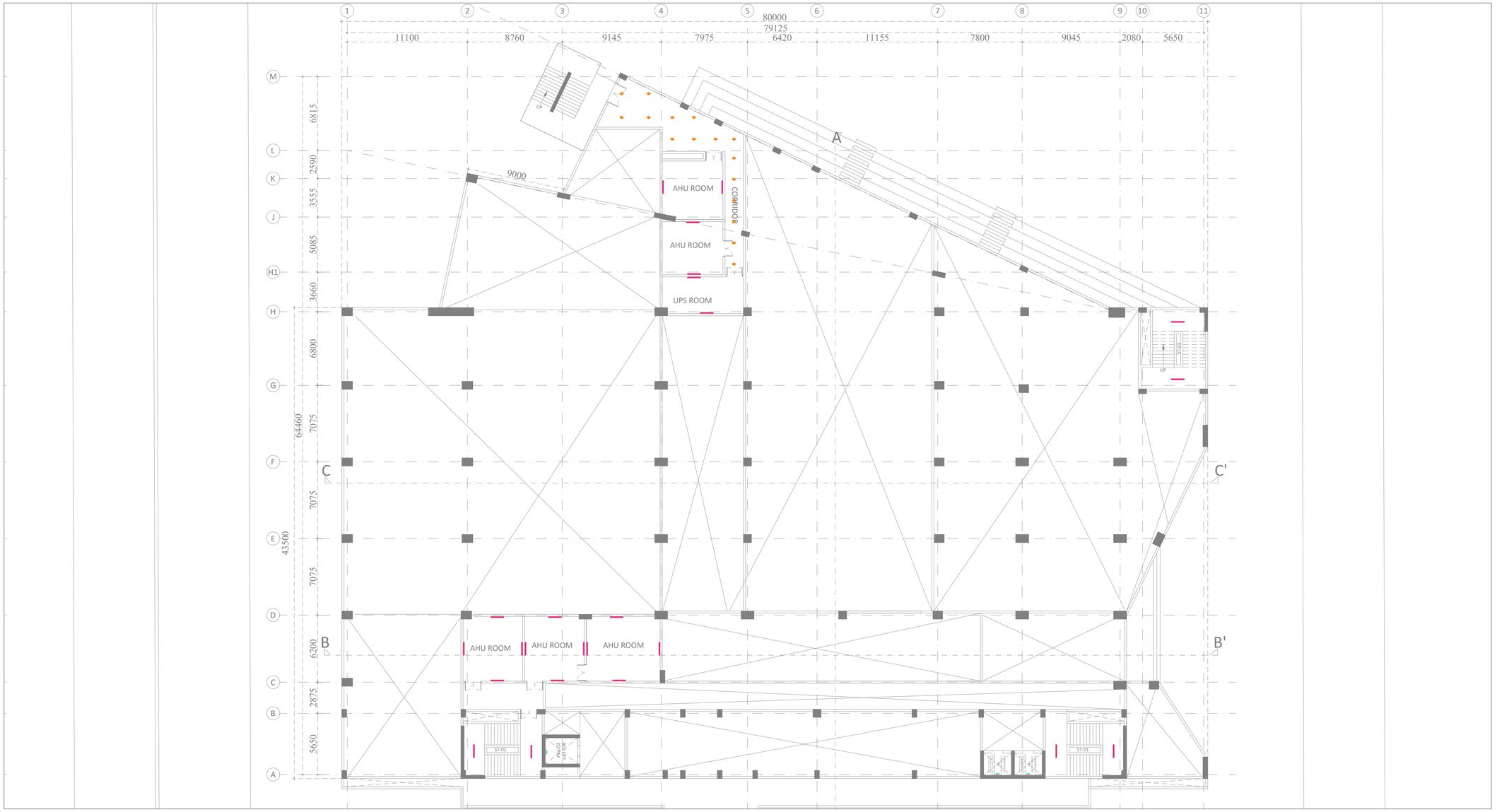
**PROJECT TITLE**

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

FIRST FLOOR LIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-1ST-LL-1003 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |




| LEGENDS:-LIGHTING | |
|---|---|
| SYMBOL | DESCRIPTION |
| | 600X600MM SQUARE LIGHT |
| | 18W LED DOWN LIGHT |
| | 15W DOWN LIGHT |
| | 9W LED SPOT LIGHT |
| | 1200MM CEILING FAN |
| | EXHAUST FAN |
| | MIRROR LIGHT |
| | 28W TUBE LIGHT FITTING |
| | BULK HEAD LIGHT |
| | 72W LED HIGH BAY LIGHT |

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|---|---|---|
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## KEY PLAN

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## ARCHITECT

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

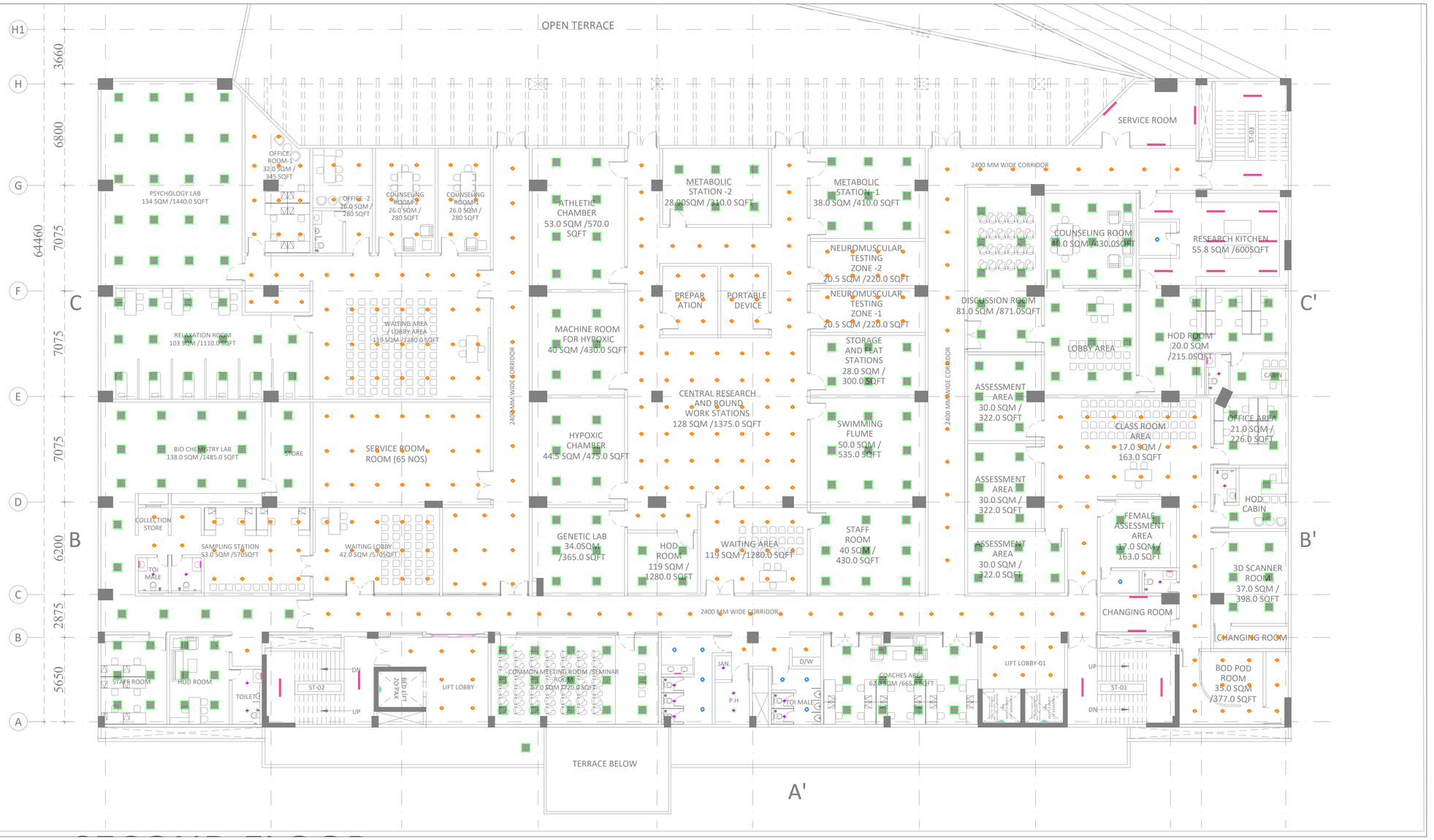
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

FIRST MEZZANINE FLOOR LIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-1ST-MEZZ-LL-1004 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:75 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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| LEGENDS:-LIGHTING | |
|---|---|
| SYMBOL | DESCRIPTION |
| | 600X600MM SQUARE LIGHT |
| | 18W LED DOWN LIGHT |
| | 15W DOWN LIGHT |
| | 9W LED SPOT LIGHT |
| | 1200MM CEILING FAN |
| | EXHAUST FAN |
| | MIRROR LIGHT |
| | 28W TUBE LIGHT FITTING |
| | BULK HEAD LIGHT |
| | 72W LED HIGH BAY LIGHT |

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| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

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## ARCHITECT

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

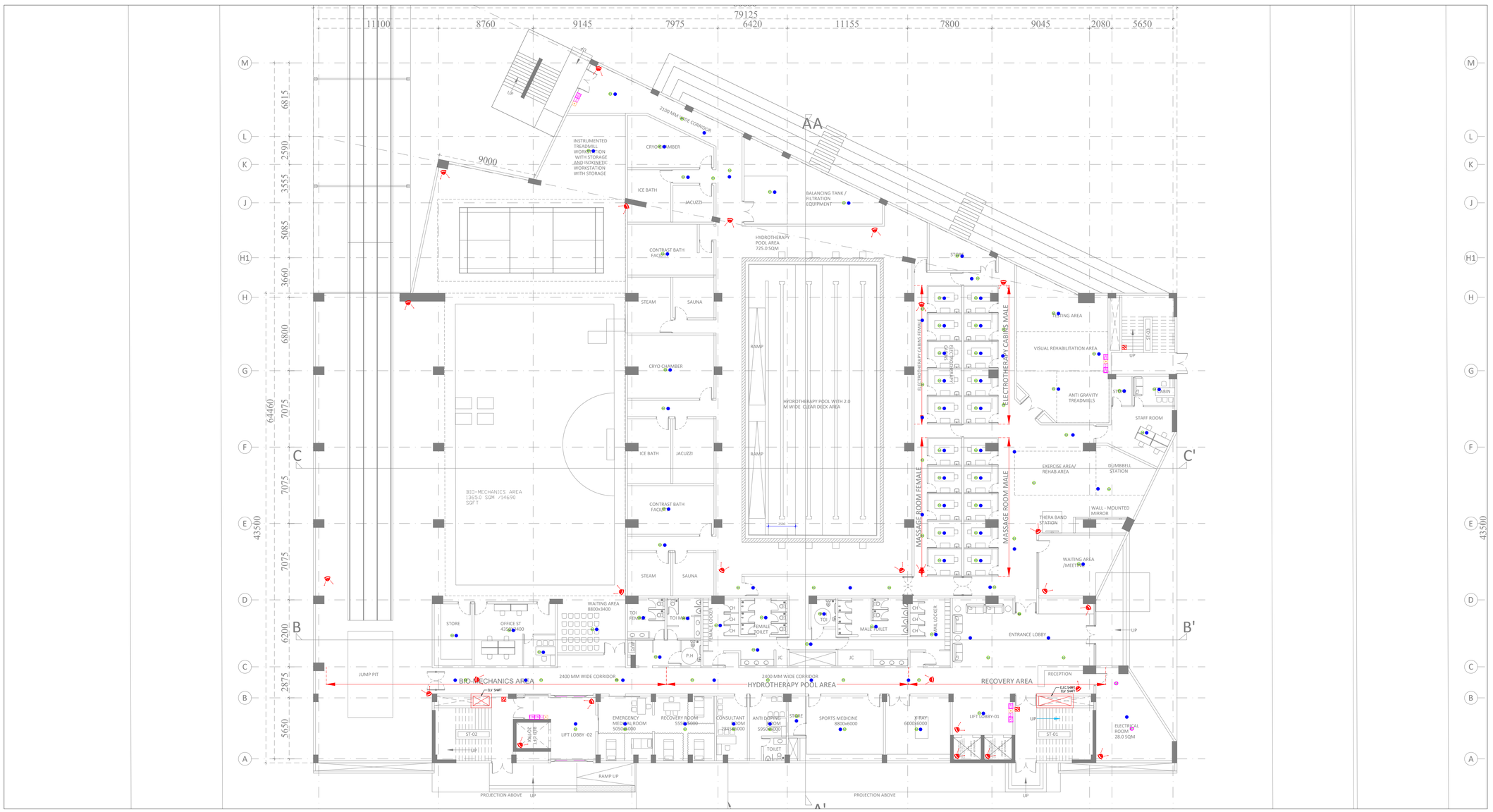
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

SECOND FLOOR LIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-2ND-LL-1005 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:125 | NORTH |
| 1st ISSUED ON | 26-09-2025 | |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
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## LEGENDS:- ELV

| LEGEND | DESCRIPTION |
|---|---|
| SD | SMOKE DETECTOR(BFC) |
| HD | HEAT DETECTOR |
| CM | CONTROL MODULE |
| | HOOTER |
| | MANUAL CALL POINT |
| FF | FIRE FIGHTER TELEPHONIC JACK |
| M | MULTI SENSE DETECTOR |
| | SPEAKER |
| | DOME CAMERA |
| | FAS PANEL |
| PAS | PAS PANEL |
| MIC | MIC |
| NVR | NVR |

# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

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## ARCHITECT

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S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

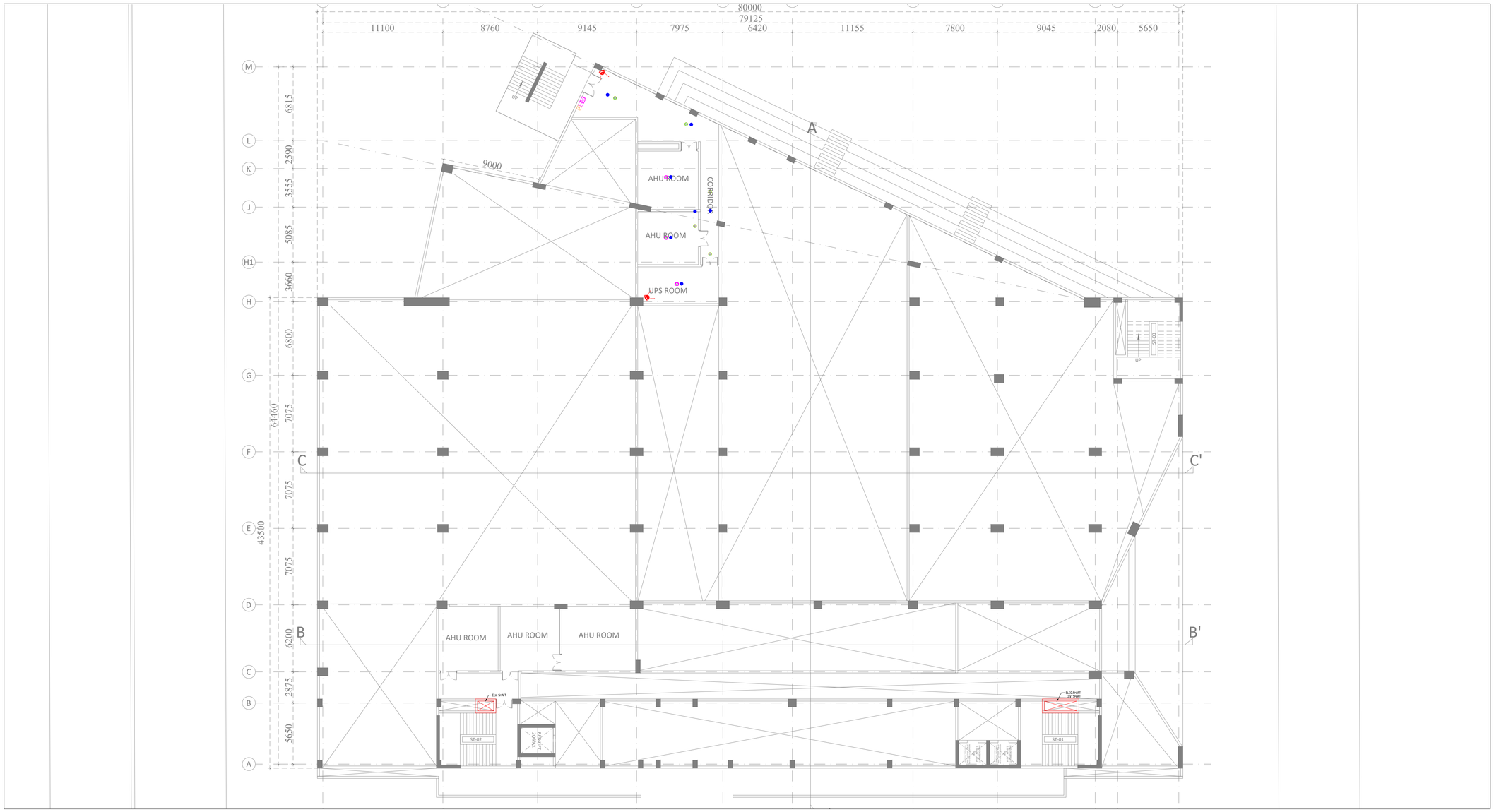
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

GROUND FLOOR FAPA LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELV-GR-FAPA-3001 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:200 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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## LEGENDS:- ELV

| LEGEND | DESCRIPTION |
|---|---|
| SD | SMOKE DETECTOR(BFC) |
| HD | HEAT DETECTOR |
| CM | CONTROL MODULE |
| | HOOTER |
| | MANUAL CALL POINT |
| | FIRE FIGHTER TELEPHONIC JACK |
| M | MULTI SENSE DETECTOR |
| | SPEAKER |
| | DOME CAMERA |
| | FAS PANEL |
| PAS | PAS PANEL |
| MIC | MIC |
| NVR | NVR |

# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

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S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

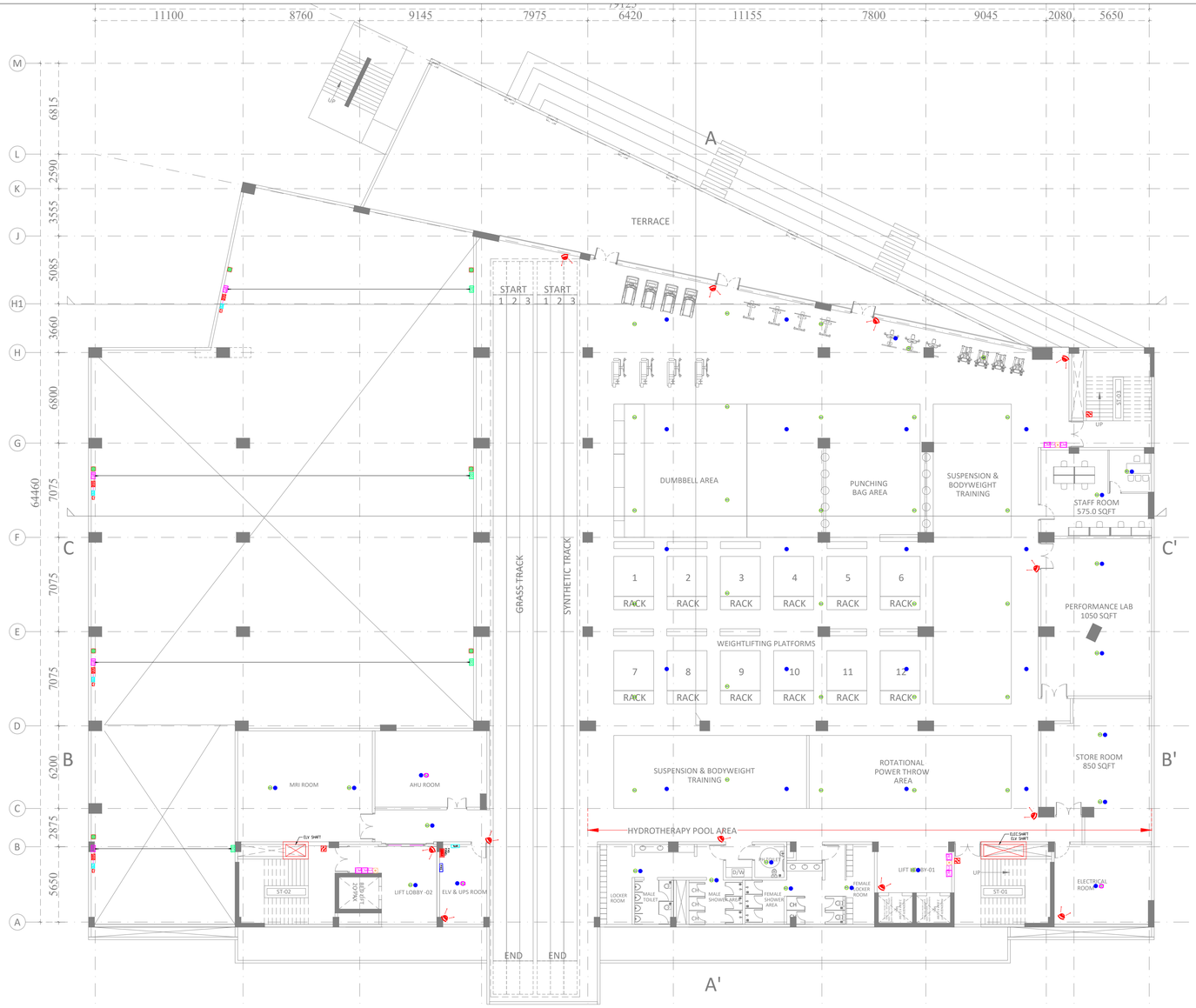
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

GROUND MEZZANINE FLOOR FAPA LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELV-GR-MEZZ-FAPA-3002 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:200 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
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## LEGENDS:- ELV

| LEGEND | DESCRIPTION |
|---|---|
| SD | SMOKE DETECTOR(BFC) |
| HD | HEAT DETECTOR |
| CM | CONTROL MODULE |
| | HOOTER |
| | MANUAL CALL POINT |
| | FIRE FIGHTER TELEPHONIC JACK |
| M | MULTI SENSE DETECTOR |
| | SPEAKER |
| | DOME CAMERA |
| | FAS PANEL |
| PAS | PAS PANEL |
| MIC | MIC |
| NVR | NVR |

## BEAM DETECTOR LEGENDS:

| SYMBOL | DESCRIPTION |
|---|---|
| FTM | FAULT ISOLATOR MODULE |
| PS M | POWER SUPPLY |
| BT | BEAM DETECTOR (TRANSMITTER) |
| BD | BEAM DETECTOR (REFLECTOR) |
| MM | MONITOR MODULE FOR BEAM DETECTOR |
| | WALL MOUNTED SPEAKER |

# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

collage design
Mumbai | Ahmedabad | New Delhi
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Hauz Khas, New Delhi 110 016
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| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

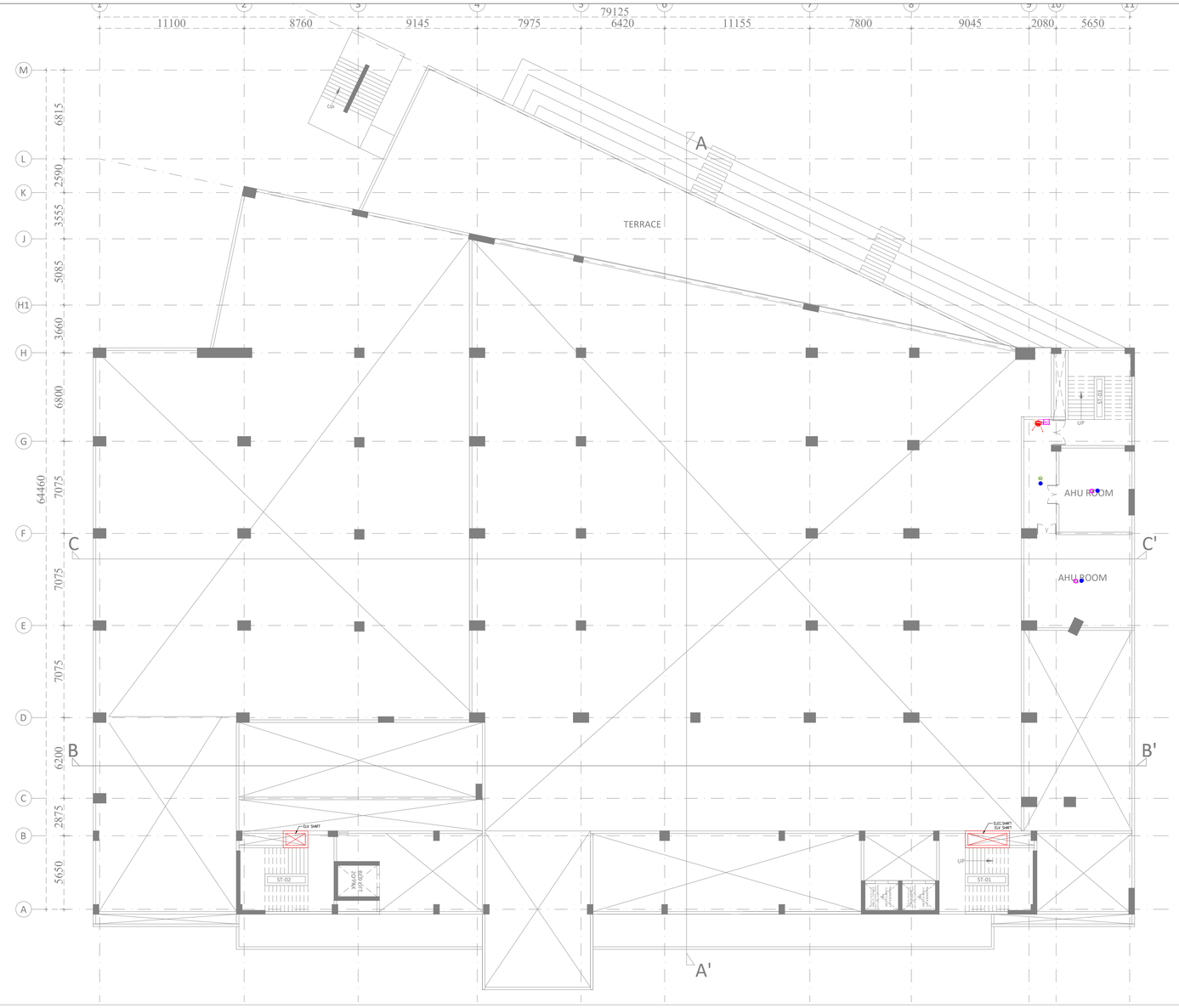
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

FIRST MEZZANINE FLOOR FAPA LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELV-1ST-FAPA-3003 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:200 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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## LEGENDS:- ELV

| LEGEND | DESCRIPTION |
|---|---|
| SD | SMOKE DETECTOR(BFC) |
| HD | HEAT DETECTOR |
| CM | CONTROL MODULE |
| | HOOTER |
| | MANUAL CALL POINT |
| | FIRE FIGHTER TELEPHONIC JACK |
| M | MULTI SENSE DETECTOR |
| | SPEAKER |
| | DOME CAMERA |
| | FAS PANEL |
| PAS | PAS PANEL |
| MIC | MIC |
| NVR | NVR |

# TENDER DRAWINGS

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|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

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| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

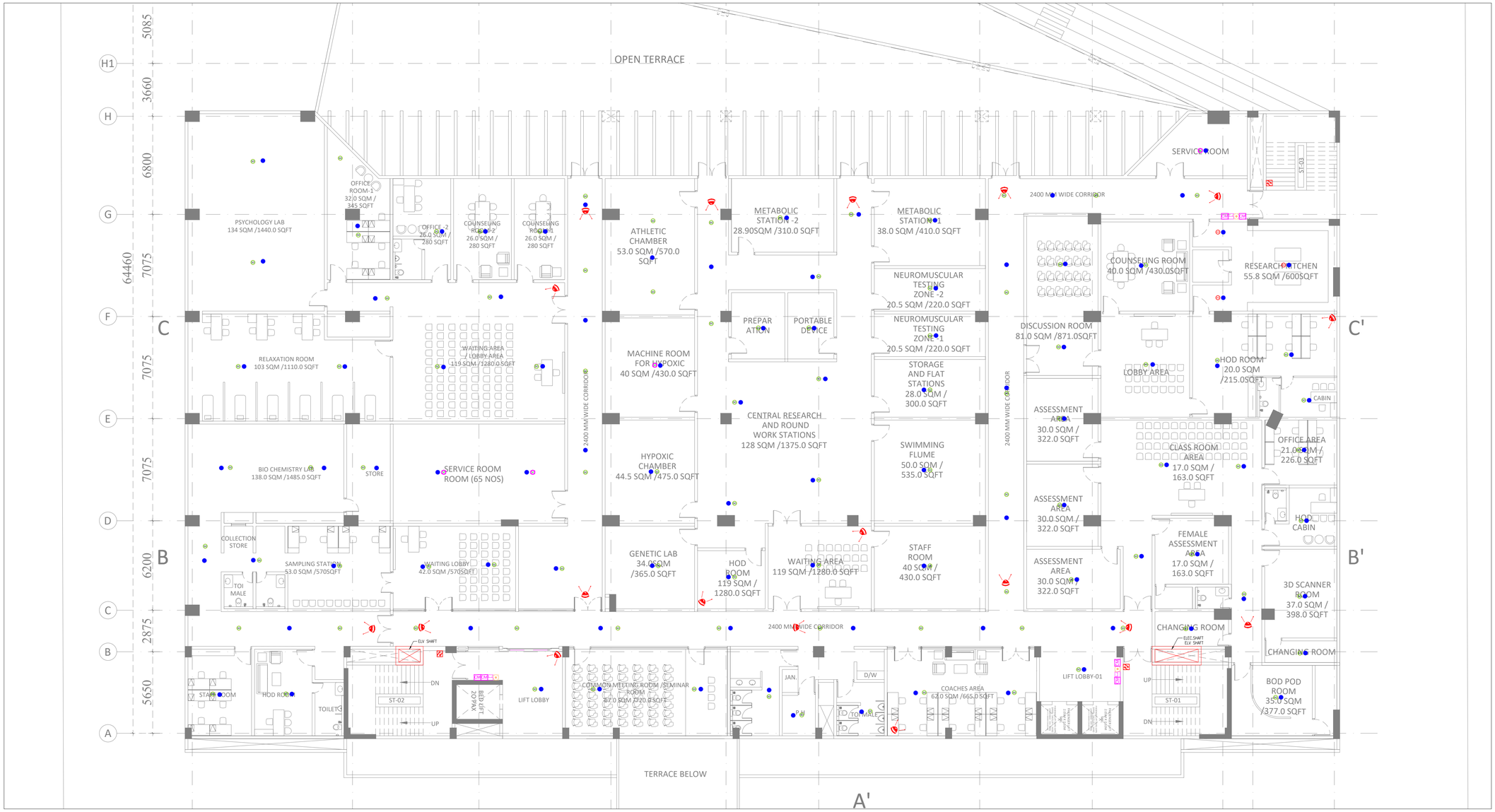
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

FIRST MEZZANINE FLOOR FAPA LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELV-1ST-MEZZ-FAPA-3004 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:200 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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LEGENDS:- ELV

| LEGEND | DESCRIPTION |
|---|---|
| SD | SMOKE DETECTOR(BFC) |
| HD | HEAT DETECTOR |
| CM | CONTROL MODULE |
| | HOOTER |
| | MANUAL CALL POINT |
| FF | FIRE FIGHTER TELEPHONIC JACK |
| M | MULTI SENSE DETECTOR |
| | SPEAKER |
| | DOME CAMERA |
| | FAS PANEL |
| PAS | PAS PANEL |
| MIC | MIC |
| NVR | NVR |

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# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

Collage Design Pvt Ltd
300, Sai Sampanna, Station Rd,
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+91 22 25740844 / 45

S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

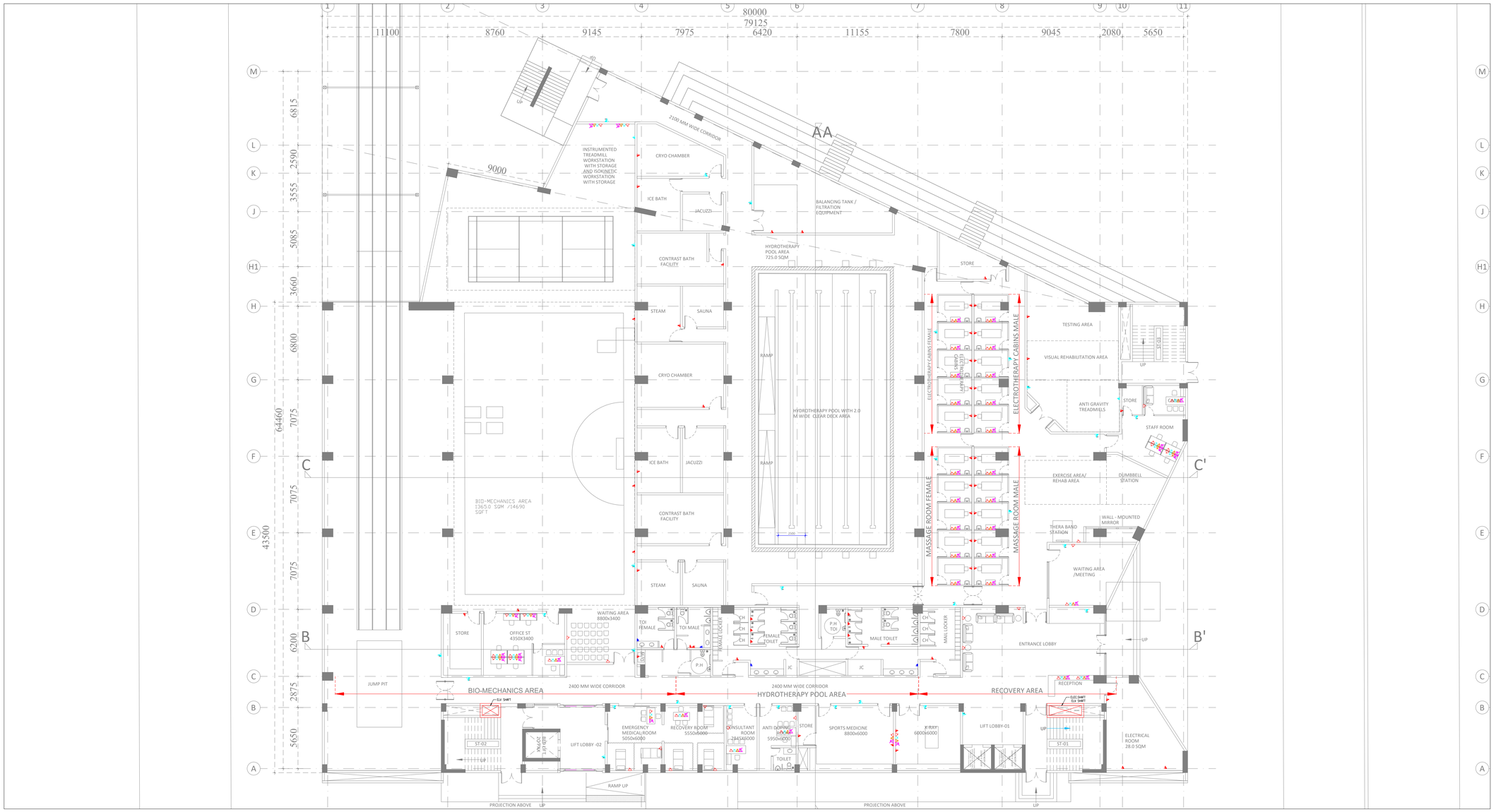
## PROJECT TITLE

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

SECOND FLOOR FAPA LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELV-2ND-FAPA-3005 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |




| SYMBOL | DESCRIPTION |
|---|---|
| | 1x6A SOCKET + 1x6A SWITCH ON RAW |
| | 2X6A SOCKET + 1x16A SWITCH ON UPS |
| | 6/16A SOCKET OUTLET WITH SWITCH ON RAW POWER |
| 1 | 1NO. DATA |
| 1 | 1NO. VOICE |
| | 6/16 A SWITCH SOCKET COMBINED IN TOILET FOR HAND DRIER |
| SHOE POLISH | 6/16 A SWITCH SOCKET COMBINED FOR SHOE POLISH |
| | 1x6/16A SOCKET + 1x16A SWITCH ON RAW @300MM |
| AC | SOCKET FOR AC |
| | 6A SOCKET @CEILING FOR HVAC |
| | 16A SOCKET @CEILING FOR HVAC |
| | POWER LOOP |
| | UPS POWER LOOP |
| GEYSER | SOCKET FOR GEYSER |
| | 16A SWITCH SOCKET FOR UPS |

# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

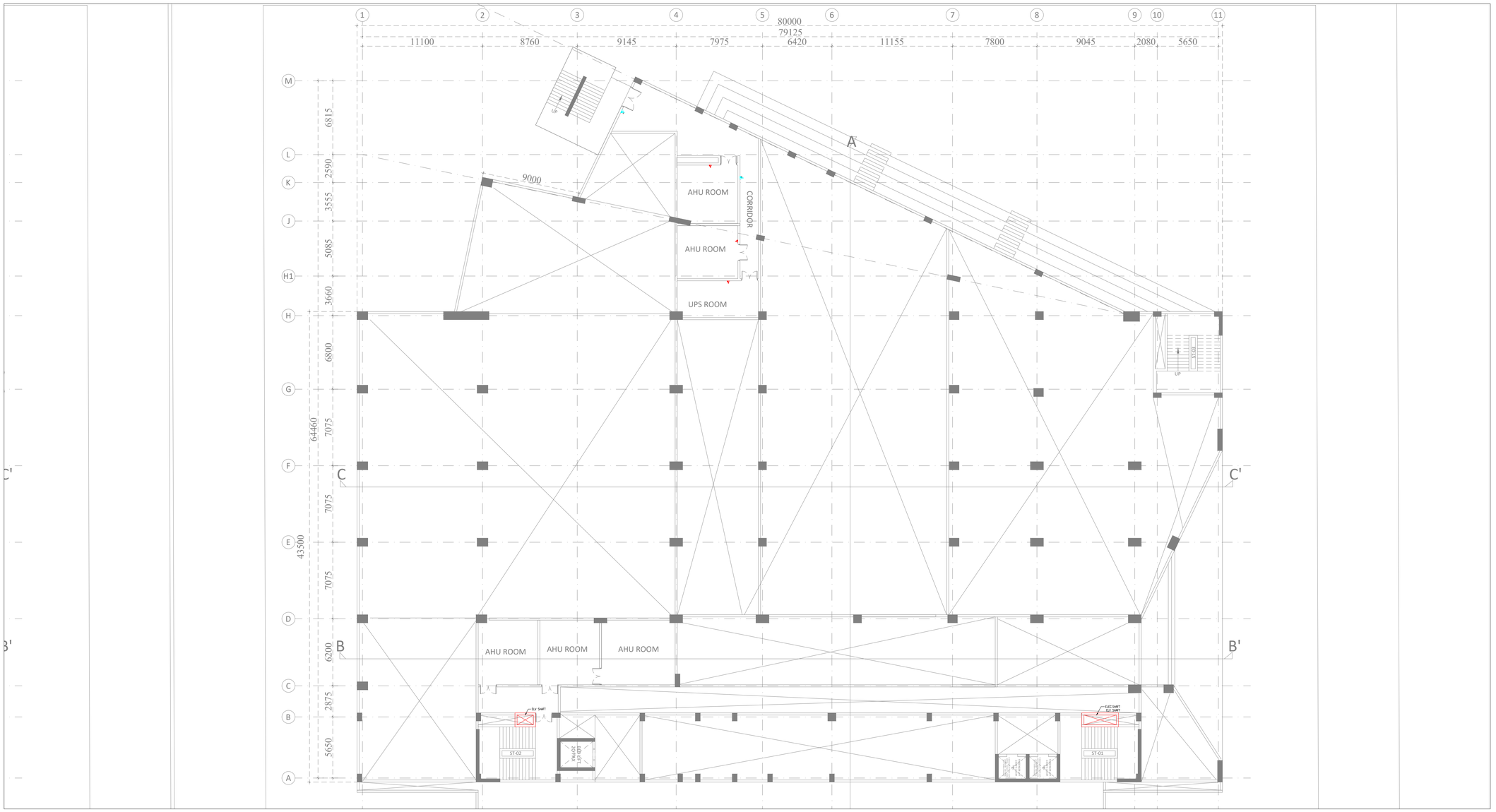
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

GROUND FLOOR POWER LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-GR-PW-2001 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:200 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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| SYMBOL | DESCRIPTION |
|---|---|
| | 1x6A SOCKET + 1x6A SWITCH ON RAW |
| | 2X6A SOCKET + 1x16A SWITCH ON UPS |
| | 6/16A SOCKET OUTLET WITH SWITCH ON RAW POWER |
| 1 | 1NO. DATA |
| 1 | 1NO. VOICE |
| HD | 6/16 A SWITCH SOCKET COMBINED IN TOILET FOR HAND DRIER |
| 16P | 6/16 A SWITCH SOCKET COMBINED FOR SHOE POLISH |
| X2 | 1x6/16A SOCKET + 1x16A SWITCH ON RAW @300MM |
| AC | SOCKET FOR AC |
| | 6A SOCKET @CEILING FOR HVAC |
| | 16A SOCKET @CEILING FOR HVAC |
| | POWER LOOP |
| | UPS POWER LOOP |
| GS | SOCKET FOR GEYSER |
| | 16A SWITCH SOCKET FOR UPS |

# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

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+91 22 25740844 / 45

S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

Mumbai | Ahmedabad | New Delhi

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

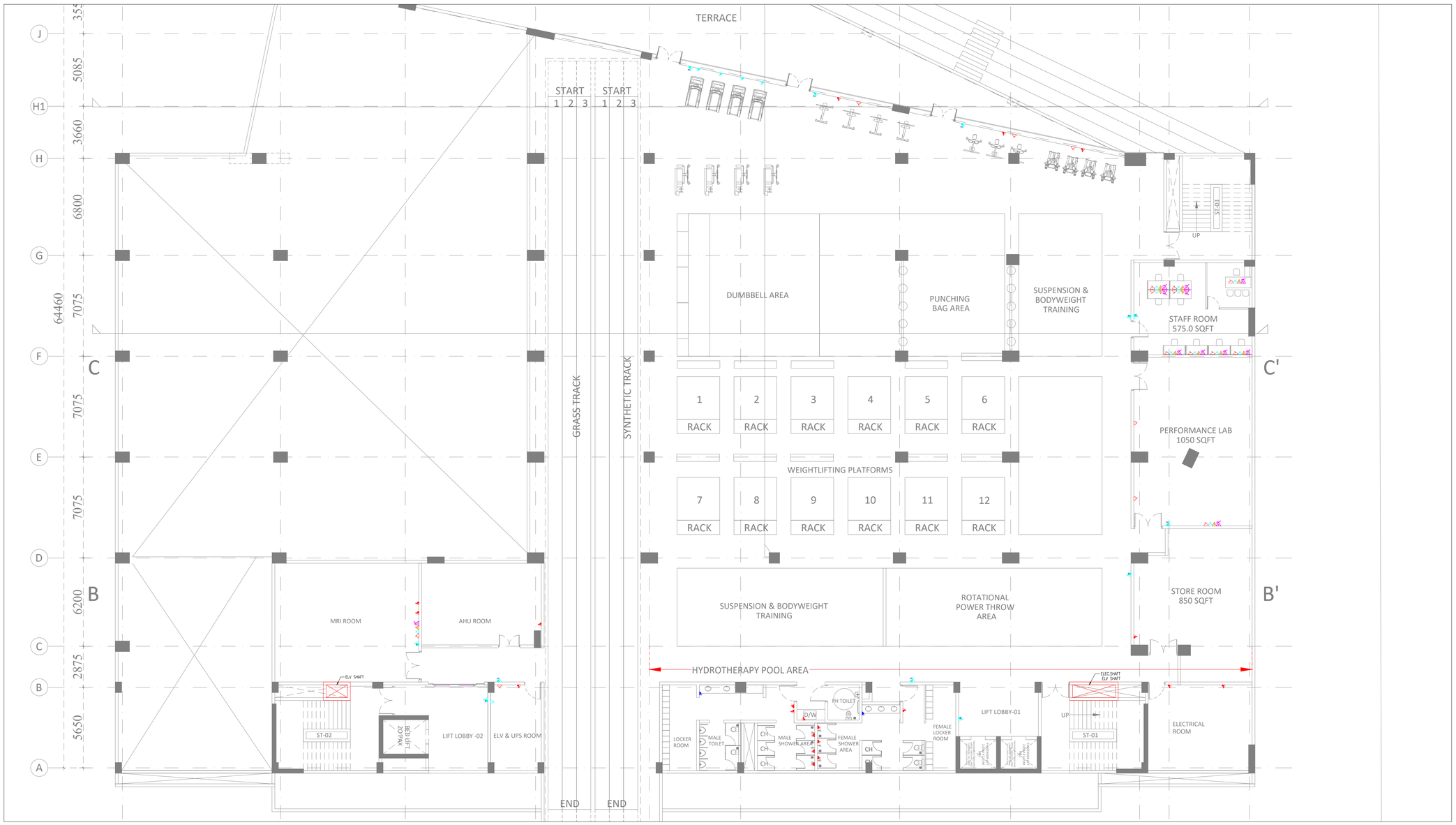
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

GROUND MEZZANINE FLOOR POWER LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-GR-MEZZ-PW-2002 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:75 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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| SYMBOL | DESCRIPTION |
|---|---|
| | 1x6A SOCKET + 1x6A SWITCH ON RAW |
| | 2X6A SOCKET + 1x16A SWITCH ON UPS |
| | 6/16A SOCKET OUTLET WITH SWITCH ON RAW POWER |
| 1 | 1NO. DATA |
| 1 | 1NO. VOICE |
| HDR | 6/16 A SWITCH SOCKET COMBINED IN TOILET FOR HAND DRIER |
| SP | 6/16 A SWITCH SOCKET COMBINED FOR SHOE POLISH |
| 2K | 1x6/16A SOCKET + 1x16A SWITCH ON RAW @300MM |
| AC | SOCKET FOR AC |
| | 6A SOCKET @CEILING FOR HVAC |
| | 16A SOCKET @CEILING FOR HVAC |
| | POWER LOOP |
| | UPS POWER LOOP |
| G | SOCKET FOR GEYSER |
| | 16A SWITCH SOCKET FOR UPS |

# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

collage design
Mumbai | Ahmedabad | New Delhi
Collage Design Pvt Ltd
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Vikhroli East, Mumbai, 400 083
+91 22 25740844 / 45

S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

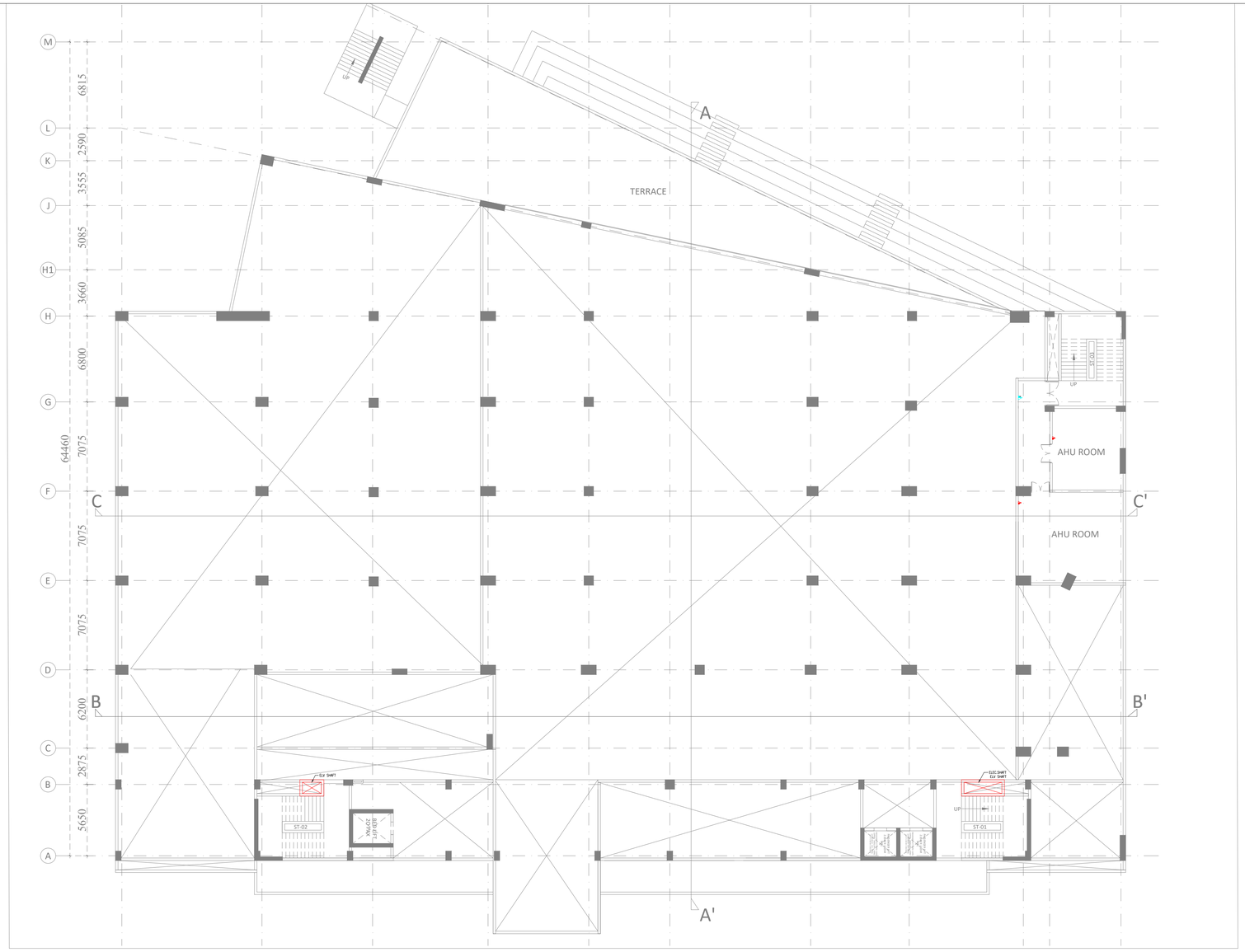
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

FIRST FLOOR POWER LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-1ST-PW-2003 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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| SYMBOL | DESCRIPTION |
|---|---|
| | 1x6A SOCKET + 1x6A SWITCH ON RAW |
| | 2X6A SOCKET + 1x16A SWITCH ON UPS |
| | 6/16A SOCKET OUTLET WITH SWITCH ON RAW POWER |
| 1 | 1NO. DATA |
| 1 | 1NO. VOICE |
| HDC | 6/16 A SWITCH SOCKET COMBINED IN TOILET FOR HAND DRIER |
| SSP | 6/16 A SWITCH SOCKET COMBINED FOR SHOE POLISH |
| 2X | 1x6/16A SOCKET + 1x16A SWITCH ON RAW @300MM |
| SAC | SOCKET FOR AC |
| | 6A SOCKET @CEILING FOR HVAC |
| | 16A SOCKET @CEILING FOR HVAC |
| | POWER LOOP |
| | UPS POWER LOOP |
| SG | SOCKET FOR GEYSER |
| | 16A SWITCH SOCKET FOR UPS |

# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

Collage Design Pvt Ltd
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S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

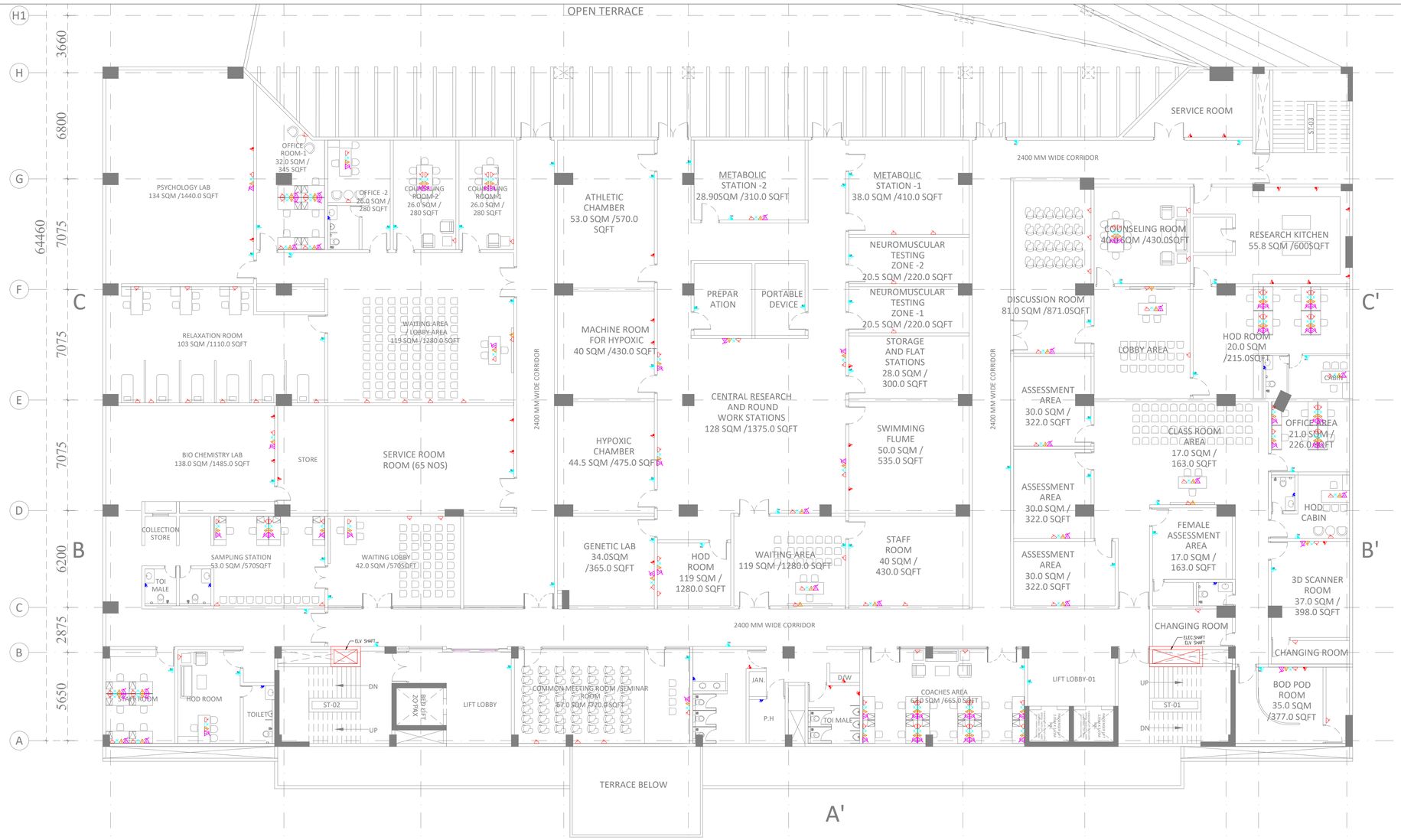
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

FIRST MEZZANINE FLOOR POWER LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-1ST-MEZZ-PW-2004 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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# SECOND FLOOR

| SYMBOL | DESCRIPTION |
|---|---|
| | 1x6A SOCKET + 1x6A SWITCH ON RAW |
| | 2X6A SOCKET + 1x16A SWITCH ON UPS |
| | 6/16A SOCKET OUTLET WITH SWITCH ON RAW POWER |
| 1 | 1NO. DATA |
| 1 | 1NO. VOICE |
| HD | 6/16 A SWITCH SOCKET COMBINED IN TOILET FOR HAND DRIER |
| SP | 6/16 A SWITCH SOCKET COMBINED FOR SHOE POLISH |
| X2 | 1x6/16A SOCKET + 1x16A SWITCH ON RAW @300MM |
| AC | SOCKET FOR AC |
| | 6A SOCKET @CEILING FOR HVAC |
| | 16A SOCKET @CEILING FOR HVAC |
| | POWER LOOP |
| | UPS POWER LOOP |
| GS | SOCKET FOR GEYSER |
| | 16A SWITCH SOCKET FOR UPS |

# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

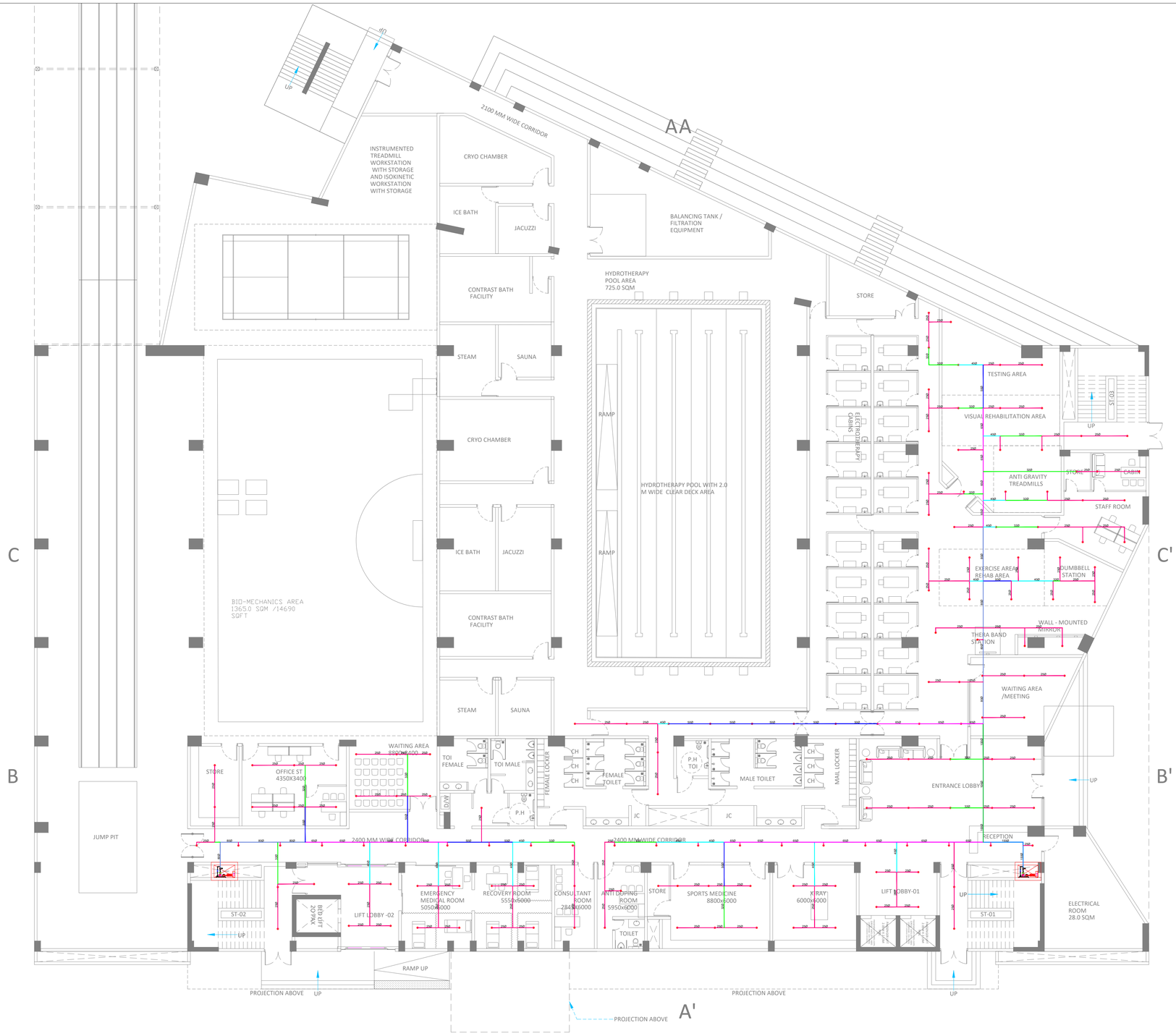
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

SECOND FLOOR POWER LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-ELE-2ND-PW-2005 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | S.R.K | |
| CHECKED BY | S.R.K | |
| DRAWN BY | S.P | |

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# GROUND FLOOR LVL-4054.5 SQM

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### REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

### KEY PLAN

### CLIENT

SPORTS AUTHORITY OF INDIA

### ARCHITECT

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

### PROJECT TITLE

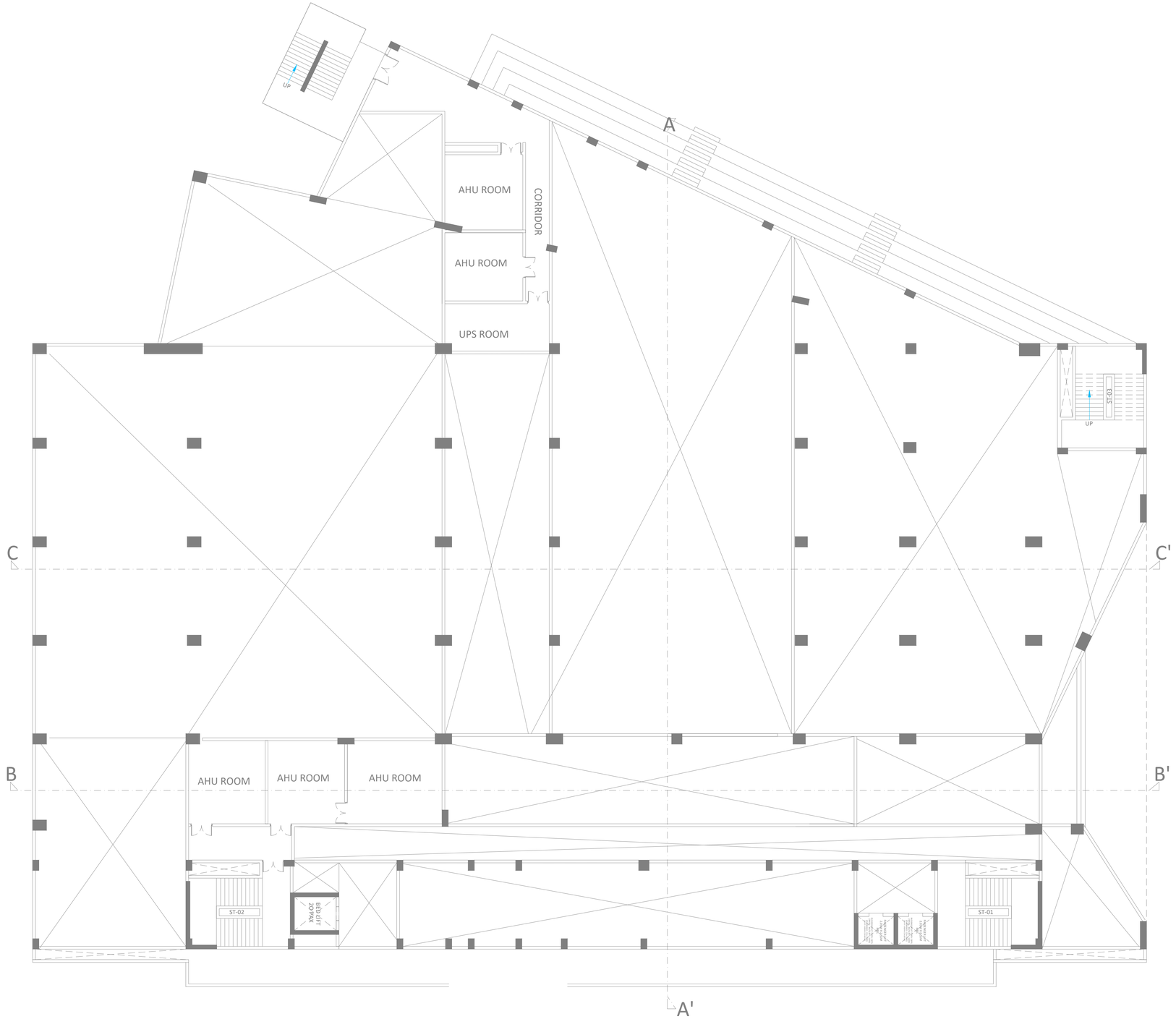
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

GROUND FLOOR FIRE FIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-FF-01 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | |
| APPROVED | ---- JK | |
| CHECKED BY | ---- NB | |
| DRAWN BY | ---- SP | |

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# GROUND MEZZANINE FLOOR LVL

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|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

### KEY PLAN

### CLIENT

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### ARCHITECT

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+91 11 35537736

Mumbai | Ahmedabad | New Delhi

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

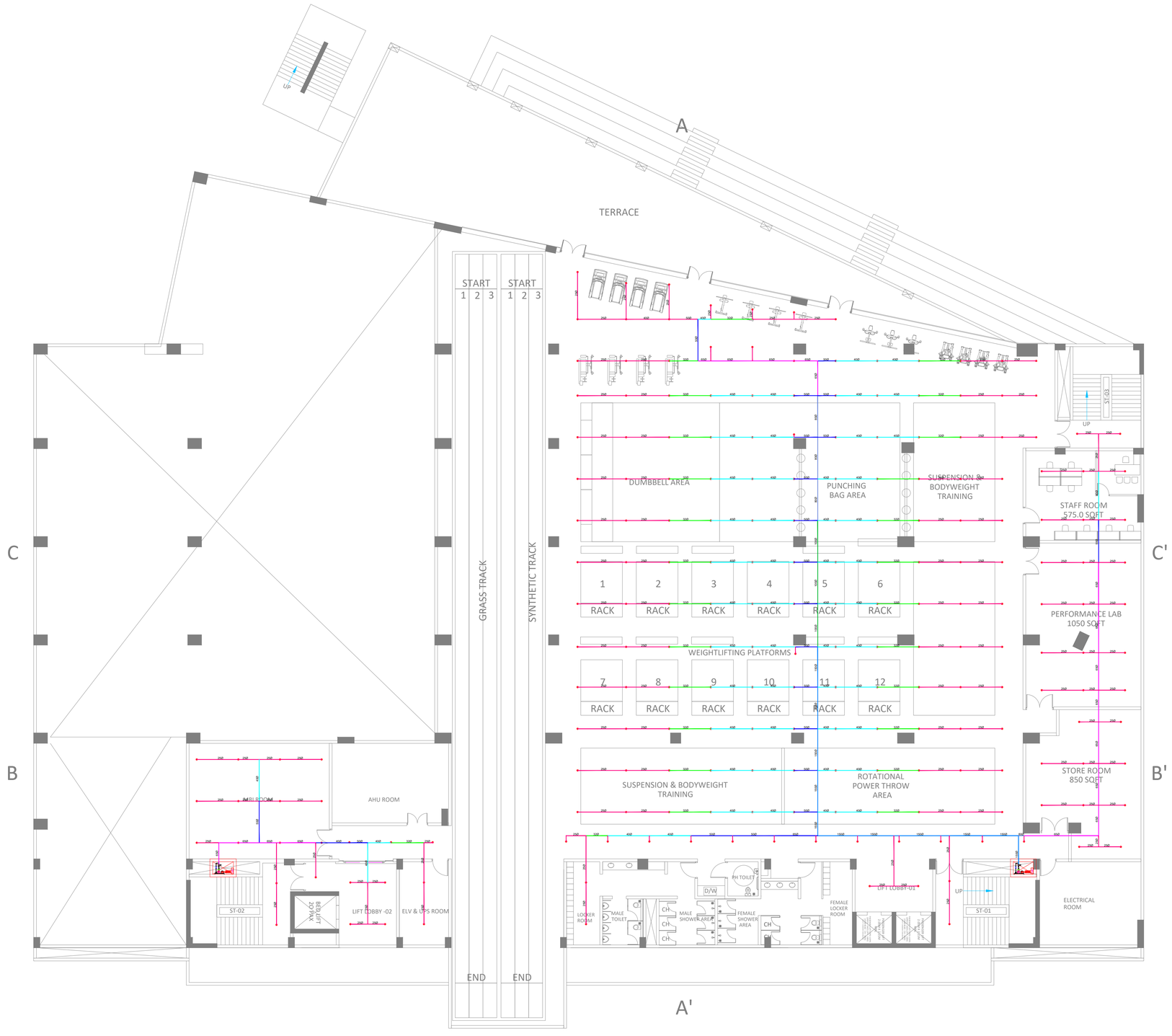
### PROJECT TITLE

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

GROUND MEZZANINE FLOOR FIRE FIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-FF-02 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | ---- JK | |
| CHECKED BY | ---- NB | |
| DRAWN BY | ---- SP | |




# FIRST FLOOR

## TENDER DRAWINGS

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### REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

### KEY PLAN

### CLIENT

SPORTS AUTHORITY OF INDIA

### ARCHITECT

Collage Design Pvt Ltd
300, Sai Sampanna, Station Rd,
Vikhroli East, Mumbai, 400 083
+91 22 25740844 / 45

S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

Mumbai | Ahmedabad | New Delhi

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

### PROJECT TITLE

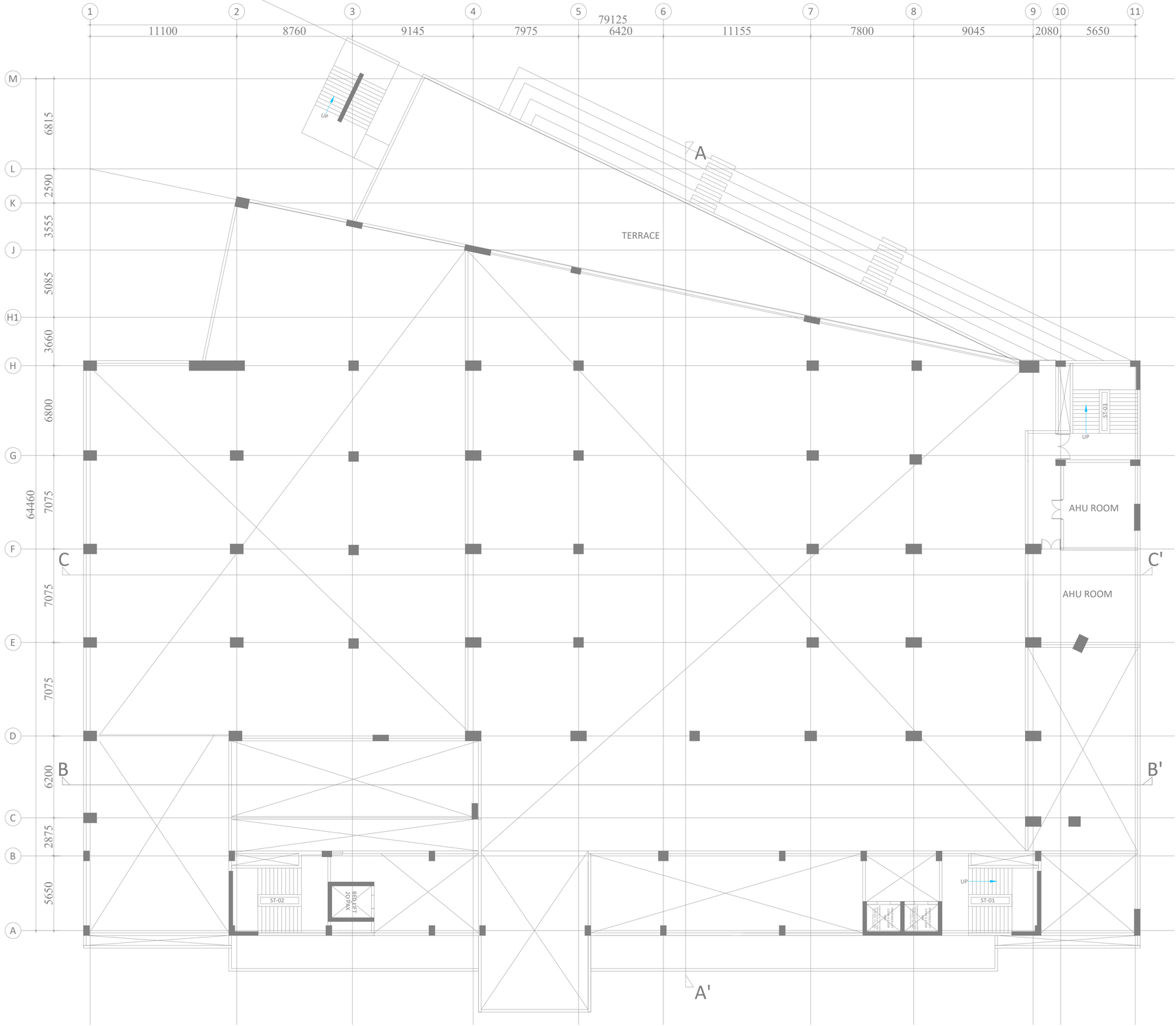
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

FIRST FLOOR FIRE FIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-FF-03 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | ---- JK | |
| CHECKED BY | ---- NB | |
| DRAWN BY | ---- SP | |

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FIRST MEZZANINE FLOOR LVL -

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# TENDER DRAWINGS

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## REVISIONS

| REV | DESCRIPTION | DATE |
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## KEY PLAN

## CLIENT

SPORTS AUTHORITY OF INDIA

## ARCHITECT

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+91 22 25740844 / 45

S06,6th FLOOR,ORCHID METROPOLIS,
Hauz Khas, New Delhi 110 016
+91 11 35537736

Mumbai | Ahmedabad | New Delhi

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

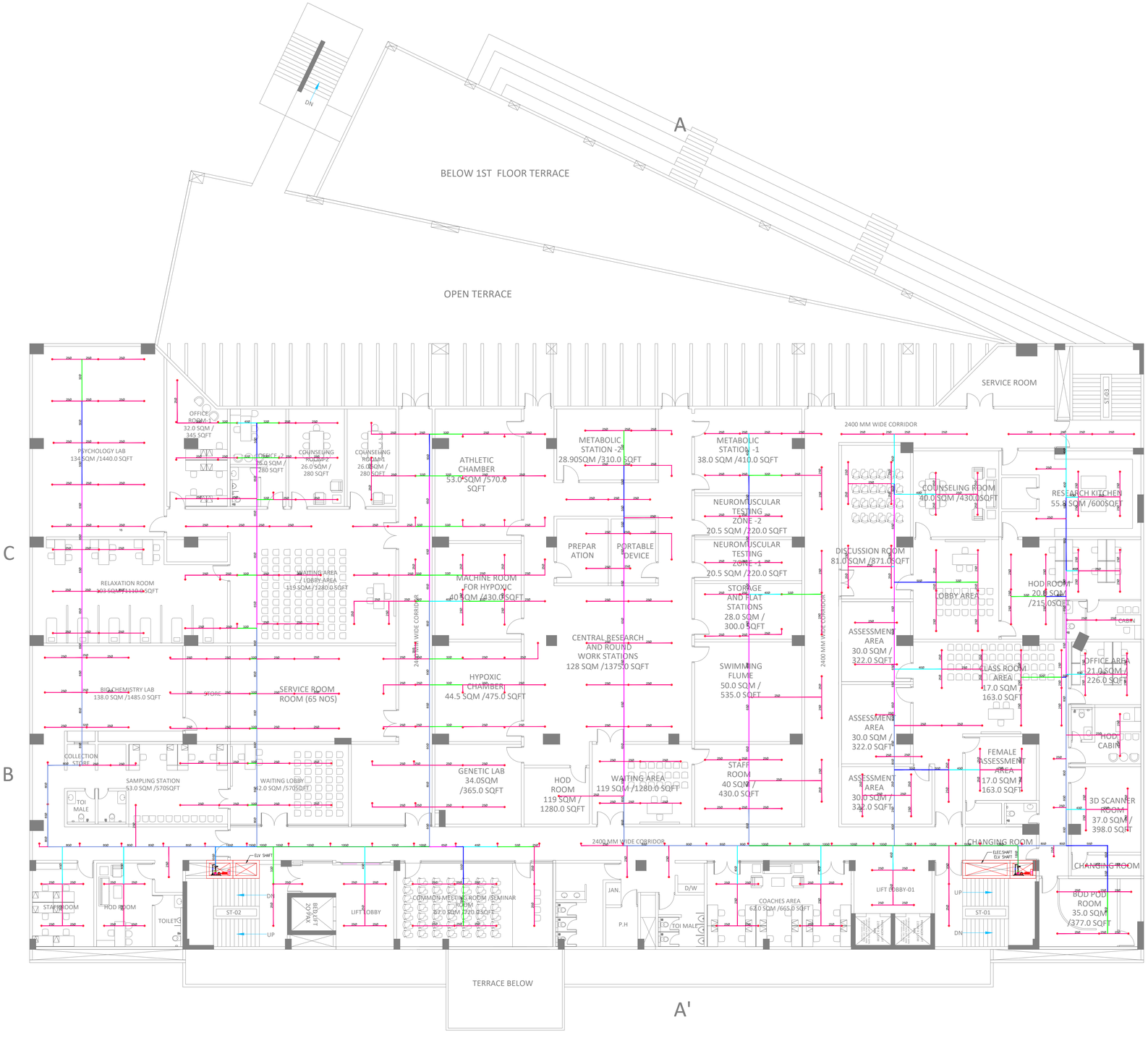
## PROJECT TITLE

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

FIRST MEZZANINE FLOOR FIRE FIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-FF-04 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | ---- JK | |
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# SECOND FLOOR

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| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

### KEY PLAN

**CLIENT**

SPORTS AUTHORITY OF INDIA

**ARCHITECT**

collage design
Mumbai | Ahmedabad | New Delhi
Collage Design Pvt Ltd
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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

**PROJECT TITLE**

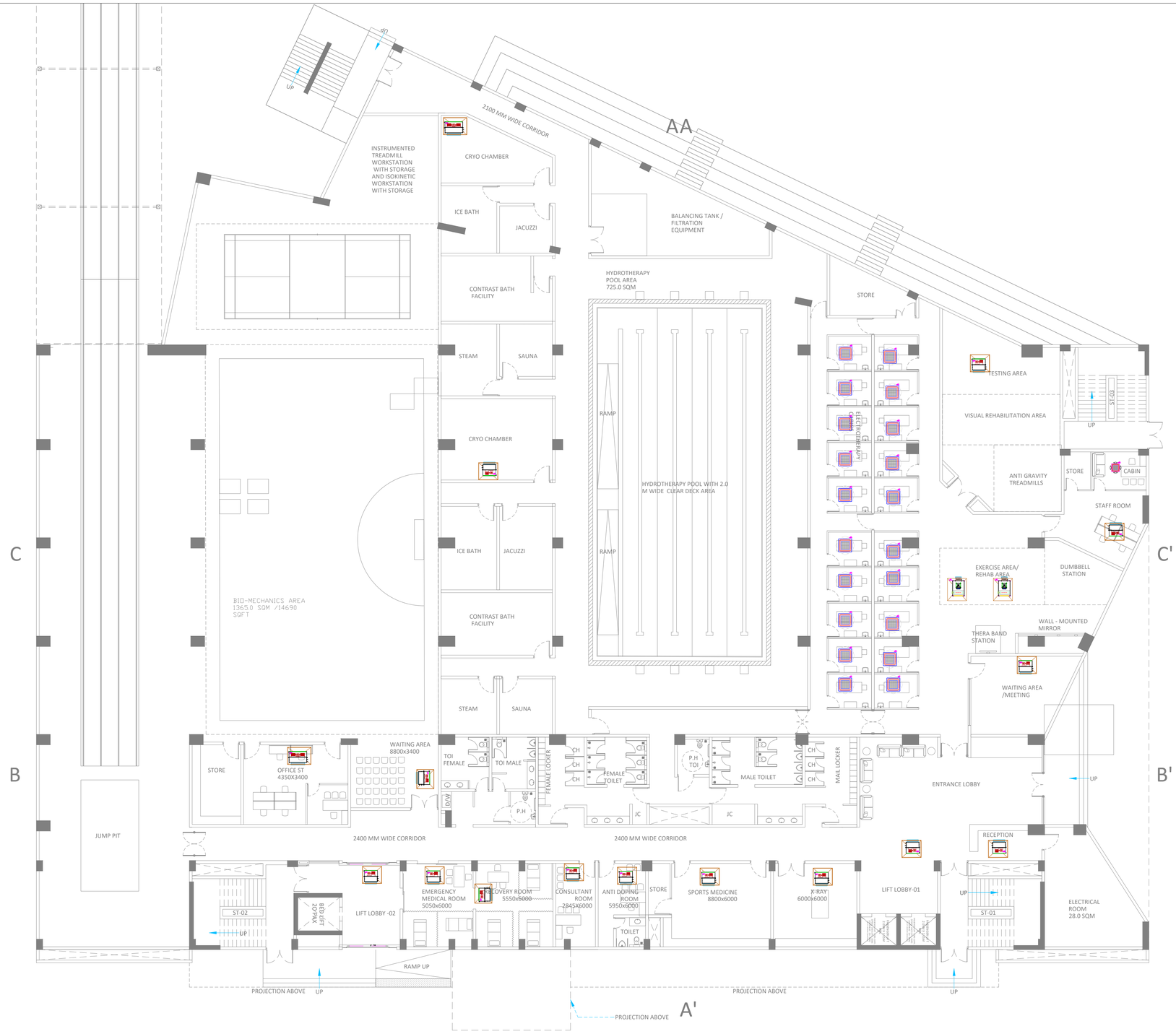
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

**DRAWING TITLE**

SECOND FLOOR FIRE FIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-FF-05 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | ---- JK | |
| CHECKED BY | ---- NB | |
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GROUND FLOOR LVL-4054.5 SQM

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## ARCHITECT

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+91 11 35537736

Mumbai | Ahmedabad | New Delhi

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

## PROJECT TITLE

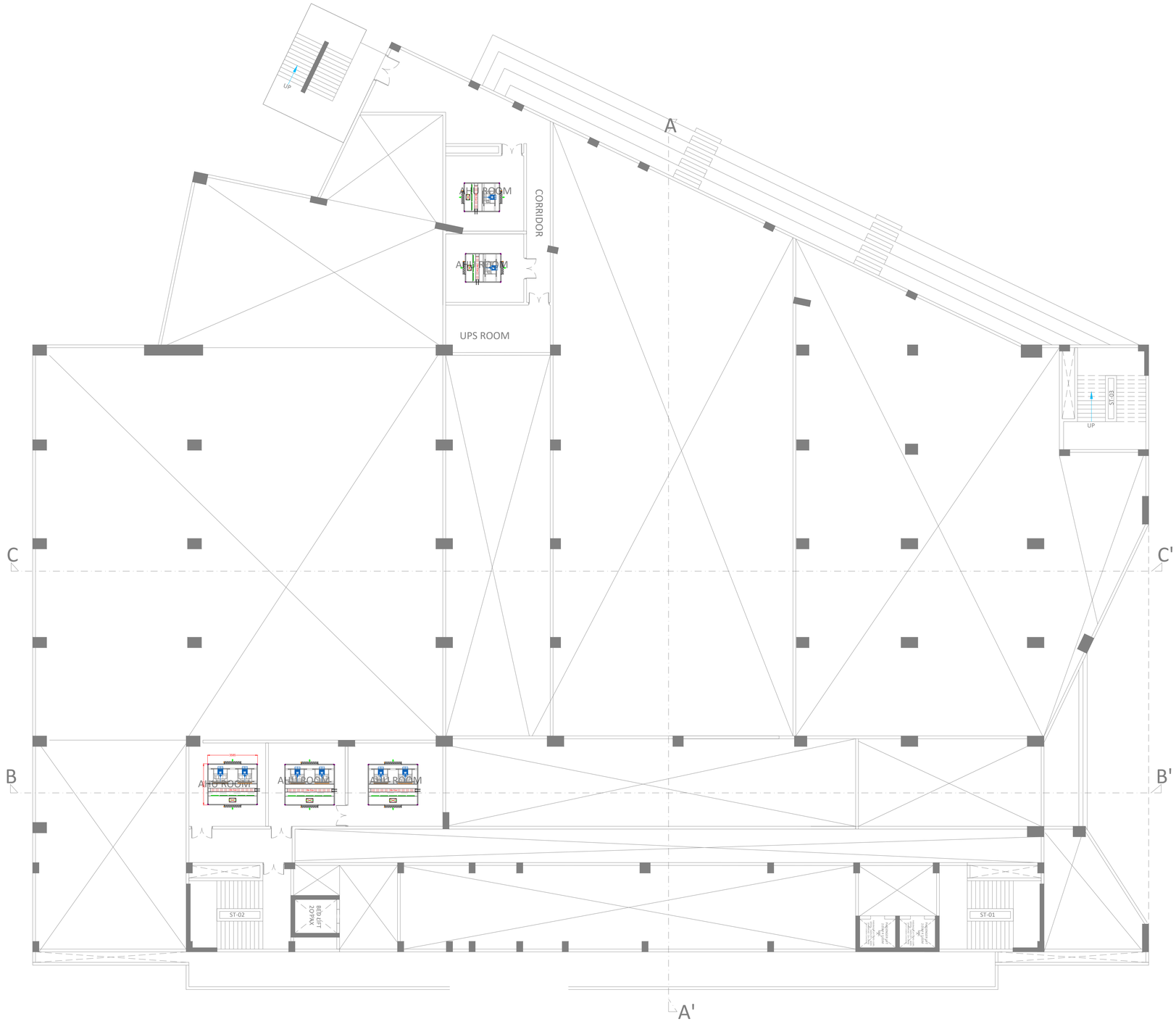
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

GROUND FLOOR HVAC LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-HVAC-01 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | ---- JK | |
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# GROUND MEZZANINE FLOOR LVL

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### ARCHITECT

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

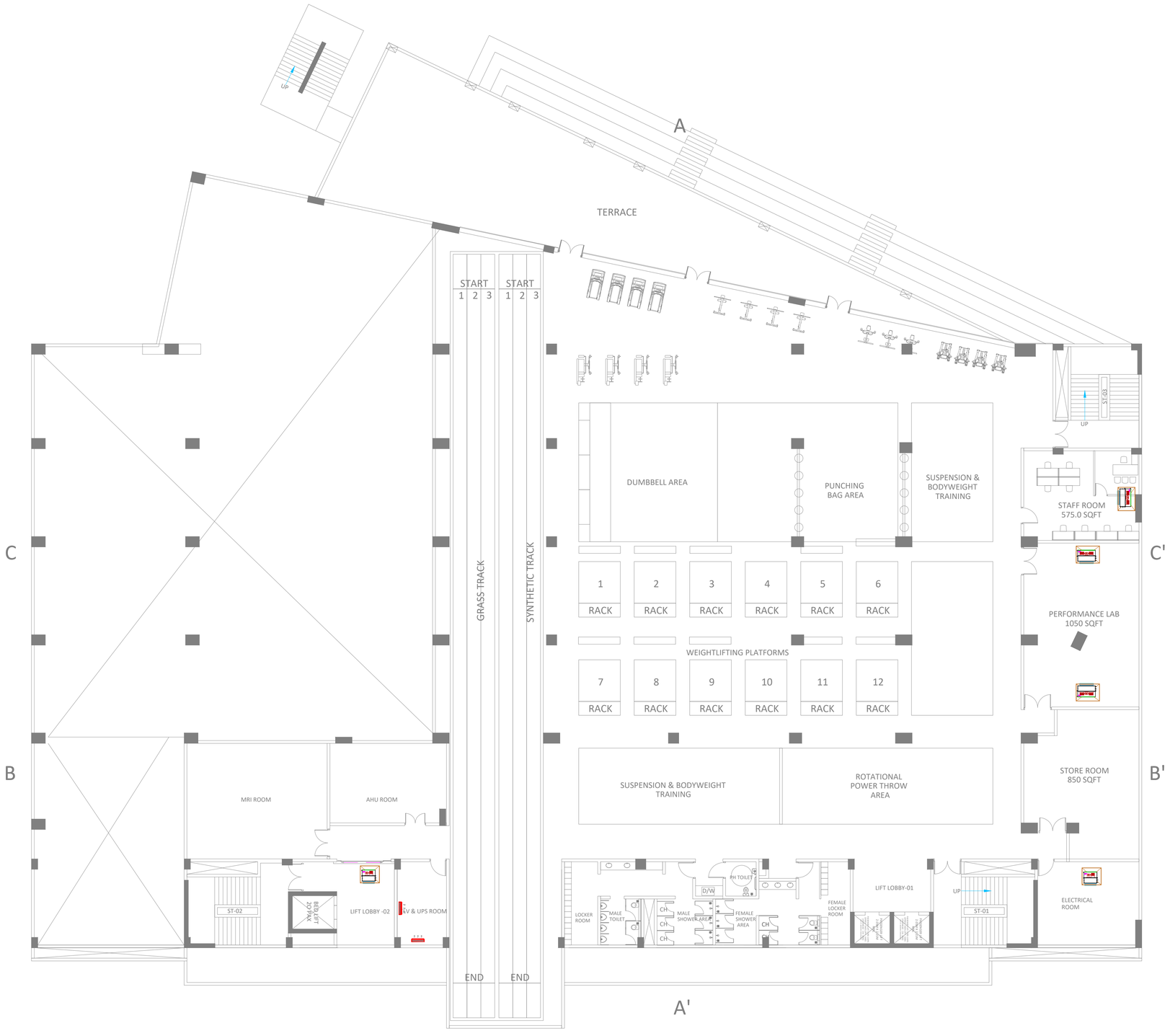
### PROJECT TITLE

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

GROUND MEZZANINE FLOOR HVAC LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-HVAC-02 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
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# FIRST FLOOR

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### KEY PLAN

### CLIENT

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### ARCHITECT

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

### PROJECT TITLE

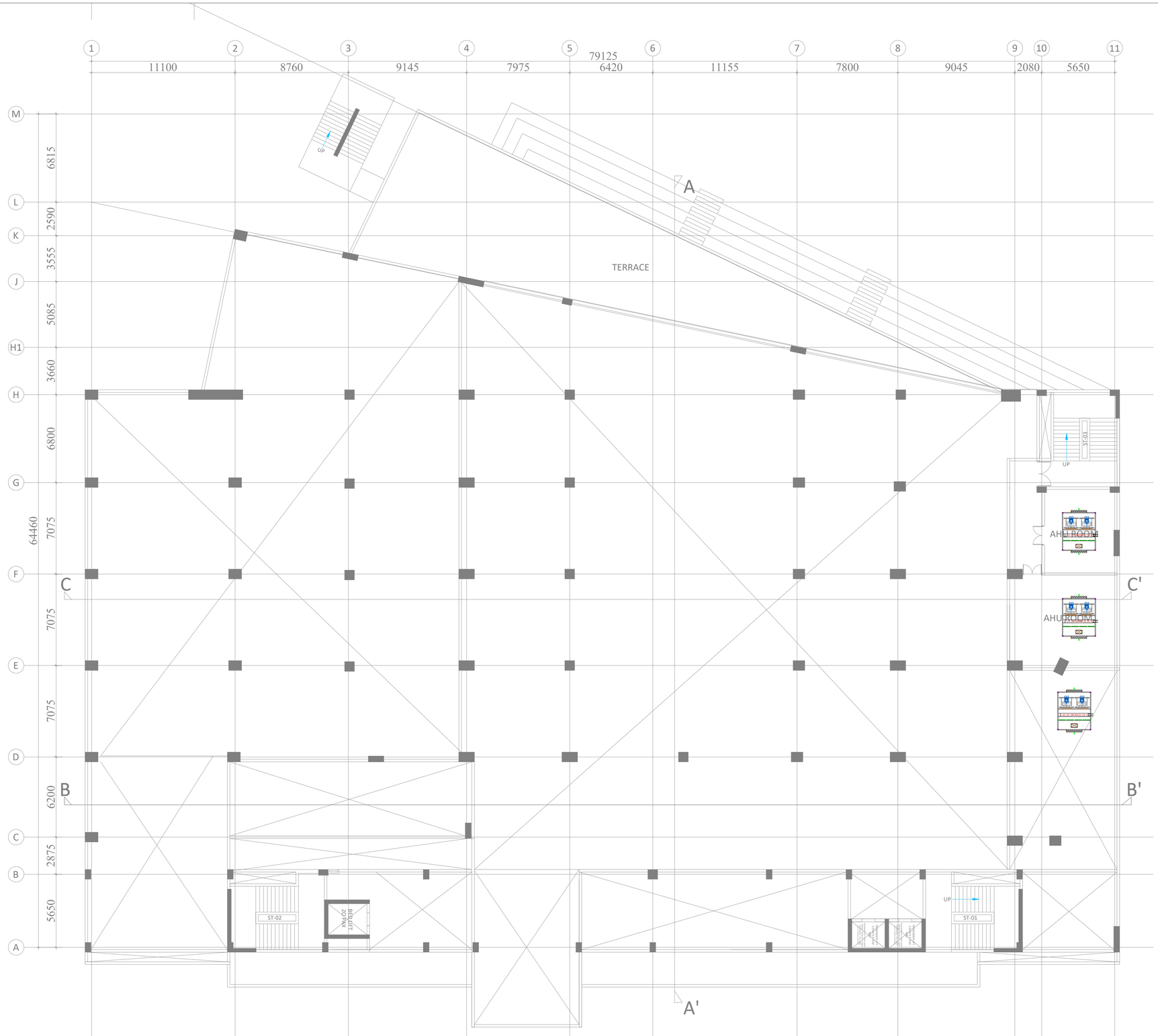
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

FIRST FLOOR HVAC LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-HVAC-03 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | N |
| APPROVED | ---- JK | |
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FIRST MEZZANINE FLOOR LVL -

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Hauz Khas, New Delhi 110 016
+91 11 35537736

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

### PROJECT TITLE

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

FIRST MEZZANINE FLOOR FIRE FIGHTING LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-FF-04 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1ST ISSUED ON | 26-09-2025 | |
| APPROVED | ---- JK | |
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# SECOND FLOOR

## TENDER DRAWINGS

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+91 11 35537736

Mumbai | Ahmedabad | New Delhi

| CLIENT | ARCHITECT | STRUCTURAL |
|---|---|---|
| | | |

### PROJECT TITLE

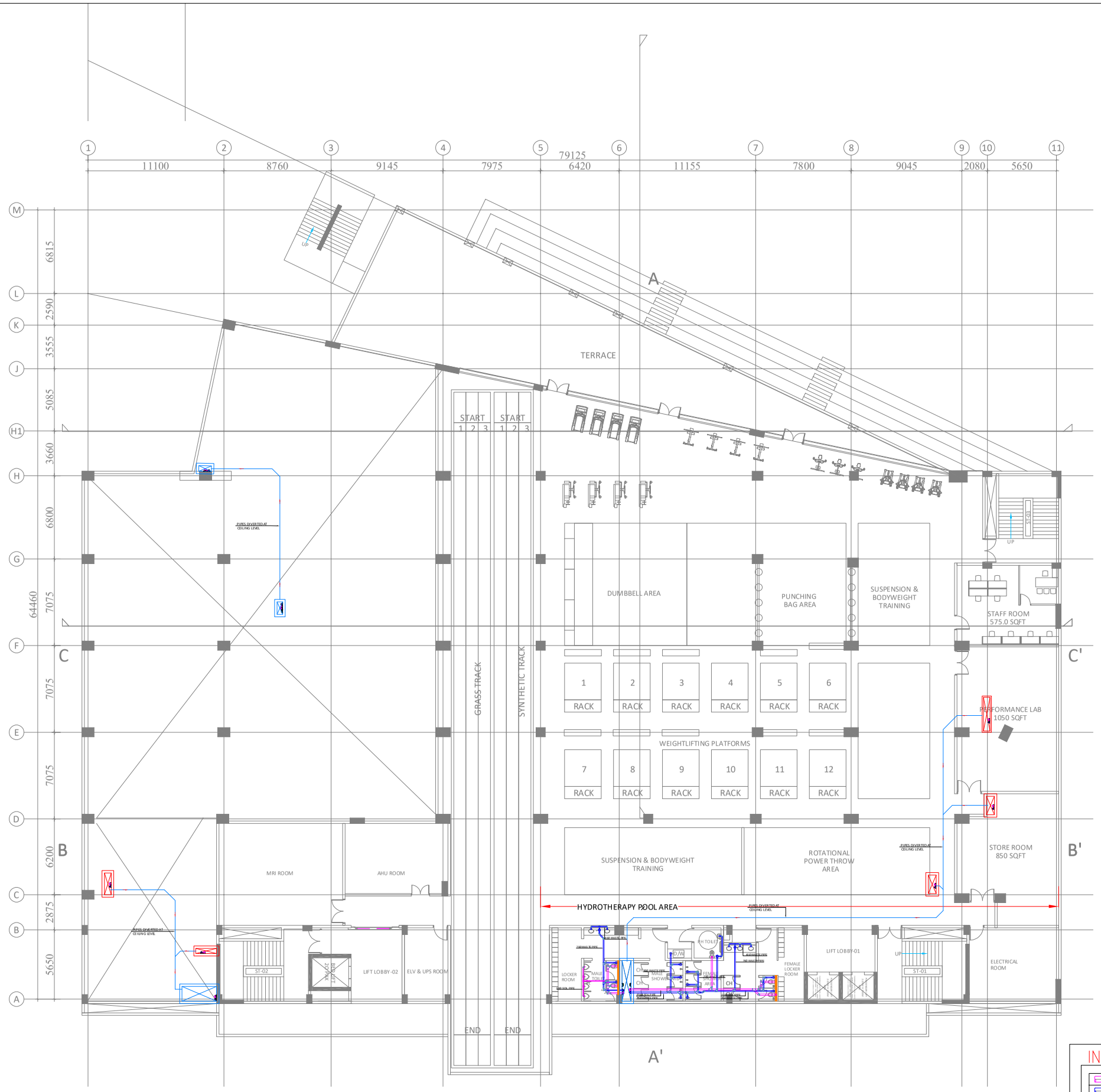
PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

SECOND FLOOR HVAC LAYOUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-HVAC-05 | | R0 |
| PROJECT NO. | 25-P388 | |
| SCALE | 1:150 | NORTH |
| 1st ISSUED ON | 26-09-2025 | N |
| APPROVED | ---- JK | |
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# FIRST FLOOR

## INTERNAL DRAINAGE LEGEND

| | |
|---|---|
| | SOIL PIPE |
| | WASTE PIPE |
| | SOIL PIPE (VERT) |
| | WASTE PIPE (VERT) |
| | ANTISYPHONE (VENT) PIPE (VERT) |
| | 'P' TRAP |
| | NHANI TRAP |
| | MULTI NHANI TRAP |
| | PLUMBING SHAFT |

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| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | ISSUED FOR TENDER | 26-09-2025 |

### KEY PLAN

### ARCHITECT

collage design
ARCHITECTURE | INTERIORS | PMC
COLLAGE DESIGN PVT. LTD
300, Sai Sampanna, Station Rd
Vikhroli East, Mumbai 400 083
+91 22 2574 0842 / 43 / 44 / 45
www.collagedesign.net

### CLIENT

SAI SPORTS AUTHORITY OF INDIA

### MEP CONSULTANT

MEPCON
902, Kamdhenu Business Bay,
Near Infinity BMW Show Room
Juinagar, Navi Mumbai,
Maharashtra-400706.

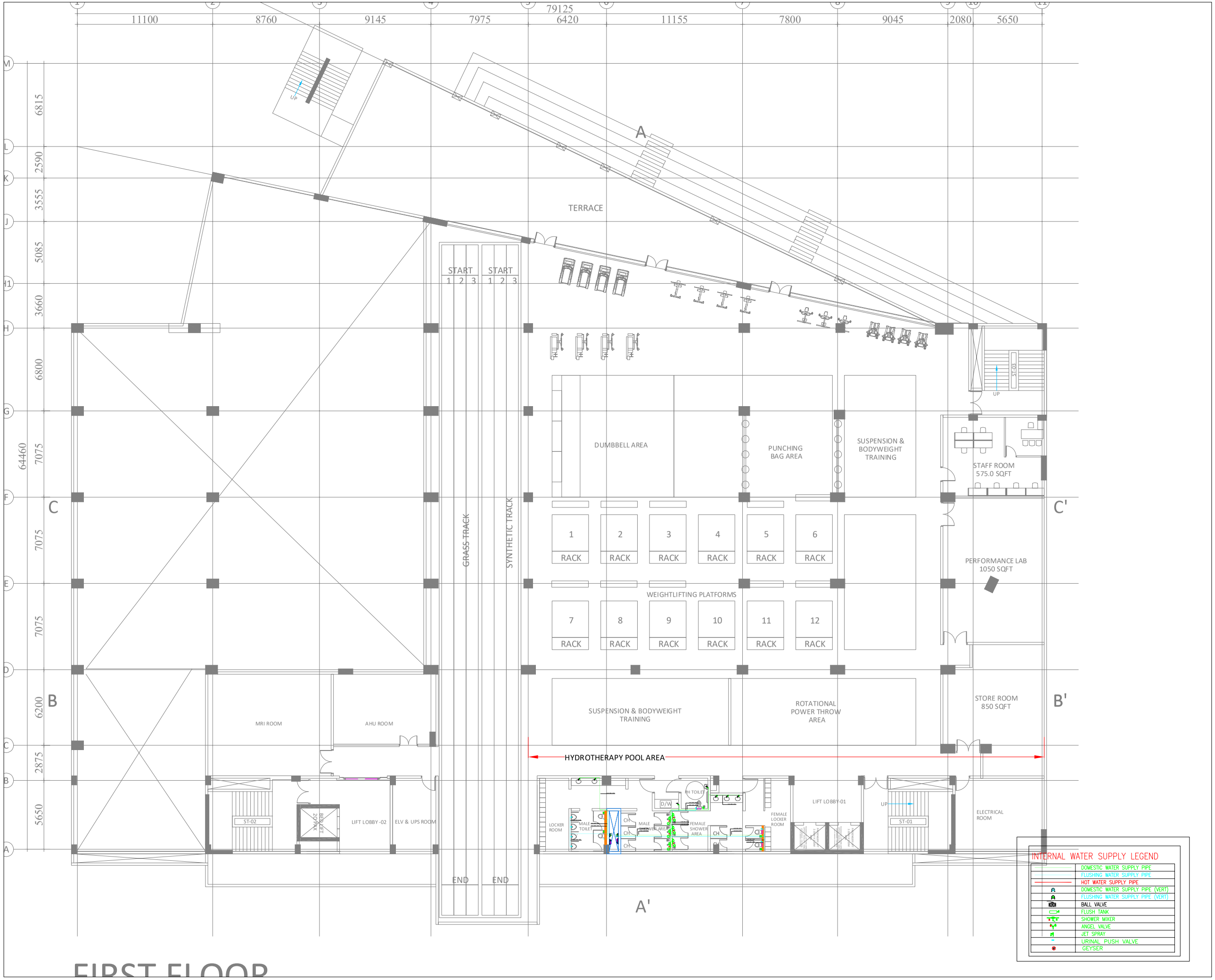
### PROJECT

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

FIRST FLOOR DRAINAGE LAYPUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-PL-DR-03 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | NTS | NORTH |
| ISSUED ON | 26.09.2025 | |
| APPROVED BY | JK | |
| CHECKED BY | NB | |
| DRAWN BY | AS | |




# FIRST FLOOR

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### KEY PLAN

### ARCHITECT

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300, Sai Sampanna, Station Rd
Vikhroli East, Mumbai 400 083
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www.collagedesign.net
ARCHITECTURE | INTERIORS | PMC

### CLIENT

SPORTS AUTHORITY OF INDIA

### MEP CONSULTANT

902, Kamdhenu Business Bay,
Near Infinity BMW Show Room
Juinagar, Navi Mumbai,
Maharashtra-400706.

### PROJECT

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

FIRST FLOOR WATER SUPPLY LAYPUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-PL-WS-07 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | NTS | NORTH |
| ISSUED ON | 26.09.2025 | |
| APPROVED BY | JK | |
| CHECKED BY | NB | |
| DRAWN BY | AS | |

# TENDER DRAWINGS

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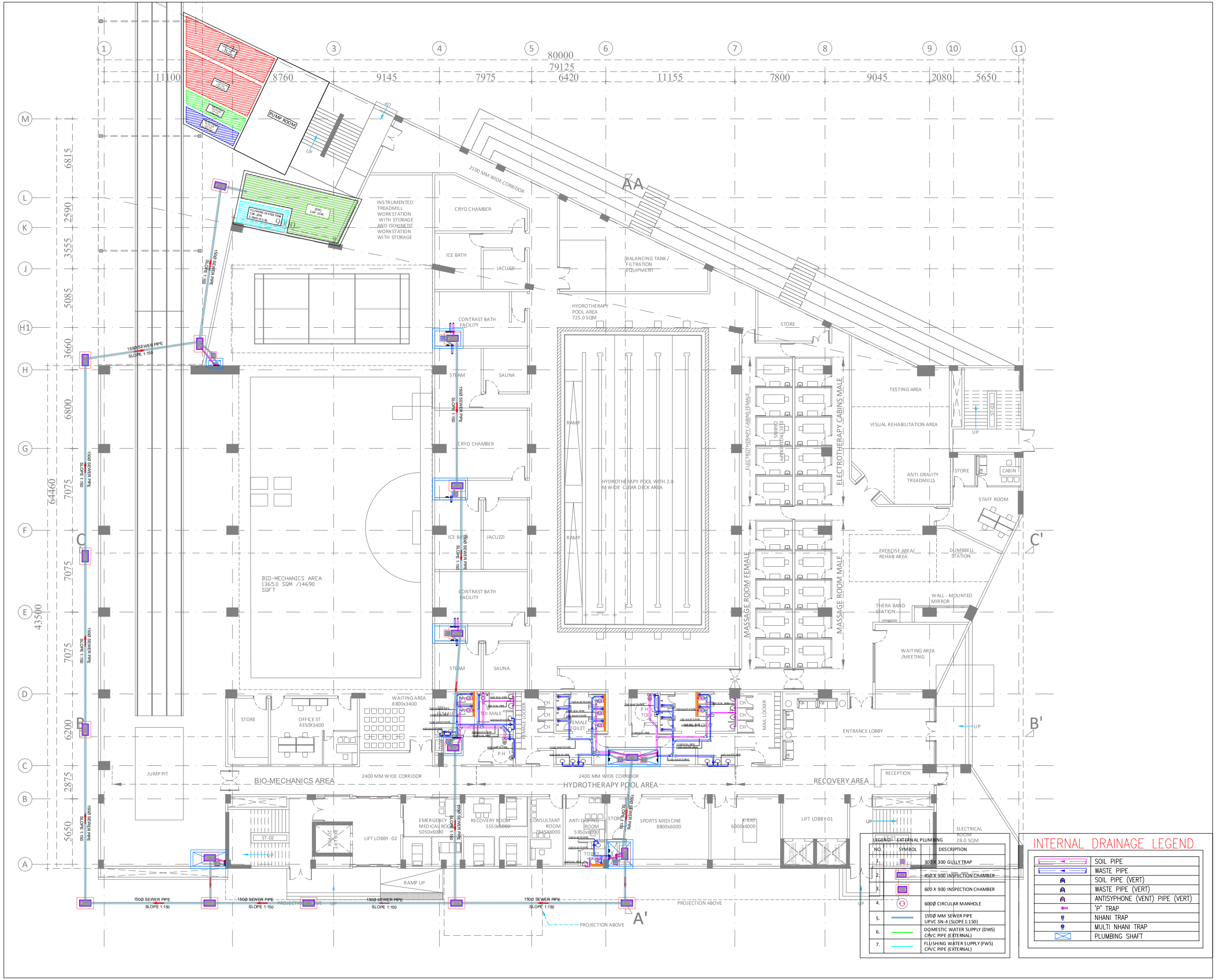
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|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN




| LEGEND - EXTERNAL PLUMBING | | |
|---|---|---|
| NO. | SYMBOL | DESCRIPTION |
| 1. | | 300 X 300 GULLY TRAP |
| 2. | | 450 X 900 INSPECTION CHAMBER |
| 3. | | 600 X 900 INSPECTION CHAMBER |
| 4. | | 600Ø CIRCULAR MANHOLE |
| 5. | | 150Ø MM SEWER PIPE UPVC SN-4 (SLOPE 1:150) |
| 6. | | DOMESTIC WATER SUPPLY (DWS) CPVC PIPE (EXTERNAL) |
| 7. | | FLUSHING WATER SUPPLY (FWS) CPVC PIPE (EXTERNAL) |

## INTERNAL DRAINAGE LEGEND

| | |
|---|---|
| | SOIL PIPE |
| | WASTE PIPE |
| | SOIL PIPE (VERT) |
| | WASTE PIPE (VERT) |
| | ANTISYPHONE (VENT) PIPE (VERT) |
| | 'P' TRAP |
| | NHANI TRAP |
| | MULTI NHANI TRAP |
| | PLUMBING SHAFT |

## ARCHITECT

collage design
ARCHITECTURE | INTERIORS | PMC
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Vikhroli East, Mumbai 400 083
+91 22 2574 0842 / 43 / 44 / 45
www.collagedesign.net

## CLIENT

SAI SPORTS AUTHORITY OF INDIA

## MEP CONSULTANT

MEPCON
902, Kamdhenu Business Bay,
Near Infinity BMW Show Room
Juinagar, Navi Mumbai,
Maharashtra-400706.

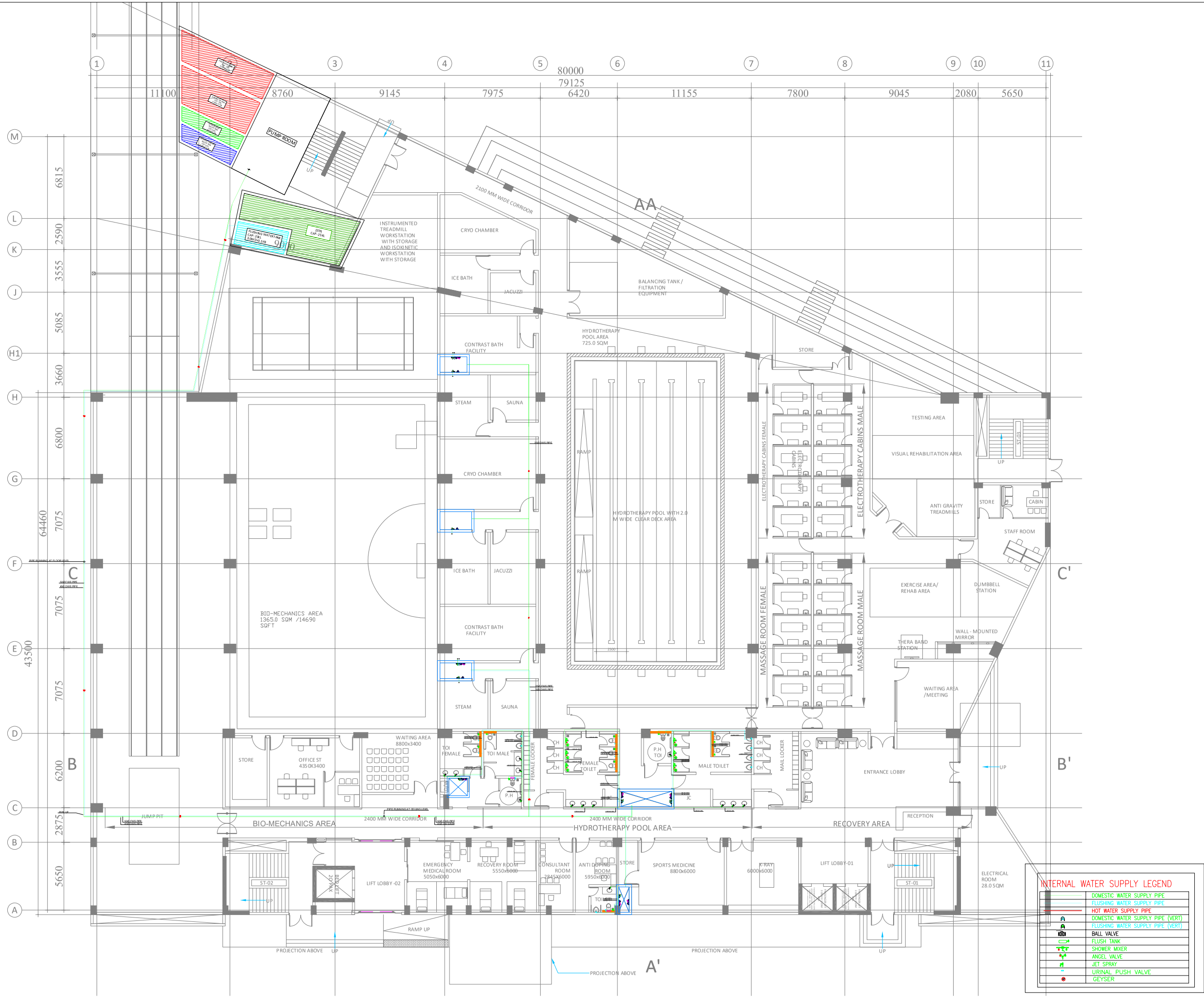
## PROJECT

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

GROUND FLOOR DRAINAGE LAYPUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-PL-DR-01 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | NTS | NORTH |
| ISSUED ON | 26.09.2025 | |
| APPROVED BY | JK | |
| CHECKED BY | NB | |
| DRAWN BY | AS | |




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## REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

## KEY PLAN

## ARCHITECT

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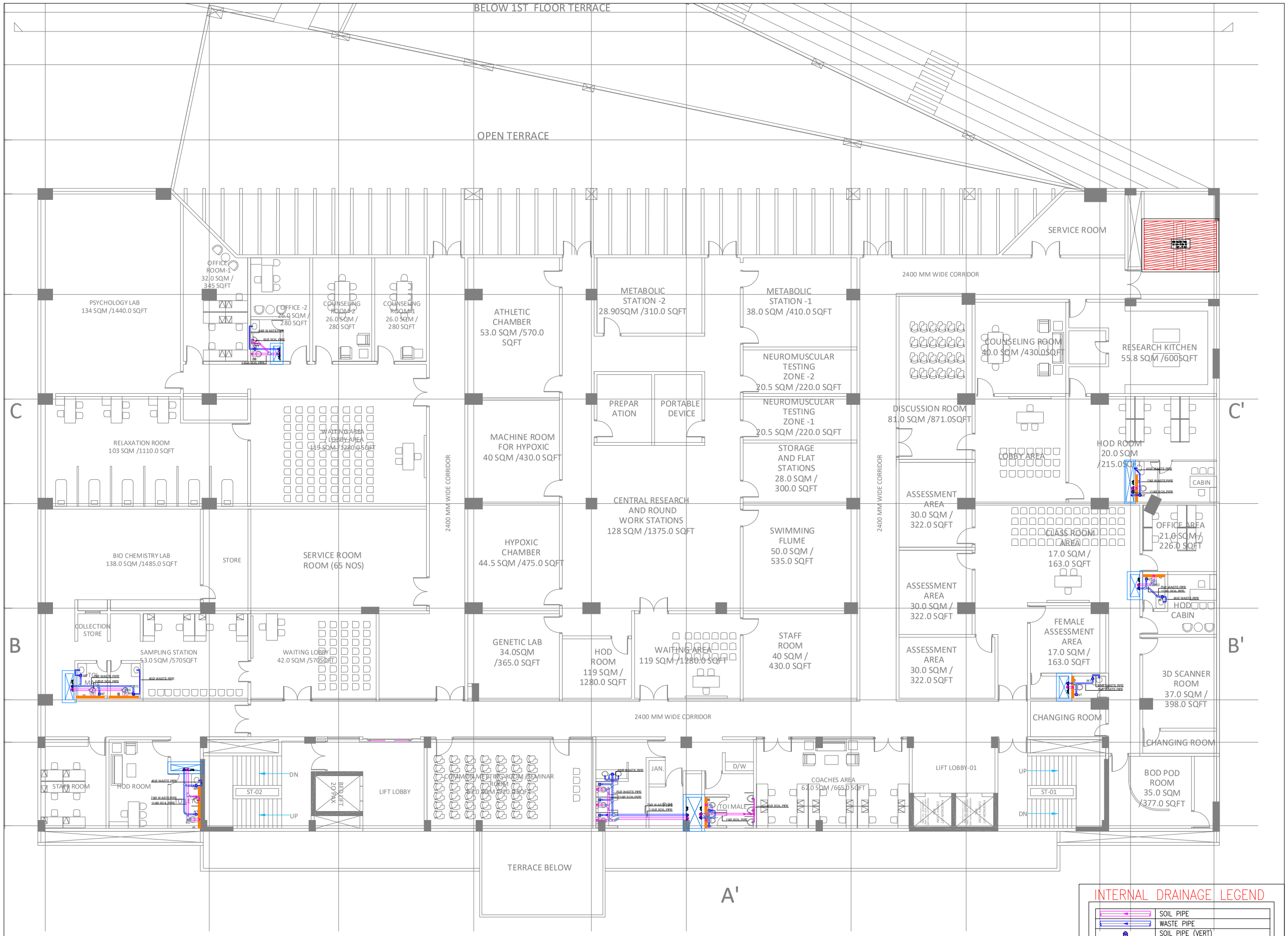
## PROJECT

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

## DRAWING TITLE

GROUND FLOOR WATER SUPPLY LAYPUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-PL-WS-06 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | NTS | NORTH |
| ISSUED ON | 26.09.2025 | |
| APPROVED BY | JK | |
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# SECOND FLOOR

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### REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

### KEY PLAN

### ARCHITECT

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### CLIENT

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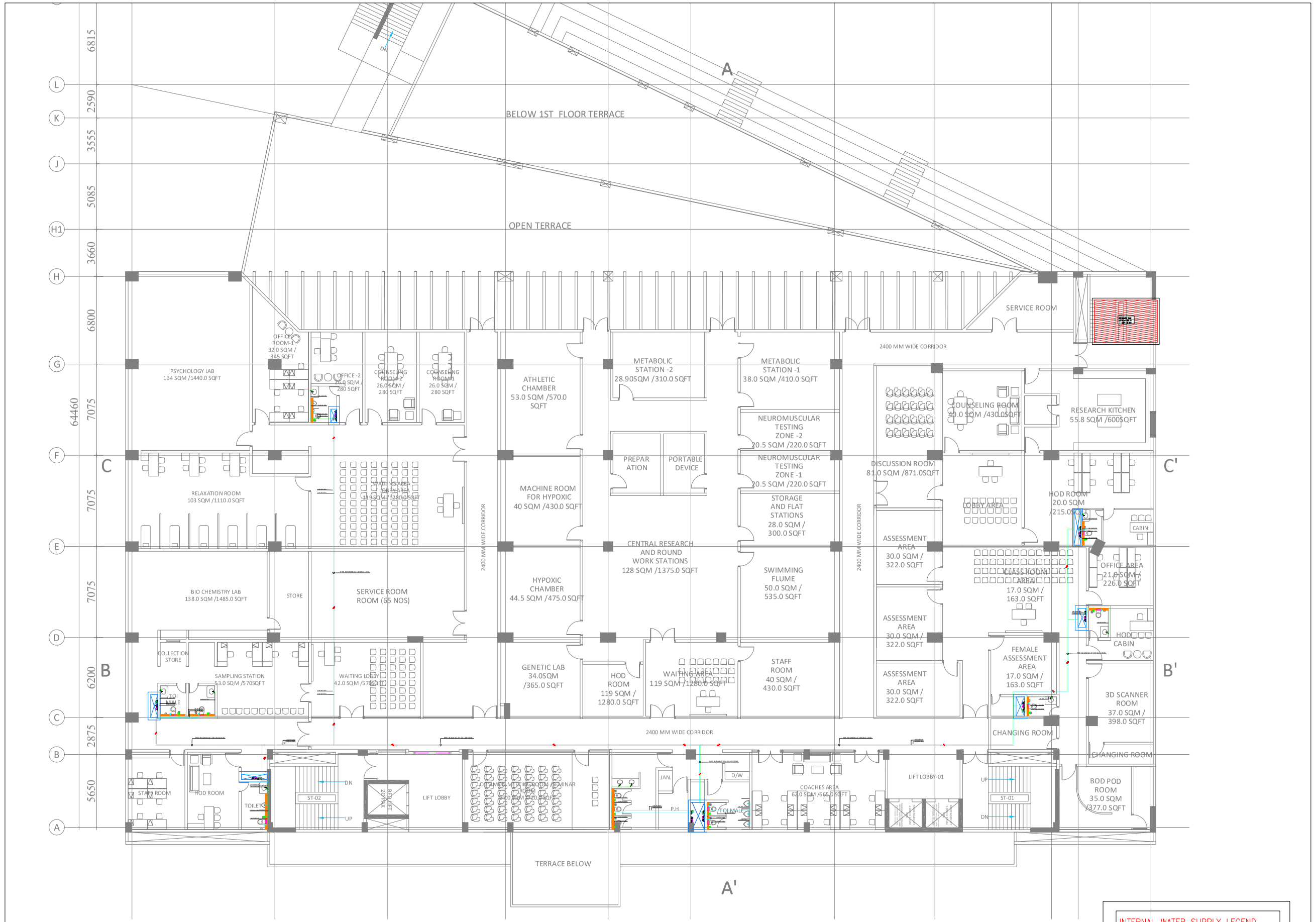
### PROJECT

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

SECOND FLOOR DRAINAGE LAYPUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-PL-DR-05 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | NTS | NORTH |
| ISSUED ON | 26.09.2025 | |
| APPROVED BY | JK | |
| CHECKED BY | NB | |
| DRAWN BY | AS | |




# SECOND FLOOR

INTERNAL WATER SUPPLY LEGEND

| | |
|---|---|
| | DOMESTIC WATER SUPPLY PIPE |
| | FLUSHING WATER SUPPLY PIPE |
| | HOT WATER SUPPLY PIPE |
| | DOMESTIC WATER SUPPLY PIPE (VERT) |
| | FLUSHING WATER SUPPLY PIPE (VERT) |
| | BALL VALVE |
| | FLUSH TANK |
| | SHOWER MIXER |
| | ANGEL VALVE |
| | JET SPRAY |
| | URINAL PUSH VALVE |
| | GEYSER |

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### REVISIONS

| REV | DESCRIPTION | DATE |
|---|---|---|
| R0 | FIRST ISSUE | 26-09-2025 |

### KEY PLAN

Signature Not Verified
Digitally signed by kailash chand meena
Date: 2025.11.12 16:08:24 IST
Location: eProcure-EPROC

### ARCHITECT

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### PROJECT

PROPOSED HIGH PERFORMANCE CENTRE AT SAI NSSC BANGALORE

### DRAWING TITLE

SECOND FLOOR WATER SUPPLY LAYPUT

| DWG. NO. | | REV. NO. |
|---|---|---|
| MEP-HPC-PL-WS-08 | | R0 |
| PROJECT NO. | 24-P370 | |
| SCALE | NTS | NORTH |
| ISSUED ON | 26.09.2025 | |
| APPROVED BY | JK | |
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