



Bhopal Smart City Development Corporation Limited

REQUEST
FOR
PROPOSAL

May 2017

“Construction of Multistory ‘F Type’ and ‘G Type’ Government Houses Including Internal Electrification, Plumbing, Fire Fighting and ICT under Smart City Project”

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SECTION-1

NOTICE INVITING TENDER

Bhopal Smart City Development Corporation Limited
NOTICE INVITING e-TENDER (NIT)

BSCDCL invites online percentage rate /item rate tender as per schedule as under:

Tendering Document No.	:	MPBSCDCL/TENDER NO -28
Name of the Work	:	“Construction of Multistory ‘F Type’ and ‘G Type’ Government Houses Including Internal Electrification, Plumbing, Fire Fighting and ICT under Smart City Project”
Brief Scope of Work	:	Construction of Multistory Houses, Internal Electrification, Plumbing, Fire Fighting and ICT under Smart City Project.
Estimated Cost	:	Rs. 204.67 Crore (Two hundred four crore sixty seven lakhs only)
Period of Completion	:	(24 Months including raining season for construction) and (36 Months for O&M After commissioning of building)
Earnest Money Deposit	:	Rs. 50,00,000/- (Fifty lakhs rupees only)
Non-refundable cost of e- Tender Document	:	Rs. 50,000/- (Fifty Thousand rupees only)
Purchase of Tender Start Date	:	16/05/2017 17:30 Hrs
Purchase of Tender End Date	:	14/06/2017 17:30 Hrs
Last date & time of submission of Online Tender(Bid Submission)	:	15/06/2017 17:30 Hrs
Period during which hard copy of the documents as per NIT shall be submitted.(With all technical credentials)	:	19/06/2017 12:00 Hrs
Date & Time of Opening of technical Tender	:	19/06/2017 15:00 Hrs
Date & Time of Opening of Financial Tender	:	Will be intimated later to successful Bidder
Validity of offer	:	90 days from the date of opening of price bid.
Pre-Tender Meeting & Venue	:	30/05/2017 at 12.00 Hrs. At BSCDCL, Bhopal Office

The tender document can be downloaded from www.mpeproc.gov.in **“Corrigendum, if any, would appear only on the www.mpeproc.gov.in web site and not to be published in any News Paper”**.

The tenderer if required may submit queries in prescribed format on E-mail Id. smartcitycell@bmconline.gov.in before **29.05.2017 up to 12.00 Noon**.

S.No	Name of Bidder	Section	Clause No.	Page No.	Description of Bid Document	Queries/Suggestions/Proposed changes

ELIGIBILITY CRITERIA FOR BIDDER:

1. The Bidder shall be registered contractor in of appropriate class with the Central Govt./ State Governments or Central / State Government Undertakings
2. **The Bidder should have completed and commissioned at-least one new High-rise Building (min 30 m height) costing not less than Rs 100 Cr. within last five years and the same should be satisfactory operational.**
3. The Bidder in their own name should have satisfactorily executed the work of similar nature Semi Govt. / Govt.& Public / Private Sector Organizations in India, during **last five 7 years** ending last day of month previous to the one in which bids are invited as a prime Contractor (In case of private work TDS certificate along with agreement, completion should be submitted)

Three similar completed works of similar nature each costing not less than 40% of the estimated cost

OR

Two similar completed works of similar nature each costing not less than 50% of the estimated cost.*

OR

One completed work of similar nature of costing not less than 80 % of the estimated cost.

Similar works means Multi storied (minimum 6 storied and above) Residential Building /commercial/IT building consisting of works like RCC , Masonry, Plastering and MEP works like Electrical, Plumbing, Firefighting, Fire alarm, ventilation, BMS, as main contractor

The Bidder should demonstrate through submission of experience certificates for collective experience of handling the following disciplines of work in the above contracts:

- i. Civil Works, structural work (RCC & steel).
 - ii. Plumbing & drainage including, Rain Water Harvesting, Pumps, etc.
 - iii. Electrical Works (internal electrification and LT) i, Street Lighting.
 - iv. Fire Alarm & Fire Fighting Systems.
 - v. Forced Ventilation work.
4. The average annual financial turnover during the last 3 years ending 2016-17 should not be less than 30% of the estimated cost. To ascertain this, Bidder(s) shall furnish the financial statement (Audited balance sheet) duly certified by Chartered Accountant.
 5. Bidder should submit Client/Users Certificate of satisfaction for the work they have executed.
 6. The Bidder(s) net worth should be positive in the past years.
 7. Bidder shall have valid registration in Service Tax, VAT Registration, EPF Registration Certificate & PAN Card, TAN No.
 8. The bidder should not get black listed by any government organization (Central/State/PSU), bidder should submit affidavit signed by Director of the company.
 9. The Bidder should be ISO 9001: 2000, ISO 14001:2004, OHSAS 18001: 2007 or equivalent certified (with Bidder or subsidiary company). These are Quality Management System,

Environment Management System and Occupational Health and Safety Management Standards Respectively.

10. Joint Ventures/Consortium are not allowed

Note:-

1. The bidder should necessarily submit completion certificate of the Qualifying works from the client/user/ duly signed by an officer not below the rank of Executive Engineer or equivalent of the concerned organization
2. The Bidder shall submit the audited balance sheets for last 5 years. Provisional balance sheets shall not be permitted.
3. For the purpose of determination of turnover of the bidder, only turnover from building construction projects shall be considered. **This shall be backed by a certificate from the Statutory Auditors of the company/Chartered Accountant.** Turnover from real estate development, sale of RMC, trading or sale of flats or offices shall not be considered for evaluation.
4. For the purpose of determining the relationship of the Bidder with their group companies, only the following documents such as the Annual Report, Balance Sheet or the Auditor Certificate, shall be considered.
5. Net worth shall be calculated as the sum of share capital and free reserves and surplus. Accumulated losses if not adjusted in reserves and surplus and shown separate in the balance sheet shall be deducted from the sum of share capital and free reserves and surplus. Reserves on account of revaluation of fixed assets shall be excluded.
6. BSCDCL shall have the authority to make enquiries with the bidder's bankers and auditors.
7. The bidders shall indicate information regarding any litigation or arbitration resulting from contracts executed by the bidder in the last five years. The information shall include the name of the parties concerned, disputed amount, cause of litigation & matter in dispute.

Physical Criteria:

In case the Main Contractor is not satisfying following Physical criteria, the same shall be satisfied by appointing Nominated Subcontractor meeting the qualifying criteria

The Main Contractor should get the specialized works executed through nominated sub-contractor duly approved by the Engineer-in-charge of BSCDCL whose qualifying criteria are as mentioned in the SCC.

Evaluation Criteria

The lowest evaluated rates including O&M for three years Will be considered at the time of evaluation.

Bid Capacity:

The bid capacity of the prospective bidders will be calculated as under:

Assessed Available Bid Capacity = (A* N* 2 - B)

Where,

A = Maximum value of Civil Engineering works executed in any one year (year means Financial year) during **the last seven years** (updated to the price level of the Financial year in which bids are received at a rate of 10% per year) taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the Project/Works,

B = Value of existing commitments (only allotted works) on the last date of submission of bids as per bidding document and on-going works to be completed during the period of completion of the Project/Works for which these bids are being invited.

Note: The statement showing the value of existing commitments and on-going works as well as the stipulated period of completion remaining for each of the works listed should be attached along

with certificates duly signed by the Engineer- in- Charge, not below the rank of an Executive Engineer or equivalent.

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

made misleading or false representation in the forms, statements and attachments submitted in proof of the qualification requirements; and/or Record for poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.

Equipment Capabilities

The Bidder(s) shall deploy equipments, in full working order, as listed below, and must demonstrate that based on known commitments, they will be available for timely use in the Proposed contract. The bidder should, undertake their own studies and **furnish with their bid**, a detailed construction planning and methodology supported with assessment study of requirements of equipment/plants & machineries to allow the employer to review their proposal. The bidder will ensure his commitment to make the arrangements of the required equipment on the day of commencement or with respect to the progress of the work in phases, as per the instructions of site in charge on an undertaking on Rs.500 stamp paper to be submitted along with the Bid

Sr.no	Equipment	Minimum Requirements	
1	Concrete batching plant of adequate capacity	1 no	
2	Concrete Pump	2 nos	
3	Concrete Transit Mixer	2 nos	
4	JCB / Excavators	2 nos	
5	Tower Crane.of adequate runway	2 nos	
6	Excavator	2 nos	
7	Rock/ Concrete pneumatic breaker	2 nos	
8	Dewatering Pumps	5 nos	
9	Needle Vibrators	5 nos	
10	Plate Vibrators	5 nos	

Personnel Capability

Project shall be handled by a project manager having at least BE civil with min. 20 yr. experience in executing high rise building project. Contractor must produce documentary evident having the following staff on their establishment atleast six months prior to submission of bid and during the duration of contract and should submit undertaking stating that this staff or equivalent will be deployed on site after award of contract.

Sr.no	Post	Qualification	Minimum Numbers to be Deployed
1	Project Manager	At least BE-civil with min. 20 years experience in executing high rise building project	1 nos
2	Site Engineer	At least BE-civil with min. 10 years experience in executing high rise building project	3 nos
3	Quality Engineer	At least BE-civil with min. 08 years experience in executing high rise building project	2 no
4	Surveyor	At least BE-civil with min. 05 years experience	1 no
5	Project planning	At least BE-civil with min. 07 years experience in executing high rise	1 no

	Engineer	building project	
6	Project Billing Engineer	At least BE-civil with min. 07 years experience in executing high rise building project	2 nos
7	Electrical & mechanical Engineer	B.E. (Electrical /IT) with min.10 years experience in executing building services	2 nos
8	Supervisory Staff	DCE with minimum 5 years experience	3 nos
9	Design Manager (Graduate Engineer)	Graduate Engineer with min 10 years experience	2 nos
10	Safety Officer	Graduate or Diploma Engineer with 5 years of Experience	1 nos.

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

- (a) Made misleading or false representations in the forms, statements and attachments submitted by them which comes to the knowledge of Employer; and/ or;
- (b) Record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, financial failures, etc.

MEMORANDUM

Sl. No.	Description	Cl. No. of NIT/ITT/Clauses of Contract (CC)	Values/Description to be Applicable for Relevant Clause (S)	
1)	Name of Work		“Construction of Multistory ‘F Type’ and ‘G Type’ Government Houses Including Internal Electrification, Plumbing, Fire Fighting and ICT under Smart City Project”	
2)	Client/Owner		Bhopal Smart City Development Corporation Ltd.	
3)	Type of Tender		Online percentage rate /Item rate	
4)	Earnest Money Deposit		Rs. 50,00,000/- (Fifty lakhs rupees only)	
5)	Estimated Cost		Rs. 204.67 Crore (Two hundred four crore sixty seven lakhs only)	
6)	Time allowed for Completion of Work		(24 Months including raining season for construction) and (36 Months for O&M)	
7)	Mobilization Advance		10% of contract value	
8)	Interest Rate of Mobilization Advance		Simple Interest Rate of 10 % Percent only) (Per Annum)	
9)	Schedule of rates applicable		CPWD 2016, UADD 2012, Non Sor Items	
10)	Validity of Tender		90 (Ninety) Days	
11)	Performance Guarantee		5.00 % (Five Percent Only) of contract value within 30 days from the issue of Letter of Award	
12)	Security Deposit/Retention Money		5.00% (Five Percent Only) of the gross value of each running bill.	
13)	Time allowed for starting the work		The date of start of contract shall be reckoned from 10 days after the date of agreement.	
14)	Deviation limit beyond as per tender document except foundation.		Building work as per requirement.	Annual repair & maintenance of buildings As per requirement.
			Note:-The Deviation Limit of Building Work shall also apply for combined works(Building).	

15)	Deviation limit beyond as per tender document shall apply for Foundation		Building work as per requirement	Annual repair & maintenance of buildings as per requirement
			Note:-The Deviation Limit of Building Work shall also apply for combined works	
16)	Escalation		All rates as per Bill of Quantities (BOQ) quoted by contractor shall be firm and fixed for entire contract period as well as extended period for completion of the works. No escalation shall be applicable on this	
17)	Incentive For Early Completion		In case the contractor completes the work ahead of scheduled completion time, a bonus @ 1% (One percent) of the tendered value per month computed on per day basis, shall be payable to the contractor, subjected to a maximum limit of 5% (Five percent) of the tendered value. The amount of bonus, if payable, shall be paid along with final bill after completion of the work.	
18)	Operation and Maintenance Period		Three (3) years after successful commissioning of all Tendered works	
19)	Defects Liability Period		Three (3) years after successful commissioning of all works i.e upto completion of Operation and Maintenance period	

The intending tenderer must read the terms and conditions of BSCDCL carefully. He should only submit his tender if he considers himself eligible and he is in possession of all the documents required.

Information and Instructions for Tenderers posted on Website(s) shall form part of tender Document.

The Tender Document as uploaded can be viewed and downloaded free of cost by anyone including intending tenderer. But the tender can only be submitted after uploading the mandatory scanned documents such as:-

1. a) Proof of e-payment towards cost of tender document,
- b) Proof of online payment through e-portal www.mpeproc.gov.in/ Bank Guarantee of any Nationalized or Commercial Scheduled Bank against in favor CEO, BSCDCL of EMD & All other documents shall be as per Notice Inviting e-tender.

List of Documents to be scanned and uploaded within the period of tender submission:

- a. Proof of online payment / Bank Guarantee of any Nationalized or all Commercial Scheduled Bank against EMD in favor of CEO, BSCDCL.

- b. Copy of documents related to qualifying requirement of bidders as per NIT clause.
- c. Letter of Acceptance of tender condition unconditional as per format enclosed
- d. Certificate of Financial Turnover duly certified by CA as indicated above.
- e. Valid service tax registration, EPF registration, VAT registration, Sales Tax registration, PAN No, TAN No
- f. Acknowledgement towards cost of tender fee submission
- g. All pages of all the Corrigendum (if any) duly signed by the authorized person.
- h. Affidavit as per "Appendix-O" of tender document.
- i. Acceptance letter and Affidavit/Undertaking for Blacklisting/ Debar.
- j. Should submit the list of tools plant and machinery.

If any condition or conditional rebate is offered by the tenderer, their tender shall summarily be rejected.

The tenderers are required to quote strictly as per terms and conditions, specifications, standards given in the tender documents and not to stipulate any deviations.

After submission of the tender the tenderer can re-submit revised tender any number of times but before last time and date of submission of tender as notified.

When it is desired by BSCDCL to submit revised financial tender then it shall be mandatory to submit revised financial tender. If not submitted then the tender submitted earlier shall become invalid. On opening date, the tenderer can login and see the tender opening process. Contractor can upload documents in the form of JPG format and PDF format.

Contractor to upload scanned copies of all the documents including valid service tax registration/EPF registration/VAT registration/Sales Tax registration, PAN NO. As stipulated in the tender document.

If the contractor is found ineligible after opening of tenders, his tender shall become invalid and cost of tender document and processing fee shall not be refunded.

If any discrepancy is noticed between the documents as uploaded at the time of submission of tender and hard copies as submitted physically by the contractor the tender shall become invalid and cost of tender document and processing fee shall not be refunded.

Notwithstanding anything stated above, BSCDCL reserves the right to assess the capabilities and capacity of the tenderer to perform the contract, in the overall interest of BSCDCL. In case, tenderer's capabilities and capacities are not found satisfactory, BSCDCL reserves the right to reject the tender.

Instructions for financial bid submission-

In case of Percentage Rate Tender, Contractor must ensure to quote single percentage rate in attached financial bid format. Quote should be in percentage higher or below on the SOR Rates the same is to quoted in the form of decimal only. For example if contractor wants to quote 5 percent higher then he have to quote 1.05 and if he wants to quote 5 [percent below he have to quote 0.95 in given column of financial bid sheet.

In case of Item Rate Tender, price shall be entered against each item in the Bill of Quantities / Schedule of Quantities. The cost of item against which the contractor has failed to enter a rate or price shall be deemed to be covered by rates and prices of other items in Bill of Quantities / Schedule of Quantities and no payment shall be made for the quantities executed for items against which rate has not been quoted by the

contractor.

In addition to this, while selecting any of the cells a warning appears that if any cell is left blank the same shall be treated as "0". Therefore, if any cell is left blank and no rate is quoted by the tenderer, rate of such item shall be treated as "0" (ZERO).

- i. Financial Bid format is uploaded in Excel Format in www.mpeproc.gov.in. At the time of financial bidding, bidder is requested to download the file, and update the same.
- ii. For SOR items bidder need to quote 1 plus percentage higher of below the quoted rate for example if bidder wants to quote 5% higher the SOR price then he have to quote 1.05 and similarly if he wants to quote 5% below the SOR price then he have to quote 0.95.
- iii. For Non SOR items bidder can quote for individual item rates in respective financial bid sheet.
- iv. Bidders are requested to check final figure in all the totals of all sheets. BSCDCL is not responsible for errors in the financial bid document.
- v. Bidders are required to upload the updated financial bid in the prescribed excel format in the www.mpeproc.gov.in at the time of final financial bid submission.

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SECTION-2

INSTRUCTIONS TO TENDERER

Instruction to Tenderer (ITT)

A. GENERAL INSTRUCTIONS:

2.1. General terms of Bidding-

2.1.1 No Bidder shall submit more than one BID for the Project.

2.1.2 The Feasibility Report / Preliminary Project Report of the Project has been assessed however the Bidders are expected to carry out their own surveys, investigations and other Preliminary examination of the Project before submitting their Bids. Nothing contained in the attached drawings/BOQ shall be binding on the BSCDCL nor confer any right on the Bidders, and the BSCDCL shall have no liability whatsoever in relation to or arising out of any or all contents of TENDER.

2.1.3 Notwithstanding anything to the contrary contained in this RFP, the Preliminary terms specified in the draft Agreement shall have overriding effect; provided, however, that any conditions or obligations imposed on the Bidder hereunder shall continue to have effect in addition to its obligations under the Agreement.

2.1.4 The BID shall be furnished in the format exactly as per financial bid format. Technical Bid and Financial Bid. BID amount shall be indicated clearly in both figures and words, in Indian Rupees in prescribed format of Financial Bid and it will be signed by the Bidder's authorized signatory. In the event of any difference between figures and words, the amount indicated in words shall be taken into account.

2.1.5 The Bidder shall deposit a BID Security (EMD) of (Rs. 50,00,000/- Fifty lakhs rupees only) in accordance with the provisions of this RFP. The Bidder has to provide the BID Security (EMD) through online payment or in the form of a Bank Guarantee acceptable to the BSCDCL, as per format.

2.1.6 The validity period of the Bank Guarantee, shall not be less than 180 (one hundred and eighty) days from the BID Due Date, inclusive of a claim period of 60 (Sixty) days, and may be extended as may be mutually agreed between the BSCDCL and the Bidder.

2.1.7 The BID shall be summarily rejected if it is not accompanied by the BID Security. The BID Security shall be refundable no later than 150 (one hundred and fifty) days from the BID Due Date except in the case of the Selected Bidder whose BID Security shall be retained till it has provided a Performance Security under the Agreement.

2.1.8 The Bidder should submit a Power of Attorney as per the format, authorizing the signatory of the BID to commit the Bidder.

2.1.9 Any condition or qualification or any other stipulation contained in the BID shall render the BID liable to rejection as a non-responsive BID.

2.1.10 The BID and all communications in relation to or concerning the Bidding Documents and the BID shall be in English language.

2.1.11 The documents including this RFP and all attached documents, provided by the BSCDCL are and shall remain or become the property of the BSCDCL and are Transmitted to the Bidders solely for the purpose of preparation and the submission of a BID in accordance herewith. Bidders are to treat all information as

strictly confidential and shall not use it for any purpose other than for preparation and submission of their BID.

- 2.1.12 The provisions of this Clause shall also apply mutatis mutandis to BIDs and all other documents submitted by the Bidders, and the BSCDCL will not return to the Bidders any BID, document or any information provided along therewith.
- 2.1.13 This RFP is not transferable.
- 2.1.14 Any award of Project pursuant to this RFP shall be subject to the terms of Bidding Documents and also fulfilling the criterion as mentioned in tender document.
- 2.1.15 While bidding is open to persons from any country, the following provisions shall apply then the Eligibility of such Bidder shall be subject to approval of the BSCDCL from national security and public interest perspective. The decision of the BSCDCL in this behalf shall be final and conclusive and binding on the Bidder. The holding or acquisition of equity or control, as above, shall include direct or indirect holding/ acquisition, including by transfer, of the direct or indirect legal or beneficial ownership or control, by persons acting for themselves or in concert and in determining such holding or acquisition, the BSCDCL shall be guided by the principles, precedents and definitions contained in the Securities and Exchange Board of India (Substantial Acquisition of Shares and Takeovers) Regulations, 1997, or any substitute thereof, as in force on the date of such acquisition. The Bidder shall promptly inform the BSCDCL of any change in the shareholding, as above, and failure to do so shall render the Bidder liable for disqualification from the Bidding Process.
- 2.1.17 Notwithstanding anything to the contrary contained herein, in the event that the Bid Due Date falls within three months of the closing of the latest financial year of a Bidder, it shall ignore such financial year for the purposes of its Bid and furnish all its information and certification with reference to the 5 (five) years or 1 (one) year, as the case may be, preceding its latest financial year. For the avoidance of doubt, financial year shall, for the Purposes of a Bid hereunder, mean the accounting year followed by the Bidder in the course of its normal business.
- 2.1.18 Any entity which has been barred by GOI or Govt. of Madhya Pradesh for the works of expressways, National highways, and the bar subsists as on the Bid Due Date, would not be eligible to submit the BID, bidder need to submit Affidavit regarding the same.
- 2.1.19 The BSCDCL reserves the right to reject an otherwise eligible bidder on the basis of the information provided in tender document. The decision of the BSCDCL in this case shall be final.

2.2 Eligibility and qualification requirements of Bidder

2.2.1 For determining the eligibility of Bidder the following shall apply:

(a) An Bidder shall not have a conflict of interest (the "Conflict of Interest") that affects the Bidding Process. Any Bidder found to have a Conflict of Interest shall be disqualified and liable for forfeiture of the BID Security or Performance Security as the case may be. A Bidder shall be deemed to have a Conflict of Interest affecting the Bidding Process, if:

(b) A Bidder shall be liable for disqualification and forfeiture of BID Security, if any legal, financial or technical adviser of the BSCDCL in relation to the Project is

engaged by the Bidder, its Member or any Associate thereof, as the case may be, in any manner formatters related to or incidental to such Project during the Bidding Process or subsequent to the (i) issue of the LOA or (ii) execution of the Agreement. In the even though such adviser is engaged by the selected Bidder or Contractor, as the case may be, after issue of the LOA or execution of the Agreement for matters related or incident alto the project, then notwithstanding anything to the contrary contained herein or in the LOA or the Agreement and without Prejudice to any other right or remedy or the BSCDCL, including the forfeiture and appropriation of the BID Security or Performance Security, as the case may be, which the BSCDCL may have there under or otherwise, the LOA or the Agreement, as the case may be, shall be liable to be terminated without the BSCDCL being liable in any manner whatsoever to the Selected Bidder or Contractor for the same. For the avoidance or doubt, this disqualification shall not apply where such adviser was engaged by the Bidder, its Member or Associate in the past but its assignment expired or was terminated 6 (six) months prior to the date of issue of this RFP. Nor will this disqualification apply where such adviser is engaged after a period of 3 (three) years from the date of commercial operation of the Project.

Other Instructions-

On line percentage rate/ Item rate tenders on behalf of Owner/Client are invited for the work. The pre-qualification / enlistment of the contractors should be valid on the last date of submission of tenders. In case the last date of submission of tender is extended, the pre-qualification of contractor should be valid on the original date of submission of tenders.

The work is estimated to _____ however, is given merely as a rough guide.

The tender document as uploaded can be seen on website www.mpeproc.gov.in and can be downloaded free of cost.

Mode of Submission:

Earnest Money Deposit

Earnest Money Deposit of amount as mentioned in “NIT/ Memorandum (Annexure-I)” required to be submitted along with the tender shall be payable online through E-tendering portal www.mpeproc.gov.in through NEFT/RTGS. The EMD shall be valid for minimum period of 150 (One Hundred Fifty) days from last day of submission of Tender.

The EMD of all unsuccessful tenderers will be returned within thirty (30) days of the Award of the contract to successful tenderer through online portal.

Financial Bidding can be done through the excel sheet uploaded on www.mpeproc.gov.in, which contains four sheets:

3. DSR 2016

4. NON SOR

*BID to be quote 1 plus % above or below (for Example. If want to quote 5% above then write 1.05 and if want to quote 5% below then write 0.95) for SOR items.

*Rates for NON SOR item can be filled in the NON SOR sheet

*Rates can be quoted in the yellow highlighted cell of the financial bid

* Bidder should fill there company/organization name in the space provided (yellow section)

Interested Bidder who wish to participate in the tender has also to make following payments through online payment e-proc portal only.

Cost of Tender Document –Rs. 50,000/- To be submit online only/-

e-Tender Processing Fee – As applicable for MPEPROC portal, Cost of Tender Document and, e-Tender Processing Fee online payment shall be payee online Copy of pre-qualification/enlistment letter and certificate of work experience (if required) and other documents as specified in the tender shall be scanned and uploaded to the e-Tendering website within the period of tender submission.

Online technical tender documents submitted by intending tenderers shall be opened only of those tenderers, whose Earnest Money Deposit, Cost of Tender Document and e-Tender Processing Fee and other.

The tender submitted shall become invalid if: the tenderer is found ineligible. The tenderer does not upload all the documents (including service tax registration/VAT registration/Sales Tax Registration) as stipulated in the tender document. If any discrepancy is noticed between the documents as uploaded at the time of submission of tender and hard copies as submitted physically in the office of tender opening authority.

VALIDITY OF TENDER

The tender for the works shall remain open for acceptance for a period of Ninety (90) days from the date of opening of financial tender. If any tenderer withdraws his tender before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the tender which are not acceptable to the BSCDCL, then the BSCDCL shall, without prejudice to any other right or remedy, be at liberty to forfeit the said earnest money as aforesaid. Further the tenderers shall not be allowed to participate in the retendering process of work.

ACCEPTANCE OF TENDER

BSCDCL reserves the right to reject any or all the tenders in part or full without assigning any reason whatsoever. BSCDCL does not bind itself to accept the lowest tender.

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

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

The acceptance of tender will rest with the BSCDCL 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.

On acceptance of tender, the name of the accredited representative(s) of the contractor who would be responsible for taking instructions from Engineer-in-Charge or its authorized representative shall be intimated by the contractor within 07 days of issue date of letter of Awards by BSCDCL.

<p>The tenderer shall not be permitted to tender for works if his near relative is posted in the project office or concerned Office of the BSCDCL. The contractor shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any of the officers in BSCDCL. Any breach of this condition by the tenderer would render him liable to the withdrawal of the work awarded to him and forfeiture of Earnest Money and Security Deposit. This may also debar the contractor from tendering for future works under BSCDCL.</p>
<p>For the purpose of operation of this clause a near relative shall mean wife, husband, parents, grandparents, children, grandchildren, brothers, sisters, uncles, aunts, cousins and their corresponding in-laws.</p>
<p>The time of completion of the entire work, as contained in contract shall be as mentioned in "Memorandum - Annexure-I", which shall be reckoned from the 10th day after issue of the letter of Award by the BSCDCL.</p>
<p>Canvassing whether directly or indirectly, in connection with tenderers is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable for rejection.</p>
<p>The tender award, execution and completion of work shall be governed by tender documents consisting of (but not limited to) Letter of Award/Letter of work order, Bill of Quantities, Special Conditions of Contract, General Conditions of Contract, Specifications, Drawings. The tenderers shall be deemed to have gone through the various conditions including sub-soil water conditions, topography of the land, drainage and accessibility etc. or any other condition which in the opinion of contractor will affect his price/rates before quoting their rates. No claim whatsoever against the foregoing shall be entertained.</p>
<p>The drawings with the tender documents are Tender Drawing and are indicative only.</p>
<p>ADDENDA/CORRIGENDA</p> <p>Addenda/Corrigenda to the tender documents may be issued prior to the date of submission 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 & acceptance 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.</p>
<p>SITE VISIT AND COLLECTING LOCAL INFORMATION</p> <p>Before tendering, the tenderers are 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 roads to the site, availability of water & power supply, application of taxes, duties and levies as applicable & any other 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 rates and no claim or extra charges whatsoever in this regard shall be entertained / payable by the BSCDCL at a later date.</p>

ACCESS BY ROAD

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 BSCDCL 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.

HANDING OVER & CLEARING OF SITE

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 requirement of local traffic police or/and 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.

The efforts will be made by the BSCDCL 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, the BSCDCL shall only consider suitable extension of time for the execution of the work. It should be clearly understood that the BSCDCL shall not consider any revision in contract price or any other compensation whatsoever viz. towards idleness of contractor's labour, equipment etc. Old structures on the proposed site, if required, shall be demolished by the contractor properly at his own cost unless and otherwise mentioned elsewhere in the tender document. The useful material obtained from demolition of structures & services shall be the property of the owner/BSCDCL and these materials shall be stacked in workmanship like at the place specified by the Engineer-in-charge.

Necessary arrangement including its maintenance is 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 progress of work under the scope of proposed project. The existing Road and Drain which are not in the alignment of the said project but are affected 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 this regards shall be deemed to be included in the quoted rates of the bill of quantity items and contractor shall not be entitled for any extra payment whatsoever in this regard.

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.

The contractor shall be responsible to obtain necessary approval from the respective authorities for shifting/ re-alignment of existing public utilities. BSCDCL shall only assist the contractor for visioning in obtaining the approval from the concerned authorities.

Any services affected by the works must be temporarily supported by the contractor who must also 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.

SCOPE OF WORK

The scope of work covered in this tender shall be as per the Bill of Quantities, specifications, drawings, instructions, orders issued to the contractor from time to time during the pendency of 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. The Work Shall be executed on Preparation of Working Drawings, Procurement and Construction Basis. Details and drawings given in Tender document is for information purpose only and successful bidder shall undertake confirmatory survey for accuracy and completeness of data. It is in scope of successful Bidder to undertake all Site surveys, Geotechnical investigations, obtaining all required approvals from the relevant authorities, Carry out Shop Drawings, Further detailing of Architectural, Structural works, Electrical, Mechanical, Plumbing, Firefighting, HVAC Works ,Landscape, External Infrastructure works, ICT works ...etc as per Employers requirement and submit the same to client for review and approval, Prepare Good for Construction Drawings, submit maintenance manual to client for approval before start of Maintenance period. The successful bidder shall have to prepare and submit 'As Built Drawings' depicting the exact construction carried out on site, in soft and hard copy format.

Statutory and other charges for getting various required approvals shall be in scope of Successful bidder

The quantities of various items as entered in the "BILL OF QUANTITIES" 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 in the bill of quantities. The variation of quantities will be governed as per conditions of contract.

Also refer section 7 for detailed Scope of work.

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's, 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.

CLARIFICATION AFTER TENDER SUBMISSION

Tenderer's attention is drawn to the fact that during the period, the tenders are under consideration, the tenderers are advised to refrain from contacting by any means, the BSCDCL and/or his employees/ representatives on matters related to the tender under consideration and that if necessary, BSCDCL will obtain clarifications in writing or as may be necessary. The tender evaluation and process of award of works is done by duly authorized Tender Scrutiny Committee and this committee is authorized to discuss and get clarification from the tenderers.

ORDER OF PRECEDENCE OF DOCUMENTS

In case of difference, contradiction, discrepancy, with regard to conditions of contract, Specifications, Drawings, Bill of quantities etc. forming part of the contract, the following shall prevail in order of precedence.

Letter of Award, along with statement of agreed variations and its enclosures, if any.

Description of Bill of Quantity / Schedule of Quantities.

Special Condition of Contract.

Technical specifications (General, Additional and Technical Specification) as given in Tender documents.

General Conditions of Contract.

Drawings

CPWD/UADD specifications (as specified in Technical Specification of the Tender) update with correction slips issued up to last date of receipt of tenders.

Relevant B.I.S. Codes under the contract.

Financial Bid

Online tender filled in either percentage plus or minus (above or below), or at par. (There is no separate provision to quote % in physical form, this is a part in Header Data of online Tendering). For Packet 'C' Bidder(s) will fill data in 'Item Data Tab' in Service Line Item via Details and quotes his percentage variation figures. **(If entered '0' it will be treated as 'at par'**. By default the value is zero only).

Note: In case of rebate/premium of 15% and above as quoted by the Bidder, the rate analysis of major items shall be submitted by L1 and L2 bidder after demand notification by e-mail to bidders by concerned Dy.Ch.Eng. The format for rate analysis is annexed at Annexure D.

BID SECURITY OR EMD

The Bidder shall furnish, as part of the Bid, Bid Security/EMD, in the amount specified in the Bid Data Sheet. This bid security shall be in favor of the authority mentioned in the Bid Data Sheet and shall be valid till the validity of the bid.

Any bid not accompanied by an acceptable Bid Security and not secured as indicated in sub-clause mentioned above, shall be rejected by the Employer as non-responsive.

The Bid Security of the successful Bidder will be discharged when the Bidder has signed the Agreement and furnished the required Security Deposits.

The Bid Security may be forfeited:

- a) if the Bidder withdraws the Bid after bid opening (opening of technical qualification part of the bid during the period of Bid validity;
- b) in the case of a successful Bidder, if the Bidder fails within the specified time limit to:
 - i. sign the Agreement; and/or
 - ii. Furnish the required Security Deposits.

No rejections and forfeiture shall be done in case of curable defects,. For non-curable defects the 10% of EMD shall be forfeited and bid will be liable for rejection.

Failure of the bidder to submit the documents mentioned under the curable defects after the return correspondence from the Employer will lead to rejection of Bid.

Note:

Curable Defect shall mean shortfalls in submission such as:

**Non-submission of following documents,
Valid Registration Certificate**

Sales Tax Registration Certificate (VAT)

Certified Copies of PAN documents and photographs of individuals, owners, etc

Partnership Deed and any other documents

Undertakings as mentioned in the tender document.

Wrong calculation of Bid Capacity,

No proper submission of experience certificates and other documents, etc.

Non-curable Defect shall mean

In-adequate submission of EMD/ASD amount,

In-adequacy of technical and financial capacity with respect to Eligibility criteria as stipulated in the tender.

ACCEPTANCE OF TENDER CONDITIONS

From: (On the letter head of the company by the authorized officer having power of attorney)

BSCDCL Limited,

Sub: Name of the work & NIT No.:

Sir,

This has reference to above referred tender. I/We are pleased to submit our tender for the above work and I/We hereby unconditionally accept the tender conditions and tender documents in its entirety for the above work. I/we are eligible to submit the tender for the subject tender and I/We are in possession of all the documents required. I/We have viewed and read the terms and conditions of this GCC/SCC carefully. I/We have downloaded the following documents forming part of the tender document:

- a) Notice Inviting e-Tender
- b) Quoting Sheet for Tenderer
- c) Instructions to Tenderers & General Conditions of Contract (Vol- I/2013)
- d) Technical Specifications (Vol-II)
- e) Bill of Quantities (Vol-III)
- f) Tender Drawing
Acceptance of Tender Conditions (Annexure II)
- g) Corrigendum, if any

I/we have uploaded the mandatory scanned documents such as cost of tender document, EMD, e-Tender Processing Fee and other documents as per Notice Inviting e-tender AND I/We agree to pay the cost of tender document, EMD, e-Tender Processing Fee (only receipt/proof of online payment) and other documents in the form and manner as described in NIT/ITT .Should this tender be accepted, I/We agree to abide by and fulfill all terms and conditions referred to above and as contained in tender documents elsewhere and in default thereof, to forfeit and pay BSCDCL, or its successors or its authorized nominees such sums of money as are stipulated in the notice inviting tenders and tender documents. If I/we fail to commence the work within 10 days of the date of issue of Letter of Award and/or I/we fail to sign the agreement as per Clauses of Contract and/or I/we fail to submit performance guarantee as per Clauses of Contract, I/we agree that BSCDCL shall, without prejudice to any other right or remedy, be at liberty to cancel the Letter of Award and to forfeit the said earnest money as specified above.

Dated: _____

Yours faithfully,
(Signature of the tenderer with rubber stamp)

SECTION-3

GENERAL CONDITIONS OF CONTRACT (GCC)

CLAUSES OF CONTRACT (CC)

DEFINITIONS

The Contract means the documents forming the tender and acceptance thereof and the formal agreement executed between the competent authority on behalf of BSCDCL and the contractor, together with the documents referred to therein 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. Bhopal Smart City Development Corporation Limited, hereinafter called 'BSCDCL' proposes to get the works executed as mentioned in the Contract on behalf of Owner/ Client as Implementing agency/Executing Agency.

- 3.1 In the contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them:-

APPROVAL means approved in writing including subsequent written confirmation of previous verbal approval.

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

CONTRACTOR shall mean the individual, firm, LLP or company, whether in corporate or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or LLP or company, or the successors of such firm or company and the permitted assignees of such individual, firm or company.

CONTRACT VALUE means the sum for which the tender is accepted as per the letter of Award.

DRAWINGS mean the drawings referred to in the contract document including modifications if any and such other drawings as may from time to time be furnished and/ or approved by BSCDCL.

DATE OF COMMENCEMENT OF WORK: The date of start of contract shall be reckoned from 10 days after the date of issue of letter of Award.

ENGINEER-IN-CHARGE means the Engineer of BSCDCL who shall supervise and be in-charge of the work.

LANGUAGE: All documents and correspondence in respect of this contract shall be in English Language.

“LETTER OF AWARD” shall mean BSCDCL's letter or notification conveying its acceptance of the tender subject to such conditions as may have been stated There in.

MONTH means English Calendar month 'Day' means a Calendar day of 24 Hr **BSCDCL** shall means Bhopal Smart City Development Corporation Limited, a company registered under the Indian Company Act, with its registered office at Near Tatpar Petrol Pump, Sector A, Berkheda, Bhopal, Madhya Pradesh 462023 or its Administrative officers or its engineer or

other employees authorized to deal with any matter with which these persons are concerned on its behalf.

OWNER/ CLIENT means the Government, Organization, Ministry, Department, Society, Cooperative, etc. who has awarded the work/ project to BSCDCL and/ or appointed BSCDCL as Implementing / Executing Agency/ Project Manager and/ or for whom BSCDCL is acting as an agent and on whose behalf BSCDCL is entering into the contract and getting the work executed.

SCHEDULE(s) referred to in these conditions shall mean the standard schedule of rates of the government mentioned in the Memorandum (Annexure-I) with the amendments thereto issued up to the date of receipt of the tender.

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 BSCDCL/client/owner or used for the purpose of the contract.

TENDER means the Contractor's priced offer to BSCDCL 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 Award or Award letter. The word TENDER is synonymous with Tender and the Word TENDER DOCUMENTS with "Tendering Documents" or "offer documents".

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

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. 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 importing persons or parties shall include firms and corporations and organizations having legal capacities.

Excepted Risk are risks due to riots (other than those on account of contractor's employees), war (whether declared or not) invasion, act of foreign enemies, hostilities, civil war, rebellion revolution, insurrection, military or usurped power, any acts of Government, damages from aircraft, acts of God, such as earthquake, lightening and unprecedented floods, and other causes over which the contractor has no control and accepted as such by the BSCDCL or causes solely due to use or occupation by Government of the part of the works in respect of which a certificate of completion has been issued or a cause solely due to BSCDCL's faulty design of works.

Market Rate shall be the rate as decided by the Engineer-in-Charge on the basis of the prevailing cost of materials and labour at the site where the work is to be executed plus the percentage mentioned elsewhere in the tender document to cover, all overheads and profits.

PERFORMANCE GUARANTEE:

"Within 30 (Thirty) days from the date of issue of letter of Award or within such extended time as may be granted by BSCDCL in writing, the contractor shall submit to BSCDCL an irrevocable performance bank guarantee in the form appended, from any Nationalized Bank or all Commercial schedule bank equivalent to 5% (five per cent only) of the contract value for

the due and proper execution of the Contract. The Performance Guarantee shall be initially valid up to the stipulated date of completion plus 60 days beyond that. In case the time for completion of works gets extended, the contractor shall get the validity of Performance Guarantee extended to cover such extended time for completion of work.

BSCDCL reserve the right of forfeiture of the performance guarantee in the event of the contractor's failure to fulfill any of the contractual obligations or in the event of termination of contract as per terms and conditions of contract.

Performance guarantee shall be returned after successful completion / testing / commissioning and handing over the project to the client up to the entire satisfaction of BSCDCL / Client.

In case the contractor fails to submit the performance guarantee of the requisite amount within the stipulated period or extended period, letter of Award automatically will stand withdrawn and EMD of the contractor shall be forfeited.

SECURITY DEPOSIT/ RETENTION MONEY

The Security deposit or the retention money shall be deducted from each running bill of the contractor @ 5% (five per cent only) of the gross value of the Running Account bill. Earnest money shall be adjusted first in the security deposit and further recovery of security deposit shall commence only when the upto date amount of security deposit exceeds the earnest money deductible under this clause. No Interest shall be paid on amount so deducted. Security deposit will be released after completion of defect liability period. The release/refund of security deposit of the contractor shall be subject to the observance/compliance of the conditions as under and whichever is later:

- a) Expiry of the defect liability period in conformity with provisions contained in clause (Defect liability clause). The expiry of defect liability period shall be extended from time to time depending upon extension of time granted by BSCDCL. The contractor produces a clearance certificate from the labour office. As soon as the work is virtually completed, the contractor shall apply for the labour clearance certificate to the Labour Officer under intimation to the Engineer-in-Charge. The Engineer-in-Charge, on receipt of the said communication, shall write to the Labour Officer to intimate if any complaint is pending against the contractor in respect of the work. If no complaint is pending, on record till after 3 months after completion of the work and/or no communication is received from the Labour Officer to this effect till six months after the date of completion, it will be deemed to have received the clearance certificate.
- 3.2 BSCDCL reserves the right of part or full forfeiture of security deposit in addition to other claims in the event of contractor's failure to fulfill any of the contractual obligations or in the event of termination of contract as per terms and conditions of contract.

MOBILIZATION ADVANCE

Mobilization advance up to maximum of amount as mentioned in the

"Memorandum (Annexure-I)" shall be paid to the contractor, if requested by him, on submission of irrevocable Bank Guarantee valid for contract period of an amount 1.2 times of the mobilization advance to take care of advance and interest at prescribed rate from a nationalized bank or all Commercial scheduled bank in the enclosed Performa. The Mobilization advance shall be interest bearing @ as mentioned in the "Memorandum (Annexure-I)". This advance shall be paid in three installments as follows:

First Installment of fifty percent of total mobilization advance shall be paid after the agreement is signed and upon submission of performance guarantee for full amount as specified.

2nd installment of twenty five percent of total mobilization advance will be paid after the setting up of site office and site laboratory, complete mobilization of plant and machinery, scaffolding & shuttering materials etc.

The Balance twenty five percent of total mobilization advance shall be paid on completion of 10% of work in terms of cost and after the contractor has fully mobilized the work at site.

The mobilization advance bear simple interest at the rate as mentioned in the Memorandum (Annexure-I) 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 mobilization advanced including interest shall be made by the deduction from the contractor's bills commencing after first 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 either by the time 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 or on expiry of eighty percent of contract period (i.e. time allowed for completion of work in terms of Memorandum-Annexure-I) whichever is earlier. The bank guarantee submitted by contractor against mobilization advance shall initially be made for the full amount as mentioned in para 4.1 above

and valid for the contract period, and be kept renewed from time to time to cover the balance amount and likely period of completion of recovery together with interest. However, the contractor can submit part bank guarantees against the mobilization advance in as many numbers as per proposed number of recovery installments equivalent to the amount of each installment.

Notwithstanding what is contained above, no mobilization advance whatsoever shall be payable, if payment of mobilization advance is not mentioned in the Memorandum (Annexure-I).

SECURED ADVANCE AGAINST NON-PERISHABLE MATERIALS

Interest free secured advance up-to a maximum of 75 % (seventy five percent) of the Market Value of the Materials or the 75 % (seventy five percent) cost of materials as derived from the tendered item rate of the contractor, whichever is less, required for incorporation in the permanent works and brought to site and duly certified by BSCDCL site Engineer shall be paid to the Contractor for all non-perishable items as per UADD/MPPWD/CPWD norms. The advance will be paid only on submission of Indemnity Bond in the prescribed pro-forma. The advance shall be recovered in full from next Running Account bill and fresh advance shall be paid for the balance quantities of materials. The contractor shall construct suitable go-down at the site of work for safe storage of the materials against any possible damages due to sun, rain, dampness, fire, theft etc. at his own cost. He shall also employ necessary watch & ward establishment for the purpose at his costs and risks.

Such secured advance shall also be payable on other items of perishable nature, fragile and combustible with the approval of the Engineer-in-Charge provided the contractor provides a comprehensive insurance cover for the full cost of such materials. The decision of the Engineer-in-Charge shall be final and binding on the contractor in this matter. No secured advance shall however, be paid on high risk materials such as ordinary glass, sand, petrol, diesel etc.

DEVIATIONS / VARIATIONS EXTENT AND PRICING

The Engineer-in-Charge shall have power (i) to make any alterations in, omissions from, additions to or substitutions for, the original specifications, drawings, designs and instructions that may appear to him to be necessary during the progress of the work, (ii) to omit part of the works in case of non-availability of a portion of the site or for any other reasons and the contractor shall be bound to carry out the works in accordance with any instructions given to him in writing signed by the Engineer-in-Charge and such alterations, omissions, additions, or substitutions shall form part of the contract as if originally provided therein and any altered, additions or substituted works which the contractor may be directed to do in the manner specified above as part of the work, shall be carried out by the contractor on the same conditions in all respects including price on which he agreed to do the main work except as hereunder provided:

The time for the completion of the work shall, in the event of any deviations resulting in additional cost over the tendered value sum being ordered be extended, if requested by the contractor, as follows:

in the proportion which the additional cost of the altered, additional or substituted work bears to the original tendered value plus 25% of the time calculated in (i) above or such further additional time as may be considered reasonable by the Engineer-in-Charge.

If the extra items includes any work for which no rate is specified in the contract, then such work shall be carried out at the rates entered in the schedule of rates (as mentioned in Memorandum (Annexure-I)) for Civil Works minus/plus the percentage which the tendered amount of scheduled items bears with the estimated amount of schedule items based on the Schedule of Rates (as mentioned in Memorandum (Annexure-I) for Civil/ Sanitary Works). The scheduled item means the items appearing in the Schedule of Rates (as mentioned in Memorandum (Annexure-I)for Civil/ Sanitary Works) which shall be applicable in this clause. This clause will apply mutates mutandis to electrical work except that Electrical Schedule of Rates as mentioned in Memorandum (Annexure-I) will be considered in place of Civil works Schedule of rates as mentioned in Memorandum (Annexure-I) However, In the case of extra item(s), (items that are completely new, and are in addition to the items contained in the contract, and not included in the schedule of rates (as mentioned in Memorandum (Annexure-I)), the contractor may within fifteen days of receipt of order or occurrence of the item(s) claim rates, supported by proper analysis, for the work and the engineer-in-charge shall within one month of the receipt of the claims supported by analysis, after giving consideration to the analysis of the rates submitted by the contractor, determine the rates on the basis of the market rates and the contractor shall be paid in accordance with the rates so determined. In the case of substituted items (items that are taken up with partial substitution or in lieu of items of work in the contract), the rate for the agreement item (to be substituted) and substituted item shall also be determined in the manner as mentioned in the following para: If the market rate for the substituted item so determined is more than the market rate of agreement item (to be substituted), the rate payable to the contractor for the substituted item shall be the rate for the agreement item (to be substituted) so increased to the extent of the difference between the market rates of substituted item and the agreement item (to be substituted). If the market rate for the substituted item so determined is less than the market rate of the agreement (to be substituted), the rate payable to the contractor for the substituted item shall be the rate for the agreement item (to be substituted) so decreased to the extent of the difference between the market rates of substituted item and the agreement item (to be substituted) In the case of contract item(s), substituted item(s), contract cum substituted items, which exceed the limits laid down in Memorandum (Annexure-I), the contractor shall within fifteen days of receipt of order of occurrence of the excess, claim revision of the rates, supported by proper analysis for the work in excess of the above mentioned limits, provided that if the rates so claimed are in excess of the rates specified in the scheduled of quantities, the Engineer-in-Charge shall within one month of receipt of the claims supported by analysis, after giving consideration to the analysis of the rates submitted by the Contractor, determine the rates on the basis of the market rates and the contractor shall be paid in accordance with the rates so determined. The provisions of the preceding paragraph shall also apply to the decrease in the rates of items for the work in excess of the limits laid down in Memorandum (Annexure-I), and the Engineer-in-charge shall after giving notice of the contractor within one month of occurrence of the excess and after taking into consideration any reply received from him within fifteen days of the receipt of the notice revise the rates for the work in question within one month of the expiry of the said period of fifteen days having regard to the market rates.

3.3 The contractor shall send to the Engineer-in-Charge once every three months,an up to date account giving complete details of all claims for additional payments to which the contractor may consider himself entitled and of all additional work ordered by the Engineer-in-Charge which he has executed during the preceding quarter failing which the contractor shall be deemed to have waived his right. However, the Engineer-in-charge may authorize consideration of such claims on merits.

For the purpose of operation of Memorandum (Annexure-I), the following works shall be treated as works relating to foundation unless and otherwise defined in the Contract:

For Buildings: All works up to 1.2 meters above ground level or up to floor 1 level whichever is lower.

For abutments, piers and well staining: All works upto 1.2m above the bed level.

For walls, compound walls, , and other elevated structures: All works upto 1.2 metres above the ground level.all items of excavation and filling including treatment of sub base.

Any operation incidental to or necessarily has to be in contemplation of tenderer while filling, tender or necessary for proper execution of the item

included in the Schedule of quantities or in the schedule of rates mentioned above, whether or not specifically indicated in the description of the item and the relevant specifications shall be deemed to be included in the rates quoted by the tenderer or the rate given in the said schedule or rates as the case may be Nothing extra shall be admissible for such operations.

Market Rates to be determined as per various sub-clauses given in tender document shall be on the basis of Prevailing rates of Material (unless mentioned otherwise), Relevant Labour authority rate for Labour, market rates of T&P etc. plus 15% towards Contractors' Profits and Overheads.

The following factors may be considered in the justification of rates on which

Contractor's overhead & profit shall not be applicable:

Buildings and Other Construction Worker Cess as applicable in the state of work place

EPF (Employer Contribution) component, as per EPF act on the portion of labour's wages

VAT on works contract / WCT, as per composite scheme in the State of work place, if applicable Service Tax

ESCALATION

No claim on account of any escalation on whatsoever ground shall be entertained at any stage of works. All rates as per Bill of Quantities (BOQ) quoted by contractor shall be firm and fixed for entire contract period as well as extended period for completion of the works. No escalation shall be applicable on this contract.

COMPENSATION FOR DELAY

If the contractor fails to maintain the required progress in terms of clause or relevant clause of GCC & Special Conditions of 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 the BSCDCL on account of such breach, pay as agreed compensation the amount calculated at the rates stipulated below as the Engineer in charge (whose decision in writing shall be final and binding) may decide on the amount of tendered value of the work for every completed day / week (as applicable) that the progress remains below that specified in Clause or the relevant clause in GCC & Special Conditions of Contract or that the work remains incomplete.

This will also apply to items or group of items for which a separate period of completion has been specified

- i) Compensation for delay of work @ 1.5% per month delay to be computed on daily basis. 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 or of the Tendered Value of the item or group of items of work for which a separate period of completion is originally given. The amount of compensation may be adjusted or set-off against any sum payable to the Contractor under this or any other contract with BSCDCL.

In case, the contractor does not achieve a particular milestone mentioned elsewhere in the tender document, or the re-scheduled milestone(s) the amount shown against that milestone shall be withheld, to be adjusted against the compensation levied at the final grant of Extension of Time. With-holding of this amount or failure to achieve a milestone, shall be automatic without any notice to the Contractor. However, if the contractor catches up with the progress of work on the subsequent milestone(s), the withheld amount shall be released. In case the contractor fails to make up for the delay in subsequent milestone(s), amount mentioned against each milestone missed subsequently also shall be withheld. However, no interest, whatsoever, shall be payable on such withheld amount.

INCENTIVE FOR EARLY COMPLETION

In case the contractor completes the work ahead of scheduled completion time, a bonus @ 1% (One percent) of the tendered value per month computed on per day basis, shall be payable to the contractor, subjected to a maximum limit of 5% (Five percent) of the tendered value. The amount of bonus, if payable, shall be paid along with final bill after completion of the work.

ACTION IN CASE WORK NOT DONE AS PER SPECIFICATIONS

All works under or in course of execution or executed in pursuance of the contract, shall at all times be open and accessible to the inspection and supervision of the Engineer-in-charge, his authorized subordinates in charge of the work and all the superior officers, officer of the Quality Assurance Unit of the BSCDCL or any organization engaged by the BSCDCL for Quality Assurance and the contractor shall, at all times, during the usual working hours and at all other times at which reasonable notice of the visit of such officers has been given to the contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that purpose. Orders given to the Contractor's agent shall be considered to have the same force as if they had been given to the contractor himself. If it shall appear to the Engineer-in-charge or his authorized subordinates in-charge of the work or to the officer of Quality Assurance or his subordinate officers or the officers of the organization engaged by the BSCDCL for Quality Assurance or his subordinate officers, that any work has been executed with unsound, imperfect, or unskillful workmanship, or with materials or articles provided by him for the execution of the work which are unsound or of a quality inferior to that contracted or otherwise not in accordance with the contract, the contractor shall, on demand in writing which shall be made within twelve months of the completion of the work from the Engineer-in-Charge specifying the work, materials or articles complained of notwithstanding 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 articles so specified and provide other proper and suitable materials or articles at his own charge and cost. In the event of the failing to do so within a period specified by the Engineer-in-Charge in his demand aforesaid, then the contractor shall be liable to pay compensation at the same rate as per conditions of contract (for non-completion of the work in time) for this default. In such case the Engineer-in-Charge may not accept the item of work at the rates applicable under the contract but may accept such items at reduced rates as the Engineer in charge may consider reasonable during the preparation of on account bills or final bill if the item is so acceptable without detriment to the safety and utility of the item and the structure or he may reject the work outright without any payment and/or get it and other connected and incidental items rectified, or removed and re-executed at the risk and cost of the contractor. Decision of the Engineer-in-Charge to be conveyed in writing in respect of the same will be final and binding on the contractor.

ACTION IN CASE OF BAD WORK

If it shall appear to the Engineer-in-Charge or his authorized representative in charge of the work or to the Chief Technical Examiner or to any other inspecting agency of Government/

State Government/ Owner 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 twelve months of the completion of the work from the Engineer-in-Charge specifying the work, materials or articles complained of notwithstanding 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 articles so specified and provide other proper and suitable materials or articles at his 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 aforesaid while the contractor failure to do so shall continue, 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.

CANCELLATION/DETERMINATION OF CONTRACT IN FULL OR PART

Subject to other provisions contained in this clause the Engineer-in-Charge may, without prejudice to his any other rights or remedy against the contractor in respect 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:

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

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 in writing of seven days from the Engineer-in-Charge; or

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 such date(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

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

If the contractor shall offer or give or agree to give to any person in BSCDCL 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 relation to the obtaining or execution of this or any other contract for BSCDCL; or

If the contractor shall enter into a contract with BSCDCL in connection with which commission has been paid or agreed to be paid by him or to his knowledge, unless the particulars of any such commission and the terms of payment thereof have been previously disclosed in writing to the Engineer-in-Charge; or

If the contractor shall obtain a contract with BSCDCL as a result of wrong tendering or other non-bona-fide methods of competitive tendering or commits breach of Integrity Pact; or If the contractor being an individual, or if a firm, any partner thereof shall at any time be adjudged insolvent or have a receiving order or order for administration of his estate made against him or shall take any proceedings for liquidation or composition (other than a voluntary liquidation for

the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or 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 If the contractor being a company, shall pass a resolution or the Court shall make an order for the winding up of the company, or a receiver 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 a receiver or manager; or 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. 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.

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 hereafter to BSCDCL, by a notice in writing to cancel the contract as whole or only such items of work in default from the Contract, the Engineer-in-charge shall have powers:

Take possession of site and any materials, constructional plant, implements, stores, etc. thereon; and/ or Carry out the incomplete work by any means at the risk and cost of the contractor; and/ or

The Engineer-in-charge shall determine the amount, if any, is recoverable from the contractor for completion of the part work/part incomplete work of any item(s) taken out of his hands and execute at the risk and cost of the contractor, the liability of contractor on account of loss or damage suffered by BSCDCL because of action under this clause shall not exceed 10% of the tendered value of the work.

To determine or rescind the contract as aforesaid (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 and performance guarantee shall be liable to be forfeited and un-used materials, construction plants, implements, temporary buildings, etc. shall be taken over and shall be absolutely at the disposal of the BSCDCL. If any portion of the Security Deposit has not been paid or received it would be called for and forfeited; and/ or

To employ labour paid by the BSCDCL 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. If the expenses incurred by the BSCDCL are less than the amount payable to the contractor at his agreement rates, the difference shall not be paid to the contractor; and/ or

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 / or relevant clause of Condition Special 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 be final and conclusive) shall be borne and paid by the original contractor and may be deducted from any money due to him by BSCDCL under his contract or on any other account whatsoever or 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 may be. If the expenses incurred by the BSCDCL are less than the amount payable to the contractor at his agreement rates, the difference shall not be paid to the contractor; and/or

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 or to be incurred by BSCDCL in completing the works or part of the works or the excess loss or damages suffered or may be suffered by BSCDCL as aforesaid after allowing such credit shall without prejudice to any other right or remedy available to BSCDCL in law be recovered from any moneys due to the contractor on any account, and if such moneys are not sufficient the contractor shall be called 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 contractors 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 BSCDCL and unsold materials, constructional plant etc. shall be returned to the contractor, provided always that if cost or anticipated cost of completion by BSCDCL 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 in case 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 above, are in excess of the security deposit forfeited, these shall be

Limited to the amount by which the excess cost incurred by the BSCDCL exceeds the security deposit so forfeited.

CONTRACTOR LIABLE TO PAY COMPENSATION EVEN IF ACTION 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 notwithstanding 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 any 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 be 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, clerk of the works, foreman or other

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 them at the contractor's expense or sell them 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.

CARRYING OUT PART WORK AT RISK & COST OF CONTRACTOR

If contractor:

At any time makes default during currency of work or does not execute any part of the work with due diligence and continues to do so even after a notice in writing of 7 days in this respect from the Engineer-in-Charge;

or

Commits default in complying with any of the terms and conditions of the contract and does not remedy it or takes effective steps to remedy it within 7 days even after a notice in writing is given in that behalf by the Engineer-in-Charge;

or

Fails to complete the work(s) or items of work with individual dates of completion, on or before the date(s) so determined, and does not complete them within the period specified in the notice given in writing in that behalf by the Engineer-in-Charge.

The Engineer-in-Charge without invoking action under conditions of contract may, without prejudice to any other right or remedy against the contractor which have either accrued or accrue thereafter to BSCDCL, by a notice in writing to take the part work/part incomplete work of any item(s) out of his hands and shall have powers to:

Take possession of the site and any materials, constructional plant, implements, stores, etc., thereon; and/or Carry out the part work / part incomplete work of any item(s) by any means at the risk and cost of the contractor.

The Engineer-in-Charge shall determine the amount, if any, is recoverable from the contractor for completion of the part work/ part incomplete work of any item(s) taken out of his hands and execute at the risk and cost of the contractor, the liability of contractor on account of loss or damage suffered by BSCDCL because of action under this clause shall not exceed 10% of the tendered value of the work.

In determining the amount, credit shall be given to the contractor with the value of work done in all respect in the same manner and at the same rate as if it had been carried out by the original contractor under the terms of his contract, the value of contractor's materials taken over and incorporated in the work and use of plant and machinery belonging to the contractor. The certificate of the Engineer-in-Charge as to the value of work done shall be final and conclusive against the contractor provided always that action under this 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 payable to the contractor.

Any excess expenditure incurred or to be incurred by BSCDCL in completing the part work/ part incomplete work of any item(s) or the excess loss of damages suffered or may be suffered by BSCDCL as aforesaid after allowing such credit shall without prejudice to any other right or remedy available to BSCDCL in law or per as agreement be recovered from any money due to the contractor on any account, and if such money is insufficient, the contractor shall be called upon in writing and shall be liable to pay the same within 30 days.

If the contractor fails 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 contractors' unused materials,

constructional plant, implements, temporary building at site etc. and adjust the proceeds of sale thereof towards the dues recoverable from the contractor under the contract and if thereafter there remains any balance outstanding, it shall be recovered in accordance with the provisions of the contract. In the event of above course being adopted by the Engineer-in-Charge, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advance on any account or with a view to the execution of the work or the performance of the contract.

SUSPENSION OF WORKS

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:

On account of any default on part of the contractor, or For proper execution of the works or part thereof for reason other than the default of the contractor, or For safety of the works or part thereof.

The contractor shall, during such suspension, properly protect and secure the works 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 plus 25% for completion period. No adjustment in 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 BSCDCL, 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.

TERMINATION OF CONTRACT ON DEATH OF CONTRACTOR

Without prejudice to any of the right or remedies under this contract if the contractor dies, the Engineer in-charge shall have the option of terminating the contract without compensation to the contractor.

TIME ESSENCE OF CONTRACT & EXTENSION FOR DELAY

The time allowed for execution of the Works as specified in the Memorandum (Annexure-I) or the extended time in accordance with these conditions shall be the essence of the contract. The execution of the works shall commence from such time period as mentioned in MEMORANDUM (ANNEXURE – I) or 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 BSCDCL shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the earnest money & performance guarantee absolutely.

- 3.4** Within 10 (Ten) days of Letter of Award, the Contractor shall submit a time and Progress Chart (CPM/ PERT/ Quantified Bar Chart) 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. It shall indicate the forecast (mile-stones) 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 contractor shall in all cases in which the time allowed for any work exceeds one month (save for special jobs for which a separate program has been agreed upon) complete 1/8th of the whole of work before 1/4th of the whole time allowed in the contract has elapsed, 3/8th of the work before one half of such time has elapsed and 3/4th of the work before 3/4th of such time has elapsed. The physical progress report including photographs shall be submitted by the contractor on the prescribed format & the intervals (not

exceeding one month) as decided by the Engineer in Charge. The compensation for delay as per tender document shall be envidable 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:

1. force-majeure or
 2. Abnormally bad weather, or
 3. Serious loss or damage by fire, or
 4. Civil commotion, local commotion of workmen, strike or lockout, affecting any or the trades employed on the work, or
 5. Delay on the part of other contractors or tradesmen engaged by Engineer-in-Charge in Executing work not forming part of the Contract, or
 6. Non-availability of stores, which are responsibility of the BSCDCL or,
 7. Non-availability or break down of tools and plant to be supplied or supplied by BSCDCL or,
 8. Any other cause which, in the absolute discretion of the BSCDCL, 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 within 07 days but shall nevertheless use constantly his best endeavor 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.
- 3.5** Request for extension of time, to be eligible for consideration, shall be made by the Contractor in writing within fourteen days of the happening of the event causing delay in the prescribed form. The Contractor may also, if practicable, indicate in such a request the period for which extension is desired. In any such case BSCDCL 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 a reasonable time from the receipt of such request. Non application by the contractor for extension of time shall not be a bar for giving a fair and reasonable extension by the Engineer-in-Charge and the extension of time so given by the Engineer-in-Charge shall be binding on the contractor.

TIME SCHEDULE & PROGRESS

- 3.6** Time allowed for carrying out all the works as entered in the tender shall be as mentioned in the “Memorandum (Annexure-I)” which shall be reckoned from the 10th day from the date on which the letter of Award is issued to the Contractor. Time shall be the essence of the contract and contractor shall ensure the completion of the entire work within the stipulated time of completion.
- The contractor shall also furnish within 10 days of date of issue of letter of Award a CPM network/ PERT chart/ Bar Chart for completion of work within stipulated time. This will be duly got approved from BSCDCL. 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.

Contractor shall mobilize and employ sufficient resources for completion of all the works as indicated in the agreed BAR CHART/PERT 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.

During the currency of the work the contractor is expected to adhere to the time schedule on mile stone and total completion and this adherence will be a part of Contractor's performance under the contract. During the time schedule on mile stone and total completion 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/BAR CHART undertaken by the BSCDCL. These reviews may be undertaken at the discretion of Engineer-in-charge either as a periodical appraisal measure or when the quantum of work order on the contractor is substantially changed through deviation orders or amendments. The review shall be held at site or any of the offices of BSCDCL/owner /consultant at the sole discretion of BSCDCL. 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.

Contractor shall submit (as directed by Engineer-in-Charge) progress reports 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. The contractor shall send completion report with as built drawings to the office of Engineer-in-Charge, of BSCDCL in writing within a period of 30 days of completion of work.

The photographs of the project taken on last day of every month indicating progress of work (in soft copies) shall be attached along with the physical progress reports to be submitted to Engineer-in-charge.

TAXES AND DUTIES

- 3.7** Except as otherwise specifically provided in the contract, the contract or shall be liable and responsible for the payment, of all taxes, such as excise duty, custom duty, sales tax, Value Added Tax including the purchase tax, consignment tax, work contract tax, service tax, entry tax or any other similar tax in the state concerned, turnover tax, toll tax, octroi charges, royalty, labour cess, levy and other tax(es) or duty(ies) which may be specified by local/state/ central government from time to time on all material articles which may be used for this work. The rates quoted by him in the tender in bill of quantities shall be inclusive of all taxes, duties, levies etc. The imposition of any new and/or increase in the aforesaid taxes, duties levies (including fresh imposition of any other Tax) is imposed by Statute, after the last stipulated date for the receipt of tender including extensions if any and the contractor thereupon necessarily and properly pays such taxes/levies/cess, the contractor shall be reimbursed the amount so paid, provided such payments, if any, is not, in the opinion of Engineering-in charge attributable to delay in execution of work within the control of contractor. The contractor shall, within a period of 30 days of the imposition of any such further tax or levy or cess, give a written notice thereof to the Engineering-in-charge that the same is given pursuant to this condition, together with all necessary information relating thereto.

In the event of nonpayment/default in payment of any of the above taxes, BSCDCL reserves the right to with-hold the dues/payments of contractor and make payment to local/state/Central Government authorities or to labourers as may be applicable.

The rate quoted by the contractor shall be deemed to be inclusive of all taxes as given in tender document Tax deductions at source shall be made as per laws prevalent in the State as applicable for the work.

The stamp duty and registration charges, if any, on the contract agreement levied by the Government or any other statutory body, shall be paid by the contractor as applicable in the state of work.

It will be incumbent upon the Contractor to obtain a registration certificate as a dealer under the Local Sales Tax Act / VAT and the Central Sales Tax Act and necessary evidence to this effect shall be furnished by the Contractor to BSCDCL.

The tenderer shall quote his rates inclusive of Service Tax, Turnover Tax / Sales Tax on Works Contract / VAT payable to State Govt. along-with other taxes, duties, levies etc. in conjunction with other terms and conditions. In case, the Turnover Tax/ Sales Tax on Works contract on

execution of works is waived off by the State Govt. at later stage for this project, the equivalent amount from the date of waiver of such tax (as per prevailing rate as on the date of waiver of Turnover Tax/ Sales Tax on Works Contract/ VAT) shall be deducted from the amount payable to the contractor from subsequent RA bills.

In the event of decrease / relaxation and / or waiver of any of the existing / prevailing tax(es), duties, levies, cess by Central / state Govt. Or any other statutory body (ies), after the last stipulated date for the receipt of tender including extension (if any), and the contractor thereupon has been paid or has raised claims of such tax(es), duties, levies, cess; such sums shall be recovered / deducted (from claims raised but which has not been paid) effective from the date as reckoned in the relevant statutory order / law / ordinance etc. The contractor, shall, within a period of 30 days of any such waiver/relaxation/decrease in tax(es), duties, levies, cess, give a written notice thereof to Engineer-in-charge stating the statutory change with Documentary proof thereto. Provided always that Engineer-in-charge shall have full powers to effect recovery/deduction on account of any such statutory change even if contractor has not intimated in the event when any such statutory action comes to his notice.

INCOME TAX DEDUCTION (TDS)

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.

VALUE ADDED TAX (VAT) / SALES TAX

The contractor shall comply with all the provisions of VAT / SALES TAX Act applicable in the respective state. The contractor shall be registered with the applicable sales tax authority of the state / Union territory as applicable for the works. The contractor shall be responsible for submission of appropriate sales tax / VAT to the authority and BSCDCL shall all times be kept indemnified for non-fulfil -ment of the sales tax / VAT obligations by the contractor including but not limited to registration, submission of tax & its returns at appropriate times and any other statutory obligation(s) in this regard as applicable. However, contractor is bound to submit the proof of deposit of Sales Tax / VAT to the BSCDCL failing which the Engineer-in-charge shall have, without prejudice to any other rights or remedy available under any of the clauses of contract, full powers to deduct / recover the sum(s) he deems fit from any amount due / payable or any security deposit available at his disposal.

SERVICE TAX

The tenderer shall quote his rates exclusive of Service Tax. The service tax shall be reimbursed on the produce of documentary evidence. The contractor must have registration No. with Service Tax Authorities and will provide copy of Registration to BSCDCL before release of any payment by the Corporation. The contractor will submit regular Invoice / Bill fulfilling 'all conditions of Service Tax Rules 1994 amended from time to time and shall produce proof of deposit of Service Tax to the Corporation as and when demanded failing which the Engineer-in-charge shall have without prejudice to any other rights or remedy available under any of the clauses of contract, full powers to deduct / recover the sum(s) he deems fit from any amount due / payable or any security deposit available at his disposal.

ROYALTY ON MATERIALS:

The contractor shall deposit royalty and obtain necessary permit for supply of bajri, stone, kankar, sand and other materials etc. from the local authorities and quoted rates shall be inclusive of royalty.

The contractor shall be deemed to have inspected the site, its surrounding and acquainted itself 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.

The rates and prices to be tendered in the bill of quantities 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's profit and establishment/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, all taxes, royalty, duties, cess, octroi and other levies, insurance liabilities and obligations set out or implied in the tender documents and contract.

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 direction of Engineer-in-Charge. If any damage is caused to any temporary or permanent structure(s) in the vicinity due to execution of the project, the contractor has to make good the same by any means as per direction of Engineer-in-Charge. The contractor should inspect the site of work from this point of view. 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 be entitled for any extra payment in this regard.

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

The materials, constructional plant, centering, shuttering and scaffolding materials and other things brought to the site for their full value. Whenever required by BSCDCL, the contractor shall produce the policy or the policies of insurance and the receipts for payment of the current premium.

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 BSCDCL the contractor shall produce the policy or the policies of Insurance and the receipt of payment of the current premiums.

THIRD PARTY INSURANCE

Contractor is required to take third party insurance cover for an amount of 5%(five percent) of contract value from an approved insurance company for insurance against any damage, injury or loss which may occur to any person or property including that of BSCDCL / owner / client, arising out of the execution of the works or temporary works. Wherever required by BSCDCL the contractor shall produce the policy or the policies of Insurance and the receipt of payment of the current premiums.

In case 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 aforesaid insurance covers are obtained by the contractor.

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 the BSCDCL's approval, by or through the subsidiary of the General Insurance Company.

The contractor shall at all times indemnify BSCDCL and Owner against all claims, damages or compensation under the provision of Payment of wages act-1936, Minimum Wages Act-1948, Employer's liability Act-1938, the workmen's compensation Act-1947, Industrial Disputes Act-1947 and Maternity Benefit Act-1961 or any modifications thereof or any other law in force or as consequence of any accident or injury to any workman or other persons in or about the works, whether in the employment of the contractor or not, against all costs, charges and expenses of any suit, action or proceedings arising out of such incident or injury and against all sum or sums which may with the consent of the contractor be paid to compromise or compound any such claim. Without limiting his obligations and liabilities as above provided, the contractor shall insure against all claims, damages or compensation payable under the Workmen's Compensation Act 1923 or any modification thereof or any other law relating thereto.

PAYMENTS

All running payments shall be regarded as payments by way of advance against the final payment only and not as payments for work actually done and completed and/or accepted by BSCDCL and shall not preclude the recovery for bad, unsound and imperfect or unskilled work to be removed and taken away and reconstructed or re-erected or be considered as an admission of the due performance of the Contract, or any part thereof, in this respect, or the accruing of any claim, nor shall it conclude, determine or affect in any way the powers of the BSCDCL under these conditions or any of them as to the final settlement and adjustments of the accounts or otherwise, or in any other way vary/ affect the contract. The final bill shall be submitted by the contractor within three months of the completion of work, otherwise BSCDCL's certificate of the measurement and of the total amount payable for the work accordingly shall be final and binding on contractor. Each Running Bills should be accompanied by two sets of at-least 20 (twenty) photographs as per direction of Engineer-in-charge taken from various points depicting status of work as on Report/ Bill date and Monthly Progress Report for the concerned month in the proforma to be given/ approved by Engineer-in-Charge. Intermittent progress Photographs as and when required shall also be provided by the Contractor at his own cost as per direction of Engineer-in-Charge. No payment of running account bill shall be released unless it is accompanied by photographs and Monthly Progress Report as above.

It is clearly agreed and understood by the Contractor that notwithstanding anything to the contrary that may be stated in the agreement between BSCDCL and the contractor; the contractor shall become entitled to payment only after BSCDCL has received the corresponding payment(s) from the client/ Owner for the work done by the contractor. Any delay in the release of payment by the client/ Owner to BSCDCL leading to a delay in the release the corresponding payment by BSCDCL to the contractor shall not entitle the Contractor to any compensation/ interest from BSCDCL.

All payments shall be released by way of e-transfer through RTGS/NEFT in India directly at their Bank account by BSCDCL.

MEASUREMENTS OF WORKS

Engineer-in-charge shall, except as otherwise provided, ascertain and determine by measurement, the value of work done in accordance with the contract.

Except where any general or detailed description of the work expressly shows to the contrary, measurement shall be taken in accordance with the

Procedure set forth in the CPWD Specification. In the case of items which are not covered by specifications, mode of measurement as specified in the Technical Specifications of the contract and if for any item no such technical specification is available, then a relevant standard method of measurement issued by the IS/Bureau of Indian Standard shall be followed.

Provided further that, In case of Cancellation/Determination of Contract in Full or in Part in accordance with clause of tender document (and its sub-clauses), following methodology shall be adopted in respect of measurements in addition to what has been mentioned in foregoing:-

All measurements and levels shall be taken jointly by the Engineer-in-Charge or his authorized representative and by the contractor or his authorized representative from time to time during the

progress of the work and such measurements shall be signed and dated by the Engineer-in-Charge and the contractor or their representatives in token of their acceptance. If the contractor objects to any of the measurements recorded, a note shall be made to that effect with reason and signed by both the parties.

If for any reason the contractor or his authorized representative is not available and the work of recording measurements is suspended by the Engineer-in-Charge or his representative, the Engineer-in-Charge and BSCDCL shall not entertain any claim from contractor for any loss or damages on this account. If the contractor or his authorized representative does not remain present at the time of such measurements after the contractor or his authorized representative has been given a notice in writing three (3) days in advance or fails to countersign or to record objection within a week from the date of the measurement, then such measurements recorded in his absence by the Engineer-in-Charge or his representative shall be deemed to be accepted by the Contractor. The contractor shall, without extra charge, provide all assistance with every appliance, labour and other things necessary for measurements and recording levels.

Any extra item which is required for completion of project rates shall be derived as per similar item available in DSR/BOQ or average as the rate quoted above or below by contractor. If both are not available rates will be derived as per market survey.

COMPUTERISED MEASUREMENT BOOKS

Engineer-in-Charge shall, except as otherwise provided, ascertain and determine by measurement the value of work done in accordance with the contract. All measurements of all items having financial value shall be entered by the contractor and compiled in the shape of the Computerized Measurement Book as per the format of BSCDCL so that a complete record is obtained of all the items of works performed under the contract. All such measurements and levels recorded by the contractor or his authorized representative from time to time, during the progress of the work, shall be got checked by the contractor from the Engineer-in-Charge or his authorized representative as per interval or program fixed in consultation with Engineer-in-Charge or his authorized representative.

After the necessary corrections made by the Engineer-in-Charge, the measurement sheets shall be returned to the contractor for incorporating the corrections and for resubmission to the Engineer-in-Charge for the dated signatures by the Engineer-in-Charge and the contractor or their representatives in token of their acceptance.

Whenever bill is due for payment, the contractor would initially submit draft computerized measurement sheets and these measurements would be got checked/test checked from the Engineer-in-Charge and/or his authorized representative. The contractor will, thereafter, incorporate such changes as may be done during these checks/test checks in his draft computerized measurements, and submit to BSCDCL a computerized measurement book, duly bound, and with its pages machine numbered. The Engineer-in-Charge and/or his authorized representative would thereafter check this MB, and record the necessary certificates for their checks/test checks.

The final, fair, computerized measurement book given by the contractor, duly bound, with its pages numbered, should be 100% correct, and no cutting or over-writing in the measurements would thereafter be allowed. If at all any error is noticed, the contractor shall have to submit a fresh computerized MB with its pages duly numbered and bound, after getting the earlier MB cancelled by the BSCDCL. The contractor shall submit two spare copies of such computerized MB's for the purpose of reference and record by the various officers of the BSCDCL.

The contractor shall also submit to the department separately his computerized Abstract of Cost and the bill based on these measurements, duly bound, and its pages numbered along with two spare copies of the "bill.

The contractor shall, without extra charge, provide all assistance with every appliance, labour and other things necessary for checking of measurements /levels by the Engineer-in-Charge or his representative.

The contractor shall give not less than seven days' notice to the Engineer-in-Charge or his authorized representative in charge of the work before covering up or otherwise placing beyond the reach of checking and/or test checking the measurement of any work in order that the same may be checked and/or test checked and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of checking and/or test checking measurement and shall not cover up and place beyond reach of measurement any work without consent in writing of the Engineer-in-Charge or his authorized representative in charge of the work who shall within the aforesaid period of seven days inspect the work, and if any work shall be covered up or placed beyond the reach of checking and/or test checking measurements without such notice having been given or the Engineer-in-Charge's consent being obtained in writing the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

Engineer-in-Charge or his authorized representative may cause either themselves or through another officer of the BSCDCL to check the measurements recorded by contractor and all provisions stipulated herein above or anywhere in the tender document shall be applicable to such checking of measurements or levels.

It is also a term of this contract that checking and/or test checking the measurements of any item of work in the measurement book and/or its payment in the interim, on account of final bill shall not be considered as conclusive evidence as to the sufficiency of any work or material to which it relates nor shall it relieve the contractor from liabilities from any over measurement or defects noticed till completion of the defects liability period.

WITHHOLDING AND LIEN IN RESPECT OF SUMS DUE FROM CONTRACTOR

Whenever any claim or claims for payment of a sum of money arises out of or under the contract or against the contractor, BSCDCL 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, BSCDCL shall be entitled to withhold 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 insufficient to cover the claimed amount or amounts or if no security has been taken from the contractor, BSCDCL 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 or which may at any time thereafter become payable to the contractor under the same contract or any other contract pending finalization of adjudication of any such claim.

It is an agreed term of the contract that the sum of money or moneys so withheld or retained under the lien referred to above by the Engineer-in-Charge or BSCDCL will be kept withheld or retained as such by the Engineer-in-Charge or BSCDCL 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 withholding 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 the BSCDCL 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 payable to any partner/limited company, as the case may whether in his individual capacity or otherwise. BSCDCL 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 work done by the contractor under the contract or any work claimed to have been 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 BSCDCL to recover the same from him in the manner prescribed in tender document of this clause or in any other manner legally permissible;

and if it is found that the contractor was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid by BSCDCL to the contractor, without any interest thereon whatsoever.

LIEN IN RESPECT 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 BSCDCL against any claim of the Engineer-in-Charge or BSCDCL 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 the BSCDCL. 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 the BSCDCL will be kept withheld or retained as such by the Engineer-in-Charge

or the BSCDCL or till his claim arising out of the same contract or any other contract is either mutually settled or determined 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 withheld or retained under this clause and duly notified as such to the contractor.

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

All items of work in the bill of quantities/ schedule of quantities shall be carried out as per the UADD (as the case may be) specifications, drawings and instructions of the Engineer-in-Charge of BSCDCL and the rates shall include for supply of required materials including proper storage, consumables, skilled & unskilled labour, supervision and tools, tackles, plant & machinery complete as called for in the detailed specifications and conditions of the contract. Latest updated UADD specification shall be followed for execution of work.

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.

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 these, is specified or is reasonably inferred from the contract. The contractor shall take full responsibility for adequacy, suitability and safety of all the works and methods of construction.

MATERIALS TO BE PROVIDED BY THE CONTRACTOR

The contractor shall, at his own expense, provide all materials, 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 materials 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 requested 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 materials to be tested or analyzed and bear all charges and cost of testing unless specifically provided for 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 persons to remove 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 be supplied and all costs which may require such removal and substitution shall be borne by the contractor

MATERIALS AND SAMPLES

The materials/products used on the works shall be one of the approved make/ 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 this matter shall be final and binding and nothing extra on this account shall be payable to the Contractor. In case single brand/ make are mentioned, other equivalent makes/ brands may be considered by the Engineer-in-Charge. In case of variance in UADD Specifications from approved products/makes specification, the specification of approved product/make shall prevail for which nothing shall be paid extra to the Contractor. 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 BSCDCL and the owner shall have the discretion to check quality of materials and equipment's to be incorporated in the work, at source of supply or site of work and even after incorporation in the work. 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 BSCDCL.

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 BSCDCL. The materials articles etc. as approved shall be *LABELLED* as such and shall be signed by BSCDCL and the Contractor's representative.

The approved samples shall be kept in the custody of the Engineer-in- Charge of BSCDCL 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.

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.

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 UADD (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. All equipment's shall be provided by the Contractor so as to be compatible with the testing requirements specified. The Contractor shall maintain all the equipment's 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 programme 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 calibration without delay. All field test shall be carried out in the presence of BSCDCL's 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 bill of quantities.

The contractor(s) shall display the calibration certificate of each equipment at the location of equipment & shall get recalibrated at least one week before its expiry date.

MATERIALS PROCURED WITH THE ASSISTANCE OF BSCDCL

If any material for the execution of this contract is procured with the assistance of BSCDCL either by issue from its stores or purchase made under orders or permits or licenses obtained by BSCDCL, the contractor shall hold and use the 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 the BSCDCL, shall return all such surplus or unserviceable materials that may be left with him after the completion of the contract or at its termination on whatsoever reason, on being paid or credited such price as the Engineer-in-charge shall determine having due regard to the conditions of materials. The price allowed to the contractor, however, shall not exceed the amount charged to him excluding the element of storage charges which shall be 10% of the cost charged to contractor. The decision of the Engineer-in-charge shall be final and conclusive.

Contractor(s) has / have to deploy security personnel for safeguarding of materials procured at site.

CONTRACTOR TO SUPPLY TOOLS & PLANTS

The contractor shall provide at his own cost all materials, machinery, tools & plants as require for completion of work. In addition to this, appliances, implements, other plants, ladders, cordage, tackle, scaffolding and temporary works required for the proper execution of the work, whether original, altered or substituted and whether included in the specifications or other documents forming part of the contract or referred to in these conditions or not, or which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer-in-Charge as to any matter as to which under these conditions he is entitled to be satisfied, or which he is entitled to require together with carriage therefore to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials, necessary for the purpose of setting out works, and counting, weighing and assisting the measurement or examination at any time and from time to time of the work or materials. Failing his so doing, the same may be provided by the Engineer-in-Charge at the expense of the contractor and the expenses may be deducted, from any money due to the contractor, under this contract or otherwise and/or from his security deposit or the proceeds of sale thereof, or of a sufficient portions thereof.

MOBILIZATION OF MEN, MATERIALS AND MACHINERY:

All expenses towards mobilization at site and de-mobilization including bringing in equipment, work force, materials, dismantling the equipment's, 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.

It shall be entirely the Contractor's responsibility to provide, operate and maintain all necessary construction equipment's, scaffoldings and 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 standby arrangement for water & electricity to ensure un-interrupted supply.

It shall be the responsibility of the contractor to obtain the approval for any revision and/or modification desired by him from BSCDCL before implementation.

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.

It is mandatory for the contractor to provide safety equipment's and gadgets to his all workers, supervisory and Technical staff engaged in the execution of the work while working. The minimum requirement (but not limited to) shall be gum boots, safety helmets, Rubber hand gloves, face masks, safety nets, safety belts, goggles etc. as per work requirements. Sufficient nos. of these equipment's and gadgets shall also be provided to BSCDCL by the contractor at his own cost for use of BSCDCL Officials and/ or workforce while working/supervision of work at site. No staff/ worker shall be allowed to enter the site without these equipment's/ gadgets.

The cost of the above equipment's/ gadgets are deemed to be included in the rates quoted by the contractor for the items & works as per Bill of Quantities and contractor shall not be entitled for any extra payment in these 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's/ 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 contractor shall abide by all rules & regulations pertaining to Health, Safety and Environment.

All designs, drawings, bill of quantities, etc., except Bar Bending Schedule, Shop & Fabrication drawings, for all works shall be supplied to the contractor for their scope of work all buildings services and development works by BSCDCL in phased manner as the works progress. However it shall be the duty and responsibility of the contractor to bring to the notice of the BSCDCL in writing as to any variation, discrepancy or any other changes required and to obtain revised drawings and designs and / or approval of the BSCDCL in writing for the same.

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.

All materials, construction plants and equipment's 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 the Engineer-in-charge. Similarly all enabling works built by the contractor for the main construction undertaken by him, shall not be dismantled and removed without the written authority of the BSCDCL.

Contractor shall have to prepare the Bar Bending Schedule, shop and fabrication drawings free of cost, if required for any of the items of work.

Five copies of these drawings each including for revision will be submitted to BSCDCL for approval. Before executing the item, shop drawings and bar bending schedule should be approved by BSCDCL.

BSCDCL shall supply Work Force in the various categories to assist the contractor in execution of the works on recoverable basis as per provision mentioned elsewhere in the contract.

All contractors' plant, machinery and equipment shall be kept in perfect condition during currency of the contract.

QUALITY ASSURANCE PROGRAMME

To ensure that the services under the scope of this contract are 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 finalize such Quality Assurance Programme within 15 days from date of issue Letter of Award. BSCDCL shall also carryout quality audit and quality surveillance of

systems and procedures of Contractor's quality control activities. A Quality Assurance Programmer of Contractor shall generally cover the following:
His organization structure for the management and implementation of the proposed Quality Assurance Program.

- ❖ Documentation control system.
- ❖ The procedure for purpose of materials and source inspection.
- ❖ System for site controls including process controls.
- ❖ Control of non-conforming items and systems for corrective actions.
- ❖ Inspection and test procedure for site activities.
- ❖ System for indication and appraisal of inspection status.
- ❖ System for maintenance of records.
- ❖ System for handling, storage and delivery.

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.

All the quality reports shall be submitted by the Contractors in the formats appended hereto. 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 BSCDCL. All the costs associate with Printing of Formats and 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.

CONTRACT COORDINATION PROCEDURES, COORDINATION MEETINGS AND PROGRESS REPORTING

The Contractor shall prepare and finalize in consultation with BSCDCL, a detailed contract coordination procedure within 15 days from the date of issue of Letter of Award for the purpose of execution of the Contract. The Contractor shall have to attend all the meetings at any place in India at his own cost with BSCDCL, Owners/ Clients or Consultants of BSCDCL/ Owner/ Client during the currency of the Contract, as and when required and fully cooperate with such personal and agencies involved during these discussions. The Contractor shall not deal in any way directly with the Clients/ Owners or Consultants of BSCDCL/Owner/ Clients and any dealing/correspondence if required at any time with Clients/ Owners/ Consultants shall be through BSCDCL only. During the execution of the work, Contractor shall submit at his own cost a detailed Monthly progress & programme report to the Engineer-in-charge of BSCDCL by 5th of every month. The format of monthly progress & programme report shall be as approved by Engineer-in-Charge of BSCDCL.

COMPLETION CERTIFICATE AND COMPLETION PLANS

Within ten days of the completion of the work, the contractor shall give notice of such completion to the Engineer-in-Charge and within thirty days of the receipt of such notice, the Engineer-in-Charge shall inspect the work and if there is no defect in the work, shall furnish the contractor with a final certificate of completion, otherwise a provisional certificate of physical completion indicating defects (a) to be rectified by the contractor and/or (b) for which payment will be made at reduced rates, shall be issued. But no final certificate of completion shall be issued, nor shall the work be considered to be complete until the contractor shall have removed from the premises on which the

work shall be executed all scaffolding, surplus materials, rubbish and all huts and sanitary arrangements required for his/their work people on the site in connection with the execution of the works as shall have been erected or constructed by the contractor(s) and cleaned off the dirt from all wood work, doors, windows, walls, floor or other parts of the building, in, upon, or about which the work is to be executed or of which he may have had possession for the purpose of the execution; thereof, and not until the work shall have been measured by the Engineer-in-Charge. If the contractor shall fail to comply with the requirements of this Clause as to removal of scaffolding, surplus materials and rubbish and all huts and sanitary arrangements as aforesaid and cleaning off dirt on or before the date fixed for the completion of work, the Engineer-in-Charge may at the expense of the contractor remove such scaffolding, surplus materials and rubbish etc., and dispose of the same as he thinks fit and clean off such dirt as aforesaid, and the contractor shall have no claim in respect of scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof less actual cost incurred on removal of materials / debris / malba etc.

The contractor shall submit completion plan as required vide General Specifications for Electrical works as applicable within thirty days of the completion of the work. In case, the contractor fails to submit the completion plan as aforesaid, he shall be liable to pay a sum equivalent to 2.5% of the value of the work subject to a ceiling of Rs.5,00,000 (Rs. Five Lakhs only) as may be fixed by the Engineer-in-charge concerned and in this respect the decision of the Engineer-in-charge shall be final and binding on the contractor.

PROHIBITION OF UNAUTHORISED CONSTRUCTION & OCCUPATION

No unauthorized buildings, construction of structures should be put up by the contractor anywhere on the project site, neither any building built by him shall be occupied in un-authorized manner by him or his staff.

It shall be the responsibility of the contractor to see that the building under construction is not occupied by anybody in un-authorized manner during construction, and is handed over to the Engineer-in-Charge with vacant possession of complete building. If such building though completed is occupied illegally, then the Engineer-in-Charge shall have the option to refuse to accept the said building/buildings in that position. Any delay in acceptance on this account will be treated as the delay in completion and for such delay, a levy of compensation upto 5% of tendered value of work may be imposed by the Engineer-in-Charge whose decision shall be final both with regard to the justification and quantum and shall be binding on the contractor.

However, the Engineer-in-Charge, through a notice, may require the contractor to remove the illegal occupation any time on or before construction and delivery.

FORECLOSURE OF CONTRACT BY BSCDCL/OWNER

If at any time after the commencement of the work the BSCDCL shall for any reason whatsoever is required to abandon the work or is not require the whole work thereof as specified in the tender to be carried out, the Engineer-in-Charge shall give 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 foreclosure of the whole or part of the works.

DEFECTS LIABILITY PERIOD

The contractor shall be responsible for the rectification of defects in the works for a period 10 years from the date of taking over of the works by the BSCDCL or clients whichever is later. Any defects discovered and brought to the notice of the contractor forthwith 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 BSCDCL at the cost and expense of the contractor.

The Contractor is expected to carry out the construction work in Workmen like manner so as to meet the requirement and specification for the project. It is expected that the

Workmanship and materials will be reasonably fit for the purpose for which they are required.

Defects or defective work is where standard and quality of workmanship and materials as specified in the contract is deficient. Defect is defined as a failure of the completed project to satisfy the express or implied quality or quantity obligations of the construction contract. Defective construction works are as the works which fail short of complying with the express descriptions or requirements of the contract, especially any drawings or specifications with any implied terms and conditions as to its quality, workmanship, durability, aesthetic, performance or design. Defects in construction projects are attributable to various reasons.

Some of the defects are structural defects results in cracks or collapse of faulty defective plumbing, inadequate or faulty drainage system, inadequate or faulty ventilation, cooling or heating systems, inadequate fire systems etc. The defects could be various on accounts of different reasons for variety of the projects.

The Engineering In charge/Project Officer shall issue the practical completion certificate for the project. During the Defect Liability Period which commences on completion of the work, the Engineering In charge shall inform or the contractor is expected to be informed of any defective works by the Employer's representative of the defects and make good at contractor's cost with an intention of giving opportunity to the contractor of making good the defects appeared during that period. It is the contractor's obligation under the contract to rectify the defects that appear during Defect Liability Period and the contractor shall within a reasonable time after receipt of such instructions comply with the same at his own cost. The Engineering In charge/Project Officer shall issue a certificate to that effect and completion of making good defects shall be deemed for all the purpose of this contract to have taken place on the day named in such defect liability certificate.

If defective work or workmanship or design have been knowingly covered-up or concealed so as to constitute fraud, commencement of the Defect Liability Period may be delayed. The decided period may be delayed until **discover** actually occurs on at least the defect could have been discovered with reasonable diligence, whichever is earlier.

Also, in case of defect, the Engineer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at. The Defects Liability Period shall be extended for as long as Defects remain to be corrected. Every time notice of Defect/Defects is given, the Contractor shall correct the notified Defect/Defects within the duration of time specified by the Engineer's notice. The Engineer may issue notice to the Contractor to carry out removal of defects or deficiencies, if any, noticed in his inspection, or brought to his notice. The Contractor shall remove the defects and deficiencies within the period specified in the notice and submit to the Engineer a compliance report.

It is the Completion Stage when the contractor has completed all of the works and fixed all of the defects that were on the list of issue by Engineer-in-charge. When this happens, the engineer must issue a 'Certificate of Completion'. On the issue of 'Certificate of Completion', the 'Defect Liability Period' starts. The contractor also must issue a 'Certificate statement' as an acknowledgment to the engineer not later than 14 days after the 'Certificate of Completion' has been issued. During the 'Defect Liability Period', the contractor has to obey all written instructions from the engineer to carryout repairs and fix any defects which appear in the Permanent Works. If the contractor does not ,due to his own faults finish the repair works or fix the defects by the end of 'Defect Liability Period', the 'Defect Liability Period' will continue until all works instructed by engineer is done.

RESTRICTION ON SUBLETTING

The contractor shall not sublet or assign the whole or part of the works except where otherwise provided, by the contract. The provision of labour on piece work basis shall not be deemed to be a subletting under this clause.

The contractor may entrust specialist items of works like MEP services, HVAC, Lifts, Building Management System, Water Proofing, and Data & Communication networking, interiors, landscaping etc. 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 BSCDCL. These details shall include the expertise, financial status, technical manpower, equipment, resources and list of works executed and on hand of the specialist agency. Further, prior written approval is required from BSCDCL to deploy such agency / sub-contractor.

FORCE MAJEURE

Any delay in or failure to perform of either party, shall not constitute default so as to give rise to any claim for damages, to the extent such delay or failure to perform is caused by an act of God, or by fire, explosion, flood or other natural catastrophe, governmental legislation, orders or regulation etc. Failure of the client / owner to hand over the entire site and / or release funds for the project, to BSCDCL, shall also constitute force majeure. The time for performance of the obligation by the parties shall be deemed to be extended for a period equal to the duration of the force majeure event. Both parties shall make their best efforts to minimize the delay caused by the force majeure event. If the failure / delay of the client /owner in handing over the entire site and / or in releasing the funds continues even on the expiry of the stipulated date of completion, BSCDCL, may, at the request of the contractor, foreclose the contract without any liability to either party. In the event of such foreclosure, the contractor shall not be entitled to any compensation whatsoever. If prior to such foreclosure the contractor has brought any materials to the site, the Engineer-in-Charge shall always have the option of taking over of all such materials at their purchase price or at the local current rates, whichever is lower.

NO COMPENSATION CLAUSE

The contractor shall have no claim whatsoever for compensation or idle charges against BSCDCL on any ground or for any reason, whatsoever.

DIRECTION FOR WORKS

All works under the contract shall be executed under the direction and subject to approval in all respect of the Engineer-in-Charge of BSCDCL who shall be entitled to direct at whatever point or points and in whatever manner works are to be commenced and executed.

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.

WORK IN MONSOON AND RAIN

The execution of the work may entail working in the monsoon also. The contractor must maintain labour force as may be required for the job and plan and execute the construction and erection according to the prescribed schedule. No special/ extra rate will be considered for such work in monsoon. The contractors' rate shall be considered inclusive of cost of dewatering due to rains required if any and no extra rate shall be payable on this account. The stipulated period for completion of project includes the monsoon period, holidays & festivals.

WORK ON SUNDAYS, HOLIDAYS AND DURING NIGHT

For carrying out work on Sunday and Holidays or during night, the contractor will approach the Engineer-in-Charge or his representative at least two days in advance and obtain his permission. The Engineer-in-Charge at his discretion can refuse such 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 with the approval of Engineer-in-Charge at no extra cost to BSCDCL.

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.

LAND FOR LABOUR HUTS/SITE OFFICE & STORAGE ACCOMMODATION

The contractor shall arrange the land for temporary office, storage accommodation and labour huts at his own cost and get the clearance of local authorities for setting up/construction 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. The vacant possession of the land used, for the purpose shall be given back by contractor 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. 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 BSCDCL, he shall comply with such instructions at his cost and risk and no claim whatsoever shall be entertained on this account.

WATCH, WARD AND LIGHTING OF WORK PLACE

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

SCHEDULE OF QUANTITIES / BILL OF QUANTITIES

The quantities shown against the various items of work are only approximate quantities which may vary as per the actual requirement at site. No item which is not covered in the bill of quantities shall be executed by the Contractor without the approval of the BSCDCL. In case any Extra/Substituted item is carried out without specific-approval, the same will not be paid.

WATER PROOF TREATMENT

- 3.8** The water proof treatment shall be of type and specifications as given in the schedule of quantities.

The water-proofing of basement, roofs, water retaining areas shall be and remain fully effective for a period of not less than 10(Ten) years to be reckoned from the date of expiring of the Defect Liability period, prescribed in the contract. At any time during the said guarantee period if BSCDCL finds any defects in the said treatment or any evidence of re-infestation, dampness, leakage in any part of buildings or structure and notifies the contractor of the same, the contractor shall be liable to rectify the defect or give re-treatment and shall commence the work or such rectification or re-treatment within seven days from the date of issue of such letter to him. If the contractor fails to commence such work within the stipulated period, the BSCDCL may get the same done by

another agency at the Contractor's cost and risk and the decision of the Engineer-in-Charge of BSCDCL 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 BSCDCL.

The BSCDCL 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 proofing 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 BSCDCL. Water proofing shall be got done through approved / specialized agencies only with prior approval of Engineer-in-Charge.

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.

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 cost and risk.

The contractor shall make his own arrangement for all equipment's required for the execution of the job. The contractor whose tender is accepted shall execute Guarantee Bond in the prescribed form as appended for guaranteeing the water proofing treatment.

INDIAN STANDARDS

Wherever any reference is made to any IS in any particular specifications, drawings or bill of quantities, it means the Indian Standards editions with up to date amendments issued till last date of receipt of tender documents.

CENTERING & SHUTTERING

Marine plywood or steel plates or any material mentioned elsewhere in the tender document or as approved by Engineer-in-Charge shall be used for formwork. The shuttering plates shall be cleaned and oiled before every repetition and shall be used only after obtaining approval of BSCDCL's Engineers at site. The number of repetitions allowed for plywood and steel shuttering shall be at the discretion of Engineer-in-Charge of BSCDCL 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.

RECORDS OF CONSUMPTION OF CEMENT & STEEL

For the purpose of keeping a record of cement and steel received at site and consumed in works, the contractor shall maintain a properly bound register in the form approved by the BSCDCL, 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 BSCDCL's representative.

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

In case cement or steel quantity consumed is lesser as compared to the theoretical requirement of the same as per MORTH/UADD/MPPWD/CPWD (as the case may be) specifications/ norms, the work will be devalued 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 item rates of the work done subject to the condition that the tests results fall within the acceptable criteria as per MORTH/UADD/MPPWD/CPWD (as the case may be) 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 effected from the contractors bills at the penal rate for the actual quantity which is lower than 98% of theoretical consumption.

TESTS AND INSPECTION

The contractor shall carry out the various mandatory tests as per specifications and the technical documents that will be furnished to him during the performance of the work. All the tests on materials, as recommended by UADD/MPPWD/CPWD, MORTH and relevant Indian Standard Codes or other standard specifications (including all amendments current at the last date of submission of tender documents) shall be got carried out by the contractor at the field testing laboratory or any other recognized institution/ laboratory, at the direction of the BSCDCL. All testing charges, expenses etc. shall be borne by the contractor. All the tests, either on the field or outside laboratories concerning the execution of the work and supply of materials shall be got carried out by the contractor or BSCDCL at the cost of the Contractor.

WORKS TO BE OPEN TO INSPECTION

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 the BSCDCL. 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 owner/lients. The compliance of observations/improvements as suggested by the inspecting officers of BSCDCL/CTE/ State authorities/ Owners shall be obligatory on the part of the Contractor at the cost of contractor.

BORROW AREAS

The contractor shall make his own arrangements for borrow pits and borrow disposal areas including their approaches and space for movement of man, machinery, other equipment's 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 unit rates quoted by the contractor for various items of bill of quantities shall deemed to include the same.

3.9 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 any damage/loss to the works or to any part thereof or to any temporary works due to lack of precautions or due to negligence on part of Contractor, the same shall be made good by the Contractor.

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 BSCDCL shall be final and binding on the contractor. No claim whatsoever shall be admissible on this account.

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 BSCDCL shall not in any way relieve the contractor of his responsibility for the correctness.

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 the reach of inspection/measurement without such notice or his consent being obtained the same shall be uncovered at the contractor expenses and he shall have to make it good at his own expenses.

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 the BSCDCL the contractor shall remove all temporary structures like the site offices, cement go-down, stores, labour hutments etc., scaffolding rubbish, debris etc. left over materials tools and plants, equipment's etc., clean the site to the entire satisfaction of the Engineer-in-charge. If this is not done the same will be got done by BSCDCL 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 rates quoted by the contractor shall be deemed to have included the same.

SET-OFF OF CONTRACTOR'S LIABILITIES

BSCDCL 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.

POSSESSION PRIOR TO COMPLETION

BSCDCL 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 BSCDCL 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 BSCDCL in such case shall be final binding and conclusive.

When the whole of the works or the items or the groups of items of work have been completed the contractor will give a notice to that effect to the Engineer in writing. The Engineer shall within 7 days of the date of receipt of such notice inspect the works and give instructions in writing to the contractor specifying the balance items of work which are required to be done by the contractor and shall also notify the contractor of any defect in the works affecting completion.

- 3.10** 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 BSCDCL by the contractor within 30 days of the completion. All costs incurred in this respect shall be borne by the contractor.

EMPLOYMENT OF PERSONNEL

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 is associated with the works.

In case BSCDCL observed misconduct negligence or incompetence etc. on the part of any representative, agent, servant and workmen or employees etc. of the contractor, the BSCDCL shall have full power and without giving any reason to the contractor, instruct the contractor to remove such engineer / staff / worker from site and provide suitable replacements. The decision of

the Engineer-in-charge shall be final and binding on the contractor. The contractor shall not be allowed any compensation on this account.

TECHNICAL STAFF FOR WORK

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 numbers to be deployed, their qualification, experience as decided by BSCDCL 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 BSCDCL to take instructions. Within 15 days of Letter of Award, the contractor shall submit a site organizational chart and resume including details of experience of the Project-in-Charge and other staff proposed to be deputed by him and the technical team shall be deputed by them on the Project after getting approval from Engineer-in-Charge. If desired by the contractor at later date, the Project-in-Charge and other staff whose resume is approved by BSCDCL can be replaced with prior written approval of BSCDCL 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 technical reasons and exigency of work can direct the contractor to depute such additional staff as in view of Engineer-in-Charge is necessary and having qualification and experience as approved by the Engineer-in-Charge. 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.

In case the contractor fails to employ the staff as aforesaid he shall be liable to pay a reasonable amount not exceeding a sum of **Rs. 50,000** (Rupees Fifty Thousand only) for each month of default in the case of each person. The decision of the Engineer-in-charge as to number of Technical Staff to be adequate for the project and the period for which the desired strength of technical staff was not employed by the contractor and as to the reasonableness of the amount to be deducted on this account shall be final and binding on the contractor as to the amount and the contractor's liability to pay the said amount.

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 be found in, under or upon the site, shall be the property of the owner/ BSCDCL.

MATERIALS OBTAINED FROM DISMANTLEMENT TO BE OWNER'S PROPERTY

All materials like stone, boulders and other materials obtained during the work of dismantling, excavation etc. will be considered BSCDCL/owner property and such materials shall be disposed off to the best advantage of BSCDCL/owner according to the instructions in writing issued by the Engineer-in-charge.

FURNISHED OFFICE ACCOMMODATION & MOBILITY COMMUNICATION TO BE ARRANGED BY CONTRACTOR

On acceptance of tender, the contractor at his own cost will construct a suitably equipped office at site with basic facilities such as telephone(s), fax, internet, photocopier, computer(s) and printer(s) along with operator(s), regular electric & drinking water supply and staff carrying vehicles for the supervisory staff with driver, fuel and maintenance etc. as per the requirement of the project. The contractor shall maintain the aforesaid facilities intact/operational during the tenancy of the contract or maximum up to 6 months beyond the stipulated contractual completion date if the work is delayed due to any reasons. Operation and maintenance cost of all such materials, equipment's / services shall be borne by the contractor.

The contractor shall also make sufficient arrangement for photography/video-graphy so that photographs video can be taken of any specific activity at any point of time. The contractor shall also make arrangement of software like MS Project etc. for the purpose of preparing progress report etc.

The contractor shall make all arrangements for ground breaking ceremony/inaugural function etc. for the project as required and the cost towards it deemed to be included in his rates/offer. Any expenditure already incurred/to be incurred by BSCDCL, shall be recovered from the contractor.

LABOUR LAWS

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 Act (Regulation & Abolition) Central Rules 1971 and amended from time to time, and continue to have a valid license until the completion of the work including defect liability period. The contractor shall also adhere by the provision of the child labour (Prohibition and Regulation) Act. 1986 and as amended from time to time.

The contractor shall also comply with the provisions of the building and other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and the building and other Construction Workers Welfare Cess Act, 1996.

Any failure to fulfill above requirement shall attract the penal provisions of this contract arising out the resultant for non-execution of the work before the commencement of work. No labour below the age of 18 years shall be employed on the work.

Payment of wages:

The contractor shall pay to labour employed by him either directly or through subcontractors, wages not less than fair wages as defined in the BSCDCL Contractor's Labour Regulations or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970 and the contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

The contractor shall, notwithstanding the provisions of any contract to the contrary, cause to be paid fair wage to labour indirectly engaged on the work, including any labour engaged by his sub-contractors in connection with the said work, as if the labour had been immediately employed by him. In respect of all labour directly or indirectly employed in the works for performance of the contractor's part of this contract, the contractor shall comply with or cause to be complied with the BSCDCL contractor's Labour Regulations in regard to payment of wages, wage period, deductions from wages recovery of wages not paid and deductions unauthorized made, maintenance of wage books or wage slips, publication of scale of wages and other terms of employment, inspection and submission of periodical returns and all other matters of the like nature or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

- (a) The Engineer-in-Charge concerned shall have the right to deduct from the moneys due to the contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfilment of the conditions of the contract for the benefit of the workers, non-payment of wages or of deductions made from his or their wages which are not justified by their terms of the contract or non-observance of the Regulations.
- (b) Under the provision of Minimum Wages (Central) Rules, 1950, the contractor is bound to allow to the labours directly or indirectly employed in the works one day rest for 6 days continuous work and pay wages at the same rate as for duty. In the event of default, the Engineer-in-Charge shall have the right to deduct the sum or sums not paid on account of wages for weekly holidays to any labours and pay the same to the persons entitled thereto from any money due to the contractor by the Engineer-in-Charge concerned.

The contractor shall comply with the provisions of the Payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees Liability Act, 1938, Workmen's Compensation Act, 1923, Industrial

Disputes Act, 1947, Maternity Benefits Act, 1961, and the Contractor's Labour (Regulation and Abolition) Act 1970, or the modifications thereof or any other laws relating thereto and the rules made there under from time to time.

The contractor shall indemnify and keep indemnified BSCDCL against payments to be made under and for the observance of the laws aforesaid and the BSCDCL Contractor's Labour Regulations without prejudice to his right to claim indemnity from his sub-contractors.

The laws aforesaid shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this contract.

LABOUR SAFETY PROVISION

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

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

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.

OBSERVANCE OF LABOUR LAWS

The contractor shall be fully responsible for observance of all labour laws applicable including local laws and other laws applicable in this matter and shall indemnify and keep indemnified BSCDCL against effect or non observance of any such laws. The contractor shall be liable to make payment to all its employees, workers and sub-contractors and make compliance with labour laws. If BSCDCL or the client/ owner is held liable as "Principal Employer" to pay contributions etc. under legislation of Government or Court decision in respect of the employees of the contractor, then the contractor would reimburse the amount of such payments, contribution etc. to BSCDCL and/ or same shall be deducted from the payments, security deposit etc. of the contractor.

The Contractor shall submit proof of having valid EPF registration certificate. He shall within 7 days of the close of every month, submit to BSCDCL a statement showing the recoveries of contributions in respect of each employee employed by or through him and shall furnish to BSCDCL such information as the BSCDCL is required to furnish under the provisions of para 36 B of the EPF scheme 1952 to the EPF authorities and other information required by EPFO authorities from time to time. He shall also submit a copy of challan every month in token of proof of having deposited the subscription and contribution of workers engaged on the project.

In case, the contractor is not complying the above provision BSCDCL shall withhold payment to the extent of 4.70% (Four point Seven Zero percent) of the value of the Running Account bill and shall release only after the submission of above mentioned details. If it is incumbent upon BSCDCL to deposit withhold amount with EPF authorities, the withhold amount shall be deposited by BSCDCL with EPF authorities. In such a case BSCDCL shall not refund this withheld amount to the contractor even after the production of EPF registration certificate.

MINIMUM WAGES ACT

The contractor shall comply with all the provisions of the minimum wages Act, 1948, contract labour Act (Regulation & Abolition) 1970, and rules framed there under and other labour laws/local laws affecting contract labour that may be brought into force from time to time.

LABOUR CESS

The rates of the contractor shall be inclusive of labour cess. BSCDCL shall make a recovery @ 1% on account of labour cess from each RA bill of the contractor and labour cess so recovered/deducted shall be deposited with the Labour Board of the concerned state. In case the Labour Board is not established in the state, recovery made by BSCDCL on account of labour

cess shall be retained under suspense account and will be deposited with the Labour Board at later date as & when the Labour Board is constituted in the state.

Every contractor, sub-contractor, affiliates, their legal assigns or heirs as the case may, shall be responsible for registration of every Building worker who has completed eighteen years of age but has not completed sixty years of age and who has been engaged in any Building or Other Construction Work for not less than Ninety Days during the preceding twelve months; with the Board / Funds as applicable under various sections of "THE BUILDINGS AND OTHER Construction workers (regulation of employment and conditions of service) act, 1996 and the building and other Construction workers' welfare cess act, 1996.

The contractor shall also be responsible for maintaining register of beneficiaries i.e. the workers in such form as may be prescribed by the competent authority & the same shall be kept open at all reasonable times for inspection of relevant authority and officials of client / BSCDCL.

The contractor shall be further responsible for maintaining such register & records; giving such particulars of Building workers employed by him, the work performed by them, the number of hours of work which shall constitute a normal working day, the wages paid to them, the receipts given by them and, such other particulars in such form as may be prescribed by the authority or BSCDCL.

In the event of contractor failing to comply with the above clause(s) in part or in full, BSCDCL, without prejudice to any other rights or remedy available under law or any other clause(s) of contract, shall be at absolute liberty to forfeit any sum or sums that are payable or could become payable on account of execution of contract work and decision of Engineer-in-charge shall be final & binding in this regard on the contractor.

RECOVERY OF COMPENSATION PAID TO WORKMEN

In every case in which by virtue of the provisions sub-section (1) of Section 12, of the Workmen's Compensation Act, 1923, BSCDCL is obliged to pay compensation to a workman employed by the contractor, in execution of the works, BSCDCL will recover from the contractor, the amount of the compensation so paid; and, without prejudice to the rights of the BSCDCL under sub-section (2) of Section 12, of the said Act, BSCDCL shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due to the contractor whether under this contract or otherwise. BSCDCL shall not be bound to contest any claim made against it under sub-section (1) of Section 12, of the said Act, except on the written request of the contractor and upon his giving to BSCDCL full security for all costs for which BSCDCL might become liable in consequence of contesting such claim.

ENSURING PAYMENT AND AMENITIES TO WORKERS IF CONTRACTOR FAILS

In every case in which by virtue of the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and of the Contract Labour (Regulation and Abolition) Central Rules, 1971, BSCDCL is obliged to pay any amounts of wages to a workman employed by the contractor in execution of the works, or to incur any expenditure in providing welfare and health amenities required to be provided under the above said Act or under the BSCDCL Contractor's Labour Regulations, or under the Rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by BSCDCL's Contractors, BSCDCL will recover from the contractor, the amount of wages so paid or the amount of expenditure so incurred; and without prejudice to any other right or remedy available under this contract, BSCDCL shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by BSCDCL to the contractor whether under this contract or otherwise BSCDCL shall not be bound to contest any claim made against it under sub-section (1) of Section 20, sub-section (4) of Section 21, of the said Act, except on the written request of the contractor and upon his giving to the BSCDCL full security for all costs for which BSCDCL might become liable in contesting such claim.

CHANGE IN FIRM'S CONSTITUTION TO BE INTIMATED

Where the contractor is a partnership firm, the prior 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 where under the partnership firm would have the right to carry out the works hereby undertaken by the contractor. If prior approval as aforesaid is not obtained, the contract shall be deemed to have been assigned in contravention as per conditions of tender document hereof and the same action may be taken, and the same consequences shall ensue as provided in the said conditions of contract.

INDEMNITY AGAINST PATENT RIGHTS

The contractor shall fully indemnify the BSCDCL from and against all claims and proceedings for or on account of any infringement of any patent rights, design, trademark or name or other protected rights in respect of any construction plant, machine, work or material used for in connection with the works or temporary works.

LAW COVERING THE CONTRACT

This contract shall be governed by the Indian laws for the time being in force.

LAWS, BYE-LAWS RELATING TO THE WORK

The contractor shall strictly adhere 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 bylaws as aforesaid, and to pay all fees and taxes payable to such authorities in respect thereof.

CONTRACT AGREEMENT

The Contractor shall enter into a Contract Agreement with the BSCDCL within 10 (TEN) days from the date of Letter of Award or within such extended time, as may be granted by the BSCDCL failing which no payment shall be released to the contractor. The cost of stamp papers, stamp duty, registration, if applicable on the contract, shall be borne by the Contractor. In case, the contractor does not sign the agreement as above or start the work within 10 (Ten) days of the issue of letter of Award, his earnest money is liable to be forfeited and Letter of award consequently will stand withdrawn.

MANNER OF EXECUTION OF AGREEMENT

The agreement as per prescribed Performa as enclosed shall be signed at the office of the BSCDCL within 10(TEN days) days from the date of issue of Letter of Award. The Contractor shall provide 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 Award read in conjunction with the Tendering Documents will constitute a binding contract.

The agreement will be signed in five originals and the Contractor shall be provided with one signed original and the other four originals will be retained by the BSCDCL

The Contractor shall provide free of cost to the BSCDCL all the Engineering data, drawings and descriptive materials submitted along with the tender, in at least three (3) copies to form an integral part of the Agreement within seven 7 days after issuing of Letter of Award.

Subsequent to signing of the Agreement, the Contractor at his own cost shall provide to the BSCDCL with at least five (5) true hard bound copies of Agreement within thirty (30) days of its signing.

JURISDICTION

The agreement shall be executed at BHOPAL on non-judicial stamp paper purchased in BHOPAL and the courts in BHOPAL alone will have jurisdiction to deal with matters arising there from, to the exclusion of all other courts.

SECTION-4

LABOUR SAFETY, HEALTH AND REGULATIONS INCLUDING FORMS

LABOUR SAFETY PROVISIONS

Suitable scaffolds should be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and hand holds shall be provided on the ladder and the ladder shall be given an inclination not steeper than $\frac{1}{4}$ to 1 (1/4 horizontal and 1 vertical).

Scaffolding or staging more than 3.6m (12 feet) above the ground or floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly attached or bolted, braced and otherwise secured at least 90 cm. (3 feet) high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

Working platforms, gangways, and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more that 3.6m (12 feet) above ground level or floor level, they should be closely boarded, should have adequate width & should be suitable fastened as described in (2.0) above. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm (3 feet).

Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9m. (30 feet) in length while the width between side rails in rung ladder shall in no case be less than 29 cm. (11.5") for ladder up to and including 3m (10 feet) in length. For longer ladders this width should be increased at least 1/4" for each additional 30 cm (1 ft.) of length. Uniform step spacing shall not exceed 30 cm (12"). Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites of the work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect the public from accident, and shall be bound to bear the expenses of defense of every suit, action or other proceeding at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit, action or proceedings to any such person or which may, with the consent of the Contractor, be paid to compensate any claim by any such person.

EXCAVATION AND TRENCHING

All trenches, 1.2mts.(four feet) or more in depth, shall at all times be supplied with at least one ladder for each 30m.(100 feet) in length or fraction thereof, ladder shall be extended from bottom of the trench to at least 90cm (3feet) above the surface of the ground. The side of the trenches, which are 1.5 m. (5feet) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger or sides to collapsing. The excavated materials shall not be placed within 1.5m (5 feet) of the edges of the trench or half of the depth of the trench whichever is more.

Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

Demolition - Before any demolition work is commenced and also during the progress of the work following precautions shall be observed:

All roads and open areas adjacent to the work site shall either be closed or suitably protected.

No electric cable or apparatus which is likely to be a source of danger or a cable or apparatus used by the operator shall remain electrically charged.

All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be overloaded with debris or materials as to render it unsafe.

All necessary personal safety equipment's as considered adequate by the Engineer-in-charge should be kept available for the use of persons employed on the site and maintained in a condition suitable for immediate use, and the contractor should take adequate step to ensure proper use of equipment by those concerned. The following safety equipment shall be invariably provided.

Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles.

Those engaged in white washing and mixing or stacking of cement bags or any materials which are injurious to the eye shall be provided with protective goggles.

- 4.1 Those engaged in welding works shall be provided with welders protective eye shields.

Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe interval.

When workers are employed for works in sewers and manholes, which are in active use, the Contractors shall ensure that the manhole covers are opened and ventilated at-least for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident the public. In addition, the contractor shall ensure that the following safety measures are adhered to:

Entry for workers into the sewer line shall not be allowed except under supervision of the JE or any other higher officer.

At least 5 to 6 manholes upstream and downstream should be kept open for at least 2 to 3 hours before any man is allowed to enter into the manholes for working inside.

Before entry, presence of Toxic gases should be tested by inserting wet lead acetate paper which changes color in the presence of such gases and gives indication of their presence. Presence of Oxygen should be verified by lowering a detector lamp into the manhole. In case, no Oxygen is found inside the sewer line, workers should be sent only with Oxygen kit.

Safety belt with rope should be provided to the workers. While working inside the manholes such rope should be handled by two men standing outside to enable him to be pulled out during emergency.

The area should be barricaded or cordoned off by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public whenever cleaning works are undertaken during night or day.

No smoking or open flames shall be allowed near the blocked manhole being cleaned.

The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of slippery nature of the malba.

Workers should not be allowed to work inside the manhole continuously. He should be given rest intermittently. The Engineer-In-charge may decide the time up to which a worker may be allowed to work continuously inside the manhole.

Gas masks with Oxygen Cylinder should be kept at site for use in emergency.

Air-blowers should be used for flow of fresh air through the manholes. Whenever called for, portable air-blowers are recommended for ventilating the manholes. The Motors for these shall be vapour proof and of totally enclosed type. Non sparking gas engines also could be used but they should be placed at-least 2 metres away from the opening and on the leeward side protected from wind so that they will not be a source of friction on any inflammable gas that might be present.

The workers engaged for cleaning the manholes / sewers should be properly trained before allowing to work in the manhole.

The workers shall be provided with Gumboots or non sparking shoes, bump helmets and gloves non sparking tools, safety lights and gas masks and portable air blowers (when necessary). They must be supplied with barrier cream for anointing the limbs before working inside the sewer lines.

Workmen descending a manhole shall try each ladder step or rung carefully before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole well.

If a man has received a physical injury, he should be brought out of the sewer immediately and adequate medical aid should be provided to him.

The extent to which these precautions are to be taken depend on individual situation but the decision of the Engineer-In-charge regarding the steps to be taken in this regard in an individual case will be final.

The Contractor shall not employ men and women below the age of 18 years on the work of painting with products containing lead in any form wherever men above the age of 18 are employed on the work of lead painting the following precautions should be taken.

4.1.1 No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

4.1.2 Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scrapped.

4.1.3 Overalls shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.

4.1.4.1 a) White lead, sulphate or lead work products containing those pigments shall not be used in painting operation except in the form of paste or of paints ready for use. Measures shall be taken whenever required in order to prevent danger arising from the application of paint in the form of spray.

Measures shall be taken, whenever practicable to prevent danger arising out of dust caused by dry rubbing down and scrapping.

b) Adequate facilities shall be provided to enable working painter to wash during and on cessation of work.

c) Suitable arrangements shall be made to prevent clothing put off during working hours being spoiled by painting materials.

4.1.4.2 a) Cases of lead poisoning and of suspected lead poisoning shall be notified and shall be subsequently verified by a medical man appointed by the competent authorities of BSCDCL.

The BSCDCL may require when necessary a medical examination of workers. Instructions with regard to the special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

When the work is done near any place where there is risk of drowning, all necessary equipment's should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provisions should be made for prompt first aid treatment for all injuries likely to be sustained during the course of the work.

Use of hoisting machines and tackle including their attachment encourage and supports shall conform to the following standard of conditions.

b) These shall be of good mechanical construction, sound material and adequate strength and free from patent, defects and shall be kept in good working order. Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in-charge of any hoisting machine including any scaffolding, winch or giving signals to operator.

In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this clause shall be loaded beyond the safe working load except for the purpose of testing.

In case of BSCDCL machines, the safe working load shall be notified by the Engineer-in-Charge. As regards Contractor's machines the Contractor shall notify the safe working load of the machine to the Engineer-in-charge whenever he brings any machinery to site of work and get verified by the Engineer-in-Charge.

Motors gearing, transmission electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguard. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulating mats, wearing apparel, such as gloves sleeves and boots as may be necessary be provided. The worker should not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.

All scaffold, ladders, and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place of work spot. The person responsible for compliance of the safety codes shall be named therein by the contractor.

To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the Contractor shall be open to inspection by BSCDCL Official or their representatives.

Notwithstanding the above Clauses from (i) to (xiv) there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force in the Republic of India.

SECTION-5

FORMS AND FORMATS

PROFORMAS:**PROFORMA- I**

The list of similar works as stated in the Minimum Qualification requirement for Bidders for Experience in High rise Building and Similar Works – Clause I

PROFORMA- I					
Sr.No.	Name of the Project	Name of the employer	Stipulated date of completion	Actual date of completion	Actual Cost of work done
1	2	3	4	5	6

NOTE:

Scanned Attested copies of completion/performance certificates from the Engineer-in-Charge for each work should be annexed in the support of information furnished in the above proforma.

Works shall be grouped financial year-wise.

PROFORMA- II

Yearly turnover of Civil Engineering Construction Works during the last three years.

PROFORMA- II					
Sr.No.	Financial year	Annual Turnover of Civil Engineering Works	Updated value to current year	Average of last 3years	Page No.
1					
2					
3					
Total					

NOTE: The above figures shall tally with the audited balance sheets uploaded by the Bidders duly certified by Chartered Accountant.

FORM XXV
DETAILS OF THE BALANCE WORK IN HAND AS ON _____
(UPTO THE PRECEDING MONTH OF SUBMISSION OF BID) WITH BSCDCL

(To be submitted in Envelop-1)

S. No	Name of the Unit/Zone/SBG/RGB	Contract Value	Date of start as per LOI/ Contract	Date of completion as per LOI /Contract	Work done up to the preceding month of submission of bid	Balance value of work

Note: The bidder shall also include the value of all such works which are awarded to bidder but yet not started up to the preceding month of submission of bid.

Appendix - 'O'

FORM XXVI
AFFIDAVIT

(To be submitted by bidder on non-judicial stamp paper of Rs. 100/- (Rupees Hundred only) duly attached by Notary Public)

(To be submitted in Envelop-1)

Affidavit of Mr.S/o
R/o

I, the deponent above named do hereby solemnly affirm and declare as under:

That I am the Proprietor/Authorized signatory of M/s
.....
Having its Head Office/Regd. Office at
.....

That the information/documents/Experience certificates submitted by M/s..... along with the tender for (NAME OF WORK).....
To BSCDCL Ltd. are genuine and true and nothing has been concealed.

I shall have no objection in case BSCDCL verifies them from issuing authority (ies). I shall also have no objection in providing the original copy of the document(s), in case BSCDCL demand so for verification.

I hereby confirm that in case, any document, information & / or certificate submitted by me found to be incorrect / false / fabricated, BSCDCL at its discretion may disqualify / reject / terminate the bid/contract and also forfeit the EMD / All dues.

I shall have no objection in case BSCDCL verifies any or all Bank Guarantee(s) under any of the clause(s) of Contract including those issued towards EMD and Performance Guarantee from the Zonal Branch /office issuing Bank and I/We shall have no right or claim on my submitted EMD before BSCDCL receives said verification.

That the Bank Guarantee issued against the EMD issued by (name and address of the Bank) is genuine and if found at any stage to be incorrect / false / fabricated, BSCDCL shall reject my bid, cancel pre-qualification and debar me from participating in any future tender for three years.

I,, the Proprietor / Authorised signatory of M/s..... do hereby confirm that the contents of the above Affidavit are true to my knowledge and nothing has been concealed there from..... and that no part of it is false.

Verified at this..... day of

DEPONENT

ATTESTED BY (NOTARY PUBLIC)

APPLICATION FOR EXTENSION OF TIME
(To be completed by the Contractor)

P A R T –I

Name of Contractor

Name of the work as given in the Agreement

Agreement No.

Estimated amount put to tender

Date of commencement work as per agreement

Period allowed for completion of work as per agreement

Date of completion stipulated as per agreement

Period for which extension of time
has been give previously

Extension granted

First extension vide Engineer-in-charge letter No... ..date	Months	Days
---	--------	------

2nd extension vide Engineer-in-charge letter No..... date	Months	Days
---	--------	------

3rd extension vide Engineer-in-charge letter No..... date	Months	Days
---	--------	------

4th extension vide engineer-in-charge letter No..... date	Months	Days
---	--------	------

Total extension previously given

Reasons for which extension have been previously given (copies of the previous application should be attached)

Period for which extension is applied for:

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.

Serial No.

Nature of hindrance

Date of Occurrence

Period for which it is likely to last

Period for which extension required for this particular hindrance.

Over lapping period, if any, with reference to item

Net extension applied for

Remarks, if any

Total period for which extension is now applied for on account of hindrances mentioned above Month/ days.

Extension of time required for extra work.

Details of extra work and on the amount involved:

Total value of extra work

Proportionate period of extension of time based on estimated amount put to tender on account of extra work.

Total extension of time required for 11 & 12

Submitted to the Engineer-in-Charges office.

DATE

SIGNATURE OF CONTRACTOR

APPLICATION FOR EXTENSION OF TIME

(PART – II)

Date of receipt of application from Contractor for the work in the Engineer-in-charge office.

Acknowledgement issued by Engineer-in-charge vide his letter No.dated

Engineer-in-charge remarks regarding hindrances mentioned by the Contractor.

Serial No.

Nature of hindrance

Date of occurrence of hindrance

Period for which hindrance, is likely to last

Extension of time period applied for by the contractor

Over lapping period, if any, giving reference to items which over lap

Net period for which extension is recommended.

Remarks as to why the hindrance occurred and justification for extension recommended.

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.

SIGNATURTE OF ENGINEER-IN-
CHARGE

**PROFORMA FOR EXTENSION OF TIME
P A R T –III**

To

NAME

ADDRESS OF THE CONTRACTOR

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 upto_____, without prejudice to the right of the BSCDCL to recover compensation for delay in accordance with the provision made in Clause of the said agreement dated the ___/ ___/ ___. It is also clearly understood that the BSCDCL shall not consider any revision in contract price or any other compensation whatsoever due to grant of this extension.

Provided that notwithstanding the extension hereby granted, time is and shall still continue to be the essence of the said agreement.

Yours faithfully,
FOR Bhopal Smart City Development Corporation Ltd.

PROFORMA OF BANK GUARANTEE IN LIEU OF E M D (TENDER BOND)
(Judicial Stamp paper of appropriate value as per stamp Act-of respective state)

Bhopal Smart City Development Corporation Ltd.
Near Tatpar Petrol Pump, Sector A, Berkheda,
Bhopal, Madhya Pradesh 462023

In consideration of Bhopal Smart City Development Corporation Limited, having its Registered Office at, Near Tatpar Petrol Pump Sector A, Berkheda (hereinafter called "BSCDCL" which expression shall unless repugnant to the subject or context include its successors and assigns) having issued Notice Inviting Tender No..... and M/s..... having its Registered Head Office at..... (hereinafter called the "TENDERER") is to participate in the said tender for.....

Whereas BSCDCL, as a special case, has agreed to accept an irrevocable and unconditional Tender Bond Guarantee for an amount of Rs..... valid upto..... from the tenderer in lieu of Cash Deposit of Rs..... required to be made by the tenderer, as a condition precedent for participation in the said tender.

We the (hereinafter called the "BANK") having its Registered, Office at..... and branch office at..... do hereby unconditionally and irrevocably undertake to pay immediately on demand in writing and without demur/protest any amount but not exceeding Rs Any such demand made by BSCDCL shall be conclusive and binding on us irrespective of any dispute or differences that may be raised by the tenderer. Any change in the constitution of the tenderer or the Bank shall not discharge our liability under the guarantee.

We, the..... Bank, lastly undertake not to revoke this guarantee during its currency without the prior consent of BSCDCL in writing and this guarantee shall remain valid upto..... Unless a claim is made within three months from the date of expiry i.e. (three months after the date of expiry), we shall be relieved of our liability under this guarantee thereafter.

FOR AND ON BEHALF OF BANK

PLACE :

DATED :

WITNESS.

- 1.
- 2

PROFORMA OF BANK GUARANTEE (PERFORMANCE)

(Judicial Stamp paper of appropriate value as per stamp Act-of respective state)

Bhopal Smart City Development Corporation Ltd.
Near Tatpar Petrol Pump, Sector A, Berkheda,
Bhopal, Madhya Pradesh 462023

Whereas the Bhopal Smart City Development Corporation Limited, having its Registered Office at BSCDCL Near Tatpar Petrol Pump Sector A, Berkheda, Bhopal (hereinafter called "BSCDCL" which expression shall include its successors and assigns) having awarded a work order/contract / supply order No. dated (hereinafter called the contract) to M/s. (hereinafter called the contractor / supplier) at a total price of Rs..... subject to the terms and conditions contained in the contract.

WHEREAS, the terms and conditions of the contract require the contractor to furnish a

Rs....
..... (Rupees.....
bank guarantee for) being % of the total value of the contract for proper execution and due fulfillment of the terms and conditions contained in the contract.

We, the Bank, (hereinafter called the "Bank") do hereby unconditionally and BSCDCL irrevocably undertake to pay to immediately on demand in writing and without protest/or demur all moneys payable by the contractor/supplier to BSCDCL in connection with the execution/supply of and performance of the works/equipment, inclusive of any loss, damages, charges, expenses and costs caused to or suffered by or which would be caused to or suffered by BSCDCL by reason of any breach by the contractor/supplier of any of the terms and conditions contained in the contract as specified in the notice of demand made by BSCDCL to the bank. Any such demand made by BSCDCL on the bank shall be conclusive evidence of the amount due and payable by the bank under this guarantee. However, the Bank's liability under this guarantee, shall be limited to Rs..... in the aggregate and the bank hereby agrees to the following terms and conditions:-

- (i) This guarantee shall be a continuing guarantee and irrevocable for all claims of BSCDCL as specified above and shall be valid during the period specified for the performance of the contract including the period of maintenance/warranty i.e. up to.....
- (ii) We, the said bank further agree with BSCDCL that BSCDCL shall have the fullest liberty without our consent and without affecting in any manner our obligations and liabilities hereunder to vary any of the terms and conditions of the said contract or to extend time for performance of contract by the contractor from time to time or to postpone for any time or from time to time any of the powers exercisable by BSCDCL against the contractor/supplier under the contract and forbear or enforce any of the terms and conditions relating to the said contract and we shall not be relieved from our liability by reason of any

such variations or extension being granted to the contractor or for any forbearance, act or omission on the part of BSCDCL or any indulgence by BSCDCL to the contractor or by any such matter or thing whatsoever, which under the law relating to the sureties would, but for this provision, have effect of so relieving us.

This guarantee/undertaking shall be in addition to any other guarantee or security whatsoever BSCDCL may now or at any time have in relation to the performance of the works/equipment and the company shall have full re-course to or enforce this security in performance to any other security or guarantee which the BSCDCL may have or obtained and there shall be no forbearance on the part of the company in enforcing or requiring enforcement of any other security which shall have the effect of releasing the Bank from its full liability. It shall not be necessary for BSCDCL to proceed against the said contractor/supplier before proceeding against the Bank.

This guarantee/ undertaking shall not be determined or affected by the liquidation or winding up, dissolution or change of constitution or insolvency of the supplier/contractor, but shall in all respects and for all purposes be binding and operative until payment of all moneys payable to BSCDCL in terms thereof are paid by the Bank.

The Bank hereby waives all rights at any time inconsistent with the terms of this Guarantee and the obligations of the bank in terms hereof, shall not be otherwise effected or suspended by reasons of any dispute or disputes having been raised by the supplier/contractor (whether or not pending before any Arbitrator, Tribunal or Court) or any denial of liability by the supplier/contractor stopping or preventing or purporting to stop or prevent any payment by the Bank to BSCDCL in terms hereof.

We, the said Bank, lastly undertake not to revoke this guarantee during its currency except with the previous consent of BSCDCL in writing. Unless a claim is made in writing

within three months from the date of expiry of this guarantee i.e.....
(three months after the date of expiry) we shall be relieved from all liabilities under
this guarantee thereafter.

Signed this day of at.....

For and on behalf of Bank

WITNESS.

1. _____

—

2. _____

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

(Judicial Stamp paper of appropriate value as per stamp Act-of respective state)

Bhopal Smart City Development Corporation Limited,
Near Tatpar Petrol Pump, Sector A, Berkheda,
Bhopal, Madhya Pradesh 462023

1.0 In consideration of the Bhopal Smart City Development Corporation Limited, having its Registered Office at BSCDCL, Near Tatpar Petrol Pump, Sector A, Berkheda, Bhopal (hereinafter called "BSCDCL" which expression shall unless repugnant to the subject or context include his successor and assigns) having agreed under the terms and conditions of Contract No..... dated..... made between..... and BSCDCL in connection with..... (hereinafter called "the said contract") to make at the request of the Contractor a Mobilization Advance of Rs..... for utilizing it for the purpose of the Contract on his furnishing a guarantee acceptable to BSCDCL, we the Bank Ltd., (hereinafter referred to the "the said Bank") and having our registered office at..... do hereby guarantee the due recovery by BSCDCL of the said advance as provided according to the terms and conditions of the Contract. We..... do hereby undertake to pay the amount due and payable under this Guarantee without any demur, merely on a demand from BSCDCL stating that the amount claimed is due to BSCDCL under the 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 BSCDCL the amount so demanded shall be absolute and unconditional notwithstanding any dispute or disputes raised by the Contractor and notwithstanding any legal proceeding pending in any court or Tribunal relating thereto. However, our liability under this Guarantee shall be restricted to an amount not exceeding Rs..... We Bank further agree that BSCDCL shall be the sole judge of and as to whether the amount claimed has fallen due to BSCDCL under the said agreement or whether the said Contractor has not utilized the said advance or any part thereof for the purpose of the Contract and the extent of loss or damage caused to or suffered by BSCDCL on account of the said advance together with interest not being recovered in full and the decision of BSCDCL that the amount has fallen due from contractor or the said Contractor has not utilized the said advance or any part thereto for the purpose of the contract and as to the amount or amounts of loss or damage caused to or suffered by BSCDCL shall be final and binding on us. We, the said Bank, further agree that the Guarantee herein contained shall remain in full force and effect till the said advance has been fully recovered and its claims satisfied or discharged and till BSCDCL certify that the said advance has been fully recovered from the said Contractor, and accordingly discharges this Guarantee subject, however, that BSCDCL shall have no claims under this Guarantee after the 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 the said Bank Guarantee in which case the same shall be enforceable against the Bank.

BSCDCL 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 the said Contract or the advance or to extend time of performance by the said Contractor or to postpone for any time and from time to time of the

powers exercisable by it against the said Contractor and either to enforce or forbear from enforcing any of terms and conditions governing the said Contract or the advance or securities available to BSCDCL and the said Bank shall not be released from its liability under these presents by any exercise by BSCDCL of the liberty with reference to the matters aforesaid or by reasons of time being given to the said Contractor or any other forbearance, act or omission on the part of BSCDCL or any indulgence by BSCDCL to the 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. 5.0 It shall not be necessary for BSCDCL 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 BSCDCL may have obtained or obtain from the Contractor or shall at the time when proceedings are taken against the Bank hereunder be outstanding or unrealized.

We, the said Bank, lastly undertake not to revoke this Guarantee during its currency except with the previous consent of BSCDCL in writing and agree that any change in the constitution of the said Contractor or the said Bank shall not discharge our liability hereunder.

Dated thisday of.....

Dated

For and on behalf of Bank

(NAME AND DESIGNATION)

PROFORMA OF BANK GUARANTEE
(IN LIEU OF SECURITY DEPOSIT)

(Judicial Stamp paper of appropriate value as per stamp Act-of respective state)

Bhopal Smart City Development Corporation Ltd.,
Near Tatpar Petrol Pump, Sector A, Berkheda, Bhopal

In consideration of the Bhopal Smart City Development Corporation Ltd., having its Registered Office at Near Tatpar Petrol Pump Sector A, Berkheda (hereinafter called "BSCDCL") which expression shall include its successors and assigns having awarded to M/s..... (hereinafter called "the Supplier/Contractor") which expression shall wherever the subject or context so permits includes its successors and assigns) a Contract in terms inter-alia of BSCDCL's letter No..... dated..... and the Contract/Purchase Conditions of BSCDCL and upon the condition of the Supplier/Contractor furnishing Security for the performance of the Supplier's obligations and /or discharge of the contractor's/supplier's liability under and/or in connection with the said supply contract upto a sum of Rs..... (Rupees..... only)

We,..... ((hereinafter called "The Bank") which expression shall include its successors and assigns) hereby undertake and guarantee payment to BSCDCL forthwith on the same day on demand in writing and without protest or demur of any and all moneys payable by the supplier/contractor to BSCDCL under, in respect or in connection with the said contract inclusive of all the losses, damages, costs, charges and expenses and other moneys payable in respect of the above as specified in any notice of demand made by BSCDCL to the Bank with reference to this guarantee up to

and aggregate limit of Rs.....(Rupees.....only) and the bank hereby

agree with BSCDCL that:

This Guarantee shall be continuing guarantee and shall remain valid and irrevocable for all claims of BSCDCL and liabilities of Supplier/Contractor arising upto and until midnight of.....

This Guarantee shall be in addition to any other Guarantee or Security whatsoever that BSCDCL now or at any time have in relation to the Supplier's obligations/liabilities under and/or in connection with the said supply/contract, and BSCDCL shall have full authority to take recourse or to enforce this Security in preference to any other Guarantee or Security which BSCDCL may have or obtain and no forbearance on the part of BSCDCL in enforcing or requiring enforcement of any other Security shall have the effect of releasing the Bank from its liability hereunder.

BSCDCL shall be at liberty without reference to the Bank and without affecting the full liability of the Bank hereunder to take any other security in respect of the Supplier's/Contractor's obligations and/ or liabilities under or in connection with the said supply/contract or to grant time and / or indulgence to the supplier / contractor or to increase or otherwise vary the prices or the total contract value or to release or to forbear from enforcement of all or any of the conditions under the said supply / contract and / or the remedies of BSCDCL under any other security/securities now or hereafter held by BSCDCL and no such dealings, increase(s) or other indulgence(s) or arrangement(s) with the supplier / contractor or releasing or forbearance

whatsoever shall have the effect of releasing the Bank from its full liability to BSCDCL hereunder or prejudicing rights of BSCDCL against the Bank. This Guarantee shall not be determined or affected by the liquidation or winding up, dissolution or change of constitution or insolvency of the supplier / contractor but shall in all respects and for all purposes be binding and operative until payment of all moneys payable to BSCDCL in terms thereof.

5. The Bank hereby waives all rights at any time inconsistent with the terms of this Guarantee and the obligations of the Bank in terms hereof shall not be otherwise affected or suspended by reason of any dispute or disputes having been raised by the supplier /contractor (whether or not pending before any Arbitrator, Tribunal or Court) or any denial or liability by the supplier/ contractor stopping/ preventing or purporting to stop or prevent any payment by the Bank to BSCDCL in terms thereof.

The amount stated in any notice of demand addressed by BSCDCL to the Guarantor

as liable to be paid to BSCDCL by the supplier/contractor or as suffered or incurred by BSCDCL on account of any losses or damages, costs, charges and / or expenses shall as between the Bank and BSCDCL be conclusive of the amount so liable to be paid to BSCDCL or suffered or incurred by BSCDCL as the case may be and payable by the Guarantor to BSCDCL in terms hereof subject to a maximum of Rs (Rupees only),

Unless demand or claim under this Guarantee is made on the Guarantor in writing

within three months form the date of expiry of the Guarantee i.e upto the Guarantor shall be discharged from all liabilities under this Guarantee there under.

Notwithstanding anything contained herein before our liability under this guarantee is restricted to Rs (Rupeesonly). This guarantee will expire on..... Any claim under this Guarantee must be received by us within three months from the date of expiry i.e. (date, three months after the expiry date) and if no such claim has been received by us by that date all your rights under this guarantee will cease.

For and on behalf of the Bank

Place Date

WITNESS:

1.

2.

PROFORMA OF BANK GUARANTEE
(FOR MOBILIZATION ADVANCE WITH INTEREST BEARING)
(Judicial Stamp per Stamp Act - paper of appropriate value as respective state)

Bhopal Smart City Development Corporation Limited,
Bhopal, Pin- 462023

In consideration of the Bhopal Smart City Development Corporation Limited., having its Registered Office at Bhopal -462023 (hereinafter called "BSCDCL" which expression shall unless repugnant to the subject: or context Include his successor and assigns) having agreed under the terms and conditions of Contract No. dated made between (name of the contractor) and BSCDCL in connection with (name of work) (hereinafter called "the said contract") to make at the request of the Contractor a Mobilization Advance of Rs. _____ carrying interest @ ... % p.a. for utilizing it for the purpose of the Contract on his furnishing a guarantee acceptable to BSCDCL, we the Bank (hereinafter referred to the "the said Bank") and having our registered office at do hereby guarantee the due recovery by BSCDCL of the said advance alongwith interest as provided according to the terms and conditions of the contract. We ...

do hereby undertake to pay the amount due and payable under this Guarantee without any demur, merely, on a demand from BSCDCL stating that the amount claimed is due to BSCDCL under the said Agreement. Any such demand made on the said bank shall be conclusive as regards the amount due and payable by the said contractor under this guarantee and agree that the liability of the said bank to pay BSCDCL the amount so demanded shall be absolute and unconditional notwithstanding any dispute or disputes raised by the Contractor and notwithstanding any legal proceeding pending in any court or Tribunal relating thereto. However, our liability under this Guarantee shall be restricted to an amount not exceeding Rs ... inclusive of interest @% p.a.

We the said bank further agree that BSCDCL shall be the sole judge of and as to whether the amount claimed has fallen due to BSCDCL under the said agreement or whether the said Contractor has not utilized the said advance or any part thereof for the purpose of the Contract and the extent of loss or damage caused to or suffered by BSCDCL on account of the said advance together with interest not being recovered in full and the decision of BSCDCL that the amount has fallen due from' contractor or the said Contractor has not utilized the said advance or any part thereto for the purpose of the contract and as to the amount or amounts of loss or damage caused to or suffered by BSCDCL shall be final and binding on us.

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

BSCDCL 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 the said Contract or the advance or to extend time of performance by the said Contractor or to postpone for any time and from time to time of the powers exercisable by it against the said Contractor and either to enforce or forbear from enforcing any of terms and conditions governing the said Contract or the advance or securities available to BSCDCL and the said Bank shall

not be released from its liability under these presents by any exercise by BSCDCL of the liberty with reference to the matters aforesaid or by reasons of time being given to the said Contractor or any other forbearance, act or omission on the part of BSCDCL or any indulgence by BSCDCL to the 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.

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

We, the said Bank, lastly undertake not to revoke this Guarantee during its currency except with the previous consent of BSCDCL in writing and agree that any change in the constitution of the said Contractor or the said Bank shall not discharge our liability hereunder.

Dated this..... day of.....

Place:

Date:

Witness:

1.

**FORM FOR GUARANTEE BOND
FOR ANTI-TERMITE TREATMENT**

THIS AGREEMENT made this ____ day of Two thousand ____ between M/s _____ (hereinafter called the guarantor of the one part and M/s Bhopal Smart City Development Corporation Limited, hereinafter called the BSCDCL hereinafter called 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 National Buildings Construction Corporation Ltd., of the other part whereby the contractor inter-alia, understood to render the buildings and structures in the said contract recited, completed, termite proof. And whereas the guarantor agreed to give a guarantee to the effect that the 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 falling which the work shall be got done by BSCDCL/ 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 Anti-Termite treatment or commits breaches hereunder then the Guarantor will indemnify BSCDCL 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 BSCDCL/ 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 BSCDCL 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 BSCDCL by/ in presence of:

- 1.
- 2.

GUARANTEE TO BE EXECUTED BY CONTRACTOR FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF WATER PROOFING WORKS

The agreement made this day of Two thousand One and between (hereinafter called Guarantor of the one part) and the BSCDCL (hereinafter called the Execution Agency of the other part).

WHEREAS this agreement is supplementary to a contract(hereinafter called the Contract), dated and made between the GUARANTOR OF THE ONE part and the BSCDCL of the other part, whereby the Contractor, inter-alia, undertook to render the buildings and structures in the said contract recited completely water and leak proof.

AND WHEREAS the Guarantor agreed to give a guarantee to the effect that the said structures will remain water and leak proof for ten years from the date of handing over o the structure of water proofing treatment.

NOW THE GUARANTOR hereby guarantees that water proofing treatment given by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be ten years to be reckoned from the date after the maintenance period prescribed in the contract.

Provided that the Guarantor will not be responsible for leakage caused by earthquake or structural defects or misuse of roof or alteration and for such purpose.

Misuse of roof shall mean any operation, which will damage proofing treatment, like chopping of fire wood and things of the same nature which might cause damage to the roof.

Alternation shall mean construction of an additional storey or a part of the roof or construction adjoining to existing roof whereby proofing treatment is removed in parts

The decision of the Engineer-in-Charge with regard to cause of leakage shall be final

During this period of guarantee, the Guarantor shall make good all defects and in case of any defect being found render the building water proof to the satisfaction of the Engineer-in-Charge at his cost and shall commence the work for such rectification within seven days from the date of issue of notice from the Engineer-in-Charge calling upon him to rectify the defects failing which the work shall be got done by the BSCDCL by some other Contractor at the guarantor's cost and risk. The decision of Engineer-in-Charge as to the cost, payable by the Guarantor shall be final and binding.

That if the Guarantor fails to execute the water proofing or commits breach there-under, then the Guarantor will indemnify the principal and his successors against all laws damage, cost, expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and / or damage and/ or cost incurred by the BSCDCL, the decision of the Engineer-in-Charge will final and binding on the parties.

IN WITNESS WHEREOF these presents have been executed by the Obligor,,,,,.....and by And for and on behalf of the BSCDCL on the day, month and year first above written.

Signed, sealed and delivered by Obligator in the presence of-

- 1.
- 2.

Signed for and on behalf of the BSCDCL by _____

In presence of:

- 1.
- 2.

PROFORMA OF INDENTURE FOR SECURED ADVANCE OR CREDIT

THIS INDENTURE made this day of _____ Between _____ (hereinafter called the contractor) which expression shall where the Context as admits or implies be deemed to include his executor/administrators and assign of the one part and National Buildings Construction Corporation Ltd., having its Registered Office at BSCDCL, Bhopal (hereinafter called the Engineer) which expression shall where the context so admits or implies be deemed to include its successors and assign of the other part.

Whereas by an agreement dated (hereinafter called the said agreement). The Contractor has agreed to construct.....

And whereas the Contractor has applied to the Engineer that he may be or be given credited for materials brought by him to the site of the work subject to the said agreement for use in construction of the work.

NOW THIS INDENTURE WITNESSETH that in pursuance of the said agreement and in consideration of the sum of Rs. _____ (Rupees _____ only) paid to the contractor by the Engineer. The receipt where the Contractor hereby acknowledges and of such advance or credited (if any) as may be made to him as aforesaid the Contractor hereby covenants and agrees with The Engineer and declares as follows:

That all sums given as advance or credit by The Engineer to the Contractor as aforesaid shall be employed by the Constructor in or toward the execution of the said works and for no other purpose whatsoever.

That the material for which the advance or credit is given are offered to and accepted by The Engineer as security and are absolutely the Contractor's own

property and free from encumbrances of any kind the Contractor will not make any application for or receives further advance or credit on the security or material which are not absolutely his own property and free from encumbrances of any kind and the Contractor shall indemnify The Engineer against any claims to any material in respect of which advance or credit has been made to him as aforesaid.

That the said material and all other material on the security of which any further advance or advances or credit may be given as aforesaid (hereinafter called the said materials) shall be used by the Contractor s solely in the execution of the said works in accordance with the direction of the Engineer and in terms of said agreement.

That the Contractor shall make at his own cost all necessary and adequate arrangement for the proper safe custody and protection against all risks of the said material and that until used in the construction as aforesaid the material shall remain at the site of the said works in Contractor's custody and on his responsibility and shall at all times be open to inspection by The Engineer. In the events of the materials or any part thereof being stolen, destroyed or damaged or becoming deteriorated in greater degree than in due to reasonable use and wear thereof the Contractor will replace the same with other materials of like quality of repair and make good the same as required by The Engineer.

That said material shall not on any account be removed from the site of work except with the written permission of The Engineer.

That the advance shall be repayable in full when or before Contractor receives payment from The Engineer of the price payable to him for the said work under the term and provisions of the said agreement. Provided that if any intermediate payments are made to the Contractor on account of work done then on the occasion of each payment The Engineer will be at liberty to make a recovery from the Contractor's bill from such payments by deducting there from the value of the said materials than actually used in the contraction and in respect of which recovery has not been made previously. The value of this purpose being determined in respect of each description of materials at the rates at which the amounts of the advance as made under these presents was calculated.

That if the Contractor shall at any time make at any default in the performance of observance in respect of any of the terms and provisions of the said agreement or of that provisions the total amount of the advance or advances that may still be owing to The Engineer, shall immediately on the happening of such default be repayable by the Contractor to The Engineer together with interest thereon at 12% p.a. from the date of respective dated to such advance or advances to the date of payment and with all costs. Damages and expenses incurred by The Engineer in or for recovery hereof or the Contractor hereby covenants and agrees with The Engineer to repay and pay the same respective to him accordingly

That the Contractor hereby charges all the said materials with the repayment to The Engineer of all sums advances or credit as aforesaid and all costs. Charges, damages and expenses payable under these presents PROVIDED ALWAYS it is hereby agreed and declared that notwithstanding anything in the said agreement and without prejudice to the powers contained therein if and wherever the covenant for payment and repayment herein before contained shall be become enforceable and the money owing shall not be paid in accordance therewith. The Engineer may at any time thereafter adopt all or any of the following courses he may deem best:

Seize the utilize the said material or any part thereof in the completion of the said works in accordance with the provision in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion and the amount due in respect of advance or credit under these presents and crediting the Contractor with value of work done as if he has carried it out in

accordance with the said agreement and the rates thereby provided if the balance is against the Contractor is to pay the same to the engineer on demand.

Remove and sell by public action the seized materials or any part thereof and out of the money arising from the sale repay the engineer under these presents and pay over the surplus (if any) to the Contractor.

Deduct all or any part of the moneys owing from any sums due to the contractor under said agreement.

Expect in the event of such default on the part of contractor as aforesaid, interest or the said advance shall not be payable.

That in the event of conflict between the provisions of these presents and the said agreements, the provision of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents, the settlement of which has not been hereinbefore expressly provided for the same shall so far as is lawful be subject to jurisdiction of BHOPAL courts only.

IN WITNESS whereof the said the engineer and the contractor hereunto set their respective hands and seals the day year first above written.

Signed Sealed and delivered by

Contractor

The Engineers

AGREEMENT FORM

This agreement made this day of (Month) (Year), between the **Bhopal Smart City Development Corporation Limited (BSCDCL)**, a company incorporated under the Companies Act, 1956 having its Registered Office at BSCDCL, Bhopal 462023 (hereinafter referred to as the "BSCDCL" which expression shall include its administrators, successors, executors and 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, BSCDCL, has desirous of construction of **(NAME OF WORK)** (hereinafter referred to as the "PROJECT") on behalf of the **(NAME OF OWNER/MINISTRY)** (hereinafter referred to as "OWNER"), had invited tenders as per Tender documents vide NIT No. _____.

AND WHEREAS **(NAME OF CONTRACTOR)** had participated in the above referred tender vide their tender dated _____ and BSCDCL has accepted their aforesaid tender and award the contract for **(NAME OF PROJECT)** on the terms and conditions contained in its Letter of Intent No. _____ and the documents referred to therein, which have been unequivocally accepted by **(NAME OF CONTRACTOR)** vide their acceptance letter dated _____ resulting into a contract.

NOW THEREFORE THIS DEED WITNESSETH AS UNDER:

ARTICLE 1.0 – AWARD OF CONTRACT

SCOPE OF WORK

BSCDCL 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 aforesaid letter of intent. The terms and expressions used in this agreement shall have the same meanings as are assigned to them in the "Contract Documents" referred to in the succeeding Article.

ARTICLE 2.0 – CONTRACT DOCUMENTS

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").

BSCDCL Notice Inviting Tender vide No. _____ date _____ and BSCDCL's tender documents consisting of:

General Conditions of Contract (GCC) along with amendments/errata to GCC (if any) issued (Volume-I).

Special Conditions of Contract including Appendices & Annexures, Volume-II.

Bill of Quantities along with amendments/corrigendum of schedule items, if any (Volume-II).

(NAME OF CONTRACTOR) letter proposal dated _____ and their subsequent communication:

Letter of Acceptance of Tender Conditions dated _____

BSCDCL's detailed Letter of Intent No. _____ dated _____ including Bill of Quantities. Agreed time schedule, Contractor's Organization Chart and list of Plant and Equipment's 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 tender documents and what has been specifically agreed to by BSCDCL in its Letter of Intent. Any matter inconsistent therewith, contrary or repugnant thereto or deviations taken by the Contractor in its "TENDER" but not agreed to specifically by BSCDCL in its Letter of Intent, shall be deemed to have been withdrawn by the Contractor without any cost implication to BSCDCL. For the sake of brevity, this Agreement along with its aforesaid contract documents and Letter of Intent shall be referred to as the "Contract".

ARTICLE 3.0 – 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 BSCDCL's Letter of Intent No. _____ dated _____ are to be read in conjunction with other aforesaid contract documents. The contract shall be duly performed by the contractor 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.

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 conform 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 effected only by a written instrument signed by the authorized representative of both the parties.

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.

ARTICLE 4.0 – NO WAIVER OF RIGHTS

Neither the inspection by BSCDCL or the Engineer-in-Charge or Owner or any of their officials, employees or agents nor order by BSCDCL 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 BSCDCL 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 BSCDCL, 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.

ARTICLE 5.0 – GOVERNING LAW AND JURISDICTION

The Laws applicable to this contract shall be the laws in force in India and jurisdiction of BHOPAL Court (s) only.

Notice of Default

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 hereto, if delivered against acknowledgment due or by FAX or by registered mail duly addressed to the signatories at the address mentioned herein 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 BHOPAL.

For and on behalf of:

For and on behalf of:

(NAME OF CONTRACTOR) (M/s Bhopal Smart City Development Corporation)

WITNESS:

WITNESS:

1.

1.

SECTION-6

**SPECIAL CONDITION OF
CONTRACT (SCC)**

SPECIAL CONDITIONS OF CONTRACT (SCC)

GENERAL-

- 6.1 The following special conditions shall be read in conjunction with General conditions 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 the Special Conditions shall take precedence.
- 6.2 Where any portion of Special Conditions of Contract is repugnant to or at variance with any provision of the instructions to Tenderer and General Conditions of Contract and / or the other documents forming part of the contract then unless a different intention appears the provision of the Special Conditions of Contract shall be deemed to override the provisions of the general conditions of contract and / or the other documents forming part of the contract only to the extent such repugnant/various in the special conditions of contract as are not possible of being reconciled with the provisions in the special conditions of contract as are not possible of being reconciled with the provision with instructions to Tenderer or General Conditions of contract and / or the other documents from part of the contract.
- 6.3 Working drawing shall be according to the drawing given in the Tender document.
- 6.4 Items mentioned in the BOQ may vary or any changes are needed then it should bring to the attention of BSCDCL.
- 6.5 Working drawings are given by BSCDCL in tender document; if any deviations found and correction required then it should be brought to BSCDCL for rectification.
- 6.6 The items which are missing or not defined in the given BOQ in this Tender Document, then the contractor has to submit the items for approval to BSCDCL.
- 6.7 The contractor has to submit sample of the items defined in BOQ the same to be Approved by BSCDCL, before use.
- 6.8 It is percentage rate tender bidder should quote percentage above or below of PAC.
- 6.9 Contractors shall construct/ refurbish Store, Cement Godown, Lab, Office for their use or shall make for BSCDCL. The space shall be provided by BSCDCL.

7.0 Post Qualification criteria for Mechanical & Electrical

The Bidder should submit declaration of Rs 100 Stamp paper that if the work is awarded they will appoint the Nominated Subcontractor meeting the qualification criteria as mentioned below.

The Main Contractor should get the specialized works executed through nominated sub-contractor duly approved by the Engineer-in-charge of BSCDCL.

The main contractor will submit all credentials of nominated sub-contractor for approval to the Engineer In charge of BSCDCL.

a) Plumbing works-

- 1) The nominated Agency should have experience in constructing & commissioning of plumbing systems, huge capacity FIRE TANK & advanced Fire Fighting systems of high rise public/ semi public buildings. (Supporting documents and certificates of a nominated sub-contractors shall be uploaded by main contractor fulfilling the below mentioned qualification criteria along with mandatory enclosures)
- 2) The agency should have a minimum experience of 05 years for the similar work.
- 3) The agency should have executed similar works in the last Seven years as under—
 - a. One project worth not less than Rs 12 Cr (80% of respected work in tender)
OR
 - b. Two projects worth not less than Rs 7.0 Cr (50% respected work in tender)
OR
 - c. Three projects worth not less Rs 5.0 Cr (40 % respected work in tender).
- 4) The nominated agency should have a minimum existence in the field for not less than 7 years.

b) Electrical Works-

The agency should have a minimum experience of 05 years for the similar nature of work. The agency should obtain registration including licence in appropriate class before execution of work. (Supporting documents and certificates of a nominated sub-contractors shall be uploaded by main contractor fulfilling the below mentioned qualification criteria along with mandatory enclosures)

The agency should have executed similar works in the last five years as under—

- a. One project worth not less than Rs 12 Cr (80 % of respected work in tender)
OR
- b. Two projects worth not less than Rs 8.0 Cr (50% respected work in tender)
OR
- c. Three projects worth not less Rs 6.0 Cr (40 % respected work in tender).

c) Fire Fighting & fire Alarm system-

Firm dealing in the line of installation of Fire Fighting & detection systems (As on Date of invitation of Tender) licensing agency for SITC of Fire fighting and detection work systems.(Supporting documents and certificates of a nominated sub-contractors shall be uploaded by main contractor fulfilling the below mentioned qualification criteria along with mandatory enclosures)

The agency should have executed similar works in the last five years as under –

1. Three similar completed works each of value not less than the value equal to Rs.1.5 Cr. (40 % respected work in tender).
Or
2. Two similar completed works each of value not less than the value equal to Rs. 2.0 Cr. (50% respected work in tender)
Or
3. One similar completed works each of value not less than the value equal to Rs.3.0 Cr (80 % of respected work in tender)

d) Security System:

The Firm in their own name should have satisfactorily executed the work of similar nature Semi Govt. /Govt. & Public Sector Organizations during last Five (5) years ending last day of month previous to the one in which bids are invited as a prime Contractor (or as a nominated sub-Contractor, where the subcontract had involved similar nature of work as described in the scope of works in this bid document, provided further that all other qualification criteria are satisfied)

a) Three similar completed works each of value not less than the value equal to Rs 1.5 Cr. (40 % respected work in tender).

OR

b) Two similar completed works each of value not less than the value equal to Rs 2.0 Cr. . (50% respected work in tender)

OR

c) One similar completed work of value equal and or not less than the Rs3.0 Cr (80 % of respected work in tender)

The bidder should make MOU (on stamp paper of Rs.200/-) with the Nominated Sub Contractors fulfilling above qualification criteria.

8.0 Additional Conditions;

- 1.1** Excavated good earth declared surplus or otherwise shall be disposed of at designated locations as per the directions of BSCDCL, which shall be different from the disposal site for disintegrated rock etc.
- 1.2** For soil required for re-filling, if sufficient space is not available for stacking at site of excavation, the Contractor shall make his own arrangements for transporting and stacking the earth elsewhere and then bring it back for re-filling. Nothing extra shall be paid on this account for to and fro carriage.
- 1.3** Disposal of surplus excavated earth including mud, liquid mud, dismantled RCC, dismantled brick work etc. shall be made only in the dumping yard approved by local authority. It will be the responsibility of the contractor to get the permission for dumping yard from local authority as required. If any royalty /fees is payable to local authority, such royalty / fees shall also be borne by the contractor. Disposal shall be carried out strictly as per the regulations of local authority. However, the above materials shall not be removed out of owner's premises without prior written authorization of BSCDCL.
- 1.4** All the Charges required for vetting of the designs done by The Contractor by IIT or any other reputable agency approved by BSCDCL etc. shall be deemed to have been included in the quoted rates.
- 1.5** The Contractor shall, at his own expense and without extra charges, make provision for all pumping, dewatering, dredging or bailing out water, if necessary, irrespective of the source of water. The water so pumped out shall be discharged as per local byelaws and as approved by the Engineer-in-charge. The Contractor shall also take all necessary precautions in diverting channels and in discharging the drained water as not to cause damage to the works, crops or any other property within/outside the plot. Excavated area for the basement/ foundation trenches shall be kept free from water while all the works below Ground level are in progress. Nothing extra shall be paid on this account in terms of time and cost.
- 1.6** Further contractor shall take all necessary precautions to protect and safe guard the foundation of the adjacent building / Structure / Overhead/Underground utilities. Nothing extra shall be payable on this account.

2.0 Construction Power, Water and other facilities

- 2.1 Contractor shall be exclusively responsible to make his own arrangements for supply of power for his use including area illumination, construction activities, and fabrication, without any extra cost to Client.
- 2.2 Contractor shall make all arrangements for water required for project work including distribution, storage, use and drainage of the same at his own cost.
- 2.3 BSCDCL shall endeavor to provide land out of available land to the Contractor, for the sole purpose of field office using Contractor's own container (porta cabin). No land shall be provided for accommodation of workers/labour.
- 2.4 The Contractor shall remove all temporary buildings / facilities etc. before leaving the site after completion of works in all respect. In the event that Contractor fails to clear the site within 3 weeks after receiving intimation from BSCDCL to do so, BSCDCL shall be free to engage the services of any third party to clear the site at Contractors risk and cost. All expenses incurred on this account shall be recovered from the Contractor.
- 2.5 If BSCDCL provides water and electricity, the cost for such facility will be borne by the contractor at the prevailing rates of local Government bodies as per actuals.

3.0 TAXES, DUTIES, ROYALTY, PRICES

3.1 Royalty

- 3.1.1 All royalties etc., as may be required for any Borrow Areas, including right of way etc. to be arranged by Contractor shall be deemed to have been included in the quoted prices.
- 3.1.2 Contractor's quoted rates should include the royalty on different applicable items as per the prevailing State Government rates.

4.0 Underground and overhead structures

- 4.1 The Contractor will familiarize himself with and obtain information and details from BSCDCL in respect of all existing structures, overhead lines, existing pipelines and utilities existing at the job site before commencing work. The Contractor shall execute the work in such a manner that the said structures, utilities, pipelines etc. are not disturbed or damaged, and shall indemnify and keep indemnified BSCDCL from and against any destruction thereof or damages thereto.

5.0 Electrical Contractor's License

- 5.1 The CONTRACTOR or its nominated Sub-Contractor(s), as the case may be, shall have a valid electrical contractor's license for working in the State in which the job site is located. The CONTRACTOR shall furnish a copy of the same to Engineer-in-charge before commencement of any electrical work or work pertaining to Electrical System.

6.0 Project Review Meetings

- 6.1 The contractor, immediately on award of work shall submit details of his key personnel to be engaged for the work at site. In addition, he shall furnish the Engineer-in-Charge detailed organogram of his staff involved with the work.
- 6.2 The Contractor shall present the programme and status at various review meetings as required.
- 6.3 Weekly Review Meetings: Shall be attended by Local Team headed by Project - in-Charge.

Agenda	<ul style="list-style-type: none"> a) Weekly programme v/s actual achieved in the past week and programme for next week. b) Remedial Actions and hold up analysis. c) Client query approval.
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6.4 Monthly Review Meetings: Shall be attended by Project-in-Charge and the Management Representative who can take independent decisions

Agenda	<ul style="list-style-type: none"> a) Progress Status/Statistics. b) Completion Outlook. c) Major hold ups / slippages. d) Assistance required. e) Critical issues. f) Client query/approval. g) Anticipated cash flow requirement for next two months
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7.0 PROJECT OFFICE ACCOMMODATION

7.1 The contractor shall provide, erect and maintain at his own cost separate temporary water tight, Puff insulated air-conditioned office accommodation in the form of two (02) Nos. Porta Cabins each of size 20' X 10' or Quantity and Size of Porta cabin as approved by BSCDCL at designated locations for the use by BSCDCL with the following minimum facilities in each cabin. These shall be available till handing over of the project.

7.1.1 Toilet facility - 1 No. portable for each cabin

7.1.2 Modular Work Stations - 3 Nos. in each cabin

7.1.3 Executive Chairs - 3 Nos. shoulder rest

7.1.4 Visitors Chairs - 6 Nos.

7.1.5 Overhead Storage Racks - All along the walls

7.1.6 Adequate Number of Power plugs –

7.1.7 White Board with Markers - 1 No. in each cabin

7.1.8 Pin-Up Display board of size as required

7.1.9 Free Drinking water, stabilized power and lighting as required for the duration of the Project.

7.1.10 Janitorial and Housekeeping services

7.2 The contractor has to relocate the Porta Cabins if required as per the exigencies of the work and as directed by BSCDCL without any extra cost. After completion of the Project the Contractor shall take away this material and the site shall be cleaned free from all construction debris.

8.0 RECOMMENDED MAKES OF MATERIALS.

8.1 A list of recommended makes of materials is as per Tender document

8.2 The order of preference amongst the various products/materials shall be as follows:

8.2.1 The products / materials shall be as per the Brand specified in the Tender document

8.2.2 If the Brand is not specified then the products/material shall be ISI marked and the same shall be got approved by the Engineer-in-Charge before execution.

8.2.3 If ISI marked product/material is not available, the same shall be as approved by the Engineer-in-Charge before execution.

8.3 In case of natural products such as Kota stone, Marble, Granite etc.,

8.3.1 the stones used shall be of **premium** grade and they shall be homogenous in color with consistency in pattern, texture, tone, marking and color. No discoloration, spots, fissures or cracks and pocked surfaces shall be allowed.

8.3.2 Where it is difficult to guarantee uniformity in colour and other properties, contractor shall make all efforts to match the colour, shade, texture of the product with the approved sample. If in the opinion of the BSCDCL there is significant variation in properties, BSCDCL shall direct the contractor to remove the same from the site immediately and replace with products matching with the approved sample within reasonable period. The decision of BSCDCL shall be final and binding.

9.0 COMPLETION CERTIFICATES/ NOC FROM LOCAL STATUTORY BODIES

- 9.1 Contractor has to arrange at his own cost building/ work completion certificates or NOCs if required to be obtained, from the local statutory bodies of central and state govt. such as Municipal Corporation, electrical, safety, Fire authority, Chief Controller of Explosives (CCOE) etc. Any fees required for obtaining such NOCs shall be paid by BSCDCL on production of relevant depository challans/ receipts from such Govt. authorities. Initial building approval drawings shall be made available by BSCDCL
- 9.2 The application on behalf of BSCDCL for submission to relevant authorities along with copies of required certificates complete in all respects shall be prepared and submitted by the Contractor well ahead of time so that the actual construction / commissioning of the work is not delayed for want of the approval / inspection by concerned authorities.
- 9.3 The inspection of the works by the authorities shall be arranged by the Contractor and necessary co-ordination and liaison work in this respect shall be the responsibility of the Contractor.

10.0 TOOLS, PLANTS AND MACHINERY

- 10.1 The Contractor shall provide and install at site adequate T&P for construction of the Project Works. The deployment of T&P shall be planned as per work requirement to suit the nature, quantum and speed of the work for lifting/hoisting construction materials/equipment etc.
- 10.2 The T&P shall be maintained in good working condition throughout the progress of work.
- 10.3 All adequate precaution regarding formal upkeep of valid Statutory/Safety credentials of major construction equipment as directed by BSCDCL, their installation, operation, maintenance, materials etc., shall be taken care of.
- 10.4 The operating staff to be deployed shall be properly qualified and adequately trained and experienced. All safety precautions shall be taken during the project duration, against possible accident. The Contractor shall deploy his representative to effectively enforce the safety rules and regulations in this regard.
- 10.5 The list of T&P is as follows :

Sr. No.	Name of Equipment
1.	Tower crane
2.	Concrete Batch Mix Plant capacity 30 and 60 cum per hour (<i>fully automatic with computer control</i>)
3.	Heavy Duty High Head Static Concrete Pumps
4.	Placer Booms
5.	Transit Mixers
6.	Telescopic cranes
7.	MIG welding machines
8.	Builder Hoists
9.	Material and Passenger lifts etc

11.0 Construction Equipment & Mechanization of Construction Activities

11.1 The above list is only minimal and indicative. The contractor shall deploy all necessary tools and plants as per the requirement of the work.

11.2 The Contractor shall without prejudice to his overall responsibility to execute and complete the work as per specifications and Time Schedule, progressively deploy adequate equipment, and tools & tackles and augment the same as decided by Engineer-in-Charge depending on the exigencies of the work so as to suit the construction schedule.

16.0 CENTRING AND SHUTTERING FOR R.C.C WORK:-

16.1 The work is to be completed within 24 months, hence the contractor shall adopt a suitable system complying with BIS standards regarding stripping time, with requisite number of sets of centring and shuttering. The slab cycle for each of the structures has to be designed for completing the construction within the stipulated completion time of the respective building, and the same shall be got approved by BSCDCL.

17.0 INTERFERENCE WITH TRAFFIC AND ADJOINING PROPERTIES/ BUILDINGS

17.1 In case any operation connected with the Works requires temporary diversion of the traffic, or obstruction or closure of any road, or any other 'right of way', the approval of BSCDCL and the respective competent authorities shall be obtained at least one week in advance.

17.2 The Contractor shall at all times during execution of the Works, ensure an uninterrupted flow of traffic around the plot so as not to cause any nuisance to the general public.

17.3 If in order to avoid undue interference with the traffic and adjoining properties, BSCDCL instructs the Contractor to take special precautions or work within restricted time periods; the Contractor shall carry out the Works during such time and in such manner as directed by BSCDCL.

18.0 LIGHTING & WATCH AND WARD:

18.1 The contractor shall at his own cost take all precautions to ensure safety of life and property by providing necessary barriers, area lighting at the construction site and approaches, watchmen, necessary watch towers etc. during progress of work at all hours including night hours, if required, as directed by the Engineer-in-charge.

18.2 The Contractor shall be responsible for the watch and ward of the all construction premises and buildings, safety of all fittings and fixtures including sanitary and water supply fittings and fixtures provided by him against pilferage and breakage during the period of installation till handing over of all the works to BSCDCL.

19.0 Monthly Bills of Contractor

Contractor shall submit Monthly bills for the work Executed. Minimum amount of such bills shall not be less than 5 % of Contract value.

20.0 Payment Schedule :

Following payment schedule shall be adopted for Plumbing, Firefighting, Electrical, Ventilation and ICT works

S. No.	Activity	Payment (%) (against Supply and Installation cost)
1.	On Supply & Delivery of Material. Prior to commencement of work, the contractor shall get approved, the procurement schedule from the Engineer-in-Charge. Quantity to be procured shall be as approved by Engineer-in-charge. Payment shall be strictly done only after approval from Engineer-in-charge	70% payment
2.	On Installation and Testing	20% payment
3.	On satisfactory Commissioning after approval from Engineer-in Charge	10% payment

21.0 _____Time period of the Project

Entire project should be completed and delivered within Twenty Four Months of time from the date of award of contract that includes Monsoon.

The time allowed for carrying out the work as entered in the Tender shall be strictly observed by the Contractor and shall be reckoned from the date on which the Letter of Acceptance is given to the Contractor. The work shall throughout the stipulated period of the Contract be proceeded with all due diligence as time being deemed to be the essence of the contract on the part of the Contractor.

The Contractor should complete the physical work as far as possible as per phase given below :

¼ of the work in	..	¼ of the
time		
½ of the work in	..	½ of the
time		
¾ of the work in	..	¾ of the
time		
Full of the work in	..	Full of the time

Full work will be completed in Twenty Four months including Monsoon.

However deviations if any from above phasing will be got duly approved by the engineer incharge.

The program for completion of work shall be a part of the Contract Document in the form of Bar Chart / GANTT Chart. The Contractor is supposed to carry out the work and keep the progress as per Bar Chart/GANTT Chart. The Contractor shall complete the work as per the Schedule given in the Contract and the program submitted by the Contractor.

22.0 Contract Execution

All required documents for execution of the contract shall be submitted within 30 days from the date of issue of letter of acceptance. If the documents are not submitted within the stipulated time a penalty of Rs 5000/- per day will be applicable to the contractor. All contract documents need to be duly affixed with stamp duty properly signed along with evidence/proof of payment of security/contract deposit/ within 30 days from the date of letter of acceptance received by him

If the amount of the Contract Deposit to be paid above is not paid within 30 days from the date of issue of Letter of Acceptance, the Tender / Contractor already accepted shall be

Considered as cancelled and legal steps be taken against the contractor for recovery of the amounts.

The amount of Security Deposit retained by the BSCDCL shall be released after expiry of period up to which the contractor has agreed to maintain the work in good order is over. In the event of the contractor failing or neglecting to complete the rectification work within the period up to which the contractor has agreed to maintain the work in good order, the amount of security deposit retained by BSCDCL shall be adjusted towards the excess cost incurred by the Department on rectification work.

23.0 Action when whole of security deposit / Retention Money is forfeited:

In any case in which under any Clause of this contract, the contractor shall have rendered himself liable to pay compensation amounting to the whole of this security deposit whether paid in one sum or deducted by installments or in the case of abandonment of the work owing to serious illness or death of the contractor or any other cause, the Engineer-in-Charge shall have power to adopt any of the following process, as he may deem best suited to the interest of BSCDCL -

(a) To rescind the contract (for which recession notice in writing to the contractor shall be conclusive evidence) and in that case, the security deposit of the contract shall stand forfeited and be absolutely at the disposal of BSCDCL .

(b) To carry out the work or any part of the work departmentally debiting the contractor with the cost of the work, expenditure incurred on tools and plant, and charges on additional supervisory staff including the cost of work-charged establishment employed for getting the un-executed part of the work completed and crediting him with the value of the work done departmentally 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 costs and other allied expenses so incurred and as to the value of the work so done departmentally shall be final and conclusive against the contractor.

(c) To order that the work of the contractor be measured up and to take such part thereof as shall be un-executed out of his hands, and to give it to another contractor to complete, in which case all expenses incurred on advertisement for fixing a new contracting agency, additional supervisory staff including the cost of work charged establishment and the cost of the work executed by the new contract agency will be debited to the contractor and the value of the work done or executed through the new contractor shall be credited to the contractor in all respects and 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 Executive Engineer as to all the cost of the work and other expenses incurred as aforesaid for or in getting the un-executed work done by the new contractor and as to the value of the work so done shall be final and conclusive against the contractor.

In case the contract shall be rescinded under Clause (a) above, the contractor shall not be entitled to recover or be paid any sum for any work there for actually performed by him under this contract unless and until the Executive Engineer shall have certified in writing the performance of such work and the amount payable to him in respect thereof and he shall only be entitled to be paid the amount so certified. In the event of either of the courses referred to in Clause (b) or (c) being adopted and the cost of the work executed departmentally or through a new contractor and other allied expenses exceeding the value of such work credited to the contractors amount of excess shall be deducted from any money due to the contractor, by BSCDCL under the contract or otherwise, howsoever, or from his security deposit or the sale proceeds thereof provided, however, the contractor shall have no claim against BSCDCL even if the certified value of the work done departmentally or through a new contractor exceeds the certified cost of such work and allied expenses, provided always that whichever of the three courses mentioned in clauses (a), (b) or (c) is adopted by the Executive Engineer, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchase or procured any materials or entered in to any engagements or made any advance on account of or with a view to the execution of the work or the performance of the contract.

Contract may be rescinded and security deposit forfeited for bribing a public officer or if contractor becomes insolvent

If the contractor assigns or sublets his contracts or attempt so to do, or become insolvent or commence any proceeding to get himself adjudicated and insolvent or make any composition with his creditors, or attempt so to do or if bribe, gratuity, gift, loan, perquisite, reward or advantage, pecuniary or otherwise, shall either directly or indirectly be given promised or offered by the contractor or any of his servants or agents through any public officer, or person in the employ of BSCDCL /Govt. in any way relating to his office or employment, or if any such officer or person shall become in any way directly or indirectly interested in the contract the Engineer In-charge may thereupon, by notice in writing rescind the contract and the Security Deposit of the Contractor shall thereupon stand forfeited and be absolutely at the disposal of BSCDCL and the same consequences shall ensure as if the contract had been rescinded under above clause J hereof; and in addition the contractor shall not be entitled to recover or be paid for any work therefore actually performed

SECTION-7

SCOPE OF WORK, EMPLOYER'S REQUIREMENT AND TECHNICAL SPECIFICATIONS

CHAPTER 1. PROJECT SITE

1.1 The site

- 1 Site of the Government Housing is on Plot No 21 and 22 of the ABD area of Bhopal Smart City. The details about the site are elaborated in **Chapter 1.1.1**.
- 2 The details of handing over the Land to the Contractor are specified in **Chapter 1.2.3** of this Schedule-A.
- 3 An inventory of the Site including trees and any other immovable property on, or attached to, the Site shall be prepared jointly by the Authority Representative and the Contractor, and such inventory shall form part of the Agreement.
- 4 The site of Government Housing superimposed over existing Development Plan 2005 (land use plan) is specified in **Chapter 1.2**.
- 5 Site topography survey is given in **Chapter 1.3**.
- 6 The status of the Environment clearances is given in **Chapter 0**.

1.1.1 Project background

Government of India plans to implement Smart City Program for next 5 years (FY 2015-16 to FY 2019-20) to transform 100 Indian Cities to Smart Cities. The objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and apply 'smart solutions'. The focus is on sustainable and inclusive development and the idea is to look at compact areas, create a replicable model which will act like a light house to other aspiring cities.

Bhopal's Area Based Development (ABD) proposal is now for redevelopment of 360 acres of North and South TT Nagar with Gammon development on one side and New Market area on the other. As per SCP, the area based development would be a state of art smart city in the heart of the city of Bhopal with all modern features in a sustainable manner and would generate more job opportunities. The area shall be developed along two MRT axes on transit oriented development (TOD) principles.

1.1.1.1 *project site*

The proposed buildings as Government housing are sited on the government land within the ABD Project area. The two adjoining plots measuring 2.56 Ha are near existing Dussehra grounds in TT Nagar. In the proposed Master Plan, Plot No. 22 has 30m wide road on the two sides and Plot No. 23 abuts 30m wide road on one sides and 12m road runs along other side. The 30m wide road connects the plots to New Market. The access to the plots is only

from 30m wide roads. It is an open ground ready for construction under the ownership of government. Its strategic position between Dussehra ground and New Market makes it lucrative for living.

1.1.1.2 seismicity

Bhopal falls under the Zone II of the Seismic zoning map of India – IS: 1893-2002 which is the least active zone.

1.1.1.3 Existing Features and Utilities/ Services

There are no utilities/ services available on site

All the utility services for the proposed housing shall need to be integrated with the ABD Project area Service Plan.

1.1.1.4 Proposed Transportation Network

Project area roads have been classified into categories such as arterials, sub-arterials, Distributor / collectors Roads, Local / Access Roads, and NMT routes in accordance with the definitions

Figure 1-1 and Figure 1-2 shows the road hierarchy and proposed NMT and pedestrian access.

Figure 1-1: Proposed Road Hierarchy

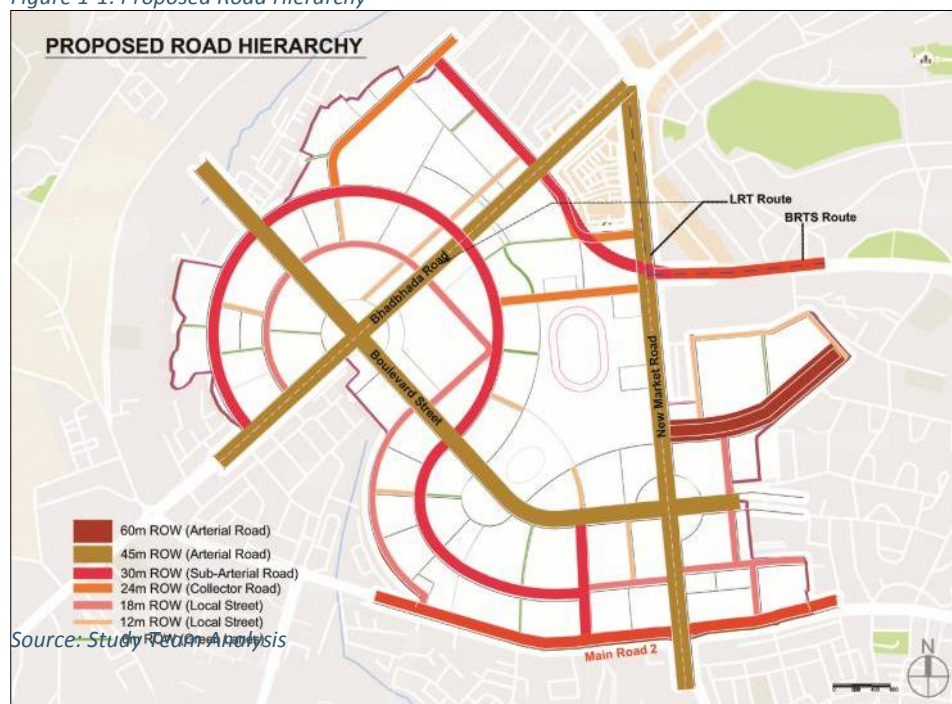
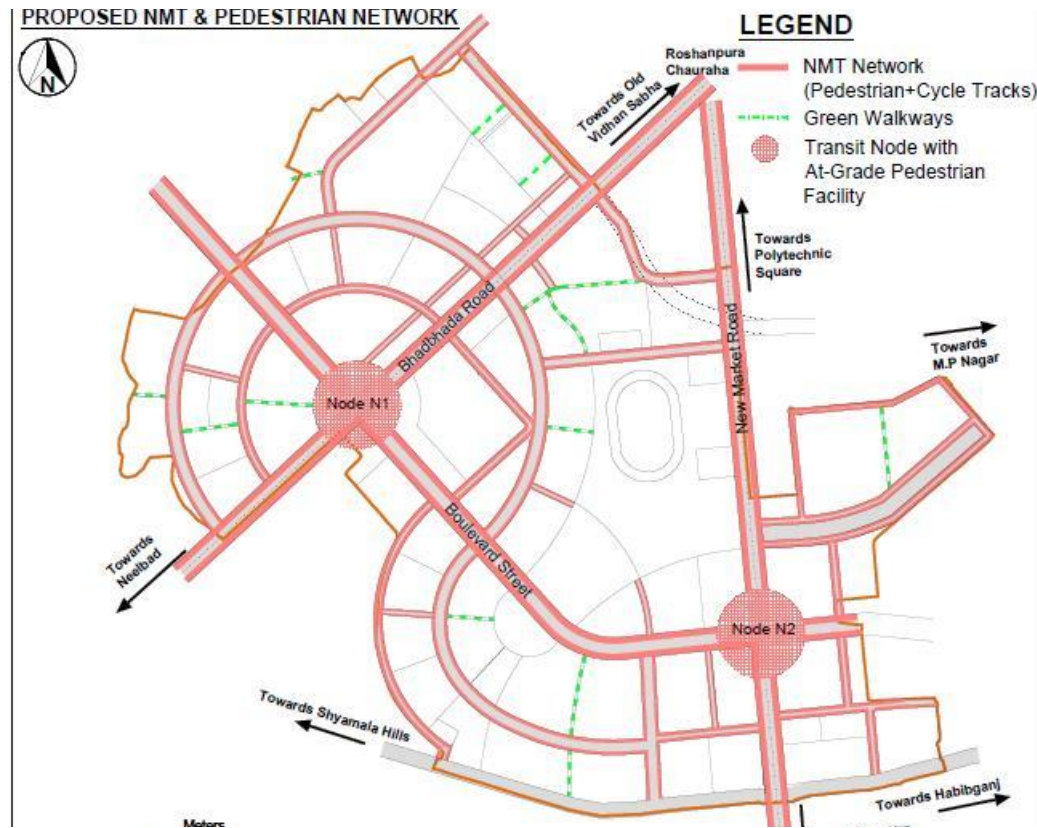


Figure 1-2: Proposed NMT and Pedestrian Network



Source: Study Team Analysis

1.2

Land details

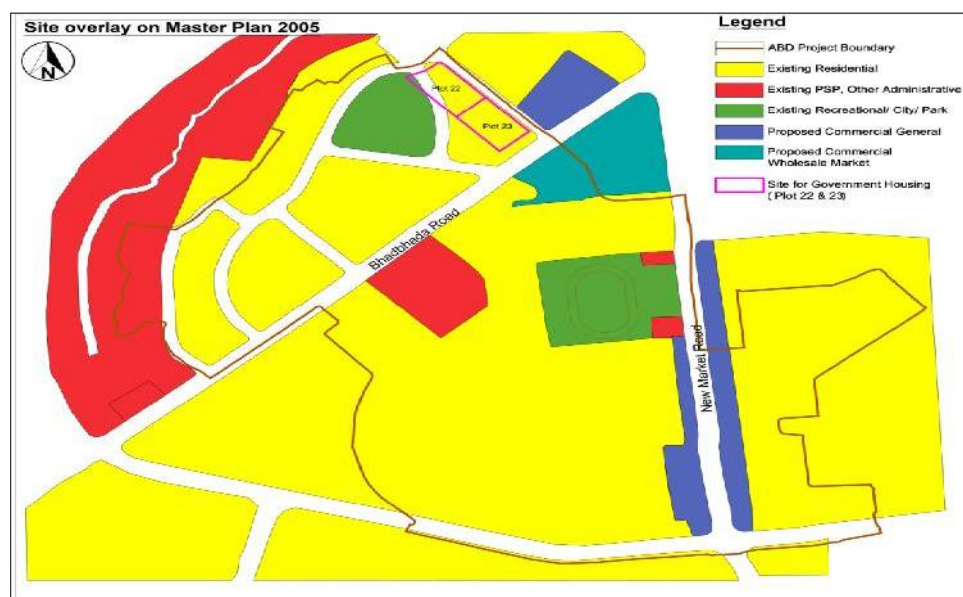
1.2.1 Existing Land Use

The existing land is under Government ownership and is marked residential in Bhopal Development Plan 2005. A very small portion falls under Recreational land use and existing road.

1.2.2 Land Use (As per sanctioned Development Plan)

The proposed land use of site as per sanctioned development plan is Residential shown in Figure 1-3.

Figure 1-3: ABD project boundary overlay over existing Landuse Plan



Source: Bhopal Master Plan 2005 & Study Team Analysis

1.2.3 Handing over of Site to Contractor

Details of handing over of Site to Contractor are given in table below. The location of the proposed plot for Govt. housing is marked in Figure 1-3.

S. No.	Site Details	
1	The size of the plot available for the construction includes Plot 22 –14350.17 sqm. Plot 23 –11126.67 sqm. The site abuts 30m wide primary road as approach road.	
	F TYPE	G TYPE
Total No. of Towers	3	3
No. of floors (excluding Upper & Lower Ground Floor)	14, 13, 14	11, 11, 11
Type of flats	F type (3 bhk)	G type (2 bhk)
No. of Flats	328	352
Unit carpet area	107.49 sqm	81.35 sqm
No. of Parking Floors (Upper & Lower Ground Floor)	2	2
No. of Parking	288	130
Population	1640	1760

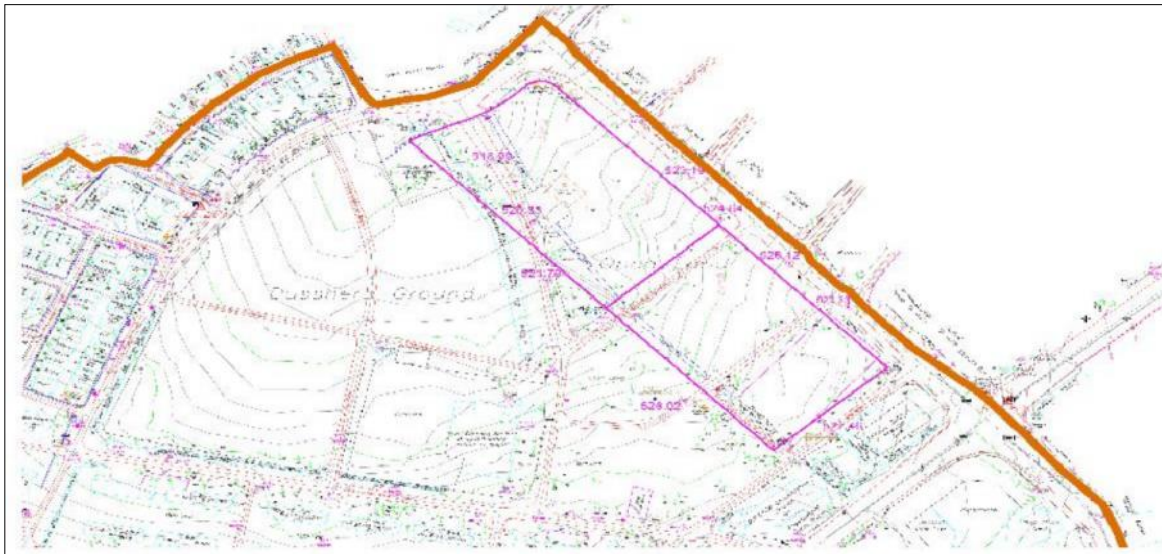
1.3 Site Topography

The Government Housing site has 7m level difference over 250m within the plot boundary sloping from New Market towards Palash Residency. The site slopes towards Dussehra ground from 30m wide road towards MLA quarter forming a level difference of 2m over 70m distance.

Detailed survey of trees and vegetation in the project area has been carried out including green cover mapping as well as numbering and listing of trees with details like co-ordinates, type and girth of each. There are approximately 80 trees, and open

lined drains on the site. A few temples are situated within the premises of the Plot 22 and 23 which shall be relocated outside the site area.

Figure 1-4: Topographical Survey of the proposed site



Source: Study Team Analysis

Environment Clearances

The overall Environment clearance for Bhopal Smart City ABD Project has been applied for approval.

1.4 Index Maps and Location Maps

Figure 1-6: Index and Location Map

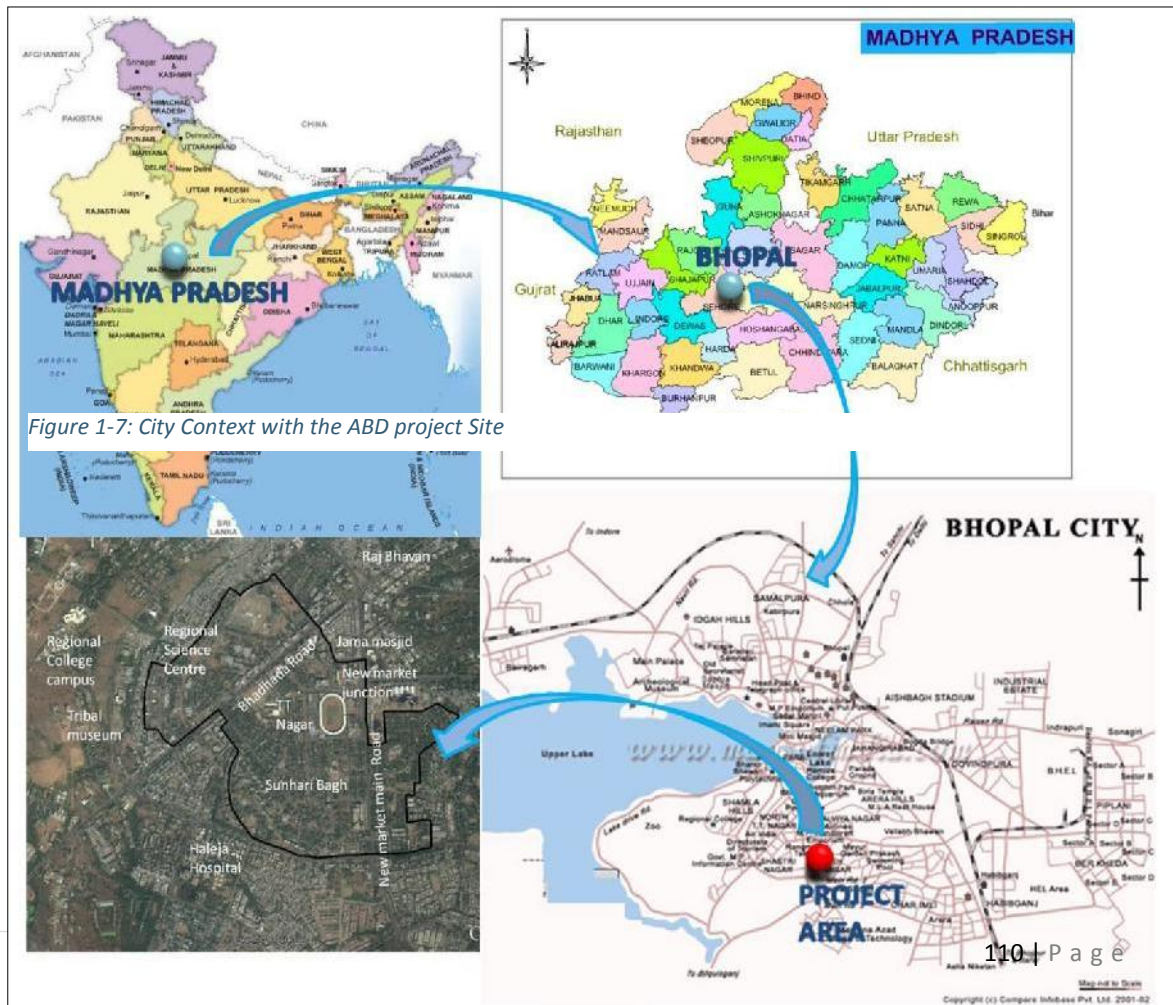
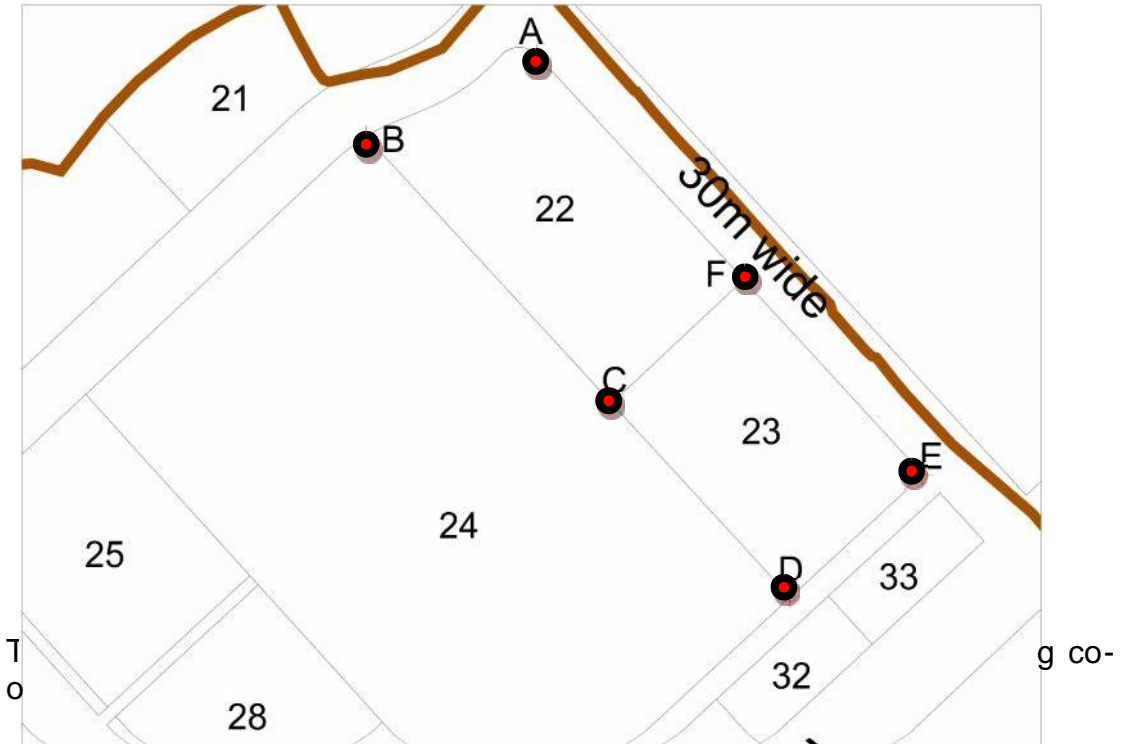
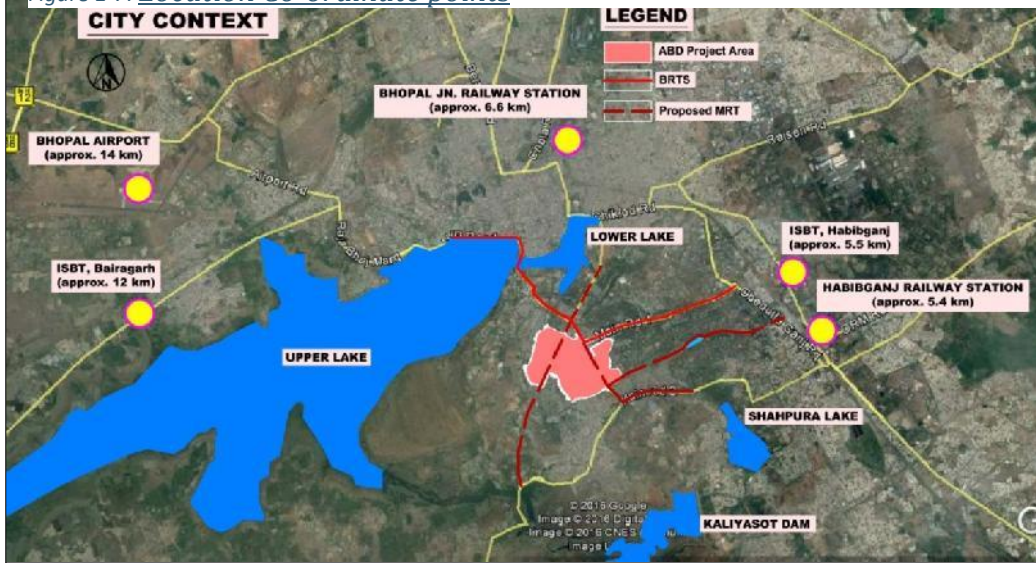


Figure 1-7: City Context with the ABD project Site

Figure 1-7: Location Co-ordinate points



Points	Easting (UTM)	Northing (UTM)
A	745212.1779	2571874.4734
B	745128.8946	2571835.1788
C	745248.5309	2571706.4301
D	745335.5715	2571612.7605
E	745400.3412	2571671.9779
F	745312.8183	2571766.1674

Chapter 2: Scope of Work:

The scope of work covered in this tender shall be as per the Bill of Quantities, specifications, drawings, instructions, orders issued to the contractor from time to time during the pendency of 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

The Work Shall be executed on Preparation of Working Drawings, Procurement and Construction Basis. Details and drawings given in Tender document is for information purpose only and successful bidder shall undertake confirmatory survey for accuracy and completeness of data. It is in scope of successful Bidder to undertake all Site surveys, Geotechnical investigations, obtaining all required approvals from the relevant authorities, Further detailing and designing of Structural works, Electrical, Mechanical, Plumbing, Firefighting, HVAC Works ,Landscape, External Infrastructure works, ICT works ...etc as per Employers requirement and submit the same to client for review and approval, Prepare Good for Construction Drawings, Carry out Shop Drawings ,submit maintenance manual to client for approval before start of Maintenance period. The successful bidder shall have to prepare and submit 'As Built Drawings' depicting the exact construction carried out on site, in soft and hard copy format.

It is envisaged to have IGBC Green Homes – Gold Rating for the Project. The Contractor shall design and construct the project meeting the prevailing IGBC norms, so as to achieve IGBC Green Homes – Gold Rating.

All the Drawings to be prepared and submitted by the Contractor shall be in Revit module and shall interface to BIM in seamless manner.

Statutory and other charges for getting various required approvals shall be in scope of Successful bidder.

The quantities of various items as entered in the “BILL OF QUANTITIES” 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 in the bill of quantities. The variation of quantities will be governed as per conditions of contract.

1.5 Architecture

Contractor shall be responsible for making the facility fit for the intended purpose while performing all of its obligations covered under the Contract Document in its entirety. The work shall be done in accordance to the drawings approved by the statutory authorities.

Currently tender drawings and Design Criteria, Brief Technical Specifications for certain items of work are available. Scope includes further detailing, as deemed necessary (without changing the foot print of the proposed “buildings and space planning”, design intent), developing required specifications, preparing Good for Construction (GFC), coordinated drawings and construct entire campus in accordance with the same. The scope shall also include preparation of as built drawings before handing over the work to the Employer, maintaining the Quality assurance & Quality control (QA&QC), corrective actions, reporting and arranging for regular inspections by all concerned.

Contractor has to obtain IGBC Gold rating for the buildings. The contractor should demonstrate feasibility of achieving a minimum of 64 points at the time of submission of bids. The buildings are to be designed as per NBC, DCR and IGBC Guidelines.

1.5.1 Architecture, Interiors, Softscape & Hardscape

The Architecture, Interiors, Softscape & Hardscape scope includes design, detailing, procure, supply, construction, installation, furnishing, equipping, testing, commissioning and execution for "Government Housing" complex that includes G and F type of residential units along with club house.

Design and detailing shall include:

- Appointment of consultants.
- Preparation of coordinated GFC drawings.
- Obtaining Employers / PMC's approval on the GFC drawings.
- Preparation of approval drawings for final Fire NOC, documents, calculations, etc, as may be necessary by the statutory authorities, at the relevant stages.
- Providing material samples and mock-ups and obtaining Employers / PMC's approval for the same.
- Preparation of As-built drawings.

1.6 LANDSCAPE

- The scope consists of design, detailing, procure, supply, construction, installation, furnishing, equipping, testing, commissioning, execution and Maintenance of landscape works including Hardscape, Softscape, outdoor landscape structures, street furniture and Irrigation works for of the project in accordance with the Employer's Requirements.
- The Scope consists of clearance of the Site of Works and preparation of the same to commence the proposed landscape execution activities. Wherever applicable, this is deemed to include all preliminary works like Dismantling/Demolition, Site Clearance, and General Leveling etc.
- The drawings shall prepared by contractor in conjunction with the specifications and matters referred to, shown or described in one are not necessarily repeated in the other.
- The work shall be carried out in accordance with the drawings and designs as would be issued to the Contractor by the Landscape consultant appointed by contractor duly signed and stamped by him. The Contractor shall not take cognizance of any drawings, designs, specifications, etc. not bearing Landscape consultants signature and stamp. Drawings prepared by the Landscape consultant appointed by contractor shall be submitted to Obtain Employers / PMC's approval prior to starting the work at site.
- Contractor shall prepare and issue all required working drawings and get them approved by Employer/ Employer's representative with required number of revisions till the details provided do not satisfy the Employer/ Employer's representative.
- The work shall be executed and measured as per metric dimensions given in the Schedule of Quantities, drawings etc.
- The scope includes maintenance of all above during Defects Liability Period (DLP) which shall be of one year after completion of Landscape Execution. The Contractor will maintain the entire landscape development area free of cost for a period of one year

after completion of all above works as certified by the Employer/ Employer's Representative's in consultation with the Landscape Architect.

1.7 IGBC

1.7.1 Objective

The objective of the contractor is to help the client meet all sustainability goals (including IGBC GREEN HOMES) set for the project. The contractor shall also help the client secure IGBC GREEN HOMES-Gold rating for this project through IGBC GREEN HOMES Version 2 (based on IGBC GREEN HOMES

The contractor shall facilitate complete green-building certification process for the project.

The contractor shall assess all available building data to understand and maintain current design goals and strategies for detail design and construction. The building is registered with IGBC for IGBC GREEN HOMES version 2..

In addition, the project contractor will appoint a suitable contractor/consultant for the following works:

- IGBC / Green Building Facilitator

The IGBC / Green Building Facilitator shall carry out green building documentation and submission work for the project. Detailed scope of work is provided below.. The client shall have final approval on appointment of green building facilitator.

1.7.2 Scope of Work

Analyze building data including IGBC GREEN HOMES data received from client

- To ensure that all Sustainability requirements are meet as per IGBC Green Homes requirements
- Ensure that any changes (design, specifications etc) to project during detailing phase meet project sustainability (including IGBC GREEN HOMES) requirements
- Help identify specific areas and subjects where potential for improvement from environmental design perspective exists
- Advise client on necessary changes in building design to meet sustainability (including IGBC GREEN HOMES) requirements
- Identify and follow IGBC GREEN HOMES documentation and submission requirements for each credit
- Fill credit submittals (templates, documentation, photographs etc) as required for IGBC GREEN HOMES documentation
- Incorporate client feedback, IGBC GREEN HOMES facilitator and IGBC feedback into credit submittals
- Provide bi-weekly updates on target credit- documentation received
- Develop and implement the fundamental commissioning plan as per the IGBC GREEN HOMES guidelines (scope of work is separately discussed below)
- To filter, cross validate, verify consistency, add value and consolidate to make the document suitable for submission to IGBC

The deliverables for the project contractor will include:

- Bi-weekly updates on target credit- documentation received
- Draft submittals for all IGBC GREEN HOMES credits identified for project
- Final submittals for all IGBC GREEN HOMES credits identified for project

1.7.2.1 Scope of Work for IGBC Green Building Facilitator:

The objective of the IGBC GREEN HOMES Facilitator is to help the client meet all sustainability goals (including IGBC GREEN HOMES) set for the project. The IGBC GREEN

HOMES facilitator shall also help the client secure IGBC GREEN HOMES-Gold rating for this project through IGBC GREEN HOMES Projects (based on IGBC GREEN HOMES). The IGBC GREEN HOMES Facilitator shall facilitate complete green-building certification process for the project. The IGBC GREEN HOMES Facilitator shall assess all available building data to understand and maintain current design goals and strategies for detail design and construction. All available building information shall be made available to the IGBC GREEN HOMES Facilitator for the same. In case the information is not available, the IGBC GREEN HOMES Facilitator shall make suitable assumptions and cross check with the client.

The building is registered with IGBC for IGBC GREEN HOMES Version 2. The Green Building Facilitator shall be provided with appropriate details to continue with the documentation, submission and rating process.

A. The general scope of work for the green building facilitator includes:

- Analyse building data including IGBC GREEN HOMES data received from client
- Convey and coordinate sustainability (including IGBC GREEN HOMES) goals and requirements to detailing project team
- Coordinate between client and project contractor (including detailing project team) to ensure all sustainability (including IGBC GREEN HOMES) requirements are met
- Ensure that any changes (design, specifications etc) to project during detailing phase meet project sustainability (including IGBC GREEN HOMES) requirements
- Help identify specific areas and subjects where potential for improvement from environmental design perspective exists
- Provide continual awareness to detailing project team of green building concepts
- Facilitate the project team to select materials/equipment, if required, to meet the IGBC GREEN HOMES requirements. Support in identifying vendors for the project to meet IGBC GREEN HOMES requirement.
- Identify and follow IGBC GREEN HOMES documentation and submission requirements for each credit
- Prepare and provide all necessary templates to the project contractor (including detailing project team), so as to meet IGBC GREEN HOMES requirements
- Provide feedback to project contractors on credit submittals
- Prepare draft submittal document for client for approval
- Incorporate client feedback and prepare submittal for IGBC GREEN HOMES
- Communicate with IGBC for related queries
- Incorporate IGBC feedback into submittals
- Advise client on necessary changes in building design as per feedback
- Provide bi-weekly updates on target credit- documentation received
- Carry out Energy Modeling as per the IGBC GREEN HOMES Version 2 guidelines (details separately discussed below) to account for any modifications in building detail design
- To filter, cross validate, verify consistency, add value and consolidate to make the document suitable for submission to IGBC

B. The energy modeling scope of work for the green building facilitator includes:

Energy model must be prepared for submission to IGBC to meet *Prerequisite 2* and *Credit 1* requirement for Energy and Atmosphere (EA) category of IGBC GREEN HOMES rating system. The detail scope of work for the same includes:

- Define modeling assumptions, schedules and collect information for simulation
- Develop proposed and base case (as per ASHRAE 90.1.2007) building simulation model
- Proposed case and base case simulation including validation and debugging

- Evaluate buildings as per IGBC GREEN HOMES requirements to ensure appropriate savings as specified by client
- Identify and simulate Energy Conservation Measures
- Validation of individual ECM results
- Prioritization and evaluation of combined ECMs
- Support in IGBC GREEN HOMES documentation and incorporating changes required in modeling subsequent to IGBC GREEN HOMES review

C. The detailed scope of work for simulation includes:

- i. Modeling Assumptions: Carryout the simulation in accordance with ASHRAE 90.12007 performance rating method. The simulation would consider appropriate modeling assumptions, schedules for the project for various occupancies, defining equipment power densities, air changes per hour, lighting density, occupant density, determining window wall ratio, floor to floor heights, plenum height, SHGC and U-factors for fenestration, etc. All assumptions must be verified with client.
- ii. Base Case Model: The base case would be developed considering the following:
 - Layout of the existing design, defining thermal zones within the building, reviewing the mechanical & electrical plans and selecting an appropriate weather file.
 - Importing the above information to relevant software and setting up the base case with appropriate information for each zone.
 - Applying modeling assumptions to various zones according to their occupancies.
 - Carryout the simulation and check generated reports for validity.
 - Carryout several iterations so as to ensure that the model accurately represents the thermal behavior of the designed case and it runs smoothly without running into errors.
- iii. Energy Conservation Measures: Evolve alternate energy conservation measures in consultation with the owner & other agencies and incorporate in the modeling to define the 'proposed case'. Under this task, various ECMs will be identified, detailed and incorporated into the base case. Several cases (Base Case + ECM1, Base Case + ECM2, base Case +... ECMn) will be defined and simulated.
- iv. Validation: Carrying out detailed validation of individual ECM results. The results from the previous task will be scanned for validity for each case.
- v. Combining ECMs: Combined ECMs based on the resultant savings from each ECM would be evaluated. Eventually, all ECMs that yield satisfactory results will be combined into a single case. Several configurations of Base Case + ECMs need to be defined and simulated before arriving at the best or optimum combination of ECMs. At the end of the simulation, detailed specifications will be prepared for selection of materials and equipment like Glass, facade material, use of onsite renewable energy, Air-conditioning equipment, insulating materials, light fixtures, etc.

The deliverables for the green building facilitator will include:

- Bi-weekly updates on target credit- documentation received
- Energy Modeling Report as per IGBC *EA Prerequisite 2* and *Credit 1* requirements
- Final certification documentation

- Draft submittal document for IGBC GREEN HOMES

FINAL SUBMITTAL DOCUMENT FOR IGBC GREEN HOMES

1.8 CIVIL & STRUCTURAL WORKS

The Scope of Work under this contract includes but is not limited to the following in relation to the design, construction, and operation of the Works:

- Site Topographic Survey and Geotechnical Investigations as deemed necessary by the Contractor as per BIS latest codes, NBC etc as applicable through any nationally accredited lab/govt. institute approved by BSCDCL. Employer may verify the results submitted by contractor, if need be.
- Construction enabling works like site office, labour camp, material stacking, laboratory, etc. shall be the responsibility of contractor.
- Setting out of the works.
- Site Clearing, Site Grading, Excavation, disposal of excavated earth and bailing out & disposal of water.
- Contractor shall do Structural Design based on approved Civil Structural Design Criteria which shall be whetted by IIT or organization approved by BSCDCL.
- Preparation of complete structural design, drawings for foundation, basements, podiums, superstructure and for other related structures in the housing pocket. i. e. UGRs, pump house, DG set meter room, substation building, gate , compound wall, chambers, trenches etc to be provided as per provision contained in IS codes/NBC but not lower than the minimum criteria mentioned in the tender. , Scales for each details in drawing and drawing sheets shall be use as per BIS standards.
- Contractor shall submit Structural stability certificate for 10 years and life span building structure certificate for 50 years for all structures and components to Bhopal smart city corporation with his own cost.
- Construction of all Civil Structures and Building finishes Work of all structures in housing pocket.
- For all structural designs and drawings the contractor must get the proof check done by accredited agencies at his own cost before submitting for the approval of the client.
- One Copy of structural design calculations and details in soft and hard copy (latest version of software) based on the approved building plan shall be submitted before commencement of the construction work at site for information and record.
- Submission of Detailed Engineering Designs, Drawings, Process Calculations, Data Sheets for approval.
- Execution of all Civil Works at Site including Construction, Erection, Testing and Handing over.
- Design and Construction of Internal Roads, Curbs, Pavements, Parking Spaces, Compound Wall, water supply and sewage disposal and Storm Water Drains, Retaining Wall, Water Bodies.

- Water tanks shall be designed for limited crack width as per BIS code and checked for water tightness after construction.
- Implementing Anti-termite treatment / Water proofing / Insulation works. Contractor shall submit warranty certificate for same in approved format.
- Plantation and Landscaping works.
- Preparation and Submission of As-Built drawings for Civil and Structural Works.
- Issuing Warranty certificate for Anti-termite treatment / Water proofing / Insulation works.
- Maintaining safety requirements and relevant Government Regulations, and ensure their implementation.
- Safety reporting: Brief reports of all accidents and hazardous incidents including descriptions of causes, extent of injuries, action taken, and precautions instituted to prevent repetition of such events.
- Contractor has to erect batch mix plant (minimum 60 cum/hr capacity) fully automatic, computerized for preparation of design mix concrete as per latest BIS codes at his own cost and shall prepare all concrete accordingly. RMC to be used for 6 cum or more than 6 cum of concrete to be done in single pour.
- Guarantee for construction defect/manufacturing defects for 12 months: Contractor shall guarantee the entire work for period of 12months after completion of work. Any damage or defect that may arise or that may remain undiscovered at the time of issue of completion certificate connected in any way with the equipment or materials supplied by him or in the workmanship be rectified or replaced by contractor at his own expense as desired by engineer-in-charge or in default may cause the same to be made good by other agency and deduct expenses there of (for which the certificate of engineer-in-charge shall be final) from any sums that may then or any time thereafter become due to contractor or of sale thereof or a sufficient portion thereof. The contractors shall be liable to construction defect/ manufacturing defects and not liable to damage caused by occupants if any.
- The scope as described above is only indicative and not exhaustive. In additions to above, the contractor shall be responsible for executing all the items required for completing the houses in all respect to make the dwelling units habitable and ready for occupation and also all services, make the environment fit for habitation with electrical, horticultural, rain water harvesting works complete as per direction of Engineer-in-charge.

1.9 ELECTRICAL WORKS

1.9.1 general

- 1.1 The scope for this Tender specification consists of engineering and manufacturing; testing at Manufacturer's works, packing, forwarding and delivery to site; unloading and handling at site (shifting from unloading point to the storage area, storage and shifting from the place of storage to the place of installation), assembly, erection, cleaning & touch up painting, testing & commissioning at site of the Electrical Equipment and Systems, as listed below for **Government Residential Buildings**

located on Plot no. 22 and 23 of the Area Based Development (ABD) project under Bhopal Smart City Development Corporation Ltd;

- 1.1.1 List of Equipment and system
 - (a) 3 Phase, 415 Volts, 50 Hz LT Indoor Switchgear panels.
 - (b) 3 Phase, 50Hz, HV and LV cables and cabling system.
 - (c) Point wiring
 - (d) Earth Stations and Earthing & lightning protection System
 - (e) Indoor and Outdoor Lighting Luminaires and its associated wiring; and receptacle system with accessories
 - (f) Miscellaneous statutory equipments – Refer BOQ.
- 1.1.2 Measurement of soil resistivity at site by Wenner's four electrode method as per IS: 3043 – 1987 and its latest amendments, at minimum two (2) locations **per plot**. The measurements shall be carried in the presence of the PURCHASER and the results/ report shall be certified by Govt. Authorised Labs or agencies.
- 1.1.3 All mounting and foundation supports and hardware accessories for electrical equipment/system installations.
- 1.1.4 All civil works associated with equipment/system electrical installations like embedment, chipping, punching, making holes, openings in walls, pipe sleeves, fire/ water proof sealing etc.
- 1.1.5 Any other electrical equipment which are not specifically listed above but are necessary to make the system complete and functional in all respect as per specification and statute.
- 1.2 This specification is the minimum requirement and should be read in conjunction with relevant latest CPWD specifications, requirements, rules and regulations. Any additional requirements as per CPWD shall be offered by BIDDER as per CPWD specifications, requirements, rules and regulations. The same shall be indicated in the BID write up and a separate Bill of Quantities (BOQ) for additional or modified items shall be submitted along with the BID write up.
- 1.3 The BIDDER shall be responsible for the selection appropriate equipment to provide the best co-ordinated performance of the entire system. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.
- 1.4 Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures, and standard accessories normally provided with such equipment and / or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specification unless included in the list of exclusions. Materials and component not specifically stated in the specification but which are necessary for commissioning and satisfactory operation unless specifically excluded shall be deemed to be included in the scope of specification and shall be supplied without any extra cost. All similar standard components/ parts of similar standard equipment provided shall be inter-changeable with one another.
- 1.5 All SAFETY considerations in design, manufacturing and installation of equipments and systems for safe operation & maintenance by PURCHASER personnel and safe practices during installation at site shall be in the scope of the BIDDER. Cost towards accomplishing the same shall be included in the BID price and no extra claim shall be entertained later.

1.6 List of Submissions

- 1.6.1 Submission of equipment/ system Detail Engineering drawings, Data sheets, sizing Calculations etc for review and approval by PURCHASER before execution/ procurement and manufacturing; and test reports, commissioning reports and performance reports of all electrical system/ equipment for review & acceptance by PURCHASER.
- 1.6.2 Submission of Type test reports carried out at accredited laboratories like ERDA, CPRI or equivalent as per requirements.
- 1.6.3 Submission of all "As Built" drawings, Data sheets, Calculations etc. after execution and commissioning of the equipment and systems above.
- 1.6.4 Submission of relevant documents and drawings to the concerned statutory authorities/ agencies and getting clearance and approval for the supplied and installed equipment under this specification is solely the responsibility of the BIDDER.
- 1.7 All coordination for Liaison and obtaining required mandatory approvals/ NOCs from Electrical Inspector, Lift Inspector and any other Statutory Authority as applicable for drawings & documents, initiation of works, Load release, charging and commissioning of entire power distribution system within the scope of this Document.

1.9.2 CODES AND STANDARD

- 1.8 The design, material, construction, manufacture, inspection, installation, testing and performance of electrical equipments & systems conform to the latest applicable Central Electrical Authority (CEA) guidelines & rules, all currently applicable IS, IEC and IEEE standards, Central PWD (CPWD) Specifications, National and International codes of practice, statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility.
- 1.9 All codes and standards referred to in this specification shall be understood to be the latest version on the date of offer made by the Bidder unless otherwise indicated.

1.9.3 ELECTRICAL POWER SUPPLY INFORMATION

- 1.10 Independent power for the Plot no. 22 and Plot no 23 shall be provided by state Distribution company Madhya Pradesh Kshetra Vidyut Vitaran Company Ltd. (MPMKVVCL) or a private Distribution Franchisee company as may be decided by BSCDCL, at 33kV through underground laid HV cables till the plot Substation.
- 1.11 The temporary Source of this power shall be from the nearest existing Substation of MPMKVVCL or as may be decided by the service provider. Permanent power shall be provided from the EHV GIS substation as per the power distribution plan of the ABD area. The power supply to the plots shall be loop in and looped out of the 33kV Rings.
- 1.12 The power within each plot substation shall be stepped down to 433 V by two redundant oil type transformers and distributed to the six towers (22 building) eight towers (23 building) and other utility areas and facilities from Main Power Control Centre (PCC) located in the same Substation.
- 1.13 Each Flat/ Dwelling units within each tower shall be provided with independent 415 V, 1 Ph tariff meter mounted on Metering Panels located in the Metering room on the podium parking floor of the respective tower. The common Utility loads and other facilities like Club House, Multi- Purpose Hall, Play Area and Lawns within the

plot shall be supplied from Common utility Panels (CUP). CUPs shall be powered through 415 V, 3 Ph tariff meter mounted in the same Metering Panel as above. All tariff meters shall be as per power supply company specifications.

- 1.14 FR PVC insulated copper conductor cable shall be laid in MS conduit mounted on cable tray in Electrical Duct or concealed through ceiling for supplying power up to the Flat Distribution Board (FDB) of individual Flat units on each floor from the respective meter of the corresponding tower. Further sub-main, circuit and point wiring for each flat shall be carried out through concealed MS conduit and Concealed Switchboards.
- 1.15 All the power distribution from the PCC to the various panels above shall be through FRLS XLPE/ PVC insulated, Armoured cables laid on the prefabricated cable trays mounted from the ceiling/ column with steel structural supports.
- 1.16 415V 3phase 50 Hz Diesel Generator set shall be provided at the substation for catering to emergency power for all the common utility loads except Fire hydrant. The distribution shall be done through a DG Emergency Panel located in the Substation.
- 1.17 Fire Hydrant loads in the pump house at basement floor shall be supplied directly from the PCC without any emergency. The metering required for the Fire Hydrant panel shall be as per Power Supply company norms and specifications.
- 1.18 Conventional light fittings and lamps are considered for the illuminations of the Flat units where as LED light fittings are considered for the illuminating the common facilities and Utility areas including parking, substation, floor lobby & staircases, pumps house, ventilation rooms, Club House, MP Hall, lawns, play areas, drive & path ways and street lights.

1.9.4 SYSTEM DESIGN PARAMETER:

- 1.19 All equipment shall be designed to operate satisfactorily and meet the requirements specified in this specification under all site conditions where the equipment is proposed to be installed. The design ambient shall be 45 deg. C for all equipment.
- 1.20 The equipment shall be designed and manufactured in accordance with the best engineering practices and shall be suitable for the intended purpose.
- 1.21 Following System Parameter to be adopted for system design.

Nominal (Rated) System Voltage	:	33kV	0.415kV
Highest System Voltage	:	36kV	1.1kV
Lightning Impulse Withstand Voltage (1.2/ 50 microsecond)	:	170 kVp	-
Power Frequency Withstand Voltage for 1 minute	:	70 kV rms	3 kV rms
System Neutral Earthing	:	Solidly Earthed	Solidly Earthed
Fault Level of System	:	25kA for 1sec.	As calculated
Frequency	:	50 Hz	50 Hz
Dynamic Short Circuit Current Rating	:	62.5 kA peak	As calculated

- 1.22 Service Condition

- (a) Design Ambient Temperature (Reference Ambient temperature for temperature rise consideration) – 45Deg C.
- (b) Relative Humidity – 100%.

1.9.5 QUALITY CONTROL PLANS

- 1.23 The Quality Control Plan shall list and define in sequential order all process control activities, inspection and tests proposed to be performed on the equipment/ material starting from component procurement and from testing stages to product dispatch. The Quality Control Plan shall indicate and identify the applicable standards, detailed description with diagram the procedure, acceptance criteria, extent of check and record to be generated.

1.9.6 INSPECTION

- 1.24 PURCHASER may inspect all the supply components/ equipments/ systems at VENDOR's works. All type test certificates of the bought out items and internal test certificates shall be furnished at the time of inspection.
- 1.25 Type/ Routine tests according to relevant standards shall be performed in the presence of PURCHASER representative if agreed.
- 1.26 All necessary measuring and testing equipments shall be arranged by the VENDOR or its Sub- VENDOR at the time of inspection as well as during commissioning at site without any cost implication to the PURCHASER. All such instruments shall be calibrated from Authorized agencies not older than a year from the date of inspection.

1.9.7 LIST OF RECOMMENDED MAKES FOR VARIOUS COMPONENTS

- 1.27 All the equipment shall be of makes listed in the enclosed list of approved makes of equipment. BIDDER shall submit the offered make from the list along with the BID. For any deviation at any stage prior approval shall be taken from PURCHASER. Highlighted makes are preferred makes. However, PURCHASER reserves the right to select the makes off the following during approval stage.
- 1.28 List of makes of Individual equipment and system are included in the respective specification section.

1.10 VENTILATION

The General scope shall cover design, supply, construction, erection, testing and commissioning of ventilation system for Plot 22&23. The Contractor shall guarantee the design parameters as stated in Basis of Design, **Section 3**. The Contractor is required to provide completely all the Ventilation and the Control Systems and other specialized services as described hereinafter. The contractor shall carry out and complete the said work under this Contract in every respect in conformity with the Contract documents and as per the directions of and to the entire satisfaction of the Engineer-in-Charge. Work under this Contract shall include providing all workmen - skilled and unskilled, materials, plant, equipment, tools, appliances, transportation necessary and required for the satisfactory completion of the Project in every respect. This also includes any materials, equipment, appliances and incidental work not specifically mentioned herein or noted on the

drawings/documents as being furnished or installed, but which are necessary and customary to make a complete installation. For equipment, instruments, controls etc., required to be imported, the Contractor shall make his own arrangements to import these equipment, instruments, controls etc. Including any spares required for the start-up/commissioning of the equipment/systems. The work, in general, to be performed under this Contract shall inter alia comprise of following:

1. Tube Axial Fans for Lift well pressurization.
2. Domestic propeller fans for pump room, Meter room, Substation.
3. Air-distribution Works.
4. Electrical starters panel for all fans and related electrical works such as cabling, earthing, cable trays etc

1.11 FIRE FIGHTING

- a) The work shall be executed on Turnkey basis from conception to commissioning fire fighting works, all necessary engineering survey, designing, method of erection in accordance with fire fighting layout plan and detailed duly approved as specified by BSCDCL approval authority / PMC/ Consultant.
- b) Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the fire fighting services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the approved Drawings.
- c) Contractor/ Developer have to obtain all the statutory clearance from the concerned authority as and when required i.e. Town Planning, Fire, Airport Authority, Environment Department's approval.
- d) Contractor will hand over all the equipments of fire fighting system after commissioning, pre-commissioning and testing of materials with guarantee, certificates.
- e) Complete design, manufacture, supply, erection, testing, commissioning and handing over of the complete fire fighting (sprinklers, fire pumps, hydrants, fire extinguishers, etc.) including but not limited to the following.
 - Buildings:
 - o Complete set of fire water pumps as mentioned in the design specifications or as per codal requirements, its drives with all accessories & base frame with foundation bolts etc.
 - o All the suction & discharge piping including valves with necessary fittings, flanges, gaskets, fasteners & consumables, their grouting, structural supports, painting and all accessories as required to complete the fire water pumping arrangement shall be provided along with pumps.

- Field instruments like pressure gauge & pressure switch and control cabling including junction box, erection hardware, etc., to MCC & diesel engine control panel.
- Electrical panels, Cabling & earthing from MCC panels to various fire fighting system, control wiring & interlocking.
- Instrumentation and Control equipment shall be complete with primary elements, initiating contacts for alarms, instrument impulse lines, fittings, power and control cables with suitable glands and terminations and instrument installation hardware.
- Fire Hydrant System for the entire building including piping, hydrant components, wet risers.
- Wrapping & coating for underground piping with proper testing.
- Sprinkler System for the complete development (within the scope of this contract).
- Contractor shall carryout the hydraulic calculation using validated software and get the approval from Owner/Consultant.
- Fire extinguisher including mounting fixtures, anchor bolts, clamps, structures, etc for all buildings in all the areas.
- Photo luminescent signage.
- Obtaining approval of the system from District Fire Department and/or Local Authority(ies) having jurisdiction (Factory Inspector, etc.) including taking out necessary number of prints of drawings, submission to approving agency, co-ordinating site visits, making any minor modification in drawings for the purpose, etc.
- Structural works like pipe supports for above ground pipes, wall supports, hose cabinet supports, etc.,
- Civil works like wall opening, chipping of foundation, grouting of foundations, sand filling and compacting for underground pipes, etc.,
- Painting of equipment, piping, supports etc. with 2 coats of primer & 2 coats of synthetic enamel as per IS: 5 shade 536 (Fire Red).
- One set of special erection and maintenance tools and tackles.
- Start up and Essential spares.
- Recommended spares for 10 years operation and maintenance.
- Anchor fasteners required for pipe supports of all the systems which are engineered by vendor and all anchor bolts, nuts, washers and inserts to be embedded in concrete for the equipment and piping.
- All foundation, supports and miscellaneous items & accessories required for system completion and required for normal operation of equipment and systems.

- Shop inspection (in Vendor's works & at project site after installation along with all required calibrated measuring instruments)
- Packing, marking and forwarding.
- Unloading at site, storage and movement of equipment to erection site.
- Complete erection of all equipment covered under this Contract.
- Testing and trial run of equipment and systems.
- Pre-commissioning checks and commissioning of all equipment and systems.
- Carrying out performance testing of equipment at site to demonstrate guaranteed performance parameters.
- Documentation of all design, drawings, analysis, tests and calculations etc.,
- Training of PURCHASER's personnel.
- Preparation and submission of detailed engineering drawings for complete fire protection system based on these specifications and latest base drawings. Drawing(s) showing layout of portable extinguishers, are also in the scope of bidder.
- Preparation of any specific fabrication drawings, if required.
- Prepare and submit as-built drawings in hard and soft copies to Client.
- Any item which may not have been specifically mentioned herein but are needed to complete the equipment / system shall also be treated as included and the same shall also be furnished and erected, unless otherwise specifically excluded as indicated.

1.11.1 DEVIATIONS

BIDDER shall quote in strict accordance with the requirements of this Invitation to Bid. BIDDERS are advised to avoid making technical and commercial deviations. BIDDERS shall note that unless any and all deviations they may wish to make from the enclosed specifications, specific technical requirements and other terms and conditions, are listed in the "Schedule of Deviations" of the bid document, it shall be deemed that the bids are in strict accordance with the requirements of this enquiry. Bids which do not include a categorical statement of compliance with the enquiry specifications and other terms and conditions of contract, and which do not list all deviations in the schedule as called for and offers not duly signed by authorised person of the company will be liable for rejection.

1.11.2 PURCHASER'S RIGHT

Where more than one item is covered by this enquiry, PURCHASER reserves the right to place orders for the various items with different BIDDERS. The PURCHASER does not bind himself to accept the lowest or any Bid and reserves the right to accept or reject any Bid or a portion thereof without assigning any reason thereof or to split the contract during progress of the work due to unsatisfactory work or progress of any one CONTRACTOR.

1.11.3 GENERAL

- a) The PURCHASER will not defray any expenses whatsoever incurred by the BIDDER for the preparation and submission and opening of bids.
- b) Should a BIDDER find discrepancies in, or omissions from the specification or other documents or should be in doubt as to their meaning except prices he would at once request in writing to the CONSULTANT for interpretation/ clarification. The CONSULTANT shall then issue interpretations and clarifications as he may think fit in writing as an addendum. Copies of such addenda, if issued, shall be signed by the BIDDER and shall form a part of his bid. After receipt of such interpretations and clarifications, the BIDDER shall submit his bid within the specified time.

1.11.4 BIDDER'S PROPOSAL

- a) To enable thorough and fast scrutiny of the BIDDER's proposal, BIDDER's are advised to respond all their technical data in the enquiry by clearly marking out their response, wherever they want to provide additional data and / or they deviate from the specified requirements. In case of full compliance, the enquiry specification and data sheets will remain unaltered.
- b) The BIDDER is advised to furnish all information called for in summary of data to be furnished along with the bid & after acceptance of Purchase order.
- c) BIDDER shall carefully study all sections of this specification, drawings and indicate all deviations in the schedule of deviations only. It will be presumed that the offer conforms in all other respects to the specification and the PURCHASER reserves the right to evaluate the bid, as such without any further reference to the BIDDER. It is binding on the BIDDER to supply the equipment and system in conformity with the specification except for the deviations stated in the schedule of deviations and accepted by the PURCHASER.
- d) BIDDER could provide additional data on their proposal by compiling the same under schedule F without altering the specification structure.
- e) BIDDER is advised to quote for the complete scope and partial response will not be entertained. In case of few items which do not directly fall under BIDDER's manufacturing range and / or not available from indigenous source, BIDDER should take the responsibility upon them to arrange to procure them and supply to ensure that their proposal is complete in all respects.
- f) Ignorance of the site shall not be accepted as basis for any claim for compensation. The submission of the tender by the BIDDER will be construed as evidence that such an examination was made and any later claims / disputes in regard to price quoted shall not be entertained or considered.

1.12 PLUMBING

- a) The work shall be executed on Turnkey basis from conception to commissioning plumbing works, all necessary engineering survey, designing, method of erection in accordance with Plumbing layout plan and detailed duly approved as specified by BSCDCL approval authority / PMC/ Consultant.
- b) Contractor shall be responsible for executing all items required for completing plumbing services, environment-fit for habitation, water supply, sewerage, storm

water, rainwater harvesting system, etc. completed as per approved design and drawing direction by Engineer-in-charge.

- c) Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Plumbing services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the approved Drawings.
- d) Contractor/ Developer have to obtain all the statutory clearance from the concern authority as and when required i.e. Town Planning, Fire, Airport Authority, Griha Accreditation/Green Building ,Environment Department's approval, approval for water supply, drainage, services etc including all the required charges to be paid to the plan passing authority.
- e) Designing and preparing drawing for internal & external plumbing services, irrigation, and execution of the same i.e. internal sanitary work, water supply work, drainage works internal and external etc. complete for the building including all pipes, its fittings, testing etc.
- f) Contractor will hand over all the equipments of plumbing system after commissioning, precommissioning and testing of materials with guarantee, certificates.
- g) Complete design, manufacture, supply, erection, testing, commissioning and handing over of the complete plumbing (water supply, sewage, rain water harvesting system) including but not limited to the following.
 - Buildings:
 - o All the transfer pumps, connection between underground tanks and transfer pumps, related piping, valves and accessories etc.
 - o Auto level sensors with required controls like solenoid valve for each tanks (both underground tanks and overhead tanks) for automatic operation of transfer pumps.
 - o Transfer pumps (2 w + 1s) for each potable water & non potable water system of capacity and head as per design.
 - o Water supply pipes for boosting system from U.G.T to O.H.T for all buildings - GI Pipes Class-C as per IS 1239
 - o From OHT to shaft at terrace level GI pipe will be used, for shaft and internal works for potable and non potable water Separate piping (CPVC) used.
 - Complete distribution of potable and non potable water distribution for each building.
 - There are three piping outlet to be taken from each potable and non potable OHT. Water supply for top three levels (12th, 11th & 10th) shall be supplied through booster pumps with pressure sensors. Individual piping connections shall be taken for next four levels (9th, 8th & 7th and 6th) and other five levels (Ground, to 5th) respectively to maintain the uniform pressure using PRV.
 - Supply & Installation of following complete Sanitary Fixtures and Fittings as per the model and make mentioned in the tender specifications.
 - o EWCs
 - o Lavatory basin
 - o Urinal with sensor system
 - o Pantry sink
 - o Shower assembly

- Cocks & taps
- ABS Rinsing spray
- Tower ring, soap dispenser, toilet paper holder, twin coat hook etc.
- Internal Water Supply – CPVC SDR 11 & Schedule 40/80 fittings
- External Water Supply – shall include excavation, trenching, backfilling etc. – DI-K-7 conforming to IS:8329 / 2000
- Internal Drainage/Sewerage /RWP/Vent pipe– Sand cast iron S&S as per IS – 3989
- Internal Drainage /RWP/Vent pipe–SWR pipes as per IS - 13592
- External Storm water Drainage – RCC NP2/NP3 pipe as per IS - 458.
- External sewerage –RCC NP2/NP3 as per IS - 458.
- Rainwater recharging well / pit
- Solar water heater at terrace and geyser inside toilet and kitchen area.
- P-trap/Nahni traps, rain water khurras, Floor gratings etc.
- Gully trap, inspection chambers, required piping connections etc.
- Required capacity VFD controlled booster pumps with pressure sensor system with required controls and instruments at terrace level for each domestic water system and flushing water system with standby for each building.
- Plumbing pumps, equipment including connection to the various equipment.
- Underground drainage, water supply pipes.
- Routing of underground pipes not allowed below the building. Bidder shall consider the suitable quantities to route them along the building boundary.
- Centralize W.T.P is proposed by BSCDCL, existing potable water distribution network is available outside plot boundary, only making connection from existing water line to U.G. water tanks with all accessories in the scope of contractor.
- Centralize S.T.P is proposed by BSCDCL, existing sewer network and recycled water line is available outside plot boundary, only making connection with existing Sewer line, and from recycled water to flushing UG water tank with all accessories including excavations, pipe protection, drop manholes will be in the scope of contractor.
- Storm water drainage, excavation, pipelines, manholes, catch basins, drain channels, recharge wells and connections to the existing storm water drain will be in the scope of contractor.
- Other Miscellaneous Items.
- Cabling & earthing from MCC panels to various plumbing/ sanitary system, control wiring & interlocking.
- Field instruments like pressure gauge & pressure switch and control cabling including junction box, erection hardware, etc., to MCC
- Instrumentation and Control equipment included in the package unit shall be complete with primary elements, initiating contacts for alarms, instrument impulse lines, fittings, power and control cables with suitable glands and terminations and instrument installation hardware.

- Cutting holes, chases & like through all types of walls /floors and finishing for all services crossings, including sealing, frame works, fire proofing, providing sleeve, cover plates, making good structure and finishes to an approved standard.
- All foundations & supports as necessary.
- Interface with Building Automation System.
- Balancing, testing & commissioning of the entire plumbing system.
- Test reports, list of recommended spares, as-installed drawings, operation & maintenance manual for the entire plumbing system.
- Supply & installation of MCC panels, control panels.
- One set of special erection and maintenance tools and tackles.
- Start up and Essential spares.
- Recommended spares for 10 years operation & maintenance.
- Anchor fasteners required for pipe supports of all the systems which are engineered by vendor and all anchor bolts, nuts, washers and inserts to be embedded in concrete for the equipment and piping.
- All accessories required for system completion and required for normal operation of equipment and systems.
- Shop inspection (in Vendor's works & at project site after installation along with all required calibrated measuring instruments)
- Packing, marking and forwarding.
- Unloading at site, storage and movement of equipment to erection site.
- Complete erection of all equipment covered under this Contract.
- Testing and trial run of equipment and systems.
- Pre-commissioning checks and commissioning of all equipment and systems.
- Carrying out performance testing of equipment at site to demonstrate guaranteed performance parameters.
- Documentation of all design, drawings, analysis, tests and calculations etc.,
- Training of PURCHASER's personnel.
- Preparation and submission of detailed engineering drawings for complete system based on these specifications and latest base drawings. Drawing(s) showing layout of portable extinguishers, are also in the scope of bidder.
- Preparation of any specific fabrication drawings, if required.
- Prepare and submit as-built drawings in hard and soft copies to Client.
- Any item which may not have been specifically mentioned herein but are needed to complete the equipment / system shall also be treated as included and the same shall also be furnished and erected, unless otherwise specifically excluded as indicated.

1.12.1 DEVIATIONS

BIDDER shall quote in strict accordance with the requirements of this Invitation to Bid. BIDDERS are advised to avoid making technical and commercial deviations. BIDDERS shall note that unless any and all deviations they may wish to make from the enclosed specifications, specific technical requirements and other terms and conditions, are listed

in the “Schedule of Deviations” of the bid document, it shall be deemed that the bids are in strict accordance with the requirements of this enquiry. Bids which do not include a categorical statement of compliance with the enquiry specifications and other terms and conditions of contract, and which do not list all deviations in the schedule as called for and offers not duly signed by authorised person of the company will be liable for rejection.

1.12.2 PURCHASER’S RIGHT

Where more than one item is covered by this enquiry, PURCHASER reserves the right to place orders for the various items with different BIDDERS. The PURCHASER does not bind himself to accept the lowest or any Bid and reserves the right to accept or reject any Bid or a portion thereof without assigning any reason thereof or to split the contract during progress of the work due to unsatisfactory work or progress of any one CONTRACTOR.

1.12.3 GENERAL

- a) The PURCHASER will not defray any expenses whatsoever incurred by the BIDDER for the preparation and submission and opening of bids.
- b) Should a BIDDER find discrepancies in, or omissions from the specification or other documents or should be in doubt as to their meaning except prices he would at once request in writing to the CONSULTANT for interpretation/ clarification. The CONSULTANT shall then issue interpretations and clarifications as he may think fit in writing as an addendum. Copies of such addenda, if issued, shall be signed by the BIDDER and shall form a part of his bid. After receipt of such interpretations and clarifications, the BIDDER shall submit his bid within the specified time.

1.12.4 BIDDER’S PROPOSAL

- a) To enable thorough and fast scrutiny of the BIDDER’s proposal, BIDDER’s are advised to respond all their technical data in the enquiry by clearly marking out their response, wherever they want to provide additional data and / or they deviate from the specified requirements. In case of full compliance, the enquiry specification and data sheets will remain unaltered.
- b) The BIDDER is advised to furnish all information called for in summary of data to be furnished along with the bid & after acceptance of Purchase order.
- c) BIDDER shall carefully study all sections of this specification, drawings and indicate all deviations in the schedule of deviations only. It will be presumed that the offer conforms in all other respects to the specification and the PURCHASER reserves the right to evaluate the bid, as such without any further reference to the BIDDER. It is binding on the BIDDER to supply the equipment and system in conformity with the specification except for the deviations stated in the schedule of deviations and accepted by the PURCHASER.
- d) BIDDER could provide additional data on their proposal by compiling the same under schedule F without altering the specification structure.
- e) BIDDER is advised to quote for the complete scope and partial response will not be entertained. In case of few items which do not directly fall under BIDDER’s manufacturing range and / or not available from indigenous source, BIDDER should

take the responsibility upon them to arrange to procure them and supply to ensure that their proposal is complete in all respects.

- f) Ignorance of the site shall not be accepted as basis for any claim for compensation. The submission of the tender by the BIDDER will be construed as evidence that such an examination was made and any later claims / disputes in regard to price quoted shall not be entertained or considered.

1.13 ICT

- Design, Engineering, Supply, Installation, Erection, Testing and Commissioning include Operation and Maintenance for a period of Ten years for all tendered works.
- The key components are:
Component-1: CCTV surveillance system.
Component-2: Access control system.
Component-3: Fire detection & alarm system.
Component-4: Video door phone.
Component-5: Provision of optical fiber connectivity for GPON & allied hardware.
- The contractor is requested to provide open API layer for future integration with city integrated Control & Command Centre. This open API layer will help in providing the required feeds to city integrated Control & Command Centre.

1.14 Storm Water

This section gives the detailed scope of work to be carried out for storm water drainage management of Government housing plot No. 22 and 23 Up to the Outfall at Banganga Nallah.

The Scope of Work for proposed Storm water Drainage system under this contract includes but is not limited to the following in relation to the supply, construction, testing and commissioning of Storm water Drainage system of the Works:

- a) Excavation, dewatering, ramming, backfilling, stacking and disposal of surplus excavated soil for RCC Box/Pipe trench/Natural Swale as applicable as per detail drawing.
- b) Supply, laying, jointing, testing and commissioning of RCC Type NP – 3 as per IS 458 conduits with diameters as per the Bill of quantities and layout plan of Storm water Drainage system.
- c) Construction of all type of chambers, catch basins as per specification and drawing.
- d) Construction of RCC storm drain as per drawing, along with arrangement of water entrance and Catch basins with RCC NP3 outlets as per Bill of Quantities, specifications
- e) Construction of Natural Swale if required
- f) Supply, laying of pipe bedding and pipe encasement as per specification and drawing.
- g) Preparation and Submission of As-Built drawings for all Civil Works.
- h) Road cutting & restoration of roads as and when required.
- i) Testing and commissioning of the entire work.
- j) Sectional water tightness / leak testing of drains and Inspection chambers.

- k) Removal of defects in laying and jointing of all storm water Drains, fittings and Inspection Chambers, after testing and during defect liability period.
- l) Utility shifting such as Electric pole / Cables / Telephone pole / Water supply lines etc. and restoration of roads and sewer lines if encountered.
- m) Stormwater system will connected with building works, by connecting the Storm water Inspection Chamber (IC) or rainwater harvesting system of building with the Storm water Drain of the site infrastructure system.

1.15 STP

1.15.1 General Scope of work

This bid is for the design, engineering, manufacture, supply, installation, testing and commissioning and operation of the STP system excluding the Civil Work execution in line with the details given in this document.

The scope of work includes all mechanical and bought-out equipment, piping, electrical and instrumentation work. The turnkey supplier shall provide all the drawings and details as required for the Consultant to carry out civil design and for a separate civil Contractor engaged by the Client at site to carry out the civil work for the STP. Turnkey supplier has to consider visits to site at key stages for guiding the civil Contractor, if required, to ascertain that work is carried out as per the drawing requirements.

1.15.2 Testing and Commissioning

All equipment and components of the STP shall be tested for the performance as per the duty points and specifications. Also the untreated and treated wastewater quality shall be tested at various stages for polluting parameters to ascertain that the STP meets the stage-wise and overall desired treatment requirements. The Contractor and consultant shall prepare a schedule of such stage-wise testing.

The Contractor shall maintain a record of all such testing carried out duly signed by Contractor, Employer and consultant.

1.15.3 Operation Services

After commissioning, the contractor shall operate the STP for a period of 120 months under his control for stabilization and to demonstrate the results. The Employer shall provide the operating manpower and consumables for this.

Turnkey system supplier can provide a separate offer for operation of STP with operating manpower separately.

1.15.4 Drawings and Documentation

System supplier shall submit the following drawings at various stages and number of copies, hard copy/ soft copy shall be as instructed by Consultant.

1.15.5 Bid Stage:

P & I diagram, General Layout, Hydraulic Flow diagram, data sheets of mechanical equipment, performance curves and catalogues for offered components, Bar Chart for Project Completion shall be submitted to consultant for approval prior to fabrication/ ordering.

1.15.6 Execution Stage:

In addition to final approved drawings of bid stage; GA drawings for all civil work, foundation drawings, piping and electrical layout, Electrical Scheme diagram etc. as applicable shall be submitted to consultant for approval prior to fabrication/ ordering.

1.15.7 Post-Completion Stage:

The system supplier will submit all as built drawings, trial runs and commissioning report and operation and maintenance manual in three sets in required format, as final documentation on completion of the STP.

1.15.8 Time of Completion

Time is an essential quality of this contract. The total completion period shall be nine months from date of Letter of Intent (LOI) which includes preparation and approval of drawings/ details, manufacture/ procurement and supply at site and completion of site fabrication and installation work. Bidder shall submit a bar chart along-with the bid document. The successful bidder shall prepare a detailed schedule of activity immediately on award of the work, for monitoring purposes.

1.15.9 Battery Limits and Exclusions

Battery limits for the system supplier scope:

Site Survey	-	In scope of Contractor.
Entry Point	-	Inlet chamber of STP as per final layout
Discharge Point	-	Final Treated water tank
Sludge/ Solids	-	Outlet of Centrifuge. Disposal as per client recommendation/CPHEEO standards.
Electrical	-	Inlet to MCC panel
Piping	-	All interconnecting piping within the STP
Instrumentation	-	As per approved P & I diagram
Operating Consumables such as Lubricating oil	-	as per requirement
Biological Seed Culture for Commissioning	-	In scope of Contractor.
Operating Chemicals and Consumables required for STP	-	In scope of Contractor.

Service Water – Employer shall provide water at one point, which shall be taken by Contractor to service points within the STP as required for operation.

Electrical power for construction shall be given at one point near STP by Employer.

Area Lighting – In scope of Contractor.

Storage Space – Storage space shall be available during construction at site.

However, Contractor may have to construct temporary secure site store, if required.

Plans/ drawings approval – In scope of Contractor.

Operating Manpower shall be provided by Employer. However, adequate manpower to be arranged by Contractor during trial runs.

1.15.10 Civil Work

Contractor shall provide the GA drawings, loading data etc. as required for the consultant to carry out the RCC / civil drawings for execution.

All major civil work such as water retaining tanks, foundations, paving etc. as listed herewith shall be provided by client.

However, minor civil work connected with the work in scope of Contractor for equipment installation, piping and electrical work; such as making and refilling trenches for laying pipes, pipe / cable rack supports, chasing in walls and beams, making holes in brick walls etc. shall be carried out by the Contractor at his cost.

1.15.11 BRIEF SCOPE OF WORK

The scope of the work shall include but not be limited to the following:

- Design and manufacture, supply, testing at manufacturers' works, storage when required, delivery to site, unloading and site transportation, erection & commissioning, site testing, painting and finishing of the Plant of capacity 500 KLD.
- Preparation of process, hydraulic, electrical, mechanical and piping design. Preparation all civil, mechanical, electrical and piping drawings including architectural, construction and as built drawings.
- Supply, erection testing & commissioning of all the electromechanical mechanical equipment, electrical units, instrumentation and interconnecting piping as per mechanical specifications.
- Providing walkways, platforms and staircase of minimum 1.0 m width.
- Drain with valve and pipe arrangement (min 200 mm dia) to all treatment plant necessary units.
- All drains shall be connected to the sump.
- Performance Run of the constructed & hydraulically tested plant along with O & M of electrical & mechanical equipment for a period of Three (3) months and operation & maintenance for 36 months after performance run as per tender specifications including providing and installing all units, labour, tools and plants all complete on turnkey basis
- Defects liability period of 24 months from the date of successful completion of O & M period
- Supply of all documentation for the plant such as As-Built drawings, Operation & Maintenance manuals (6 sets)
- Supply of all spares required during performance run and during 24 months of O & M period.
- Oil painting with anti corrosive treatment for package unit, railing and all MS, CI and GI works.
- Bidders are advised to visit STP site before quoting for the proposed STP.
- Any other items of work which have not been specifically mentioned in the specifications but are necessary for construction of the plant as per good engineering practice and safety norms and operation and guaranteed performance of the entire plant shall be deemed to be included within the scope of work of this specifications and shall be provided by the contractor without any extra cost to the employer.

1.15.12 DETAILS FOR MAINTENANCE TO BE CARRIED OUT:

- i) The Contractor shall operate and maintain the entire plant within its Contract price for a total operation and maintenance period of 10 years from the date of

taking over of the plant by the client after successful Installation, commissioning of the Plant.

- ii) All necessary repairs, maintenance, overhaul, replacements etc., shall be made during the O & M to maintain the plant at the status of formal handling over after the P G test. Contractor shall be responsible for comprehensive repair, break down repair for operation and maintenance during this 10 years period of O&M.
- iii) The O & M price by the Tenderer shall include supply of all tools, tackles, spares, lubricants, laboratory chemical, and glassware, chemicals like Sodium hypochlorite, Alum, Poly-electrolyte etc.
- iv) During O & M cost of power consumed shall be in the Contractor price and bills of electric power shall be paid as per actual consumption as per the figures guaranteed by the Tenderer, directly to the concerned authorities.

The scope shall but not limited to the following items:

- Operation and Maintenance including Electrical, Mechanical and Instrumentation all allied works.
- Sampling and testing of Raw Water
- Sampling of treated Water to ensure that the guarantee Parameters are as stipulated in the design criteria.
- The dewatered sludge could be collected and disposed of by the Contractor. Loading, Unloading and Transportation of dewatered sludge out of treatment plant site at own cost.

Maintenance of log books of all the equipments/instruments various readings of process parameters, record of failures and alarms and shall be forwarded at monthly intervals.

The O & M shall include the appropriate preventive maintenance of equipment as per the Manufacturer's recommendation.

- All the equipment even standby supplied, installed and commissioned by the Contractor should be in operational/ functional condition throughout the O & M period. The Contractor shall take all preventive measures to maintain them in working condition.
- The frequency of break downs of various equipments shall be the least as far as possible. The total number of such re-occurrences shall not exceed three times per annum otherwise penalty shall be levied on the Contractor at the discretion of Engineer-in-charge.

1.15.13 MECHANICAL, ELECTRICAL & INSTRUMENTS:

- 1) Preventive maintenance of all the Equipments and Machineries for Water treatment plant including Pumps, Piping, Valves, equipments, Motors, HT and LT Panels, Transformers, Cables, PLC, Field Instruments, Laboratory Instruments etc. and as directed by Engineer-in-Charge.
- 2) Breakdown maintenance of all the Equipments and Machineries as indicated above and as directed by Engineer-in-Charge.

- 3) Calibration of all necessary Field Instruments.

1.16 Solid Waste management

1.16.1 Collection and Segregation

- Segregation of waste at source
- All waste generated at source shall be collected by waste collection chutes within the buildings and Outdoor Disposal Inlets (ODI) in the open & public spaces.
- The waste collected from chutes and ODI shall be further collected by using Refuse pipe which will be connected to the respective plots further transporting the waste to the Waste Collection Station.
- The waste collection station will be a centralized facility from where the segregated waste shall be further transported to the necessary treatment, secondary segregation and disposal.
- Provision of colour coded bins for waste collection from common areas.
- Segregation of waste into biodegradable, recyclables and inert.
- Maintain hygienic condition during the entire collection and segregation process.
- Bidders are advised to visit site before quoting for the proposed AWC system.
- Supply, erection testing & commissioning of all the AWC system with 12 months followed by Operation and Maintenance for 5 years after performance run and installing all civil, material, labour and tools.
- Construction of civil engineering works for the platform for vehicles carrying the segregated waste to treatment and disposal site.
- Supply of all documentation for the plant such as As-Built drawings, Operation & Maintenance manuals (6 sets)
- Supply of all spares required during performance run and during 12 months of O & M period.
- Any other items of work which have not been specifically mentioned in the specifications but are necessary for installation of the plant as per good engineering practice and safety norms and operation and guaranteed performance of the OWC shall be deemed to be included within the scope of work of this specifications and shall be provided by the contractor without any extra cost to the employer.

1.16.2 Disposal of Biodegradable, Recyclables and Inert Waste

- Biodegradable waste shall be given to Bhopal Municipal Corporation for treatment presently till the whole Area Based Development in Bhopal Smart City is completed. Later the same will be sending to the dedicated treatment plant within Bhopal Smart City.
- The recyclables like paper, plastic and metal to be stored in the Waste Collection Station area for a maximum duration of 7 days and then be sold to authorised vendors for handling recyclables.

- The inert waste will be stored in Waste Collection Station area and will be sent to the nearest authorised municipal solid waste landfill site.
- Any hazardous waste generated from the complex like used DG oil, old batteries etc to be handed over to SPCB authorized hazardous waste handling vendors.
- Bio Medical waste shall be collected separately by the present system of Bio Medical Waste Collection system for the Bhopal City. This shall not be mixed with the AWC system.
- E waste generated within complex will be collected once in month by SPCB authorized E Waste collecting agency.

Chapter 2: Project Facility

The Contractor shall construct the Project Facilities in accordance with the provisions of this Chapter 3. Such Project Facilities shall include:

1.17 Architectural

1.17.1 Site Level Facilities

1. **The Project:** consists of two plots for government housing within ABD area. Plot 22 has 328 number F type dwelling units and Plot 23 has 352 number G type dwelling units. F type housing has 3 towers without two parking floors and 11 residential floors where as G type housing has two towers with 14 residential floors and one tower with 13 residential floors with 2 parking floors each.
2. **Open Spaces:** Plot 22 as well as 23 have central open space with recreational facilities described in landscape section. They also have direct access to Dussehra ground towards the south, which makes the location of government housing unique.
3. **Parking:** The car parks are given in upper ground floor and lower ground floor. Residential units start from 1st floor. The parking along the road is to be provided with sheds having solar panels on them.

Plot 22 will house 306 cars and Plot 23 will have space for 133 cars. For F type housing, dwelling unit will have one car parking space each, more than required as per norms.

4. Multipurpose hall in the central recreational area is provided in the both the plots.
5. The safety and security is addressed in the campus by providing security cabins at the entry /exit along with CCTV cameras. Surveillance is also provided at each lobby at upper ground and lower ground level. The central surveillance room in both the plots is part of the campus design.
6. Store room and staff toilets are provided at upper ground floor for drivers, watchmen, maintenance persons etc.

1.17.2 Residential Unit Level Facilities

1. Each tower has four dwelling units at each floor sharing 2 lifts.
2. The dwelling units are planned with various facilities including –
 - Cable connections to each dwelling unit
 - Modular kitchen with cabinets below cooking platform and shuttered slab above the working platform.

- Cylinder area is provided in the dry balcony of the residential unit. Copper gas pipeline is provided from the cylinder to the cooking range.
- Bedrooms are provided with wooden wardrobes and toilets with mirrors
- Tube lights and fans will be provided in all rooms.
- MS safety doors as the front door
- Three channel, sliding window that accommodates mosquito net.

1.17.3 Utilities

1. Water line connection and non-portable line connection at the periphery of the plot shall be provided by the authority. Further distribution within the plot shall be done by the contractor while making provision for Dual piping system.
2. Roof top solar panel provision and rain water harvesting into recharge pits as per requirement of IGBC guidelines.
3. Automated solid waste disposal is one of the major features in the government housing. The provisions will be made on each floor of all blocks.
4. Sub-station for the two plots is clubbed together to minimize on space.
5. A modular STP outside the plot shall cater to the population of the concerned government housing.

1.18 Landscape

- The entry level of the housing has green strips where large trees are proposed, for aesthetic & shade, harmonised with green shade loving shrubs under them.
- The parking areas have concrete grass pavers to maximise the green areas.
- Inside the campus, green strip and road runs along the periphery of the two plots. These streets shall be defined by unique pavement designs and blocking.
- The buildings are inwardly oriented giving space for central greens that can be perceived as extension of open green land of Dussehra ground and City Park. The main courtyard acts as the lungs for the housing, It is the generator of activities
- The central greens courtyards are the recreational spaces of the housing which is accentuated with the presence of various landscape elements and club. These landscape elements include

- children play area with sand bed & equipments,
 - park for senior citizen with seating,
 - badminton court- synthetic surface,
 - open air theatre- stepped OAT with Stamped concrete surface,
 - Metal pergola – on pavilion ,
 - Meditation court
 - Green lawns with walkway all around
 - Ample tree shade.
- The club has spill over as greens, terraced towards the city greens making it infinite in perception.

1.19 LEED

Please provide the following facilities on site during construction. Submit appropriate drawings and details along with photographs.

1. Dedicated covered storage for HVAC material and equipment. Storage area should be clean and dry.
2. Refer to [LEED Special Conditions of Contract](#) for additional requirements.

1.20 Civil & Structural

Earthquake preventive measures: Earthquake cannot be prevented. However, earthquake can be sustained by designing earthquake resistant structures using Indian Standards.

1.21 electrical

- Independent power for the Plot no. 22 and Plot no 23 shall be provided by state Distribution company Madhya Pradesh Kshetra Vidyut Vitaran Company Ltd. (MPMKVVCL) or a private Distribution Franchisee company as may be decided by BSCDCL, at 33kV through underground laid HV cables till the plot Substation.
- The temporary Source of this power shall be from the nearest existing Substation of MPMKVVCL or as may be decided by the service provider. Permanent power shall be provided from the EHV GIS substation as per the power distribution plan of the ABD area. The power supply to the plots shall be loop in and looped out of the 33kV Rings.
- 2 Nos. Oil type distribution transformer are considered for each building to maintain redundancy and 550kVA DG Set is considered for Emergency power for common and essential services/ utilities.
- Each Flat/ Dwelling units within each tower shall be provided with independent 230 V, 1 Ph tariff meter mounted on Metering Panels located in the Metering room on the podium parking floor of the respective tower. The common Utility loads and other facilities like Club House, Multi- Purpose Hall, Play Area and Lawns within the plot shall be supplied from Common utility Panels (CUP). CUPs shall be powered through 415 V, 3 Ph tariff meter mounted in the same Metering Panel as above. All tariff meters shall be as per power supply company specifications.

1.22 Ventilation

- All Toilet areas will be ventilated with minimum air quantity of 50 CFM.
- All Kitchen areas shall be ventilated with air quantity of 100 CFM.
- All three phase fans used either for ventilation or for fire emergency shall be provided with energy efficient motor of Eff1 class.
- All Pump Rooms, Meter Rooms & Substation will be ventilated with 20 ACPH as per NBC.
- Split Air conditioner (if required to be provided) shall be with minimum 3 star rating and with cfc/hcfc free refrigerant.

1.23 Fire fighting

- Buildings have been classified as Residential buildings, Group – A, Sub division A3 for BSCDCL Bhopal as per NBC 2016. However, the fire pumps and static fire water storage are provided as per Group A, Sub Division A3 requirement of NBC 2016.
- Underground (UG) water tank for firefighting system is provided in the basement level/LG floor of building which will be indivisual for both Plot No- 22 & 23 requirements. One (1) no. 200cum capacity static fire water storage tank at underground level in basement/LG area and building terrace level fire water storage tanks of capacity 10cum for each buildings respectively to be provided to cater the NBC requirement.
- Fire pumps are provided in the basement/LG level of building (working & standby) as per NBC requirement.
- External and internal hydrant, sprinkler system shall be provided for the complete development covered under this scope of work.

Description of Project facilities

- Following capacity fire pumps shall be provided in Basement/LG area of building.

SI. No.	Name	Qty.	Parameter
PLOT-22			
(i)	Sprinkler pump Electric Motor driven	1	2280 LPM @ 100mWC total head
(ii)	Hydrant pump Electric Motor driven	1	2280 LPM @ 100 mWC total head
(iii)	Diesel engine driven pump (standby) (heat exchanger type)	1	2280 LPM @ 100 mWC total head

Sl. No.	Name	Qty.	Parameter
(iv)	Electric Motor driven (Jockey pump)	2	180 LPM @ 100 mWC total head
PLOT-23			
(i)	Sprinkler pump Electric Motor driven	2	2280 LPM @ 100mWC total head
(ii)	Hydrant pump Electric Motor driven	2	2280 LPM @ 100 mWC total head
(iii)	Diesel engine driven pump (standby) (heat exchanger type)	2	2280 LPM @ 100 mWC total head
(iv)	Electric Motor driven (Jockey pump)	4	180 LPM @ 100 mWC total head

- Piping connection between UG tanks to the suction header, pump connections, further distribution with required valves, accessories etc.
- Required electrical MCC cum instrument control panels with controls like pressure switch etc. to make the system to work automatically.
- Fire extinguishers, internal hydrants and yard hydrants.

1.24 Plumbing

- Underground (UG) water tanks for each potable, non potable and fire fighting system are provided in the basement/LG floor level for buildings. Capacities of these tanks will cater individual plots requirements.
- Individual transfer pumps with 24x7 with VFD pumps controlled via motorize (working & standby) for each system (potable and non potable) are located in the LG/basement level for the buildings (adjacent to UG tanks) to transfer the water to the over head tanks (OHT) located in terrace level of each building.
- Booster pumping system with sensor is proposed for top 3 levels of each building and for other lower levels, the water shall flow through gravity.
- Individual VFD system is proposed for irrigation system.
- Complete sewage, waste and rain water piping required.
- Piping connection between UG tanks to the suction header, pump connections etc.
- Transfer pumps with standby for each building and each potable and non potable water system

- Sanitary fixtures and CP fittings as per Griha/Green building.
- Piping, valves, accessories required for the complete system.
- Sewage, waste and rain water piping.
- Geyser for hot water.

1.25 ICT

The broad details of the works to be executed for the Scope as mentioned shall consist of but not limited to the following:

1.25.1 Fire Detection & Alarm System

A system for fire detection & alarm is to be provided in either security cabin OR surveillance room of each plot 22 & plot 23 Building. The Design & installation of the system will be limited to the designated common areas, but the system should be scalable if required to be extended later for the remaining areas of the buildings.

The system will essentially consist of installation of devices and equipment like; Integrated Dual optical thermal Detectors, Manual Call Points, Hooter/Sounder/Flasher, and appropriate Addressable Fire Panels.

The automatic addressable fire detection system shall be provided at Lower ground & upper ground floor. And the MCPs & Hooters/strobes shall be provided at staircase lobby/ lift lobby of each wing of floor.

1.25.2 CCTV Video Surveillance System

A system for CCTV is to be provided in surveillance room of each plot 22 & plot 23 Building at main gate entrances, Lower ground floor & Upper ground floor. The Design & installation of the system will be limited to the designated common areas, but the system should be scalable if required to be extended later for the remaining areas of the buildings.

The system will essentially consist of installation of devices and equipment like; Indoor IP based CCTV Dome Cameras, NVR, & Monitors.

The system shall also consist of a scalable NVR with appropriate Application Software for monitoring of the system. The storage of video data is to be considered for a period of 30 days.

1.25.3 RFID Card based Access Control System

A system for RFID Card based Access Control system such controllers, switches & client PC shall be provided in the Security cabin.

The system will essentially consist of installation of devices and equipment like; Access controller, RFID long range reader, Ethernet switches & UHF vehicle passive tags.

The system shall also consist of a PC Workstation with appropriate Application Software for accessing vehicle entries.

1.25.4 Video door phone

A system for Video door (MAIN GATE GUARD UNIT) shall be provided in security cabin of each plot 22 & plot 23 Building. And Video door phone indoor monitor & outdoor camera shall be provided at each plot of both plots 22 & 23. The Design & installation of the system will be limited to the designated common areas, but the system should be scalable if required to be extended later for the remaining areas of the buildings.

The system will essentially consist of installation of devices and equipment like; INDOOR UNIT: 7" Capacitive Touch Screen monitor, OUTDOOR UNIT: IP 1.3 Megapixel camera & GUARD UNIT at security gate.

1.25.5 PROVISION OF OPTICAL FIBRE CONNECTIVITY FOR GPON

All the floors, flats of Plot 22 & 23 are being provided the provision of Optical single mode (SM) fiber backbone for GPON application. The same will be utilized by the service providers/sub contractors for value added solutions of IP EPABX system, Wi-Fi, CATV/IPTV & Common surveillance in future while implementing the additional requirement as per client demand.

The same optical fibre cable which is being utilized for GPON will be get utilized for Video door phone system for Audio intercom within flat to flat & flat to security entries gates for visitor confirmation at entry gate.

1.26 Storm water

- The rooftop run off will be collected through pipes from the respective buildings inside the Plot area and then drained into stormwater drainage network outside the plot.
- The storm drainage system is proposed in such a way that to maintain the aesthetic view of the building and with minimal crossings in the building area by providing boundary drains along the compound wall.
- The rainwater harvested/stored during monsoon season will be utilised for non-potable/ irrigation purposes during the non- monsoon seasons as per the availability.
- The HFL of the trunk drain in which proposed drainage system (drains along the internal roads) is discharging should be lower than the IL of the incoming drain. The proposed layout of the storm water drainage scheme is planned along the sides of the main arterial roads and peripheral boundary. Individual plot developer is expected to connect their internal drains to these main drains planned for the project area.
- It was assumed that there is some flood risk that nallah capacity would be exceeded during flood events causing backflow from the nallah. To prevent back water flow non return valve arrangement is recommended at the point of discharge into the nallah.

1.27 STP

1.27.1 Plant Capacity

Package Sewage Treatment Plant (PSTP): - 500 KLD capacity.

A PSTP of 500 KLD capacity is planned which will cater the sewage generated from Plot No. 22 & 23 these plots comprise of Government Residential Houses.

1.27.2 Reuses of Treated Sewage

Understanding of the nature of physical, chemical and biological characteristics of sewage is essential in planning, design and operation of treatment and disposal facilities and in the engineering management of environmental quality. The reclaimed water should not contain measurable levels of viable pathogens.

The reclaimed water shall be following features.

- Reclaimed water should be clear and odorless.
- Higher chlorine residual and/ or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed.
- Chlorine residual of 0.3-0.5 mg/l or greater in the distribution system is recommended to reduce odours, slime, and bacterial re-growth.

Treated water from tertiary treatment of STP is proposed to be stored in a separate treated water tank near STP. This treated/ recycled water is proposed to be supplied for Flushing, irrigation, gardening, make up water for HVAC system etc.

The reuse of the treated wastewater for the project area will be for Flushing, irrigation, gardening, make up water for HVAC system etc.

Hence, expected standard will be as given in Table 1-13-1

Table 1-1: Treated Sewage Standards

Maximum limits/Type	Unit	Desired Values
Colour	-	Acceptable
BOD	mg/lit	10
COD	mg/lit	50
Residual Chlorine	mg/lit	1
Faecal Coliform	mg/lit	No detectable Faecal Coliform
Turbidity	NTU	2*
pH		6.5-8.5
TSS	mg/lit	5

Residual chlorine for flushing water need not be >1.

* From Practical Consideration

1.27.3 Operation Services

After commissioning, the system supplier shall operate the STP for a period of 36 month under his control for stabilization and to demonstrate the results. The Employer shall provide the operating manpower and consumables for this.

Turnkey system supplier can provide a separate offer for operation of STP with operating manpower separately

1.28 Solid waste management

- Solid Waste Management is one among the basic essential services to be provided to the Bhopal Smart City Area Development. The objective of solid waste management is to reduce the quantity of solid waste disposed off on land by recovery of materials, thereby maintaining the land clean and disposal of solid waste in an environmental friendly manner. Solid waste management should be in such a manner that is in accordance with the best principles of public health, economics, engineering, aesthetics, and other environmental considerations. Solid waste management and handling has to be done in accordance with the Solid Waste (Management and Handling) Rules 2016 framed under the Environment (Protection) Act 1986.
- An Automated Waste Collection (AWC) system is proposed for the entire Bhopal Smart City Area Based Development (ABD) project. It is proposed that the Buildings designed on plots 22 and 23 will be developed in the initial phase which will be connected by the AWC system of waste collection. The waste is targeted to be collected in segregated manner i.e. Dry and Wet by using the chutes designed within the building, thus no manual handling shall be performed and further reducing the door to door collection work.
- The individual chutes from buildings will be further connected to the refuse pipe through suction and transporting to the central pipes of AWC. This facility will be provided in the lower ground floor of each building. The waste transported through the refuse pipe will be reaching a Centralized Collection Station facility proposed on plot 21 which will have all the necessary equipments and machineries to collect the waste through vacuum pressure. This facility will also be extended to have a temporary storage of dry recyclable waste and inert waste. The recyclable waste shall be sold to the authorized recycling vendors and inert waste will be sent to the inert landfill site dedicated to rest of Bhopal City.
- Organic waste shall be presently collected and treated by Bhopal Municipal Corporation. Once the whole development will be completed with the Bhopal Smart City Area, separate system within ABD area for wet waste treatment will be developed.

Chapter 2: Project facility

The Contractor shall construct the Project Facilities in accordance with the provisions of this Chapter 3. Such Project Facilities shall include:

1.29 Architectural

1.29.1 Site Level Facilities

7. **The Project:** consists of two plots for government housing within ABD area. Plot 22 has 328 number F type dwelling units and Plot 23 has 352 number G type dwelling units. F type housing has 3 towers without two parking floors and 11 residential floors where as G type housing has two towers with 14 residential floors and one tower with 13 residential floors with 2 parking floors each.

8. **Open Spaces:** Plot 22 as well as 23 have central open space with recreational facilities described in landscape section. They also have direct access to Dussehra ground towards the south, which makes the location of government housing unique.
9. **Parking:** The car parks are given in upper ground floor and lower ground floor. Residential units start from 1st floor. The parking along the road is to be provided with sheds having solar panels on them.

Plot 22 will house 306 cars and Plot 23 will have space for 133 cars. For F type housing, dwelling unit will have one car parking space each, more than required as per norms.
10. Multipurpose hall in the central recreational area is provided in the both the plots.
11. The safety and security is addressed in the campus by providing security cabins at the entry /exit along with CCTV cameras. Surveillance is also provided at each lobby at upper ground and lower ground level. The central surveillance room in both the plots is part of the campus design.
12. Store room and staff toilets are provided at upper ground floor for drivers, watchmen, maintenance persons etc.

1.29.2 Residential Unit Level Facilities

3. Each tower has four dwelling units at each floor sharing 2 lifts.
4. The dwelling units are planned with various facilities including –
 - Cable connections to each dwelling unit
 - Modular kitchen with cabinets below cooking platform and shuttered slab above the working platform.
 - Cylinder area is provided in the dry balcony of the residential unit. Copper gas pipeline is provided from the cylinder to the cooking range.
 - Bedrooms are provided with wooden wardrobes and toilets with mirrors
 - Tube lights and fans will be provided in all rooms.
 - MS safety doors as the front door
 - Three channel, sliding window that accommodates mosquito net.

1.29.3 Utilities

6. Water line connection and non-portable line connection at the periphery of the plot shall be provided by the authority. Further distribution within the plot shall be done by the contractor while making provision for Dual piping system.
7. Roof top solar panel provision and rain water harvesting into recharge pits as per requirement of IGBC guidelines.
8. Automated solid waste disposal is one of the major features in the government housing. The provisions will be made on each floor of all blocks.
9. Sub-station for the two plots is clubbed together to minimize on space.
10. A modular STP outside the plot shall cater to the population of the concerned government housing.

1.30 Landscape

- The entry level of the housing has green strips where large trees are proposed, for aesthetic & shade, harmonised with green shade loving shrubs under them.
- The parking areas have concrete grass pavers to maximise the green areas.
- Inside the campus, green strip and road runs along the periphery of the two plots. These streets shall be defined by unique pavement designs and blocking.
- The buildings are inwardly oriented giving space for central greens that can be perceived as extension of open green land of Dussehra ground and City Park. The main courtyard acts as the lungs for the housing, It is the generator of activities
- The central greens courtyards are the recreational spaces of the housing which is accentuated with the presence of various landscape elements and club. These landscape elements include
 - children play area with sand bed & equipments,
 - park for senior citizen with seating,
 - badminton court- synthetic surface,
 - open air theatre- stepped OAT with Stamped concrete surface,
 - Metal pergola – on pavilion ,
 - Meditation court
 - Green lawns with walkway all around
 - Ample tree shade.

- The club has spill over as greens, terraced towards the city greens making it infinite in perception.

1.31 LEED

Please provide the following facilities on site during construction. Submit appropriate drawings and details along with photographs.

3. Dedicated covered storage for HVAC material and equipment. Storage area should be clean and dry.
4. Refer to *LEED Special Conditions of Contract* for additional requirements.

1.32 Civil & Structural

Earthquake preventive measures: Earthquake cannot be prevented. However, earthquake can be sustained by designing earthquake resistant structures using Indian Standards.

1.33 electrical

- Independent power for the Plot no. 22 and Plot no 23 shall be provided by state Distribution company Madhya Pradesh Kshetra Vidyut Vitaran Company Ltd. (MPMKVVCL) or a private Distribution Franchisee company as may be decided by BSCDCL, at 33kV through underground laid HV cables till the plot Substation.
- The temporary Source of this power shall be from the nearest existing Substation of MPMKVVCL or as may be decided by the service provider. Permanent power shall be provided from the EHV GIS substation as per the power distribution plan of the ABD area. The power supply to the plots shall be loop in and looped out of the 33kV Rings.
- 2 Nos. Oil type distribution transformer are considered for each building to maintain redundancy and 550kVA DG Set is considered for Emergency power for common and essential services/ utilities.
- Each Flat/ Dwelling units within each tower shall be provided with independent 230 V, 1 Ph tariff meter mounted on Metering Panels located in the Metering room on the podium parking floor of the respective tower. The common Utility loads and other facilities like Club House, Multi- Purpose Hall, Play Area and Lawns within the plot shall be supplied from Common utility Panels (CUP). CUPs shall be powered through 415 V, 3 Ph tariff meter mounted in the same Metering Panel as above. All tariff meters shall be as per power supply company specifications.

1.34 Ventilation

- All Toilet areas will be ventilated with minimum air quantity of 50 CFM.
- All Kitchen areas shall be ventilated with air quantity of 100 CFM.
- All three phase fans used either for ventilation or for fire emergency shall be provided with energy efficient motor of Eff1 class.
- All Pump Rooms, Meter Rooms & Substation will be ventilated with 20 ACPH as per NBC.

- Split Air conditioner (if required to be provided) shall be with minimum 3 star rating and with cfc/hcfc free refrigerant.

1.35 Fire fighting

- Buildings have been classified as Residential buildings, Group – A, Sub division A3 for BSCDCL Bhopal as per NBC 2016. However, the fire pumps and static fire water storage are provided as per Group A, Sub Division A3 requirement of NBC 2016.
- Underground (UG) water tank for firefighting system is provided in the basement level/LG floor of building which will be indivisual for both Plot No- 22 & 23 requirements. One (1) no. 200cum capacity static fire water storage tank at underground level in basement/LG area and building terrace level fire water storage tanks of capacity 10cum for each buildings respectively to be provided to cater the NBC requirement.
- Fire pumps are provided in the basement/LG level of building (working & standby) as per NBC requirement.
- External and internal hydrant, sprinkler system shall be provided for the complete development covered under this scope of work.

Description of Project facilities

- Following capacity fire pumps shall be provided in Basement/LG area of building.

Sl. No.	Name	Qty.	Parameter
PLOT-22			
(i)	Sprinkler pump Electric Motor driven	1	2280 LPM @ 100mWC total head
(ii)	Hydrant pump Electric Motor driven	1	2280 LPM @ 100 mWC total head
(iii)	Diesel engine driven pump (standby) (heat exchanger type)	1	2280 LPM @ 100 mWC total head
(iv)	Electric Motor driven (Jockey pump)	2	180 LPM @ 100 mWC total head
PLOT-23			
(i)	Sprinkler pump Electric Motor driven	2	2280 LPM @ 100mWC total head
(ii)	Hydrant pump Electric Motor driven	2	2280 LPM @ 100 mWC total head
(iii)	Diesel engine driven pump (standby) (heat exchanger type)	2	2280 LPM @ 100 mWC total head

Sl. No.	Name	Qty.	Parameter
(iv)	Electric Motor driven (Jockey pump)	4	180 LPM @ 100 mWC total head

- Piping connection between UG tanks to the suction header, pump connections, further distribution with required valves, accessories etc.
- Required electrical MCC cum instrument control panels with controls like pressure switch etc. to make the system to work automatically.
- Fire extinguishers, internal hydrants and yard hydrants.

1.36 Plumbing

- Underground (UG) water tanks for each potable, non potable and fire fighting system are provided in the basement/LG floor level for buildings. Capacities of these tanks will cater individual plots requirements.
- Individual transfer pumps with 24x7 with VFD pumps controlled via motorize (working & standby) for each system (potable and non potable) are located in the LG/basement level for the buildings (adjacent to UG tanks) to transfer the water to the over head tanks (OHT) located in terrace level of each building.
- Booster pumping system with sensor is proposed for top 3 levels of each building and for other lower levels, the water shall flow through gravity.
- Individual VFD system is proposed for irrigation system.
- Complete sewage, waste and rain water piping required.
- Piping connection between UG tanks to the suction header, pump connections etc.
- Transfer pumps with standby for each building and each potable and non potable water system
- Sanitary fixtures and CP fittings as per Griha/Green building.
- Piping, valves, accessories required for the complete system.
- Sewage, waste and rain water piping.
- Geyser for hot water.

1.37 ICT

The broad details of the works to be executed for the Scope as mentioned shall consist of but not limited to the following:

1.37.1 Fire Detection & Alarm System

A system for fire detection & alarm is to be provided in either security cabin OR surveillance room of each plot 22 & plot 23 Building. The Design & installation of the system will be limited to the designated common areas, but the system should be scalable if required to be extended later for the remaining areas of the buildings.

The system will essentially consist of installation of devices and equipment like; Integrated Dual optical thermal Detectors, Manual Call Points, Hooter/Sounder/Flasher, and appropriate Addressable Fire Panels.

The automatic addressable fire detection system shall be provided at Lower ground & upper ground floor. And the MCPs & Hooters/strobes shall be provided at staircase lobby/ lift lobby of each wing of floor.

1.37.2 CCTV Video Surveillance System

A system for CCTV is to be provided in surveillance room of each plot 22 & plot 23 Building at main gate entrances, Lower ground floor & Upper ground floor. The Design & installation of the system will be limited to the designated common areas, but the system should be scalable if required to be extended later for the remaining areas of the buildings.

The system will essentially consist of installation of devices and equipment like; Indoor IP based CCTV Dome Cameras, NVR, & Monitors.

The system shall also consist of a scalable NVR with appropriate Application Software for monitoring of the system. The storage of video data is to be considered for a period of 30 days.

1.37.3 RFID Card based Access Control System

A system for RFID Card based Access Control system such controllers, switches & client PC shall be provided in the Security cabin.

The system will essentially consist of installation of devices and equipment like; Access controller, RFID long range reader, Ethernet switches & UHF vehicle passive tags.

The system shall also consist of a PC Workstation with appropriate Application Software for accessing vehicle entries.

1.37.4 Video door phone

A system for Video door (MAIN GATE GUARD UNIT) shall be provided in security cabin of each plot 22 & plot 23 Building. And Video door phone indoor monitor & outdoor camera shall be provided at each plot of both plots 22 & 23. The Design & installation of the system will be limited to the designated common areas, but the system should be scalable if required to be extended later for the remaining areas of the buildings.

The system will essentially consist of installation of devices and equipment like; INDOOR UNIT: 7" Capacitive Touch Screen monitor, OUTDOOR UNIT: IP 1.3 Megapixel camera & GUARD UNIT at security gate.

1.37.5 PROVISION OF OPTICAL FIBRE CONNECTIVITY FOR GPON

All the floors, flats of Plot 22 & 23 are being provided the provision of Optical single mode (SM) fiber backbone for GPON application. The same will be utilized by the service providers/sub contractors for value added solutions of IP EPABX system, Wi-Fi, CATV/IPTV & Common surveillance in future while implementing the additional requirement as per client demand.

The same optical fibre cable which is being utilized for GPON will be get utilized for Video door phone system for Audio intercom within flat to flat & flat to security entries gates for visitor confirmation at entry gate.

1.38 Storm water

- The rooftop run off will be collected through pipes from the respective buildings inside the Plot area and then drained into stormwater drainage network outside the plot.
- The storm drainage system is proposed in such a way that to maintain the aesthetic view of the building and with minimal crossings in the building area by providing boundary drains along the compound wall.
- The rainwater harvested/stored during monsoon season will be utilised for non-potable/ irrigation purposes during the non- monsoon seasons as per the availability.
- The HFL of the trunk drain in which proposed drainage system (drains along the internal roads) is discharging should be lower than the IL of the incoming drain. The proposed layout of the storm water drainage scheme is planned along the sides of the main arterial roads and peripheral boundary. Individual plot developer is expected to connect their internal drains to these main drains planned for the project area.
- It was assumed that there is some flood risk that nallah capacity would be exceeded during flood events causing backflow from the nallah. To prevent back water flow non return valve arrangement is recommended at the point of discharge into the nallah.

1.39 STP

1.39.1 Plant Capacity

Package Sewage Treatment Plant (PSTP): - 500 KLD capacity.

A PSTP of 500 KLD capacity is planned which will cater the sewage generated from Plot No. 22 & 23 these plots comprise of Government Residential Houses.

1.39.2 Reuses of Treated Sewage

Understanding of the nature of physical, chemical and biological characteristics of sewage is essential in planning, design and operation of treatment and disposal facilities and in the engineering management of environmental quality. The reclaimed water should not contain measurable levels of viable pathogens.

The reclaimed water shall be following features.

- Reclaimed water should be clear and odorless.
- Higher chlorine residual and/ or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed.

- Chlorine residual of 0.3-0.5 mg/l or greater in the distribution system is recommended to reduce odours, slime, and bacterial re-growth.

Treated water from tertiary treatment of STP is proposed to be stored in a separate treated water tank near STP. This treated/ recycled water is proposed to be supplied for Flushing, irrigation, gardening, make up water for HVAC system etc.

The reuse of the treated wastewater for the project area will be for Flushing, irrigation, gardening, make up water for HVAC system etc.

Hence, expected standard will be as given in Table 1-13-1

Table 1-2: Treated Sewage Standards

Maximum limits/Type	Unit	Desired Values
Colour	-	Acceptable
BOD	mg/lit	10
COD	mg/lit	50
Residual Chlorine	mg/lit	1
Faecal Coliform	mg/lit	No detectable Faecal Coliform
Turbidity	NTU	2*
pH		6.5-8.5
TSS	mg/lit	5

Residual chlorine for flushing water need not be >1.

* From Practical Consideration

1.39.3 Operation Services

After commissioning, the system supplier shall operate the STP for a period of 36 month under his control for stabilization and to demonstrate the results. The Employer shall provide the operating manpower and consumables for this.

Turnkey system supplier can provide a separate offer for operation of STP with operating manpower separately

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1.40 Solid waste management

- Solid Waste Management is one among the basic essential services to be provided to the Bhopal Smart City Area Development. The objective of solid waste management is to reduce the quantity of solid waste disposed off on land by recovery of materials, thereby maintaining the land clean and disposal of solid waste in an environmental friendly manner. Solid waste management should be in such a manner that is in accordance with the best principles of public health, economics, engineering, aesthetics, and other environmental considerations. Solid waste management and handling has to be done in accordance with the Solid Waste (Management and Handling) Rules 2016 framed under the Environment (Protection) Act 1986.
- An Automated Waste Collection (AWC) system is proposed for the entire Bhopal Smart City Area Based Development (ABD) project. It is proposed that the Buildings designed on plots 22 and 23 will be developed in the initial phase which

will be connected by the AWC system of waste collection. The waste is targeted to be collected in segregated manner i.e. Dry and Wet by using the chutes designed within the building, thus no manual handling shall be performed and further reducing the door to door collection work.

- The individual chutes from buildings will be further connected to the refuse pipe through suction and transporting to the central pipes of AWC. This facility will be provided in the lower ground floor of each building. The waste transported through the refuse pipe will be reaching a Centralized Collection Station facility proposed on plot 21 which will have all the necessary equipments and machineries to collect the waste through vacuum pressure. This facility will also be extended to have a temporary storage of dry recyclable waste and inert waste. The recyclable waste shall be sold to the authorized recycling vendors and inert waste will be sent to the inert landfill site dedicated to rest of Bhopal City.
- Organic waste shall be presently collected and treated by Bhopal Municipal Corporation. Once the whole development will be completed with the Bhopal Smart City Area, separate system within ABD area for wet waste treatment will be developed.

Chapter 2: Specifications & Standards

All designs, materials, works and construction operations shall conform to the Standards and Specifications given below.

Where the Contractor intends to use an alternative to these Standards/Guidelines for delivering an equal or better product, he shall be permitted to use such alternative subject to the following conditions:

He shall demonstrate that the proposed alternatives conform to any of the following international Standards, Codes of Practice, Specifications, Guidelines, etc.

In case the Consultant intends to use any alternative material/technology/method, whether patented or otherwise, that is not specifically covered in the Indian or International Standards as listed above, but the use of which has been permitted on similar projects (similar in category of buildings) as the Building Projects, he would be permitted, its use on certification by the owners of such similar projects regarding the continued successful performance of such materials, technologies, methods, procedures or processes for at-least 5 years of the service life of the project. Such a certification shall be supported with details of critical performance parameters.

Such other reference standards published by the following that may be considered:

DIN	Deutsche Industries Normen (German Standards)
AFNOR	Association Francaise de Normalisation (French Standard Institute)
BSI	British Standard Institute
ASTM	American Society for Testing and Materials
ANSI	American National Standards Institute

The above is the list of codes included for guidance and compliance with applicable portions only and the omission of any from the list does not relieve the contractor from compliance therewith.

Latest version of the Codes, Standards, Specifications, etc., notified/published at least 60 days before the last date of bid submission shall be considered applicable.

Where the Standards and Specifications for a work are not given, Good Industry Practice shall be adopted to the satisfaction of the Employer's Engineer.

1.41 Architecture

The Codes, Standards and Technical Specifications applicable for the design and construction of project components are:

The following list is included for guidance only and the omission from the list does not relieve the contractor from compliance there with:

Table 1-3: Codes for Architectural and Finishes

Code	Description
IS 1200	Mode of measurement.
IS 269	Ordinary Portland cement.
IS 3812, 1981	Fly ash for use as pozzolana and admixtures.
IS 2386	Method of test for aggregate for concrete.
IS 516	Method of test for strength of concrete.
	Coarse and fine aggregate from natural sources for concrete.
IS 1077, 1970	Method of test for Bricks.
IS 456	Code of practice for plain and reinforced concrete.
IS 1597	Code of practice for construction of stone masonry.
IS 1597 PART 1	Code of practice for construction of rubble stone masonry.
IS 1130	Marble (blocks, slabs and tiles).
IS 287	Recommendation for maximum permissible moisture contents of Timber used for different purposes.
IS 1141	Code of practice for seasoning of timber.
IS 6313 PART 2	Anti-termite measures in buildings, pre-constructional chemical treatment measures.
IS 2571	Code of practice for laying in situ cement concrete flooring.
IS : 226	Structural Steel (Standard Quality).
IS : 451	Technical Supply Conditions for Wood Screws.
IS : 800	Code of Practice for Use of Structural Steel in General Building Construction.
IS : 806	Code of Practice for Use of Steel Tubes in General Building Construction.
IS : 813	Scheme of Symbols for Welding.
IS : 814	Covered Electrodes for Metal Arc Welding of (part I & II) Structural Steel.
IS : 816	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.
IS : 822	Code of Practice for Inspection of Welds.
IS : 961	Structural Steel (High Tensile).
IS 73	Paving bitumen.
IS 702	Industrial Bitumen.
IS 1322	Bitumen felts for waterproofing and damp proofing.
IS 1609	Code of practice for laying damp proof treatment using bitumen felts.
IS 13711 & 13712	Ceramic tiles.

Code	Description
IS 13630 Part 1 to 13	Testing for Ceramic tiles.
IS 104	Specification for ready mixed painted, brushing, zinc chrome, priming.
IS 137	Ready mixed paint, brushing, matt or egg-shell flat, finishing, interior to Indian standard colour as required.
IS 5410	Cement paint, colour as required.
IS 6241	Method of test for determination of stripping value of road aggregate.
IS 2720	Density test of aggregate.

1.42 Landscape

1.42.1 GENERAL ITEMS

The more important Codes, Standards and publications applicable to this section are listed hereinafter.

1.42.1.1 *Setting out the works*

- The Contractor shall supply without additional charges the requisite number of persons with the means and material necessary for the purpose of setting out works and checking, weighing and assisting in the measurement or examination at any time and from time to time, of the work or the materials. Failing this, the same may be provided by the client's designated representative In-charge at the expense of the Contractor and the expenses shall be deducted from any money due to the Contractor under the contract or from his security deposit.
- The Contractor shall arrange for a qualified surveyor to set out the works and obtain certification of its accuracy from the surveyor. The Contractor shall then set out the works and shall be responsible for the true and perfect setting out of the same and for the correctness of the positions, levels, dimensions, and alignment of all parts thereof and for provision of all necessary instruments, appliances and labour in connection therewith. The Contractor shall submit to the client and the Landscape Architects, margins and the verifications of layout within seven days from the date of getting site layout from Landscape Architects / client.
- Mark the layout on the site. All bench marks, levels should be properly established and preserved for future use.
- Clearly check the surveyed map provided by the client and mark all drainage lines, water pipe lines, electrical lines, etc. client has been asked to remove the electrical lines and electrical poles. It needs to be checked by Contractor to satisfy him / herself from safety point of view before starting of work.
- The checking of any setting out or of any line or level by the Landscape Architects and CLIENT's representative or their representative shall not in any way relieve the Contractor of his responsibilities, for the correctness thereof. The Contractor shall carefully protect and preserve all benchmarks and other things used in setting out of the work.

1.42.1.2 *Site Clearing / Excavation / Site Grading*

- Light irrigation, by flooding the whole site with water. The water should penetrate up to depth of 15-20 cm only so that the weeds can germinate. Remove all grasses, small shrubs/weeds etc. with roots. Excavating the site as marked on the drawing/as instructed at the site, up to any lead and lift.
- Verify the levels and bench-marks from the up-dated surveyed drawing made available by the client. If there are any discrepancies between the site and the survey drawing, the same are to be brought to the client's notice by addressing a letter to the client and copy marked to the Landscape Architects.
- Grading and levelling of site as shown in drawing / specified on site by Landscape Architects. This will include spreading manually or by help of soil unloaded at different working areas in the site so as to obtain basic datum levels and grades.
- Excavated material shall be stacked off in the manner indicated at the site including stacking of excavated material up to any lead and lift. The rate shall only cover the cost of excavation, stacking and/or spreading of the material, if required at the site.
- Clearing the area of unwanted materials including the weeds, stones, masonry pieces etc. and all such matter that may cause damage to growth of the plant materials immediately or in future.

1.42.2 EARTH WORKS

- Earthworks shall involve the grading of soil for earth mounding, the excavation of trenches and soil for formation levels of pathways and foundations, and the fine grading of earth banks and landscape areas roughly graded by others.
- Excavation shall be carried out to the depth shown on or implied in the drawings or to such greater or lesser depths as the Landscape Architect may direct. The Contractor shall supply and fit all shoring, sheeting, strutting and walling required to maintain the sides of excavations as long as necessary and to remove them as required. The Contractor is to allow for making all necessary adjustments to existing manholes in accordance to bring them to the same level as the required profiled grades. No claim shall be entertained for either bulking or compacting and all other quantities shall be measured net from the drawings.
- The stripping and replacement of the subsoil shall only be done in dry weather and ground conditions unless in exceptional circumstances the Landscape Architect authorizes otherwise. Subsoil in heaps or dumps shall not be sited so as to damage or impede water courses or other drainage so long as they are capable of remaining in operation. Any weeds which may grow on the heaps of subsoil shall be sprayed with an approved selective weed-killer to prevent seeding.
- Notwithstanding the general description for the type of material to be excavated, if original bed rock is encountered during these operations which can only be

removed by blasting or compressed air tools this work will be paid for separately as an extra over item for that given for normal excavation. This work shall only be undertaken when authorized in writing by the Landscape Architect.

- During excavation it is expected that the Contractor will take every prudent step or precautions such as tests or borings in order to prove the nature or type of material underneath or the ground bearing capacity in order to protect his workmen, plant or machinery employed in these operations.
- In the event of the Contractor excavating below the proper levels or otherwise in excess of the dimension given, he shall at his own expenses, remove all loose excavated material and replace the soil excavated in error.
- If, in the opinion of the Landscape Architect the bottoms of any excavation or any material to be excavated become unsuitable due to the Contractor's operations, the Contractor shall, at his own expenses, carry out any necessary excavation and make up in a similar manner to the above.
- If, in the opinion of the Landscape Architect the weather conditions are such as to preclude the satisfactory completion of any operation or cause unnecessary nuisance or disturbance to other parties, the Contractor shall, on receiving directions from the Landscape Architect suspend operations on that particular portion of the work until the Landscape Architect considers that weather conditions are satisfactory, or issues a direction to re-commence operations. The absence of such a direction shall in no way constitute the basis of a claim for delay or remedial work to a formation which is unsuitable.

1.42.2.1 *Major Grading*

- Site shall be complete with rough dressing including the base levels by civil contractor before handed over to landscape contractor for execution.
- Role of Landscape contractor involves major grading forming earth mounds / hillocks from imported fill materials where specified, or from the site debris and soil generated by excavations. The soil shall be graded using suitable earth moving machinery to the contoured earth forms indicated on the drawings. Soil, when in a dry enough state for easy working, shall be distributed to the correct areas and laid in layers not exceeding 100mm thick and compacted by at least 2 passes of the earth moving machine in each direction for each 100mm layer.
- Earth slopes are to be formed from the compacted mounds to the gradients and levels shown on the drawings, accounting for the topsoil depths to be included after subsoil formation is complete. If insufficient fill is available to complete the levels shown, additional suitable subsoil is to be imported to make up the required quantities. Importation of additional fill shall only be carried out with written permission of the Landscape Architect.
- Earthworks levels are to be carried out to the contours shown on the drawings to a maximum tolerance of 150mm measured vertically, and to a maximum gradient of 1:2. All subsoil levels are to account for the later additional of specified depths of topsoil.

- The Contractor shall be responsible for protection of completed subsoil mounds and shall take preventative measures to control erosion and siltation restore or replace any portion of the earthwork areas which erodes, slumps, silts or is otherwise damaged by the out-washing of soil.

a. Excavation for Formation Levels and Trenches

- For footpath areas or other paving areas, excavate subsoil to create a smooth formation for taking the sub-base for the paved area, to levels shown on the drawings accounting for the depth of the paving build up.
- Firmly compact sub-grade with a smooth wheeled vibratory roller to achieve an even level. Finished sub-grade is to be protected until the path sub-base or other construction such as pool sub-base is laid. If sub-grade is too dry to be compacted, water shall be added until suitable texture is achieved. If sub-grade is too wet, the material shall be left to dry out until workable.
- A completed sub-grade/formation on which there is standing water, soft spots or slurry shall be deemed to be unsuitable and shall be rectified at the Contractor's expense including making up of additional material as required to bring the formation to line and level again.
- Where soft or wet ground is encountered prior to preparation of the sub-grade and this soft or wet ground cannot satisfactorily be compacted, the Contractor shall submit a written request for this to be inspected and the area to be dug out and replaced with suitable material shall be evaluated by the Landscape Architect and directed accordingly.
- Surplus material resulting from excavations for path formation or drainage trenches shall be taken off site at Contractor's own expense unless otherwise directed by the Landscape Architect in writing.
- Excavation of drainage or formation trenches shall be carried out after the major grading has been completed and approved. Trenches shall be cut to lines and gradients shown on the drawings. Planking and strutting shall be carried out as required to make the sides of the trenches safe. The Contractor will be responsible for ensuring that drainage trenches are kept free from mud and water and side slippage.

1.42.2.2 *Fine Grading and Shaping*

- Slight unevenness, ups and downs and shallow depressions shall be removed by fine dressing the surface to the formation levels of the adjoining land, as directed by Landscape consultant and adding suitable quantities of Good earth, brought from approved source, if necessary.
- Fine grading shall be carried out using small sized earth moving equipment or by hand, and shall involve final modeling of the earth contours produced by the major grading exercise. The shaping will follow the contours shown on the plans in general terms, but the final forms will be developed by eye to create smoothly flowing and pleasing contours.

- The Fine Grading will provide the detailed earth contouring prior to cultivation of soil. Soil cultivation and the application of topsoil mixes shall not take place until the Fine Grading is completed.

1.42.3 SOILS: MATERIALS AND PREPARATION

1.42.3.1 *Soils*

a. Subsoil

- Subsoil shall be a free draining soil, generally from horizon over 300mm below the original surface to be used as fill materials, either excavated from areas of the site, or imported.
- The Contractor shall:
 - I. Furnish the source of top soil to Client.
 - II. Study the soil report provided with the tender document, providing soil details such as pH, alkalinity, total soluble salts, porosity, sodium content and organic matter.
 - III. Use the restored soil at site for landscape purpose, manure mixture, Neemcake, weedicide shall be added if required.
 - IV. Not consider any external soil source unless the existing soil conserved from site is lacking in quality and/or quantity.

b. Topsoil Mixes

- The components of the Topsoil Mixes shall be as follows:
 - Topsoil shall be a free draining organic soil from horizons less than 300mm from the original surface, of a workable crumbly and lump free loamy character and shall contain no grass or weed growth of any kind or other foreign material or stones exceeding 25mm in diameter. Total stone content shall be no greater than 15% by volume. A 1 litre sample with back up soil test data is required before installation, or mixing.
 - TOPSOIL SPECIFICATION: The following criteria shall be tested at an approved laboratory before use on site.
 - pH: 5.5 - 7.8
 - Electrical conductivity: 1:2.5 (w/v)
 - Soil-water extracts not exceeding 1500 micromho/cm (1500 micro-Siemens/cm)
 - Soil texture:
 - Sand (0.05 - 2.00mm): Max. 75% Min. 20%
 - Silt (0.002 - 0.05mm): Max. 60% Min. 5%
 - Clay (less than 0.002mm): Max. 30% Min. 5%

- Soil Conditioner shall be dried treated sludge, organic compost or other fibrous approved organic matter suitable for mixing with topsoil to make a friable growing medium for plants, resistant to rapid decay, free of soluble salts below 900ppm, pH 6-7, free of large lumps or debris.
- Organic Compost shall be organic vegetable compost produced by a thorough horticultural or industrial composting process or Farm Yard Manure (Cow Dung Manure). Compost is to have a clean, un-decomposed smell free from any rotting substances, debris, refuse, clay or visible fungus. A sample is to be submitted for approval before usage. All composts are to be sterilised before being packed for transport and odorous materials used on site will be rejected. Any vermin resulting from use of organic composts will have to be controlled by the Contractor within 12 hours of any infestation.
- Sand shall be a clean, coarse grained and angular material sourced from a river bed with a minimum 1mm diameter section. It shall be well graded, free from soluble salts ranging in size so that 80-100% passes the 3mm sieve and 0-50% passes the 2mm sieve, with 0% passing through a 1mm sieve.
- Lightweight Aggregate shall be an approved low density inert material such as expanded shale or clay or volcanic scoria or other porous aggregate capable of being compacted within the soil zone to 90% compaction without being crushed, free from dust and debris, pH 6-6.5, free of soluble salts. A 2 litres sample shall be submitted and tested as part of the soil mix for physical and chemical performance. Materials are to be approved in writing before installation.
- Soil Mixes
- The following soil mixes are to be used for different areas and for different types of planting. Minor changes to the proportions shown for particular species may be required, as specified by the Landscape Architect from time to time.
 - i. Soil Mix A: for use in natural ground level areas shall comprise the components listed below, which shall be mechanically cultivated to the correct proportions, prior to placement on site or backfilling. Soil Mix A shall comprise the following proportions by volume:
 - Topsoil: 50%
 - Sand: 20%
 - Soil Conditioner: 15%
 - Organic Compost: 15%
 - ii. Soil Mix B: for use in podium area shall be prepared under controlled mixing conditions such as a concrete floor to ensure even mixing. Soil Mix B shall comprise the following proportions by volume:
 - Topsoil: 30-50%
 - Sand: 10-30%
 - Conditioner: 0-20% (as required)
 - Lightweight Aggregate: 0-20% (as required)
 - Organic Compost: 20%

- iii. Soil Mix C: for use in planter boxes. Soil Mix C shall comprise the following proportions by volume:

Topsoil: 40%

Sand: 30%

Charcoal: 20%

Organic Compost: 20%

1.42.3.2 *Soil Preparation and Application of Soil Mixes*

- All subsoil areas to be topsoiled shall be cleaned free of rubbish, weeds, all stones exceeding 50mm in diameter and builders debris shall be removed from site. Any areas which are contaminated by petrol, soil or other toxic substances shall be excavated to 300mm below the contamination and have the excavated material removed from site. The excavated areas shall be back filled with imported topsoil as specified. These operations shall take place immediately before topsoiling (with soil mixes) commences.
- Where directed by the Landscape Architect, the ground shall be decompacted by ripping to a depth of 300mm. All obstructions to cultivation or deleterious material brought to the surface shall be removed from the site and any voids left by this operation shall be backfilled with imported subsoil as specified.
- Subsoil shall be formed to the finished levels and contours after settlement and with overall even compaction.
- No topsoil or soil mixes shall be spread or cultivation carried out until the subsoil operations have been approved by the Landscape Architect.
- Topsoil or soil mixes shall be spread on the designated areas to the depth shown on the drawings. The loose depth of the topsoil shall be sufficient to allow the area to conform to the levels shown on drawings after natural settlement has taken place. Soil Mixes shall not be compressed or rolled to achieve levels. Conversely if levels drop below specified levels, additional soil mixes are to be added to achieve levels.
- Soil Mixes are to be carefully spread by machine or hand in a moist condition. Very wet or dry soil mixes must not be used. Heavy compaction of soil mixes is to be prevented and compacted soil will be rejected. Soil Mixes are to be spread to the following minimum depths in open ground areas:
 - i. Lawn / Turf areas: 300mm
 - ii. Shrub areas: 450mm deep
 - iii. Tree pits: 1000 x 1000 x 1000mm

Unless directed otherwise or as shown on the drawings

- The prepared topsoil mix shall be compacted to 80% of maximum density to the depth shown on the drawings in 150mm layers. When planter is filled, water

topsoil mix thoroughly to ensure proper and uniform compaction. After 2 weeks, fill with additional topsoil mixture and compact to level and before pavers are laid indicated on drawings.

- When in the opinion of the Landscape Architect site conditions are unsuitable for working, soiling operations shall cease and shall only be resumed when authorized by him.
- Contractor shall be responsible for soil protection and shall take preventative measures to control erosion and siltation of all areas and shall restore or replace any portion of the site which erodes, silts up or is otherwise damaged by out-washing of soil.

1.42.3.3 *Fertilizers*

- Chemical fertilizers shall be approved granular slow release compound fertilizers. They shall be stored in waterproof sealed bags under shelter away from water and direct sunlight. Samples of the same to be submitted by contractor before use at site.
- Organic fertilizers shall be organic products such as organic liquid fertilizer, pellets or granules manufactured primarily from organic materials. These products are to be from accredited sources and technical data indicating sources or origin and manufacturing process must be submitted before use. Animal by products must be sterilized before being packed for transport and odorous materials used on site will be rejected. Any vermin resulting from use of organic fertilizers will have to be controlled by the Contractor within 12 hours of any infestation. A sample shall be submitted for review by the Landscape Architect before use on site.

1.42.3.4 *Mulches*

- Mulches shall be approved friable composted organic materials. Coco-Peat will not be allowed on its own unless mixed in a proportion of 50-50 with another mulching material free from soluble salts or toxic materials and resistant to rapid decay. Mulches shall have a pH of between 5.5 - 7.0. Samples to be submitted and approved before use.
- Mulches are to be applied in a minimum 50mm layer over the entire surface of shrub and ground cover areas.
- Mulches is to be re-applied to all planting areas every 3 months after initial installation until the end of the maintenance period or until complete surface cover by vegetation is achieved.
- Initial mulching is to take place within 2 days of installation of planting.

1.42.4 SUBSOIL DRAINAGE

1.42.4.1 *Subsoil, Field Drains and Trench Drains*

- Before beginning installation of drain lines establish invert elevation of city storm drains at points where tree drains will tie in and prepare schematic layout for approval of Landscape Architect before digging trench.

- Surplus material resulting from excavations shall be carted to other fill areas within the site. If no additional fill sites are available the Contractor shall remove all surplus material from site and deposit it in a Local Authority approved tip.
- The Contractor shall survey the gradient levels of all trench bases to ensure that all falls are continuous from the highest point down to the outlet point at the sump. These findings shall be submitted to the Landscape Architect for verification before any further work is undertaken, either pipe laying or backfilling.
- All trenches when completed and approved shall be lined with approved filter membrane laid over the base of the trench and up the sides with sufficient membrane to wrap over the top of the gravel backfilling with a minimum overlap of 300mm.
- The base of each drainage trench shall have a layer not less than 30mm and not more than 50mm depth of fine stone chippings 8-12mm diameter or coarse sand laid to accurate falls for bedding the perforated pipes.
- The drainage pipes to the sizes shown on the drawings shall be prefabricated subsoil drainage system or similar approved type. PVC pipes with drilled holes will not be permitted. Drainage pipes shall be laid to the lines to the falls shown on the drawings and accurately boned in to correct gradients before backfilling.
- All pipe junctions shall be as supplied by the selected manufacturer and shall be fitted to the manufacturer's instructions to provide smooth flow and to fit the correct pipe sizes. Where changes in pipe diameters occur the correct junctions shall be used to match the changed pipe diameters.
- Connect drainage system to percolation pits.
- Where subsoil drainage pipes pass under paths or structure the pipe shall be of non perforated pipe joined at either end to the perforated pipe, and be surrounded by 100mm of concrete haunching.
- Trenches shall be backfilled to within 100mm of the finished level with clean coarse grained sand or crushed stone chippings 8-12mm diameter free of any fine particles. The gravel backfill shall be lightly compacted in 100mm depth layers.
- All drains shall be tested on completion to ensure a satisfactory water flow. Any pipes that do not flow are to be taken up and re-laid at the Contractor's expense.
- After testing has been approved, remaining depth of the trench shall be filled with a layer of coarse grained sand up to the finished soil level (after final settlement). Where the top layer is specified as such, clean graded gravel 20-40mm stone chippings free from fine particles shall be placed up to the finished surface mix, free from clay lumps or any item likely to inhibit drainage.

1.42.4.2 *Sub-surface drainage Layers for podium planters*

- Drainage mat shall be 30mm thick mat or cell. Lay drainage mat over base of podium ensuring individual sections are close butted. Lay filter fabric over drainage mat and return 300mm up walls. Overlap filter fabric by 300mm along seams and bond with filter fabric cement. Spread 50mm sand blinding layer, over filter fabric.
- Filter fabric shall be of approved make, as specified in this document. This shall be laid over the drainage mat and turned up the sides of the planter boxes 300mm.

- o Filter fabric cement shall be an approved non-solvent bonding agent that will join filter fabric together. Submit manufacturer's technical data and sample for review.
- o Sand shall be coarse washed river sand. It shall be free from soluble salts ranging in size so that 80-100% passes the 3mm sieve and 0.50% passes the 2mm sieve with 0% passing through a 1mm sieve.

1.42.5 Holding Nursery

i. A piece of land has been secured within the site for use as a holding nursery as indicated on the Contract Drawing. (Ref. Dwg. No)

ii. As a holding nursery the Contractor shall provide all necessary plant and equipment to store his plant material, machinery and equipment for the duration of the contract, including the two-year maintenance period.

iii. The Contractor shall be required to install and establish all equipment that may be required to run a major landscape contract and ensure plant materials remains in a healthy and fit condition. The list of requirements includes, but is not limited to:

- Provision of a 3,000 high tensioned chain link fence (with at least 2 no. lockable gates) around the extent of the holding nursery)
- Grading and laying of crusher together with associated storm water drainage to take vehicular loading
- Provision of all site utilities including water, telephone, electricity
- Provision of any shade structures that may be required to maintain the plants in a healthy condition prior to planting out
- Provision of any irrigation systems, pumps, sprinklers that may be required to maintain the plants in a healthy condition prior to planting out
- Provision of a site office to include at least one conference/meeting room capable of comfortably accommodating 15 persons

iv. The Contractor may wish to use the holding nursery for the purpose of propagation of plant stock for the contract. This is not a mandatory requirement since it is assumed that plant stock will need to be outsourced in order to meet the programme target dates. The decision to use the holding nursery as a propagation area rests entirely with the Contractor having taken into account the programme constraints, the nature of the site location (relatively remote) and his own commercial considerations.

a. Provision of Site Utilities

i. The Contractor is to allow for the provision at his own cost of all site utilities for the duration of the contract including but not limited to water, electricity and telephone.

b. Landscape Development Technique

- i. The contractor will not be allowed to use different techniques or quality criteria or materials unless his alternative system has been confirmed in writing by the Employer/Employers representative.
- ii. No cost increases for alternative specifications will be entertained unless formally submitted in writing as an improvement in the quality of a product and accepted in writing, following Employer/Employer's Representative approval, by the Employer/Employers representative.

c. Quality of Workmanship and Materials

- i. All materials and workmanship shall be of the high standards and quality demanded by this specification. Sub-standard work and materials identified by the Employer/Employer's representative will be rejected and will be required to be rebuilt or replaced at the Contractor's costs.
- ii. All plant material shall be of the genus, species and variety specified and substitutions will not be permitted unless authorized in writing by the Employer/Employer's representative. The sizes and plant description set out in the section headed Plant Material.
- iii. All trees and shrubs supplied for the contract shall be free of pest, disease, discolouration and damage. Plants shall be well branched with vigorous shoots. The root system of each plant shall contain a good proportion of fibrous roots.
- iv. All materials are to be approved by the Employer/Employer's representative prior to use on site. Materials shall be obtained from approved sources/manufacturers and/or suppliers. All guarantees and warranties shall be copied and submitted to the Employer/Employer's representative prior to requests for approval.
- v. Where particular products are specified, the Main contractor's specialists subcontractors if he wishes to use similar products from other manufacturers must seek prior confirmation from the Employer/Employer's representative.

d. Site Responsibilities

- i. From the commencement of the works until the Certificate of virtual Completion has been issued by the Employer/Employer's representative, the Main contractors specialists subcontractors shall, in respect of all areas of soft landscape works, adjacent areas and parts of the site used by him, be responsible as follows:
 - For adequate protection to grassed areas, planted areas and trees and for making good Softscape works on removal of any protective measures at completion.

- For any damage to existing works and features and any necessary rectification work required to obtain approval from Employer/Employer's Representative.
 - For keeping all paved surfaces used by him in a clean and tidy condition.
 - For periodic removal of all surplus excavations and waste matter produced by his operations to a Local Authority registered tip off site, to be found by the Main contractors specialists subcontractors.
 - For keeping all Softscape areas in a weed-free and tidy condition and adequately watered.
- ii. The Main contractor's specialist subcontractors shall make appropriate allowance for these requirements in his rates.
- iii. The Main contractor's specialist subcontractors shall, within 24 hours of notification and as directed by the Employer/Employer's representative, undertake at his own expense any remedial works arising from the stated requirements.
- iv. Tree conservation:
- All trees to be conserved shall be protected with a 3-4 foot high enclosure constructed using brick/fencing (with an access gate for tree maintenance) at a distance indicated in the table below depending on the diameter of the tree trunk.

TRUNK DIAMETER (measured at 4.5 feet above natural grade)	DISTANCE FROM TRUNK ON ALL SIDES
Up to 6 inches	Past dripline
6-9 inches	5 feet
10-14 inches	10 feet
15-19 inches	12 feet
over 19 inches	15 feet

- This tree enclosure shall be erected before demolition, grading, or construction begins and remain until final inspection of the project. A "Warning" sign of size 8.5"x 11" shall be prominently displayed on each protective enclosure to state the following:
 - The following activities are prohibited within and in the vicinity of the tree protection zone throughout the entire duration of the construction project:
 - Cutting of tree roots by utility trenching, foundation digging, placement of curbs and trenches, or other miscellaneous excavations
 - soil disturbance or grade change
 - drainage changes
 - storage of material, topsoil, vehicles, or equipment
 - Activity including but not limited to compaction, grading, construction etc.

- dumping of any material including but not limited to paint, petroleum products, concrete, mortar, dirty water, waste
- use of the tree trunks as a backstop, support or anchorage as
- a temporary power pole, signpost or other similar function
- The following activities are permitted or required within the Tree Protective Zone with approval from Landscape Architect:
 - Mulching with wood chips (unpainted/untreated) or approved material to a four to six inch depth, leaving the trunk clear of mulch to prevent inadvertent soil compaction and moisture loss.
 - Irrigation, Aeration, fertilization indicated by Landscape Architect for the healthy growth/maintenance of the tree
 - if tree is adjacent to or in the immediate proximity to a grade slope of 8% or more, erosion control measures shall be installed outside the Tree Protection Zone to prevent siltation and/or erosion within the zone

e. Plant Protection

- i. All plant material is to be carefully protected and if necessary wrapped in the nursery during lifting, awaiting transportation, during transportation, unloading and during storage on site.
- ii. Any evidence of unsatisfactory protection to roots, stems, branches and leaves will result in plants being rejected.
- iii. Unprotected plants must not be transported during very hot weather, and all plants must be kept moist during transportation and storage. No plant material shall be left on site unplanted for more than two days.

f. Work by Machine or Hand

- i. All operations herein described shall be carried out by suitable approved machines or by hand.
- ii. Any work around the base of existing trees, in confined spaces or which is impractical to carry out by machine for any reason shall be executed by hand and the contractor shall include for this in his rates.

g. Notice of Intentions

- i. The contractor shall give forty-eight hours written notice to the Employer/Employer's representative of his intention to commence any of the following operations:
 - Setting out,
 - Planting,
 - Topsoiling,
 - Turfing,
 - Sprigging,
 - Maintenance visits

- h. Heavy Machinery
 - i. Heavy machinery, which would excessively consolidate the sub-soil, shall not be used during any operations nor shall heavy machinery be taken over areas prepared for planting or grassing.

- i. Substitutions
 - i. If the Main contractor's specialist subcontractor is unable to supply a particular species of plant he is to notify the Employer/Employer's representative in advance of his intention to make a substitution. No substitution will be allowed without prior written agreement of the Employer/Employer's representative.
 - ii. Notices of substitutions are to be made sufficiently for in advance of installation to ensure that the substituted material conforms to specifications. Substitutions requested by the Main contractor's specialist subcontractor after work has started on site will not be entertained.

- j. Setting Out
 - i. The Contractor shall be responsible for accurately setting out all the works prior to the commencement of the works and shall rectify errors in setting out at his own expense.
 - ii. Any discrepancy in site area between that shown on the drawings by Landscape Architect appointed by contractor and the actual area on the ground shall be notified to the Employer/ Employer's representative.
 - iii. The Contractor shall supply all necessary materials, equipment and labour to enable the Landscape Architect to check the setting out, levels and dimensions on the site along with the Employer/ Employer's representative.

- k. Tools and Equipment
 - i. The Contractor shall use proper tools and equipment for the carrying out of the works and is to ensure that the work force is fully and properly equipped with the correct equipment and experience for the job at hand.

- l. Failures of Plants (Pre-practical completion)
 - i. Any trees, shrubs, grass or other plants (other than those found to be missing or not in accordance with the Contract Documents as a result of theft or malicious damage and which shall be replaced), which are dead, dying, missing or found not to be have been in accordance with the Contract Documents at practical completion of the Works shall be replaced by the Contractor entirely at his own cost unless the Contract Administrator shall otherwise instruct.

- ii. The Contract Administrator shall certify the dates when in his opinion the Contractor's obligations under this clause have been discharged.
- m. Plants Defects Liability and Post Practical Completion Care by Contractor
- i. Any grass which is found to be defective within 24 months, any shrubs, ordinary nursery stock trees or other plants found to be defective within 24 months and any semi-mature, advanced or extra large nursery stock trees found to be defective within 24 months of the date of virtual completion due to materials or workmanship not in accordance with the Contract Documents shall be replaced by the Contractor entirely at his own cost unless the Contract Administrator shall otherwise instruct.
- ii. The Contract Administrator shall certify the dates when in his opinion the Contractor's obligations under this clause have been discharged.
- iii. Malicious Damage or Theft (Before Practical Completion): All loss or damage arising from any theft or malicious damage prior to practical completion shall be made good by the Contractor at his own expense.
- n. Submittals
- i. The Contractor shall submit for review drawings by Landscape Architect appointed by contractor completely dimensioned, indicating any pattern layouts, special installation procedure, cutting, fitting, sinking and adjacent equipment materials for coordination.
- ii. The Contractor shall submit samples of all materials and samples of workmanship for approval by Employer/Employer's representative.
- iii. The Contractor shall be responsible for producing and submitting for comment and approval to the Employer/Employer's representative the shop drawings and samples of all elements indicated in this section. All should be based on the drawings provided by Landscape Architect appointed by contractor. All submissions should be reviewed, approved and endorsed by the Contractor.
- o. Handling, Storage And Delivery
- i. The Contractor shall:
- Coordinate delivery with suppliers, to minimize handling.
 - Handle and store equipment and materials in such a manner that no damage will be done to the materials or the work of other trades.
 - Store packaged materials, undamaged in their original wrappings, or containers with manufacturer's labels and seals intact.
 - Stack equipment and materials on wooden platforms at least 150mm clear of the ground and protect with weatherproof covers.
 - Damaged equipment, material or works will be rejected by the Employer/Employer's representative whether built-in or not.
 - For equipment, materials and work, covering shall be of suitable material containing nothing that may injure or stain the materials.

- p. Protection of Work
- i. The Contractor shall protect all equipment, materials and completed work from damage until final completion of the work.
 - ii. The Contractor shall remove and replace damaged work at no extra cost.
- q. Reference Standards
- i. The Contractor shall comply with all relevant Indian Standards, ASTM, British Standard Code of Practice, Draft BS or DIN Standard applicable to elements indicated in this section, the recommendations and requirements of such documents shall be considered a minimum standard of such work described and must be complied with.
 - ii. Nothing shall relieve the Contractor of his responsibility for providing a higher standard than the relevant Code or Standard where it is required to comply with other sections of the Specification.

1.42.6 PLANT MATERIALS AND PLANTING OPERATIONS

The following plant descriptions cover the different categories of plant material to be used on the site.

These descriptions and their accompanying drawings requirements must be studied carefully and adhered to.

Plants that do not reach the specified dimension or quality, characteristics in this section or in the sizes and descriptions set out in the Bill of Quantities will be rejected and will have to be replaced at the Contractor's cost.

Trees and palms and large feature plants that are growing in open ground are to be prepared for transplanting at least 2 months before moving, either to containers in the nursery or direct to the site.

Preparation of in-ground trees and palms shall be by root pruning to the stated rootball dimensions.

Trenching around the outer edge of the rootball using pruning and a sharp spade shall be done in four separate stages trenching in quarters, with one quarter of the tree roots being cut and backfilled each week, the next quarter the following week, with all of the ball being cut in one month.

If roots over 25mm are encountered these are to be cleanly cut with large secateurs or pruning saw.

The trench which shall be at least 200mm wide shall be dug to the full specified depth of the rootball and undercut at the end of the root-pruning exercise to sever base roots.

The whole trench shall by this time be backfilled with sand. The tree is then to be allowed to settle for one month before final wrapping with protection and lifting. The rootball is to be well watered during this period.

For trees and palms that are to be containerised or root wrapped, the lifting and placing in containers or being wrapped is to be done immediately after the root trenching operation is complete.

Plants to be transported or moved are to be thoroughly wrapped and protected prior to transporting.

Rootballs are to be wrapped and tied with Gunny sack or hessian sacking if not containerised.

Exposed trunks are to be wrapped in rice straw including the lower parts of the branch system.

The upper branch system, especially if well furnished with leaves and twigs during transportation is to be completely wrapped in Lightweight netting or cloth tied and palms are to be laid at an angle to prevent damage from overhead structures and from buffeting and shall be covered by canvas as protection from wind.

Damaged trees will automatically be rejected on arrival at site.

All trees and palms are to be purchased, stored and grown on in suitable nursery conditions within one month of the contract and made ready for direction by the Landscape Architect appointed by Contractor.

Failure to procure within this time and to reveal the source of supply and location will result in the Employer/Employer's representative sourcing the plant materials for the Contractor, and the cost of this sourcing operation will be deducted from the Contractor's payments.

All dimensions shown with tolerances (that is 120 - 150mm) refer to maximum and minimum dimensions that will be accepted. Measurement of all plants of one species shall, as a minimum, average between the upper and lower figures (that is in the above case 135mm).

All trees and palms specified for containerising or root wrapping after root pruning operations are to be well furnished with leaves over the crown of the tree. Thinning of leaves to reduce transpiration to give a 50% cover is permissible providing due notification is given that thinning is required to ensure that the trees can be inspected before thinning work is done. Bare crowned trees will not be permitted.

Leave cover: Any trees or palms which shed their leaves within 2 weeks of transplanting are to be replaced by the Contractor at no extra charge.

1.42.6.1 *Trees*

a. Instant Trees

These are semi-mature trees especially prepared in advance for transplanting.

Root pruning to cleanly cut roots to the diameter of the rootball shall be carried out 3 months in advance of transplanting.

Trees shall be 300 - 450mm (12" - 18") circumference of stem when measured 1.0m (3') from ground level and shall have a clear stem of minimum 1.8 metres.

The head shall be well balanced and contain at least four main branches 500-1000mm long giving an overall height of 3 - 4m after pruning.

All saw cuts are to be painted with an approved insecticide/fungicide solution.

b. Extra Heavy Standard Trees (EHS)

These are large size nursery grown trees pruned during growth to produce a tight well rounded head and a straight stem clear of leaves or twigs.

Trees shall be 140 - 180mm circumference of stem when measured 1m above ground level and shall have a clear straight stem of minimum 2m.

The head shall be well balanced and rounded and contain at least four main branches, and a well developed secondary branch system giving an overall height of 4.5 - 4.8mm at the time of planting.

Trees shall have a defined central leader. Pruning at the time of removal from the nursery will not be permitted.

In dry weather conditions trees are to be sprayed with approved Anti-transpirant.

Rootball dimensions: diameter 750mm x 600 deep minimum. Branching/leaf spread shall be of 2.2 - 2.4m diameter.

c. Heavy Standard Trees

These are large size nursery grown trees pruned during growth to produce a tight well rounded head, and a straight stem clear of leafs or twigs.

Trees shall be 120 - 150mm (5" - 6") circumference of stem when measured 1.0m (3') from ground level and shall have a clear straight stem of minimum 1.8 metres.

The head shall be well balanced and rounded and contain at least four main branches with a well developed secondary branch system and a central leader, giving an overall height of 3.5 - 4.0cm (10' - 13') at the time of planting.

Pruning at the time of removal from the nursery will not be permitted.

In dry weather conditions, trees are to be sprayed with approved Anti-transpirant.

Rootball dimensions: diameter 600mm (2') x 450mm (1'6") deep minimum. Branching/leaf spread to be of 1.8 - 2.0m diameter.

d. Standard Trees

These are medium size nursery grown trees pruned during growth to produce a tight well rounded head, and a straight stem clear of leaves or twigs.

Trees shall be 100 - 120mm circumference stem when measured 0.9m from ground level and shall have a clear straight stem of minimum 1.5mm.

The head shall be well balanced and rounded and contain at least four main branches with a well developed secondary branch system and a defined central leader that has not been pruned, giving an overall height of 2.5 -3.0m at the time of planting.

Pruning at the time of removal from the nursery will not be permitted.

In dry weather conditions, trees are to be sprayed with approved Anti-transpirant.

Rootball dimensions: diameter 500mm (1.6") x 300mm (1') deep minimum. Branching/leaf spread shall be of 1.5 - 1.8m diameter.

e. Standard Feathered Whips

These are medium sized nursery grown trees having a single straight stem and unbroken leader giving an overall height of 2.5 - 3m.

The stem shall be fully furnished with evenly spread and balanced lateral branches down to ground level and shall be 80 - 100 mm circumference of stem when measured 1m from ground level.

The tree shall have a strongly developed fibrous root system and shall be container grown. Leaves or branches shall not be cut off before planting.

Rootball dimensions 450 x 300mm minimum. Branching/leaf spread shall be of 1.5 - 1.8m diameter.

f. Ships/Saplings

These are young tree grown from seed or cuttings which are trimmed or pruned, furnished with branches down to ground level.

Trees shall have a single straight stem and unbroken leader between 900 - 1500mm overall height.

Stem thickness will vary between species, but a strong stem which does not bend over is required.

The tree shall have a strongly developed fibrous root system and shall be container grown. Leaves shall not be cut before planting.

Container dimensions: 250mm diameter x 250mm deep minimum.

1.42.6.2 *Palms*

All palms shall be single stem. Single Stem Palms shall have clear straight trunks of heights as stated in the Bill of Quantities as measured from the root collar to the base of the lowest leaf sheath. The stem girth shall be of dimension normally found for palms for the stem height and species specified.

Acceptable tolerances to variations in stem height shall be +200mm or - 200mm from the height specified in the Bills of Quantities.

The heads of palms shall be well balanced with at least 7 leaves and a healthy growing apical shoot all free from pest and disease.

- a. Rootball dimensions shall be in proportion to stem heights as follows:

Stem height	Rootball diameter	Depth
1m	400mm	400mm
2m	750mm	600mm
3m	900mm	600mm
4m	1200mm	750mm

1.42.6.3 *Shrubs, Herbaceous Plants and Ground Covers*

- a. Shrubs

These are woody perennials of generally multi stemmed and bushy habit ranging from 3 - 4.5m down to 500mm height.

Shrubs shall have no less than three main stems and shall be well balanced and bushy, with strongly developed fibrous root systems, and shall be pruned in advance as required to achieve the specified height tolerances.

Branches shall break from the base of the plant just above the root collar, and shall be well furnished with leaves right down to ground level.

All plants are to be container grown in containers of suitable dimensions for the species.

- b. Herbaceous Plants

These are non-woody perennials usually of a clump forming habit.

Plants shall have a well developed main stem or stems with good symmetry, a healthy root system, free from pest or disease.

Clumps of herbaceous plants shall include rhizomes, corns, tubers or roots and soil undisturbed by lifting with evidence of growing shoots emerging above soil level.

All herbaceous plants are to be grown in containers unless specified as being produced by alternative method.

- c. Groundcover plants

These are low growing, 500mm or less, or prostrate shrubs or herbaceous plants whose habit is to totally cover the soil.

All groundcover species shall be evenly balanced to allow equal growth in all directions.

Plants shall have fully developed roots and leaves.

Rooted cuttings will not be accepted. All plants to be container grown.

Rooted shoots of certain spreading ground cover plants shall be used only where specified, planted as 'sprigs' as opposed to established plants in soil.

Plants shall be rooted shoots and shall have at least one and evidence of vigorous root growth.

Recent cuttings with no root development shall not be acceptable.

d. Climbers

Climbers are plants whose growth habit is to climb upwards by means of twinning stems, tendrils or clinging roots.

Plants shall be grown to reach the recommended size using stocks no less than one year old, and no more than five years old at the time of the start of the contract.

Plants shall have at least two leader shoots up to the recommended height and a vigorous root system.

All plants to be container grown.

1.42.6.4 *Hedging Plants*

Hedging Plants shall be shrubs such as Lawsonia, Ixoras, etc as per design requirements of Landscape Architect appointed by contractor as suited to regular clipping, previously prepared to establish a uniform height and complete foliage cover to the stem from ground level upwards.

Plants shall be a minimum overall height of 500mm with a minimum of 4 branches arising from ground level and a strongly developed fibrous root system.

Branches shall be well clothed in leaves down to ground level.

All plants to be container grown in suitably sized containers.

Hedging plants shall be prepared by root and branch pruning to achieve the 'box' shape shown, at least 3 months before transplanting.

1.42.6.5 *Container Grown Plants*

Container grown plants shall mean trees and shrubs which have been grown in containers sufficiently large to hold the developing root system from seed or cutting and shall be filled with suitable nutrient rich, free draining compost as per design requirements of Landscape Architect appointed by contractor.

Container grown stock shall be well watered prior to dispatch from the nursery and shall remain in the container until planted on site, whereupon the container shall be carefully removed to avoid soil disturbance.

Empty containers are to be removed from site.

1.42.6.6 *Cultivation of Plant Beds*

Cultivation of the completed soil mix beds shall take place only when the seeding or planting operations can begin immediately after cultivation. No cultivation shall be undertaken in weather or ground conditions in which operations may destroy soil structure or where soil mix has not been approved by the Landscape Architect.

Cultivation shall be by approved mechanical or manual means to a depth of 250mm for Ground Cover and 450mm for Shrubs to provide an even, weed free texture.

After cultivation, stone picking from the surface of soil areas shall be carried out such that all stones and lumps exceeding 50mm in diameter are collected. All stones, weeds and rubbish brought up shall be removed from the site to a tip to be found by the Contractor.

Ground cover, rooted shoot and herbaceous beds are to have 25mm solid conditioner spread over the entire area and well forked in to the top 250mm of soil during cultivation. This operation is separate from the mulching specified.

1.42.7 PLANTING TECHNIQUES AND ACCESSORIES

All plants shall be planted to accommodate the spreading root system of the plant to the same soil depth as in the nursery and shall be well watered before removing them from containers. Plants are to be positioned upright and the soil firmed around the roots.

Planting shall be carried out in accordance with the schedule of plants and drawings supplied by Landscape Architect appointed by contractor. The number of each species and variety shall be evenly distributed over the area as indicated on the drawings by Landscape Architect appointed by contractor.

For large areas the outer rows are to be set out first to ensure the correct shape to the bed is established. The remaining plants are then to be evenly distributed to cover the planting area. The Landscape Architect is to be notified in advance if there are too many or too few plants to fill the area required and an assessment of setting out adjustments will be directed accordingly.

Setting out of plants is to be completed and approved by Landscape Architect appointed by contractor before planting into the soil bed can commence.

1.42.7.1 *Small Shrubs, Herbaceous, Ground Cover and Root Planting in Beds*

Small shrubs, ground cover and herbaceous plants shall be planted in pockets formed by a trowel or spade.

The pocket shall be deep enough and wide enough to accommodate the root of the plant.

The sides and base of the pocket shall be loosened and the plant roots lightly loosened from the rootball.

The plant shall be placed upright in the pocket and firmed into the ground by backfilling and treading or hand pressure.

The topsoil in areas to receive rooted shoots shall be brought to a fine layer 75mm deep by approved mechanical means or hand raking.

Approved slow release fertiliser shall be applied evenly over the area at a rate of 40gms per square metre and shall be lightly raked into the surface.

Rooted shoots shall be firmly bedded into the soil at 75mm centres with each shoot spread on the topsoil surface, separated from adjacent shoots.

The area shall be top-dressed with finely sifted topsoil/compost mix as approved by the Landscape Architect appointed by Contractor to lightly cover the rooted shoots after laying.

The ground shall then be firmed by lightly treading or hand pressure around the roots, taking care not to damage the shoots, to ensure good contact with the soil.

Watering shall take place immediately after planting, using a fine spray.

The firmed up area is to be tightly cultivated after completion of this operation to leave an even layer before mulching.

1.42.7.2 *Shrub Pits*

Shrub pits for large and medium shrubs, feature plants and climbers shall be excavated to 150mm wider on either side than the root spread, and to a depth of 150mm deeper than the root depth and shall not be less than 300mm x 300mm x 450mm deep.

The bottom 150mm of the pit is to be forked loose prior to backfilling.

Backfill material shall be topsoil Mix A for backfilling purposes. (Ref. Section 8-Part 1: 4.1.3 Soil Mixes)

The Contractor shall note that for planting into turf areas, where topsoil has not been spread topsoil mix will be required for backfilling purposes.

Climber pits shall be 150 - 200mm away from the supporting structure with the roots spread away from the wall or adjacent supporting structure.

The climbing plants shall be trained through the wire mesh with leading shoots directed upwards and tied.

Pits for shrubs and feature plants in planters shall be excavated to 150mm wider on either side than the root spread and to a total depth of the rootball.

The bottom of the pit shall be lightly formed, prior to planting taking care not to damage the terrain layer below.

After planting shrubs the area is to be watered immediately to bed the shrubs in.

Once the water has percolated away and left the surface relatively dry the soil area is to be lightly forked to loosen the surface and leave an even soil layer.

1.42.7.3 *Tree Pits*

Tree pits shall be excavated to the dimensions and the location shown on the drawing by Landscape Architect appointed by Contractor.

Tree pits shall be dug a minimum of 3 weeks period prior to back filling.

The bottom of the pit shall be forked to loosen the soil. In case the soil is clayey, a layer of broken bricks and stones shall be spread on the bottom of the hole and this layer shall be covered with dried leaves or straw.

No tree pit shall be less than 300mm wider on either side than the root spread, and to a depth of 150mm deeper than the root depth, and shall not be less than 1m x 1m x 1m.

The trees shall be planted to the same depth in the nursery or as in their containers.

In case the site is infested with white ants the sides of the pits shall be brushed with a mixture of BHC (10% concentration) and water in a proportion of 200 gms of BHC mixed in 5 litres of water. BHC is the common name for the insecticide.

1.42.7.4 *Backfilling of Pits (trees, shrubs and climbers)*

Before backfilling, imported topsoil and sand is to be thoroughly mixed with soil conditioner and organic fertiliser as specified for Topsoil Mix A. (Ref. Section 8-Part 1: 4.1.3 Soil Mixes)

The tree pit shall be backfilled with the Soil Mix A to a depth which will allow soil, after settlement to match surrounding ground level.

The filled pit shall be watered and allowed to settle. After settlement soil levels shall be topped up as required.

The centre of the backfilled tree pit shall be excavated large enough to allow placing of the rootball, and to allow even compaction all round during backfilling.

After careful removal of the container or wrapping, the rootball of trees shall be placed carefully in the pit, and soil replaced gradually into the pit.

The soil is to be consolidated during backfilling in layers to ensure that the plant is firmly held in the ground and that voids are not left around the roots.

Care shall be taken during planting to avoid damage to the root system, branches or leaves.

After careful removal of the container or wrapping, the rootball of the roots of shrubs and climbers shall be placed carefully and the soil replaced gradually in the pit.

The soil is to be consolidated during backfilling in layers to ensure that the plant is firmly held in the ground and that voids are not left around the roots.

Care should be taken during planting to avoid damage to the root system, branches or leaves.

1.42.7.5 *Staking and Supports*

Stakes shall always be used when planting instant trees, standards and single stem palms and for tall shrubs when directed by the Landscape Architect appointed by Contractor.

Stakes shall be in sawn timber of an approved type and be carried out according to the size of plant to be supported. The types of approved staking methods are:

a. Tripod or Quadropod staking for large trees or palms (extra heavy standard and above)

Three or four stakes each 50 x 50mm section shall be positioned equidistantly around the tree and firmly driven into the ground at angles of between 30 - 40 degrees.

The inner ends of the stakes shall extend beyond the tree stem by not more than 150mm and shall not be higher than 300mm below the lowest branch.

The tree stem shall be wrapped in hessian or gunny sacking at the point where the tree stakes are to be fastened in order to prevent bark damage.

The stakes shall be neatly and firmly fastened to the tree stem using rubber hose or cord; String are not be used.

The stakes are to be adjusted and the position of the protective wrapping is to be altered up or down every month.

The hessian wrapping is to be sprayed with an approved horticultural pesticide.

b. Multiple guying - for large trees or palms (heavy standard and above)

A minimum of three wire guys are to be used per tree.

Each guy wire is to be fastened by a loop around the lowest branches of the tree at the junction with the main trunk or branches of the tree at the junction with the main trunk or stem.

Loops are to have protective rubber or plastic hose to prevent chafing and are to be fastened back to the guy wire by means of U-clamps or bolts.

Guy wires are to be fastened at ground level to short stakes firmly driven at an angle into the ground.

Stakes shall be minimum length of 600mm and are to be driven deep enough to resist movement.

A notch is to be made near the top of each stake for the fastening of the guy wire.

Stakes shall be positioned equidistantly and equally around the tree and shall be at least 300mm beyond the extent to the tree pit.

Distance away from the tree shall be gauged on site to provide firm and secure guying.

Each guy wire is to have one turnbuckle located near the fastening to the stake.

Guy wires are to be kept in a proper tension and adjusted to maintain the tree in a vertical position without guy wires being rigid.

c. Double Staking - for trees and palms (heavy standard and smaller)

Two stakes each 50mm x 50mm cross section shall be driven into the ground in a vertical position on either side of and outside the rootball of the tree so as to form a straight line outside the rootball of the tree so as to form a straight line with the stem at the centre.

Stakes shall be driven in to penetrate the bottom of the tree pit and be deep enough to resist lateral movement when tested.

Stakes shall not extend beyond the lowest branch of the tree and if necessary are to be sawn off at the top.

Fastening or securing of the tree may be carried out by using either:

i. Cross bar

A wooden cross bar of same section as the stakes is fastened in a horizontal position to the outside of the stakes by nails or tying securely at a level below the lowest branch.

The tree is fastened to the cross bar with a single adjustable tie of an approved rubberised or plastic type with a spacer and shall be fastened to prevent any chafing or abrasion of the bark.

No nails or fixings are to be driven into the tree trunk.

ii. Wire/Hose loops

Two separate wire or rope loops are made about the stem just below the lowest branch with each being fastened back to one of the vertical stakes.

Each loop is to have a protective outer covering or sheath of rubber hose to prevent chafing or abrasion of the bark.

The wire or rope is to be fastened to the stakes in a manner that allows adjustment of the tension to be made easily.

Tension on each wire is to be equal to maintain the tree in a vertical position.

Where directed by the Landscape Architect appointed by Contractor the tree may be secured with a second set of loops at a lower level.

d. Single Staking - for trees and palms of sapling size only

A single stake of cross section 50mm x 50mm is driven vertically into the ground 150mm - 250mm away from the tree.

The stake is driven down beyond the base of the tree pit and shall be firm when tested.

The top of the stake shall be 100mm below the lowest branch.

Two ties of an approved rubberised or plastic type are to be used.

The top tie is to be located 100mm below the top of the stake; the lower tie 300mm from the base.

Ties are to have spacers to maintain the 150mm - 250mm distance between the stake and the tree.

Ties are to be fastened to avoid rubbing, chafing or abrasion of the bark.

e. Climber wires

Wires for training climbing plants against walls shall be approved lightweight PVC mesh, fixed at 600mm intervals to screw eyes supplied under the sub contract.

Maximum mesh coverage shall be 180mm high x 240mm wide.

The climbing plants shall be trained through the wire mesh with the shoots directed upwards and tied.

1.42.7.6 *Turfing*

a. Close Turfing

Close Turf shall be a live grass sod or mat at least 300mm square with a well developed root system growing in a minimum of 25mm soil bed, free from stones or extraneous roots, cut mechanically or by hand to give an extra thickness and texture.

A sample of one square metre of Turf shall be submitted to the Employer/Employer's representative for approval before Turf is brought in for use on site.

The source of the material shall be stated by the Contractor.

Turf shall be free from weeds, fungus, pest or disease and contamination or pollutants.

Turf sods shall be kept moist and in shade and shall be planted within 24 hours after lifting.

In exceptionally dry weather, the turf must be kept well watered at the nursery or turf farm in order to keep full green leave structure.

Dry, brown or wilting grass turf will be rejected and growth or recovery on site will not be permitted.

i. Close Turfing: Ground Preparation

Rake the topsoil mix area to a smooth and uniform grade free of any slight mounds or depressions to achieve a uniformly flat surface.

Re-grade any depressions or humps that may occur until a satisfactory grade is achieved.

The area to be turfed is to be brought to a fine tilth by approved mechanical means or by hand raking.

Any stones over 25mm in diameter shall be removed from the site of turfing.

Watering of the area shall be carried out to produce a moist condition of the soil and to consolidate the soil.

If consolidation occurs to produce any areas with topsoil depths less than 100mm these areas shall have extra topsoil spread to produce finished levels.

Fertiliser shall be applied to all areas to be turfed prior to turfing at the rate of 40gm per square meter, evenly spread over the whole area and lightly worked into the soil.

ii. Close Turfing: Operations

Close turf sods shall be laid onto the surface of the prepared ground with leaf turfs upwards, butt jointed as closely as possible to achieve a uniform cover.

The turf shall be laid off planks working over turves previously laid.

The whole area is then to be top dressed with finely sifted topsoil mix to give an evenly smooth surface. The finished close turfing shall be lightly compacted by treading or with a wooden beater to ensure even coverage and compaction.

Watering shall take place over the area that has been turfed immediately after planting. Watering shall be undertaken by use of a fine spray to avoid disturbance of soil particles.

Turfing shall be only accepted as complete after the growth of an even grass cover is evident. Any areas not covered by green healthy grass to the satisfaction of the Employer/Employer's representative within 28 days after turfing shall be re-laid as specified at the Contractor's own expense.

For the period of 28 days after turfing the vegetative cover shall:

- I. Evenly cover at least 90% of the areas with leaves and spreading shoots of specified grass variety
- II. be free of perennial weeds or disease
- III. be healthy and vigorous and showing a strongly developed root system

Should there be any settlement due to lack of even compaction this will be corrected by application of topdressing of finely sifted soil to maximum depth of 25mm.

If the depression is greater than 25mm the grass in the affected area shall be lifted, the depression filled with sifted topsoil, lightly compacted and the affected area re-turfed as specified. These operations shall be done as often as necessary to produce an even and smooth surface free from bumps and hollows.

All turfing operations shall be carried out from wooden planks or plywood boards, with the workers moving away from completed turfed areas, raking any compressed soil or footprints before laying of sods.

All access onto soil areas shall be on wooden boards or plywood sheets. Areas compacted by working are to be re-cultivated and re-laid.

iii. Maintenance of Close Turfing Before Completion

The following operations are to be carried out as often as required to achieve the specified quality of turf:

- I. Cutting before Completion shall be carried out as necessary to keep the grass to a maximum height of 30mm.
- II. Watering shall be carried out as often as necessary before Completion to allow a satisfactory green sward to develop over the whole close turfed area.
- III. One fertiliser application per month is to be carried out for before Completion.
- IV. Topdressing as specified as often as required to establish smooth even grades and levels free of hollows.
- V. If compaction or consolidation takes place or hard passing or baking of the soil occurs, the soil areas are to be well watered first and lightly loosened by mechanical means such as spiking, slitting or hollow tinning using approved equipment.
- VI. Completed close turfed areas are to be kept in a weed free insect free, fungus free and tidy condition until Completion (that is start of maintenance period).

iv. Sourcing of Turf Types

Close turfing materials are to be obtained from a bona-fide horticultural source or private landowner.

No turf is to be removed from unauthorised locations, roadside, riverbanks or private property without permission of the owner.

The Contractor is to inform source of all turf delivered to the Employer/Employer's representative before any turf is laid at site.

b. Fine Turf

Fine Turf shall consist of fine bladed rhizomatous grass such as Bermuda grass or cultivar specified by Landscape Architects appointed by the Contractor.

Fine Turf shall be a live grass sod or mat at least 300mm square with a well developed root system growing in a minimum of 25mm soil bed, free from stones or extraneous roots, cut mechanically or by hand to give an even thickness and texture.

A sample of one square metre of Fine Turf or both types shall be submitted to the Employer/Employer's representative for approval before fine Turf is brought in for use on site.

The source of the material shall be stated by the Contractor.

Fine Turf shall be free from weeds, fungus, pest or disease and contaminants or pollutants.

Fine Turf sods shall be kept moist and in shade and shall be planted within 24 hours after lifting.

i. Fine Turfing Operations

Subsoil mix shall be hand raked to provide an even and fine tilth to an even and accurate level matching kerb edge levels.

Any lumps or stones over 25mm in diameter brought up in this operation shall be removed from site.

Soil areas shall be lightly sprinkled with water to moisten surface in dry weather before laying turf.

Pre-Turfing fertiliser shall be applied to all areas to be turfed prior to turfing at the rate of 40gm per square metre evenly spread over the whole area and lightly worked into the soil.

The turves shall be laid on the prepared soil bed and firmed into position in consecutive rows with broken joints, closely butted and to the correct levels.

The turf shall be laid off planks working over turves previously laid.

Where necessary, the turves shall be lightly and evenly firmed with wooden beaters, the bottom of the beaters being frequently scraped clean of accumulated soil and mud.

A dressing of finely sifted topsoil/sand/compost mix shall be applied and well brushed into the joints to give an overall even surface.

Watering shall take place over the area that has been turfed immediately after planting. Watering shall be undertaken by use of a fine spray to avoid disturbance of soil particles.

Fine turfing shall only be accepted as complete when new growth has caused turves to knit together and adhere by rooting to the soil bed.

Any areas not covered by green healthy grass to the satisfaction of the Landscape Architect within 28 days after fine turfing shall be re-laid as specified at the Contractor's own expense.

If shrinkage occurs or the joints open, finely sifted topsoil/ sand/ compost mix shall be brushed into the gaps and shall be watered in.

Any inequalities in finished levels owing to variation in turf thickness or uneven consolidation of soil shall be adjusted by lifting turves and by re-spreading fine soil mix to correct levels and relaying turves as specified.

The finished level of the Fine Turf shall be 25mm above adjoining paved surfaces or other hard edges after allowing for final settlement.

Turf edges and margins shall be laid with whole turves and uneven edges trimmed to give an even line.

ii. Maintenance of Fine Turfing before Completion

Watering shall be carried out as often as necessary before completion to allow a satisfactory green sward to develop over the whole fine turfed area.

Cutting before completion shall be carried out as necessary to keep the grass to a maximum height of 25mm.

One extra fertiliser application is to be allowed for before completion, to be used if directed by the Landscape Architect appointed by Contractor.

Completed fine turfed areas are to be kept in a weed free insect free, fungus free and tidy condition until completion (that is start of maintenance period).

Edge cutting shall be carried out as required along edges of paths, plant beds or other junctions with other materials. Only sharp edge cutting tools are to be used for this operation.

Over cutting or ragged edges will require the relaying of the turf edge strip as specified (that is 300mm wide).

iii. Specification for Sourcing of Turf Types

Fine Turf is to be specially prepared horticultural turf, re-lawn or turf-carpet, mechanically cut to specified tolerances.

c. Slope retention work with Coir Mat Turfing

i. Site Preparation

Sub-grade shall be excavated to proper lines and grades based on construction plans.

The sub-grade shall be fairly smooth and free of sharp objects and debris that may damage the Coir Mat.

The soils should be proof rolled prior to Coir Mat and backfill placement.

The soils should be compacted to 95 Percent of the relative density based on the Site Engineer's recommendations.

Above the compacted soil, Top soil mix 'A' to be laid upto 150 mm thick layer for planting turf.

Coir mat to be laid first and then planting operation should take place.

ii. Laying of Coir Mat

Coir Mat should be placed in correct orientation as shown on the construction plans and approved by the Engineer.

The Contractor should verify the orientation. The orientation of the Coir Mat should be such that it is rolled in the direction of the slope – not perpendicular to it.

The Coir Mat should be cut to length based on construction plans using an Engineer approved cutting tool.

Each sheet of Coir Mat should be pulled taut by hand to get rid of any wrinkles.

Adjacent sheets should be overlapped for minimum width of 0.30 M.

Each sheet may be secured in place using staples, pins, sandbags, backfill, or by other Engineer approved methods to help prevent disruption during the installation of adjacent sheets

iii. Turfing

Turfing should be done as per procedures mentioned above once Coir mat is installed.

1.42.7.7 *Watering of all Plants*

After planting all plants are to be thoroughly watered to soak the ground all around the rootball.

After watering and the water has percolated away leaving the surface relatively dry the soil is to be lightly cultivated to give an even soil tilth.

1.42.7.8 *Mulching*

After completion of planting and watering and light cultivation operations a 50mm deep layer of approved mulch shall be spread and forked in over all cultivated planting areas.

Around each tree and palm and around the base of each climber, additional mulch is to be applied to a 50mm depth to a diameter of 600mm.

Mulching is to be done within 2 days of completing planting and watering in.

1.42.7.9 *Fertilising*

After a period of settling in of at least one month, all pit planted materials shall be fertilised with an approved slow release fertiliser at the rate of:

Trees	: 250gm per tree
Shrubs/climbers	: 50gm per plant
Ground Cover/Herbaceous	: 100gm per square meter spread
Rooted Shoots	: around the base of the plants - 40gm per square meter

All fertilised areas are to be watered immediately after fertiliser application.

1.42.7.10 *Disease Control*

The Contractor shall take all necessary precautions to prevent or eradicate any outbreak of disease or insect attack.

1.42.7.11 *Planting into Turf Areas*

Where planting is to be carried out in areas of turf, the turf shall be carefully cut to the size of the tree or shrub pit, rolled and stored for re-use, being kept moist and in shade.

After planting is complete stored turf shall be re-laid around the base of the plant.

The Contractor shall replace at his own expense, any turf which is damaged during planting operations.

1.42.7.12 *Protection of Planted Areas*

The contractor shall be responsible for protecting all planted areas.

If it is necessary for the Contractor to erect protective fencing, the Contractor shall be responsible for keeping the fencing in position and in good repair until the end of the maintenance period.

Fencing proposals shall be submitted to the Employer/Employer's representative for approval.

Post and string fences shall not be acceptable.

1.42.8 FOR JOINING OF PVC PIPES (AGRICULTURAL GRADE)

- Use special grade solvent cement for joining.
- Pipe cutting should be perfectly perpendicular.
- All Pipes should be at least 1 ½' below finish soil level.
- All fittings should be heavy duty, 10 kg./cm² rating.
- While joining any fittings, pipe alignment should be straight so that there is no stress on fittings later.
- Excess solvent used should be wiped out immediately otherwise it damages the pipe.
- Keep the joint for 3 hours for setting and only then it can be pressure tested.

1.42.9 FOR JOINING ASTM WHITE PVC PIPES

- Use primer (code – P 70) for cleaning of pipe surface.
- Use special grade solvent cement for joining.

- All pipes should be at least 1 ½' below finish soil level.
- All fittings should be SCH 80 only.
- While joining any fittings, pipe alignment should be straight so that there is no stress on fittings later.
- Excess solvent used should be wiped out immediately otherwise it damages the pipe.
- Keep the joint for 3 hours for setting and only then it can be pressure tested.

1.42.10 INSTALLING POPUP SPRINKLERS

- All pop-ups should be necessarily installed on swing joint or shrub riser assembly.
- The connection between popup and swing joint / shrub riser is threaded which should be wrapped with sufficient Teflon tape. No glue should be used for connecting popup sprinkler.
- As far as possible the position of popup sprinkler should be perfectly vertical. It should not be inclined.
- The top of the popup should be level with finish soil level.
- The angle setting and deflector setting of popup must be in accordance with the guidelines of the manufacturer. Any mishandling of settings will damage the gear assembly of pop-ups.
- The selection of nozzle must be in accordance with the design.
- The swing joint threading should be just tight enough not to allow any leakage.
- The service saddle mounted on pipe for popup connection must be perfectly vertical.
- Drill a hole in service saddle outlet same as the size of outlet and not more.
- Make sure that 'O' ring seals the service saddle outlet completely to make it leak proof.
- Service saddle should be tightened just enough to make it leak proof but not more to damage the pipe.
- Make sure that service saddle is not under stress after installation.
- Use P P saddles / metal saddles.
- Use popup shields with sand filled to allow drainage of leaked water and protect popup.

1.42.11 INSTALLING LATERAL POLYTUBES / INLINE POLYTUBES

- Use hose nipple connection to join lateral / inline with sub main line.

- Use all poly fittings in ring title variety. Only barbed fittings will be inadequate.
- Make sure that lateral laid is not under stress.
- While laying the lateral the initial twist given to lateral during machine winding has to be removed.
- Align the lateral properly and make sure that it serves the area it requires to irrigate.
- Use lateral ends with heavy duty 8 shape end stops only.

1.42.12 INSTALLING CONTROL VALVES

- All fittings used for installing control valves must be heavy duty, 10 kg./cm² rating.
- Alignment of inlet pipe and outlet pipe must be perfectly straight which otherwise leads to leakage or failure of valve function.
- All valves should have sufficient reaction through proper support on both sides of valve.
- All valves should be located near approachable area so that valve operation can be done easily.
- All threaded ends of fittings / valves should be wrapped with Teflon tape.
- There should be sufficient protection to valve by using readymade valve chambers or by constructed valve chambers.

1.42.13 INSTALLING FILTER STATION

- Filter station (Sand Filter and Disc / Screen Filter) must have sufficient filter foundation to accommodate both filters properly. It should be 0.3 mtr above ground.
- As far as possible alignment of pump outlet and filter inlet should be straight.
- All threaded ends should be wrapped with Teflon tape.
- The inlet and outlet of filters must have either flanged or union connection so that it can be easily dismantled.
- All fittings used must be heavy duty of at least 10 kg./cm² pressure rating.
- Back wash water should not be recycled back in the system.
- Maintain sand level in the filter to the specified mark.
- 1..1. Make sure that there is sufficient working space all around the filter station.

- All pressure gauges should be easily visible.
- The quality of workmanship must be good enough to give an attractive look for the filter station and must be easy for maintenance.

1.42.14 INSTALLING QUICK COUPLE OUTLETS

- Use only metal service saddles for giving quick couple outlet connections.
- Use only brass QRC outlets.
- Location of QRC outlet should be easily approachable.
- Use swivel elbows for QRC keys.
- Distance between two QRC outlets should not be more than 50 meters.
- Use valve chambers to protect QRC outlets.
- All QRC outlets must be below finished soil level.
- Use only metal fittings in QRC outlet.

1.42.15 INSTALLING VALVE BOX

- Use only heavy duty HDPE Valve Boxes.
- Top of valve box must be level with top of finish soil level.
- Valve box must be properly supported on bricks at bottom.
- Make sure that valve is placed exactly in the centre of valve box.
- The size of valve box should be sufficient enough to give working space between valve & valve box.

1.42.16 INSTALLING DRIPPERS

- Use proper lateral punch to make hole in lateral.
- Use barbed connector to make connection in lateral.
- Use 6 mm extension tube to connect dripper with lateral.
- Placement of dripper should be according to the design to irrigate the tree.

1.42.17 GENERAL NOTES FOR INSTALLATION

- Use hacksaw frame for cutting the pipes.
- Use suitable spanners, pipe plyers for installation.
- Use fine polish paper on PVC pipes before applying jointing material.
- Use brush to apply jointing material.

- Use hand gloves for handling jointing material.
- Proper drilling tools and other tools should be used while installation.
- The quality of workmanship should be good enough to give proper appearance to the system. It should not look ugly.

1.43 IGBC

Following are the standards and codes are part of these specifications / guidelines:

Table 1-4: Standards and Codes for IGBC Rating

Codes / Specifications	Descriptions
LEED 2011 for India	Core and Shell Projects (based on LEED 2009).
ASHRAE 90.1.2007	Energy Standard for Buildings.

Table 1-5: Green Material Specifications

Name of the Material (Exclude MEP, Equipment and Devices)	Reference Brands Supplying Materials with Green Specifications	Insulation Value (U=W/Sqm K)	Note	Solar reflective Index (SRI)	Liters/ Minute or Liters /Flush	Distance between Manufacturing Site and Project Site (Km) (at least 75% of material by cost shall meet the below requirement)	Recycle Content (% by Cost) (Trade off across material is acceptable)	VOC in Grams / Liter
Concrete								
Structural Steel	-	-		-	-	< 400	25	-
Reinforcement Steel	-	-		-	-	< 400	25	-
Cast-in-Place RCC	-	-	30% Fly-Ash Content	-	-	< 400	30	-
Plain Cement Concrete (PCC)	-	-	30% Fly-Ash Content	-	-	< 400	30	-
Coarse Aggregate	-	-	Reuse concrete debris from same or other construction site - for non-structural purpose	-	-	< 400	-	-
Sand	-	-		-	-	< 400	-	-
Ready Mix Concrete	-	-	30% Fly-Ash Content	-	-	< 400	30	-
Masonry								
AAC Blocks for external walls	-	0.5 W/Sqm K	30% Fly-Ash Content; Please check for different thickness	-	-	< 400	30	-
Brick	-	-	Not for external walls	-	-			-
Hollow Flyash Blocks	-	-	30% Fly-Ash Content	-	-	< 400	30	-
Solid Flyash Blocks	-	-	30% Fly-Ash Content	-	-	< 400	30	-
Insulation								
Roof and Exposed Terrace- XPS	-	0.3 W/Sqm K	-	-	-	< 400	-	-
Terrace Finishes								

Name of the Material (Exclude MEP, Equipment and Devices)	Reference Brands Supplying Materials with Green Specifications	Insulation Value (U=W/Sqm K)	Note	Solar reflective Index (SRI)	Liters/ Minute or Liters /Flush	Distance between Manufacturing Site and Project Site (Km) (at least 75% of material by cost shall meet the below requirement)	Recycle Content (% by Cost) (Trade off across material is acceptable)	VOC in Grams / Liter
Tiles/ Coating/ Screed/Paint	-	-	-	SRI > 78	-	< 400	15-20	-
Stone/Tiles								
IPS	-	-	30% Fly-Ash Content	-	-	< 400	30	-
Marble Stone Slab	-	-	-	-	-	< 400	0	-
Granite Stone Slab	-	-	-	-	-	< 400	0	-
Kota	-	-	-	-	-	< 400	0	-
Cudappah	-	-	-	-	-	< 400	0	-
Ceramic Tiles	-	-	-	-	-	< 400	15-20	-
Vitrified Tiles	-	-	-	-	-	< 400	15-20	-
China Mosaic Flooring	-	-	-	-	-	< 400	15-20	-
Paints/Coatings/Polishes								
Water-Proof Cement Paint	Asian Paint, Dulux, Jotun, Oikos	-	-	-	-	< 400	-	Refer Tab VoC-Paints and Adhesives in same worksheet
Wood Surface Paint	Jotun, Oikos	-	-	-	-	< 400	-	Refer Tab VoC-Paints and Adhesives in same worksheet

Name of the Material (Exclude MEP, Equipment and Devices)	Reference Brands Supplying Materials with Green Specifications	Insulation Value (U=W/Sqm K)	Note	Solar reflective Index (SRI)	Liters/ Minute or Liters /Flush	Distance between Manufacturing Site and Project Site (Km) (at least 75% of material by cost shall meet the below requirement)	Recycle Content (% by Cost) (Trade off across material is acceptable)	VOC in Grams / Liter
Metal/Steel Surface Paint	Asian Paint, Dulux, Jotun, Oikos	-	-	-	-	< 400	-	Refer Tab VoC-Paints and Adhesives in same worksheet
Acrylic Emulsion Paint- Walls,Ceilings	Asian Paint, Dulux, Jotun, Oikos	-	-	-	-	< 400	-	Refer Tab VoC-Paints and Adhesives in same worksheet
Acrylic External Paint	Asian Paint, Dulux, Jotun, Oikos	-	-	-	-	< 400	-	Refer Tab VoC-Paints and Adhesives in same worksheet
Door Polish	Asian Paint, Dulux, Jotun, Oikos	-	-	-	-	< 400	-	Refer Tab VoC-Paints and Adhesives in same worksheet
Epoxy Coating	Jotun	-	-	-	-	< 400	-	Refer Tab VoC-Paints and Adhesives in same worksheet

Name of the Material (Exclude MEP, Equipment and Devices)	Reference Brands Supplying Materials with Green Specifications	Insulation Value (U=W/Sqm K)	Note	Solar reflective Index (SRI)	Liters/ Minute or Liters /Flush	Distance between Manufacturing Site and Project Site (Km) (at least 75% of material by cost shall meet the below requirement)	Recycle Content (% by Cost) (Trade off across material is acceptable)	VOC in Grams / Liter
Primer	Asian Paint, Dulux, Jotun, Oikos	-	-	-	-	< 400	-	Refer Tab VoC-Paints and Adhesives in same worksheet
Adhesives	-	-	-	-	-	< 401	-	Refer Tab VoC-Paints and Adhesives in same worksheet
Doors								
Hollow Metal Door	-	-	-	-	-	< 400	20	-
Flush Wooden Door	-	-	-	-	-	< 400	20	-
Fire-Rated Wooden Door	-	-	-	-	-	< 400	20	-
PVC Door	-	-	-	-	-	< 400	20	-
Steel Doors	-	-	-	-	-	< 400	20	-
Ceilings								
Gypsum Ceiling	-	-	-	-	-	< 400	25	-
Mineral Fiber Ceiling	-	-	-	-	-	< 400	25	-
Glazing								
Door - Glass (all elevations)	-	-	-	-	-	< 400	15-20	-

Name of the Material (Exclude MEP, Equipment and Devices)	Reference Brands Supplying Materials with Green Specifications	Insulation Value (U=W/Sqm K)	Note	Solar reflective Index (SRI)	Liters/ Minute or Liters /Flush	Distance between Manufacturing Site and Project Site (Km) (at least 75% of material by cost shall meet the below requirement)	Recycle Content (% by Cost) (Trade off across material is acceptable)	VOC in Grams / Liter
Exterior Window- Glass (all elevations)	Saint Gobain	1.5 to 1.6 W/SqmK	Double Glazing with Low E coating, SHGC- 0.25 to 0.30 and VLT not more than 40 %	-	-	< 400	15-20	-
Metals								
Stairs-Hand Railing	-	-	-	-	-	< 400	25	-
Chain Link Fencing	-	-	-	-	-	< 400	25	-
Rolling Shutter	-	-	-	-	-	< 400	25	-
Aluminium Work	-	-	-	-	-	< 400	30	-
M.S. Grills	-	-	-	-	-	< 400	25	-
Framing for Internal Partitions/False Ceiling	-	-	-	-	-	< 400	25	-
Galvanised Roofing Sheets	-	-	Precoated	-	-	< 400	25	-
Gates	-	-	-	-	-	< 400	25	-
Door/Window Frames	-	-	-	-	-	< 400	25	-
Landscape								
Precast Paver Blocks	Pavers India, Gubbi	-	Light gray/white	SRI > 29	-	< 400	20-25	-
It is mandatory to achieve the specified recycled content for highlighted materials								

1.44 Civil & structure

1.44.1 EARTHWORK IN GARDING, EAXCAVATION AND BACK FILLING

1.44.1.1 SCOPE

This specification covers the general requirements of earthwork in excavation in different materials, site grading, filling in areas as shown in drawing, filling back around foundations and in plinths, conveyance and disposal of surplus soils or stacking them properly as shown on the drawings and as directed by the Engineer and all operations covered within the intent and purpose of this specification.

1.44.1.2 APPLICABLE CODES

The following codes in their latest revision shall be read in conjunction with and shall be part of Design Criteria. In case of conflict the most stringent shall apply.

IS 783	Code of practice for laying of concrete pipes.
IS 1200	Method of measurement of building and civil engineering works.
(Part 1)	Part 1 Earthwork
(Part 27)	Part 27 Earthwork done by mechanical appliances.
IS 3764	Excavation work-code of safety.
IS 2720	Methods of test for soils:
(Part 1)	Part 1 Preparation of dry soil samples for various tests.
(Part 2)	Part 2 Determination of water content.
(Part 4)	Part 4 Grain size analysis.
(Part 5)	Part 5 Determination of liquid and plastic limit.
(Part 7)	Part 7 Determination of water content-dry density relation using light compaction.
Part (9)	Part 9 Determination of dry density - moisture content relation by constant weight of soil method.
(Part 14)	Part 14 Determination of density index (relative density) of cohesionless soils.
(Part 28)	Part 28 Determination of dry density of soils in place, by the sand replacement method.
(Part 33)	Part 33 Determination of the density in place by the ring and water replacement method.
(Part 34)	Part 34 Determination of density of soil in place by rubber balloon method.
(Part 38)	Part 38 Compaction control test (Hilf Method).

1.44.1.3 DRAWINGS

The Engineer will furnish drawings wherever, in his opinion, such drawings are required to show areas to be excavated/ filled grade level, sequence of priorities etc. The Contractor shall follow strictly such drawings.

1.44.1.4 GENERAL

The Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the job in accordance with the specification requirements.

The Contractor shall carry out the survey of the site before excavation and set properly all lines and establish levels for various works such as earthwork in excavation for grading, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established

reference/ grid lines at specified intervals or nearer as determined by the Engineer based on ground profile. These shall be checked by the Engineer and thereafter properly recorded.

The excavation shall be done to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night for ensuring safety.

The rates quoted shall also include for dumping of excavated materials in regular heaps, bunds, riprap with regular slopes as directed by the Engineer, within the lead specified and levelling the same so as to provide natural drainage. Rock/ soil excavated shall be stacked properly as directed by the Engineer. As a rule, all softer material shall be laid along the centre of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

1.44.1.5 CLEARING

The area to be excavated filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall also be removed. The material so removed shall be burnt or disposed off as directed by the Engineer. Where earth fill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable matter/ materials before fill commences.

1.44.1.6 PRECIOUS OBJECTS, RELICS, OBJECTS OF ANTIQUITY, ETC.

All gold, silver, oil, minerals, archaeological and other findings of importance, trees cut or other materials of any description and all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the Owner and the Contractor shall duly preserve the same to the satisfaction of the Owner and from time to time deliver the same to such person or persons as the Owner may from time to time authorise or appoint to receive the same.

1.44.1.7 CLASSIFICATION

All materials to be excavated shall be classified by the Engineer, into one of the following classes and shall be paid for at the rate tendered for that particular class of material. No distinction shall be made whether the material is dry, moist or wet. The decision of the Engineer regarding the classification of the material shall be final and binding on the Contractor and not be a subject matter of any appeal or arbitration.

Any earthwork will be classified under any of the following categories:

Ordinary and Hard Soils

These shall include all kinds of soils containing kankar, sand, silt, murrum and/ or shingle, gravel, clay, loam, peat, ash, shale, etc., which can generally be excavated by spade, pick axes and shovel, and which is not classified under "Soft and Decomposed Rock" and "Hard Rock" defined below. This shall also include embedded rock boulders not longer than 1 metre in any one direction and not more than 200 mm in any one of the other two directions.

Soft and Decomposed Rock

This shall include rock, boulders, slag, chalk, slate, hard mica schist, laterite and all other materials which in the opinion of Engineer is rock, but does not need blasting and could be removed with picks, hammer, crow bars, wedges, and pneumatic breaking equipment. The mere fact that the Contractor resorts to blasting for reasons of his own, shall not qualify for classification under 'Hard Rock'.

This shall also include excavation in macadam and tarred roads and pavements. This shall also include rock boulders not longer than 1 metre in any direction and not more than 500 mm in any one of the other two directions. Masonry to be dismantled will also be measured under this item.

Hard Rock

This shall include all rock occurring in large continuous masses which cannot be removed except by blasting for loosening it. Harder varieties of rock with or without veins and secondary minerals which, in the opinion of the Engineer require blasting shall be considered as hard rock. Boulders of rock occurring in such sizes and not classified under (a) and (b) above shall also be classified as hard rock. Concrete work both reinforced and unreinforced to be dismantled will be measured under this item, unless a separate provision is made in the Schedule of Quantities.

1.44.1.8 EXCAVATION

All excavation work shall be carried out by mechanical equipment unless, in the opinion of the Engineer, the work involved and time schedule permit manual work.

Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the drawings or such other lines and grades as may be specified by the Engineer. Rough excavation shall be carried out to a depth 150 mm above the final level.

The balance shall be excavated with special care. Soft pockets shall be removed even below the final level and extra excavation filled up as directed by the Engineer. The final excavation if so instructed by the Engineer, should be carried out just prior to laying the mud-mat.

The Contractor may, for facility of work or similar other reasons excavate, and also backfill later, if so approved by the Engineer, at his own cost outside the lines shown on the drawings or directed by the Engineer. Should any excavation be taken below the specified elevations, the Contractor shall fill it up, with concrete of the same class as in the foundation resting thereon, upto the required elevation. No extra shall be claimed by the Contractor on this account.

All excavation shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer shall be obtained by the Contractor in each individual case, for the method he proposes to adopt for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval, however, shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope. Removal of the slipped earth will not be paid for if the slips are due to the negligence of the Contractor.

Excavation shall be carried out with such tools, tackles and equipment as described herein before. Blasting or other methods may be resorted to in the case of hard rock; however not without the specific permission of the Engineer.

The Engineer may also direct that in some extreme case, the rock may be excavated by heating and sudden quenching for splitting the rock. Fire-wood shall be used for burning and payment shall be made for such work as called for in the schedule of quantities.

- **Trench excavation**

The trench excavation of pipe line shall be in accordance with IS 12288. Pipe trenches shall be excavated to the lines and levels as shown in the drawings or as directed by the Engineer. The depth of the excavated trench shall be as given in the drawings or as directed by the Engineer. The width of the trench at bottom between the faces of sheeting shall be such as to provide 300mm clearance on either side of the DI pipe except where rock excavation is involved. No pipe shall be laid in a trench until the section of trench in which the pipe is to be laid has been approved by the Engineer.

The depth should be sufficient to provide a cover not less than 1000 mm. It may be necessary to increase the depth of pipeline to avoid land drains or in the vicinity of roads, railways or other crossings. Care should be taken to avoid the spoil bank causing an accumulation of rainwater.

The bottom of the trench shall be trimmed and levelled to permit even bedding of the pipes. It should be free from all extraneous matter which may damage the pipe or the pipe coating.

Additional excavation shall be made at the joints of the pipes, so that the pipe is supported along its entire length.

All excavated material shall be stacked in such a distance from the trench edge that it will not endanger the work or workmen and it will avoid obstructing footpaths, roads and drive ways. Hydrants under pressure, surface boxes, fire or other utility controls shall be left unobstructed and accessible during the construction work. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water-courses shall not be obstructed.

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, torches, red lanterns and guards, as required, shall be placed and maintained during the progress of the work and until it is safe for traffic to use the roadways. All materials, piles equipment and pipes which may serve as obstruction to traffic shall be enclosed by fences or barricades and shall be protected by illuminating proper lights when the visibility is poor.

As far as possible, the pipe line shall be laid below existing services, like water and gas pipes, cables, cable ducts and drains but not below sewers, which are usually laid at greater depth. Where it is unavoidable, pipe line should be suitably protected. A minimum clearance of 500 mm shall be provided between the pipe line and such other services.

Trees, shrubbery fences, poles, and all other property and surface structures shall be protected. Tree roots shall be cut within a distance of 50 cm from pipe joints in order to prevent roots from entering them. Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers and other obstructions encountered in the progress of the work shall be provided. The structures, which will be disturbed shall be restored after completion of the work.

Where water forms or accumulates in any trench the Contractor shall maintain the trench free of water during pipe laying.

Wherever necessary to prevent caving, trench excavations in soils such as sand, gravel and sandy soil shall be adequately sheeted and braced. Where sheeting and bracing are used, the net trench width after sheeting shall not be less than that specified above. The sides of the excavation shall be adequately supported at all times and, except where described as permitted under the Contract, shall be not battered.

The Engineer in co-operation with the Contractor shall decide about the sheeting/ bracing of the trench according to the soil conditions in a particular stretch and taking into account the safety requirements of the Contractor's and Engineer's staff. Generally, safety measures against caving have to be provided for trenches with vertical walls if they are deeper than 2.0m.

1.44.1.9 STRIPPING LOOSE ROCK

All loose boulders, semi-detached rocks (along with earthy stuff which might move therewith) not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of the Engineer, to fall or otherwise endanger the workmen, equipment, or the work, etc., shall be stripped off and removed away from the area of the excavation. The method used shall be such as not to shatter, or render unstable or unsafe the portion, which was originally sound and safe.

Any material not requiring removal as contemplated in the work, but which, in the opinion of the Engineer, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed as directed by the Engineer. The cost of such stripping will be paid for at the unit rates accepted for the class of materials in question.

1.44.1.10 FILL, BACK FILLING AND SITE GRADING

1.44.1.10.1 General

All fill material will be subject to the Engineer's approval. If any material is rejected by the Engineer, the Contractor shall remove the same forthwith from the site at no extra cost to the Owner. Surplus fill material shall be deposited/ disposed off as directed by the Engineer after the fill work is completed.

No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the Engineer.

1.44.1.10.2 Material

To the extent available, selected surplus soils from excavated materials shall be used as backfill. Fill material shall be free from clods, salts, sulphates, organic or other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murrum or earth to fill up the voids and the mixture used for filling.

If any selected fill material is required to be borrowed, the contractor shall make arrangements for bringing such material from outside borrow pits. The material and source shall be subject to prior approval of the Engineer. The approved borrow pit area shall be cleared of all bushes, roots of trees, plants, rubbish, etc. top soil containing salts/ sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by the Engineer. The Contractor shall make necessary access roads to borrow areas and maintain the same, if such access road does not exist, at his cost.

1.44.1.10.3 Filling In Pits And Trenches Around Foundations Of Structures, Walls, Etc.

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches, etc. shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm., each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of the Engineer. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Engineer is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and levelled to proper profile as directed by the Engineer or indicated on the drawings.

1.44.1.10.4 Plinth Filling

Plinth filling shall be carried out with approved material as described herein before in layers not exceeding 15 cm, watered and compacted with mechanical compaction machines. The Engineer may however permit manual compaction by hand tampers in case he is satisfied that mechanical compaction is not possible. When filling reaches the finished level, the surface shall be flooded with water, unless otherwise directed, for at least 24 hours allowed to dry and then the surface again compacted as specified above to avoid settlements at a later stage. The finished level of the filling shall be trimmed to the level/ slope specified.

Where specified in the schedule of works, compaction of the plinth fill shall be carried out by means of 12 tonne rollers smooth wheeled, sheep-foot or wobbly wheeled rollers. In case of compaction of granular material such as sands and gravel, vibratory rollers shall be used. A smaller weight roller may be used only if permitted by the Engineer. As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill.

The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300 mm. The Engineer will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used.

Rolling shall commence from the outer edge and progress towards the centre and continue until compaction is to the satisfaction of the Engineer, but in no case less than 10 passes of the roller will be accepted for each layer.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated and filled and consolidated.

At some locations/ areas it may not be possible to use rollers because of space restrictions etc. The Contractor shall then be permitted to use pneumatic tampers, rammers, etc. and he shall ensure proper compaction.

1.44.1.10.5 Sand Filling In Plinth And Other Places

At places backfilling shall be carried out with local sand if directed by the Engineer. The sand used shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded condition shall be to the Contractor's account. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer has inspected and approved the fill.

1.44.1.10.6 Back Filling Trenches

Back-filling and compaction shall be done by hand or approved mechanical methods in layers of 150 mm up to proctor density of 90%, special care shall be taken to avoid damage of the pipe and the coating or moving of the pipe.

Note: The Employer gives very high priority to proper compaction of the backfill as per specifications. It is mandatory that mechanical compaction device shall be used for compacting each layer. The compaction shall be tested as per stipulations of QA/QC document.

Where the excavation is made through permanent pavements, curbs, paved footpaths, or where such structures are undercut by the excavation, the entire back-fill to the subgrade of the structures shall be made with sand in accordance with IS 12288.

All excavations shall be backfilled to the level of the original ground surfaces unless otherwise shown on the drawings or ordered by the Engineer, and in accordance with the requirements of the specification. The material used for backfill, the amount thereof, and the manner of depositing and compacting shall be subject to the approval of the Engineer, but the Contractor will be held responsible for any displacement of pipe or other structures, any damage to their surfaces, or any instability of pipes and structures caused by improper depositing of backfill materials.

Trenches crossing a road shall be backfilled with selected material placed in layers not exceeding 15 cm in thickness after compacting, wetted and compacted to a density of not less than 90 percent of the maximum dry density at optimum moisture content of the surrounding material. Any shortfall in the quantity of material for backfilling the trenches shall be supplied by the Contractor at his expense.

The Contractor shall at his own expense make good any settlement of the trench backfill occurring after backfilling and until the expiry of the defects liability period.

On completion of pressure and leakage tests exposed joints shall be covered with approved selected backfill placed above the top of the pipe and joints in accordance with the requirements of the above specifications. The Contractor shall not use backfilling for disposal of refuse or unsuitable soil.

1.44.1.11 GENERAL SITE GRADING

Site grading shall be carried out as indicated in the drawings and as directed by the Engineer. Excavation shall be carried out as specified in the specification. Filling and compaction shall be carried out as specified under Clause **Error! Reference source not found.** and elsewhere unless otherwise indicated below.

If no compaction is called for, the fill may be deposited to the full height in one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and levelled uniformly and compacted as indicated in Clause 10.0 before the next layer is deposited.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor at his cost.

Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well.

The Contractor shall protect the earthfill from being washed away by rain damaged in any other way. Should any slip occur, the Contractor shall remove the affected material and make good the slip at his cost.

The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.

If specifically permitted by the Engineer, compaction can be obtained by allowing loaded trucks conveying fill or other material to ply over the fill area. Even if such a method is permitted, it will be for the Contractor to demonstrate that the desired/ specified compaction has been obtained. In order that the fill may be reasonably uniform throughout, the material should be dumped in place in approximately uniform layers. Traffic over the fill shall then be so routed to compact the area uniformly throughout.

If so specified, the rock as obtained from excavation may be used for filling and levelling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 tonne roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

1.44.1.12 FILL DENSITY

The compaction, only where so called for, in the schedule of quantities/ items shall comply with the specified (Standard Proctor/ Modified Proctor) density at moisture content differing not more than 4 percent from the optimum moisture content. The Contractor shall demonstrate adequately at his cost, by field and laboratory tests that the specified density has been obtained.

1.44.1.13 LEAD

Lead for deposition/ disposal of excavated material, shall be as specified in the respective item of work. For the purpose of measurement of lead, the area to be excavated or filled or area on which excavated material is to be deposited/ disposed off shall be divided into suitable blocks and for each of the blocks, the distance between centre lines shall be taken as the lead which shall be measured by the shortest straight line route on the plan and not the actual route taken by the Contractor. No extra compensation is admissible on the grounds that the lead including that for borrowed material had to be transported over marshy or 'katcha' land/ route.

1.44.1.14 MEASUREMENT AND PAYMENT

All excavation shall be measured net. Dimensions for purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, tanks, rafts or other foundations/ structures to be built, multiplied by the mean depth from the surface of the ground in accordance with the drawings. Excavation in side slopes will not be paid for. The Contractor may make such allowance in his rates to provide for excavation in side slopes keeping in mind the nature of the soil and safety or excavation. Reasonable working space, beyond concrete dimensions and shuttering where considered necessary in the opinion of the Engineer will be allowed in excavation and considered for payment. However, if concreting is proposed against the excavated sides, no such over-excavation will be permitted. In such cases over-excavation shall be made good by the Contractor with concrete of the same class as in the foundations at his cost.

Unless otherwise specified, the unit rates quoted for excavation in different types of material shall also account for a basic lead of 100 metres for disposal as specified or directed. Only leads beyond the basic lead of 100 metres will be considered as extra lead and paid for at the rates quoted in the schedules.

Backfilling as per specification the sides of foundations of columns, footings, structures, walls, tanks, rafts, trenches, etc. with excavated material will not be paid for separately. It shall be clearly understood that the rate quoted for excavation including backfilling shall include stacking of excavated material as directed, excavation/ packing of selected stacked material, conveying it to the place of final backfill, compaction etc. as specified. As a rule material to be backfilled shall be stacked temporarily within the basic lead of 100 metres unless otherwise directed by the Engineer. If the Engineer directs/ permits a lead of over 100 metres for such material, the conveyance of the material for the extra distance over the basic lead of 100 metres for backfilling will be paid for.

Payment for fill inside trenches, plinth or similar filling with selected excavated material will be made for only compaction as specified/ directed. Cost of all other operations shall be deemed to have been covered in the rate quoted for excavation. Payment for this work will be made based on measurement of plinth/ trench dimensions filled. The plinth ground levels shall be surveyed before hand for this purpose. If no compaction is specified/ desired such filling will not be separately paid for. In such a event the fill shall be levelled/ finished to the profile as directed at no extra cost.

Backfilling, plinth filling etc. with borrowed earth will be paid for at rates quoted. The quoted rate shall include all operations such as clearing, excavation, lead and transport, fill, compaction, etc. as specified. Actual quantity of consolidated filling or actual quantity or excavation in the borrow pits (less such top soil which has been excavated and not used for filling) whichever is less shall be measured and paid for in cubic metres. The lead, lift etc. shall be as indicated in the schedule of quantities.

Actual quantity of consolidated sand filling shall be measured and paid in cubic metres.

1.44.2 CONCRETE & ALLIED WORKS

1.44.2.1 SCOPE

This Specification covers the general requirements for ready mixed concrete and for concrete using on-site production facilities including requirements in regard to the quality, handling, storage of ingredients, proportioning, batching, mixing, transporting, placing, curing, protecting, repairing, finishing and testing of concrete; formwork; requirements in regard to the quality, storage, bending and fixing of reinforcement; grouting as well as mode of measurement and payment for completed works.

It shall be very clearly understood that the specifications given herein are brief and do not cover minute details. However, all works shall have to be carried out in accordance with the relevant standards and codes of practices or in their absence in accordance with the best accepted current engineering practices or as directed by ENGINEER from time to time. The decision of ENGINEER as regards the specification to be adopted and their interpretation and the mode of execution of work shall be final and binding on CONTRACTOR and no claim whatsoever will be entertained on this account.

1.44.2.2 APPLICABLE CODES AND SPECIFICATION

The following specifications, standards and codes, including all official amendments/revisions and other specifications & codes referred to therein, should be considered a part of this specification. In all cases the latest issue/edition/revision shall apply. In case of discrepancy between this specification and those referred to herein below or other specifications forming a part of this bid document, this specification shall govern.

1.44.2.2.1 Materials

IS:269	Specification for 33 grade ordinary portland cement.
IS:455	Specification for Portland slag cement.
IS:1489	Specification for Portland pozzolana cement(Parts 1 & 2)
IS:8112	Specification for 43 grade ordinary portland cement.
IS:12330	Specification for sulphate resisting Portland Cement.
IS:383	Specification for coarse and fine aggregates from natural sources for concrete.
IS:432	Specification for mild steel and medium tensile (Parts steel bars and hard drawn steel wires for 1 & 2) concrete reinforcement.
IS:1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS:1566	Specification for hard drawn steel wire fabric for (Parts II) concrete reinforcement.
IS:9103	Specification for admixtures for concrete.
IS:2645	Specification for integral cement waterproofing compounds.
IS:4900	Specification for plywood for concrete shuttering work.
IS:4926	Ready mixed concrete
IS:12269	Specification for 53 grade ordinary portland cement.
IS:8041	Specification for rapid hardening cement.
IS:12600	Specification for low heat cement.
IS:6909	Specification for supersulphated cement.
IS:12089	Specification for granulated ground blast furnace slag.
BS:6699	Specification for granulated ground blast furnace slag.
BS:6073	Specifications for precast concrete masonry units (Part 1) Methods for specifying precast concrete masonry (Part 2)

1.44.2.2.2 Material Testing

IS:4031	Methods of physical tests for hydraulic cement. (Parts 1 to 15)
IS:4032	Method of chemical analysis of hydraulic cement.
IS:650	Specification for standard sand for testing of cement.
IS:2430	Methods for sampling of aggregates for concrete.
IS:2386	Methods of test for aggregates for concrete (Parts 1 to 8)
IS:3025	Methods of sampling and test (physical and chemical) water used in industry.(Part 1 to 51)
IS:6925	Methods of test for determination of water soluble chlorides in concrete admixtures.

1.44.2.2.3 Material Storage

IS:4082	Recommendations on stacking and storing of construction materials at site.
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1.44.2.2.4 Concrete Mix Design

IS:10262	Recommended guidelines for Concrete Mix Design.
SP:23	Handbook on Concrete Mixes.

1.44.2.2.5 Concrete Testing

IS:1199	Method of sampling and analysis of concrete.
IS:516	Method of test for strength of concrete.
IS:9013	Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.
IS:8142	Method of test for determining setting time of concrete by penetration resistance.
IS:9284	Method of test for abrasion resistance of concrete.
IS:2770	Methods of testing bond in reinforced concrete.

1.44.2.2.6 Equipment

IS:1791	Specification for batch type concrete mixers.
IS:2438	Specification for roller pan mixer.
IS:4925	Specification for concrete batching and mixing plant.
IS:5892	Specification for concrete transit mixer and agitator.
IS:7242	Specification for concrete spreaders.
IS:2505	General Requirements for concrete vibrators: Immersion type.
IS:2506	General Requirements for screed board concrete vibrators.
IS:2514	Specification for concrete vibrating tables.
IS:3366	Specification for pan vibrators.
IS:4656	Specification for form vibrators for concrete.
IS:11993	Code of practice for use of screed board concrete vibrators.
IS:7251	Specification for concrete finishers.
IS:2722	Specification for portable swing weigh batchers for concrete (single and double bucket type).
IS:2750	Specifications for steel scaffoldings.

1.44.2.2.7 Codes Of Practice

IS:456	Code of practice for plain and reinforced concrete.
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IS:457	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
IS:3370	Code of practice for concrete structures for storage of liquids (Parts 1 to 4)
IS:3935	Code of practice for composite construction.
IS:2204	Code of practice for construction of reinforced concrete shell roof.
IS:2210	Criteria for the design of reinforced concrete shell structures and folded plates.
IS:2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS:5525	Recommendation for detailing of reinforcement in reinforced concrete works.
IS:2751	Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
IS:9417	Specification for welding cold worked bars for reinforced concrete construction.
IS:3558	Code of practice for use of immersion vibrators for consolidating concrete.
IS:3414	Code of practice for design and installation of joints in buildings.
IS:4326	Code of practice for earthquake resistant design and construction of buildings.
IS:4014	Code of practice for steel tubular scaffolding. (Parts 1 & 2)
IS:2571	Code of practice for laying in situ cement concrete flooring
IS:7861	Part1 - Recommended practice for hot weather concreting Part2 – Recommended practice for cold weather concreting
IS:13920	Ductile detailing of reinforced concrete structures subjected to seismic forces
IS:1893	Criteria of Earthquake resistant design of structures.(Part I to IV)

1.44.2.2.8 Construction safety

IS:3696	Safety code for scaffolds and ladders.(Parts 1 & 2)
IS:7969	Safety code for handling and storage of building materials.
IS:8989	Safety code for erection of concrete framed structures.

1.44.2.2.9 Measurement

IS:1200 (Part 1 to 12)	Method of measurement of building and engineering works (Part 2 and 5)
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1.44.2.3 GENERAL

ENGINEER shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and ENGINEER's approval obtained, prior to starting of concrete work. This shall, however, not relieve CONTRACTOR of any of his responsibilities. All materials, which do not conform to this specification, shall be rejected.

Materials should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements

and the environmental conditions to which the structure will be subjected. Materials complying with codes/standards shall only be used. Other materials may be used after approval of the ENGINEER and after establishing their performance suitability based on previous data, experience or tests.

1.44.2.4 MATERIALS

1.44.2.4.1 Cement

Unless otherwise specified or called for by ENGINEER/OWNER, cement shall be ordinary Portland cement conforming to IS: 269, IS: 8112 or IS: 12269.

The Portland pozzolana cement shall conform to IS: 1489 and it shall be used as directed by ENGINEER. Where Portland pozzolana or slag cements are used, it shall be ensured that consistency of quality is maintained and there will be no adverse interactions between the materials and the finish specified is not marred.

Only one type of cement shall be used in any one mix unless specifically approved by ENGINEER. The source of supply, type or brand of cement within the same structure or portion thereof shall be approved from ENGINEER prior to its use.

Cement, which is not used within 90 days from its date of manufacture, shall be tested at a laboratory approved by ENGINEER and until the results of such tests are found satisfactory, it shall not be used in any work.

1.44.2.4.2 Aggregates

Aggregates shall consist of naturally occurring stones and gravel (crushed or uncrushed) and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/silt/organic impurities/deleterious materials and conform to IS: 383. Aggregates such as slag, crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.

Aggregates shall be washed and screened before use where necessary or if directed by the ENGINEER.

Aggregates containing reactive materials shall be used only after tests conclusively prove that there will be no adverse affect on strength, durability and finish, including long term effects, on the concrete.

The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2. If use of sand having fineness modulus more than 3.2 is unavoidable then it shall be suitable blended with crusher stone dust.

The maximum size of coarse aggregate shall be as stated on the drawings, but in no case greater than 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. For most work 20mm aggregate is suitable. Where there is no restriction to the flow of concrete into sections, 40mm or larger size is permitted.

In concrete elements with thin sections, closely spaced reinforcements or small cover, consideration should be given to the use of 10mm nominal maximum size.

Plums 160 mm and above of a reasonable size may be used where directed. Plums shall not constitute more than 20% by volume of concrete unless specified by ENGINEER.

1.44.2.4.3 Water

Water used for both mixing and curing shall conform to IS:456. Potable water is generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.

The pH value of water shall not be less than 6.

Seawater shall not be used for concrete mixing and curing.

The proposed admixtures shall comply with requirements of TCE.M4-403-02.

1.44.2.4.4 Reinforcement

Reinforcement bars shall conform to IS:432 and/ or IS:1786 and welded wire fabric to IS:1566 as shown on the drawing.

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust or any other substance that will destroy or reduce bond. Special precaution like coating of reinforcement may be provided with the prior approval of ENGINEER.

1.44.2.4.5 Wastage

Wastage allowance for cement and steel (supplied by OWNER) shall be as specified under Instruction to Bidders.

1.44.2.4.6 Samples And Tests

All materials used for the works shall be tested before use. The frequency of such confirmatory tests shall be decided by ENGINEER.

Manufacturer's test certificate shall be furnished for each batch of cement/steel and when directed by ENGINEER samples shall also be got tested by the CONTRACTOR in a laboratory approved by ENGINEER at no extra cost to OWNER. However, where material is supplied by OWNER, all testing charges shall be borne by OWNER, but transportation and preparation of material samples for the laboratory shall be done by CONTRACTOR at no extra cost.

Sampling and testing of aggregates shall be as per IS:2386 under the supervision of ENGINEER. The cost of all tests, sampling, etc. shall be borne by CONTRACTOR. For coarse aggregate crushing value shall be tested.

Water to be used shall be tested to comply with clause 5.4 of IS:456.

CONTRACTOR shall furnish manufacturer's test certificates and technical literature for the admixture proposed to be used. If directed, the admixture shall be got tested at an approved laboratory at no extra cost.

1.44.2.4.7 Storing Of Materials

All material shall be stored in a manner so as to prevent its deterioration and contamination, which would preclude its use in the works. Requirements of IS:4082 shall be complied with.

CONTRACTOR will have to make his own arrangements for the storage of adequate quantity of cement even if cement is supplied by OWNER. If such cement is not stored properly and has deteriorated, the material shall be rejected. Cost of such rejected cement, where cement is supplied by OWNER, shall be recovered at issue rate or open market rate whichever is higher. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage arrangement shall be approved by ENGINEER. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order of receipt. CONTRACTOR shall maintain record of receipt and consumption of cement.

Each size of coarse and fine aggregates shall be stacked separately and shall be protected from dropping leaves and contamination with foreign material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.

CONTRACTOR shall make his own arrangements for storing water at site in tanks of approved capacity. The tanks shall be cleaned at least once a week to prevent contamination.

The reinforcement shall be stacked on top of timber sleepers to avoid contact with ground/water. Each type and size shall be stacked separately.

1.44.2.4.8 Concrete

o General

Concrete grade shall be as designated on drawings. Concrete in the works shall be "DESIGN MIX CONCRETE" OR "NOMINAL MIX CONCRETE". All concrete works of upto grade M15 shall be NOMINAL MIX CONCRETE whereas all other grades, M20 and above, shall be DESIGN MIX CONCRETE.

o Design Mix Concrete

Design Mix Concrete are classified in three categories, viz. "Normal Concrete (M)", "Heavy Concrete (H)", "Super Heavy Concrete (SH)". Each class of concrete shall be identified by a prefix and two numbers. Prefix "M" would denote Normal Concrete, prefix "H" would denote heavy concrete and prefix "SH" would denote super heavy concrete. The two numbers e.g. 25 - 40 would denote the crushing strength of cube at 28 days in N/sq.mm and maximum size of the coarse aggregates in millimetres respectively.

Normal concrete shall have a net dry unit weight of not less than 25 kN/cum, for the finished structure after curing, Heavy concrete shall have a net dry unit weight of not less than 36.30 kN/cum, for the finished structure after curing and special heavy concrete shall have a net dry unit weight of not less than 41 kN/cum for the finished structure after curing.

o Mix Design & Testing

For Design Mix Concrete, the mix shall be designed as per any of four methods given in SP: 23 to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS: 456. The design mix shall in addition be such that it is cohesive and does not segregate during placement and should result in a dense and durable concrete capable of giving the specified finish. For liquid retaining structures, the mix shall also result in watertight concrete. The CONTRACTOR shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.

The minimum grade of concrete shall be as per Table 5 of IS: 456 for various exposure conditions of concrete. For various environmental conditions, refer Table 3 of IS: 456.

The minimum cement content for Design Mix Concrete shall be as per Table 5 of IS: 456 or as given below, whichever is higher.

Table 1-6. Grade of Concrete and Minimum Cement Content

Grade of Concrete	Minimum Cement Content in kg/cum. of Concrete
M 20	300
M 25	320
M 30	340
M 35	360
M 40	360
M 45	400

The minimum cement content stipulated above shall be adopted irrespective of whether the CONTRACTOR achieves the desired strength with less quantity of cement. The

CONTRACTOR's quoted rates for concrete shall provide for the above eventuality and nothing extra shall become payable to the CONTRACTOR on this account. Even in the case where the quantity of cement required is higher than that specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the CONTRACTOR.

It shall be CONTRACTOR's sole responsibility to carry out the mix designs at his own cost. He shall furnish to ENGINEER for approval at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS:516 shall comply with the requirements of IS:456.

Table 1-7. Grade of Concrete and Compressive Strength

Grade of Concrete	Minimum Strength N/Sq.mm at 7 days	Compressive Specified N/sq.mm at 28 days	Characteristic strength
15	10.0	15.0	
20	13.5	20.0	
25	17.0	25.0	
30	20.0	30.0	
35	23.5	35.0	
40	27.0	40.0	
45	30.0	45.0	

A range of slumps recommended for various types of construction, unless otherwise instructed by the ENGINEER, shall be as given below:

Table 1-8. Recommended Slump

Structure/Member	Slump in millimetres	
	Maximum	Minimum
Reinforced foundation walls and footings	75	25
Plain footings, caissons and substructure walls	75	25
T. G. and massive compressor foundations	50	25
Slabs, Beams and reinforced walls	50	25
Pumps & miscellaneous Equipment	75	25
Foundations		
Building columns	50	25
Pavements	50	25
Heavy mass construction	50	25
Liquid retaining/ conveying structures	50	25

(NOTE: These values are not meant for pumped concrete placed using slip formed technique.)

Where single size graded coarse aggregate are not available, aggregates of different sizes shall be properly combined. The contractors mix design shall show that combined grading of coarse aggregate meets the requirements of Table 2 of IS: 383 for graded aggregates.

o Batching & Mixing of Concrete

Proportions of aggregates and cement, as per approved concrete mix design, shall be by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the weights within $\pm 2\%$ for cement and $\pm 3\%$ for aggregate. The batching equipment shall be calibrated at the frequency decided by ENGINEER.

Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for

moisture content in the aggregates. Water- cement ratio specified for use by ENGINEER shall be maintained. Each time the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional sand and cement to allow for sticking in the drum.

Arrangement should be made by CONTRACTOR to have the cubes tested at his own expense in an approved laboratory or in field with prior consent of ENGINEER. Sampling and testing of strength and workability of concrete shall be as per IS:1199, IS:516 and IS:456. It is preferable to cast additional cubes (minimum 3 specimen) for testing at 7 days and 14 days.

1.44.2.4.9 Nominal Mix Concrete

o Mix Design & Testing

Mix Design and preliminary tests are not necessary for Nominal Mix Concrete. However works tests shall be carried out as per IS:456. Proportions for Nominal Mix Concrete and w/c ratio may be adopted as per Table 9 of IS:456. However, it will be CONTRACTOR's sole responsibility to adopt appropriate nominal mix proportions to achieve the specified characteristic strength.

o Batching & Mixing of Concrete

Based on the adopted nominal mixes, aggregates shall be measured by volume. However cement shall be by weight only. Appropriate correction shall be made for bulking of sand after testing.

1.44.2.4.10 Ready mixed concrete

All specification as per IS:4926 – “Specification for ready mixed concrete” shall be used.

The Contractor shall identify at least two sources of ready mix concrete supplier and get it approved by ENGINEER prior to start of the Works. Any change in the source of the RMC, shall be got approved by the ENGINEER.

The design mix prepared by the RMC supplier shall be the responsibility of the Contractor. The testing of concrete as per Codal provisions and the specifications shall be done by the Contractor same as the normal concreting works.

1.44.2.4.11 Precast Concrete

o **General**

Precast concrete shall comply with the preceding Sections relating to Concrete as far as they are applicable. Precast concrete blocks shall comply with the requirements and recommendations of BS 6073.

o Precasting bed

All precast units shall be cast on, or their shutters supported from a suitably prepared level unyielding paved area.

o Marking

All units shall be suitably marked in a clean and legible manner with a reference number and the date of casting, which information shall be clearly visible when units are stacked. Reinforced precast members shall be clearly marked to indicate the upper face.

o Formwork

The formwork shall be either steel or lined with steel, waterproof / laminated board or such other material as directed and approved by the ENGINEER. Forms shall be strongly constructed, closely jointed and smooth and shall be such as to ensure true sharp arises and

a perfect surface. Forms shall be so designed that they can be taken apart and reassembled readily.

- Casting tolerance

The casting tolerance, unless otherwise ordered or directed, shall be within +3mm of true dimensions.

- Striking forms

The method and time of striking the side shutters after casting the units will normally be left to the discretion of the CONTRACTOR, but the ENGINEER may specify minimum time in which case the CONTRACTOR must comply with the ENGINEER'S directions. In the event of any damage resulting from premature removal of shutters, or from any other cause, the unit will be liable to rejection and replacement by the Contractor at his own cost, whether the Engineer has specified a minimum striking time or not.

- Lifting, stacking and removal

Precast units shall not be lifted, transported or used in the Works until they are sufficiently mature. The crushing tests on the test cubes, which are to be kept along with relevant the precast units, will be used to assess the maturity of the units.

Lifting, stacking and removal of precast units shall be undertaken without causing shock, vibration or undue stress to or in the units. The CONTRACTOR shall satisfy the ENGINEER that the methods he proposes for lifting, transporting and setting precast units will not overstress or damage the units in any way. In the event of overstress or damage due to whatever cause, the unit or units concerned will be liable to rejection. Rejected units shall be immediately broken up and removed from the site. The CONTRACTOR shall replace such rejected units at his own cost.

- Curing

The top and sides of all precast units shall be kept covered constantly and in a damp condition with clean, potable fresh water for at least seven days after casting or for such further period as the ENGINEER may direct. It is preferable to have a curing pond for this purpose.

- Precasting records

Complete records shall be maintained of all precast work. Every unit shall have a reference number, date of casting, date of removal from bed and date and position of placing shall be recorded together with corresponding test cube reference number and results.

CONTRACTOR shall submit a method statement to ENGINEER for approval, furnishing details of each stage of operation.

1.44.2.4.12 Formwork

Formwork shall be all inclusive and shall consist of but not limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs, etc. including ties, anchors, hangers, inserts, false work, wedges, etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of CONTRACTOR. However, if so directed by ENGINEER, the drawings and calculations for the design of the formwork shall be submitted to ENGINEER for approval.

Formwork shall be designed to fulfil the following requirements:

Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.

Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.

Capable of withstanding without deflection the worst combination of selfweight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.

Capable of easily striking without shock, disturbance or damage to the concrete

Soffit forms capable of imparting a camber if required.

Soffit forms and supports capable of being left in position if required.

Capable of being cleaned and/or coated if necessary immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork may be of lined timber, waterproof / plastic coated plywood, steel, plastic depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of ENGINEER. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and formwork and between formwork and structure shall be sufficiently tight to prevent loss of slurry from concrete using foam and rubber seals.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces, dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of ENGINEER. CONTRACTOR shall equip himself with enough quantity of shuttering to allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves may be used. Formwork spacers left in situ shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage of moisture.

For liquid retaining structures sleeves shall not be provided for through bolts nor shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.

Where specified or shown on drawings all corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size.

Forms for substructure may be omitted when, in the opinion of ENGINEER, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavation shall be slightly larger, as directed by ENGINEER, than that required as per drawing to compensate for irregularities in excavation.

CONTRACTOR shall provide adequate props of adjustable steel pipes carried down to a firm bearing without overloading any of the structures.

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.5 m or as directed by ENGINEER. CONTRACTOR shall temporarily and securely fix items to be cast (embedment/inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

Formwork showing excessive distortion, during any stage of construction, shall be removed. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete at CONTRACTOR's cost.

The striking time for formwork shall be determined based on the following requirements:

- a) Development of adequate concrete strength;
- b) Permissible deflection at time of striking form work;
- c) Curing procedure employed - its efficiency and effectiveness;
- d) Subsequent surface treatment to be done;
- e) Prevention of thermal cracking at re-entrant angles;
- f) Ambient temperatures; and Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

Before removing formwork of soffit of slabs/ beams compressive strength at 7/14/21 days shall be checked.

Under normal circumstances (generally where temperatures are above 20 Deg. C) forms may be struck after expiry of the period given in IS: 456 unless directed otherwise by ENGINEER. For Portland Pozzolona/slag cement the stripping time shall be suitably modified as directed by the ENGINEER. It is the CONTRACTOR's responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resists surface damage and any stresses arising during the construction period.

1.44.2.4.13 Reinforcement Fabrication And Placement

Reinforcing bars supplied in the form of bent coils shall be straightened cold without damage at no extra cost. No bending shall be done when ambient temperature is below 5 Deg.C. Suitable preheating may be permitted if steel bar bending is to be done at below 0 Deg.C. Bars supplied in bent coils shall be straightened only by machine.

All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/ schedules or as directed by ENGINEER. Bar bending machines shall be used to achieve desired accuracy.

Re-bending or straightening incorrectly bent bars shall not be done without approval of ENGINEER.

Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire, etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by ENGINEER prior to concrete placement. Spacers (PVC or Concrete) shall be of such material and design as will be durable, not lead to corrosion of the reinforcement and not cause spalling of the concrete cover.

Binding wire shall be 16 gauge soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

Substitution of reinforcement, laps/splices not shown on drawing shall be proposed by CONTRACTOR and approved by ENGINEER.

If permitted by ENGINEER, welding of reinforcement shall be done in accordance with IS: 2751, IS: 9417 and SP: 34 as applicable.

Tolerance on placement of reinforcement shall be as per Cl. 12.3 of IS: 456.

1.44.2.4.14 Tolerances

Tolerance for formed and concrete dimensions shall be as per IS: 456 and/ or ACI-117-90, ACI-347 unless specified otherwise.

Tolerance specified for horizontal or vertical building lines or footings shall not be construed to permit encroachment beyond the legal boundaries.

Tolerance for top of concrete of equipments and structural steel foundations shall be as under:

- a) Where grout thickness is less than or equal to 25mm: +5mm and –10mm.

- b) Where grout thickness is more than 25mm: ± 15 mm.

1.44.2.4.15 Preparation Prior To Concrete Placement

Before concrete is actually placed in position, the inside of the formwork shall be cleaned and mould oil applied, inserts and reinforcement shall be correctly positioned and securely held, necessary openings, pockets, etc. provided.

All arrangements-formwork, equipment and proposed procedure, shall be approved by ENGINEER. CONTRACTOR shall maintain separate Pour Card for each pour as per the format enclosed.

1.44.2.4.16 Transporting, Placing And Compacting Concrete

Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.

In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation, concrete shall not be rehandled or caused to flow. For locations where direct placement is not possible and in narrow forms, CONTRACTOR shall provide suitable drops and "Elephant Trunks". Concrete shall not be dropped from a height of more than 1.5 m.

Concrete shall not be placed in flowing water. Under water concrete shall be placed in position by tremie or by pipeline from the mixer and shall never be allowed to fall freely through the water.

While placing concrete the CONTRACTOR shall proceed as specified below and also ensure the following:

- a) Continuously between construction joints and predetermined abutments.
- b) Without disturbance to forms or reinforcement.
- c) Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits, etc.
- d) Without dropping in a manner that could cause segregation or shock.
- e) In deep pours only when the concrete and formwork is designed for this purpose and by using suitable chutes or pipes.
- f) Do not place if the workability is such that full compaction cannot be achieved.
- g) Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.
- h) If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.
- i) Ensure that there is no damage or displacement to sheet membranes.
- j) Record the time and location of placing structural concrete.

Concrete shall normally be compacted in its final position within thirty minutes (Initial setting time) of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids, thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at

points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over-vibration leads to segregation and shall be avoided.

Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by ENGINEER. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

CONTRACTOR shall submit a method statement to ENGINEER for approval, furnishing details of pour sequence, thickness of each layer, mixing and conveying equipments proposed etc. preferably with a sketch.

Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as determined by ENGINEER. Concrete shall be protected against damage until final acceptance.

1.44.2.4.17 Placing Of Concrete By Pumping Methods

o **General**

Placing of concrete by pumping will be as specified or authorised by Engineer to achieve the required speediness of construction and maintain targeted schedules.

Pumping of concrete shall be done only after conducting pumpability trials to ascertain the performance of fresh concrete on pumping in presence of the Engineer as per approved procedure. During pumping, concrete shall be conveyed either through rigid pipe or through flexible hose and discharged directly into the desired area. A steady supply of pumpable concrete is necessary for satisfactory pumping. Pumpable concrete requires properly graded aggregates, material uniformity, consistent batching and thorough mixing. Concrete pumps used shall be able to deliver concrete over a horizontal distance of about 400 m or of about 100 m in a vertical direction, (with intermediate figures for a combination of horizontal and vertical movements). They shall be used for concreting densely reinforced structures, internal structural elements of buildings and for large pours of concrete.

Placement of normal concrete by pumping will be permitted as specified or authorised by the Engineer. The decision, whether or not to pump any particular mix shall rest entirely with the Engineer and no extra claims for payment on this account will be entertained. The pumping equipment, pipe lines and accessories as well as proportioning of pumpable concrete shall generally conform to the recommendations of ACI-304.2 (latest revision) – Placing of concrete by pumping method - Proportioning of pumpable mixes gives certain guide lines on concrete mix. However, final selection of mix shall be as instructed by the Engineer.

1.44.2.4.18 Pumping Equipment

Requisite numbers of modern dependable concrete pumps capable of pumping concrete of specified quality at a rate required to meet the construction schedules,

together with a balanced complement of pipelines, accessories, spare parts, power controlled placing booms, and experienced pump operators and maintenance staff shall be provided at locations and in a manner approved by the Engineer.

The pumping plant shall be completely installed on each occasion, with preliminary mock operation for a sufficient length of time prior to scheduled placement of a particular concrete pour, to enable the Engineer to conduct pumpability tests and necessary adjustments for the concrete mix, prior to use of the pumping for placement of concrete.

- **Type of Pump**

The selection of the concrete pump shall be done as per the project requirement. The Contractor shall submit the concrete pump data sheets proving the suitability for the given project to ENGINEER for approval.

The concrete pump shall be selected on its best pumping capacity and the speediness to be achieved in the project. The piston pumps of a net horizontal pumping capacity of 30 m³/ hr or 20 m³/ hr or 15 m³/ hr or 10 m³/ hr can be utilised. The combination of various pumps to be used shall be decided by Contractor and shall submit the necessary documents and targeted progress to be achieved in line with the Time Period and Milestones.

These pumps shall have capacity to pump the concrete up to at a horizontal distance of 400 m and capable of generating a minimum pressure of 80 bar. These parameters shall depend upon the building sizes, manoeuvrability and other construction features. These pumps shall consist of a receiving hopper with a bolted grill at top of capacity not less than 600 liters. The hoppers shall be provided with hydraulically driven re-mixing blades or other agitating devices to keep the concrete mixed continuously and maintain consistency and uniformity. The pumps shall be provided with two cylinders with max. diameter not less than 150 mm, stroke of about 1200 mm and the number of strokes not exceeding 25 per minute. The outlet valves shall be located on the discharge lines. Type of inlet and outlet valves may vary depending on the manufacturer, but they shall preferably be of sliding-rod-flat-gate type. The piston shall be hydraulically driven. Primary power shall be supplied by gasoline, diesel or electric motor of requisite power rating. Care shall be taken by the Contractor to ensure uninterrupted operation of the pumps during the entire period of concreting by providing adequate standby arrangements. The primary power and pump equipment shall be either truck or trailer mounted, and not skid mounted.

1.44.2.4.19 Pipelines And Accessories

- **Rigid pipelines**

Concrete transported to the placement area by pumping methods shall be pumped through rigid pipes or a combination of rigid and heavy-duty flexible hoses. Rigid pipe shall be made available in minimum 125 mm diameter size. Aluminium alloy lines shall not be used for delivery of concrete. Rigid pipes shall be furnished in such lengths as can be manually handled by a single person.

- **Flexible conduit (hose)**

Flexible conduit shall be made of rubber, or spirally wound flexible metal, and plastic flexible conduits generally present greater resistance to movement of concrete and their performance is not the same as that of a rigid pipe and also larger sizes (100

mm to 123 mm) have a tendency to leak. Flexible conduits provided, shall be interchangeable with rigid pipes and their use restricted to curves, difficult placement areas, and as connection to moving cranes or to water borne lines.

- **Couplings**

The couplings provided to connect both flexible and rigid pipe sections shall be adequate in strength to withstand handling during erection of the pipe system, misalignments, and poor support along the lines. They should be nominally rated for at least 3.45 Mpa and greater for rising over 30 mtr. The strength and tightness of joints shall be guaranteed. Couplings shall be designed to allow replacement of any pipe section without moving other pipe sections, and shall provide a full internal cross-section with no obstructions or crevices to disrupt the smooth flow of concrete.

- **Accessories**

The pump and the distribution system for a particular concreting job shall use the accessories as listed below and they shall be approved by the Engineer.

- a) Rigid and flexible pipes in varying lengths, such as 3, 1.5, 0.9, 0.6 and 0.3 m lengths.
- b) Curved sections of rigid pipes such as large radius elbows at angles of 90 deg., 45 deg., 22 deg. 30 min. and 11 deg. 15 min.
- c) Swivel joints and rotary distributors.
- d) Pin and gate valves to prevent back-flow in the pipe line.
- e) Switch valve to direct flow into another pipe line.
- f) Connection devices to fill form the bottom up.
- g) Temporary supports, rollers and other devices for protection of conduit over rock, concrete, reinforcement steel and forms. Lifting and leashing points.
- h) Extra strong coupling for vertical runs in inaccessible areas.
- i) Transition for connecting different sizes of pipes.
- j) Air vents for downhill pumping
- k) Clean-out equipment
- l) Adequate numbers of separate placement booms of various radius and reach, either stationary steel column mounted or tower crane mast mounted moving on rail tracks, or truck mounted shall be provided by the Contractor to match within concrete placement schedule and pumps. For maximum flexibility of operation the separate placement boom shall be such that they can be easily lifted by the tower cranes provided. Their mounting arrangements shall be quick connecting type and interchangeable between tower crane masts, steel columns and truck mountings etc. The placement booms shall consist of three hinged parts incorporating a concrete pipe line with articulated inserts at boom joints and ending in a flexible hose. The boom shall be remote controlled.

The pumping plant and the pipe distribution system

The concrete pumping plant apart from the receiving hopper and the pump shall also be provided with a water pressure valve, connecting pipes with needle valve,

cleaning rods, outlets for drainage water and a high pressure pumps for flushing out the concrete in pipe line.

The shortest way shall be selected in planning the direction of the concrete pipeline, and the number of bends (elbows) shall be as small as possible. Should a change be made of the direction in plan of the pipe lines or a change of their vertical profile, these shall be arranged with easy transitions.

Before the pipeline is assembled all pipe flanges shall be tested and carefully cleaned, packing rings cleaned or replaced, and the internal surfaces of all pipe section cleaned. Horizontal lengths of concrete pipe lines shall be laid on supports, wooden trestles, scaffolding, staging etc. Vertical and inclined lengths of pipe shall be fastened by clamp irons or stirrups to masts, or to the frame of the structure being erected. It is recommended to replace vertical sections of the pipeline by inclined sections where possible. Sharp turns and bends at an angle of 90 deg. shall be avoided. Pipes shall be supported in such a manner that they do not disturb the forms during concreting.

A vertical section of the concrete pipeline shall not be arranged closer than 8 to 9 m from the concrete pump. Before a vertical section a valve shall normally be placed, to prevent back flow of the concrete when the pump stops or when the pipe is cleaned or replaced. When pumping vertically through the placer boom, a thrust block shall be provided at the base of the vertical riser to resist the forces in the pipeline due to the pumping of concrete.

When pumping downwards, 15 m or more, it is desirable to provide an air release valve at the middle of the top bend.

1.44.2.4.20 Line Resistance And Lubrication

When concrete is pumped through a straight section of a pipe or hose, it moves as a cylinder riding on a thin lubricant film of a grout or mortar. At changes in direction or cross-section some re-mixing occurs. In all cases at the start of pumping operation lubricating mortar is required, and this shall be a properly designed mortar of cement-sand grout (1:1) or a batch of the regular concrete with the coarse aggregate omitted. Except for a small portion of this mortar which may be used for bedding at the construction joint, it shall be wasted and not used in the concrete placement. It can be assumed that about 0.35 cu. m of mortar will lubricate a 125 mm diameter horizontal pipeline of about 300 m length and the lubrication shall be maintained as long as the pumping continues. For vertical or smaller lines less mortar will be required. The mortar shall have the same cement content as that of the concrete. The water cement ratio shall be determined by the placing condition and finally decided by the Engineer. In order to ensure that only minimum quantity of grout mortar is used to lubricate the pipeline, a rubber sponge ball shall be allowed to pass through the pipeline immediately before the first batch of grout mortar is pumped. This rubber ball shall be pushed by the following mortar along the pipeline slowly and allowed to emerge at the open end. The cost of the lubricating mortar to be used, shall be deemed to have been included in the general rate structure for works in the schedule of items and nothing extra shall be payable.

It shall be taken into account when planning the pipeline that, in straight horizontal and vertical section of pipe and at bends the resistance to the movements of concrete differ. For convenience in calculating the resistance of a concrete pipeline experimental co-efficient of equivalent length shall be used by means of which the equivalent length of a horizontal concrete pipeline is to be obtained. In absence of

the pump manufacturer's data, equivalent lengths of concrete pipeline as indicated in Table 1-9 may be used.

Table 1-9. EQUIVALENT LENGTH OF CONCRETE PIPELINES

Characteristics of a length of concrete	Equivalent length of horizontal pipeline Concrete pipeline in meter
Bend in pipeline at an angle of 90 deg.	12
Bend in pipeline at an angle of 45 deg.	7
Bend in pipeline at an angle of 22 deg. 30 min.	4
1 m of vertical concrete pipeline	8

The equivalent length of the concrete pipeline must be less than or equal to the range of feed in horizontal direction as specified by the pump manufacturer for the same rate of pumping. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends and preferably with no change in pipe size. If two sizes of pipes are required to be used, the smaller diameter shall be used at the pump end and the larger at the discharge end. The contractor shall exercise care in handling of the pipeline, during assembly, cleaning and dismantling so as to lower the line resistance by preventing the formation of rough surfaces, dents in pipe section and crevices in couplings. If any pipe, bend, coupling and other accessories are considered to be defective or damaged by the Engineer, the same shall not be used in the concrete pipeline till such time the defect has been removed and the damage repaired to the entire satisfaction of the Engineer. Qualified chemical admixtures shall be used effectively to get workable concrete.

1.44.2.4.21 Proportioning Pump Able Concrete

- **Basic Consideration**

Although the ingredients of concrete to be placed both by pumping and by other means are the same, more emphasis shall be laid on the quality control and proportioning of a dependable pumpable mix. Dependability is effected by the equipment and the operator, with the control of all of the ingredients in the mixture, the batching and mixing operations, and the knowledge and experience of all the personnel from beginning to end.

Concrete mixes for pumping shall be “plastic” at all times. Stiff mixes shall not be used for pumping as they do not pump well. Particular attention shall be given to the mortar (cement, sand and water) and the amounts and sizes of coarse aggregates.

- **Normal Weight Aggregates**

- **Coarse normal weight aggregates**

The maximum size of angular coarse aggregate shall be limited to one-third of the smallest inside diameter of the hose or pipe based on simple geometry of cubical shape aggregates. For well-rounded aggregates, the maximum size shall be limited to 40% of the pipe or hose diameter. Adequate provisions shall be made to eliminate over size particles in the concrete by screening or by careful selection of aggregate. Gradation of sizes of coarse aggregates shall correspond to Grades A and B of Table 1-10 and shall meet IS: 2386 requirements. If required certain fractional sizes shall be combined and blended to produce the required gradation. Greater emphasis shall be laid on uniformity of gradation throughout the entire job.

The maximum size of the coarse aggregate has a significant effect on the volume or amount of coarse aggregate that may be effectively used in a mix. As will be seen from

Table 1-11 the quantity of coarse aggregate must be substantially reduced as the maximum size become smaller. Mixes consisting of too large a portion of coarse aggregate with less cement shall be avoided.

Table 1-10. GRADING REQUIREMENT OF COARSE AGGREGATES FOR PUMPED CONCRETE

Grade - A (Maximum Size 40 mm)		Grade -B (Maximum Size 20 mm)	
Sieve Size(mm)	Percent Passing	Sieve Size(mm)	Percent Passing
50	100	25	100
40	95 to 100	20	90 to 100
20	35 to 70	12.5	20 to 55
10	10 to 30	10	0 to 15
4.75	0 to 5	4.75	0 to 5

Table 1-11. VOLUME OF COARSE AGGREGATE PER UNIT OF VOLUME OF CONCRETE

Max. size	Volume of Dry-rodded Coarse Aggregate per Unit volume of aggregates of concrete for different fineness modulli of sand			
	FMS =2.40	FMS =2.60	FMS =2.80	FMS =3.00
10	0.50	0.48	0.46	0.44
12.5	0.59	0.57	0.55	0.53

20	0.66	0.64	0.62	0.60
25	0.71	0.69	0.67	0.65
40	0.76	0.74	0.72	0.70
50	0.78	0.76	0.74	0.72

Note:

Volume is based on aggregates in dry-rodded condition.

These volumes are selected from empirical relationships to produce concrete with a degree of workability suitable for usual reinforced construction. When placement is to be by pump, they shall be reduced by about 10 percent.

FMS = Fineness Modulus of Sand.

Fine normal weight aggregate

Fine aggregate shall consist of natural sand, manufactured sand or a combination thereof and shall be graded within the following limits.

Sieve Size	Percent passing by weight
9.5 mm	100
4.75 mm	95 to 100
2.36 mm	80 to 100
1.18 mm	50 to 85
600 microns	25 to 60
300 microns	10 to 30
150 microns	2 to 10

Fine aggregates shall conform to the requirements of IS: 2386. Particular attention shall be given to those passing through finer screen sizes. For small line system (less than 150 mm) 15 to 30 percent shall pass 300 micron sieve and 5 to 10 percent shall pass 150 micron sieve. Sands which are deficient in either of these two sizes shall be blended with selected finer sands or inert material such as quarry dust to produce these desired percentages.

The fineness modulus of sand meeting the above grading limits will fall between 2.13 and 3.37 with the median being 2.75. Pumpability of mixes will generally improve with a decrease in the fineness modulus value or in other words with the use of finer sands. Sands having a fineness modulus between 2.40 and 3.00 are generally satisfactory provided that the percentages passing 300 micron and 150 micron sieves meet the previously stated requirements. It shall also be emphasized that for uniformity, the fineness modulus of the sand shall not vary more than 0.20 from the average value used in proportioning.

Table –10 is suggested as a guide to determine the amounts of coarse aggregate to be combined with sand of different fineness modulus. The foot note of

Table 1-11 require a reduction in the volume of coarse aggregate by 10 percent for pumping. This margin shall be considered as a safety margin for variations in sand gradation to reduce pumping pressure. Under conditions of good materials control and uncomplicated line systems, this reduction may not be required.

Although in practice it may not be possible to duplicate this recommended sand gradation exactly, sands having a gradation closer to the upper limit (fine sand) are more desirable for pumping than those near the lower limit (coarse sand). The

fineness modulus of sand according to the recommended curve is 2.68 and the gradation meets all the requirements stated earlier.

1.44.2.4.22 Water And Slump

Water requirements and slump control for pumpable normal weight concrete are interrelated and extremely important considerations. The mixing water requirements for a particular mix shall be determined by the Engineer and modified to suit the fineness of sands, quality of admixtures, additives, cement replacements or other special materials being used in the concrete.

The Contractor shall establish the optimum slump jointly with the Engineer for a pumpable mix at the discharge hose end and shall maintain control of that particular slump throughout the course of a job. Excess water shall not be added in the receiving hopper to make the concrete mix pumpable, instead attempt shall be made to obtain 'truly plastic mix' by proper proportioning.

Slump of concrete may undergo change between initial mixing and final placement. If the slumps at the discharge hose end are to be maintained within specified limits, it will be necessary for the concrete to enter the pump at a higher slump to give the required mobility during transport. Slump adjustments by re-proportioning of the constituents as may be required shall be carried out by the Contractor jointly in consultation with the Engineer for every type of mix and for every new placement and set up of pump and pipelines.

1.44.2.4.23 Cement Content

- a) The determination of the cement content for a normal weight pump mix shall follow the same basic principles used for conventionally placed concrete. The water cement ratio shall be established by the Engineer on the basis of exposure conditions, strength requirements or minimum cement consumption, whichever governs. However, because of slightly higher ranges of slump and ratios of fine to coarse aggregates, the pump mix may require an increase in the amount of cement above those pumpable concrete mass. The total quantity of fines passing through the 300 micron sieve including cement, fine sand, stone dust etc shall be in the range of 380 to 450 kg/cu.m of concrete.
- b) Cement content in case of M-50 shall be maximum 425 kg/m³, and shall be a mix with high range of workability i.e. 175 mm +/- 25 mm. All the contents shall be mixed based on the mix design & trial studies.
- c) While establishing the cement content for normal weight trial mixes, it will be necessary to take into account the capabilities of the particular pump and its operator for over strength proportioning in the laboratory to provide for field variations.
- d) In case of pumping difficulties, it is desirable and economical to correct any deficiencies in the aggregates, especially in the sand instead of using extra quantities of sand. With well graded coarse and fine aggregates properly combined, the cement requirement for pumpable mixes shall closely resemble to those used in conventionally placed concrete.

1.44.2.4.24 Admixtures

The use of poor aggregate grading or aggregate with continuous change in overall grading of the 'combinations' during concreting operation will make special

admixtures quite useful in overcoming the main difficulty like blockage in pumping. These admixtures shall be incorporated in pumpable concrete to aim the following.

- Increase in the range of mix designs which may be successfully pumped using water reducing admixtures/Super plasticizers with the approval of the Engineer.
- Reducing the risk of pipeline blockages by preventing segregation of concrete mix.
- To have satisfactory/specified performance both in fresh and hardened state.

Any admixture that increases workability in normal weight concrete may usually improve pumpability. The choice of type of admixture and the advantage gained from its use in concrete to be pumped will depend on the characteristics of the pump mix and will be finally decided by the Engineer in consultation with the admixture manufacturer.

For improvement of pumpability the following admixtures are generally recommended. Such admixtures used shall conform to ASTM C-494/IS 9103.

a) Water Reducing Admixtures/Super Plasticizers

These cause reduction in water requirements at constant slump or an increase in slump at constant water-cement ratio. They can be designed to have no apparent effect on setting time, or alternately to achieve varying degrees of acceleration or retardation in rate of hardening of the mixture. Most water reducing admixtures increase the pumpability of the concrete mix through plasticising action.

b) Air Entraining Admixtures

Air entrained concrete is considerably plastic and more workable than non air entrained concrete. It can be pumped with less coarse aggregate segregation and has fewer tendencies for concrete to bleed. Start-up after shut down is also generally easier due to reduced bleeding. For pumped concrete these limits shall be obtained at the point of placement in the structure. To compensate for air content loss in the air entrained concrete higher entrainment of air may be required at the batching plant. The required adjustment of admixture dose shall be carried out by the Engineer after carrying out necessary air loss tests. An air content in the range of 3 to 5 % shall be preferred as higher ranges reduces the delivery capacity of pump systems due to increased compressibility of the concrete and also reduces strength of concrete.

If air-entraining plasticizer is used, typically 13 % minimum water reduction is possible. Therefore, strength loss due to air entrainment will be compensated by using such air-entraining plasticizer.

c) Finely Divided Mineral Admixtures

Contractor, if specifically approved by the engineer, can use mineral admixture. In concrete mixtures, deficient in fines, the addition of a finely divided inert mineral admixture generally improves workability, pumpability, reduces the amount of bleeding and increases the strength. The effect on strength depends on the type of mineral admixture used, conditions under which the concrete is cured, and the amount of admixture used. Water soluble polymers obtained from cellulose derivations may also be used as an admixture with a small dose of 60 to 150

gms/cu.m to increase viscosity of the mixing water and reduce the frictional resistance to flow and bleeding in the pipe system.

1.44.2.4.25 Trial Mixes

The trial mixes for pumping shall be prepared and tested in the Site laboratory by contractor in accordance with clause 1.44.2.4.26 of this specification. The ingredients, particularly the coarse and fine aggregates shall also be checked for the conformance to the desired properties described, by the contractor. Table –10 may be used to select the volume of coarse aggregate per cu. m. of concrete. In using this table it is recommended that the highest probable fineness modulus of sand be used rather than the average fineness modulus to ensure consistent performance during pumping. For additional plasticity, 10 % reduction in coarse aggregate quantities shall be considered. Experience with the use of local aggregate and their uniformity shall also be considered in the proportioning concepts.

1.44.2.4.26 Mix Design For Pumpable Concrete

Taking the above factors into account, the concrete shall first be designed for normal placement conditions and then modified as necessary to suit pumping. The following procedure shall be adopted:

- a) Design the mix for specified characteristic strength and workability.
- b) Check and ensure combined grading of aggregates i.e. as uniform grading as possible. This requirement is vital as gaps or partial gaps are the basic reasons for poor water retention property and segregation under pressure.
- c) Determine the optimum sand content for the required workability and increase sand content by reducing volume of coarse aggregate per unit volume of concrete by about 10 % as a degree of protection against under sanding due to batch variations.
- d) Recheck the minimum cement content for durability.
- e) Examine the total fines content i.e. cement and fine aggregates passing through 300 micron sieve and readjust the mix, if necessary. A very rich mix with fine sand will be as problematic as coarse sand with lean mix.
- f) Re-appraise the grading if the particle shape of any particular fraction is such as may cause excessive voids. Re-adjust as required, if necessary examining the void ratio of various combinations, using void meter to achieve minimum voids at the expense of 'sufficient fines' content.
- g) If dissatisfied with (a) to (f) as above, consider what remedial action may be taken to overcome the troublesome factor. For example, the following two situations may occur :
- h) If the sand has more coarser fraction it is worth considering the addition of a proportion of finer sand, or alternately if the sand has finer fraction, the addition of coarse fraction may be considered. Addition or reduction of cement may help, but the correct solution is to overcome the gap in overall grading as stated above.
- i) In a 20 mm aggregate max size, if there is an excess of 10 to 4.75 mm fraction, and this fraction is flaky with unduly large surface area, either increase the sand content to reduce the possibility of segregation and to reduce the inter-practical stresses, or (better) re-grade using single sized aggregates.

At the trial mix stage small variations can be made preferably in the light of the pressures registered and observed performances through the pump. In certain cases admixtures may be economically and beneficially used to improve or eliminate circumstances that cannot readily be overcome by other means

1.44.2.4.27 Testing For Pumpability

No mix shall be accepted for use on a pumping job until an actual test under field condition has been completed. Testing a mix for pumpability involves duplication of the anticipated job condition from beginning to end. The batching and conveying by truck mixers shall be the same as will be used, the same pump and operator shall be present. The pipe and hose layouts shall simulate the actual condition as far as practicable. Prior use of a mix on another job may furnish evidence of pumpability but only if conditions are duplicated. Before commencing a new concreting job, the contractor shall carry out pumpability tests in consultation with the Engineer. Concrete used in such tests shall not be used in the actual construction, unless specifically permitted by the Engineer.

Following parameter shall be established by pumpability trials:

- a) Insitu compressive & split tensile strength of concrete by
- b) Curing the sample at Site by sprinkling water.
- c) Curing the sample at Laboratory in curing tanks.
- d) Wet sieve analysis of concrete to ensure that proportions of ingredients before and after pumping are same.

o **Field Practices**

- a) Proper planning of concrete supply, pump location, line layout, placing sequence and the entire pumping operation shall be done by the Contractor and got approved by the Engineer on every occasion before commencement of concreting job. The pump shall be as near the placing area as practicable, and the entire surrounding area must have adequate bearing strength to support the concrete delivery trucks, thus assuring a continuous supply of concrete. For important concrete placements and large jobs, adequate standby power and pumping equipment shall be provided as replacement, should break down occur.
- b) Direct communications shall be maintained between the pump operator, concrete placing crew and batching plant. The placing rate shall be estimated so that concrete can be operated at an appropriate delivery rate. As a final check, the pump shall be started and operated without concrete to ascertain that, all moving parts are operating properly. As stated previously, the grout mortar shall be pumped into the line to provide initial lubrication for the concrete. As soon as concrete is received, the pump shall be run slowly until the lines are completely full and the concrete is slowly moving. Once the pumping is started, the operator shall ensure that the hopper of the pump is not emptied beyond a certain level, as air may enter the pipeline and cause choking. Continuous pumping should be ensured. If a delay occurs because of concrete delivery, form repairs, or other factors, the pump shall be slowed down to maintain some movement of the concrete till normal supply is resumed. For longer delays, the concrete in the receiving hopper shall be made to last as long as possible by moving the concrete in the lines occasionally with one stroke of the pump. In confined areas,

attempt shall be made by the Contractor to run a return line back to the pump, so that concrete can be re-circulated during delays.

- c) The Contractor shall ensure that obstructions are not found in the pipe due to interruption in the feed of the concrete by more than 30 to 45 minutes.
- d) Minor blockages shall be cleared by operating a few strokes of the pump in reverse momentarily and then by returning to normal forward pumping. If this fails, a succession of reverse and forward strokes shall be carried out to remove the blockage. Should this fail also, the blockage may be due to air-lock and the entrapped air has to be removed.
- e) Attempt to push through the obstructions by repeatedly starting the pump will result in compaction of the concrete and complicate the removal of the concrete in the pipe. Blockages in the pipe are usually discovered by the sound when the pipe is struck. To remove the obstruction, the concrete pipe shall be taken apart at the assured position and cleaned. Then the pumping process shall be started all over again.
- f) This method of checking the blockage and setting it right shall be done with great speed as excessive delay will cause setting of concrete in the pipeline downstream of the choke and will lead to further blockage. When the blockage is being found out and remedied, the pump shall periodically be given one or two strokes forward to keep the concrete in motion. If blockage occurs in the placer boom, a pipe joint near the base of the placer boom shall be opened and the boom made vertical to drain the pipeline by gravity.
- g) Cleaning blockages are time consuming and as such major blockages shall best be avoided by ensuring a pumpable mix. Concrete that is either under or over sanded, short of fines, gap graded, has an excess of a particular size, or excessively wet or dry will be rejected by the pump either by blockage or by hard pumping involving excessive pressures.
- h) The termination of pumping operations shall be carefully planned to utilize the concrete dormant in the pipeline and the hopper when the pump is stopped and to avoid wastage.
- i) When the form is nearly full, and there is enough concrete in the line to complete the placement, the pump shall be stopped and a go-devil be inserted and forced through the line to clear it out. Water under pressure shall be used to push the go-devil. The go-devil shall be stopped about one metre from the end of the line, so that the water in the line will not spill over into the placement area. After flushing, water in the pipe shall be removed by drain cock which shall be located for this purpose in the lowest part of the line. After all concrete has been removed from the lines, all lines and equipment shall be immediately cleaned thoroughly.

- o **Quality Control**

- a) Contractor shall ensure that workmanship and plant shall be maintained at peak efficiency. Degree of control on all the concrete operation from selection of the ingredients to the final testing of specimen shall be in line with the assumptions made in mix design with respect to the standard deviation and co-efficient of variation.

- b) The Contractor shall ensure that any compromise in quality is not done for the pumped concrete. To be pumpable, a high level of quality control for the assurance of uniformity must be maintained. Sampling at both the truck discharges and point of final placement shall be done by the Contractor and the Engineer jointly, as frequently as the Engineer desires to determine, if any change in the slump air content, and other significant mix characteristics occur take necessary corrective actions.
- c) The Contractor shall engage experienced supervision at all levels. The placing crew shall be experienced and qualified and each operation shall be well planned and properly scheduled.
- d) All the crew engaged in each of the concrete activities shall demonstrate in the presence of the Engineer, their skills and capabilities to produce the final product as specified.

1.44.2.4.28 Mass Concrete Works

Sequence of pouring for mass concrete works shall be as approved by ENGINEER. CONTRACTOR shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.

- o **Placing temperature of concrete**

Placing temperature of concrete should be maintained as specified in Bill of Quantities or as directed by ENGINEER, to avoid shrinkage cracking

Mixing water shall be kept cool by storing it under cover. Chilled water or crushed ice as part of the mixing water to achieve the specified placing temperature shall be used. For chilled water, it is recommended that the contractor install and maintain refrigeration facility of required capacity. The contractor shall also build and maintain well insulated adequate capacity storage tank for cold water with insulated connected piping. To supplement this refrigeration facility, the contractor will have to have ice plant or use commercial ice subject to approval of the ENGINEER. The full quantity of crushed ice shall be stored in cold storage 24 hours in advance of the start of concreting. The temperature in cold storage shall not be more than -20°C . The contractor should study the placing temperature condition and work out plant capacity commensurate with the construction schedule requirements and submit his scheme along with the tender.

Ice when used as replacement for a portion or all the mixing water shall be produced from water which meets the requirements of Clause 1.44.2.4.3. Ice when used shall be in flakes of size 3mm or below or crushed condition and the crushed ice shall be such as to pass completely, 10mm sieve.

- o **Curing**

Curing and protection shall start immediately after the compaction of the concrete to protect it from:

- a) Premature drying out, particularly by solar radiation and wind;
- b) leaching out by rain and flowing water;
- c) rapid cooling during the first few days after placing;
- d) high internal thermal gradients;
- e) low temperature or frost;

- f) Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

All concrete, unless directed otherwise by ENGINEER, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas, hessian or other absorbent material for the period of complete hydration with a minimum of 7 days. The quality of curing water shall be the same as that used for mixing.

Where a curing membrane is directed to be used by the ENGINEER, the same shall be of a non-wax base and shall not impair the concrete finish in any manner. The curing compound to be used shall be got approved from the ENGINEER before use and shall be applied with spraying equipment capable of a smooth, even textured coat.

Curing may also be done by covering the surface with an impermeable material such as polyethylene, which shall be well sealed and fastened.

Extra precautions shall be exercised in curing concrete during cold and hot weather as per Clause no. 8.3 of IS: 7861(Part II) and Clause no. 8.2 of IS:7861(Part I) respectively.

Curing arrangement shall be subjected to ENGINEER's approval.

o **Construction Joints And Keys**

Construction joints (location and type) shall be as shown on the drawing or as approved by ENGINEER. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approval of ENGINEER.

Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as directed by ENGINEER.

Before resuming concreting on a surface which has hardened all laitance and loose aggregates shall be thoroughly removed by wire brushing and/ or hacking, the surface washed with high pressure water jet and treated with thin layer of cement slurry for vertical joints and a 15 mm thick layer of cement sand mortar for horizontal joints, the ratio of cement and sand being the same as in the concrete mix.

When concreting is to be resumed on a surface, which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

Approved epoxy Bonding agent, for bond between old (say 28 days or more) and new concrete may also be used as per manufacturer's specifications.

o **Foundation Bedding**

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy area shall be cleaned out and back filled with either soil-cement mixture, lean concrete or clean sand compacted as directed by ENGINEER. The surfaces of absorptive soils shall be moistened.

Concrete shall not be deposited on large sloping rock surfaces. The rock shall be cut to form rough steps or benches by picking, barring or wedging. The rock surface shall be kept wet for 2 to 4 hours before concreting.

- **Base Concrete**

The thickness and grade of concrete and reinforcement shall be as specified in the item of work.

Before placing the blinding concrete of 1:4:8 mix, 50/75mm thick as per the item of work, the sub-base of rubble packing shall be properly wetted and rammed. Concrete for the base shall then be deposited between the forms, thoroughly tamped and the surface finished level with the top edges of the forms. Two or three hours after the concrete has been laid in position, the surface shall be roughened using steel wire brush to remove any scum or laitance and swept clean so that the coarse aggregates are exposed. The surface of the base concrete shall be left rough to provide adequate bond for the floor finish to be provided later.

- **Measurement**

Measurement shall be in sq.m correct to two places of decimal. This work could be either separate or combined along with the floor finish as indicated in the respective items of work.

1.44.2.4.29 Finishes

- **General**

The formwork for concrete works shall be such as to give the finish as specified. The CONTRACTOR shall make good as directed any unavoidable defects consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. CONTRACTOR shall construct the formwork using the correct materials and to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

- **Integral Cement Finish On Concrete Floor**

In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screeded off to proper level and tamped with tamper having conical projections so that the aggregate shall be forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener of appropriate thickness as approved by the ENGINEER shall be supplied and used as recommended by the manufacturer.

- **Repair And Replacement Of Unsatisfactory Concrete**

Immediately after the shuttering is removed, all the defective areas such as honeycombed surfaces, rough patches, etc. shall be brought to the notice of ENGINEER who may permit patching of the defective areas or reject the concrete work. ENGINEER'S decision on rejection of concrete work shall be final.

All through holes for shuttering shall be filled with cement mortar for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as directed by the ENGINEER.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the ENGINEER as to be the method of repairs to be adopted shall be final and binding on the CONTRACTOR and no extra claim shall be entertained on this account. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as directed by ENGINEER.

CONTRACTOR shall submit a method statement for such repairs to ENGINEER for approval.

1.44.2.4.30 Vacuum Dewatering Of Slabs

Where specified floor slabs, either on grade or suspended, shall be finished by vacuum dewatering including all operations such as poker vibration, surface vibration, vacuum processing, floating and trowelling as per equipment manufacturer's recommendation. The equipment to be used shall be subject to ENGINEER'S approval.

1.44.2.4.31 Hot Weather Requirement

Concreting during hot weather shall be carried out as per IS:7861 (Part I).

Adequate provisions shall be made to lower concrete temperatures which shall not exceed 40 °C at the time of placement of fresh concrete.

Where directed by ENGINEER, CONTRACTOR shall spray non-wax based curing compound on unformed concrete surface at no extra costs.

1.44.2.4.32 Cold Weather Requirements

Concreting during cold weather shall be carried out as per IS:7861 (PART 2).

The ambient temperature during placement and upto final set shall not fall below 5 deg.c. Approved anti-freeze/accelerating additive shall be used where directed.

For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

1.44.2.4.33 Liquid Retaining Structures

The CONTRACTOR shall take special care for concrete of liquid retaining structures, underground structures and those other specifically called for to guarantee the finish and water tightness.

The minimum level of surface finish for liquid retaining structures shall be of smooth type. All such structures shall be hydro-tested.

The CONTRACTOR shall include in his price hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines, etc.

Any temporary arrangements that may have to be made to ensure stability of the structures shall also be considered to have been taken into account while quoting the rates.

Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other method as may be approved by the ENGINEER. All such rectification shall be done by the CONTRACTOR to the entire satisfaction of the OWNER/ENGINEER at no extra cost to the OWNER.

1.44.2.4.34 Testing Concrete Structures For Leakage

Hydro-static test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by ENGINEER, as described below:

In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.

In the case of structures whose external faces are submerged and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling; the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs over period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the water tightness of the structure. The ENGINEER shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

Each compartment/segment of the structure shall be tested individually and then all together.

For structures such as pipes, tunnels, etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

1.44.2.4.35 Optional Tests

If ENGINEER feels that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the ENGINEER, as per relevant IS Codes. OWNER shall pay only for the testing of material supplied by the OWNER; otherwise CONTRACTOR shall have to pay for the tests. Transporting of all material to the laboratory shall however be done by the CONTRACTOR at no extra cost to OWNER.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strength, ENGINEER reserves the right to order the CONTRACTOR to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure, as per relevant IS specifications. All these tests shall be carried out by CONTRACTOR at no extra cost to the OWNER. Alternately ENGINEER also reserves the right to ask the CONTRACTOR to dismantle and re-do such unacceptable work at the cost of CONTRACTOR.

If the structure is certified by ENGINEER as having failed, the cost of the test and subsequent dismantling/reconstruction shall be borne by CONTRACTOR.

The quoted unit rates/prices of concrete shall be deemed to provide for all tests mentioned above.

1.44.2.4.36 Grouting

o **Quality Control**

- a) TCE Consulting Engineers have over the years developed in house quality control formats for concrete works. CONTRACTOR shall note that it required adopting all such formats. A copy of formats shall be furnished to CONTRACTOR by ENGINEER/ OWNER after the contract is awarded.
- b) Alternatively, if CONTRACTOR has his own QC formats he may adopt them subjected to such modifications considered necessary by ENGINEER.
- c) In either case CONTRACTOR shall submit his detailed Quality Assurance Plan along with the bid. This would be reviewed, appropriately modified and approved by CONSULTANT after the award of contract.

o **Inspection**

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of ENGINEER. Materials rejected by ENGINEER shall be expressly removed from site within 3 working days and shall be replaced by CONTRACTOR immediately at no extra cost to OWNER.

o **Clean-Up**

Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris, scraps of wood, etc. resulting from the work shall be removed and the premises left clean.

o **Acceptance Criteria**

Any concrete work shall satisfy the requirements given below individually and collectively for it to be acceptable.

- a) properties of constituent materials;
- b) characteristic compressive strength;
- c) specified mix proportions;
- d) minimum cement content;
- e) maximum free-water/cement ratio;
- f) workability;
- g) temperature of fresh concrete;
- h) density of fully compacted concrete;
- i) cover to embedded steel;
- j) curing;
- k) tolerances in dimensions;
- l) tolerances in levels;
- m) durability;

- n) surface finishes;
- o) special requirements such as :
 - i. Water tightness
 - ii. resistance to aggressive chemicals
 - iii. resistance to freezing and thawing
 - iv. very high strength
 - v. improved fire resistance
 - vi. wear resistance
 - vii. resistance to early thermal cracking

ENGINEER's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the CONTRACTOR.

For work not accepted, ENGINEER may review and decide whether remedial measures are feasible so as to render the work acceptable. ENGINEER shall in that case direct the CONTRACTOR to undertake the remedial measures. These shall be expeditiously and effectively implemented by CONTRACTOR. Nothing extra shall become payable to CONTRACTOR by OWNER for executing remedial measures.

- o **Mode of Measurement and Payment**

The unit rate for concrete work under various categories shall be all inclusive and no claims for extra payment on account of such items and leaving holes, embedding inserts, etc. shall be entertained unless separately provided for in the Schedule of Quantities. No extra claim shall also be entertained due to change in the number, position and/or dimensions of holes, slots or openings, sleeves, inserts or on account of any increased lift, lead of scaffolding etc. All these factors shall be taken into consideration while quoting the unit rates. Unless provided for in the schedule of Quantities the rates shall also include fixing inserts in all concrete work, whenever required.

Payments for concrete will be made on the basis of unit rates quoted for the respective items in the Schedule of Quantities. No deduction in the concrete quantity will be made for reinforcements, inserts etc. and opening less than 0.100 sq.m in areas where concrete is measured in sq.m and 0.010 cum. where concrete is measured in cubic metres. Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets, etc. will not be made. Similarly, the unit rates for concrete work shall be inclusive or exclusive of shuttering as provided for in the Schedule of Quantities.

Payment for beams will be made for the quantity based on the depth being reckoned from the underside of the slabs and length measured as the clear distance between supports. Payment for columns shall be made for the quantity based on height reckoned upto the underside of slabs.

The unit rate for precast concrete members shall include formwork, mouldings, finishing, hoisting and setting in position including setting mortar, provision of lifting arrangement etc. complete. Reinforcement and inserts shall be measured and paid for separately under respective item rates.

Only the actual quantity of steel embedded in concrete including laps as shown on drawings or as approved by ENGINEER shall be measured and paid for, irrespective of the level or height at which the work is done. The unit rate for reinforcement shall include all wastage, binding wires, chairs, spacer bars etc. for which no separate payment shall be made.

Where the formwork is paid for separately, it shall be very clearly understood that payment for formwork is inclusive of formwork, shuttering, shoring, propping, scaffolding, deshuttering etc. complete. Only the net area of concrete formed (shuttered) shall be measured for payment.

Where reinforcement is supplied by OWNER, the quantity of chairs and spacer bars shall be measured for accounting wastage only.

1.44.3 APPLICABLE CODES AND SPECIFICATIONS

The more important Codes, Standards and Publications applicable to this section are listed hereinafter:

Code Reference	Description
IS: 110	Ready mixed paint, brushing, grey filler, for enamels for use over primers
IS: 269	Specification for 33 grade Ordinary Portland Cement
IS: 280	Specification for mild steel wire for general engineering purposes
IS: 287	Recommendations for maximum permissible moisture content of timber used for different purposes
IS: 383	Specification for coarse and fine aggregates from natural sources for concrete
IS: 456	Code of practice for plain and reinforced concrete
IS: 712	Specification for building limes
IS: 1077	Specification for common burnt clay building bricks
IS: 1124	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones
IS: 1200	Methods of measurement of building and Civil engineering works
IS: 1489 (Part 1)	Portland Pozzolana Cement: Flyash based
IS: 1489 (Part 2)	Portland Pozzolana Cement: Calcined clay based
IS: 1542	Specification for sand for plaster
IS: 1597	Code of practice for construction of stone masonry: Part 1 Rubble stone masonry
IS: 1661	Code of practice for application of cement and cement-lime plaster finishes
IS: 1834	Specification for hot applied sealing compound for joint in concrete
IS: 2074	Ready mixed paint, air drying, red oxide-zinc chrome, priming
IS: 2116	Specification for sand for masonry mortars
IS: 2185	Specification for concrete masonry units (Parts 1 & 2)
IS: 2212	Code of practice for brickwork
IS: 2250	Code of practice for preparation and use of masonry mortars
IS: 2395	Code of practice for painting concrete, masonry and

Code Reference	Description
(Parts 1 & 2)	plaster surfaces (Parts 1 & 2)
IS: 2402	Code of practice for external rendered finishes
IS: 2572	Code of practice for construction of hollow concrete block masonry
IS: 2645	Specification of integral cement waterproofing compounds
IS: 2691	Specification for burnt clay facing bricks
IS: 2750	Steel Scaffoldings
IS: 3620	Specification for laterite stone block for masonry
IS: 3696	Safety code of scaffolds and ladders (Parts 1 & 2)
IS: 4082	Recommendation of Stacking and Storage of construction materials
IS: 5410	Cement paint, colour, as required
IS: 6041	Code of practice construction of autoclaved cellular concrete block masonry
IS: 6042	Code of practice for construction of light weight concrete block masonry
IS: 8042	Specification for white Portland cement
IS: 8112	Specification for 43 grade Ordinary Portland Cement
IS: 12269	Specification for 53 grade Ordinary Portland Cement
Legend	
IS	Indian Standards

1.44.4 QUALITY ASSURANCE AND QUALITY CONTROL

- I. The work shall conform to high standards of design and workmanship, shall be structurally sound and aesthetically pleasing. Quality standards prescribed shall form the backbone for the Quality Assurance and Quality Control system.
- II. At the site level the Contractor shall arrange the materials, their stacking/ storage in appropriate manner to ensure the quality. Contractor shall provide equipment and manpower to test continuously the quality of materials, assemblies, etc., as directed by the Engineer. The tests shall be conducted continuously and the results of tests maintained. In addition, the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of the surface.
- III. The Engineer shall be free to carry out such tests as may be decided by him at his sole discretion, from time to time, in addition to those specified in this document. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples or for the collection of the samples.
 - a) The test shall be conducted at the Site laboratory that may be established by the Contractor or at any other Standard Laboratory selected by the Engineer.
 - b) The Contractor shall transport the samples to the laboratory for which nothing extra shall be payable. In the event of Contractor failing to arrange transportation of the samples in proper time Engineer shall have them transported and recover two times the actual cost from the Contractor's bills.
 - c) The testing charges shall be borne by the Contractor.
 - d) Testing may be witnessed by the Contractor or his authorised representative. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.

1.44.5 AUTOCLAVED AERATED CONCRETE BLOCKS

DEFINITIONS

- AAC unit: Autoclaved Aerated Concrete Unit.
Bed joint: Horizontal mortar joint between two AAC units.
Head joint: Vertical joint between two AAC units.

1.44.5.1 *Material*

Cement: Cement complying with any of the above mentioned Indian Standards may be used at the discretion of the manufacturer

Fly Ash: Use of fly ash conforming to IS:3812 may be permitted to a limit of 20 percent in cement conforming to IS:269. However, it shall be ensured that blending of fly ash with cement is as intimate as possible, to achieve maximum uniformity.

Lime: The lime shall satisfy the requirements for Class C lime Specified in IS : 712

Aggregate: The aggregate used for the manufacture of cellular concrete block shall conform to the following requirements

Sand - Conforming to IS : 383 except for the grading which may be made to suit the product and the silica content shall not be less than 80 percent.

Fly Ash - Conforming to IS : 3812 with loss on ignition not more than 6 percent.

Granulated Blast Furnace Slag - Generally conforming to Note 1 and 2 of 4.2 of IS:455 may be used.

Water: The water used in the manufacture of concrete masonry units shall be free from matter harmful to concrete or reinforcement or matter likely to cause efflorescence in the units and shall meet requirements of IS : 456.

Additives or admixtures: Additives or admixtures may be added, either as additives to the cement during manufacture, or as admixture to the concrete mix. Additives or admixtures used in the manufacture of concrete masonry units may be

- a) accelerating, water-reducing and air-entraining admixtures conforming to IS:9103
- b) waterproofing agents conforming to IS : 2645, and
- c) colouring pigment

Where no Indian Standards apply, the additives or admixtures shall be shown by test or experience, to be not detrimental to the durability of the concrete

1.44.5.2 *Project Conditions*

1.44.5.2.1 Cold weather precautions for AAC masonry work:

When temperature of AAC units is below -6°C , do not install. Remove visible ice on AAC units prior to installation. Use of de-icing chemicals on AAC is prohibited. Heat mortar sand or mixing water to produce mortar temperatures between 5°C and 48°C at time of mixing. Maintain mortar temperature above freezing until placed.

i. Ambient temperature requirements:

Between -4°C and -5°C : Use heat sources on both sides of AAC walls under construction. Install wind breaks when wind velocity is in excess of 15 mph.

Below -5°C : Provide enclosure for AAC walls under construction. Use heat sources to maintain temperatures above 0°C within enclosures.

ii. Daily mean temperature requirements:

Between 5°C and 0°C : Protect completed AAC walls from rain or snow by covering with weather resistive membrane for a minimum of 24 hours after construction.

Between 0°C and -4°C : Completely cover completed AAC walls with weather resistive membrane for a minimum of 24 hours after construction.

Between -4°C and -5°C : Completely cover completed AAC walls with insulating blankets or equal protection for a minimum of 24 hours after construction.

Below -5°C : Maintain AAC wall construction above 0°C for 24 hours after completion by enclosure with supplementary heat, electric heating blankets, infrared heat lamps, or other acceptable methods outlined to Architect.

1.44.5.2.2 Hot weather precautions for AAC masonry work:

When erected in ambient air temperature of 38°C or ambient air temperature of 32°C with wind velocity in excess of 13 kmph, implement the following: Protect AAC wall construction from direct exposure to wind and sun. Spreading mortar beds more than 1.2m ahead of AAC units is prohibited. Setting AAC unit more than one minute after spreading mortar is prohibited.

1.44.5.3 *Sequencing And Scheduling*

Loading AAC unit walls or columns is prohibited prior to the following:

Uniform floor or roof loads: 12 hours, minimum.

Concentrated loads: Three days, minimum.

Construction activities coordination specified in other Sections for work built into walls:

Work required under this Section includes chase and routing coordination with construction activities specified in other Sections.

As walls are completed, coordinate with work required in other Sections for chases or routing areas required in AAC walls for electrical, plumbing, and other items.

Request relevant construction activities to mark actual routing or chase locations; include required depth.

1.44.5.4 *Size and Properties of Blocks*

Autoclaved aerated concrete mixture consisting of quartz, sand, lime, cement, proprietary additives, and water.

Table 1-12. Size and Properties

Particulars	Units	Sizes / Values
Size	mm	625x240xthickness
Thickness	mm	75,100,125,150,200,230,300
Compressive Strength	N/mm ²	3.5-4.0 (IS 2185)
Dry Density (Over dry)	Kg/m ³	550-650
Sound Absorption	dB	Upto 42
Fire Resistance	Hrs	4*
Thermal Conductivity 'K'	w/mk	0.16
Thermal Resistance	K-m ² /W	0.46
Heat Transmission Coefficient 'u'	w/m ² k	2.17
Drying Shrinkage	%	0.04% (of the length of block)

*For 200mm thick wall

1.44.5.5 *Protection:*

Keep walls dry during erection by covering at end of each work period with non-staining waterproof membrane covering. Protect partially completed walls not being worked on with non-staining waterproof membrane until construction activities specified in other sections completes protection of walls.

Covering: Overhang at least 600mm on each side of wall; anchor on each side of wall. Protect finished exposed work from stains. Take particular care to keep AAC units clean. Brace walls during construction to protect from wind damage.

1.44.5.6 *Workmanship:*

Lay AAC units plumb, level, and true to line for range. Lay units in running bond with 100mm minimum head joints lap in alternate courses. Cut AAC units with unit manufacturer recommended hand type saw or electric bandsaw specially designed for cutting AAC units. Lay out units to minimize cutting. Proper dust protection is recommended when cutting AAC.

Delivery, Storage, And Handling: Offload AAC units with pallets resting on ground. Placing AAC units in direct contact with earth is prohibited. Protect AAC units from oil and chemical staining.

1.44.5.6.1 Building in other work:

Install work of other sections required to be incorporated with AAC units as work progresses; include anchors, and accessories. Space and align built-in parts; exercise care not to disturb other materials from position.

Fill in interior spaces around built-in items with fine grout or interior plaster. Fill in exterior spaces around built-in items with fine grout or stucco. Fill hollow metal frames in AAC unit walls with fine grout as wall is laid. Rake back 12mm joint between hollow metal frame and adjacent AAC unit to receive sealant at butt type frames.

1.44.5.6.2 Mortar joints:

Head and bed joints:

Lay first course in full bed of leveling bed mortar in thickness necessary to level AAC unit top; not less than 12mm.

Apply AAC unit head joint and bed joint mortar on full face of AAC unit already laid.

Make adjustment while mortar is still soft and plastic by tapping to plumb and bringing to alignment.

Check each AAC unit as laid with mason's level for level and plumb with wall below.

Remove and replace mortar with fresh mortar, where adjustment must be made after mortar has started to set.

Keep bed and head joints uniform in width.

Standard thickness for both horizontal and vertical mortar joints:

Base course bed joint: 12mm nominal, +/- 6mm.

Other vertical coursing and head joints: 2mm, nominal.

Take particular care to avoid spreading mortar on exposed face of AAC unit. Only normal mortar droppings will be accepted on face of AAC unit; remove only after mortar has dried enough not to smear.

1.44.5.6.3 Grout Filled Cells

Provide a clean-out opening at the base of the AAC wall at each vertical reinforcing bar locations. Remove debris through-out from core area prior to placement of concrete grout. Pre-wet the core cells with clean water prior to placement of concrete grout. Fill core cell with concrete grout using appropriate lift procedures to avoid wall blow-outs. Consolidate the grout filled core with a needle vibratory device.

1.44.5.6.4 Flexible flashing:

Clean AAC unit surfaces smooth; maintain free from projections capable of puncturing flashing material. Follow requirements indicated in Flexible Flashing Section. Joint treatment: Remove excess extruded mortar immediately after laying AAC unit; tooling joints is not required.

1.44.5.6.5 Control joints:

Make joint 12mm wide, unless indicated otherwise, rake out control joints to depth of 20" while mortar is still plastic. Provide joints at 4.5m O.C. unless otherwise indicated. Follow recommendations of finish manufacturer for proper treatment at control joints when finish is applied directly to AAC surface. Chases routed on wall surface are considered to act as a control joint. Leave joint open and clean for caulking in accord with Joint Sealants Section.

1.44.5.6.6 Tolerances:

Maximum variation from plumb: 6mm in 3m; not to exceed 10mm in 6m.

Maximum variation from level: 6mm in 6m, not to exceed 12mm in 15m or more.

Maximum variation in linear building line from location indicated: 6mm in 6m.

Cleaning And Patching

Keep AAC unit work free of mortar droppings as work progresses and, at completion of work, rub AAC unit to remove excess mortar. Patch AAC units with excessive spalls or chips.

1.44.5.7 *Measurement*

Measurement shall be in cum correct to two places of decimal for blockwork of thickness one brick i.e. 75mm/ 100mm/ 125mm and above. Measurement shall be for the quantities as actually executed duly deducting for openings, lintels, transoms/ mullions, etc. All concrete works shall be measured and paid for separately under the respective items of work.

Rate shall include the following:

- (a) Making openings for pipes, conduits, ducts etc. and closing the same after completion of such works and finishing as directed.
- (b) Providing openings at exact locations and exact sizes.
- (c) Making one layer of masonry layout and obtaining Engineer's approval before proceeding with further layer.

1.44.5.8 *BRICKWORK*

1.44.5.8.1 *Materials*

Bricks used in the works shall conform to the requirements laid down in IS: 1077. The class of the bricks shall be as specifically indicated in the respective items of work.

The nominal size of the modular brick shall be 200 mm x 100 mm x 100 mm with the permissible tolerances over the actual size of 190 mm x 90 mm x 90 mm as per IS: 1077. The nominal thickness of one brick and half brick walls using modular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of traditional bricks of nominal size 230 mm x 115 mm x 75 mm with tolerance up to ± 3 mm in each dimension, one brick and half brick walls shall be considered as 230 mm and 115 mm respectively.

Bricks shall be sound, hard, homogenous in texture, well burnt in kiln without being vitrified, hand/ machine moulded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. Hand moulded bricks shall be moulded with a frog and those made by extrusion process may not be provided with a frog. Bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 5 N/mm² unless otherwise specified in the items of work.

The average water absorption shall not be more than 20% by weight up to class 12.5 and 15% by weight for higher classes. Bricks which do not conform to this requirement shall be rejected. Over or under burnt bricks are not acceptable for use in the works.

Sample bricks shall be submitted to the Engineer for approval and bricks supplied shall conform to approved samples. If demanded by Engineer, brick samples shall be got tested as per IS: 3495 by Contractor. Bricks rejected by Engineer shall be removed from the site of works within 24 hours.

Mortar for brick masonry shall consist of cement and sand and shall be prepared as per IS: 2250. Mix shall be in the proportion of 1:5 for brickwork of thickness one brick or above and 1:4 for brickwork of thickness half brick or below, unless otherwise specified in the respective items of work. Sand for masonry mortar shall conform to IS: 2116. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by Engineer. If so directed by the Engineer, sand shall be screened and washed till it satisfies the limits of deleterious materials.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Mixing shall be done thoroughly in a mechanical mixer, unless hand mixing is specifically permitted by the Engineer. The mortar thus mixed shall be used as soon as possible, preferably within 30 minutes from the time water is added to cement. In case, the mortar has stiffened due to evaporation of water, this may be re-tempered by adding water as required to restore consistency, but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar, which is partially set shall be rejected and shall be removed forthwith from the site. Droppings of mortar shall not be re-used under any circumstances.

The Contractor shall arrange for test on mortar samples if so directed by the Engineer.

1.44.5.8.2 Workmanship

Workmanship of brick work shall conform to IS: 2212. All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work. Brick work 200 mm/ 230 mm/ 250 mm thick and over shall be laid in English Bond unless otherwise specified. 100 mm/ 115 mm/ 125 mm thick brickwork shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be slightly pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Only full size bricks shall be used for the works and cut bricks utilised only to make up required wall length or for bonding. Bricks shall be laid with frogs uppermost.

All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. In case of one brick thick or half brick thick wall, at least one face should be kept smooth and plane, even if the other is slightly rough due to variation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. All interconnected brickwork shall be carried out at nearly one level so that there is uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45°. But in no case the level difference between adjoining walls shall exceed one metre. Brick work shall not be raised more than one metre per day.

Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 10 mm/ 15 mm by raking tools during the progress of work when the mortar is still green, so as to provide a proper key for the plastering/ pointing respectively to be done later. When plastering or pointing is not required to

be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top.

During inclement weather conditions, newly built brick masonry works shall be protected by tarpaulin or other suitable covering to prevent mortar being washed away by rain.

Brickwork shall be kept constantly moist on all the faces for at least seven days after 24 hrs of laying. The arrangement for curing shall be got approved from the Engineer.

Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in IS: 2750 and IS: 3696 (Part I). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on important works and will be permitted only in certain cases as decided by the Engineer. Where single scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good before plastering/ pointing.

In the event of usage of traditional bricks of size 230 mm x 115 mm x 75 mm or local bricks of size 250 mm x 125 mm x 75 mm, the courses at the top of the plinth and sills as well as at the top of the wall just below the roof/ floor slabs and at the top of the parapet shall be laid with bricks on edge.

A rendering of cement mortar 1:4 rough coat plaster shall be applied on Reinforced Cement Concrete (RCC) surfaces, which are in contact with masonry before starting masonry. All brickwork shall be built tightly against columns, floor slabs or other structural members.

To overcome the possibility of development of cracks in the brick masonry following measures shall be adopted.

RCC/ steel beams resting on masonry wall shall be provided with reinforced concrete bed blocks of 50 mm thickness, projecting 50 mm on either sides of the beam, duly finished on top with 2 layers of Kraft paper Grade 1 as per IS: 1397 or 2 layers of 50 micron thick polyethylene sheets.

PVC mesh fabric shall be provided at the junction of brick masonry and concrete before taking up plastering work.

Bricks for partition walls shall be stacked adjacent to the structural member to pre-deflect the structural member before the wall is taken up for execution. Further, the top most course of half or full brick walls abutting against either a deshuttered slab or beam shall be built only after any proposed masonry wall above the structural member is executed to cater for the deflection of the structural element.

Reinforced cement concrete transoms and mullions of dimensions as indicated in the construction drawings are generally required to be provided in the half brick partition walls.

Where the drawings indicate that structural steel sections are to be encased in brickwork, the brick masonry shall be built closely against the steel section, ensuring a minimum of 20 mm thick cement-sand mortar 1:4 over all the steel surfaces. Steel sections partly embedded in brickwork shall be provided with bituminous protective coating to the surfaces at the point of entry into the brick masonry.

Contractor shall note that the unit rates quoted for the masonry work shall be deemed to include for the installation of miscellaneous inserts such as pipe sleeves, bolts, steel sections with anchors, etc. and provide pockets, leaving openings, cutting chases, etc. in accordance with the construction drawings. Miscellaneous inserts shall be either supplied free by the Owner or to be furnished by the Contractor as per item description or as shown in drawings. Any of the miscellaneous inserts which are required to be fabricated and supplied by the Contractor and cement concrete to be provided in the pockets for holdfasts of door/ window frames, etc. shall however, be measured and paid for separately under the respective items of work.

Facing bricks of the type specified conforming to IS: 2691 shall be laid in the positions indicated on the drawings and all facing brickwork shall be well bonded to the backing bricks/ RCC surfaces. The level of execution of the facing brick work shall at any time be lower by at least 600 mm below the level of the backing brickwork.

Facing bricks shall be laid over 10 mm thick backing of cement mortar. The mortar mix, thickness of joint and the type of pointing to be carried out shall be as specified in the item of works. The pattern of laying the bricks shall be as specifically indicated in the drawings.

For facing brickwork, double scaffolding shall be used.

Faced works shall be kept clean and free from damage, discoloration, etc., at all times.

1.44.5.8.3 Measurement

Measurement shall be in cum correct to two places of decimal for brickwork of thickness one brick i.e. 200 mm/ 230 mm/ 250 mm and above. Measurement shall be in sqm correct to two places decimal for facing brickwork and brickwork of thickness half brick i.e. 100mm/ 115mm/ 125 mm and below. Measurement shall be for the quantities as actually executed duly deducting for openings, lintels, transoms/ mullions, etc. All concrete works shall be measured and paid for separately under the respective items of work.

Rate shall include the following:

Making openings for pipes, conduits, ducts etc. and closing the same after completion of such works and finishing as directed.

Providing openings at exact locations and exact sizes.

Making one layer of masonry layout and obtaining Engineer's approval before proceeding with further layer.

M20 RCC Patli beam including shuttering for 75 mm/ 115 mm brick work.

1.44.5.9 *UNCOURSED RANDOM RUBBLE MASONRY IN FOUNDATION, PLINTH AND SUPERSTRUCTURE*

1.44.5.9.1 Materials

Stones for the works shall be of the specified variety which is hard, durable, fine grained and uniform in colour (for superstructure work) free from veins, flaws and other defects. Quality and work shall conform to the requirements specified in IS: 1597 (Part-I). The percentage of water absorption shall not exceed 5% as per test conducted in accordance with IS: 1124. The Contractor shall supply sample stones to the Engineer for approval. Stones shall be laid with its grains horizontal so that the load transmitted is always perpendicular to the natural bed.

Cement-sand mortar for stone masonry works shall be in the proportion of 1:6. Materials and preparation of mortar shall be as specified or as directed by ENGINEER.

1.44.5.9.2 Workmanship

For all works below ground level the masonry shall be random rubble un-coursed with ordinary quarry dressed stones for the hearting and selected quarry dressed stones for the facing.

For all works above ground level and in superstructure the masonry shall be random rubble un-coursed, well bonded, faced with hammer dressed stones with squared quoins at corners. The bushings on the face shall not be more than 40 mm on an exposed face and on the face to be plastered it shall not project by more than 12 mm nor shall it have depressions more than 10 mm from the average wall surface.

Face stones shall extend back sufficiently and bond well with the masonry. The depth of stone from the face of the wall inwards shall not be less than the height or breadth at the face. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three-fourths the thickness of wall nor less than 150 mm. The height of stone may be up to a maximum of 300 mm. Face stones or hearting stones shall not be less than 150 mm in any direction.

Chips and spalls shall be used wherever necessary to avoid thick mortar joints and to ensure that no hollow spaces are left in the masonry. The use of chips and spalls in the hearting shall not exceed 20% of the quantity of stone masonry. Spalls and chips shall not be used on the face of the wall and below hearting stones to bring them to the level of face stones.

The maximum thickness of joints shall not exceed 20 mm. All joints shall be completely filled with mortar. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool during the progress of the work while the mortar is still green.

Through or bond stones shall be provided in walls up to 600 mm thick and in case of walls above 600 mm thickness, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous lime stone and sand stone, etc.) the bond stone shall extend about two-thirds into the wall and a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. Each bond stone or a set of bond stones shall be provided for every 0.5 sqm of wall surface.

All stones shall be sufficiently wetted before laying to prevent absorption of water from the mortar. All connected walls in a structure shall be normally raised uniformly and regularly. However, if any part of the masonry is required to be left behind, the wall shall be raked back (and not saw toothed) at an angle not exceeding 45°. Masonry work shall not be raised by more than one metre per day.

Green work shall be protected from rain by suitable covering. Masonry work shall be kept constantly moist on all the faces for a minimum period of seven days for proper curing of the joints.

Type of scaffolding to be used shall be as specified in Clause 1.44.5.8.2.

1.44.5.9.3 Measurement

Measurement shall be in cum correct to two places of decimal. The quantities measured and paid for, shall be those as actually executed after making necessary deductions for openings, lintels, etc.

1.44.5.10 CONCRETE BLOCK MASONRY

1.44.5.10.1 Materials

Masonry units of hollow and solid concrete blocks shall conform to the requirements of IS: 2185 (Part 1).

Masonry units of hollow and solid light-weight concrete blocks shall conform to the requirements of IS: 2185 (Part 2).

Masonry units of autoclaved cellular concrete blocks shall conform to the requirements of IS: 2185 (Part 3).

The height of the concrete masonry units shall not exceed either its length or six times its width.

The nominal dimensions of concrete block shall be as under.

Length 400, 500 or 600 mm

Height 100 or 200 mm

Width 100 to 300 mm in 50 mm increments

Half blocks shall be in lengths of 200, 250 or 300mm to correspond to the full length blocks. Actual dimensions shall be 10mm short of the nominal dimensions.

The maximum variation in the length of the units shall not be more than ± 5 mm and maximum variation in height or width of the units shall not be more than ± 3 mm.

Concrete blocks shall be either hollow blocks with open or closed cavities or solid blocks.

Concrete blocks shall be sound, free of cracks, chipping or other defects which impair the strength or performance of the construction. Surface texture shall as specified. The faces of the units shall be flat and rectangular, opposite faces shall be parallel and all arises shall be square. The bedding surfaces shall be at right angles to the faces of the block.

The concrete mix for the hollow and solid concrete blocks/ light weight concrete blocks shall not be richer than one part of cement to six parts of combined aggregates by volume.

Concrete blocks shall be of approved manufacture, which satisfy the limitations in the values of water absorption, drying shrinkage and moisture movement, as specified for the type of block as per relevant IS code. Contractor shall furnish the test certificates and also supply the samples for the approval of Engineer.

1.44.5.10.2 Workmanship

The type of the concrete block, thickness and grade based on the compressive strength for use in load bearing and/ or non-load bearing walls shall be as specified. The minimum nominal thickness of non-load bearing internal walls shall be 100 mm. The minimum nominal thickness of external panel walls in framed construction shall be 200 mm.

The workmanship shall generally conform to the requirements of IS: 2572 for concrete block masonry IS: 6042 for light weight concrete block masonry and IS: 6041 for autoclaved cellular concrete block masonry works.

From considerations of durability, generally concrete block masonry shall be used in superstructure works above the damp-proof course level.

Concrete blocks shall be embedded with a mortar, which is relatively weaker than the mix of the blocks in order to avoid the formation of cracks. Cement mortar of proportion 1:6 shall be used for the works. Preparation of mortar shall be as specified and as directed by ENGINEER.

The thickness of both horizontal and vertical joints shall be 10mm. The first course shall be laid with greater care, ensuring that it is properly aligned, levelled and plumb since this will facilitate in laying succeeding courses to obtain a straight and truly vertical wall. For the horizontal (bedding) joint, mortar shall be spread over the entire top surface of the block including front and rear shells as well as the webs to a uniform layer of 10mm. For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. The mortar may be applied either to the unit already placed on the wall or on the edges of the succeeding unit when it is standing vertically and then placing it horizontally, well pressed against the previously laid unit to produce a compacted vertical joint. In case of two cell blocks with slight depression on the vertical sides these shall also be filled up with mortar to secure greater lateral rigidity. To assure satisfactory bond, mortar shall not be spread too far ahead of actual laying of the block as the mortar will stiffen and lose its plasticity while hardening shrinks slightly and thus pulls away from the edges of the block. The mortar shall be pressed against the units with a jointing tool after it has stiffened to effect intimate contact between the mortar and the unit to obtain a weather tight joint. The mortar shall be raked to a depth of 10 mm as each course is laid to ensure good bond for the plaster.

Dimensional stability of hollow concrete blocks is greatly affected by variations of moisture content in the units. Only well dried blocks should be used for the construction. Blocks with moisture content more than 25% of maximum water absorption permissible shall not be used. The blocks should not be wetted before or during laying in the walls. Blocks should be laid dry except slightly moistening their surfaces on which mortar is to be applied to obviate absorption of water from the mortar.

As per the design requirements and to effectively control cracks in the masonry, RCC bound beams/studs, joint reinforcement shall be provided at suitable locations. Joint reinforcement shall be fabricated either from mild steel wires conforming to IS: 280 or welded wire fabric/high strength deformed basis as per the drawings.

For jambs of doors, windows and openings, solid concrete blocks shall be provided. If hollow units are used, the hollows shall be filled with concrete of mix 1:3:6. Hold fasts of doors/windows should be arranged so that they occur at block course level.

At intersection of walls, the courses shall be laid up at the same time with a true masonry bond between at least 50% of the concrete blocks. The sequence for construction of partition walls and treatment at the top of load bearing walls for the RCC slab shall be as detailed under Clause 1.44.5.8.2 for the brick work.

Curing of the mortar joints shall be carried out for at least 7 days. The walls should only be lightly moistened and shall not be allowed to become excessively wet.

Double scaffolding as per Clause 1.44.5.8.2 shall be adopted for execution of block masonry work.

Cutting of the units shall be restricted to a minimum. All horizontal and vertical dimensions shall be in respectively, adopting modular co-ordination for walls, opening locations for doors, windows, etc.

Concrete blocks shall be stored at site suitably to avoid any contact with moisture from the ground and covered to protect against wetting.

1.44.5.10.3 Measurement

Measurement shall be in cum. correct up to two places of decimal for walls of thickness 200 mm and above. Measurement shall be in sqm correct up to two places of decimal for walls of 100 mm/ 150 mm in thickness. Measurement shall be for the

quantities as actually executed duly deducting for openings and concrete works. Concrete and reinforcement will be measured and paid for separately. The rate quoted shall be for the type of masonry blocks specified in the respective items of work, which shall include for the specific sequential operations as stipulated in the construction drawings.

1.44.5.11 *RUBBLE SUB-BASE*

1.44.5.11.1 Materials

Stones used for rubble packing under floors on grade, foundations, etc., shall be clean, hard, durable rock free from veins, flaws, laminations, weathering and other defects. Stones shall generally conform to the requirements stipulated in IS: 1597 (Part I).

Stones shall be as regular as can be obtained from quarries. Stones shall be of height equal to the thickness of the packing proposed with a tolerance of ± 10 mm. Stones shall not have a base area neither less than 250 cm² nor more than 500 cm², and the smallest dimension of any stone shall not be less than half the largest dimension. The quality and size of stones shall be subject to the approval of the Engineer.

1.44.5.11.2 Workmanship

Stones shall be hand packed carefully and laid with their largest base downwards resting flat on the prepared sub-grade and with their height equal to the thickness of the packing. Stones shall be laid breaking joints and in close contact with each other. All interstices between the stones shall be wedged-in by small stones of suitable size, well driven in by crow bars and hammers to ensure tight packing and complete filling-in of the interstices. The wedging shall be carried out simultaneously with the placing in position of rubble packing and shall not lag behind. After this, any interstices between the smaller wedged stones shall be filled with clean hard sand by brooming so as to fill the joints completely.

The laid rubble packing shall be sprinkled with water and compacted by using suitable rammers.

1.44.5.11.3 Measurement

Measurement shall be in sqm correct to two places of decimal for the specified compacted thickness of rubble sub-base.

1.44.5.12 *BASE CONCRETE*

The thickness and grade of concrete and reinforcement shall be as specified in items of work.

Before placing the blinding concrete, the sub-base of rubble packing shall be properly wetted and rammed. Concrete for the base shall then be deposited between the forms, thoroughly tamped and the surface finished level with the top edges of the forms. Two or three hours after the concrete has been laid in position, the surface shall be roughened using steel wire brush to remove any scum or laitance and swept clean so that the coarse aggregates are exposed. The surface of the base concrete shall be left rough to provide adequate bond for the floor finish to be provided later.

1.44.5.12.1 Measurement

Measurement shall be in sqm correct to two places of decimal. This work could be either separate or combined along with the floor finish as indicated in the respective items of work.

1.44.5.13 *DAMP - PROOF COURSE*

1.44.5.13.1 Materials And Workmanship

Where specified, all the walls in a building shall be provided with damp-proof course cover plinth to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall, even under the door or other openings. Damp-proof course shall consist of 50 mm thick cement concrete of 1:2:4 nominal mix with approved water-proofing compound admixture conforming to IS: 2645 in proportion as directed by the manufacturer. Concrete shall be with 10 mm downgraded coarse aggregates.

The surface of brick work/stone masonry work shall be levelled and prepared before laying the cement concrete. Side shuttering shall be properly fixed to ensure that slurry does not leak through and is also not disturbed during compaction. The upper and side surface shall be made rough to afford key to the masonry above and to the plaster.

Damp-proof course shall be cured properly for at least seven days after which it shall be allowed to dry for taking up further work.

1.44.5.13.2 Measurement

Measurement of damp-proof course shall be in sq.m correct to two places of decimal as actually executed. No separate payment will be made for formwork.

1.44.5.14 *CEMENT PLASTERING WORK*

1.44.5.14.1 Materials

The proportions of the cement mortar for plastering shall be 1:4 (one part of cement to four parts of sand). Cement and sand shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS standards. The quality and grading of sand for plastering shall conform to IS: 1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the Engineer. If so desired by the Engineer, the sand for internal and external plaster shall be machine washed to restrict silt content of sand to less than 2% by volume of sand to meet the Specifications. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re-tempered by adding water as required to restore consistency, but this will be permitted only up to 30 minutes from the time of initial mixing of water to cement. Any mortar, which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances.

1.44.5.14.2 Workmanship

Preparation of surfaces and application of plaster finishes shall generally conform to the requirements specified in IS: 1661 and IS: 2402.

Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/ window panels, pipes, conduits, etc. are completed.

All joints in masonry shall be raked as the work proceeds to a depth of 10 mm/ 20 mm for brick/ stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean water to remove all dirt, loose materials, etc. Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. Hacking of concrete surfaces shall be about 144 hacks of 8-10 mm deep per square feet of surface area to be hacked. Excess bulges and uneven surfaces must be removed and chipped properly to line and level and no additional payment shall be made for this work. The masonry surfaces should not be too wet, but only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

Interior plain faced plaster - This plaster shall be laid in a single coat of 12 mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall be carried out on jambs, lintel and sill faces, etc. as shown in the drawing and as directed by the Engineer. In case more than 12 mm/ 10 mm thick plaster has to be rendered to the RCC surface then, the same has to be rendered in layers of maximum 15 mm thick each. This plaster has to be cured for at least 3 days before applying the subsequent or final neeru layer. Contractors quoted rate for plastering is deemed to include for above provision.

Plain Faced Ceiling plaster - This plaster shall be applied in a single coat of 6 mm thickness. Application of mortar shall be as stipulated in above paragraph.

Exterior plain faced plaster - This plaster shall be applied in 2 coats. The first coat or the rendering coat shall be approximately 14 mm thick. The rendering coat shall be applied as stipulated above except finishing it to a true and even surface and then lightly roughened by cross scratch lines to provide bond for the finishing coat. The rendering coat shall be cured for at least two days and then allowed to dry. The second coat or finishing coat shall be 6 mm thick. Before application of the second coat, the rendering coat shall be evenly damped. The second coat shall be applied from top to bottom in one operation without joints and shall be finished leaving an even and uniform surface. The mortar proportions for the coats shall be as specified in the respective item of work. The finished plastering work shall be cured for at least 7 days.

Interior plain faced plaster 20 mm thick if specified for uneven faces of brick walls or for random/ coursed rubble masonry walls shall be executed in 2 coats similar to the procedure stipulated in above paragraph.

Exterior Sand Faced Plaster - This plaster shall be applied in 2 coats. The first coat shall be approximately 14 mm thick and the second coat shall be 6 mm thick. These coats shall be applied as stipulated above. However, only approved quality white sand shall be used for the second coat and for the finishing work. Sand for the finishing work shall be coarse and of even size and shall be dashed against the surface and sponged. The mortar proportions for the first and second coats shall be as specified in the respective items of work.

Wherever more than 20 mm thick plaster has been specified, which is intended for purposes of providing beading, bands, etc. this work shall be carried out in two or three coats as directed by the Engineer duly satisfying the requirements of curing each coat (rendering/ floating) for a minimum period of 2 days and curing the finished work for at least 7 days.

In the case of pebble faced finish plaster, pebbles of approved size and quality shall be dashed against the final coat while it is still green to obtain as far as possible a uniform pattern all as directed by the Engineer.

Where specified in the drawings, rectangular grooves of the dimensions indicated shall be provided in external plaster by means of timber battens when the plaster is still in green condition. Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the drawings.

Curing of plaster shall be started as soon as the applied plaster has hardened sufficiently so as not to be damaged when watered. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

For waterproofing plaster, the Contractor shall provide the water-proofing admixture as specified in manufacturer's instructions while preparing the cement mortar.

For external plaster, the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for the walls shall commence at the top and carried downwards. Plastering shall be carried out to the full length of the wall or to natural breaking points like doors/ windows, etc. Ceiling plaster shall be completed first before commencing wall plastering.

Double scaffolding to be used shall be as specified in Clause 1.44.5.8.2.

The finished plaster surface shall not show any deviation more than 4 mm when checked with a straight edge of 2 m length placed against the surface.

To overcome the possibility of development of cracks in the plastering work following measures shall be adopted:

Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.

PVC fabric shall be provided at the junction of brick masonry and concrete to overcome reasonably the differential drying shrinkage/ thermal movement.

Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

1.44.5.14.3 Measurement

Measurement for plastering work shall be in sqm correct to two places of decimal. Unless a separate item is provided for grooves, mouldings, etc., these works are deemed to be included in the unit rates quoted for plastering work. The quantity of work to be paid for under these items shall be calculated by taking the projected surface of the areas plastered after making necessary deductions for openings for doors, windows, fan openings, etc. The actual plaster work carried out on jambs/ sills of windows, openings, etc. shall be measured for payment.

Rate shall include the following:

Taking reference level pads in CM 1:4 for lines, plumb, right angles, etc. at all corners including edge of beams, columns, doors and window jambs. This level pad, required for accurate working, shall be taken at the skirting level height.

Making and finishing the openings of electrical switch boxes, ceiling points, etc.

Labour required for mixing additional admixture for the improvement of quality.

1.44.5.15 CEMENT POINTING

1.44.5.15.1 Materials

The cement mortar for pointing shall be in the proportion of 1:3 (one part of cement to three parts of fine sand). Sand shall conform to IS: 1542 and shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by Engineer and if so directed it shall be washed/ screened to meet specification requirements.

1.44.5.15.2 Workmanship

Where pointing of joints in masonry work is specified, the joints shall be raked at least 15 mm/ 20 mm deep in brick/ stone masonry respectively as the work proceeds when the mortar is still green.

Any dust/ dirt in the raked joints shall be brushed out clean and the joints shall be washed with water. The joints shall be damp at the time of pointing. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be disturbed after it has once begun to set. The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk or 'V' as may be specified in the respective items of work. No false joints shall be allowed.

The work shall be kept moist for at least 7 days after the pointing is completed. Whenever coloured pointing has to be done, the colouring pigment of the colour required shall be added to cement in such proportions as recommended by the manufacturer and as approved by the Engineer.

1.44.5.15.3 Measurement

The quantity of work to be paid for under this item shall be measured in sqm correct to two places of decimal by taking the projected surface of the area pointed after making necessary deductions for openings, etc.

1.44.5.16 PAINTING OF CONCRETE, MASONRY AND PLASTERED SURFACES

1.44.5.16.1 Materials

Oil bound distemper shall conform to IS: 428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper.

Cement paint shall conform to IS: 5410. The primer shall be a thinned coat of cement paint.

Lead free acid, alkali and chlorine resisting paint shall conform to IS: 9862.

White wash shall be made from good quality fat lime conforming to IS: 712. It shall be slaked at site and mixed with water in the proportion of 5 litres of water to 1 kg of unslaked lime stirred well to make a thin cream. This shall be allowed to stand for a minimum period of one day and strained through a clean coarse cloth. Four kg of gum dissolved in hot water shall be added to each cum of cream. 1.30 kg of sodium chloride dissolved in hot water shall then be added per 10 kg of lime used for the white wash to be ready for application.

Colour wash shall be made by addition of a suitable quantity of mineral pigment, not affected by lime, to the prepared white wash to obtain the shade/ tint as approved by the Engineer.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the Engineer for the brand of manufacture and the colour/ shade. All materials shall be brought to the site of works in sealed containers.

1.44.5.16.2 Workmanship

Contractor shall obtain the approval of the Engineer regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting.

Painting of new surfaces shall be deferred as much as possible to allow for thorough drying of the sub- strata.

The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence. Efflorescence shall be removed only by dry brushing of the growth. Cracks shall be filled with Gypsum. Workmanship of painting shall generally conform to IS: 2395.

Surfaces of doors, windows, floors, fittings, fixtures, etc. shall be protected suitably to prevent paint finishes from splashing on them. In case of any splashing and/ or droppings, the same shall be thoroughly cleaned to the satisfaction of the Engineer.

1.44.5.16.3 White Wash

The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other from top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of 2 coats shall be applied unless otherwise specified. The dry surface shall present a uniform finish without any brush marks.

1.44.5.16.4 Colour Wash

Colour wash shall be applied in the same way as for white wash. A minimum of 2 coats shall be applied unless otherwise specified. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs of peeling/ powdery and come off readily on the hand when rubbed.

1.44.5.16.5 Cement Paint

The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Waterproof cement paint of "Snowcem Plus" or approved equivalent make and of approved shade and colour shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat of cement paint. The quantity of thinner shall be as per manufacturer's instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint film free from pinholes for effective water proofing in addition to decoration. Cement paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 kg/m². A minimum of 2 coats of the same colour shall be applied. At least 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day. Curing shall commence after about 12 hours when the paint

hardens. Curing shall be continued for at least 2 days after the application of final coat. The operations for brushing each coat shall be as detailed above.

1.44.5.16.6 Oil Bound Distemper

The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for at least 48 hours. In case, white wash has been applied to the surface then, the surface shall be cleaned and the coat of white wash shall be scraped by sand papering, and holes and surface defects repaired with Plaster of Paris (POP) punning and allowed to set hard. All cracks shall be opened wide as V-notch and filled with crack sealant approved by the Engineer. All irregularities shall be removed by sand papering and wiped clean. The surface so prepared shall be completely dry and free from dust before application of distemper is commenced. A minimum of two coats of oil bound distemper shall be applied, unless otherwise specified. The first coat shall be of a lighter tint. At least 24 hours shall be left after the first coat to become completely dry before the application of the second coat. Broad, stiff, double bristled distemper brushes shall be used for the work. The operations for brushing each coat shall be as detailed above.

1.44.5.16.7 Acid, Alkali Resisting Paint

A minimum of 2 coats of acid/ alkali resisting paint shall be applied over the prepared dry surfaces by brushing. Primer coat shall be as per manufacturer's instructions.

1.44.5.16.8 Plastic Emulsion Paint

The prepared surface shall be dry and provided with one coat of primer, which shall be a thinned coat of emulsion paint. The quantity of thinner shall be as per manufacturer's instructions.

Priming coat shall be applied to the surface by brush and allowed to dry properly. Holes and depressions shall be filled with putty prepared with whitener and plastic emulsion paint and rubbed smooth and dry. Surface shall be cleaned and all cracks, holes and surface defects repaired with gypsum and allowed to set hard. All irregularities shall be removed by sand papering smooth and wiped clean. Surface so prepared shall be completely dry and free from dust before painting is commenced.

The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off constitutes one coat. The next coat shall be applied only after the first coat has dried and sufficiently become hard which normally takes about 2 to 3 hours. A minimum of 2 finishing coats of the same colour shall be applied unless otherwise specified. The application of paint shall be finally finished by using rollers. The surface on finishing shall present a flat velvety smooth finish and uniform in shade without any patches.

1.44.5.16.9 Acrylic Emulsion Paint

Acrylic emulsion paint shall be applied in the same way as for plastic emulsion paint. A minimum of 2 finishing coats over one coat of primer shall be provided unless otherwise specified.

1.44.5.16.10 Measurement

Measurement shall be in sqm correct to two places of decimal. Measurement shall be for the areas as executed duly deducting for any openings, etc. Rate quoted shall take into account the provision of necessary enabling works such as scaffolding (single/ double) including erection and removal, painter's cradle, etc.

Rates shall include the following:

- a) Application of the specified number of coats of approved paint including priming coat and application of extra coat(s) as directed where proper, even surface or shade is not obtained and final approval of Engineer.
- b) Application of additional priming or other preparatory coat(s) to obtain thoroughly saturated surfaces and filling with putty as required and/ or as directed.
- c) Extra cost of painting smooth and/ or rough surfaces such as precast concrete pardis, sand faced plaster, etc.
- d) Curing cement paint as directed for a minimum of 7 days or as per the manufacturer's instructions
- e) Protection of doors, windows, floors, fittings and fixtures including ironmongery and metalwork from splashing and droppings, including cleaning surfaces as directed.
- f) Repair of cracks, developing in plaster prior to or after final painting, by filling with suitable crack filling sealant and painting surfaces again as directed to obtain even surfaces to the satisfaction of the Engineer. Neeru surfaces damaged due to any reason before painting shall be done by using POP, as directed.
- g) Plumb, straightness, right angle of all visible edges, corners of doors, windows, beam soffit, columns, etc.

1.45 Electrical

1.45.1 INTRODUCTION

The general requirement include design, manufacture, testing at works, supply and delivery at site, unloading and storing the equipment at site, installation, testing and commissioning of the equipment at site of all electrical equipments are covered under this section of this Specification.

Contractor shall supply the equipment in accordance with the specification, data sheets.

For uniformity of appearance, all switchgear and control panels shall have a common appearance and colour.

In order to reduce the spares holding to a minimum electrical, control and instrumentation components of a similar type and purpose used throughout the Works shall, unless it can be shown by the Contractor to be impractical, be of the same Manufacturer and type / series.

1.45.2 CPWD SPECIFICATIONS

The Electrical works shall also conform to following standards as amended up to date wherever relevant and applicable;

- CPWD General Specification for Electrical Works Part I-Internal (2013).
- CPWD General Specification for Electrical Works Part II-External (1994).
- CPWD General Specifications for Electrical Works Part III (Lifts & Escalators) - 2003
- CPWD General Specification for Electrical Works Part IV-Substation (2013).
- CPWD General Specification for Electrical Works Part VII-DG Sets (2013).

1.45.3 L V PANELS

1.45.3.1 *The scope of supply covers design, manufacture, testing and supply of LV panels. The specification is minimum requirements and should be read in conjunction with relevant latest cpwd specification.*

1.45.3.2 *All panels shall be type tested in accordance with IS 8623/ IEC 61439-1 and arc resistant tested in accordance with IEC 61641-part 500, supplement 2 for 0.3sec minimum.*

1.45.3.3 *The metal enclosed switchgear shall be designed to operate continuously with reference of ambient temperature of 45°C without any deration.*

1.45.3.4 *The equipment shall be designed and manufactured in accordance with the best engineering practice and shall be such that has been proved to be suitable for the intended purpose.*

1.45.3.5 *Provision for interlocking of LV incomer breaker with HV side breaker shall be provided such that if the HV breaker trips then the LV breaker will trip and it shall not be possible to close the LV breaker unless the HV side breaker is closed.*

1.45.3.6 *Air circuit breakers draw out of suitable $icu=ics=icw$ for 1 second ratings, switch fuse units fixed type, MCCBs of suitable $icu=ics$ ratings. MCCBs shall invariably be current limiting type. Features like double break, positive isolation functions, class II front face shall be integral feature of the device.*

1.45.3.7 *The panel shall be indoor type having incoming sectionalization and outgoing switchgears as specified. The design shall be cubical type. The degree of enclosure protection shall be IP 52 for indoor and IP 55 for outdoor as per IS: 13947 (part-I).*

1.45.3.8 *Constructional requirements:*

- I. All panel boards shall be free standing, metal enclosed, single front, fabricated with 2mm CRCA sheet steel for all doors, partitions and covers and 2.5mm CRCA sheet steel for load bearing sections including all ACB feeders.

A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels.

- II. The gasket shall be suitable to withstand all weathers for long tenure of service. All hardware shall be HD Galvanized or stainless steel.
- III. All panels shall conform to FORM 3B as per IS 8623: 1993, Part I. The LV switchboards shall be as per the standards IEC 61439.
- IV. Each door & cover shall have adequate reinforcement of suitable ribs & stiffeners. All feeders and cable alleys shall have hinged type door with panel locks. All such doors shall open min 105 deg. All bus-bar covers and other panel covers shall be screw fixed. Cable alleys and bus-bar chamber shall have minimum width of 300mm.
- V. All doors shall be with concealed type hinges and captive screws. Rear doors of panels requiring rear access shall be provided with removable hinged doors. Side covers of panels shall be with removable panels.
- VI. All doors shall be provided with durable and easy fitting locks with special keys to ensure opening by authorised personnel. Rubber grommets shall be provided at the cable entry.
- VII. All mounting accessories like base channels, cross angles if required, nuts, bolts etc. shall be supplied by the vendor.
- VIII. All the panels shall have uniform height. The operating height of all the panels shall not be less than 300mm and more than 1900mm.
- IX. All the panel boards shall have cable entry from bottom. Split gland plate of 2mm thick shall be supplied for termination of power, control and instrumentation cables sized as per the required no. of cable mentioned in the SLDs and 20% spare space for future addition.
- X. Bus-Bars:

Bus-bar of the panels shall be rated for Continuous current at site conditions.

All bus-bars shall be electrolytic grade copper. BIDDER shall specify the purity and conductivity of the bus bar along with the BID.

All the bus bars shall be sleeved with heat shrinkable black Black colour PVC sleeve or better insulation with coloured polyester tapes for phase identification at regular intervals/ locations. Make and Type test reports carried out at accredited laboratory, of such sleeves shall be submitted **during testing.**

BIDDER shall submit all calculations & documental proof of the adequacy of the bus bar sizes to meet the continuous and short time current ratings specified for approval during procurement/ manufacturing.

Vertical bus-bars shall have S.C. rating same as main bus bar and shall be suitable for all connected load of vertical section.

BIDDER shall ensure that incoming feeder shall be suitably designed for terminating the required no. of runs of 1.1kV grade XLPE insulated armoured cables with 20% spare capacity. BIDDER shall consider the necessary arrangement (dummy panel, adapter panel, rear extension etc.) if required, for terminating the cables within the limits specified above.

The bus-bars shall be designed considering the following criteria:

- Current density of 0.8A/sq mm maximum for aluminium and 1.6A/Sq mm for copper.
- Sleeves made of insulating material on all bus bars.
- Bus bars carrying rated current continuously at Design Ambient Temperature shall be considered as 45°C and temperature rise shall be considered as per latest relevant standard.
- Configuration of bus bars and Proximity effect
- Bus bars shall withstand the short time rating of the panel.

Bus bar supports shall only be SMC irrespective of bus bar size. The span between the two insulators shall be as per the approved TYPE TEST REPORT for short time rating. Joint positions and insulators

shall be properly adjusted so that they don't interfere. Bus bar bending shall be carried out on appropriate machines designated for the same rather than doing manually.

Neutral bus-bars of the panel boards shall be rated equal to the size of phase bus.

All bus-bar shall be treated with anti-oxide paste wherever bi-metallic contact is required.

1.45.3.9 *Earthing:*

Earth bus bars of Aluminium material shall be run all along the panel, extended out at both ends of value equal to the rated symmetrical short circuit rating of the associated switchboard/ panel. The same shall be properly supported to withstand stresses induced by the rated symmetrical short circuit current.

Earthing bus-bar shall be terminated at both ends of the switchgear to suit the connections to earthing conductor. The locations where the bus are protruding out of the panel boards, CONTRACTOR shall ensure that proper ingress protections are provided at all such locations.

All doors and detachable components inside the feeder are required to be earthed individually with green (with yellow band) colour PVC insulated multi stranded copper conductor wire of size 4 sq.mm duly crimped with ring type lugs and are to be looped & connected to horizontal earth bus.

Earthing bus shall be run continuously in panel drawn out suitably considering respective cable entry inside the panel.

Separate Al earth bus shall be provided at each cable alley for all the panels.

1.45.3.10 *Power Wiring (Inside The Feeder):*

All power wiring for rating upto and including 63A shall be carried out with 1.1kV grade coloured HFFR/ FRLS PVC insulated, coloured for phase identification, multi stranded copper wires duly crimped with ring type lugs.

Power connections for rating above 63A shall be done with AL bus bars (machine bend for proper profile) insulated with black heat shrinkable sleeves with phase identification coloured tapes duly supported on SMC insulators and placed with required minimum clearance of 25mm between phases and between phase to ground/ neutral. Such bus when brought out of the feeder for cable connections shall be sufficient enough and profiled suitable for termination of the number of LT cables as indicated above.

1.45.3.11 *Control Wiring (For Panel And Feeders):*

All panel Control wiring shall be done by 1.1kV grade HFFR/FRLS PVC insulated multi-stranded copper wire. CT circuit wiring shall be done with minimum 2.5 Sq.mm size wire of above specification. Control and Potential circuits shall be wired with minimum 1.5 sq. mm size wires of above specifications. Wires shall be gray coloured with suitable crimp able copper lugs. CT's & PT's wiring shall be colour coded for multi-phase identifications (R-Y-B-N).

Panel wiring & cabling shall be cross-ferruled. Ferrules shall be etched & painted type. **'Printed' ferrules are not acceptable.**

1.45.3.12 *General Requirements:*

DP MCB shall be provided for all control circuits where the fault level is less than 10kA. Else the control supply shall be tapped through a control transformer of adequate capacity supplied with MCCB/ MPCB/ SFU of adequate short time rating. Independent DP MCBs shall be provided for each circuit such that tripping due to fault in one circuit should not affect other functions adversely.

Self explanatory Wiring diagrams with terminal and wire numbers, component numbers shall be provided on the inner face of the door of each feeder. Drawing set in the panel shall be laminated.

All labels for identification of feeders as well as internal and external components as per legends provided By PURCHASER shall be on white acrylic sheet with black engraving. These labels shall be fixed by screws/rivets and shall not be pasted.

Aluminium etched 415V Caution boards written in three languages (English, Hindi and Gujarati) shall be riveted on the panel at locations where live bus bars are present and need isolation before any access to it. In case secondary covers have been provided inside the panel, then caution boards shall be also marked on these boards in addition to the external covers. **Stickers are not acceptable.**

Selector/control switches shall have an 'Off' position. The 'Off' position shall not be wired in any circuit and shall be utilised to disconnect (or bypass) power supply to control circuit for any maintenance work.

All electrical panels (internal components & arrangement) shall have finger touch protection, for human safety viz. working on one component shall not cause shock to the personnel due to any other live component in the panel. Also, the terminal live parts shall not be accessible by fingers (finger cannot come in contact with live parts of the terminals).

No openings/ holes meant for fixing hardware shall be left open. All the hardware (esp. screws, nuts, bolts, and washers) shall be in all appropriate positions & properly tightened.

Phase separators, shrouds, falling tool barriers shall be suitably provided. Any additional requirements as observed at any stage upto

handing-over shall be provided (for safety and ease of maintenance) without any cost implication to the PURCHASER.

All PVC/engineering plastic based items (including but not limited to conduits, casing-capping, trough, trunk, enclosures, covers, plugs, etc) shall be **with FR properties**.

Lifting hooks/eyes shall be provided in each shipping section of the equipment and shall be removable type. The equipment shall be given tropical and fungicidal treatment.

Insulation mat of suitable standard width shall be provided in front of the HV and LV panels.

At least one 230V, 1Ph, Space heater shall be provided for each vertical section of the switchboard. Each Space heater shall be provided with an isolating switch, a thermostat and dedicated MCB protection of appropriate rating. Heater shall be mounted at bottom of the panel with cover to avoid accidental contact of heater with skin.

230V 1Ph, Panel illumination (11W CFL/ LED fixture with lamp, limit switch and isolation switch) along with 1 no. 5/15A 5 pin socket with switch shall be provided for each vertical section. Bare holder with open lamp is not acceptable.

Adequate space shall be provided for terminating the outgoing cables.

1.45.3.13 *Equipment Requirement:*

All the panels shall have MCCBs upto 630Amp. All MCCBs shall be rated for 415V, 3 Ph, 50Hz. The service breaking capacity of all the MCCBs shall be for 1sec for symmetrical short circuit of the respective transformer rating (ICS = ICU = ICW = 100%). The incoming MCCBs/ACBs shall be suitable for remote communication (SCADA control/ BMS integration). All the MCCBs shall be of current limiting type and shall provide a cut off in, < 10 ms for prospective

currents during faults. All MCCBs shall be provided with rotary handle with door interlock and extension links/ spreaders with proper shrouds. All MCCBs shall be with Utilization Category "B" (i.e. offering time discrimination with downstream devices).

The incomer MCCB of the LV Panel shall be provided with a Microprocessor based OL, SC and EF release while all the outgoing MCCBs shall be provided with Thermal Magnetic based OL, SC and EF.

Earth fault release for microprocessor based release shall be inbuilt in the release.

For Distinct Fault Indication, required voltage supply shall be derived from the existing control supply by BIDDER. No separate charges shall be asked for later during execution.

All instrument transformers shall be cast resin type and shall have insulation of class B or better.

Indicating lamps shall be of the Multi chip LED type with low watt consumption.

Each incomer shall be provided with a Multi Function Meter displaying all electrical parameters like (but not limited to) current, voltage, kW, kVA, KVAr, kWh, MD, PF, Hz, etc. and shall have provision for remote communication with SCADA. The Make and Model of MFM shall be Schneider make EM6400 or equivalent.

The switchgear shall be complete with all equipment such as CT, VT, switches etc. duly wired up to terminal blocks. Terminal blocks shall be located at suitable place for easy access. CT shorting, isolating terminals shall be provided for CTs and isolating terminals shall be provided for VT connections. Twenty (20) percent spare terminals

shall be provided in each cubicle. Ring type lugs suitable for termination of 2.5 sq mm copper wires shall be used.

1.45.4 SAFETY REQUIREMENTS

Refer CPWD General Specification for Electrical Works Part IV-Substation (2013).

1.45.5 CABLES AND CABLE CARRIER SYSTEM

1.45.5.1 *Scope*

This specification also covers the design, material, construction features, manufacture, inspection and testing at the VENDOR's/his SUB-VENDOR's works and delivery to site of LT Cables, Cabling Accessories, conduits and pipes etc.

1.45.5.2 *Applicable Codes & Standards*

The design, construction, manufacture and performance of the equipment/components shall conform to latest applicable standards as on date of submission of the bid and comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment/components will be installed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

Unless otherwise specified, equipment shall conform to the latest applicable standards for cables IS 1554, 7098, 8130, 5831, 3975, IEC 60183, 60227, 60502, 60885, 10418.

1.45.5.3 *Technical Specification for Cables & Cable termination*

The various types of cables covered in this specification shall meet the following requirements:

1. 1100 V Grade XLPE Insulated Power Cables

The cable shall be extruded XLPE insulated. The inner sheath over laid up cores and outer sheath over the armour shall be extruded PVC compound type ST-2. Core identification shall be by printed numerals. The construction, performance and testing of the cable shall comply with IS 7098-Part1 (Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100 V).

2. 1100 V grade PVC insulated Power / control cables

The cables shall be insulated with extruded PVC compound type C, provided with inner sheath and outer sheath of extruded black PVC compound type ST-2.

The construction, performance and testing of the cable shall comply with IS 1554 - Part 1 (PVC insulated heavy duty electric cables for working voltages upto and including 1100 V).

3. 1100 V Grade Lighting/Misc./Light duty unarmoured cables

Cables shall be insulated with extruded PVC type-C. Outer sheath shall be extruded black PVC type ST-2. The sheathed cables shall be

weather proof suitable for indoor/outdoor use. Twin and multicore cables shall be laid up and filled with thermoplastic material, bound by plastic tape and provided with outer sheath.

The construction, performance and testing of the cable shall comply with IS 694 (PVC insulated cables for working voltages upto and including 1100 V).

1.45.5.4 *For all It power and control cables, double compression glands with aluminium lugs for aluminium cables and tinned copper lugs for copper cables shall be used in indoor and outdoor application.*

1.45.5.5 *The termination shall be inclusive of miscellaneous items such as clamps, cleats, cable tags, cable markers etc.*

1.45.5.6 *In general cable installation works shall be carried out in accordance with is 1255 – 1983, latest version. At road crossings, the depth of the pipe shall be minimum 1m else proper concrete encasing shall be provided.*

1.45.5.7 *For underground cables, cable marker shall project 150mm above ground and shall be spaced at an interval of 30 metres, and at every change in direction. They shall be located on both side of road and drain crossings. Top of cable marker/joint marker shall be sloped, to avoid accumulation of water/dust on marker. On finished surface like foot path etc. The marking shall be accomplished with a separate colour tiles/ paver block for highlighting the route of the cable.*

1.45.5.8 *Cable tags shall be provided on all cables both at s feeder pillar end as well as on each pole (just before entering the equipment enclosure.*

1.45.5.9 *Cable glands*

- a) Double compression type cable glands shall be used for the termination of all the power and control cables. Cable glands shall be brass casting, machine finished and Nickel-plated to avoid corrosion and oxidation. Rubber components used in cable gland shall be of neoprene.
- b) For single core cables, gland shall be with brass ring.
- c) Cable glands shall be with metric threads.
- d) Cable glands shall be conical (& not flange type).

1.45.5.10 *Cable Lugs*

- a) Cable lugs shall be of tinned Copper, solder less crimping type for Cu cables & Al lugs for the Al cables.
- b) The current rating of the lugs shall be same as that of the respective cable conductors.

- c) Ring type cable terminations shall be used.
- d) Insulated lugs are not acceptable for any cable terminations.
- e) Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.
- f) Double hole extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.
- g) Fork terminals shall be used for luminaires & decorative switch/ socket. Pin terminals may be acceptable during execution only in case other terminals/ lugs cannot be accommodated.
- h) Reducer / wire pin terminals shall be avoided for MCB terminations. MCB terminations shall be with 'long palm terminals.
- i) All terminations in Feeder Pillars / enclosure for earthing & neutral busbars / terminals shall be with ring type terminals.
- j) All earthing terminations shall be with ring type lugs only.
- k) All control & interlock cable terminations shall be with ring type lugs.
- l) Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs [This shall especially be ensured for Al cable terminations & any bimetallic terminations (Cu cable termination using tinned Copper lugs)].
- m) If termination is done with crimping tool employing crimping die then forming dies shall be used to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimping the lug, the conductor shall be thoroughly cleaned and special jelly applied over it to prevent further oxidation.

1.45.5.11 *The cable carrier system covers the supply of cable racks, cable trays and its supporting accessories hardware and their installation. It shall be the responsibility of the contractor to complete the cabling system in all respects.*

1.45.5.12 *Cable trays shall be of galvanised steel and of perforated type, complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware as required. All hardware (i.e. Bolts, nuts, screws, washers, etc.) Shall be hot dip galvanised. (galvanisation thickness not less than 70 microns).*

1.45.5.13 *Each 2.5 metre section of all types of cable trays and all elbows, tees, crosses, etc. Shall be provided with two side coupler plates and associated bolts, nuts and washers.*

1.45.5.14 *Note:*

This specification is the minimum requirement and should be read in conjunction with relevant latest CPWD general specification for electrical works, requirements, rules and regulations.

1.45.5.15 *Requirement of Special Sheath For FRLS Cable*

1) Tests and Test Equipment

Cables shall be subjected to routine and acceptance tests in accordance with standards specified Test methods shall conform to IS 10810 (Methods of Test for Cables). Type tests and optional tests according to applicable standards shall be conducted on cables as specified. Contractor shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratory traceable to National Standards. Outer sheath for FRLS/FS cables shall meet the following test requirements related to flame retardance, low smoke emission, low acid and toxic gas emission. The Contractors shall have proper test apparatus to conduct all the relevant tests as per the applicable Standards mentioned herein.

2) Test for flame Retardance

(a) Oxygen Index

The critical oxygen index value shall be minimum 29 when tested at 27 +/- 2 deg.C as per ASTM-D-2863 and the temperature index value shall be minimum 250°C at oxygen index of 21 when tested as per NES 715.

(b) Flammability

- i. Cables shall pass test under fire conditions as per IS-10810-Part-53.
- ii. Cables shall also pass tests as per IS-10810 Part- 61 & Part-62.
- iii. Fire survival cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.

3) Test for smoke generation

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The maximum smoke density rating shall not be more than 60% when tested as per ASTM-D-2843.

4) Tests for acid gas generation

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than 20% by weight.

5) Tests For Resistance To Ultra Violet Radiation

This test shall be carried out as per DIN 53387. The retention values of tensile strength and ultimate elongation after the tests shall be minimum 60% of tensile strength and ultimate elongation before test.

6) Tests for water absorption

Outer sheathes shall be subjected to tests for water absorption as per IS 10810. When additional characteristics are required, the tests shall be as agreed to between Employer and VENDOR before the placement of order.

1.45.6 LIGHTING & SMALL POWER System

1.45.6.1 *General requirements*

(a) The Lighting system includes the following items.

- Lighting fixtures complete with Lamps and accessories (lumen per watt shall be indicated)
- Lighting system equipment (ISI make)
- Light control switches, receptacle units with control Switch units, lighting wires, conduits and other similar items necessary to complete lighting system.
- Lighting fixture supports, street lighting poles and flood light towers
- Main Lighting distribution board, lighting panels.
- Multi core cables for street, boundary and flood lighting.
- MS Conduit

(b) Load balancing of lighting system shall be made.

1.45.6.2 *Design*

The lighting system design shall comply with the acceptable norms and the best engineering practices. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.

The value of the ratio of spacing (S) to mounting height (H) shall be commensurate with the type of fittings selected and uniformity of illumination.

1.45.6.3 *Applicable Codes & Standards*

All standards and codes of practice referred to below shall be the latest edition including all official amendments and revisions.

- 3 pin plugs & sockets : IS 1293
- General safety requirements : IS 1913
for luminaires
- Luminaires for street lighting : IS 10322(Paart-5,S 3)
- Fitting for rigid steel : IS 2667
conduits for electrical wiring
- Code of practice for interior : IS 3646 & IS 6665
illumination
- Switches for domestic & : IS 3854
similar purposes
- Electric ceiling type fans : IS 374
& regulator
- Code of practice for electrical : IS 732
wiring installation (system
voltage not exceeding 650 Volts)

- General lighting LED and LED Modules : IS 16101
- Self ballast LED lamps for general lighting services : IS 16102 (Part-1 & 2)
- LED modules for general lighting : IS 16103(Part-1 & 2)
- Safety of lamp control gear : IS 15885 (Part-2/sec-13)
- DC or AC supplied electronic control gear for LED modules : IS 16104
- Method of measurement of lumen maintenance of solid state light (LED) sources : IS 16105
- Method of electrical and photometric measurements of solid state light (LED) products : IS 16106
- Luminaires performance : IS 16107 (Part 1 &2)
- Photo biological safety of lamps and lamp system : IS 16108

1.45.6.4 *LED luminaires*

LED luminaires shall be used for internal & outdoor lighting. Luminaires shall be installed to permit ease of maintenance. The Contractor shall provide all equipment necessary to carry out maintenance on the lighting installation and demonstrate its operation to the satisfaction of the Engineer.

MCB + RCCBs shall be provided at the incomer of Lighting panels and DP MCB for outgoing feeders..

Refer clause No. 8.5 for General requirements for LED lighting.

1.45.6.5 *Testing of Installation*

Refer CPWD General Specification for Electrical Works Part I-Internal (2013).

1.45.6.6 *Lighting System Installation*

1.45.6.7 *Refer CPWD General Specification for Electrical Works Part I-Internal (2013).*

1.45.6.8 *Internal Wiring & Non metallic conduit wiring system*

1.45.6.9 *Refer CPWD General Specification for Electrical Works Part I-Internal (2013).*

1.45.7 LIGHTING DISTRIBUTION BOARD

Refer CPWD General Specification for Electrical Works Part I-Internal (2013).

1.45.8 STREET LIGHTING SYSTEM

1.45.8.1 *General*

Energy Efficient LED lighting system is considered for Outdoor Street Lighting system.

A Centralized Smart Street lighting control system is proposed for monitoring and control of the street lights throughout the Building. The centralized lighting management system is a complete web based solution with advanced communication facilitating remote control and monitoring of the entire street lighting system. The system shall be modular and easily scalable. The centralized solution shall provide on/off control for burn hour optimization; to simplify maintenance and remote operation. Programming shall be enabled remotely and can be changed at any time. The ON / OFF times shall be optimized for the different daylight hours every day for energy optimization based on the sunrise and sunset times.

1.45.8.2 *Design Criteria*

The illuminance level for road lighting in India is governed by IS 1944 (Part 1& 2): 1970/ Code of practice for lighting of public thoroughfare.

The layout for street lighting system will be planned in such a way that uniformity ratio as required by IS: 1944 is maintained.

The vendor should submit the design reports for the same in Dialux.

1.45.8.3 *Applicable codes & standards*

Sr.No.	Brief Title	IS/IEC Code
1.1	Testing procedure of photometric testing for LED luminaires	LM 79
1.2	Testing procedure on the lifespan of LEDs	LM 80
1.3	National Lighting Code	SP72
1.4	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources	IS:16105
1.5	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products	IS:16106
1.6	Limits of Harmonic Current Emissions	IS 14700-3-2
1.7	DC or AC supplied electronic control gear for LED modules performance requirements	IEC 62384
1.8	Lamp control gear: particular requirements for DC or AC supplied electronic control gear for LED modules	IEC 61347-2-13
1.9	Environmental Testing: Test Z- AD: composite temperature/ humidity cyclic test	IEC 60068-2-38
1.10	Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission-- (equipment input current 16 A per phase)	IEC 61000-3-2
1.11	EMC Immunity requirement	IEC 61547

1.12	LED modules for general Lighting-Safety requirements	IEC 62031
1.13	Classification of degree of protections provided by enclosures (IP Codes)	IEC 60529
1.14	Fixed general purpose luminaires	IEC 60598-2-1
1.15	General Lighting - LEDs and LED modules – Terms and Definitions	IS:16101 / IEC TS 62504
1.16	LED Modules for General Lighting Part 1 Safety Requirements	IS:16103(Part1)
1.17	LED Modules for General Lighting Part 2 Performance Requirements	IS:16103(Part2)
1.18	Safety of Lamp Control Gear, Part 2 Particular Requirements Section 13 D.C. or A.C. Supplied Electronic Control gear for Led Modules	IS:15885(Part2/Sec13)

1.45.8.4 *Luminaire Description*

- i. The Luminaires shall have a sturdy and corrosion resistant high pressure Die cast Aluminium housing with weatherproof gasket for lamp and control gear accessories. The Housing shall be Epoxy coated, without any cracks or thorough holes, made in a single piece of die-cast LM6 aluminium alloy. The luminaires shall be totally enclosed, dust tight and water proof.
- ii. Heat sink used should be aluminium extrusion having high conductivity. The dimensions of luminaires shall be optimum and adequate to permit sufficient heat dissipation, through the body itself, so as to prevent abnormal temperature rise inside the lantern and consequential damage to the cover and gasket materials, LEDs, lenses and electronic drivers. Heat sink must be thermally connected to MCPCB/ LED light source.
- iii. The Luminaire Housing shall be suitable for termination of Cable with Double Compression Cable Glands
- iv. The optical system shall consists of individual PC lenses on high power LEDs designed & tested to achieve typical street lighting distribution from the LED lantern. These lenses provided for individual LEDs are to be fixed on lens plate in order to have consistent light distribution from luminaires. Luminaires should conform to the photometric Distribution / requirements of Cut-Off / Semi Cut – off light distribution and optics as classified in IS 1944.
- v. Suitable number of LED lamps shall be used in the luminaires. The manufacturer shall submit the proof of procurement of LEDs from OEMs at the time of testing
- vi. The Luminaires shall be provided with high tensile heat resistant toughened glass of minimum 0.8mm thickness or UV resistant polycarbonate cover fixed with stainless Steel screws.
- vii. An extruded silicon loop gasket shall be provided in the lantern body to ensure a weather proof seal between the cover and the metal housing to exclude the entry of dust, water, insects, etc. Luminaire should conform to degree of protection of IP 65 or above. Felt gasket will not be accepted.

- viii. Year of Manufacture, Batch No., Serial Number or Identification No. Luminaire Manufacturer's Name / Logo, Wattage and Frequency should be embossed on the housing.
- ix. LED luminaires, should conform to the various National / International standards for safety & performance. Manufacturer should provide test reports as per LM 79 & LM80. Lumen maintenance report as per LM 80 guidelines shall be submitted for the LEDs used along with the BID.
- x. Luminaires should conform to the IS standards for Safety & Performance and test certificates as per IS 16107 should be provided by the manufacturer. In case of luminaires are imported, the BIDDER shall conform to test parameters as per UL or equivalent standards.
- xi. The electrical component of the LED and LED driver must be suitably enclosed in sealed unit to function in environment conditions mentioned earlier.
- xii. All the connecting wires inside the Luminaire shall be low smoke halogen free, fire retardant cable.
- xiii. Adequate protection against Overloading, Short Circuit, Over Voltage, Over temperature, Under Voltage, String Open shall be provided within the Luminaire.
- xiv. Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.
- xv. The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/PAS 62612 depending on the type of luminary.
- xvi. All the material used in the luminaries shall not contain any toxic material/ metal like mercury; shall be halogen free and fire retardant confirming to relevant standards.
- xvii. The Manufacturer shall have all the relevant testing facilities certified by an accredited laboratory and shall be offered for inspection to the PURCHASER for verification of the required parameters and tests. BIDDER shall confirm the same in the BID.
- xviii. The control gear shall comply to the provisions of IEC 61347-2-13, IEC 62031 and IEC 62384 as appropriate.
- xix. The following three types of luminaires are not accepted:
 - (a) Full glass luminaire: Full glass luminaire is not accepted as toggles/clamps are used which will compromise the IP of the luminaire.
 - (b) Chip on board (COB) LED luminaire: COB LEDs are not accepted as there is extremely high per square inch heat generation and the heat sink is too small to take this heat out.
 - (c) Double driver luminaire: Where single luminaire is split into two parts and driven by double drivers.
- xx. The lighting fixtures offered shall comply with the following requirements;

1.45.8.5 *Luminaire Datasheet*

Sr. No.	Parameter	Requirement / Value
1.	Type	LED Luminaries complete with all accessories for Street Lighting
2.	Rated Voltage	230 V
3.	Expected Frequency	50 Hz +/- 3%
4.	Operating Voltage Range	150 V to 270 V
5.	Power Factor	> 0.95
6.	Operating Temperature Range	0 Deg C to 50 Deg C
7.	Working Humidity	10% - 90% RH
8.	Driver Type	Constant Current based Electronic Driver
9.	Driver Efficiency	> 92%
10.	Driver Life	>20000 hrs.
11.	Protection required in Drive module	
a.	Short Circuit	Yes
b.	Over Voltage	Yes
c.	Over Temperature	Yes
d.	Under Voltage	Yes
e.	String Open Protection	Yes
12.	Luminaire IP Protection	Minimum IP 65 for Outdoor Fixtures
13.	Minimum Surge Protection	>4 KV
14.	THD	<=10%
15.	Rated Minimum LED Life (L70)	50000 Burning Hours
16.	Rated Minimum Driver Life	20000 Burning Hours
17.	CRI	>75
18.	Junction temperature rise	< 85 Deg C
19.	Solder point temperature	< 70 Deg C
20.	Maximum temperature rise for Driver	<30 Deg C at 45 Deg C ambient
21.	Make of LED	Cree / Nichia/ Philips / Osram
22.	Make of Driver	Cree / Nichia/ Philips / Osram
23.	Operating Hours	Dusk to Dawn (max 12 Hrs.)
24.	Efficacy of Luminaries	>100 lm/W
25.	Efficacy of LED	>120 lm/W
26.	Colour Temperature	5500K –6500K

27.	Illumination Regulation	<5%
28.	Material used for following	
a.	Housing	Die cast aluminium/ extruded Aluminium bod with powder coated finish
b.	Heat Sink	Aluminium extrusion
c.	Clip / Fastners	Stainless steel.
d.	Diffuser	Toughened glass (0.8mm thick)/ UV stabilize Poly carbonate material
29.	Maximum temperature of Heat sink	<70 Deg C
30.	IK protection of Optic Cover	>IK05
31.	Wires used Inside Luminaries	Cu conductor, low smoke halogen free, fire retardant e-beam cable
32.	Cable gland IP protection	IP 65
33.	Scotopic to Photopic Ratio	>2.15

1.45.8.6 Testing Of Luminaire

- (a) The Routine test on each of the offered Luminaire shall be carried out by the BIDDER before dispatch. Following tests shall be carried out as Routine tests by the BIDDER for the offered Luminaires;
- (i) Visual and Dimensional check
 - (ii) Checking of documents of purchase of LED
 - (iii) Insulation resistance test
 - (iv) HV test
 - (v) Reverse polarity
- (b) The Acceptance test shall be carried out by PURCHASER or PURCHASER's Representative on a sample of the lot offered for Acceptance. The Lot shall be different from the lot from which the Type test samples have been drawn. The cost of the testing shall be borne by the BIDDER. Following tests shall be carried out as Acceptance tests by the BIDDER for the offered Luminaires;
- (i) Visual and Dimensional check
 - (ii) Checking of documents of purchase of LED
 - (iii) Insulation resistance test
 - (iv) HV test
 - (v) Over voltage protection
 - (vi) Surge protection
 - (vii) Reverse polarity
 - (viii) Lux measurement

- (ix) Test for IP 65 protection
- (c) Following Type tests reports shall be provided by the BIDDER for the offered Luminaires along with the BID;
 - (i) Resistance to humidity
 - (ii) Insulation resistance test
 - (iii) HV test
 - (iv) Over voltage protection
 - (v) Surge protection
 - (vi) Reverse polarity
 - (vii) Temperature rise Test
 - (viii) Ra (Colour Rendering Index) measurement test
 - (ix) Lux measurement
 - (x) Fire retardant Test
 - (xi) Test for IP 65 protection
 - (xii) Endurance Test,
 - (xiii) Life Test
 - (xiv) Photometric Measurements Test Report (IES LM 79)
 - (xv) LED Lumen Maintenance Test Report (IES LM 80)
 - (xvi) Vibration test as per ANSI
 - (xvii) Drop Test

1.45.8.7 *Centralized Street Lighting Control*

The Segment controller acts an intermediary between internet and lamps which can operate up to 60 Luminaire controllers. It also buffers measurement data via internet. Segment Controller will be located in a portion of the Feeder Cabinet.

The centralized lighting management system is a complete web based solution with advanced communication. The centralized solution is easy to implement and requires less equipment and easy to install. The solution features:

- a) Central Control
- b) Complete Monitoring.
- c) Remote Metering.
- d) Power quality monitoring.
- e) Voltage Stabilization.
- f) Control Room Installation

Centralized lighting management system features:

- a) Central control, fault detection and reporting.

- b) Energy savings and power metering. Automated reading of digital power meters in control cabinets.
- c) Burn hour reports for planning proactive lamp replacements.
- d) High up-time and speedy fault rectification.
- e) One central photo cell ensuring uniformity.
- f) Improved quality of light
- g) Simplified maintenance & Real time control.
- h) Load balancing and load scheduling, area specific settings.
- i) Fast reaction to special traffic and weather conditions.
- j) Up gradation in existing cabinets possible.
- k) Integration of tool with mapping services from internet.

1.45.8.8 *Lighting Control System*

This section covers the design, construction and testing of Lighting Control System (LCS) with programmable timer unit, contactors, relays, internal wiring with remote operation and housing.

The Lighting Automation System shall feature a web based solution for remote management of lighting. The system shall control and monitor lighting distribution boards remotely via wireless communications such as GPRS as one of the primary communications network to the server.

The system shall be modular and easily scalable to include platforms, yards, streets and over bridges. The centralized solution shall provide on/off control for burn hour optimization, simplified maintenance and a remotely operated system. Programming shall be enabled remotely and can be changed at any time. The ON / OFF times shall be optimized for the different daylight hours every day for energy optimization. That is, it would be optimized to follow the sunrise and sunset times every day.

Electrical cabinet monitoring configurations shall be enabled remotely and can be changed at any time. Power supply voltage input to electrical cabinets shall be available on demand.

All alarm/fault detection events shall be logged and available for report out printing for analysis. Each street lighting controller shall be provided with optical fibre cable port.

1.45.8.9 *System Specifications*

a) Outdoor Lighting Control CPU

The CPU module shall be equipped with a 32 Bit processor capable of running DSP, Microcontroller and Java applications, running on open source operating system.

It shall have inbuilt 3 Phase power supply input terminals, USB port, internal health monitoring & logging, 2 analog inputs, 1 digital input for Photocell, Ethernet and GPRS ports, and communication capability on RS 232 along with built in Flash memory for data storage. The CPU shall monitor and control all other modules in the LCS. Direct communication between the modules shall take place by means of an industrially proven RS 485 technology. The same interface shall also be used for power supply between

the modules. The CPU module shall serve as a WAN communications and data concentrator module. It shall be capable of two way communication with the central server takes place via a) GPRS

- b) SMS
- c) Ethernet

The module shall have the ability to automatically switch between different available communications carriers in order to provide stable and reliable communication. It shall be upgradable for used with WIFI and WIMAX in future using the USB or the Ethernet port on the module. It shall support remote Software and configurations updates from the server enabling it to autonomously execute tasks. It shall monitor Voltage values on all three phases of main supply. Battery shall be supplied with backup power via the A.Bus in the event of power failure enabling the CPU module to store data and send a main power failure alarm to the central server before it shuts down safely. It shall be light weight (not more than 300 grams), compact and DIN rail mountable, supporting Tri band GSM900 / EGSM900, GSM1800, 1900 MHz Compliant to GSM Phase 2/2+. It shall have a local Real time clock synchronized with remote time server, to enable functionality even in case of communication network failure.

b) Guard for Overvoltage Protection

This module shall provide Overvoltage protection specifically for the CPU, capable of withstanding surge pulses up to ± 6 kV and burst pulses up to ± 4 kV. The module shall consist of four independent protected mains rated channels which each have a built in thermal protection, Surge protection level ± 6 kV according to EN61000.4. 5, Burst protection level ± 4 kV according to EN61000.4. 4, Three mains rated phase (line) inputs: L1, L2 and L3 and shall be DIN Rail Mounted.

c) Switching Unit

The Switch module shall act as a client interface module in the LCS. It shall consist of two individually controllable relays. These relays shall be galvanically isolated shall be used for switching minor loads on and off directly and three phase or larger loads via an intermediate breaker. One of the two relays shall provide both NO and NC functionality. It shall be based on industrially proven RS.485 technology. Common interface shall be used for system power supply and for direct communication between the modules.

d) DIN Rail Battery

The Battery module shall supply other modules with emergency power in the event of power failure. All modules in the system shall incorporate RS485 based communication technology used for both power supply and for direct communication between the modules. This Battery module shall be installed together with CPU module, and shall be recharged by the CPU. If the main power fails, Battery shall instantaneously take over the power supply, enabling the CPU module to store data and send a main power failure alarm to the central server via GPRS/SMS before it shuts down safely.

e) Additional System Requirements

- a) The system shall generate power failure alarm or Individual Phase failure alarm, detect the panel door open condition and should notify the user.
- b) The system shall support to integrate both analog and digital type of Photocell.

- c) The system shall allow configuring priority levels for commands (E.g. Fixed programs , Manual switching, twilight switching).
- d) The system shall provide API for integrating with third party applications like SCADA or ERP applications for basic monitoring and control.
- e) The system shall be modular to support dimming with configurable scenes with varying dimming levels.
- f) The system shall provide facility for inventory management for luminaries

f) Web based management of the Lighting system

- a) It shall be possible to create a node hierarchy to reflect the geographical area that is monitored and controlled by the system.
- b) All actions performed in the GUI (Graphical user interface) are related to selected node and its child nodes.
- c) It shall be possible to post messages on the GUI for the other users of the web based Management system.
- d) Management system.
- e) The GUI shall have a search box to search for nodes, boxes, modules, meters and programs.
- f) The GUI shall give an overview of the communication status of all the boxes in the selected node tree.
- g) The GUI shall indicate the photocell history.
- h) It shall be possible in the GUI to manually operate the light for the selected node tree to switch the light to ON, OFF.
- i) The GUI shall indicate the light status for all the boxes of the selected node tree.
- j) It shall be possible to set an operational mode for the boxes. The operational modes shall be “operational”, “Installation”, “maintenance w/ alarm”, or “maintenance w/o alarm”
- k) It shall be possible to generate an alarm overview, filtered on alarm severity, alarm type, alarm state, alarm period.

g) Network connectivity

Since the system will utilize GPRS connectivity for SMS as well as data. Connectivity charges will be paid by the end user to the telecom service provider.

h) Reporting

Following reports shall be generated by software:

- a) Reports both as html pages or as Excel files.
- b) Generate an alarm report, filtered on alarm severity, alarm type, alarm state, alarm period, no. of parent nodes.
- c) Generate a report on the meter readings.
- d) Generate a burn time report.

- e) Create an action report, based on modules, light commands, report, alarm, photocell or light status.
- f) Create lamp surveillance report for critical lamp failure, preventive lamp replacement or failures before burning hours.
- g) Generate reports from Historical data available in Lighting control system server for following:
 - Switching operations
 - Alarms/ Warning generated • Run Time of Circuits

i) Programming

Following programming shall be done:

- Create programs based on a fixed time table. In the fixed time table program, it shall be possible to define ON and OFF commands.
- Programming to activate the fixed time table on a daily, weekly or monthly basis
- Programming to activate the fixed time table based on a time period; from day/month to day/month.
- Create programs based on a twilight table and to generate a twilight table based on a geographic location.
- Programming to combine a twilight table with a primary and secondary photocell.
- In the twilight table program, it shall be possible to define a Twilight table sunrise offset & Twilight table sunset offset.
- In the twilight table program, it shall be possible to include ON and OFF commands at fixed times between sunset and sunrise.
- In the twilight table program, it shall be possible to define a photocell event delay for the
 - primary and for the secondary photocell.

j) Software upgrade

- It shall be possible to upgrade the software locally on the CPU using a USB stick.
- It shall be possible to upgrade the software remotely through the webpage application.

k) Customers, permission groups and users

- It shall be possible to define “Customers” to limit access for users within these “Customers” to only a part of the node tree.
- It shall be possible to define permission groups to define different levels of user access.
- It shall be possible to design user accounts within customers, and assign a permission group and a password to each user.
- It shall be possible to subscribe users to alarms via SMS or email. -
It shall be possible for a user to control ON, OFF

I) Control Room Application

- The streetlight automation system shall feature a map application that gives an overview of all boxes on top of a street map or a satellite image.
- It shall be possible to visualize the light status of the boxes or the alarm status of the boxes.
- It shall be possible to see the geo-location data, serial number, node, name, communication status, alarm status, phone number, light status of a selected box and communication status of the carriers of a selected box.
- It shall be possible to upload and view .jpg pictures of the box.
- It shall be possible to set the Configurable communication class with Control station / server:-Ethernet, GPRS or SMS
- The following faults shall be displayed in alarms
 - a) Under/over voltage detection
 - b) Main breaker error
 - c) Contactor fault
 - d) Circuit breaker off
 - e) Circuit phase errors (fuse, breaker, etc.)
 - f) Main power failure
 - g) Leakage to ground
 - h) Manual switch activated
 - i) Phase current out of range
 - j) Control cabinet door open
 - k) Flashing bulbs
 - l) Bulb failures
 - m) Low Power Factor
 - n) Communication failure with server

1.45.8.10 *Galvanized Octagonal Poles*

The Octagonal poles shall be designed to withstand the maximum wind speed of 169 km / hr as per IS 875. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BS : 5649 Part VI 1982.

i. Pole Shaft

The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by submerged Arc Welding (SAW) process.

All octagonal pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding

shall be done as per qualified MMAW process approved by Third Party Inspection agency.

ii. Door opening

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

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

iii. Material

Octagonal Poles	HT Steel Conforming to grade S355JO
Base Plate	Fe 410 conforming to IS 226 / IS 2062
Foundation Bolts	EN.8 grade

iv. Welding

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

v. Pole sections

The Octagonal Poles shall be in single section (up to 11 M). There shall not be any circumferential weld joint.

vi. Galvanization

The poles shall be hot dip galvanized as per IS 2629 / IS 2633 / IS 4759 standards with average coating thickness of 70 micron. The galvanizing shall be done in single dipping.

vii. Xing type

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

viii. Top Mountings

The galvanized mounting bracket shall be supplied along with the Octagonal Poles for Installation of the luminaries.

ix. Manufacturing

The pole manufacturing & galvanizing unit shall be ISO 9001: 2000 & ISO 14001 certified to ensure consistent quality & environmental protection.

x. Service window

A service window of the size 150 mm x 100 mm shall be provided in the base of the pole to allow access to electrical connections and terminations. It shall be covered with MS plate and proper rubber gaskets shall be provided to prevent any ingress of water etc..

xi. Electrical connections

Four way connectors shall be provided along with slide lock and 1 no. 6 amp. SP MCB including 2.5 sq mm PVC insulated copper conductor wires from the terminal block to the fixture and 2 nos. 32 mm dia GI sleeves of suitable length shall be provided up to the service window. An earth boss is provided on the control plate along with connectors and interrupters.

1.45.8.11 Drawings and Data

All Drawings, data, technical particulars, calculations, detailed literature, catalogues, test certificates etc shall be submitted along with the bid/ after award of contract as specified in Bid Document.

1.45.8.12 EARTHING SYSTEM

Scope

- 1 This specification covers supply, design, installation, commissioning & testing of items required for earthing system including grounding conductors, rods, fittings, accessories and hardware to permanently and effectively ground the electrical apparatus, electrical equipment frames, conduit, cable trays and all non-current-carrying metal parts, including structural steel and fences.
- 2 The equipment shall be complete with all necessary accessories and components as required as per IS standard and CPWD requirements.

1.45.8.13 Grounding System

GENERAL REQUIREMENTS

The design of the equipment shall meet the following requirements:

- 3 It should provide means to dissipate the current into the earth during normal and fault conditions without exceeding the operating and substation equipment limits and connections.
- 4 The ground grid shall provide least resistance path for grounded neutral circuits.
- 5 The ground grid shall provide means of discharging current carrying parts which are to be handled by personnel.
- 6 Grounding consists of all conductors, ground rods, connectors and all other necessary items to make a complete grounding system.
- 7 The Contractor shall finalize the layout of the grounding system as required for the final equipment dimensions and locations.
- 8 The ground grid shall be designed so as to provide a maximum ground resistance of 1.0 ohm or less.
- 9 Ground grid shall be installed at a minimum depth of 600 mm from ground level.
- 10 Earthing of transformers will be done separately through plate electrodes & further connected to the main collector network using connectors/ risers.
- 11 Where the ground conductor crosses the cable/ pipe trenches, the conductor shall be suitably lowered so as to cross cable trench at least 150 mm below its bottom surface.
- 12 Risers shall be brought out above the ground level for further extension and connection to equipment.
- 13 All conductors in the ground grid shall be welded together at every crossing and at every point where from risers emanate. Continuous lap welding shall be done instead of tack welding.
- 14 The risers from the grid shall be laid to avoid contact with reinforcement to guard against false grounding during resistance tests.
- 15 All non carrying current metal parts of electrical equipment and apparatus shall be earthed with two separate diametrically/ diagonally opposite connectors. The apparatus shall include:

- 16 Bodies of electrical machinery, transformers etc.
- 17 Frames of panels and cubicles
- 18 Metallic structures of switchgear, casing of cable boxes
- 19 Shielding of cables and electrical wiring conduits

1.45.8.14 *Design Criteria*

a. Fault Current & Duration

The earthing system will be designed for fault current of 30kA for 1 sec or as per actual fault current.

b. Soil Resistivity

The Contractor shall undertake the soil resistivity measurements at site and select suitable type of conductors.

Refer CPWD General Specification for Electrical Works Part IV-Substation (2013).

1.45.9 LIGHTNING PROTECTION SYSTEM

1.45.9.1 *Scope*

The Specification covers for Design, Supply, Installation, Testing and Commissioning of the Lightning material as required. The Lightning Material and Its installation should be strictly as per CPWD.

1.45.9.2 *General*

Supply & installation of Lightning Protection System shall be strictly in accordance with IEC: 62305-2010.

1.45.9.3 *Zone of Protection*

The zone of protection of a lightning conductor defines the space within which a lightning conductor provides protection against a direct lightning stroke by diverting the stroke to itself. For a single vertical conductor, this zone is described as a cone with its apex at the highest point of the conductor and with an angle called as protective angle.

1.45.9.4 *Material and Dimensions*

The materials of lightning conductor, down conductors, earth termination etc. shall be copper / GI as per schedule of quantities and shall be protected against corrosion.

All air terminations and down conductors shall be of copper / GI as per schedule of quantities and shall conform to IS/IEC: 62305-2010.

Joints and Bonds

The lightning protective system shall have as few joints as far as possible. Wherever joints in the conductor are necessary they shall be mechanically and electrically effective, and shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner.

Earth Terminations

Each down conductor shall have an independent earth termination. All the earth termination shall be inter-connected and shall be capable of isolation for testing.

1.45.9.5 *Earth Electrode*

Earthing with GI plate will be used.

1.45.9.6 *Down conductor*

In order to reduce probability of damage it is often necessary to have several parallel current paths. As recommended by IS/IEC: 62305-2010 equal spacing of down conductors, 20 x 3 mm GI external strip, around the building perimeter

The down conductor must be kept in constant physical contact with the structure via conductive mounting clamps.

Each down conductor shall be directly connected at the dedicated earthing pit and the dedicated Earth pit shall be connected to the other earth pits in the earthing grid.

1.45.9.7 *Alternatively, steel reinforcement can be used as down conductor in line with IS/IEC: 62305-2010.*

Steelwork within reinforced concrete structures is considered to be electrically continuous, provided that major part of interconnections of vertical & horizontal bars are welded, clamped or overlapped a minimum of 20 times their diameter and bound or otherwise securely connected.

While using structural reinforcement as down conductor,

- Preferably outer columns which are straight from terrace up to the ground floor shall be used as down conductor. Steel bars in this column should be welded \ bolted with proper overlapping at every floor to ensure, proper continuity throughout.
- At ground level steel bars shall be taken out & welded \ bolted to the GI tape, and the tape will be carried out till the earthing pit at ground
- Also at terrace level steel bars will be taken out & to the connected to the Air terminal.

1.46 VEntilation

- All Toilet areas will be ventilated with minimum air quantity of 50 CFM.
- All Kitchen areas shall be ventilated with air quantity of 100 CFM.
- All three phase fans used either for ventilation or for fire emergency shall be provided with energy efficient motor of Eff1 class.
- All Pump Rooms, Meter Rooms & Substation will be ventilated with 20 ACPH as per NBC.
- Split Air conditioner (if required to be provided) shall be with minimum 3 star rating and with CFC/HCFC free refrigerant.

1.47 plumbing

1.47.1 Work under this contract shall be carried out strictly in accordance with specifications of the latest central public works department with up to date amendments as applicable in the contract and or as per the requirement of the client or its representative.

1.47.2 Items not covered under cpwd specifications, or additional works, the work shall be carried out as per mentioned specifications attached with the tender.

1.47.3 Works not covered above in para 4.7.1 and 4.7.2 shall be carried out as per relevant indian standards and in case of its absence as per british standard code of practice.

1.48 ict

1.48.1 COMPONENT-1: CCTV SURVEILLANCE SYSTEM

1.48.1.1 *SCOPE OF WORK*

An integrated **CCTV SURVEILLANCE SYSTEM** is required to be Design, Supply, & Installation, Testing & Commission at Bhopal Government Housing Project, consisting of 2 Plot (22 & 23) in the compound with 688 flats and having a 2 main entrance to the Project Plot. Access to each flat inside each Plot shall be through the respective main entrance.

1.48.1.2 *SYSTEM DESCRIPTION*

Bhopal Government Housing Project has decided to install the latest technology IP CCTV to provide surveillance through outdoor/indoors cameras at each Entries and each lobby on upper and lower ground of Plot 22 & Plot 23.

The proposed surveillance system shall consist of

- (a) Cameras
- (b) NVR(Network Video Recorder)
- (c) Viewing Monitors

This system will be used for monitoring at predetermined places on each Plot.

Video Surveillance system is useful tool for intelligence gathering, protecting properties, prevention of crime and investigating crime. Thus it helps in reduction of unlawful activities in public places, discourages vandalism & theft, identify offenders and act as an investigating tool.

The contractor shall refer the datasheet for detailed technical specifications & requirement to be offered.

1.48.2 COMPONENT-2: ACCESS CONTROL SYSTEM

1.48.2.1 *SCOPE OF WORK*

An integrated **Access Control System** is required to be Design, Supply, & Installation, Testing & Commission at Bhopal Government Housing Project, consisting of 2 Plot (22 & 23) in the compound with 688 flats and

having a 2 main entrance to the Project Plot. Access to each flat inside each Plot shall be through the respective main entrance.

1.48.2.2 *SYSTEM DESCRIPTION*

Bhopal Government Housing Project has decided to install the Boom barriers to provide Physical Access through outdoor/indoors auto operated RFID long range readers at each Entries of Plot 22 & Plot 23.

The proposed surveillance system shall consist of:

- (a) Boom Barriers
- (b) Long range readers
- (c) Access reader interface controllers
- (d) UHF passive vehicle tags

When it comes to keeping your Residential plot and people secure, The Access control is the most efficient way to prevent unauthorized visitors & residential people, restrict certain people from accessing sensitive areas and managing your visitor's access. So according herewith the Auto operated Boom Barriers have been recommended at entrance gate for granting/refuse access.

A. PHILOSOPHY OF OPERATION OF ACCESS CONTROL SYSTEM

- i. When vehicle get into entry through main gate, the RFID UHF vehicle tag is read at a reader, the card number and issue level are sent to the controller for database purpose. The reader shall communicate with the Door Access Controller. As the Door Access Controllers (DACs) shall be networked & interfaced with the Access Control System server, the data from the card reader shall be compared with the database in the server.
- ii. If access is granted, the DAC shall send a signal to the appropriate electronic lock to activate so as to open the door. If access is denied, the transactions shall be recorded in the server as well in the respective DAC and an alarm shall be raised identifying time, date and DAC name and card name at server as well as in the Client PCs.

The contractor shall refer the datasheet for detailed technical specifications & requirement to be offered.

1.48.3 COMPONENT-3: FIRE DETECTION & ALARM SYSTEM

1.48.3.1 *SCOPE OF WORK*

An integrated **Fire Detection & Alarm System** is required to be Design, Supply, & Installation, Testing & Commission at Bhopal Government Housing Project, consisting of 2 Plot (22 & 23) in the compound with 688 flats and having a 2 main entrance to the Project Plot.

The solution is being recommended at each lobby on upper and lower ground of Plot 22 & Plot 23.

1.48.3.2 *SYSTEM DESCRIPTION*

The proposed Fire Detection & Alarm system shall consist of:

- (a) Min. Four loop addressable fire alarm Panel
- (b) Active Repeater Panel
- (c) Addressable Dual optical heat sensor
- (d) Addressable Manual call station
- (e) Addressable Hooter
- (f) Signal & Power cables.

1.48.3.3 *General*

This performance specification provides the minimum requirements for the Fire Alarm System (Life Safety System). The system shall include, but not limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system to include but not limited to the following functions:

Smoke Detection and Fire Alarm System.

A. Materials & Equipment

All equipment and components shall be the approved manufacturer's current model. The materials, appliances, equipment and devices shall be listed by a nationally recognized approvals agency like UL864/FM/EN54 for use as part of a protected premises protective signaling (fire alarm) system and smoke control system. The authorized representative of the manufacturer, to be designated as the contractor, shall be responsible for the satisfactory installation of the complete system. The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building owner. All specified operational features must be met without exception. All equipment and components shall be the manufacturer's current model. The contractor shall be responsible for the satisfactory installation of the complete system. All control panel assemblies and connected field appliances shall be provided by the same system supplier, and shall be designed and tested to ensure that the system operates as specified. The system shall utilize electronically addressable, microprocessor-based detectors as described in this specification. The equipment to be supplied will be considered only if it meets all sections of the performance specification.

The supplier shall submit a point-by-point statement of compliance for all sections in this specification. The statement of compliance shall consist of a list of all paragraphs within these sections. Where the proposed system complies fully with the paragraph, as written, placing the word "comply"

opposite the paragraph number shall indicate such. Where the proposed system does not comply with the paragraph as written and the supplier feels the proposed system will accomplish the intent of the paragraph, a full description of the function as well as a full narrative description of how its proposal will meet its intent shall be provided. Any submission that does not include a point-by-point statement of compliance as described herein shall be disqualified. Where a full description is not provided, it shall be assumed that the proposed system does not comply. The Contractor shall furnish all labor, services and materials necessary to furnish and install a complete, functional fire alarm system (System). The System shall comply in respects with all pertinent codes, rules, regulations and laws of the Authority, and local jurisdiction. The system shall comply in all respects with the requirements of the specifications, manufacturer's recommendations and Underwriters Laboratories (UL) listings. It is further intended that upon completion of this work, the Owner/Consultant be provided with:

- a. Complete information and drawings describing and depicting the entire system(s) as installed, including all information necessary for maintaining, troubleshooting, and/or expanding the system(s) at a future date.
- b. Complete documentation of system(s) testing.
- c. Certification, software licenses that the entire system(s).

B. Codes and Standards

The equipment and installation shall comply with the current provisions of the following codes and standards:

Codes

- a. National Fire Protection Association (NFPA):
 - NFPA 72 National Fire Alarm Code
 - NFPA 76 Telecommunication Facilities
 - NFPA 101 Life Safety Code
 - NFPA 90A Air conditioning & ventilation system

Listings

- a. 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 268 A Smoke Detectors for Duct Applications
 - UL 521 Heat Detectors for Fire Protective Signaling Systems
 - UL 464 Audible Signaling Appliances
 - UL 38 Manually Actuated Signaling Boxes
 - UL 346 Water flow Indicators for Fire Protective Signaling Systems
 - UL 1971 Visual Notification Appliances

- UL 228 Door Holders
- UL 1481 Power Supply for fire protective signaling system.
- UL 1711 Amplifiers for Fire Protective Signaling Systems.
- UL 1635 Digital Alarm Communicator System Units

ADDENDUMS thereafter in UL Code for Fire Detection (2007).

- UL 9th Schedule Certification
 - International Standards Organization (ISO)
 - ISO-9000
 - ISO-9001
 - European Union (EU)
 - EMC Directive 89/336/ EEC
 - Electromagnetic Compatibility Requirements
 - Factory Mutual (FM) Approval
- b. Local Codes
- NATIONAL BUILDING CODES
 - IS-2189
- c. European Standards
- EN54

The contractor shall refer the datasheet for detailed technical specifications & requirement to be offered.

1.48.4 COMPONENT-4: VIDEO DOOR PHONE

1.48.4.1 SCOPE OF WORK

An integrated video door phone system is required to be Design, Supply, & Installation, Testing & Commission at Bhopal Government Housing Project, consisting of 2 Plot (22 & 23) in the compound with 688 flats and having a 2 main entrance to the Project. Access to each flat inside each Plot shall be through the respective main entrance.

The Fiber optic cable which is laid for GPON will be utilized for transmission of audio & video data of Video door phone.

The Video door phone vendor/contractor has to co-ordinate with GPON contractor while doing project implementation.

1.48.4.2 GENERAL

The Video door phone system will be suitable for transmission of audio & video data from the main entrance to the resident inside the flat and audio data from the resident of the flat to another resident of flat. The communication will be full duplex type (ensuring complete and simultaneous two way communication without loss of signal) between the Monitors inside each flat with the Guard Unit at the main entrance of the colony.

Calls to an indoor station within a flat will be possible by dialling the corresponding Flat number in the Guard Unit at the main gate.

Guard units will be provided inside the security cabin at the main entrance of the colony. Monitor inside the Flat will have a feature to establish an audio communication with the Guard unit and vice-versa. Monitor inside the flat will also have feature to establish flat to flat intercommunication directly in a one to one conversation in full privacy.

By pressing the single push button on the Panel outside the Flat, it will be possible to call the indoor station (monitor) within the same Flat.

For the purpose, the system shall consist of mainly following units:

1. **Guard Unit**

2. **Resident unit** consisting of monitor unit (inside the flat) and the door unit (outside the flat) with necessary interconnecting cables through PVC casing-capping.

These units shall further be wired/integrated with necessary cables/distributors and accessories etc. In case of failure of guard unit, the resident units shall continue to work independently providing full functionality.

A. SYSTEM EQUIPMENT OVERVIEW

(a) Main entrance shall be provided with the following equipments, collectively called Guard unit :

- Convenient desk top design
- Handset, speaker and numeric key-pad
- High Resolution built-in Camera
- Power Supply with necessary interconnecting video/audio/power cables
- Necessary Software

(b) Each ONT shall be provided with the following equipments:

- PoE Switch/Injector
- Power Supply(If Required)

(c) Each Flat shall be provided with the following items, collectively called Resident unit:

- Wall mounted LCD colour hands-free Monitors having both the features communication of Audio & Video mode.
- 1 Way Colour Video Outer door Panel with camera, microphone and speaker
- Power Supply (If required) with necessary interconnecting video/audio/power cables through PVC casing-caping

B. SYSTEM DESCRIPTION

Main entrance to the Plots shall have a Guard Unit which will be connected with all the Monitors provided in the flats. This will be by means of a Fiber optic cable through ONT connection, which is being laid for GPON application, the required cabling after ONT has to be considered respectively by Video door phone vendors. There will be a switch in ONT

between the fibre cable and the CAT6 cable in the shaft Riser/inside Flat will include the following cables:

- CAT 6 for Indoor
- CAT 6 for Outdoor

When Visitor arrives at the Plots entrance, the guard at the main gate will initiate a call to flat number through numeric keypad on the Guard station. The call will then be initiated by directly pressing the call button of the Guard Unit. The guard unit shall have blue backlit LCD display and voice guided message. The residents will be alerted by a ringtone and the Monitor will automatically display the image of the camera of the main gate Guard Station. The Image of the caller from guard unit shall always be recorded in the monitor and can be viewed when ever required.

There will be optional port to connect Server with necessary software in the system to record all incidences of usage (eg. Incidences of Call Details from/to Guard Unit, Call Details from/to Flat) & other features like message broadcasting.

The contractor shall refer the datasheet for detailed technical specifications & requirement to be offered.

1.48.5 COMPONENT-5: PROVISION OF OPTICAL FIBRE CONNECTIVITY FOR GPON

1.48.5.1 SCOPE OF WORK

This specification covers specific requirements of supply, inspection at Bidder's/Sub-Bidder's works, packing, forwarding, transportation, transit insurance, delivery at site, installation, testing at site and commissioning of the GIGABIT PASSIVE OPTICAL NETWORK (GPON) SYSTEM.

GPON consisting of Optical Line Terminal Unit, Optical Network, Splitters, EPBAX, Switches & shall be proposed for Plot 22 & Plot23 of Individual Flat. Main GPON Optical Line Terminal (OLT) shall be placed either in the surveillance room at upper ground Floor Or security cabin of each individual plot.

It is not the intent to specify completely herein all details of design and construction of equipment or materials to be supplied or of services to be rendered. However, the equipment, materials and services shall conform in all respects to high standards of engineering design, workmanship and be capable of performing in continuous commercial operation in a manner acceptable to PURCHASER who will interpret the meaning of drawings and specifications and shall have the power to reject any work or material which in his judgment are not in full accordance therewith.

All the floors, flats of Plot 22 & 23 are being provided the provision of Optical multi mode (SM) fiber backbone for GPON application. The same will be utilized by the service providers/sub contractors for value added solutions of IP Epabx system, Wi-Fi, and CATV/IPTV & Common surveillance in future while implementing the additional requirement as per client demand.

The same optical fibre cable which is being utilized for GPON will be get utilized for Video door phone system for Audio intercom within flat to flat & flat to security entries gates for visitor confirmation at entry gate.

General

This performance specification provides the minimum requirements for the GIGABIT PASSIVE OPTICAL NETWORK (GPON) SYSTEM. The system shall include, but not limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system to include but not limited to the following functions:

GIGABIT PASSIVE OPTICAL NETWORK (GPON) SYSTEM for the Internet, Telephone, Intercom, CATV and CCTV common area camera viewing in each flat on the same network.

The contractor shall refer the datasheet for detailed technical specifications & requirement to be offered.

1.49 storm water

1.49.1 Reinforced Cement Concrete (RCC) Pipes

1 Scope

This Specification covers the requirements for manufacturing, testing, supplying, lowering, laying, jointing, testing at work sites and commissioning of Reinforced Cement Concrete (RCC) pipes, of non-pressure used as road crossings for conveyance of storm water.

2 Applicable Codes & Standards

The manufacturing, testing, supplying, jointing and testing at work sites of RCC pipes shall comply with all currently applicable statutes, regulations, standards and codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of the Codes and standards, this Specification shall govern.

2.1 Materials

IS: 458	Specification for Concrete Pipes (with and without Reinforcement).
IS: 3597	Method of Tests for Concrete Pipes.
IS: 5382	Specification for Rubber Sealing Rings for Gas Mains, Water Mains and Sewers.
IS: 432 Part I & II	Specification for mild steel and medium (tensile steel bars and hard drawn steel) wires for concrete reinforcement.
IS: 516	Method for test for strength of concrete.

2.2 Code of practice

IS: 456	Code of Practice for Plain and Reinforced Concrete.
IS: 783	Code of Practice for Laying of Concrete Pipes.

2.3 Design

Design of RCC pipes, details of reinforcement and the ends of the pipe shall be in accordance with the relevant clauses of IS: 458. The Class of the pipe shall be RCC Type NP-III.

3 Manufacturing

3.1 General

- i) The method of manufacture shall be such that the form and the dimensions of the finished pipes are accurate within the limits specified in relevant IS: 458. The surfaces and edges of the pipes shall be well defined and true, and their ends shall be square with the longitudinal axis. The ends of the pipes

shall be further reinforced by an extra ring of reinforcement to avoid breakage during transportation.

- ii) The RCC pipes and rubber rings shall be systematically checked for any manufacturing defects by experienced supervisors so as to maintain a high standard of quality.
- iii) ENGINEER-IN-CHARGE shall at all reasonable times have free access to the places where the pipes and rubber rings are manufactured for the purpose of examining and testing the pipes and rubber rings and of witnessing the test and manufacturing.
- iv) All tests shall be performed by Supplier / CONTRACTOR at his own cost and in presence of ENGINEER-IN-CHARGE, if desired. For this, sufficient notice before testing of the pipes shall be given to ENGINEER-IN-CHARGE.
- v) If the test is found unsatisfactory, ENGINEER-IN-CHARGE may reject any or all pipes of that lot. The decision of ENGINEER-IN-CHARGE in this matter shall be final and binding on CONTRACTOR and not subject to any arbitration or appeal.

4 Materials

For all materials, Factory's test result and written guarantee document with necessary analysis data shall be submitted to obtain the approval of the ENGINEER-IN-CHARGE before carrying to sites.

4.1 Cement

Portland Cement shall be used for the manufacture of RCC pipes and fittings and shall conform to relevant IS codes. The use of pozzolana as an admixture to Portland cement shall not be permitted.

4.2 Aggregates

Aggregates used for the manufacture of RCC pipes shall conform to IS: 383. The maximum size of aggregate should be 10mm for pipes of internal diameter 150 to 250mm but should not exceed one third thickness of the pipe or 20mm, whichever is smaller, for pipes of internal diameter above 250mm.

4.3 Mixing and Curing Water

Water used for mixing of concrete and curing of pipes shall conform to IS: 456. Water shall be clean, colorless and free from objectionable quantities of organic matter, alkali, acid, salts, or other impurities that might reduce the strength, durability or other desirable qualities of concrete and mortar. CONTRACTOR shall submit water quality report before using it.

4.4 Reinforcement

Reinforcement used for the manufacture of the spigot and socket RCC pipes shall be mild steel Grade I or medium tensile steel bars conforming to IS: 432 (Part-1) or hard-drawn steel wire conforming to IS: 432 (part-2). A reinforcement cage for pipes shall be as per relevant requirement of IS: 458.

4.5 Concrete

Concrete used for the manufacture of spigot and socket RCC pipes shall conform to IS: 456. The minimum cement content and minimum compressive strength of concrete shall be as per relevant requirements of IS: 458. Compressive strength tests shall be

conducted on 15cm cubes in accordance with the relevant requirements of IS: 456 and IS: 516.

5 Curing

Pipes manufactured in compliance with IS: 458 shall be either water cured or steam cured in accordance with the relevant requirements of IS: 458.

6 Dimensions and Tolerances

The internal diameter, wall thickness and length of barrel, reinforcement (longitudinal and spiral), type of ends and minimum clear cover to reinforcement and strength test requirements shall be as per the relevant clauses / tables of IS: 458 for different class of pipes.

The tolerances regarding overall length, internal diameter of pipes or socket and barrel wall thickness shall be as per relevant clauses of IS: 458.

7 Workmanship and finish

- a) Pipes shall be straight and free from cracks except that craze cracks may be permitted. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight line in the trench no opening between ends in contact shall exceed 3mm in pipes upto 600mm diameter (inclusive), and 6mm in pipes larger than 600mm diameter.
- b) The outside and inside surfaces of the pipes shall be smooth, dense and hard, and shall not be coated with cement wash or other preparation unless otherwise agreed to between ENGINEER-IN-CHARGE and the manufacturer or supplier.
- c) The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or molding.
- d) The pipes shall be free from local dents or bulges greater than 3.00 mm in depth and extending over a length in any direction greater than twice the thickness of barrel.

- e) The deviation from straight in any pipes throughout its effective length, tested by means of a rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameters, 3 mm for every meter run.

8 Testing

- a) All pipes for testing purposes shall be selected at random from the stock of the manufacturer and shall be such as would not otherwise be rejected under the criteria

of tolerances as mentioned in IS: 458.

- b) During manufacture, tests on concrete shall be carried out as per IS: 456. The manufacturer shall supply, when required to do so by ENGINEER-IN-CHARGE the

- c) results of compressive tests of concrete cylinders or cubes made from the concrete used for the pipes. Every pressure pipe shall be tested by the manufacturer for the hydrostatic test pressure.

- d) The specimen of pipes for the following tests shall be selected in accordance with Clause 9.1 of IS: 458 and tested in accordance with the methods described in IS: 3597.

- i) Hydrostatic test
- ii) Three edge bearing test or sand bearing test
- iii) Absorption test
- iv) Visual Examination

Note: Three edge bearing strength to produce 0.25 mm crack shall be as per IS: 458.

9 Sampling and inspection

- a) In any consignment, all the pipes of same class and size and manufactured under similar conditions of production shall be grouped together to constitute a lot. The conformity of a lot to the requirements of this Specification shall be ascertained on the basis of tests on pipes selected from it.

- b) The number of pipes to be selected from the lot shall be in accordance with column 1 and 2 of Table 9 of IS: 458.

- c) Pipes shall be selected at random. In order to ensure randomness, all the pipes in the lot may be arranged in a serial order and starting from any pipe, every "rth" pipe be selected till the requisite number is obtained, "r" being the integral part of N/n where "N" is the lot size and "n" is the sample size.

- d) The number of pipes selected for testing shall be in accordance with Table 15 of IS: 458 and tested in accordance with methods described in IS: 3597. These pipes shall
- e) be selected from pipes that have satisfied the requirements mentioned in the above clause. All the pipes shall be inspected for dimensional requirements, finish and deviation from straight. A pipe failing to satisfy one or more of these requirements shall be considered as defective.
- f) A lot shall be considered as conforming to the requirements of IS: 458 if the following conditions are satisfied.
 - i) The number of defective pipes (those not satisfying one or more of the requirements for dimensions, finish and deviation from straight) shall not be more than the permissible number given in Column 3 of Table 9 / 15 of IS: 458.
 - ii) All the pipes tested for various tests as per IS: 3597 shall satisfy corresponding requirements of the tests.
 - iii) In case the number of pipes not satisfying requirements of any one or more tests, one or two further sample of same size shall be selected and tested for the test or tests in which failure has occurred. All these pipes shall satisfy the corresponding requirements of the test.

All result of tested data must be prepared by CONTRACTOR at site so that the ENGINEER-IN-CHARGE shall make decision of “fail or pass” at once. All cost for the test shall be borne by the CONTRACTOR.

10 Storage

Each stack of pipes shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible. Storage shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes lay lengthways and crosswise in alternate layers. The pyramid stack shall be made for smaller diameter pipes for conserving space in storing them. The height of the stock shall not exceed 1.5 m.

Rubber rings shall be stored in a clean, cool store away from windows, boiler, electrical equipment and petrol, oils or other chemicals.

11 Jointing

Jointing of RCC pipes shall be done as per the requirements of following Specifications and as per the relevant IS. The type of joints shall be as socket / spigot type. After jointing extraneous material if any, shall be removed from the inside of the pipe and newly made joints shall be thoroughly cured. In case, rubber sealing rings are used for jointing, these

shall conform to IS: 5382. The pipe joint work must be done neatly and keep even slope and level for pipe laying works.

11.1 Spigot and Socket Joint (Flexible)

The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipes. The manufacturer's instructions

shall be used, and the manufacturer's instructions shall be deemed to form a part of these Specifications. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

12 Cleaning of pipes

As soon as a stretch of RCC pipes has been laid complete from manhole to manhole or for a stretch as directed by ENGINEER-IN-CHARGE, CONTRACTOR shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by ENGINEER-IN-CHARGE to prevent entry of mud or slit etc.

If as a result of the removal of any obstruction, ENGINEER-IN-CHARGE considers that damages may have been caused to the pipe lines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory CONTRACTOR shall amend the work and carry out such further tests as are required by ENGINEER-IN-CHARGE.

It shall also be ascertained by CONTRACTOR that each stretch from manhole to manhole or the stretch as directed by ENGINEER-IN-CHARGE is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably enlightened by projected sunlight or otherwise.

13 Testing at work site

After laying and jointing of RCC pipes is completed the pipe line shall be tested at work site as per the following Specifications and as directed by ENGINEER-IN-CHARGE. All equipment for testing at work site shall be supplied and erected by the CONTRACTOR and shall be rectified by him / her to the full satisfaction of ENGINEER-IN-CHARGE. Water used for test shall be removed from pipes and not released to the excavated trenches.

After the joints have been thoroughly jointed and have been checked by ENGINEER-IN-CHARGE and before backfilling the trenches, the entire section of the sewer shall be proved by CONTRACTOR to be water tight by filling in pipes with water at a Constant Head of 2.5m above the top of the highest pipe in the stretch and heading the water up for the period of one hour. The testing apparatus used for the purpose

1.49.2 INSPECTION CHAMBERS

1. General requirements

Inspection chambers dimension shall depends upon the diameter of pipe along with its depth as given in the Bill of Quantities. These shall be

constructed in the drains at such places and levels and dimensions as indicated on the drawings. Sizes specified shall be clear internal dimensions of the chamber.

The different types of storm water chamber sizes for different pipe diameter connection are as follows:-

Storm water Drainage Chamber Size (mm)	Storm Water Pipe diameter (mm)
750x750	300 -450
1000x1000	450- 600
1200x1000	600-750
1800x1200	900-1200
2000x1500	1200-1400

Depth of the drains shall be measured from the finished Ground level. Invert level shall be with reference to the GTS or whichever reference level given by ENGINEER-IN-CHARGE-in charge.

2. Location and sizes

The size indicated in the drawings shall be the internal size of chamber. Unless otherwise specified, inspection chambers shall be provided at all changes of direction of drains and where branch drain meets the main drain. Chambers shall be of such size as to allow necessary examination and clearance of drains. The minimum internal sizes shall be taken as per detail drawings; standards specified and local byelaws if any. The work shall be done strictly as per standard drawings and following specifications:

3. Excavation

This shall be done to dimensions and levels on the drawings.

4. Bed Concrete

Bed concrete shall be in 1:2:4 cement concrete, 100 mm thick for inspection chambers, 150 mm thick for depths upto 3 m and 300 mm thick for greater depths in case of chambers or as specified by the ENGINEER-IN-CHARGE. In case of sewers laying in storm water channels, the pipe is encased with cement concrete M15 grade with a thickness of 150mm all around.

5. RCC

Inspection chambers shall be constructed in reinforced cement concrete to grade M25. The base and walls shall be designed for all loads coming over including the earth and water pressure.

6. Plaster

Inside walls chambers shall be plastered with 12mm thick cement plaster 1:3 mixed with waterproofing material and finished smooth with a floating coat of neat cement. External walls shall be plastered in CM 1:3 and sponge finished.

7. Vata

75 mm fillet shall be made with C.M. 1:3 all round the external joint between the bed concrete and brick masonry wall of chamber.

8. Benching

Channels and benching inside the inspection chambers shall be done in cement concrete 1:2:4, rendered smooth with neat cement. The channel provided shall be of semicircular shape of the same diameter as the diameter of the pipe drain with vertical walls. The depth of channel shall be equal to the pipe drain diameter and the P.C.C. benching top will have a slope of 1 in 12 from the side walls to the channel.

9. PCC cap

PCC M20 cap of 200mm thickness shall be provided on top of inspection chambers for fixing the gully trap.

10. Steps

Steps shall be provided wherever the depth of the chamber is more than 1.2 m. Foot rest shall be C.I. rungs weighing 5.3 kg and conforming to IS 5455-1969. These shall be embedded 20 cm deep in 20 × 20 × 10 cm blocks of P.C.C. 1:3:6. The blocks with C.I. foot rest placed in its centre shall be cast in site along with masonry.

Footrest shall be placed 300 mm apart vertically and 375 mm horizontally in staggered fashion. First footrest shall be 450 mm below top. Footrest shall be painted with bituminous paint and the portion embedded shall be painted with thick cement slurry before fixing.

11. Testing

Chamber after it is raised above highest expected subsoil water level in monsoon shall be tested for water tightness. The mouths of all pipes entering the chamber shall be suitably plugged with brick masonry or wooden or any other type of plug. Chamber under test shall then be filled with water up to general subsoil water level and the level observed for one hour, it shall then be deemed as watertight. During testing the pit around shall be kept free of water and CONTRACTOR shall observe the places where leakage takes place and take steps to correct the same.

12. Measurement

Inspection chambers, gullies etc. shall be enumerated under relevant items in the schedule of quantities. Depth shall be measured from top the cover to the invert of channel. Depth shall be measured as an extra over the depth specified under enumerated item and paid per running meter under separate item following the main item. Weight and duty of gully gratings shall be specified in the item.

13. Rates

The rate shall include the cost of material and labour involved in all the operations from above up to specified depth in the item. Excavation and refilling is generally paid for separately under relevant item or excavation can be clubbed with the item of chambers, but in that case maximum depth will have to be specified in the item. If the duty of the cover in the item is

changed during execution by the ENGINEER-IN-CHARGE-in-charge amount due to difference in weight of the cover shall be paid extra or deducted as the case may be.

1.49.3 GRATING (DUCTILE IRON)

1. The work shall consist of supply of structural steel, fabrication & erection in position as per drawing including marking, cutting, bending, assembling, bolting, riveting, welding, machining and painting as specified, including all labour, materials, equipments, tools and plants. The gratings will be of mild steel.

2. Materials

All structural steel such as angles, flats, plates, channels, I-sections, shall conform to IS-2062. The steel shall be free from cracks, flaws, seams, laps, blisters, imperfect edges and other defects mentioned in IS-2062 and shall have smooth finish. It shall be free from loose mill scale, rust pits and other defects affecting the strength & durability. If required by the ENGINEER-IN-CHARGE, the CONTRACTOR shall furnish the manufacturer's test certificates for the lot brought by him for the work. All deformed structural material shall be worked in the shop or straightened prior to fabrication by the methods not injurious to the strength.

The rivets shall conform to IS-1148.

3. Fabrication

The fabrication work, such as marking, cutting, holding, bending, assembling, bolting, riveting, welding, machining shall be carried out to produce the final fabricated work as per approved drawings or as ordered by the ENGINEER-IN-CHARGE from time to time. The work shall comply with IS-800. Before taking up actual fabrication work, the materials to be used shall be closely examined piece by piece and any material found damaged or defective shall be stacked separately and shall not be used in the work.

4. Welding

The welding electrodes used for the work shall conform to IS-814 and the welding work shall be carried out as per IS-816. The welding work shall conform to Specification B 18 of Standard Specifications Volume 1 published by PW&H Dept of Govt. of Maharashtra.

The size and location of the weld shall be entirely as per the drawings or as directed by the ENGINEER-IN-CHARGE. The welding work shall preferably be carried out in the fabrication shop. The structural steel members to be welded shall be cleaned to remove paint, rust, other materials to expose original clean metal surface before welding. The members to be welded shall be securely held in proper position by means of tack welds, clamps or jigs before welding commences. The welds showing slag inclusions, porosity or lack of proper penetration shall be cut out and re-welded. Grinding of finished weld shall be permitted only if the weld is not reduced below prescribed section

5. Inspection & approval

When multiple numbers of same fabrication products are to be produced, the CONTRACTOR shall prepare a sample of such fabrication product, complete in all respects as per the drawings and the direction of the ENGINEER-IN-CHARGE. The sample shall be inspected by the ENGINEER-IN-CHARGE at the fabrication shop. If any modifications are suggested in the sample piece, the same shall be incorporated and the final version of the sample shall be got approved from the ENGINEER-IN-CHARGE. The subsequent fabrication products shall be exact replica of the approved sample.

In case the nature of the product is not repetitive, the CONTRACTOR shall get the fabrication product approved at the shop unless waiver for such inspection is given by the ENGINEER-IN-CHARGE.

The painting work shall be undertaken only after the inspection and approval to the fabrication by the ENGINEER-IN-CHARGE.

6. Painting

The painting shall generally comply with IS-800 and IS-1477, subject to such stipulations, additions and alteration as prescribed in the particular item.

The surfaces to be painted shall be cleaned off the dust, rust, oil stains etc without causing any damages to the work, so as to receive paint properly. The primer coat shall be applied at the fabrication shop soon after the cleaning to avoid deterioration of the surface.

Red lead paint shall be used as primer coat unless other paints are specified. The number of primer coat shall be as per description of the item and when not mentioned, it shall be one coat.

The finishing coats shall be applied after erection. The type of paint for finishing coat and number of finishing coats shall be as specified in the item. The surfaces shall be cleaned before application of the finishing coats.

Ready mix paints, conforming to relevant IS, from reputed manufacturers shall be used. The make and colour shed of all the paints to be used shall be got approved from the ENGINEER-IN-CHARGE.

The painting shall be normally done in dry weather with the surfaces being dry. The paint may be applied with spray or brushes and shall be worked in crevices & corners. If some part of surface is not accessible, the method as directed by the ENGINEER-IN-CHARGE shall be resorted. The paint shall be applied to produce uniform even coating over entire surface, free of streaks, pitting, wrinkles or other irregularities. Sufficient time shall be allowed for previous coat to dry, before the next is applied. The surfaces to be embedded in the concrete or masonry shall not be painted.

The painted surface shall be protected from Sun, rain, condensation, contamination or surface damage until it is fully dry.

7. Erection

The work fabricated in the shop shall be erected properly at the site as per drawings or as directed by the ENGINEER-IN-CHARGE. Necessary lifting, hoisting, holding devices and scaffolds required shall be provided by the CONTRACTOR. In case of large fabrication works, the method of erection shall be got approved from the

ENGINEER-IN-CHARGE.

8. Mode of measurements

The work shall be measured and paid for on basis units as prescribed in the related item i.e. on per sqm basis or per number basis or on weight basis; as the case may be.

In case, the work is measured on weight basis, the payable weight of the fabrication work shall be worked out from the quantities of members actually used in work proper and .the standard weights as per ISI Hand book of the structural members, without accounting for wastages, weights of welds etc.

The work shall be strictly carried out as directed by ENGINEER-IN-CHARGE-in-charge.

9. DUCTILE IRON GRATING WITH FRAME

The gratings and frame shall be manufactured from appropriate grade of Ductile iron (Spheroid graphite or nodular iron) conforming to IS 1865. However Grade SG500/7 & SG500/7A is recommended as per manufacturer specifications.

The micro-structure of ductile iron shall contain minimum 80 percent graphite in the form of V or VI designations as specified in IS7754.

The castings shall be sound, clean and free from blow-holes, slag inclusions, distortion, hard spots, sand—fusion ,porous space sand/air holes, cold shuts and all surface and other defects . They shall be well dressed, fettled and shall be straight, regular and true in every respect, Casting shall not be welded or plugged except by agreement between the ENGINEER-IN-CHARGE in charge & manufacturer as per site requirement.

9.1 Opening angle of hinged covers and gratings:

The opening angle of hinged covers or gratings shall be at least 100° to the horizontal however the recommended opening angle shall be 120° to the horizontal.

9.2 Bituminous coating for covers and frames

The covers and frames shall be coated with materials having base with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to temperature of 63°C and shall not be so brittle as to chip off at temperature of 0°C.

9.3 Size and shape.

The size & shape of grating& frames shall be as per Table 9.A unless & otherwise specified by the ENGINEER-IN-CHARGE.

Table 9A

Size	of	Approx. weight in kg for grade
------	----	--------------------------------

clear grating (mm)	B 125 (MD)	C 250(HD)	D 400 (EHD)
600 x 600	70	90	315
600 x 500	60	80	180
450 x 450	34	56	140

The performance requirement of manhole covers and frames/ grating with frames shall conform to EN 124.

9.4 Frame Seating area

The bearing area shall be designed in such a way that: a) the bearing pressure in relation to the test load shall not exceed 7.5 N/mm²; and it should provides an adequate contribution to stability under working conditions. Minimum 75mm frame seating is recommended.

9.5 Slot area as waterway in grating.

The dimension of slots shall be selected considering hydraulic capacity and slots shall be evenly distributed throughout the clear size of grating. The total area of opening shall not be less than 30% of clear size of grating & the same shall be specified by manufacturers.

9.6 Marking

All chamber covers and frame shall have cast with the following information marked on them:

- a) Manufacturer's name or trade-mark
- b) Grade/ class designation: like B125-MD, C250 -HD, D400 –EHD.
- c) Year of manufacture

The words SWD to denote 'storm water drain' .

9.7 Installation of covers & Frame

Installation shall be carried out in accordance with the relevant Code of Practice. Until such Codes of Practice exist, the National Code of Practice or the manufacturer's guide should be used.

The Frames shall be fixed with manhole/Inspection Chamber top in M20 grade of concrete as per IS 456.

The cover shall be air tight and water tight.

The sizes of covers specified shall be taken as the clear internal dimensions of the frame.

The weight of the various types gratings and frames shall be Sufficient to sustain test load as per EN 124 & IS 1726.

The cover shall be capable of easy opening and closing and it shall be fitted in the frame in workmanship like manner.

The manhole covers with frame and grating with frame shall conform to EN124.

9.8 Inspection and Testing for Gratings and frames

Covers & frames shall be subjected to following tests for acceptance:

- a) Visual & Dimensional check as per EN 124
- b) Load test as per EN 124 and in line comparison with as per Clause 10 of IS 1726.
- c) Mechanical properties test as per EN124 & IS1865.

9.9 Transporting & handling

- a) The Gratings & frames should be preferably transported by road from the factory and stored as per the manufacturer specifications to protect damage.
- b) The Gratings & frames shall be transported from the factory to the work sites at places along the alignment of Storm water drain as directed by ENGINEER-IN-CHARGE and as specified by manufacturer.
- c) CONTRACTOR shall be responsible for the safety of Gratings & frames in transit, loading/unloading. Every care shall be exercised in handling Gratings & frames to avoid damage.
- d) The Gratings & frames shall be unloaded on timber skids with steadying ropes for by any other approved means.
- e) Suitable gaps in the Gratings & frames stacked shall be left at intervals to permit access from one side to the other.
- f) The Gratings & frames received on site shall be jointly checked for any visible damages shall be pointed out immediately to the ENGINEER-IN-CHARGE at the site and recorded properly. Such defects shall be rectified or repaired to the satisfaction of the ENGINEER-IN-CHARGE entirely at the CONTRACTOR's risk and cost. Any cover & frame which shows sufficient damage to preclude it from being used shall be discarded.

9.10 Measurement & Payment

Measurement shall be done in number basis with specified clear cover size. All concrete works shall be measured and paid for separately under the respective items of work.

The rate shall include the cost of materials and labour involved in all the operation described above unless specified otherwise in the item.

1.49.4 RUBBLE SOLING

The item covers providing and laying the rubble soling of specified thickness including preparing the sub grade to the proper section, hand packing the

rubble and spreading of the hard murum / gravel. The rubble soling shall be provided below the catch pit and apron foundations for box culvert and below bridge openings of slab culvert.

The work shall be strictly carried out in accordance with standard specification of Public Works Department of Government of Maharashtra. - Spec No.: Bd. A. 12.

1. **General**

The work shall consist of supply of stone rubble of specified type and laying the rubble soling of specified thickness including preparing the sub grade to the proper section by scrapping, dressing, compaction etc. and hand packing with rubble chips to the required line, curve, grade & section. The work shall also include supply and spreading of the murum / gravel for filling interstices & voids in the rubble soling.

2. **Rubble**

The rubble shall be of trap / granite / quartzite / gneiss type. The quality of rubble shall be as per the relevant specifications. The rubble shall be hard, tough, sound durable, dense, clean, of close texture, free from unsound material, cracks, decay and weathering. The water absorption shall not exceed 5 % by weight. The broken rubble shall be used.

The shape of the stones shall be as regular as can be obtained from the quarries, without attempt at shaping or dressing. They shall be sufficiently flat bedded. The stone shall be broken with smallest dimension equal to specified thickness of the soling. The length & breadth shall generally not exceed twice the thickness. Before starting the collection, the CONTRACTOR shall get a sample conforming to quality, shape and size required approved by the ENGINEER-IN-CHARGE, who will keep it in his office for reference.

3. **Preparation of formation**

The area where soling is to be provided shall be marked by stakes & strings for the required width for laying of soling in line, curve, section and grade wrt. the center line. The edge line stakes shall be ranged for a sufficiently long length to obtain straight lengths & uniform curves. The CONTRACTOR

shall clear off the area & do the necessary trimming or filling for laying of the soling in line, curves, grades and section. All fillings shall be watered & compacted to achieve maximum consolidation.

4. Laying of soling

The rubble shall be laid with the largest face downwards and in contact with each other. The stones shall break joint as far as possible. The full thickness of the soling shall be made in one stone only. As the laying of rubble advances, the soling shall be hand packed by wedging and packing with 80 mm metal in the joints of the soling and driving them by hammers in place, so as to fill the voids as completely as possible. This operation of hand packing shall follow closely the rubble laying. The soling shall be laid and hand packed true to the grade & section, which shall be frequently checked by use of boning rods, template boards and such other devices. The rubble soling shall be compacted fully by using heavy rammers. The finished grade and section of soling shall be matched with the next surfacing coming on it by knocking out the projections of the stones and by filling the depressions with the metal chips.

5. Spreading gravel over the soling and compaction

The gravel shall be hard, tough & dense of particle size less than 12 mm. It shall be evenly spread over the rubble soling and made to enter the interstices of the soling by using brooms to fill in voids completely. The surface shall be compacted again to wedge the gravel in the interstices of the soling tightly.

6. Mode of Measurement and Payment

The rubble soling shall be measured on volumetric basis considering finished dimensions of soling. The width and depth dimensions shall be restricted to those shown on the drawing or as directed by the ENGINEER-IN-CHARGE. No deduction shall be made for voids. Payment will be made on cubic metre basis.

A. CATCH BASINS

RCC Catch basins will have 450x450 mm clear opening of DI gratings and 1000 mm-1500mm invert depth with RCC NP2/RCC NP3 at road crossings

with encasement (200 mm internal diameter) joining to nearest stormwater drain. They will be constructed as per position and number mentioned in layout drawing. The outgoing pipe invert shall be minimum 225mm above the catch basin invert. The invert of the pipe can be suitably adjusted for connection to the adjacent drain. The catch basins shall be measured and paid in per number basis excluding pipe providing and jointing cost.

B. Outfall Screens

Outfall screens shall be provided at the storm water drain outfall section to screen out any floating debris from the water flowing into the pond. The size of the screens shall be as mentioned in the BoQ.

The screens shall be of SS 304 grade Manual bar screen suitable for channel of size as per design, and having clear spacing between the bars of 10 mm. The size of flat bar shall be 5 mm x 50 mm. Angle of inclination of screen 45 to 60 degrees. The screens are to be procured from approved manufacturers. Suitable manual racking arrangement shall be provided for cleaning of the screens at regular intervals.

C. Precast Open able drain covers

Precast openable drain covers shall be provided on the surface storm water drains which are coming under the sidewalk. The open able cover shall be provided at an regular interval of 15 m for cleaning and inspection purpose. The precast RCC openable drain cover shall be of M20 grade and shall have the dimensions 0.43x0.43x0.15 m. The drain cover shall have lifting hook arrangement for removal of the drain cover.

1.50 sTP

1.50.1 plant capacity

Package Sewage Treatment Plant (PSTP): - 500 KLD capacity.

A PSTP of 500 KLD capacity is planned which will cater the sewage generated from Plot numbers 22 & 23 these plots comprise of Government Residential Houses.

1.50.2 Characteristics of Raw Water

Understanding of the nature of physical, chemical and biological characteristics of sewage is essential in planning, design and operation of treatment and disposal facilities and in the engineering management of environmental quality. The influent characteristics expected for domestic sewage is given Table 13.

Table 13: Influent Characteristics

Sl. No.	Parameter	Concentration Values (Expected)	Concentration Values (CPHEEO 2013)
1	pH	6.5 - 8.5	-
2	BOD ₅ @ 20°C, mg/L	250 – 300	250
3	COD , mg/L	425 – 600	425
4	Total suspended solids, mg/L	300 – 400	375
5	Oil and grease, mg/L	10 – 20	-
6	Total kjeldahl Nitrogen (as N), mg/L	50 – 60	45
7	Total Phosphorus, mg/L	8 – 10	7.1
8	Feecal Coliforms MPN/100 ml	10 ⁶ to 10 ⁸	-

1.50.3 Characteristics of Treated Sewage

It is proposed that the sewage which is generated is to be treated to such standards that it can be used in Solid waste management Plant for Floor washing, vehicle washing etc.

From the point of view of better environment, it is contemplated that the residential project will have treatment system which treats the entire sewage to 10mg/l (BOD and TSS) standards. The latest discharge standards of treated sewage as per CPCB & CPHEEO manual are mentioned in Table 14.

Table 14 : CPHEEO Discharge Standards of Treated Sewage

Parameters	After secondary treatment (CPCB Dec 2016)	After Secondary treatment (CPHEEO 2013)
BOD ₅ (mg/L)	<10	<10
COD (mg/L)	<50	-
TSS (mg/L)	<10	<10
Total Nitrogen (mg/L)	<10	<10
Total Phosphorous (mg/L)	<2	<2
pH	6.5 – 8.5	-
Turbidity (NTU)	-	-
Ammonical Nitrogen (NH ₄ -N)	<5	-
Residual chlorine	-	-

Fecal Coliform, (MPN/100ml)	< 230	< 230
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The reuse standards of treated sewage as per CPHEEO manual are mentioned in Table 15

Table 15 : Treated Sewage Standards for Reuse

Type of Reuse	All types of landscape irrigation, toilet flushing, use in fire protection systems and commercial air conditioners and other uses with similar access or exposure to the water
Treatment	Secondary, Filtration, Disinfection
pH	6.5-8.5
BOD (mg/L)	< 10
Turbidity (NTU)	< 2
Faecal	No detectable Faecal Coli
Residual Chlorine (mg/L)	1

- The reclaimed water should not contain measurable levels of viable pathogens.
- Reclaimed water should be clear and odourless.
- Higher chlorine residual and/ or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed.
- Chlorine residual of 0.3-0.5 mg/l or greater in the distribution system is recommended to reduce odours, slime, and bacterial re-growth.

Treated water from tertiary treatment of STP is proposed to be stored in a separate treated water tank near STP. This treated/ recycled water is proposed to be supplied for landscape & irrigation.

The reuse of the treated wastewater for the project area will be for gardening, road washing, etc. Hence, expected standard will be as given in **Table 16**.

Table 16: Treated Sewage Standards

Maximum limits/Type	Unit	Desired Values
Colour	-	Acceptable
BOD	mg/lit	10
COD	mg/lit	50
Residual Chlorine	mg/lit	1

Faecal Coliform	mg/lit	No detectable	Faecal
Turbidity	NTU	2*	
pH		6.5-8.5	
TSS	mg/lit	5	

Residual chlorine for flushing water need not be >1.

* From Practical Consideration

1.51 solid waste management

- Fully automatic equipment with minimalistic intervention
- Equipment should be silent and odorless
- Equipment with low electricity consumption and low operating cost.
- Minimum Volume reduction to be 80 – 90%.
- The operating temperature should be such that all pathogens are killed thus making it safe for human handling.
- The design should be fully packed and the high temperature must ensure that it does not attract rodents, insects or flies.
- The bacterial culture to be provided along with the machine during commissioning and need not be put in again in its lifetime. Hence no recurring costs of bacteria, dry leaves or labor.

CHAPTER 2. List of approved makes

2.1 Architecture

Sr. No.	Product	Manufacturer's Name
1.	AAC / flyash blocks	Charbuja, Aerocon, Siporex, Ecolite, CEEFpro, BLIT
2.	Waterproofing Treatment	Pidilite, BASF
3.	GRC	Unistone, Birla White
4.	Concrete, Stone Sealar	Degussa, Wacker, Hytek, Aquamix, Laticrete, Kerakoll
5.	Fire Check Wood, Steel Doors	Signum, Godrej, Guardian, Navair, Shakti Hormann, Promat, Alhada,
6.	Flush Doors	Tata Conswood, Greenwood, Garnet, Merino, Century
7.	Door seals [dust / fire]	Lorient, Enviroseals, Pemko, Assorted
8.	Structural, Weather Sealant	Dow Corning, GE, Dupont
9.	Glazed, Ceramic & Vitrified Tiles	Euro, Naveen, Kajaria, Nitco, Jhonson, RAK
10.	Pigmented Joint fillers	Laticrete, Pidilite
11.	Tensile Roof	Unique, Ecostructures
12.	Cement Putty	Birla White, J K white
13.	Paint	Nerolac, Asian Paints, Dulux, Jenson & Nicholson, Berger, ICI, Oikos, Akzonobel, MRF
14.	Glass	Saint Gobain, AIS, Pilkington, Emirates
15.	Glazing Systems	Hydro, Domal, Kawneer
16.	Fire rated glass	Schott, Saint Gobain
17.	Doors, Window Fittings And Fixtures	Dorma, Giesse, Dline, Union, Yale, Assa Abloy brands
18.	Toughening Agencies	Sejal, GSC, Gold Plus, Impact
19.	Lamination Films	Garware, Dupont
20.	Polycarbonate sheet	Lexan, Danpalon, GE, Tuflite, Plaram
21.	Gypsum & Mineral Fibre boards,	Saint Gobain, India Gypsum, Rondo, Armstrong, AMF, Knauf, Rehau, Lafarge,

Sr. No.	Product	Manufacturer's Name
	systems, access panels & accessories	Gypsemma, USG
22.	False Floor	Unitile, Solidfeel
23.	Handrails	Technorails, Dline, Dorma, Carlf India,
24.	Toilet Modular Partitions	Merino,
25.	Acoustic treatment / boards, etc	Anutone
26.	Fencing	A1Fence
27.	Polypyopylene Rungs	Pranali, Mase Safety Works, StepX
28.	Paver Blocks	Basant Beton, Vyara
29.	Grass Pavers	
30.	Thermoplastic Road Marking Paint	Asian Paint PPG-Apcomark, Automark Technologies (India) Pvt. Ltd.
31.	Fire Stop Mortar & Foam	Firestop, Hilti, Promat, Newkem
32.	Expansion Joints	CS expansion joints, BASF Eabco, Excel Tech
33.	Cast in Channels	Halfen Deha, Jordhal
34.	Sanitary wares	Hindware, Parryware, Cera, HR Jhonson
35.	Concealed flush tanks / valves	Gebrit, Jaquar, Schell, Commander, Viega, Parryware
36.	Faucets /sanitary fittings	Jaquar, Grohe, Schell,
37.	HDPE drain boards	Doerken, Green global, Pidilite
38.	CPVC plumbing pipes & adhesives	Flowgaurd, Astral ,Ashirwad, Prince
39.	Manhole covers	Neco, Municast,
40.	Light Fittings	Corvi, Bajaj, Philips, Trilux, Schreder, Reiz
41.	Gate automation & control	Gandhi automation, Boon Edam
42.	AAC / flyash blocks	Charbuja, Aerocon, Siporex, Ecolite, CEEFpro, BLIT
43.	Waterproofing Treatment	Pidilite, BASF
44.	Anchor Fastener	Fischer, Hilti

Sr. No.	Product	Manufacturer's Name
45.	Entry Mat	Euronics, 3M
46.	Stamp Concrete	Unistone, Bromanite
47.	Curb Stone	Super Tiles

Note : Bidders to consider any of the approved makes indicated above. If any equivalents are suggested by the bidder, they shall be specifically highlighted in the bid submissions, along with technical documentation supporting compliance / equivalency.

2.2 landscape

Sr. No.	Product/ Equipment	Manufacturer's Name
1.	Irrigation System	RAINBIRD- Harvel Irrigations Pvt. Ltd. JAIN IRRIGATION SYSTEMS LTD. PREMIER WORLD
2.	Gunmetal And Brass Valves	ZOLTO LEADER SANT
3.	PVC Pipes And Fittings	FINOLEX SUPREME PRINCE
4.	Stamped Concrete	UNISTONE, BROMANITE
5.	Terrace Garden Composite System (includes drainboard, geotextiles, secondary waterproofing if required)	STP CICO
6.	Fountain System	RIPPLE FOUNTAINS PREMIER FOUNTAINS DEEP- N - DEEP
7.	Curb Stone	SUPER TILES

2.3 Civil & structural

Sr. No.	Category	Sub Category	Brand Name
1	Cement	OPC 43/53 Grade (ISI marked), PPC	Ambuja Cement, L & T, ACC, Birla, VIKRAM, J.K., Ultratech, Ambuja, Grasim, JK, Binani, India cement
3	Cement	White Cement	Ultra tech, ACC, Birla ,J.K,

Sr. No.	Category	Sub Category	Brand Name
4	Cement	Chemical Admixtures	Kerakoll, MC Bauchemie, BASF, MYK Schomburg, Pidilite, Sunanda Chemicals, Sika, FOSROC, Choksey Chemicals
5	Cement	Expansion joint board	Supreme Industries or equivalent
6	Steel	Rebars	Vizag Nigam Ltd., SAIL
7	Steel	Structural Steel	Vizag, TISCON, SAIL, Metro structure, RINL, AGRASEN ISPAT, JSW, CORUS
8	Steel	HYSD Bars	Metro HSDS bars
9	Steel	TMT Bars	Thermex TMT
10	Steel	M.S. Pipe, Tubes, Bar, Flats, Angle, Tee Sections	SAIL, TISCO
11	Masonry Work	AAC blocks	BILT Industries Pvt. Ltd, Aerocon, Siporex India limited, Xtralite; Pragma Marketing Co. Ltd
12	Water Proofing	Water proofing compound	CICO, Pidilite, Laticrete
13	Water Proofing	Membrane Waterproofing system	BASF, STP limited, Texsa, W R Grace
14	Water Proofing	Chemical Waterproofing system	BASF, MC-Bauchemie, Sika, Sunanda Specialty Coatings, Perma Construction Aid Pvt. Ltd.
15	Water Proofing	Water stops	Hydrotite, BASF, Hydroswell
16	Ready Mix Concrete	Ready Mix Concrete	ACC, RMC, Ultra tech
17	Miscellaneous	Structural Sealant	Wacker, Dow Corning, GE
18	Miscellaneous	Polysulphide sealant	Pidilite, Chemetall-Rai
19	Miscellaneous	Bitumen Impregnated Board	Shalitex
20	Miscellaneous	Polyethylene back up rod	Supreme Ind. Ltd.
21	Miscellaneous	Epoxy	Fosroc/ STP/ CICO/ Ardex
22	Miscellaneous	Welding rod	ADVANI
23	Miscellaneous	Shear Stud/Connector	KOCO

Sr. No.	Category	Sub Category	Brand Name
24	Miscellaneous	Clamp, Rebar, Chemical fastener	Hilti, Fischer, Würth
26	Miscellaneous	Anchor Fasteners / bolts	Hilti, Fischer, Halfen
27	Miscellaneous	Masking Tapes	3M, Sun Control/ Wonder Polymer
28	Miscellaneous	Dash Fasteners	SS grade, Hilti/
29	Miscellaneous	Stainless Steel Bolts, Washers and Nuts	Kundan/ Puja/ Atul
30	Miscellaneous	Stainless Steel Pressure Plate Screws	Kundan/ Puja/ Atul
31	Miscellaneous	Stainless Steel Friction Stay	Hetish, Haffle, Securistyle
32	Miscellaneous	Weather Silicon make and grade	Dow Corning/ Momentive (GE)
33	Miscellaneous	Structural Silicon	Dow Corning/ Momentive (GE)
34	Miscellaneous	Tensile fabric System	Ferrari, Mehler, MakMax, Akruiti
35	Miscellaneous	Stainless Steel	Jindal/ SAIL/ Golden
36	Miscellaneous	Polycarbonate Sheet	Danpalon, Alcox, Polygal, V. A. Corporation, Joy Fab, Yadav Engineering
37	Miscellaneous	Adhesives & Grouts	Bal, Laticrete, KeraKoll, Pidilite

2.4 electrical

Sr. No.	Material/ Equipment	Vendor
1.	Protection Relays (Numeric / Electro mechanic Type)/ Auxiliary relays)	ABB Schneider Electric Siemens Alstom
2.	Potential & control Transformer (CT/PT)	Automatic Electric Precise Kappa Pragati
3.	Current Transformer (Cast Resin Epoxy Coated)	Automatic Electric Gilbert & Maxwell Kappa Pragati
4.	Electronic Digital Meter (A/V/PF/HZ/KWH) /MFM with LCD/LED Display.	Schneider Siemens AE

		Socomec L & T
5.	HRC Fuse and Fuse Fitting	ABB GE Siemens L&T
6.	ACB / MCCB	ABB Schneider Siemens
7.	Contactors	ABB Schneider Siemens L&T
8.	Change over switch (automatic/ manual)	HPL Hager Socomec GE
9.	Electronic / Microprocessor based relays	Siemens ABB Schneider Electric
10.	Bi-metal / Overload Relays	Siemens Schneider Electric L&T
11.	Thermister relay	Alstom/ Minilec/ Siemens
12.	Push Buttons	ABB L&T Schneider Siemens BCH
13.	A. Power Distribution Panels & Boards Totally Type Tested Assembly (TTA) (AS PER IEC61439- 1 & 2). To be sourced directly from OEM or authorized licensed partner.	Siemens Siepan 8PU – By Advance Panels & switchgears (P) Ltd. Schneider blockset –By Adlec Power Pvt Ltd. ABB Ar Tu- by Trisquare
	B. Power Distribution Panels & Boards (Non TTA)	Advance Panels & switchgears (P) Ltd. Adlec Power Private Limited Vidhyut Control
14.	Switches, Time Delay Relay	Schneider Siemens Hager Legrand

15.	Indicating Lamps	Siemens Schneider ABB L&T BCH Esbee
16.	HT/ LT Power & Control Cables	Universal NICCO KEC International Polycab Finolex Cable Corporation Of India Ltd
17.	HT/ LT Jointing Kit & Termination Kits	Birla-3M Raychem Safe Kit M seal
18.	Termination (Lugs)/ Cable Glands(Double compression)	Commet Dowell Jainson
19.	Selector Switches	Kaycee ABB Siemens Schneider
20.	Alarm Annunciators (solid state type with LED illumination) / Facia Annunciator	Industrial Instruments & Controls Minilec Alstom ICA
21.	Cable Management Systems- Raceways/Floor Boxes/ Trunkings , Cable trays	Legrand OBO-Betterman Indiana Profab
22.	Cable tray hangers and Supports	Gripple Hilti
23.	MS Black Stove Enameled ERW Conduits/GI pipes(ISI Approved) & accessories	AKG BEC Precision
24.	UPVC Conduit/JB/flexible conduit / tees/ Bevels, elbow & accessories	AKG Plaza Avon Plast Precision
25.	Copper Conductor PVC Insulated Wires/ Stranded Flexible Wires (FRLS) (including panel wiring)	Finolex RR Kabel KEI Havells

26.	Non-insulated conductors	Copper	Earthing	Gupta Industrial Corporation (Vasai, Palghar) Bharat Wires & Ropes Diamond Cables
27.	Modular Switches, Socket Outlets And Wiring Accessories With Moulded Cover Plate.			Legrand (Myrius) Schneider (Opale) MK (Blenze)
28.	Metal Clad Plug & Socket (Industrial)			Legrand Schneider Neptune (Balls)
29.	MCB/RCCB/ SPD/RCBO			Legrand Schneider Siemens ABB L & T
30.	MPCB			Schneider Siemens ABB
31.	Distribution Boards(MCB DBs)			Legrand Schneider Siemens ABB
32.	a	Light Fixtures (General) LED/ CFL/T5		Wipro Philips Crompton Greaves Trilux Bajaj
	b	LED / Driver		Cree Nichia Philips Osram
33.	Electronic Ballast for Fluorescent (To be selected as per fixtures' manufacturer)			Philips Wipro Osram
34.	CFL / T5 Lamps			Philips Osram Wipro
35.	Exit lights			Prolite Legrand Philips Zumtobel
36.	Ceiling Fan (5 star rating)			Crompton Bajaj USHA ORIENT
37.	Exhaust Fans (5 star rating)			Crompton Almonard Havells Orient

38.	External & Street Lighting	Schreder Wipro Trilux BAJAJ Philips
39.	Landscape Lighting	NOVA REIZ BAJAJ KLITE
40.	MS Tubular / Octagonal/ Decorative Poles	Bajaj Philips Schreder Vamount Klite
41.	Lightning Protection System	DEHN ONAY J. Propster
42.	Lightning & Surge Voltage Protection	ABB Hager OBO Betterman DEHN
43.	Fire Sealant & Fire Retardant Paint	3 M India Ltd. HILTI Promat
44.	Fire Barriers / Sealing	Brattberg Roxtec Signum Navell Multikil
45.	Water barriers/sealing system	Roxtec Rayflate (Tyco Electronics)
46.	Insulating mats	Electromat Dozz Raychem RPG
47.	Terminal Blocks /connectors	Jainson Elmex Connect well Wago
48.	Single Phase Preventers	Minilec Siemens Schneider Electric L&T
49.	Selector Toggle Switch	Kaycee Salzer (Larsen & Toubro) ABB

50.	Sealed Maintenance Free Batteries	Amar Raja Exide Hitachi
51.	Battery Charger	Caldyne Chhabi Electricals Amar Raja Hitachi
52.	Water barriers/sealing system	Roxtec Rayflate (Tyco Electronics)
53.	Fire Survival cables	INDIA-IMPEX(FRTEK) LEONI Bonton Fusion Polymer
54.	Timers	Schneider Siemens L&T Legrand
55.	HSD – Storage Tank	Engineers Syndicate Multi Engineering Sermes Hydrotherm Engineering
56.	Flexible Coupling	Resistoflex Kanwal
57.	Polycarbonate Sockets	Clipsal MANNEKER Legrand
58.	Water Tight Polycarbonate Boxes	Hensel Legrand Phraser
59.	Astronomical Timer	The ben ABB Siemens
60.	APFC Capacitor Panels	P2 Power Solutions Schneider EPCOS ABB
61.	Capacitor (APP) / Series reactors / APFC realy	Schneider EPCOS ABB L & T

Note:-

- 1) Only one of the above makes of the materials will be acceptable. The Contractor has to comply with the approved makes given in the tender document.

- 2) The Bidder shall offer the equipment of makes mentioned above. Other makes are subjected to Client approval before procurement.
- 3) The items manufactured in India shall be permitted only if the items are ISI marked (any other definition of compliance to BIS shall not be acceptable).
- 4) Samples from all the approved makes shall be offered for selection.
- 5) For standardization, inventory, electrical system coordination, the Employer/ Employer's Representative can insist on any one make from the makes indicated above.
- 6) The items shall meet specifications. Mere mention of a make as approved make in the above list does not qualify for acceptance of an item.

2.5 Ventilation

Sr. No.	Product/ Equipment	Manufacturer's Name
1.	Cabinet type Axial flow Fan	Caryaire, Greenheck, Kruger, Nicotra
2.	Centrifugal Fan	Caryaire, Crompton Greaves Ltd., Kruger, Nicotra
3.	Propeller Fan	Caryaire, Crompton Greaves Ltd., Kruger
4.	Air-Distribution Accessories (Grilles/ Diffusers/ Volume Control Dampers/ Automatic Dampers)	Air Master, Air Products, Ajanta, Caryaire, Cosmos, Dynacraft, Nutech, Ravistar
5.	Fire Damper	Caryaire, Cosmos, Greenheck, Ravistar, Ruskin, TSC
6.	Cables	CCI, Finolex, Polycab
7.	Air Filters	Airtech, Dyna filters, Fab tech
8.	Damper Actuator	Belimo, Siemens, Schneider Electric
9.	Sheet Metal	TATA Steel, Jindal, Sail

2.6 Fire fighting

2.6.1 GENERAL

- a) This section provides details of the Approved Vendors / Approved makes for bought-out items, which form a part of this enquiry package.
- b) BIDDER shall clearly indicate the makes of all bought-out items and shall at no point in time during execution shall deviate from those indicated in the offer document.

2.6.2 LIST OF APPROVED VENDORS / MAKES

S.No	Details of Materials / Equipment	Manufacturer's Name
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S.No	Details of Materials / Equipment	Manufacturer's Name
1.	G.I. / M.S. Pipes (IS : 1239 / IS : 3589)	Tata Steel / Jindal Hissar / Surya/ APL-Apollo
2.	Standard M.S. Fittings	Pipeline Products or Approved Equivalent
3.	Forged Fitting (up to 50 mm)	Saint/Jainsons/ VS Forging
4.	Paints	Asian Paints /Berger /ICI /Shalimar Paints/Johnson & Nicolas
5.	Pipe clamp & supports	Easyflex /Gripple /Hitech
6.	Single Headed Landing Valve	Newage/Safeguard /Padmini/Eversafe
7.	Fire Canvas Hose	Newage /Safeguard/ Padmini
8.	First Aid Hose Reel (LPCB Approved)	Newage /Safeguard/ Padmini
9.	Branch Pipe	Newage/Safeguard /Padmini/Eversafe
10.	Fireman Axe	Newage /Safeguard
11.	Hose Reel Drum (ISI marked)	Newage / Safeguard / Padmini
12.	Orifice Plate	As per Approved Drawing
13.	Sprinkler Heads	Tyco /Victaulic /Viking/HD
14.	Water Flow Switch	Honeywell /Viking-Potter /System Sensor /Spray Safe
15.	Butterfly Valve	Audco /sant/Danfoss /Honeywell/Lehry
16.	Check Valve – Wafer Type	Advance /sant/Danfoss /Kirloskar /Honeywell
17.	GM / Forged Brass Valves	CIM /Danfoss /RBM Italy /Tiemme /SKS / Lehry
18.	Air Release Valve	Arco /CIM /Fouress /SKS
19.	Y Strainer CI	Kirlosker/Emerald / Zoloto
20.	Fire Sealant	Hilti/3M/Fisher
21.	Pressure Gauge	H-Guru/Fiebig /Wika
22.	Welding Rod	Advani/D&H (Secheron)/ sab
23.	Flexible Drop Connection (UL Listed)	Flexhead / Newage/Tyco
24.	Deluge Valve – For Water Curtain	HD/Viking/Tyco

S.No	Details of Materials / Equipment	Manufacturer's Name
25.	Anti Vibration Mounting & Flexible Connections	Resistoflex /Dunlop/Easy flex/
26.	Foot valve	Kirloskar/Normex
27.	Water curtain nozzles	HD Fire/Viking
28.	Fire pumps	Kirloskar / Wilo - Mather & Platt/KSB
29.	Diesel Engine	Cummins / Kirloskar/Catterpillar
30.	Motor	Kirloskar /Siemens/ ABB /Crompton
31.	Wrapping Coating	IWL/Coaltek
32.	Test Drain Valve	Giacomini
33.	Installation Control Valve	HD /Viking /Tyco
34.	Pressure reducing Valve	Wilkins/OCV
35.	Fire Extinguisher	Newage/Safeguard /Padmini
36.	Ball Valve	Sant /SKS
37.	C.I Gate Valve	Kirloskar /IVC/sant
38	Mechanical seal	Sealol/Burgman/Hindustan
39.	Dash Fasteners	Hilti/Fisher

NOTE:

- Only one of the above makes of the materials will be acceptable at the discretion of the Client.
- The contractor will have to get the sample approved from the Client whose decision will be binding on the contractor.
- This condition is also applicable for materials not mentioned in the specifications or schedule of work.

2.7 Plumbing

2.7.1 LIST OF APPROVED MAKES FOR PLUMBING AND SANITARY WORKS

NOTE:

All materials and products shall conform to the relevant standards and shall be of approved make and design. A list of manufacturers/ vendors is given separately herein below for guidance. The Engineer shall give the approval of a manufacturer/ vendor/ only after review of the sample/ specimen. In case the same is not available

in the market or in case of change in trade name, equivalent makes/ re-designated manufacturer then an equivalent approved make shall be used with the approval of Employer/ Engineer. The complete system and installation shall also be in conformity with applicable Codes & Standards and Tender specifications.

Only “First” class quality materials shall be used.

Employer reserves the right to choose any of the approved make / vendors as per this list.

In case of products not indicated in this list, bis marked products shall be preferred. Specification of manufacturer’s item shall be checked against tender item / specifications before selecting any product or brand name. In case of any discrepancy, tender item/ specifications shall prevail, and any such brand of item shall not be used which is not conforming to tender specifications even if it is listed in this list.

For use of material from a bis listed/ certified manufacturer, the contractor shall furnish a copy of the BIS certificate to Employer before procuring the material.

In case non-availability of any item/ material among approved manufacturers/ brands at a particular site/ region, alternate manufacturers/ brands conforming to BIS/ BS etc. shall be used subject to approval by Employer.

In case of non-availability of any manufacturer among approved manufacturers at a particular site/ region, alternate manufacturer’s name shall be proposed along-with required credentials for Employer’s approval.

In case of any item/ product neither covered in this list nor having A BIS specifications, the contractor shall submit the proposed item/ product along-with technical details/ specifications (as per bid), test certificates etc. And other credentials of the manufacturer for Employers approval.

2.7.2 LIST OF APPROVED MAKES OF MATERIALS IN THE ORDER OF PREFERENCE

S. No.	MATERIAL DESCRIPTION	APPROVED MAKES
1	Vitreous China Sanitary ware	: Kohler, Hind ware, American standard, Roca
2	CP Fitting	: Kohler, Jaquar.
3	CI (Spun) Pipes/fittings	: NECO /SKF
4	i) uPVC Pipe & Fitting ii) uPVC SWR Pipes & Fittings	: AKG/Supreme / Jain PVC Pipe / Prince : AKG/Supreme / Jain PVC Pipe / Prince
5	CPVC Pipe & Fittings	: Supreme/Astral / Ajay / Ashirwad
6.	G.I. Pipes/MS pipe	: Jindal (Hissar) / Prakash Surya / APL Apolo / TATA Steel

7.	G.I. fittings (Malleable)	:	Crescent/Unik / Zoloto 'M' / DRP 'M' / R Brand
8.	DI pipes	:	Electro steel / Jindal/Kesoram / Lanco Kalahasthi
9.	DI Fittings	:	Kartar / Electrosteel
10.	WC Pan Connector	:	MC Alpine (UK)/Multikwik (UK)/ Veiga
11.	Stainless Steel Grating	:	Chilly / Camry / Cardin
12.	Thermal Insulation	:	Kaiflex/Thermafex / Armafex
13.	Ball Valve	:	SANT/CIM/ SKS/RBM & CATY
14.	Butterfly valves	:	SANT/ SKS / AIP
15.	Check Valve Forged Screwed	:	SANT/SKS // AIP
16.	Air Release Valve	:	Sant CIM/Tiemme / Arco
17.	Motorised Valve	:	SANT /Aira / /Deltech
18.	Float Valve (C.I)	:	Sant / Leader/SANT / CSA
19.	PRV	:	Honeywell/ SANT//SKS / Foures
20.	Pipe Supports, Clamps	:	Chilly /Camry / Easy flex
21.	Anti-Corrosive Bitumastic Paint	:	Asian/Berger/J&N
22.	Epoxy Paint	:	Asian/Berger /J&N
23.	Pipe Protection for Water Supply Pipes	:	Pypkote / Makpolykote / Coaltek
24.	Pressure Gauges	:	Fiebig / H Guru
25.	Fasteners	:	Hilti / Fischer / Canon
26.	Stoneware pipes	:	Perfect/R.K/ Anand
27.	R.C.C Pipe	:	Jain Spun Pipe / Pragati / Dewan Spun Pipe
28.	SFRC Manhole Cover/Grating	:	K.K.Manhole
29.	C.I Manhole Cover (IS: 1726–1991)	:	NECO/Crescent Foundry

30. D.I. Manhole Cover / Grating : NECO / RIF / BIC
31. Recessed Manhole Cover : NECO/RIF/SKF
32. C.I. Grating : NECO/RIF/SKF
33. Gully Traps : Perfect/RK/Anand
34. Plastic Encapsulated Foot Rests : KGM/Patel
35. Clean out Plug : Neer / GMGR
36. Water Meter : kent / SANT/Actaris
37. SS Bellows : kanwal.
38. Rain water Outlet : Aco/Neer
39. Water Treatment Plant : GE Water Systems / Ion Exchange / Thermax
40. Water Treatment Vessel : Astral / Structural
41. UV Water Purifier : Alfa UV-Mumbai / Eureka Forbes / Pentair
42. Dosing Pumps : Heidelberg Prominent Fluid Controls/Ion Exchange/Asia LMI
43. Dosing Units : Asia LMI / Ion Exchange
44. Auto PH Correction System : Asia LMI / Ion Exchange / Heidelberg Prominent Fluid Controls
45. Reverse Osmosis Membranes : Toray / Film Tech / Cock / GE
46. Water Supply Nozzle : Astral
47. Ozonisation System : Oraipl / Tesla Technologies / Voltas
48. GI Pipe Sealment : Henkel-LOCTITE 55
49. Copper Pipes : Flowflex / Maxflow
50. HDPE Pipes & Fittings : Kissan / Finolex
51. SS Pipes : Remi / Viega
52. Paint : Asian Paints

53. Gate Valve / Non-return Valve : Audco / Sanders
54. Foot Valve : Kirloskar / Hawa
55. Check Valve – Dual Plate : Advance/SANT
56. Check Valve – Wafer Type : Advamce / SANT
57. Flow Control Devices : Aquaplus / Con-serve / Jaquar / RST
58. Floor Drain Fixture & Channel Gratings : ACO / GMGR / Neer
59. Floor trap frame & grating : Neer (Material : SS)
60. 'Y' Strainer : Emerald / Zoloto
61. Pumps : Kirloskar / Grundfos / Flowmore / Mather & Platt
62. Booster pumps with pressure tanks : Grundfos
63. Storm water / sewage submersible pumps : Grundfos / KSB Pumps Ltd.
64. Hydro-pneumatic System : DP / Grundfos
65. Transfer Pumps : Grundfos
66. Self-Priming Pumps : Johnson / Kirloskar
67. Domestic Water Lift Pumps : DP / Grundfos
68. Mechanical Seal : Burgmann / Sealol
69. Couplings : Lovejoy
70. Anti Vibration Mounting & Flexible Connection: Dunlop / Flexionics / Easyflex
71. Water Tank/Plastic Steps : KGM / Patel / Pranali Industries
72. Electronic Flow Meter : Krohne (forbes Marshall) / Rockwin
73. U. V. Sterlizer : Alfa / Goodlife / Pentair
74. Welding Electrode : Advani Qerlikon / Esab
75. Fire Sealant : Birla 3 M / Hilti / Promat
76. Level Controller & Indicator (Water) : Autopump / Technika / Techtrol / Pumptrol

77.	GRP / FRP tanks	:	Sintex / Thermoset / Binani / Devi Polymers / Smartage
78.	Liquid Level Controllers	:	Honeywell / Johnson Control
79.	Pipe protection tape Concealed /Buried	:	Tapex / Pipe Coat
80.	Concealed Cistern	:	Gebrit
81.	CI LA Class pipe & fittings	:	Electrosteel / Neco
82.	Toilet Accessories	:	Kohler / Bob Rick
83.	Urinal flushing sensor	:	TOTO
84.	Kitchen Sink	:	Frankee / Jayna
85.	Soap Dispenser	:	Bob rick
86.	Hand Dryer	:	Bob rick
87.	Rain Water collection kurra	:	Neer
88.	Water hammer arrester	:	CPP / Zurn Wilkins
89.	RCC Hume pipes	:	Indian Hume Pipes
90.	Sch -80 pipes and fittings	:	Astral / Ajay / Ashirvad
91.	PPR pipe and fittings	:	Supreme / Prince
92.	Grease / Oil Separator	:	ACO

2.7.3 APPROVED MAKES/ MANUFACTURERS (ELECTRICAL Equipments):

NOTE:

All materials and products shall conform to the relevant standards and shall be of approved make and design. A list of manufacturers/ vendors is given separately herein below for guidance. The Engineer shall give the approval of a manufacturer/ vendor/ only after review of the sample/ specimen. In case the same is not available in the market or in case of change in trade name, equivalent makes/ re-designated manufacturer then an equivalent approved make shall be used with the approval of Employer/ Engineer. The complete system and installation shall also be in conformity with applicable Codes & Standards and Tender specifications.

Only "First" class quality materials shall be used.

Employer reserves the right to choose any of the approved make / vendors as per this list.

In case of products not indicated in this list, bis marked products shall be preferred. Specification of manufacturer's item shall be checked against tender item / specifications before selecting any product or brand name. In case of any discrepancy, tender item/ specifications shall prevail, and any such brand of item shall not be used which is not conforming to tender specifications even if it is listed in this list.

For use of material from a bis listed/ certified manufacturer, the contractor shall furnish a copy of the BIS certificate to Employer before procuring the material.

In case non-availability of any item/ material among approved manufacturers/ brands at a particular site/ region, alternate manufacturers/ brands conforming to BIS/ BS etc. shall be used subject to approval by Employer.

In case of non-availability of any manufacturer among approved manufacturers at a particular site/ region, alternate manufacturer's name shall be proposed along-with required credentials for Employer's approval.

In case of any item/ product neither covered in this list nor having A BIS specifications, the contractor shall submit the proposed item/ product along-with technical details/ specifications (as per bid), test certificates etc. And other credentials of the manufacturer for Employers approval.

2.7.4 LIST OF APPROVED MAKES OF MATERIALS IN THE ORDER OF PREFERENCE

SL NO	DESCRIPTION	VENDOR/MANUFACTURER/MAKE
1.	Protective relays (Numerical Type)	ABB Siemens GE SEL (Schweitzer Engineering Laboratories) Alstom
2.	Protective relays (Electromechanical Type)	ABB Siemens GE Schneider Electric (formerly Areva/EE)
3.	Auxiliary Relay	Schneider Electric (formerly Areva/EE) ABB Siemens VA Tech L & T
4.	Electronic circuit Relay	OEN Omron Allen Bradley PLA
5.	Control and Relay Panel	ABB Siemens Easun Reyrolle Alstom Schneider Electric
6.	Instrument Transformers (CT/PT)	Automatic Electric

		Crompton Greaves Indcoil Kappa Precise Pragati Gilbert and Maxwell Silkaans Jyoti ECS Schneider Electric ABB Siemens
7.	Switchgear/Switchboard L.V.- Drawout/Fixed Type (PCC/MCC/PMCC/MLDB/MPDB/ MOVDB/APFC)	Siemens L&T Schneider Electric ABB
8.	Air circuit breakers	L & T Siemens Schneider Electric (M&G) ABB
9.	MCCB's	L & T Siemens Schneider Electric (M&G) ABB
10.	Switch Disconnecter Fuse Unit (SDF) And Switch Disconnecter Isolator	Siemens Technoelectric Schneider Electric L&T
11.	Change-over switch	Havells (euroload) C&S Schneider Electric GE Power Kraus & Naimer Siemens BCH L&T

12.	VVVF Drives / Electronic Softstarter	Siemens Allen Bradley (Rockwell Automation) Yaskawa Schneider Electric ABB Danfoss
13.	LV capacitors (APP)	Universal Cables ABB Malde Madhav Epcos Aswani Schneider Electric L&T
14.	Series Reactors For Capacitors	Manohar Brothers WHEPL Epcos
15.	AC Power Contactor	Siemens ABB L&T BCH Schneider Electric (Telemecanique)
16.	DC Power Contactor	BCH BHEL Siemens L&T Schneider Electric
17.	Auxiliary contactors	Siemens L & T Schneider Electric (Telemecanique)
18.	Electronic / Microprocessor based overload relay	Siemens ABB Schneider Electric
19.	Bi-metal / Overload Relay	Siemens Schneider Electric L&T
20.	Thermister relay	Alstom/ Minilec/ Insta controls
21.	Single Phasing Preventer	Siemens Minilec Alstom Schneider Electric L & T
22.	Time switch	GIC Theben Siemens Schneider Electric Legrand

23.	Timers	GIC Theben BCH Siemens Electronic Automation Pvt Ltd. Minilec L&T Legrand Schneider Electric
24.	Time Delay Relay	Schneider Electric ABB Siemens BCH L&T Omron PLA
25.	Motors	Siemens Bharat Bijlee Crompton Greaves Marathon Electric Motors (India) Ltd. (Formerly Alstom Ltd) BHEL ABB Kirloskar
26.	Battery Charger & DCDB	Hitachi Caldyne Automatics Chhabi Electricals Mass-tech Controls HBL Power Systems Automatic Electric Amara Raja Universal Instruments
27.	Luminaire	Philips Zumtobel Crompton Greaves Bajaj GE
28.	Lamps	Philips GE Osram Sylvania LVD Neptune, USA
29.	Ballast	Philips Crompton Greaves Bajaj ATCO
30.	LT Power Cables/ Earthing Cable	Universal Cables Ltd. NICCO KEC International Ltd

		Cable Corporation Of India Ltd Finolex INCAB Polycab LAPP RR Kabel
31.	LT Control Cables	LAPP Polycab NICCO Universal Cables Ltd. KEC International Ltd Finolex INCAB KEI Cable Corporation Of India Ltd
32.	HFFR wires (including panel wiring)	Finolex Polycab LAPP RR Kabel
33.	Non-insulated Copper Earthing conductors	Gupta Industrial Corporation (Vasai, Palghar) Bharat Wires & Ropes Diamond Cables
34.	Distribution Boards (other than MLDB, MPDB, MOVDB) / Panels / Enclosures / JB / Marshalling Panel	Siemens C&S Schneider Electric Rittal President Enclotek Eldon Hensel Legrand Manshu Comtel Pentair ABB BCH
35.	MCB, RCCB, RCBO / MCB Isolators	Legrand Siemens Schneider Electric Klockner Moeller ABB
36.	MPCB	Siemens Schneider Electric Moeller ABB L&T
37.	Alarm Annunciators (solid state type with LED illumination) / Facia Annunciator	Digicont Industrial Instruments & Controls Procon Inst. (P) Ltd MTL India Pvt. Ltd.

		Rochester Instruments System Ltd. IDECIZUMI Minilec IICP Proton Electronics Alstom Yashmun ICA Ronan (Waree)
38.	Decorative switches, sockets and metal boxes (single plate arrangement)	Honeywell (MK Electric) Anchor (Panasonic) Havells (Crabtree)
39.	Modular switch & socket (wraparound) (twin plate arrangement)	Anchor (Panasonic) Anchor (Roma / Ave) Honeywell (MK Electric) Legrand Havells (Crabtree) Schneider Electric (Clipsal) Siemens ABB Gewiss
40.	Ceiling fan	Usha Crompton Greaves Bajaj Orient Khaitan Almonard
41.	Wall mounting fan	Almonard GEC Crompton Bajaj Orient Usha
42.	Exhaust Fan / Ventilation Fan	Nadi Usha Almonard Bajaj Crompton Greaves
43.	Air Circulators/Man Coolers (Pedestal/Wall Mounted)	Almonard Bajaj Crompton Greaves
44.	Cable termination/jointing kits	Raychem (Tyco Electronics / RPG) 3M(Cold Shrink/Push-on) ABB Kabeldon
45.	Control / selector switch	Kraus & Naimer Kaycee GE Power controls L&T Siemens ABB

		Schneider Electric
45.	Indicating Lamps (Multi-chip LED)	Binay Teknic Controls Vaishno Siemens L & T Schneider Electric Concord BCH
46.	Terminal Block / Connectors	Wago / Connectwell / Pheonix / Elmex
47.	Control transformer	Indcoil Precise Silkaans NEC Gauss Electricals
48.	Semiconductor Fuse	Siemens Schneider Electric (Ferraz Shawmut) Eaton (Cooper Bussmann) GE
49.	HRC fuse (Power & Control)	Siemens L&T GE Eaton (Cooper Bussmann) Technoelectric Schneider Electric (Ferraz Shawmut)
50.	Pushbuttons	Siemens Schneider Electric (Telemecanique) Teknic Controls L&T Concord BCH Vaishno Electricals
51.	Push button station	Siemens Schneider Electric R Stahl Hensel Bals Gewiss
52.	Non metallic enclosures (including Industrial Receptacles)	Rittal Hensel SCAME Menekkes Bals Siemens Schneider Electric BCH PCE Legrand Gewiss
53.	Digital Meter – Ammeter &	Schneider Electric (Conzerv)

	Voltmeter	AE Rishabh Schneider Electric (Power Measurement/ ION) Circutor Siemens Masibus
54.	Electromechanical – Ammeter & Voltmeter	Automatic Electric MECO IMP Rishabh
55.	Load Manager / Multi Function Meter / kWh	Schneider Electric (Conzerv / (Power Measurement / ION) Circutor Rishabh Schneider Electric Alpha (ABB) Schlumberger SEMS (Secure) Electro Industries / GaugeTech
56.	Power quality analyser	A-eberle Schneider Electric (Power Measurement/ ION) Schneider Electric (Conzerv) Chino – Laxsons Yokogawa Rishabh Fluke Hioki
57.	Cable lugs	Dowells Comet 3D (Billets Elektro Werke Pvt.Ltd)
58.	Cable Glands (safe area - double seal cone grip type)	Comet Jainson Braco Baliga R. Stahl Crouse Hinds Siemens Hex (Brass Copper & Alloy(I)) Cosmos
59.	Polyamide Cable Glands	Lapp Hensel Gewiss Fibox
60.	Lightning Arrestors	WS Jayshree Elpro Oblum Crompton Greaves

61.	Surge Suppressors	OBO Emerson Furse Dehn+Sohne Erico Pepperl+Fuchs MTL Schneider Electric ABB Weid Muller Siemens Phoenix Contact
62.	Uninterrupted Power Supply (UPS)	Emerson Network Power (India) Pvt. Ltd. (Liebert / Chloride) Schneider Electric (MGE / Gutor / APC / Invensys) Aplab Fuji Electric , Japan Hitachi Eaton Riello-PCI Socomec ABB (Newave)
63.	Floor trunking system (GI trays, troughs & pull boxes) and GI Cable trays	OBO Honeywell Legrand Indiana Profab Patny Sadhana Sterlite Reliance Jenco/Pentax Ferro Incorporate
64.	Furniture trunking system / Cable management System	Legrand Schneider Electric Rittal Panduit Honeywell Eubiq
65.	UPVC Conduit/JB/flexible conduit/tees/ Bevels,elbow & accessories/fittings	Precision Polycab Sudhakar AKG
66.	GI Conduit / Pipes	JK Tube Company (AKG) BEC Industries Zenith SAIL TATA Steel Jindal
67.	MS Conduit	JK Tube Company (AKG)

		BEC Industries Jindal TATA Steel SAIL
68.	Casing Capping	Precision Circle ARK Mody
69.	Lighting Controller / Lighting Management System	Lutron Zumtobel Philips Tridonic Atco
70.	Lead Acid Battery (Plante / Tubular)	Exide HBL Power Systems Ltd. Amara Raja Batteries Ltd. Hoppecke
71.	SMF/VRLA battery	Exide HBL Power Systems Ltd Amara Raja Batteries Ltd. Hoppecke
72.	Ni – Cd Battery	HBL Power Systems Ltd. Hoppecke Amco Saft
73.	High mast lighting system	Philips Bajaj Crompton Greaves BP Projects Valmont
74.	SCADA / EMS	ABB Siemens Alstom Schneider Electric Electro Industries / GaugeTech Rishabh
75.	Fire Barriers / Sealing	Brattberg Roxtec Signum Navell Multikil
76.	Water barriers/sealing system	Roxtec Rayflate (Tyco Electronics)
77.	Decontactor	BCH
78.	Insulating mats	Electromat Dozz Raychem RPG
79.	Emergency Light / Installite / Conversion module / Battery Pack	Prolite Legrand Philips Tridonic Atco Zumtobel
80.	Choke (for VVFD)	Siemens

		ABB Danfoss Allen Bradley (Rockwell Automation) Yaskawa
81.	Power Supply Unit	Siemens MTL Aplab Pheonix Cosel
82.	PLC	Allen Bradley Siemens Schneider Electric
83.	Voltage / Power / Current / Frequency / Energy Transducer	ABB AE Siemens Schneider Electric Rishabh Masibus
84.	Encoders	Hubner Honeywell Turck
85.	Limit Switch	BCH Honeywell Siemens Jay Balaji Wago
86.	Aviation Obstruction Light (multiple LED type)	Binay
87.	Diesel Engines	Cummins Caterpillar MTU Mitsubishi Wartsila Rolls Royce
88.	Alternators for DG Sets	Cummins (Stamford / AvK) Leroy Somer BHEL
89.	Digital Multimeter for Operation & Maintenance	Beckmann Fluke AVO
90.	Clip-On Ammeter for Operation & Maintenance	HCK, Germany Kyoritsu Electrical , Japan

2.8 ICT

2.8.1 Fire Detection Panels & Accessories / Devices

S.NO.	Cables proposed	Make
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1	Addressable Fire alarm panel & Active Repeater panel	Bosch, Siemens, Notifier, Essar by Honeywell, GST, Edwards
2	Addressable Dual optical heat sensor, Addressable Manual call station, Addressable Hooter	Bosch, Siemens, Notifier, Essar by Honeywell, GST, Edwards
4	Power Cable (Copper)	Polycab, Finolex, KK Cable

2.8.2 CCTV System

S.No.	Cables Proposed	Make
1	CCTV Cameras & NVR	Bosch, Pelco, Axis, Honeywell, HIKVision, Alba Urmet
2	CAT6 Cable	D-Link, Belden, Systemax
3	Power Cable (Copper)	Polycab, Finolex, KK Cable
4	OFC Cable	D-LINK, Belden, Molex, Clipsal

2.8.3 Access control system

S.NO.	Cables proposed	Make
1	Boom Barriers	CAME, Boon Edam, Magnetic, Alba Urmet
2	Long Range Reader & Card interface controller, Vehicle access software	HID, Honeywell, Siemens, ESSL, IDcube, Securityshell, Alba Urmet
3	CAT6 Cable	D-Link, Belden, Systemax
4	Power Cable (Copper)	Polycab, Finolex, KK Cable
5	OFC Cable	D-LINK, Belden, Molex, Clipsal

2.8.4 Video door phone

S.NO.	Cables proposed	Make
1	Video Door Phone	Alba Urmet, HIKVision, Godrej
2	CAT6 Cable	D-Link, Belden
3	Power Cable (Copper)	Polycab, Finolex, KK Cable
4	OFC Cable	D-LINK, Belden, Molex, Clipsal

2.9 Storm Water

S.NO.	Product	Brand Name
1	Manhole covers/Frames/Gratings	Crescent/ Neco/ Thermo Drain

1.0 STP

S.No.	Equipment/ Item	Approved Vendors
1.	Centrifugal Pumps	KSB Pumps, Grundfos, Jyoti Limited, Mather & Platt, Kirloskar Brother Ltd
2.	Submersible Pump	Kirloskar Brother Ltd, Grundfos, ABS, KSB
3.	Dosing Pumps	Asia LMI, Sandur fluids control, V.K.Pump industries.
4.	FRP Storage Tanks	Sintex
5.	Blower	Everest/Kay
6.	CS Pipes	Zenith, Tata Iron & Steel Company Ltd., Surya Roshni Limited, Jindal, Indus Tubes Limited, Madras Steel & Tubes, Chennai
7.	SS Pipes	Decora Tubes Ltd, Industrial metal corp, Maharashtra Seamless Ltd, Ishardas Aggarwal & Sons
8.	CS & SS Fittings	Arvind Pipes & Pipe Fittings, Alliance Fittings & Forgings Incorporated, Mumbai, Gujarat Infra Pipes Pvt. Limited, Baroda, MS Fittings Manufacturing Co. Pvt. Limited, Kolkata, Super Forge, Mumbai, Gautam fittings, Mumbai
9.	Bolts & Nuts	Radicon Engg. Co., FE Darukhanawalla and Co., Maharashtra bolts & nuts, Industrial fasteners, GKW, Unbrako, TVS
10.	Gaskets	Gaskets India Pvt. Ltd, IGP Engg. Ltd, Mechanical Packing Industries.
11.	Paints	Berger, Nerolac, Asian paints, Shalimar paint
12.	Diaphragm valve	Floway Valves, BDK, Audco, Intervalve
13.	Globe valve	A.V.Valves, BDK Engg Industries Ltd., Chemtech Industrial Valves Pvt.Ltd., DemblaValves, Globe Industrial Valves
14.	Check valves (wafer)	Intervalve , BDK, Advance, Audco

S.No	Instrumentation Equipment/ Item	Approved Vendors
1.	Programmable Logic Controllers (PLCs)	ABB, Siemens, Rockwell Automation, Schneider GE Fanuc
2.	Panel Enclosures	Rittal / Enclotek
3.	On-Off Valves with Actuators	
(a)	Ball Valves	Festo, Virgo, Dezurik, NAF, Neles (Metso Automation)

S.No	Instrumentation Equipment/ Item	Approved Vendors
(b)	Butterfly valves / Diaphragm Valves	Fisher Xomox India Ltd., Neles (Metso Automation), NAF, IL, Masoneilan Dresser Valves, Samson Valves
(c)	Knife Edge Gate Valves	DEZURIK, VAAS Industries
4.	Solenoid Valves	ASCO, Norgren, Rotex, Schradder, Festo
5.	Air Filter Regulators	Norgren, Placka, Fair Child (Precision), Festo (Precision)
6.	Pressure Gauges / Pressure Switches	General Instruments Consortium, FIEBIG, Warea, Pyroelectric, Wika
7.	Differential Pressure gauge with Switch	General Instruments, Wika, Pyroelectric
8.	Conductivity type Level switches	Pune Techtrol, Nivo Controls, Levcon
9.	Reflex Type Level Gauges	Pune Techtrol, Warea, Nivo Controls
10.	Magnetic Flowmeters	Emerson, ABB, Yokogawa, Endress & Hauser
11.	Rotameters	TRAC, Fitzer, Forbes Marshall, Fiebig
12.	Orifice Plates	General Instruments Consortium, Starmech Pyroelectric
13.	pH Meter	Endress + Hauser, Yokogawa, Emerson, Mettler-Toledo India Private Limited
14.	Conductivity meter	Endress + Hauser, Yokogawa, Emerson, Mettler-Toledo India Private Limited
15.	ORP Analyser(Residual Chlorine Analyser)	Endress + Hauser, Krhone Marshall, Emerson
.	24 V DC Power Supply Units	Aplab, Pheonix, Cosel
.	Junction Boxes (Thermoplastic)	Hensel
.	Cables	TCL cables, Delton cables, LAPP Cables, Finolex, Udey Pyrocables
.	Cable Glands	Braco, Comet, Baliga, R. Stahl
.	GI Cable Trays	Indiana, Profab, Patny, Sterlite,

S.No	Instrumentation Equipment/ Item	Approved Vendors
		Reliance
.	Relays	Siemens, OEN, Omron
.	Limit Switches	Siemens, BCH, Jai Balaji, L&T
.	Terminals	Elmex, Connectwell, Wago, Phoenix
.	Instrument erection Hardware	Parker, Swagelok, Excel Hydropneumatics, Wintec, Champ Instruments & Engineers

2.10 Solid Waste Management

S.NO.	System	Product	Vendor
1	Automated Waste Collection System (AWC)	ENVAC	203, Sri Sai Plaza, M.G.E.H.B co-operative society, New BEL Rd, R.M.V. 2nd Stage, Bengaluru, Karnataka 560054

CHAPTER 3. Employers General Requirements

3.1 Architecture

1. Look & Feel Of The Project

- 1.1. The Bidder shall study the drawings, visualizations, specifications, material finishes indicated in the Tender document and understand all parameters of the design including the architectural look & feel intent of the design consultants. The contractor shall clarify any doubts / discrepancies with PMC /consultants.
- 1.2. The contractor is bound to maintain and deliver the core and shell of the building as per the design intent of the consultants.

1.3. Construction Drawings / Documents /

- 1.4. The drawings issued along with the tender are based on the applicable statutory regulations and guidelines. In due course of time the PMC shall issue the drawings approved by the statutory authorities for "commencement of works at site" It is in the Scope of Contractor to do further detailing, provide design of necessary element of the Work for the Employers Representative to review and shall proceed further only after its approval and sign off, related Construction activities shall not commence prior to approval of the same. Contractor shall further prepare Good For Construction Drawings and shop drawings. All development works shall conform to, shall be designed and constructed / executed in compliance with the applicable statutory regulations and guidelines and comments received from the concerned statutory agencies.

2. Approval Drawings / Documents For Subsequent Approvals

- 2.1. Contractor shall prepare and submit approval drawings, documents, calculations, certificates, etc, as may be necessary by the statutory authorities, at the relevant stages. The contractor shall prepare and modify the GFC drawings based on the drawings approved by the statutory authorities.

3. Good for Construction Drawings / Documents Approval Process

- 3.1. All GFC drawings shall be in Revit including for Architecture, Structure, MEP, Landscape, ICT etc. Such that they become input to the Building Information Management System (BIM). Contractor shall submit at least following number of sets for approval of Employer's Representative.
 - 3.1.1. Construction Documents - 08 sets
 - 3.1.2. Samples, datasheets etc - 08 sets
- 3.2. Each of the submission should clearly identify the Work, purpose of the submission, document number etc. as approved in the procedure referred above. Upon review of the said submission Employer's Representative shall return the submission with following codes
 - a. Work may proceed.

- b. Revise and Resubmit. Work may proceed subject to resolution of indicated comments.
 - c. Revise and Resubmit. Work may not proceed.
 - d. Review not required. Work may proceed.
- 3.3. Although Work may proceed on receipt of a drawing coded 2, Contractor must resolve the comments indicated, resubmit and obtain a Code 1 before release for shipment or completion of the affected Work.
- 3.4. Employer/ Employer's Representative and Consultant/PMC's review and permission to proceed does not constitute acceptance or approval of submittals including, but not limited to, design details, calculations, analyses, test methods, construction methods, plans, certificates or materials developed or selected by Contractor and does not relieve Contractor from full compliance with the Contract requirements.

4. Technical Standards And Regulations

- 4.1. Contractor shall refer and implement all relevant and all applicable codes, technical standards, regulations, as amended, required for performance of Work covered under this Contract. Also, all the conditions of statutory approval already taken by the Employer need to be complied during construction stage, the same need to be complied for future approval required if any.

5. Samples

- 5.1. Contractor shall necessarily submit samples of all finishing materials that may affect the look and feel of the project, especially those where generic materials are indicated. Submission of samples shall not be limited to the above, and the Employer/ Employer's Representative and Consultant/PMC reserves the right to demand any sample of materials, as deemed necessary.
- 5.2. Where samples are required, they shall be submitted by and at the expense of Contractor allowing at least fourteen (14) calendar days for review by Employer/ Employer's Representative and Consultant/PMC unless otherwise shown on the Contract Schedule. The materials represented by such samples shall not be manufactured, delivered to the Site or incorporated into the Work without Employer/ Employer's Representative and Consultant/PMC review.
- 5.3. Each sample shall bear a label showing Contractor's name, Work name, Contract number, name of the item, manufacturer's name, brand name, model number, supplier's name, and reference to the appropriate drawing number, technical specification section and paragraph number, all as applicable.
- 5.4. Samples, which have been reviewed, may at Employer's option, are returned to Contractor for incorporation into the Work.

6. Mock-Up

- 6.1. As deemed necessary by the Employer/Employer's Representative/PMC, Contractor shall execute necessary mock-ups of all items/activities related to the Work performed required under this Contract as indicated below and the cost for the same shall be deemed to be included in the Contract price.

6.2. The following mock-ups shall be executed by the contractor:

Item	Extent / Size
1. A fully finished and furnished flat for each type – 2 bed room and 3 bed room - along with all fittings specified, painting internal and external, windows, glazing, ICT etc complete	One complete flat each for type F and type G
2. Facade / Glazing systems	Height - One floor Width - 03 modules [including one operable module, if any]
3. GRC Jail	1.0 x 1.0 M
4. Stone cladding, including window glazing, aluminum louvers, flashings and interface details	6.0 x 6.0 M
5. All finishing items including but not limited to toilets, flooring, wall cladding, doors & windows, false ceiling, etc.	Toilets - 01 module including all fittings, fixtures and modular partitions Hard & soft finishes - approx 50 sqft, including all typical interfaces and details.
6. Railings and other metal fabrication works	Min 2.0 RM including all types of details [turns, bends, ends, etc]
7. Polycarbonate Skylights	3.0 x 3.0 M including all interface details
8. Stamped Concrete	1.5 x 1.5 M

7. DOCUMENTS AT SITE

7.1. The contractor shall maintain in a conspicuous place on the site a copy of development permission and a copy of approved drawings and specifications and GFC drawings.

8. AS-BUILT DRAWINGS.

8.1. Progress As-Built / GFC drawings

8.1.1. During construction, Contractor shall keep a marked-up-to-date set of progress as-built / GFC drawings and specifications on the Site as an accurate record of all deviations between Work as shown and Work as installed. These drawings and specifications shall be available to Employer for inspection at any time during regular business hours.

8.2. Final As-Built

8.2.1. Contractor shall at his expense and not later than thirty (30) calendar days from Taking over Certificates and before Final Payment furnish to

Employer a complete set of marked-up as-built reproducible drawings and specifications with “AS-BUILT” clearly printed on each sheet and on the specification cover.

8.2.2. Contractor shall accurately and neatly transfer all deviations from progress as-built to final as built drawings and all annotations from progress as-built to final as-built specifications.

8.2.3. Contractor will provide eight (8) copies of the as-built drawings of which one (1) is in fully editable electronic format in Revit as well as autocad for all disciplines (archi, structure, MEP, Landscape, Interiors, ICT) in a form acceptable to the Employer.

8.3. Endorsement

8.3.1. Contractor shall sign each final as-built drawing and the cover of the as-built specifications and shall note thereon that the recording of deviations and annotations is complete and accurate.

3.2 Landscape

The Contractor will have to provide the following items at no extra cost to Employer:

- a. The Contractor will supply and install 3.0 metres high barricades for safeguarding landscape development area and works, as indicated in the drawing. He may also install the barricades in the landscape development area according to his own understanding if he feels that any part of the landscape area is bound to be damaged for any reason, after taking prior permission from the Employer/ Employer’s Representative.
- b. The Contractor will supply, install and maintain at his own cost, the most modern, automated watering system for the landscape, which will take care of the requirement for particular plants, save water and does not waste water, including any requirements specified by the Landscape Architect appointed by contractor. He will give full details of the layout, size of the pipe, size of the sprinklers, bubblers, etc and their warranty period. All equipment must conform to international standards and / or Indian Standards if available. The design of the irrigation system has to be approved by Employer/ Employer’s representative.
- c. All equipment required for development shall be made available by Contractor, and its maintenance shall be his responsibility. This includes Tagara, Phawdas, Hose Pipes, Ground Roller, Manual and/or Electric lawn Mowers, Sprinklers, etc.
- d. All the plant species should be native and adaptive in nature. The landscape area should be at least 15% of the total plot area (in ground (mother earth’s) contact - On ground)
- e. Contractor will ensure that all plants remain free of diseases, pests, etc during development and maintenance periods. The contractor shall, without any

additional charge renew any dead or defective plant material and shall fully maintain including watering, de-weeding etc. of the whole landscape as mentioned above.

- f. The Contractor shall maintain Nursery at his own cost at designated locations as shown in the drawing or at a suitable location within the plot as directed by Employer/ Employer's Representative. The Nursery will be fenced with gates for protection from cattle. The area of Nursery will be approximately 5000sqm. The item would include construction and maintenance of Green Houses if required.
- g. Contractor shall follow pre construction and during construction soil erosion control measures as per the NBC Part 10, section 1, Chapter 4 – Protection of Landscape during Construction.
- h. The contractor in co-ordination with the Employer as applicable shall ensure conservation and storage of top soil: Topsoil shall be stripped to a depth of 200 mm from areas proposed to be occupied by buildings, roads, paved areas and external services. It shall be stockpiled to a height of 400 mm in designated areas and shall be re-applied to site during plantation of the proposed vegetation. Topsoil shall be separated from sub-soil debris and stones larger than 50 mm diameter. The stored topsoil may be used as finished grade for planting areas. It is the landscape contractor's responsibility to conserve top soil that is not disturbed by the civil contractor.
- i. The Contractor shall:
 - I. Furnish the source of top soil to Employer/ Employer's Representative.
 - II. Study the soil report provided with the tender document, providing soil details such as pH, alkalinity, total soluble salts, porosity, sodium content and organic matter. Ref. Soil Test Report
 - III. Use the restored soil at site for landscape purpose, manure mixture, Neemcake, weedicide shall be added if required.
 - IV. Not consider any external soil source unless the existing soil conserved from site is lacking in quality and/or quantity.

Soil Analysis for Top Soil fertility determination

To determine the fertility of top soil for conservation, soil investigation shall be carried out by an NABL accredited laboratory.

Adequate number of test samples of soil from a depth of 10-200mm below ground level shall be collected from at least 5 representative locations from site, preserved and transported (as per standard procedures specified by the laboratory) carefully to the laboratory for carrying out necessary tests.

All relevant Indian Standards for sampling and conducting laboratory tests shall be followed.

This soil samples shall be analyzed to determine soil type, texture, total organic content, pH, extractable nutrients such as nitrogen, phosphorus, potassium, salinity, cation exchange capacity, % base saturation and extractable heavy metals.

The soil analysis report from the laboratory shall also include a statement on the fertility and suitability of the soil for plant growth based on the analysis, in addition to the test results.

Top Soil conservation

Topsoil shall be removed for conservation to a depth of 200 mm (not more than 400 mm) and shall be separated from subsoil debris and stones larger than 50 mm diameter.

It shall be stockpiled to a height of 400 mm in designated areas. The stockpiled topsoil shall be protected from erosion during storage by installing earthen berms/solid walls, temporary seeding (using native grass), covering with mulch or plastic, etc.

The topsoil shall be protected with sand bags/solid walled enclosures (2 feet high) on all sides for containment.

Appropriate drainage channels shall be dug around the storage area to prevent flooding of the top soil storage area.

The top soil shall be reapplied to site during plantation of the proposed vegetation as finished grade for planting areas.

Seeding will take place immediately after respreading topsoil and decompacting, unless timing is inappropriate (for e.g., not in mid-summer).

- j. The contractor to identify erosion prone areas on site and protect them from construction activities throughout the construction period. Prevent / mitigate the disturbances caused to site due to construction activity.
- k. The contractor shall execute a sedimentation and erosion control plan that conforms to the best management practices highlighted in the National Building Codes of India (NBC) Part 10, section 1, Chapter 4 – Protection of Landscape during Construction. This standard describes two types of

measures that can be used to control sedimentation and erosion. Stabilization measures include temporary seeding, permanent seeding and mulching. Structural control measures include earth dikes, silt fence, sediment trap, and sediment basin. All of these measures are intended to stabilize the soil to prevent erosion.

- l. The erosion and sedimentation control plan must be approved by Employer/ Employer's Representative and the erosion sedimentation control plan must be maintained throughout the execution period.
- m. The contractor shall execute measures of protection and preservation of existing landscape on site during entire construction time.
- n. Design, execute and maintain a temporary storm water management layout for the duration of construction activity. The storm water management layout should conform to National Building Codes of India (NBC) Part 10, section 1, chapter 4 – Protection of Landscape during Construction.
- o. Contractor should take measures to prevent entry of any soluble/ insoluble construction waste to enter the water table/ water ways/ ravines on site.

3.3 Civil

Design Philosophy-

Buildings shall be designed as cast in-situ RCC Structure.
Raft / isolated foundation shall be adopted for building foundations.

Material-

For Foundations cement used shall be Portland Slag Cement as per IS 455 or blended OPC with Slag (Ref. note 7, Table 4 of IS 456:2000)
Corrosion resistant steel of grade Fe 500D/Fe500 shall be used for longitudinal reinforcement of columns, beams, slabs and for ties/ stirrups.
Specifications for civil/structural material shall be confirmed with the IGBC Green Homes requirements. Contractor shall provide the supporting document for the same.

Drawings- Drawings are attached with the tender document and shall be for tendering purpose only and not for execution.

Scope of supply- Employer shall not issue any material on free issue basis. All the materials required for execution of the work shall be procured and supplied by the contractor.

Construction water / Electricity-

Subject to availability, Construction Water shall be provided by Owner to the Contractor at one point near the battery limit of the plot. Contractor shall make his own arrangement for further distribution of the same at his own cost.

Subject to availability, Construction Power shall be provided by Owner to the Contractor at one point near the battery limit of each location. Contractor shall make his own arrangement for further distribution of the same at his own cost.

All the water and electricity provided by the owner for construction, labour hutments, site offices ..etc shall be on chargeable basis. Owner does not accept any responsibility for providing water and electricity and same be arranged by the Contractor, in case owner do not provide the same.

Defect Liability Period-

The defect liability period for the work shall be 36 (Thirty Six Months) from the date of completion and Commissioning of all works

Royalty- CONTRACTOR to pay all Royalties, Taxes etc. for the soil, quarry stone, gravel etc and Prices quoted by him shall include such provisions.

3.4 ELECTRICAL

- a) The Bidder shall deploy minimum number of personnel with requisite qualifications and experience for execution of works.
- b) The Bidder shall deploy all installation & testing equipment necessary for the commissioning of the works.
- c) The Bidder shall train the designated purchaser's, Employer's staff for operation of the system on-site, as necessary.
- d) The Bidder will ensure 99.9% uptime of the system during the entire period of 3 Years beginning from the date of commissioning & acceptance.
- e) The required drawings of the building layouts with estimated requirements will be provided as a reference (and are not limited for designing the systems).
- f) Any material (civil, Mechanical, communication / networking hardware) required for installation work, site improvisation / retrofitting the systems in the buildings will be arranged by the Bidder.
- g) The Acceptance test requirements & the Test procedure / plan to be submitted by the Bidder.
- h) The Bidder shall obtain the required permits / permissions from the related authorities / regulatory bodies as applicable before commencing the work.

3.5 IGBC requirements

The project will be registered with IGBC for certification and is aspiring for Gold rating under Green Homes version 2.0. To achieve Gold rated certification the project has to follow certain best engineering practices and select materials that are compliant with the IGBC rating system. Hence the following roles and responsibilities have been identified for the contractors to ensure that the project achieves this target.

1. General Conditions for all Contractors

- The contractor must comply to all MoEF and IGBC requirements. Contractor must follow the more stringent standard in case of conflict.
- The contractor must follow construction waste management and engineering practices detailed below.
- The contractor must provide details of material/product with specifications, company/brand details, contact person and contact number as required.

2. Best Engineering Practices

Soil erosion and sedimentation control during construction:

Prepare and implement Erosion and Sedimentation control plan for all construction activities as per Local Standards or National Building Code of India (NBC) Part 10, Section 1, Chapter 4 & 5. Measures such as temporary and permanent seeding, mulching, earth dikes, silt fencing, sediment traps, and sediment basins as appropriate are to be implemented to limit disturbances due to construction activity. The following actions are to be implemented:

- i. Tyre washing facility shall be provided at the entry and exit of the construction entry to arrest the erosion of soil due to truck movement. This is during the construction period. Alternatively, stone / gratings can be provided at vehicular entrance/exit way to the site to ensure that the tyres are clean.
- ii. Vehicular movement shall be restricted to stabilized paths in site.
- iii. Topsoil (top 15 cm layer of the soil) shall be stabilized & preserved with temporary seeding, grassing, mulching techniques through the construction period and later used for onsite landscaping purpose. No amount of topsoil shall be taken to municipal landfill. Cover the top soil to protect it from erosion during storm. Site conditions shall have to be check for applicability of this measure.
- iv. Excavated soil (below top 15 cm layer) shall be used for backfilling within the site and surplus shall be donated to other construction sites.
- v. Temporary storm water drains/ channels shall be proposed at the periphery of the site in accordance with the natural gradient through the construction period and the channels shall empty into a sedimentation tank to arrest the sediments.
- vi. Photographic documentation of the erosion sedimentation measures implemented at site shall be maintained by the contractor.

Construction waste management during construction:

A construction waste management plan to reuse waste within the site or divert minimum 75% of construction waste from landfills must be prepared. The following measures must be implemented to ensure the same:

- i. A separate yard needs to be identified on site for collecting all types of construction waste.
- ii. All construction waste needs to be documented in either weight or in volume. Please refer Annexure2 – Construction Waste Materials Diversion for recording format.
- iii. Contractor shall maintain a copy of challans & receipts for recyclable material and topsoil going out of the site for various reuse / recycle purpose and submit to project manager at regular intervals.
- iv. Pictures need to be captured as per construction waste management plan for support.
- v. Site plan with the location of materials and waste storage should be prepared.

- vi. The contractor shall segregate the construction waste in separate categories such as reinforcement steel, concrete debris, brick or masonry debris, wires, tile waste, wood waste aluminum, metal, paper, plastics and packaging waste etc.
- vii. The construction waste with recyclable potential shall be used within the site for non structural purposes such as providing reinforcement in curbs, crushed concrete debris used as aggregates in landscape features, tiles and stone chips in landscape paving, fillers in landscape mounds etc.
- viii. Surplus segregated debris with reuse potential shall be sold to recyclers / donated to other construction sites.
- ix. Topsoil (top 15 cm layer of the soil) shall be stabilized & preserved with temporary seeding, grassing, mulching techniques through the construction period and later used for onsite landscaping purpose. No amount of topsoil shall be taken to municipal landfill.
- x. Excavated soil (below top 15 cm layer) shall be used for backfilling within the site and surplus shall be donated to other construction sites.

Construction IAQ Management Plan:

Develop and implement an IAQ management plan for the construction and preoccupancy phases of the building:

- i. During construction, meet or exceed the recommended control measures of the Sheet metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).
- ii. Protect stored on-site and installed absorptive materials from moisture damage.
- iii. If permanently installed air handlers are used during construction, filtration media with a MERV of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-1999. Replace all filtration media immediately prior to occupancy.

This includes addressing the following project-specific issues:

- i. Source Control**
 - Protect finish materials from construction dust.
 - Avoid finish materials with high VoC and formaldehyde levels
 - Recover, isolate and ventilate as appropriate when using any toxic materials or creating exhaust fumes.
 - Protect stored on-site and installed absorptive materials from moisture damage. Do not install moisture-damaged materials unless they have been properly dried.
 - Implement measures to avoid the tracking of pollutants into work area and occupied portions of the building.
- ii. Pathway Interruption**

- Isolate areas to prevent contamination of clean or occupied spaces using physical separation and depressurization.
- iii. Housekeeping**
 - Implement practices to ensure a clean job site to control potential contaminants such as dirt, dust and debris.
 - Clean up spills, and keep work areas dry.
- iv. Scheduling**
 - Coordinate construction activities to minimize disruption of occupied spaces.
 - Carefully sequence construction activities to minimize IAQ issues.
 - Protect stored on-site and installed absorptive materials from moisture damage
 - If permanently installed air-handlers are used during construction, one of the filtration media must be used at each return air grille. Replace all filtration media immediately prior to occupancy.
 - Use filtration media with a minimum efficiency reporting value of 8 or higher as determined by ASHRAE Standard 52.2-1999

Note: Filtration media with MERV 8 used during construction shall be replaced with filtration media with MERV 13 prior to occupancy.

3. Material Specification and Sourcing:

The following measures need to be implemented while purchasing and using materials on site.

Recycled content – for building construction and interior materials

- Out of the client approved materials, select materials with *recycled content such that the sum of *post-consumer recycled content and 1/2 of the *pre-consumer content constitutes at least 10% or 20%, based on cost, of the total value of the materials in the project.
- Mechanical, electrical and plumbing components and specialty items such as elevators cannot be included in this calculation. Include only CIVIL materials permanently installed in the project.
- Recommended materials for achieving this credit are: Steel, Ready Mix Concrete and AAC blocks.
- There could be many more such materials but supporting test certificates and letter from manufacturer need to be collected along with material purchase invoice/challan.

Notes:

**Recycled content is defined in accordance with the International Organization of Standards document, ISO 14021 — Environmental labels and declarations — Self-declared environmental claims (Type II environmental labeling).*

**Post-consumer material is defined as waste material generated by households or by commercial, industrial and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.*

**Pre-consumer material is defined as material diverted from the waste stream during the manufacturing process. Reutilization of materials (i.e., rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it) is excluded.*

Regional material– for building construction and interior materials

- Out of the client approved materials select materials for building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 250 miles (400 kilometers) of the project site for a minimum of 10% or 20%, based on cost, of the total materials value.
- If only a fraction of a product or material is extracted, harvested, or recovered and manufactured locally, then only that percentage (by weight) can contribute to the regional value.
- Mechanical, electrical and plumbing components and specialty items such as elevators and equipment must not be included in this calculation. Include only materials permanently installed in the project.
- Recommended materials to comply for this credit could be steel, concrete, furniture, laminates, and gypsum boards which have manufacturing unit/factories in 400 kms radius from the project site.
- A *template* is available in *Annexure 3-Regional_Recycled Material* to be filled in with relevant information.

Name of the Material (Exclude MEP, Equipment and Devices)	Note	Distance between Manufacturing Site and Project Site (Km) (at least 75% of material by cost shall meet the below requirement)	Recycle Content (% by Cost) (Trade off across material is acceptable)
Concrete			
Structural Steel		< 400	25
Reinforcement Steel		< 400	25
Cast-in-Place RCC	30% Fly-Ash Content	< 400	30
Plain Cement Concrete (PCC)	30% Fly-Ash Content	< 400	30
Coarse Aggregate	Reuse concrete debris from same or other construction site - for non-	< 400	-

	structural purpose		
Sand		< 400	-
Ready Mix Concrete	30% Fly-Ash Content	< 400	30
Masonry			
AAC Blocks for external walls (insulation value – U=0.5 W/Sqm K)	30% Fly-Ash Content; Please check for different thickness	< 400	30
Brick	Not for external walls		
Hollow Flyash Blocks	30% Fly-Ash Content	< 400	30
Solid Flyash Blocks	30% Fly-Ash Content	< 400	30
Insulation			
Roof and Exposed Terrace- XPS (insulation value – U=0.3 W/Sqm K)	-	< 400	-
Terrace Finishes			
Tiles/ Coating/ Screed/Paint	-(SRI>78)	< 400	15-20
Stone/Tiles			
IPS	30% Fly-Ash Content	< 400	30
Marble Stone Slab	-	< 400	0
Granite Stone Slab	-	< 400	0
Kota	-	< 400	0
Cudappah	-	< 400	0
Ceramic Tiles	-	< 400	15-20
Vitrified Tiles	-	< 400	15-20
China Mosaic Flooring	-	< 400	15-20
Paints/Coatings/Polishes			
Water-Proof Cement Paint	-	< 400	-
Wood Surface Paint	-	< 400	-
Metal/Steel Surface Paint	-	< 400	-
Acrylic Emulsion Paint-Walls,Ceilings	-	< 400	-
Acrylic External Paint	-	< 400	-

Door Polish	-	< 400	-
Epoxy Coating	-	< 400	-
Primer	-	< 400	-
Adhesives	-	< 401	-
Doors			
Hollow Metal Door	-	< 400	20
Flush Wooden Door	-	< 400	20
Fire-Rated Wooden Door	-	< 400	20
PVC Door	-	< 400	20
Steel Doors	-	< 400	20
Ceilings			
Gypsum Ceiling	-	< 400	25
Mineral Fiber Ceiling	-	< 400	25
Glazing			
Door - Glass (all elevations)	-	< 400	15-20
Exterior Window-Glass (all elevations) (Insulation value – U=1.5 to 1.6 W/SqmK)	Double Glazing with Low E coating, SHGC- 0.25 to 0.30 and VLT not more than 40 %	< 400	15-20
Metals			
Stairs-Hand Railing	-	< 400	25
Chain Link Fencing	-	< 400	25
Rolling Shutter	-	< 400	25
Aluminium Work	-	< 400	30
M.S. Grills	-	< 400	25
Framing for Internal Partitions/False Ceiling	-	< 400	25
Galvanised Roofing Sheets	Precoated	< 400	25
Gates	-	< 400	25
Door/Window Frames	-	< 400	25
Landscape			
Precast Paver Blocks	Light gray/white (SRI>29)	< 400	20-25

Appropriate flow/ flush rates- for water supply and sanitary fittings

Out of the client approved list, water supply and sanitary fixtures shall meet the following flow / flush rate.

Fittings	Flush/Flow Rate	Remarks
WC	2/4 LPF	Dual flush with sensors
Urinals	0.8/1.2 LPF	Pre-rinse with sensors
Wash basin faucets	Less than 1.2 LPM	With sensors or pressmatic
Shower heads	Less than 6 LPM	
Kitchen faucets	Less than 6 LPM	
<i>All the above LPM and LPF shall be at 5 bar pressure/80 PSI</i>		

Notes: LPM = Liters per Minute, LPF = Liters per flow

Low VOC Adhesives, Paints and Carpets

All adhesives and sealants used in the interior of the building (i.e., inside the weatherproofing system and applied on-site) must comply with the following requirements as applicable to the project scope:

1. Adhesives must comply with the VOC limits listed in the table below:

Architectural Applications	VOC Limit (g/L less water)	Specialty Applications	VOC Limit (g/L less water)
Indoor carpet adhesives	50	PVC welding	510
Carpet pad adhesives	50	CPVC welding	490
Wood flooring adhesives	100	ABS welding	325
Rubber floor adhesives	60	Plastic cement welding	250
Subfloor adhesives	50	Adhesive primer for plastic	550
Ceramic tile adhesives	65	Contact adhesive	80
VCT and asphalt adhesives	50	Special purpose contact adhesive	250
Drywall and panel adhesives	50	Structural wood member adhesive	140
Cove base adhesives	50	Sheet applied rubber lining operations	850
Multipurpose construction adhesives	70	Top and trim adhesive	250
Structural glazing adhesives	100		

2. Sealants must comply with the VOC limits listed in the table below:

Substrate Specific Applications	VOC Limit (g/L less water)	Sealants	VOC Limit (g/L less water)
Metal to metal	30	Architectural	250
Plastic foams	50	Nonmembrane roof	300
Porous material (except wood)	50	Roadway	250
Wood	30	Single-ply roof membrane	450
Fiberglass	80	Other	420

3. Sealant Primer must comply with the VOC limits listed in the table below:

Sealant Primers	VOC Limit (g/L less water)
Architectural, nonporous	250
Architectural, porous	775
Other	750

4. Aerosol Adhesives must comply with the VOC limits listed in the table below:

Aerosol Adhesives	VOC Limit
General purpose mist spray	65% VOCs by weight
General purpose web spray	55% VOCs by weight
Special purpose aerosol adhesives (all types)	70% VOCs by weight

5. Architectural paints and coatings, anti-corrosive and anti-rust paints applied to interior ferrous metal substrates, clear wood finishes, floor coatings, stains, primers and shellacs applied to interior elements must not exceed the VOC limits as defined below:

Product Type	VoC Limit (g/L minus water)
Interior Flat Coating or Primer	50
Interior Non-Flat Coating or Primer	150
Anti-Corrosive/ Anti-Rust Paint	250
Clear Wood Finish: Lacquer	550
Clear Wood Finish: Sanding Sealer	350
Clear Wood Finish: Varnish	350
Clear Brushing Lacquer	680
Floor Coatings	100
Sealers and Undercoaters	200
Shellac: Clear	730
Shellac: Pigmented	550
Stain	250

Concrete Curing Compounds	350
Japans/Faux Finishing Coatings	350
Magnesite Cement Coatings	450
Pigmented Lacquer	550
Waterproofing Sealers	250
Waterproofing Concrete/Masonry Sealers	400
Wood Preservatives	350
Low-Solids Coatings	120

6. All flooring must comply with the following as applicable to the project scope:

- All hard surface flooring must demonstrate maximum emissions factors less than or equal to those stated below, as shown with testing by an independent third party:
 - Formaldehyde, 1.65 µg/m³ per hour
 - Acetaldehyde, 9 µg/m³ per hour
- All other organic chemicals with established Chronic Reference Exposure Levels (CRELs) less than or equal to 1/2 CREL as listed in the latest edition of the Cal/EPA OEHHA list of chemicals with non-cancer CRELs.

Note:

*The testing protocol must follow the ICC Evaluation Service (ICC-ES) Evaluation Guideline for Determination of Volatile Organic Compound (VOC) Content and Emissions of Floor Covering Products, EG107

The LPD for each area (as per space function) can be referred to from the following table:

Lighting Power Density	W/ (Proposed) ft ²
Lobby	0.67
Restrooms	0.31
Dressing/Fitting Room	0.67
Corridor	0.2
Stairs	0.2
Storage	0.22
Electrical/Mechanical Rooms	0.32
Facade Lighting	0.14
Landscape	0.04
Plazas, 10' wide walk-ways, special features	0.14
Open Parking	0.11
Building Entrances - Main (W/ft)	21
Building Entrances - Other (W/ft)	14
Walkways and Internal Roads	0.11

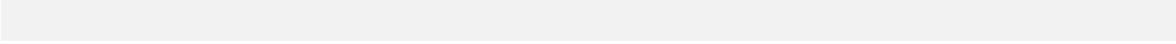
1.0 Fire Detection Alarm System, Smart Card Based Access and CCTV Surveillance

- a) The Contractor shall provide Authorized Dealership Certificate from OEM if not an OEM.
- b) The Contractor shall deploy minimum number of personnel with requisite qualifications and experience for execution of works.
- c) The Contractor shall deploy all installation & testing equipment necessary for the commissioning of the works.
- d) The Contractor will carry-out any interfacing / Integration of the systems as required between the systems and also with the BMS (Lift, AHU, Lighting, DG Set Panels pumps, water tanks,) in future.
- e) The Contractor shall train the designated purchaser's, Employer's staff for operation of the system on-site, as necessary.
- f) The required drawings of the building layouts with estimated requirements will be provided as a reference (and are not limited for designing the systems).
- g) Required UPS Power only will be made available by the purchaser. The power cabling & Ethernet / Optical Fiber cabling, Ethernet Switches and other network hardware shall be provided by the Contractor.
- h) Any material (civil, electrical, communication / networking hardware) required for installation work, site improvisation / retrofitting the systems in the buildings will be arranged by the Contractor.
- i) The Acceptance test requirements & the Test procedure / plan to be submitted by the Contractor.
- j) The Contractor shall obtain the required permits / permissions from the related authorities / regulatory bodies as applicable before commencing the work.

3.6 Solid Waste Management

- All the waste generated within the complex should be treated as per the Solid Waste management and Handling Rules 2016.
- The contractor to maintain a waste log to keep a track of the total quantity of waste generated in the facility.
- Trained staff to be appointed for managing the AWC system and the OWC plant.
- The contractor to ensure that the entire (100%) organic waste collected within the Complex to be given to Bhopal Municipal Corporation for treatment and no organic waste reaches the landfill site.
- Contractor to ensure that all the staff engaged in Solid waste management system are well trained for the required job.
- Clean water to be supplied at the waste segregation center for the staff working in the facility.
- All required safety and hygiene equipments like gloves, mask, shoes etc to be provided to all the staff engaged in handling the waste.
- All the recyclables collected should be given to authorized vendors.

- The inert collected after treatment of organic waste and recycling of waste will be transferred to the nearest approved municipal landfill site.



CHAPTER 4. MAINTENANCE REQUIREMENTS

4.1 Maintenance Requirements

- 1.0 The Contractor shall, at all times maintain the Project Components in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits. The Contractor shall maintain the Project Works for a period of 3 (Three) years commencing from the date of Of commissioning of al Works
- 1.1 During the Maintenance Period, the Employer shall provide to the Contractor access to the Site for Maintenance in accordance with this Agreement. The obligations of the Contractor hereunder shall include:
 - a) undertaking routine maintenance;
 - b) undertaking repairs to structures;
 - c) informing the Employer of any encroachments on the Project Site; and
 - d) operation and maintenance of all utility service lines, communication, patrolling, and administrative systems necessary for the efficient maintenance of the Project Works in accordance with the provisions of this Agreement.
- 1.2 The Contractor shall repair or rectify any Defect or deficiency set forth in Paragraph 2 of this Schedule-E within the time limit specified therein and any failure in this behalf shall constitute non-fulfillment of the Maintenance obligations by the Contractor. Upon occurrence of any breach hereunder, the Employer shall be entitled to effect reduction in monthly Operation and Maintenance payment, without prejudice to the rights of the Employer under this Agreement, including Termination thereof.
- 1.3 All materials and works for operations and maintenance of roads and pavements shall conform to the Specifications for Road and Bridge Works (Fifth Revision, April 2013), issued by the Ministry of Road Transport & Highways (MoRT&H) and the relevant IRC publications.
- 1.4 All materials and works for operations and maintenance of Potable water supply rising mains and distribution networks, Elevated Service Reservoirs (ESR), Recycled water supply rising mains and distribution networks including valves, flow meters etc. shall confirm to CPHEEO Manual on Operation and Maintenance of water supply systems, 2005, MoUD, GOI
- 1.5 Where the Standards and Specifications for any of the above work are not given, Good Industry Practice shall be adopted to the satisfaction of the Employer's Engineer.

4.2 Repair/Rectification of Defects and Deficiencies

The obligations of the Contractor in respect of Maintenance Requirements shall include repair and rectification of the Defects and deficiencies specified in Appendix E-I of this Schedule-E within the time limit set forth therein.

4.3 Other Defects and Deficiencies

In respect of any Defect or deficiency not specified in Appendix E-I of this Schedule-E, the Employer's Engineer may, in conformity with Good Industry Practice, specify the permissible limit of deviation or deterioration with reference to the Standards and Specifications, and any deviation or deterioration beyond the permissible limit shall be repaired or rectified by the Contractor within the time limit specified by the Employer's Engineer.

4.4 Extension of Time Limit

Notwithstanding anything to the contrary specified in this Schedule-E, if the nature and extent of any Defect or deficiency justifies more time for its repair or rectification than the time specified), the Contractor shall be entitled to additional time in conformity with Good Industry Practice. Such additional time shall be determined by the Employer's Engineer and conveyed to the Contractor and the Employer with reasons thereof.

4.5 Emergency Repairs/Restoration

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

4.6 Daily Inspection by the Contractor

The Contractor shall, through its engineer, undertake a daily visual inspection of the Project Components and maintain a record thereof in a register to be kept in such form and manner as the Employer's Engineer may specify. Such record shall be kept in safe custody of the Contractor and shall be open to inspection by the Employer and the Employer's Engineer at any time during office hours.

4.7 Repairs On Account Of Natural Calamities

All damages occurring to the Project Components on account of a Force Majeure Event or default or neglect of the Employer shall be undertaken by the Employer at its own cost. The Employer may instruct the Contractor to undertake the repairs at the rates agreed between the Parties.

4.8 Landscape Areas

4.8.1 MAINTENANCE WORKS of landscaped areas

1.1. General

- i. The Contractor shall maintain the landscape for a 3 year period after the date certified by the Employer that the work has been satisfactorily completed (issue of Certificate of Completion).
- ii. The extent of the landscape to be maintained by the Contractor shall be deemed to cover and include all soft landscape areas within the overall project boundaries as shown on the drawings including all existing soft landscape not affected by the contract works and retained intact or nearly so through the end of the contract period as well as all the landscape works covered in the contract scope of works. No additional maintenance charges will be allowed unless specifically agreed to by the Employer in writing.
- iii. The Contractor shall ensure that a senior qualified supervisor is made available for organising and running the maintenance programme. The Contractor shall also have available an experience foreman who can supervise the workers on a day-to-day basis. An adequate trained labour force of at least 3 workers must be available for routine work and they must be on site for at least half a working day, 5 days per week during the maintenance period. Additional grass cutting operators will be needed to ensure adequate cutting and cleaning.
- iv. The Contractor's Supervisor shall inspect the site once per week during the maintenance period and shall prepare a brief schedule of operations required for the coming week. The format for the schedule of operations will cover each distinct areas of the site such as frontage, rear, courtyard, roof, interior, etc. The schedule shall describe the operations the Contractor intends to carry out in the coming week to cover the items listed in the specification and to ensure that the current weather conditions and growing performances, insect attack, etc is taken into account.
- v. A copy of this schedule is to be submitted to the Employer every week so that a running record of proposed operations can be checked at the maintenance inspections each month. If in the opinion of the Employers Landscape Architect the maintenance works have not been satisfactorily carried out according to site conditions and the specifications, part of the monthly payment will be withheld until the works have been satisfactorily carried out.
- vi. The contractor shall carry out all necessary measures to ensure that all pot plants, trees and shrubs and other plants shall thrive and become established within this period. All landscape areas will be inspected monthly and lists of remedial works issued after each inspection. All items on the remedial lists are to be carried out by the time of the next inspection, ie within one month.
- vii. The Contractor shall keep the landscape areas clean and tidy at all times and dispose of all waste materials arising from the cleaning.

1.2. Maintenance of Planted Areas: Trees, Shrubs, Climbers, Herbaceous and Ground Covers

- i. The Contractor shall water all trees, palms, shrubs, ground cover, rooted shoots, herbaceous plants and other planting areas as often as necessary to keep the ground moist all around and to the full depth of the roots of the plants to a minimum depth of saturation of:
 - 100mm for groundcover
 - 300mm for shrubs
 - 750mm for trees
- ii. Fresh water only shall be used for the Works. Water shall be supplied to the Contractor from agreed points on the site. However, it will be only to necessary for the Contractor to supply his own means of transport from the watering points to the plant beds.
- iii. An inspection of watering requirements is to be made by the Contractor at least two times a week in dry weather.
- iv. Water shall be supplied using an approved hose or sprinkler so as not to cause compaction or wash-outs of the soil or loosening of plants. The Contractor shall immediately make good any such damage, soil erosion or outwash and plants loosened by erosion are to be replanted or if damaged, replaced.
- v. All plant beds are to be kept in a weed free condition with a weeding operation once a month. All weeds, stones and rubbish collected from this operation shall be removed from the site to a tip to be found by the Contractor. Herbicides may not be used on this site unless a specific application in writing is made by the Contractor with full back up data on the performance of the chemicals and the particular need for the chemicals use. Approval will in all cases be subject to the Landscape Architect's decision.
- vi. After weeding, at least once per month the soil surface is to be lightly broken up between plants using a pronged fork upto maximum depth of 100mm. Contractor shall Take care not to disturb the root systems of plants. After forking the soil loose, the mulch and loosened soil are to be raked to give an even re-distribution of the mulching materials
- vii. Firming up and adjusting of stakes/ties shall be carried out monthly to ensure that the trees and shrubs are firmly held in the ground. If required guy ropes or tree pits shall be adjusted, tightened or loosened. If tree ties or ropes are rubbing the bark of the trees, the ties are to be taken off and retied. Any damaged branches are to be carefully pruned and the wounds sealed.
- viii. All protective fencing is to be maintained and kept in good condition and in position until the end of the maintenance period.

- ix. Trees shall be pruned if dead, rotten or crossed branches are present or to maintain a clear stem up to the specified height using the methods described below. Tree pruning is to be reviewed monthly.
- x. All shrubs and ground covers are to be reviewed monthly and pruned as and when required during the Maintenance Period to promote bushy growth and good flowering characteristics. The shrubs shall be checked and all dead wood, broken, damaged or crossed branches shall be cut back, depending on species. Pruning and removal of branches is to be carried out using sharp clean implements to give a clean sloping cut with one flat face. Ragged edges of bark or wood are to be trimmed with a sharp knife.
- xi. Pruning for all plants shall be carried out as follows:
- Pruning is to be done with the cut just above and sloping away from an outward facing health bud.
 - Removal of branches is to be done by cutting flush with the adjoining stem and in such a way that no part of the stem is damaged or torn.
 - Ragged edges of bark are to be trimmed with a sharp knife.
 - Any cuts or wounds over 25mm diameter are to be painted with an approved sealant after trimmed.
 - All pruning to be cleared up and removed from site after pruning.
- xii. All hedges, mat forming herbaceous plants and ground cover plants shall be clipped with shears as often as necessary (at least monthly) to maintain a tidy appearance. Tall hedges are to be cut to forms shown on the drawings. Fertiliser is to be applied to clipped areas around 1-2 weeks after clipping.
- xiii. Selective pruning of flowering plants shall be done where special flowering characteristics are required such as for Ixoras, Hibiscus, Allamanda where flowering takes places on twig ends. Heavy clipping must not be used for these species since this will remove future flower buds. Selective pruning by clipping non flowering twigs and leaving flowering twigs is necessary for these plants, and this operation must be done by experienced workers.
- xiv. The Contractor shall allow for monthly fertiliser operations during the Maintenance Period. An approved slow release fertiliser shall be applied to each plant at the rate of 50gm per shrub and 200gm per tree, one month after planting and thereafter monthly. After spreading the fertiliser around the base of the plant the granules shall be lightly forked into the soil, and the plant well watered. Herbaceous and ground cover areas shall receive 25mm of approved soil conditioner, evenly spread and mixed with 50gm/m² of approved slow release fertiliser, evenly spread over entire area and lightly forked into the soil to break up the top layer, and the area well watered on a month by month basis.

- xv. The horticultural requirements of different plants or areas may involve variations to those techniques (such as the use of organic liquid fertilisers for sensitive plants) and variations in method will be authorised as required.
- xvi. Heavy feeding plants such as Canna, Heliconia and Lantana shall be dressed with a 25mm mulch of approved organic compost or similar approved compost every 2 months, lightly forked in around the base of the plants.
- xvii. Additional mulching layer, 25mm deep to be spread and forked in over all planted areas at 3 monthly intervals.
- xviii. The Contractor shall make regular weekly checks to ensure that the plant material is insect and pest and fungus free. No pesticides may be used unless approval from the Landscape Architect is given from the Contractor stating the chemical intended for use; concentration, spraying programme and including full technical details of the product.

1.3. Maintenance of Lawn Areas

- i. The Contractor shall mow all lawn areas using approved cutting equipment to maintain a close sward to a height of not less than 20mm and not more than 30mm for all grass types.
- ii. Mowing shall be carried out generally weekly, except in dry weather and grass shall not be allowed to flower between cuts.
- iii. Weekly inspections are to be made to ensure adequate planning of grass cuts to suit growth and weather conditions. All clippings to be gathered up and removed from site.
- iv. All grass areas are to be watered by means of sprinklers during dry weather as often as is required to keep the grass green and the soil moist.
- v. The Contractor shall provide hoses and sprinklers for use from water points provided. Weekly inspections are to be made to determine the need for water and, in dry weather watering must be done to moisten the soil to a depth of 100mm.
- vi. Fertiliser of NPK value 10-15-15 or similar approved be spread at a rate of 40gm/sq m over all grass areas at monthly intervals, using approved spreading equipment to give an overall even spread. Grass areas that have been fertilised shall be watered if no rain falls within 24 hours.
- vii. The Contractor shall apply top-dressing of not more than 15mm depth fine sand and granulated compost raked and spread evenly over the lawn areas. The next top-dressing shall be applied only after the grass has grown through to a mowable height.
- viii. There shall be at least two applications of topdressing during the maintenance period, to be directed by the Landscape Architect appointed by Contractor.

- ix. If depressions or bumps over 25mm deep or high in turf areas during the maintenance period these are to be levelled out by lifting the turf and raising the soil level with sand/compost mix or trimming to level grades, followed by re-turfing.
- x. Grass areas are to be kept free of weeds, annual grasses, fungus and insect attack and free of stones or other debris throughout the maintenance period as often as is required.
- xi. All chemicals used shall be to the approval of the Employer/Employer's representative. Assessment of these operations is to be prepared on the basis of the weekly maintenance inspection chart.
- xii. If compaction or consolidation takes place or hard passing or baking of the soil occurs, the soil areas are to be well watered first and lightly loosened by mechanical means such as spiking, slitting or hollow tinning using equipment approved by the Employer/Employer's representative.

1.4. Replacement Planting

- i. If during the course of the Maintenance Period trees or shrubs or other plants die because of a fault by the Contractor, the Contractor shall replace the plant at no cost to the Employer.
- ii. All questions related to responsibility for the replacement planting will be subject to site inspection and agreement of the appointment of responsibility.
- iii. This will be done very month at the monthly maintenance inspections.

1.5. Final Handover

- i. Two weeks before the end of the Maintenance Period a joint inspection shall be held with the Maintenance Agency, Contractor and the Employer/Employer's representative review the requirements for alteration or replacement in order to gain approval for Final Handover.
- ii. In order to ensure satisfactory handover procedures, the site meetings held each month between the Contractor and Employer/Employer's Representative will be used to inspect and approve the maintenance works which will be reviewed to ensure adequate work has been done.
- iii. At the time of the final inspection, all areas under this contract shall be free of weeds, neatly cultivated and raked, and all plant boxes in good order.
- iv. Grass shall be neatly cut and all clippings removed. No bare patches of earth shall be visible in turf or planting areas unless specified (that is rings around tree trunks).
- v. If, after this inspection, the Employer/Employer's representative is of the opinion that all work has been performed in accordance with the drawings and

specifications, the Employer/Employer's representative will give written letter of acceptance and completion of the project.

vi. If, all or certain portions of the work are not acceptable under the terms and intent of the drawings and specifications, the formal maintenance period for all the work shall be extended at no cost to the Employer/Employer's representative until the defects in the work have been corrected and the work is accepted by the Employer/Employer's representative.

- Space for storing all equipments and other materials to be finalized as directed by the owner.
- Site inspection by the chief horticulturist with owner/owner's representative shall be made every week to analyze the health of the plants and for improvements it is mandatory for contractor to remain present at site during such visits.
- All maintenance charges to be consolidated towards all types of services mentioned below including the supply of required numbers of trained malis, materials, manures and fertilizers, pesticides and fungicides, lawn mowers and other required machineries and tools, etc, all complete.

Annual Maintenance of Irrigation System, Water Features Including Filtration System

Contractor shall perform following activities while maintaining the system,

- Routine cleaning of the water features
- Vacuum suction of sediments on the floor / wall cleaning
- Grubbing of hard settlement / salts Periodically
- Skimming to remove moulds / scale formation
- Removal of floating debris by nets
- Operation of the filtration system for filtration & daily back wash
- Addition of consumables such as chlorine & acids, etc

4.8.2 ICT Works :

- The Contractor shall, at all times maintain the Project Components in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits.
- The Contractor shall, through its engineer, undertake a daily visual inspection & duct clearance on camera lenses, detectors of the Project Components.
- Any damage breakage of any apparatus, equipment, sensors and system in general should not remain nonfunctional for more than two hour.
- Essential maintenance spares to be available for immediate repair.

- Any damage to splitter/OLT/ONT shall be replaced or rectified within 2 hours.
- Any breakage to communication, power & Ethernet fibre cables shall be replaced or rectified within 2 hours.
- Up-gradation of licenses during Operation and Maintenance Period for physical access control system, CCTV surveillances system, Management software of GPON and Video door phone system shall be considered by contractor without any additional cost.
- The min. maintenance spare of MCP & Key to reset the MCPs has to be considered by contractor without any additional cost.
- The additional future required UHF vehicle tags have to be considered by contractor without any additional cost.

4.8.3 Electrical Works :

4.8.3.1 SCOPE

The scope of Contractor includes O&M for 10 year and Training of Employer's staff for operation and handling of the respective systems, carry out Operation & Maintenance of Electrical Distribution Network, system along with its associated components including the following;

- i) 415 V Switchboards
- ii) LV Cable network,
- iii) Earthing & Lightning protection System
- iv) Lighting System with wiring including flat's internal wiring, DB & fans.
- v) Comprehensive Maintenance of all the Systems installed.

4.8.3.2 WORK DESCRIPTION

CONTRACTOR shall carry out the following maintenance activities

- a. Contractor should carry out Operation and Maintenance requirements as per O&M manual of each equipment, CPWD norms and as per DISCOM Company.
- b. Carry out Preventive & Predictive maintenance of the equipment and associated system to ensure the health of the network.
- c. Carry out breakdown maintenance of equipment and systems including identifying the fault and its location; repairs with all required spares and tools; testing and regularize the operations with minimum downtime.

- d. Maintain the Critical Spares required for emergency resolution of outages of Key equipments and systems.
- e. Carry out Root Cause Analysis to find the reasons and taking measures to eliminate its reoccurrence.
- f. Provide required all the necessary latest Tools and Tackles along with Test Equipments for carrying maintenance activities
- g. Necessary Human Safety Norms as per the updated Indian Electricity Rules.

4.8.3.3 REPAIR / RECTIFICATION OF DEFECTS AND DEFICIENCIES

i) Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 2 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist. Corrective actions to problem experienced, if takes longer time, shall be complied 100% by during next business hours.

ii) Repairs

All equipment that require repairing shall be immediately serviced and repaired as defined below. Since the period of Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

- a) Minor rectifications - 2 to 4 hours
- b) Major rectifications - 12 to 24 hours

iii) Extension of time limit

Notwithstanding anything to the contrary as specified above, if the nature and extent of any Defect or deficiency justifies more time for its repair or rectification than the time specified herein, the Contractor shall be entitled to additional time in conformity with Good Industry Practice. Such additional time shall be determined by the Owner's Engineer and conveyed to the Contractor and the Owner with reasons thereof.

iv) Emergency Repairs/Restoration

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

4.8.3.4 UPTIME GUARANTEE

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperatures,

pressures, humidity, and power consumption, starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Engineer In-charges/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

4.8.3.5 OPERATION AND MAINTENANCE

- i) Operation contract (Electrical System)
 - a. 10 hours a day, year round during working office hours for full load
 - b. 14 hours a day, year round during non-work hours for part load.
 - c. All stand-by equipment to be operated as per mutually agreed programme.
 - d. Proper entry and upkeep of relevant log books.
 - e. Maintain complaints register. Submit weekly report.
 - f. Proper housekeeping of all areas under the contract.
 - g. Prepare daily consumption report and summary of operation.

- ii) All Inclusive Maintenance Contract

- a. Scope.

- The AMC shall cover all the items installed by the contractor including replacement of all switches, fittings etc. consumable like bulbs, tubes, oil etc. shall be excluded.

- b. Routine Preventive Maintenance Schedule to be submitted

- i. Schedule to cover manufacturer's recommendation and/or common engineering practice (for all plant and machinery under contract).
 - ii. Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.
 - iii. Monthly status report.
 - iv. Entire Electrical installation to be repainted in fourth year (from commissioning) before the expiry of operation and maintenance

contract.

c. Uptime during maintenance contract

- i. 99.9% uptime of all systems under contract.
- ii. Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.
- iii. There shall be no reimbursement for the extended period.
- iv. Break-downs shall be attended to within ten hours of reporting.

d. Manpower

- i. Adequate number of persons to the satisfaction of the Engineer In-charge shall be provided including relievers.
- ii. Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.
- iii. Duty allocation and Roaster control shall be contractor's responsibility.
- iv. No overtime shall be payable by Owner for any reason whatsoever.

e. Shut Downs

- i. Routine shut downs shall be permitted only as allowed by the Chief Engineer.
- ii. Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.

4.9 Ventitation

- a) The Contractor shall, at all times maintain the Project Components for Bhopal Government Housing Tender for Plot 22 & 23 in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits.
- b) The Contractor shall, through its engineer, undertake a daily visual inspection & duct clearance on camera lenses, detectors of the Project Components.
- c) Any damage breakage of any apparatus, equipment, sensors and system in general should not remain nonfunctional for more than two hour.
- d) Essential maintenance spares to be available for immediate repair.
- e) Any damage to fan/damper/VCD/grilles/louvers shall be replaced or rectified within 2 hours.

- f) Any breakage to power cables shall be replaced or rectified within 2 hours.
- g) The min. maintenance spare of ventilation fans has to be considered by contractor without any additional cost.
- h) CONTRACTOR shall replace/repair burnout motor/ damage actuator/ damage fan blade within 48hours.
- i) CONTRACTOR should check physical and working condition of fans once in 3 months and should take necessary actions, if finds any defects in the same.
- j) CONTRACTOR should conduct dry run test of all lift well pressurization fans for 15 mins once in a six months. CONTRACTOR should specifically check these fans are automatically get operated based on signal received from fire panel.
- k) CONTRACTOR should coordinate with instrumentation person to conduct the same.

4.10 ICT

1. The Contractor shall, at all times maintain the Project Components for Bhopal Government Housing Tender for Plot 22 and Plot 23 in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits.
2. The Contractor shall, through its engineer, undertake a daily visual inspection & duct clearance on camera lenses, detectors of the Project Components.
3. Any damage breakage of any apparatus, equipment, sensors and system in general should not remain nonfunctional for more than two hour.
4. Essential maintenance spares to be available for immediate repair.
5. Any damage to splitter/OLT/ONT shall be replaced or rectified within 2 hours.
6. Any breakage to communication, power & Ethernet fibre cables shall be replaced or rectified within 2 hours.
7. Up-gradation of licenses upto 10 years for physical access control system, CCTV surveillances system, Management software of GPON and Video door phone system shall be considered by contractor without any additional cost.
8. The min. maintenance spare of MCP & Key to reset the MCPs has to be considered by contractor without any additional cost.
9. The additional future required UHF vehicle tags have to be considered by contractor without any additional cost.

4.11 STP

The scope of the work shall include but not be limited to the following:

- Design and manufacture, supply, testing at manufacturers' works, storage when required, delivery to site, unloading and site transportation, erection & commissioning, site testing, painting and finishing of the Plant of capacity 500 KLD
- Preparation of process, hydraulic, electrical, mechanical and piping design. Preparation all civil, mechanical, electrical and piping drawings including architectural, construction and as built drawings.
- Supply, erection testing & commissioning of all the electromechanical mechanical equipment, electrical units, instrumentation and interconnecting piping as per mechanical specifications.
- Providing walkways, platforms and staircase of minimum 1.0 m width
- Drain with valve and pipe arrangement (min 200 mm dia) to all treatment plant necessary units.
- All drains shall be connected to the sump.
- Performance Run of the constructed & hydraulically tested plant along with O & M of electrical & mechanical equipment for a period of Three (3) months and operation & maintenance for 36 months after performance run as per tender specifications including providing and installing all units, labour, tools and plants all complete on turnkey basis
- Defects liability period of 24 months from the date of successful completion of O & M period
- Supply of all documentation for the plant such as As-Built drawings, Operation & Maintenance manuals (6 sets)
- Supply of all spares required during performance run and during 24 months of O & M period.
- Oil painting with anti corrosive treatment for package unit, railing and all MS, CI and GI works.
- Bidders are advised to visit STP site before quoting for the proposed STP.
- Any other items of work which have not been specifically mentioned in the specifications but are necessary for construction of the plant as per good engineering practice and safety norms and operation and guaranteed performance of the entire plant shall be deemed to be

included within the scope of work of this specifications and shall be provided by the contractor without any extra cost to the employer.

4.11.1 DETAILS FOR MAINTENANCE TO BE CARRIED OUT:

- a) The Contractor shall operate and maintain the entire plant within its Contract price for a total operation and maintenance period of 10 years from the date of taking over of the plant by the client after successful Installation, commissioning of the Plant.
- b) All necessary repairs, maintenance, overhaul, replacements etc., shall be made during the O & M to maintain the plant at the status of formal handling over after the P G test. Contractor shall be responsible for comprehensive repair, break down repair for operation and maintenance during this 10 years period of O&M.
- c) The O & M price by the Tenderer shall include supply of all tools, tackles, spares, lubricants, laboratory chemical, and glassware, chemicals like Sodium hypochlorite, Alum, Poly-electrolyte etc.
- d) During O & M cost of power consumed shall be in the Contractor price and bills of electric power shall be paid as per actual consumption as per the figures guaranteed by the Tenderer, directly to the concerned authorities.

The scope shall but not limited to the following items:

- Operation and Maintenance including Electrical, Mechanical and Instrumentation all allied works.
- Sampling and testing of Raw Water
- Sampling of treated Water to ensure that the guarantee Parameters are as stipulated in the design criteria.
- The dewatered sludge could be collected and disposed of by the Contractor.

Loading, Unloading and Transportation of dewatered sludge out of treatment plant site at own cost.

Maintenance of log books of all the equipments/instruments various readings of process parameters, record of failures and alarms and shall be forwarded at monthly intervals.

The O & M shall include the appropriate preventive maintenance of equipment as per the Manufacturer's recommendation.

- All the equipment even standby supplied, installed and commissioned by the Contractor should be in operational/ functional condition throughout the O & M period. The Contractor shall take all preventive measures to maintain them in working condition.
- The frequency of break downs of various equipments shall be the least as far as possible. The total number of such re-occurrences shall not exceed three times per annum otherwise penalty shall be levied on the Contractor at the discretion of Engineer-in-charge.

4.11.2 MECHANICAL, ELECTRICAL & INSTRUMENTS:

- a) Preventive maintenance of all the Equipments and Machineries for Water treatment plant including Pumps, Piping, Valves, equipments, Motors, HT and LT Panels, Transformers, Cables, PLC, Field Instruments, Laboratory Instruments etc. and as directed by Engineer-in-Charge.
- b) Breakdown maintenance of all the Equipments and Machineries as indicated above and as directed by Engineer-in-Charge.
- c) Calibration of all necessary Field Instruments.

4.12 SWM

- The selected contractor shall carry out the operation and comprehensive maintenance of AWC system (including all equipment and accessories) from the date of handing over to the end of contract period.
- O & M contractor is responsible for round the clock operation of the system by trained and qualified personnel.
- Annual Maintenance related works to be planned in advance and to be carried out, after obtaining prior approval from Owner.
- Generating weekly operating reports and submitting to Owner.
- Trouble-shooting of equipment related problems by carrying out necessary rectification / replacement and putting back the equipment into operation within the stipulated time mentioned in the contract documents.
- Generating spare consumption reports on a monthly basis and submitting to Owner.
- Reporting of breakdowns / abnormalities to Owner.
- The contractor shall maintain the minimum stock critical spares at site.

- The Contractor will refer all operational and maintenance management issues for consideration and decision to the Owner.
- The Contractor will operate and maintain the equipment and system daily in accordance with Original Equipment Suppliers operation and maintenance specifications as a minimum requirement, and Standard O&M Procedures.
- The Contractor will carry out routine checks to ensure continuous and efficient operation of the equipment and system
- Daily operation and Maintenance of the equipment will include routine checkup and adjustment to the equipment preventive maintenance works and management of any breakdowns.
- The Contractor will maintain log books and registers in which full and detailed records of all daily maintenance and repair activities will be kept to provide a basis for preparation of periodic reports by the Contractor as required to the Owner. All Log books and registers shall be accessible to Owner at all times during the period of contract.
- The Contractor shall submit daily, weekly, monthly and annual reports as required by the Owner.
- The required power and water will be supplied by Owner and other than the above all the consumables and spares are in the scope of contractor.
- Any emissions or leachate generated during handling of waste shall be taken care by the Contractor and necessary precautions will be taken to comply with the CPCB/ MPPCB and SWM Rule 2016 standards.

4.13 Repair / Rectification of Defects and Deficiencies

The Contractor shall repair and rectify the Defects and deficiencies specified in the **Chapter 8.1.**

1.0 Architectural, Civil maintenance

- 1.1 Any break down of door / window / hatch accessories should be replaced / rectified within 24 hours.
- 1.2 Any breakage of flooring, false ceiling and peeling of paint should be rectified in 48 hours.
- 1.3 Any damage to External stone cladding, flooring, paving, hardscape, façade etc. shall be rectified within 48 hours.
- 1.4 Any crack / peeling of Plaster shall be repaired within 48 hrs
- 1.5 Any water leak in building shall be stopped with 2 hrs and suitable rectification process undertaken.

- 1.6 Housekeeping services for common utility areas for SPV, BEC building and connecting street / corridor.

2.0 Landscape

- 2.1 Any non-surviving/ unhealthy saplings should be replaced within 48 hours.
- 2.2 Trees uprooted / damaged should be removed within 8 hours and replaced in one week time.
- 2.3 Blockages/ leakages / damages in Irrigation System, Water Features Including Filtration System should be made good in 24 hours.
- 2.4 Any Hardscape / signage damage shall be repaired within 24 hrs.

3.0 Electrical

- 1.0 Any Electrical equipment / Apparatus/ cables, etc. shall be restored within two hours in case of minor faults and within eight hours in case of major faults.
- 1.1 Faulty lighting fixtures should be rectified within six hours.
- 1.2 Essential spares to be available for immediate repairs.

4.0 HVAC

- 2.1 The Contractor shall, at all times maintain the Project Components in accordance with the provisions of this Agreement, Applicable Laws and Applicable Permits.
- 2.2 The Contractor shall, through its engineer, undertake a daily visual inspection & duct clearance on camera lenses, detectors of the Project Components.
- 2.3 Any damage breakage of any apparatus, equipment, sensors and system in general should not remain non functional for more than two hour.
- 2.4 Essential maintenance spares to be available for immediate repair.
- 2.5 Any damage to fan/damper/VCD/grilles/louvers shall be replaced or rectified within 2 hours.
- 2.6 Any breakage to power cables shall be replaced or rectified within 2 hours.
- 2.7 The min. maintenance spare of ventilation fans has to be considered by contractor without any additional cost.
- 2.8 CONTRACTOR shall replace/repair burnout motor/ damage actuator/ damage fan blade within 48hours.
- 2.9 CONTRACTOR should check physical and working condition of fans once in 3 months and should take necessary actions, if finds any defects in the same.
- 2.10 CONTRACTOR should conduct dry run test of all lift well pressurization fans for 15 mins once in a six months. CONTRACTOR should specifically check these fans are automatically get operated based on signal received from fire

panel. CONTRACTOR should coordinate with instrumentation person to conduct the same.

5.0 Fire detection , alarm system ,access control and surveillance

- 2.1 Any damage breakage of any apparatus, equipment, sensors and system in general should not remain nonfunctional for more than two hour.
- 2.2 Essential spares to be available for immediate repair.

6.0 Roads and Parking Areas

Nature of Defect or Deficiency		Time Limit For Repair/Rectification
(a) Carriageway and Paved Areas		
(i)	Any cracks in road surface	15 (fifteen) days
(ii)	Any depressions, rutting exceeding 10 mm in road surface	30 (thirty) days
(iii)	Bleeding/skidding	7 (seven) days
(iv)	Any other defect/distress on the road	15 (fifteen) days
(v)	Damage to pavement edges	15 (fifteen) days
(iv)	Removal of debris, dead animals	6 hours
(b) Earthen Shoulders, Side Slopes, Drains and Culverts		
(i)	Variation by more than 1 % in the prescribed slope of camber/cross fall (shall not be less than the camber on the main carriageway)	7 (seven) days
(ii)	Edge drop at shoulders exceeding 40 mm	7 (seven) days
(iii)	Variation by more than 15% in the prescribed side (embankment) slopes	30 (thirty) days
(iv)	Rain cuts/gullies in slope	7 (seven) days
(v)	Damage to or silting of culverts and side drains	7 (seven) days
(vi)	De-silting of drains	24 hours
(vii)	Railing, parapets, crash barriers	7 (seven) days (Restore immediately if causing safety hazard)
(c) Road Lighting		
(i)	Any major failure of the system	24 hours
(ii)	Faults and minor failures	8 hours
(d) Trees and Plantation		
(i)	Obstruction in a minimum head-room of 5 m above carriageway or obstruction in visibility of road signs	24 hours
(ii)	Removal of fallen trees from	4 hours

Nature of Defect or Deficiency		Time Limit For Repair/Rectification
	carriageway	
(iii)	Deterioration in health of trees and bushes	Timely watering and treatment
(iv)	Trees and bushes requiring replacement	30 (thirty) days
(v)	Removal of vegetation affecting sight line and road structures	15 (fifteen) days
(e) Other Project Facilities and Approach Roads		
(i)	Damage in approach roads and pedestrian facilities	15 (fifteen) days

7.0 Sewage Treatment Plant (STP)

4.1 Details for maintenance to be carried out:

4.1.1 The plant should not remain nonfunctional for more than two hours in a month.

4.1.2 Any leakage in pipelines shall be restored within 2 hrs.

8.0 Solid Waste Management (SWM)

5.1 The bins should not be allowed to overflow at any point of time and should be emptied irrespective of pre-determined frequency of lifting the bins.

5.2 OWC maintenance should be backed by proper plan so that the organic waste does not get accumulated for more than six hours.

4.14 If the contractor fails to rectify defects / deficiency within time stipulated in schedule e, the employer is entitled for reduction in payment for non compliance to the maintenance requirement. The reduction in payment shall be done against operation and maintenance payments of the contractor.

CHAPTER 5. APPLICABLE PERMITS

The Contractor shall obtain, as required under the Applicable Laws, the following Applicable Permits:

- a) License from inspector of factories or other competent Authority for setting up batching plant;
- b) Clearance of Pollution Control Board for setting up batching plant;
- c) Any other permits, clearances or approvals required under Applicable Laws.

Applicable permits, as required, relating to environmental protection and conservation shall have been procured by the EMPLOYER in accordance with the provisions of this Agreement.

5.1 Architecture

- Commencement Certificate, Intermediate Certificates, Occupancy Certificate and Completion Certificate from local municipal body or designated authority for the buildings.
- Town Planning Department remarks for applicable norms / zones / uses.

5.2 Civil & Structures

- Forest department Clearance for clearing of site of trees and shrubs if required.
- Water Connection from Public Health Engineering Department (State).
- Provision and permit for connection to proposed municipal sewage collection system at directed location from local municipal body.
- Project Clearance from General Inspectorate for Emergency Situations.
- Project Clearance from the Solid Waste Management Authority.

5.3 Electrical

The Contractor shall obtain, as required under the Applicable Laws, the following Applicable Permits:

- (a) Liasoning and approval from State Electricity Board / DISCOM to complete the work.
- (b) Any other permits, clearances or approvals required under Applicable Laws.
- (c) License:- It is mandatory to obtain the licenses to install, operate and maintain the lifts from Lift Inspector (P.W.D.) Government of Madhya

Pradesh, by paying necessary government charges. The rates quoted shall be inclusive of this.

5.4 Fire Fighting

- Preliminary approval from Chief Fire Officer prior to construction and final approval on completion of project.

5.5 FDA Access Control & Security

- Fire Detection & Alarm System - Compliance with IS:2189:1988, BIS: 15908 standards and certification from the Regional Fire Officer / Chief Fire Officer.

5.6 STP

- State Pollution Control Board approval for STP.
- If any hazardous waste is generated from the facility like used DG oil, used batteries etc., the same should be handed over to only SPCB approved agencies for handling hazardous waste.

5.7 Solid Waste Management

Permit from the Municipal Corporation for disposal of inert in the land fill site.

CHAPTER 6. list of drawings

Sr. No.	Discipline	Drawing Number	Name of Drawing	Size
1	Architecture	TCE.10339A-AC-1012-AC-10101	Master Plan	A0
		TCE.10339A-AC-1012-AC-10101	Plot – 22 & 23 – Lower Ground Floor Plan	A0
		TCE.10339A-AC-1012-AC-10102	Plot – 22 & 23 – Upper Ground Floor Plan	A0
		TCE.10339A-AC-1012-AC-10103	Plot – 22 & 23 – Typical Floor Plan	A0
		TCE.10339A-AC-1012-AC-10104	Plot – 22 & 23 – Terrace Floor Plan	A0
		TCE.10339A-AC-1012-AC-10105	Plot – 22 & 23 – Site Sections	A0
		TCE.10339A-AC-1012-AC-10003	Plot – 22 – “F” Type unit Plan Sheet (1 of 2)	A1
		TCE.10339A-AC-1012-AC-10003	Plot – 22 – “F” Type unit Plan Sheet (2 of 2)	A1
		TCE.10339A-AC-1012-AC-10108	Plot – 22 – Section & Elevation (F Type)	A1
		TCE.10339A-AC-1012-AC-10109	Plot – 23 – “G” Type unit Plan	A1
		TCE.10339A-AC-1012-AC-10006	Plot – 23 – Section & Elevation (G Type)	A1
		TCE.10339A-AC-1012-AC-10111	Plot – 22 & 23 – Typical Details (1 of 2)	A1
		TCE.10339A-AC-1012-AC-	Plot – 22 & 23 – Typical Details (2 of 2)	A1

Sr. No.	Discipline	Drawing Number	Name of Drawing	Size
		10112		
		TCE.10339A-AC-1012-AC-10113	Plot – 22 & 23 – Door & Window Detail	A1
2	Landscape	TCE.10339A-AC-1018-LP-10010	Plot 22 – Landscape Plan	A1
		TCE.10339A-AC-1018-LP-10011	Plot 23 – Landscape Plan	A1
3.	Civil/Structure	TCE.10339A-CV-3000-RC-32001	Structural GA of Typical Floor for Cluster - 22	A0
		TCE.10339A-CV-3000-RC-32002	Structural GA of Upper Floor for Cluster - 22	A0
		TCE.10339A-CV-3000-RC-32003	Structural GA of Typical Floor for Cluster - 23	A0
		TCE.10339A-CV-3000-RC-32004	Structural GA of Upper Ground Floor for Cluster - 23	A0
4.	Electrical	TCE.10339A-EL-4002-AU-40002	Schematic SLD for Bhopal Smart City for plot No-22 Sheet (1 of 4)	A0
		TCE.10339A-EL-4002-AU-40002	Schematic SLD for Bhopal Smart City for plot No-22 Sheet (2 of 4)	A0

Sr. No.	Discipline	Drawing Number	Name of Drawing	Size
			4)	
		TCE.10339A-EL-4002-AU-40002	Schematic SLD for Bhopal Smart City for plot No-22 Sheet (3 of 4)	A0
		TCE.10339A-EL-4002-AU-40002	Schematic SLD for Bhopal Smart City for plot No-22 Sheet (4 of 4)	A0
		TCE.10339A-EL-4026-GL-40015	Lighting and power Layout typical floor-4 Unit Cluster for Type-F Plot No-22 Sheet (1 of 2)	A1
		TCE.10339A-EL-4026-GL-40015	Lighting and power Layout typical floor-4 Unit Cluster for Type-F Plot No-22 Sheet (2 of 2)	A1
		TCE.10339A-EL-4002-GA-40010	Metering room Equipment layout for Plot No-22	A0
		TCE.10339A-EL-4027-CT-40020	Cable Tray layout for Lower Ground Floor of Plot No-22	A0
		TCE.10339A-EL-4027-CT-40025	Cable Tray layout for Upper Ground Floor of Plot No-22	A0
		TCE.10339A-EL-4002-GL-40020	Lighting and Receptacle Layout for Lower ground floor of Plot No-22	A0
		TCE.10339A-EL-4002-GL-40023	Lighting and Receptacle Layout for Upper ground floor of Plot No-22	A0
		TCE.10339A-EL-4027-CT-40030	Lighting protection and Earthing Layout for Plot no-22	A0
		TCE.10339A-EL-4002-AU-40001	Schematic SLD for Bhopal Smart City for plot No-23 Sheet (1 of 4)	A0

Sr. No.	Discipline	Drawing Number	Name of Drawing	Size
		TCE.10339A-EL-4002-AU-40001	Schematic SLD for Bhopal Smart City for plot No-23 Sheet (2 of 4)	A0
		TCE.10339A-EL-4002-AU-40001	Schematic SLD for Bhopal Smart City for plot No-23 Sheet (3 of 4)	A0
		TCE.10339A-EL-4002-AU-40001	Schematic SLD for Bhopal Smart City for plot No-23 Sheet (4 of 4)	A0
		TCE.10339A-EL-4026-GL-40011	Lighting and power Layout typical floor-4 Unit Cluster for Type-G Plot No-23 Sheet (1 of 2)	A1
		TCE.10339A-EL-4026-GL-40011	Lighting and power Layout typical floor-4 Unit Cluster for Type-G Plot No-23 Sheet (2 of 2)	A1
		TCE.10339A-EL-4002-GA-40011	Metering room Equipment layout for Plot No-23	A0
		TCE.10339A-EL-4027-CT-40016	Cable Tray layout for Lower Ground Floor of Plot No-23	A0
		TCE.10339A-EL-4027-CT-40018	Cable Tray layout for Upper Ground Floor of Plot No-23	A0
		TCE.10339A-EL-4002-GL-40021	Lighting and Receptacle Layout for Lower ground floor of Plot No-23	A0
		TCE.10339A-EL-4002-GL-40024	Lighting and Receptacle Layout for Upper ground floor of Plot No-23	A0
		TCE.10339A-EL-4027-CT-40031	Lighting protection and Earthing Layout for Plot no-23	A0
		TCE.10339A-EL-4002-GA-40004	Equipment Layout for Substation of plot No-23 & 23	A1

Sr. No.	Discipline	Drawing Number	Name of Drawing	Size
		TCE.10339A-EL-4027-CT-40005	Cable Trench, Earthing and Lightning protection layout for Substation of plot No- 22 & 23	A1
		TCE.10339A-EL-4026-GL-40007	Lighting and Receptacle layout for Substation of Plot 22 & 23	A1
5	Ventilation	TCE.10339A-ME-6054-HV-60101	HVAC Ventilation Layout-Plot 22 Lower Ground Floor Plan	A1
		TCE.10339A-ME-6054-HV-60106	HVAC Ventilation Layout-Plot 22 Overall Upper Floor Plan	A1
		TCE.10339A-ME-6054-HV-60107	Lift Well Pressurization Layout - Plot 22 Terrace Floor Plan	A1
		TCE.10339A-ME-6054-HV-60109	HVAC Ventilation Layout-Plot 23 Overall Lower Ground Floor Plan	A1
		TCE.10339A-ME-6054-HV-60108	HVAC Ventilation Layout-Plot 22 Overall Podium Plan	A1
		TCE.10339A-ME-6054-HV-60115	Lift Well Pressurization Layout - Plot 23 Terrace Floor Plan	A1
6	Fire Fighting	TCE-10339A-ME-6041-FF-60006	Lower Ground Floor Fire Protection Layout	A0
		TCE-10339A-ME-6041-FF-60007	Upper Ground Floor Fire Protection Layout	A0

Sr. No.	Discipline	Drawing Number	Name of Drawing	Size
		TCE-10339A-ME-6041-FF-60008	Typical Floor Fire Protection Layout	A0
		TCE.10339A-ME-6041-FF-60009	Terrace Floor Fire Protection Layout	A0
		TCE-10339A-ME-6041-FF-60010	External Fire Hydrant Layout	A0
7	Plumbing	TCE.10339A-CV-3019-IP-60011	External Layout Services	A0
		TCE.10339A-CV-3019-SL-60012	Typical Manhole Details	A3
		TCE.10339A-CV-3019-SW-60013	Typical Details Of Recharge Pit	A3
		TCE.10339A-CV-3019-SL-60014	Typical Details Of House Connecting Chamber	A3
		TCE.10339A-CV-3019-WS-60015	Typical Valve Chamber Details	A3
8	ICT	TCE.10339A-5003-CC-50000	Configuration schematic drawing for FDA	A3
		TCE.10339A-5005-CC-51000	Configuration schematic drawing for CCTV	A3
		TCE.10339A-5002-CC-52000	Configuration schematic drawing for ACS	A3
		TCE.10339A-5009-CC-53000	Configuration schematic drawing for Video door phone	A3
		TCE.10339A-5009-CC-53001	Configuration schematic drawing for Fibre optic connectivity to GPON at each floor	A3
		TCE.10339A-5009-GA-54001	Layout drawing for Floor Level for FDA, CCTV, ACS, Video door phone& Fibre optic connectivity to GPON for Plot 22 & Plot 23	A0
		TCE.10339A-5009-GA-54002	Layout drawing for Lower ground floor for Plot 22 & Plot 23	A0
		TCE.10339A-5009-GA-54003	Layout drawing for Upper ground floor for Plot 22 & Plot 23	A0

Sr. No.	Discipline	Drawing Number	Name of Drawing	Size
9	Storm Water	TCE.10339A-3006-SL-33003	Typical Storm Water Network Appurtenances Details	A1
		TCE.10339A-3006-SL-33007	Typical Plan & Sectional Details of Storm Water Drain	A1
		TCE.10339A-3019-SW-31997	Bhopal Smart City Storm Water Network Layout For Plot No. 22 & 23	A0

CHAPTER 7. TESTS on completion

7.1 Civil & Structural

- Joints Inspection
- Water Proofing Test for sunken slabs of utility room, toilets, etc., drive way and parking slab, roof slabs, water tank walls, retaining wall.
- Non-destructive Testing of Building Envelope Systems Using Infrared Thermography.
- Hydrostatic checks for UGTs, OHTs , and all water retaining structures as per IS 3370.

7.2 electrical

7.2.1 Completion and Post Completion Activities

Mechanical completion is said to occur, when all erection/installation and commissioning of all electrical works and minor civil works under the scope of the Contractor are completed to the satisfaction of the Client's Representative with,

a) All installation alignment checks.

b) All panels and equipment erected, grouted, with all cabling and wiring, terminations, routing, clamping, dressing, tagging, ferruling duly completed including continuity and megger testing, and all installation checks.

At the stage of Mechanical completion, the Contractor shall ensure that all physical, aesthetic and workmanship aspects are totally completed, and the plant is fit and sound for undertaking pre-commissioning checks followed by commissioning.

Upon achieving mechanical completion, the Contractor shall notify the Client of such mechanical completion upon which the Client shall proceed with the checking of the works.

The Client may inform the Contractor regarding deficiencies for rectification by the Contractor within a jointly agreed period before the pre-commissioning checks could be undertaken. Alternately the Client, when the defects are of minor nature may undertake the pre-commissioning checks, permitting the Contractor to concurrently undertake rectification of such defects. Rectification of all defects, so notified by the Client, to his satisfaction shall be a prerequisite to issue of Taking Over Certificate.

7.2.2 Testing and Commissioning

The Contractor shall carry out commissioning tests in the presence of the Client's representative. The evaluation of test results and decision passed by the Client's representative regarding the test results will be final and binding on the Contractor. Any additional tests or repetition of tests to establish satisfactory operation of any equipment shall be carried out by the Contractor, if so desired by the Client's representative at no extra cost.

The completion checks and commissioning tests to be carried out shall include, but not be limited to, those described in subsequent paragraphs, as applicable to the individual equipment/system.

All checks and tests shall be as per the Manufacturer's drawing manuals, relevant codes of installation and commissioning checklists described in subsequent paragraphs.

Among other commissioning tests, the following shall be carried out at site after completion of installation. Contractor shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards / International Standards. All tests to be carried out in the presence of Client's representatives.

- a) Switchboard: Power frequency high voltage test, IR test, operation tests
- b) Relays: Check internal wiring, relay settings
- c) Cables
 - All new LT cables shall be megger tested before terminating / jointing. After terminations / joints shall be megger tested by 1000V megger.
 - All HT cables shall be megger tested before terminating / jointing. After terminations / joints shall be megger tested by 5000V megger.
 - Cable core shall be tested for
 - Continuity
 - Absence of cross phasing
 - Insulation resistance to earth
 - Insulation resistance between conductors

d) Earthing System

Continuity of all conductors and joints. The Client's representatives may ask for earth continuity tests, earth resistance measurements and other tests, which in his opinion are necessary, to prove that the system is in accordance with design, specification, code of practice and CEA Regulations 2010. Earth resistance value should be not greater than one (1) ohm.

e) Lighting System

Commissioning tests stipulated in applicable standards and code of practice covering all lighting system equipment

The Contractor shall carry out insulation resistance tests by a megger of following rating
Control circuits up to 220 V 500 V megger
Power circuits up to 1.1 kV 1000 V megger

In general, the following checks shall be carried out on all the equipment/systems, as applicable.

- a) Name plate details according to approved drawings/ specifications
- b) Any physical damage or defect and cleanliness
- c) Tightness of all bolts, clamps and connections
- d) Oil leakages and oil level
- e) Condition of accessories and their completeness
- f) Clearances
- g) Earthing connections
- h) Correctness of installation with respect to approved drawings/specifications
- i) Lubrication of moving parts
- j) Alignment
- k) Correctness and condition of connections

7.2.3 Commissioning Tests

The following commissioning tests are to be carried out on all the equipment/systems, as applicable and as desired by EMPLOYER/ STATUTORY requirements.

- a) Insulation resistance measurement of equipment, accessories, cabling/wiring etc.
- b) Dielectric tests on equipment, accessories, cabling/ wires etc.
- c) Phase sequence and polarity
- d) Voltage and current ratios
- e) Vector group
- f) Resistance measurement of winding, contacts etc.
- g) Continuity tests
- h) Calibration of indicators, meters, relays, etc.
- i) Control and interlock checks
- j) Settings of equipment and accessories
- k) Checking of accuracy/error
- l) Checking of operating characteristics, pick-up voltages and currents, etc.
- m) Operational and functional tests on equipment, accessories, control schemes, alarm/trip/indication circuits, etc.
- n) Operational Checks for all the equipments for Auto and Manual mode through SCADA interface.
- o) Measurement of guaranteed/approved design values including lighting levels, earth resistance measurement, etc.
- p) Complete commissioning checks of the system

7.2.4 Specific Tests to be carried out Equipments are as follows;

7.2.4.1 *Control Circuit*

- a) Operational test of control circuits to be tested as per schematic drawing.
- b) Indications/Alarm/Annunciation circuit to be tested as per control schematic drawing.
- c) Check for panel space heater and illumination circuits.

7.2.4.2 *LT Switchgear Panels*

- a) Check of electrical wiring.
- b) IR Values of power circuits & control circuits
- c) Tests on auxiliary and control circuits.
- d) Check of electrical operation of safety (interlocking, automatic changeover, Remote closing / Tripping circuits etc...).
- e) Check of mechanical operations (insertion and withdrawal of removable parts, locks and interlocks system, operation of safety shutters, charging - closing - tripping of breaker etc..).
- f) Check of setting of all protective and measurement devices (e.g. protection relays, smart devices, Secondary injection testing of protective relays/releases, Trip circuit healthiness and tripping through relays/ release etc...).

- g) Indication / Annunciation / Panel space heater circuit / Space contacts for customer use
- h) CT testing for polarity, ratio, IR values and magnetization for class PS characteristics
- i) PT testing for ratio, IR values
- j) Testing of modules for DOL/ Star-Delta/ATS/ Soft Starter starting or any other starting method as per the schematic drawings applicable.

7.2.4.3 *LV power cable, control cable & cable accessories*

- a) IR Values before Hipot
- b) Hi Pot test for MV & HV cables.
- c) IR Values after Hipot

7.2.4.4 *Induction Motor*

- a) Measurement of insulation resistance on motor windings, built-in RTDs, anti-condensation heaters and bearing insulation, if any.
- b) Tests on auxiliary and control circuits-Interlocks and simulation tests Auto/ Manual and local / remote operations
- c) Bump start to check direction of rotation to match with driven equipment. Bump start shall be performed with motors uncoupled to prevent damage to equipment by reverse operation.

7.2.4.5 *Earthing System*

- a) Earthing resistance of each electrode
- b) Earth continuity check.
- c) Overall resistance of earthing installation.

7.2.4.6 *Lighting system*

- a) Check of electrical wiring.
- b) Functional tests.
- c) Lux level measurement for each plant area.

7.3 ICT

- a) **CCTV, Access Control & Surveillance:** Visual and physical test for Security systems including access control card readers and cards, CCTV cameras, monitors, recording and retrieval system, Visitor management system, operating software & hardware, etc., including performance verification.
- b) **FDAS:** Visual and physical test for Fire Alarm sensors / detectors, alarms / hooters, etc., including performance verification.

- c) **Entry Gates and Boom Barriers:** Visual and physical check for Boom Barriers, Automated Entry gate operations including performance verification for sensors, remote and manual controls, etc.
- d) Commissioning of Project equipments.
- e) Network integration testing
- f) Software testing
- g) Hardware and Software integration test run
- h) Full load testing/ Stress Testing

7.4 STP

- All equipment and components of the STP shall be tested for the performance as per the duty points and specifications.
- Also the untreated and treated wastewater quality shall be tested at various stages for polluting parameters to ascertain that the STP meets the stage-wise and overall desired treatment requirements.
- Provision of test reports at the frequency of twice a month for the 6 consecutive months after commissioning. Water quality of the incoming wastewater and outgoing treated water shall be included. Parameters shall be analyzed shall include pH, odour, colour, BOD, COD, TSS, E.Coli Count and total Residual Chlorines.
- The Contractor and consultant shall prepare a schedule of such stage-wise testing.
- The Contractor shall maintain a record of all such testing carried out duly signed by Contractor, Employer and consultant.
- Performance Run of the constructed & hydraulically tested plant along with O & M of electrical & mechanical equipment for a period of Three (3) months and operation & maintenance for 120 months after performance run as per tender specifications including providing and installing all units, labour, tools and plants all complete on turnkey basis
- Defects liability period of 24 months from the date of successful Testing, Commissioning & Performance Run of STP.

7.5 SWM

- All equipment and components of the Automated Solid Waste Collection system shall be tested for the performance as per the duty points and specifications.
- Performance Run along with O & M of equipment for a period of twelve (12) months and operation & maintenance for 60 months after performance run as per tender specifications including providing and installing all units, labour and necessary tools all complete on turnkey basis
- Defects liability period of 24 months from the date of successful completion of O & M period.

CHAPTER 8. design basis report

8.1 civil/struture

SCOPE1

This Structural Design Basis is intended to provide general guidelines for the structural design, selection of materials, and preparation of engineering specifications and drawings for buildings in Plot No. 22, 23.

This report will form the design criteria and basis for methods of analysis and design to be adopted in this building, with the aim of achieving a design that satisfies all strength and serviceability requirements under all types of loadings. The document also records all inputs assumed in the design and will form the basis for all future detailed structural work. This Report will include following-

INPUT

ARCHITECTURAL

Buildings shall be designed as per architectural drawings

GEOTECHNICAL

Please refer relevant soil investigation report (attached as annexure with this report)

SOIL INVESTIGATION AND FOUNDATION RECOMMENDATIONS

FOUNDATION SYSTEMS

Raft foundation is recommended for this building. Foundation system can be revised to isolated Footing after confirmation of strata on site.

DESIGN CRITERIAS FOR FOUNDATION SYSTEM

Assumed allowable (design) Bearing Capacity of soil is 27.0 T/m^2 i.e. 270 kN/m^2 at basement level below the ground as per available adjacent site soil investigation report. Coefficient of friction between concrete and soil strata ranges between 0.55 to 0.60 (Ref: NAVFAC DM 7.2, table 1, pg. 7.2-63).

Modulus of sub-grade reaction can be considered as 10800 kN/m^3 . ground water table is considered far below raft level.

CODES, STANDARDS AND SPECIFICATIONS

The design shall comply with the latest editions and revisions of the codes, specifications, and standards listed below:

❖	NBC	:	National Building Code of India.
❖	IS: 875 (Part 1)	:	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Dead Loads).
❖	IS: 875 (Part 2)	:	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Imposed Loads).

Please note that, information provided in this report is subject to revisions, based on final geotechnical report

❖	IS: 875 (Part 3)	:	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Wind Loads).
❖	IS: 875 (Part 5)	:	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures (Special Loads and Combinations).
❖	IS: 1893 (Part 1)	:	Criteria for Earthquake Resistant Design of Structures (Part 1 – General Provisions and Buildings).
❖	IS: 1893 (Part 2)	:	Criteria for Earthquake Resistant Design of Structures (Part 2 – Liquid retaining tanks – Elevated and ground supported).
❖	IS: 1893 (Part 3)	:	Criteria for Earthquake Resistant Design of Structures (Part 3 – Bridges and retaining walls).
❖	IS: 1893 (Part 4)	:	Criteria for Earthquake Resistant Design of Structures (Part 4 – Industrial Structures including Stack-Like Structures).
❖	IBC	:	International Building Code.
❖	IS 3414	:	Code of practice for design and installation of joints in buildings

REINFORCED CEMENT CONCRETE

- ❖ IS: 432 : Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
- ❖ IS: 456 : Plain and Reinforced Concrete – Code of Practice.
- ❖ IS: 1786 : High strength deformed steel bars and wires for concrete reinforcement.
- ❖ IS: 2502 : Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement.
- ❖ IS: 4326 : Code of practice for earthquake resistant design and construction of buildings.
- ❖ IS:13920 : Code of practice for ductile design and detailing of reinforced concrete structures subjected to seismic forces.
- ❖ IS: 1080 : Code of practice for design and construction of shallow foundations in soils (other than raft, ring and shell).
- ❖ IS: 1904 : Code of practice for design and construction of foundations in soils: General requirements.
- ❖ IS: 2911: : Code of Practice for Design and Construction of Pile Foundation.
(Part 1 to 4)
- ❖ IS: 2950 (Part : Code of practice for design & construction of raft Foundations.
1)
- ❖ IS: 2974 : Code of Practice for Design and Construction of Machine Foundations.
(Part 1 & 2)
- ❖ IS: 3370 : Concrete structures for the storage of liquids - Code of Practice.
(Part 1 to 4)

- ❖ IS: 5249 : Determination of dynamic properties of soil, method of test.
- ❖ IS: 8009 : Code of practice for calculation of settlements of foundations.
- ❖ IS: 3414 : Code Of Practice For Joints In The Buildings.
- ❖ SP: 16 : Design Aids for Reinforced Concrete to IS 456: 1978.
- ❖ SP: 24 : Explanatory Hand Book on Indian Standard Code of Practice for Plain and Reinforced Concrete (IS 456: 1978).
- ❖ SP: 34 : Hand Book of Concrete Reinforcement and Detailing.
- ❖ SP: 20 (S & T) : Explanatory Hand Book on Masonry Design and Construction.
- ❖ BS 8110 : : Plain and reinforced concrete - Code of practice British standard
- ❖ ACI 318-2011 : Plain and reinforced concrete - Code of practice American standard
- ❖ CP65 : Plain and reinforced concrete - Code of practice Singapore standard

STRUCTURAL STEEL

- ❖ IS: 800 : Code of Practice for General Construction in Steel.
- ❖ IS: 811 : Cold formed light gauge structural steel sections.
- ❖ IS: 814 : Covered electrodes for manual metal arc welding of carbon and carbon manganese steel.
- ❖ IS: 816 : Code of Practice for Use of metal arc welding for general construction in mild steel.
- ❖ SP: 6 : Handbook for Structural Engineers.
- ❖ IS: 1977 (Part 1 to 7) : Low Tensile Structural Steels – Specification.
- ❖ IS: 2062 : Hot Rolled low, medium and high tensile structural steel.
- ❖ IS: 1363 : Hexagonal head bolts, screws & nuts of product Grade C.
- ❖ IS: 2016 : Plain washers.
- ❖ IS: 3138 : Hexagonal bolts and nuts (M42 to M150).
- ❖ IS: 3502 : Steel chequered plates.

COMPUTER PROGRAMS

Following computer programs are used for preliminary analysis and design.

- ETABS: This is commercial general-purpose analysis and design package acceptable internationally. It supports design of concrete and steel structures by Indian as well as other International codes. Analysis capabilities include wind and seismic analysis.
- SAFE: For Foundation design.
- In-house developed spread sheets in MS-Excel etc.

MATERIAL, WORKMANSHIP AND DESIGN CRITERIA

The proposed structure will consist of concrete and Steel reinforcement as main materials used for construction of the structures.

STRUCTURAL DESIGN OF RCC ELEMENTS

The design aims to achieve an acceptable probability that structures being designed will perform satisfactorily during their intended life. With an appropriate degree of safety, they should sustain all the loads and deformations of normal construction and use and have adequate durability and resistance to the effects of earthquake, wind as well as misuse and fire. Structures and structural elements will be designed by Limit State Method. Due consideration will be given to the accepted theories, experience and modern design philosophy and practices.

CONCRETE

a) Cement

Generally Ordinary Portland cement (OPC) conforming to IS: 8112 or Portland pozzolana cement conforming to IS: 1489 shall be used for superstructure.

b) Reinforced Cement Concrete (RCC)

Reinforced concrete conforming to Table 2; IS 456-2000 shall be used with 20mm and down size graded crushed stone aggregate unless noted otherwise. recommended Minimum grade of reinforced cement concrete shall be M30 considering high rise structure for superstructures and substructures. Recommended grades for the different members are as follows:

- | | |
|---------------------------|-----|
| • Beams and Slabs | M30 |
| • Columns and Shear walls | M30 |
| • Footings & Raft | M30 |
| • Water Tanks | M30 |
| • Retaining Walls | M30 |

The contractor has to submit the detailed methodology including quality control measures for the manufacture and supply of concrete to the project site and take prior approval of the client before proceeding.

c) Lean Concrete

Concrete of minimum 100 mm thickness of lean concrete mix 1: 2 :4 (by weight, using 20mm and down size grade crushed stone aggregate) shall be provided under all RCC foundations.

REINFORCEMENT BARS

- a) High Strength Deformed Thermo mechanically treated (TMT) Steel bars of grade Fe 500D, conforming to IS: 1786 with minimum elongation of 14.5% and of approved make listed in the tender document shall be used.
- b) No re-rolled reinforcement bars shall be used.
- c) Mechanical couplers for laps of bars higher than 32 mm diameter shall be done as per IS 16172.

Min. Reinforcement steel

As per Indian standard code provisions, min & max. reinforcement to be provided as below:

1. Footing : Min. 0.12 % of total cross section area IS 456 : 2000
2. Column : Min. 0.8 % & max 4 % of gross sectional area IS 456 : 2000
3. Beam : Min. $0.24 \sqrt{f_{ck}}/f_y$ % or 0.85 f_y % Of efficient cross sectional area
whichever is high. Max 4 % of cross sectional area IS 13920 :2016 & IS 456 :2000
4. Slab : 0.12 % of total cross sectional area IS 456 :2000
5. Shear wall : Minimum reinforcement as per IS 13920-2016

- a) Squat walls: $h_w / L_w < 1$,
- b) Intermediate walls: $1 \leq h_w / L_w \leq 2$, and
- c) Slender walls: $h_w / L_w > 2$.

Sl. No.	Type of Wall	Reinforcement Details
i)	Squat walls	$(\rho_h)_{\min} = 0.0025$ $(\rho_v)_{\min} = 0.0025 + 0.5 \left(1 - \frac{h_w}{t_w}\right) (\rho_h - 0.0025)$ $(\rho_{v,\text{net}}) = (\rho_{v,\text{web}}) + \left(\frac{t_w}{L_w}\right) \cdot [0.02 - 2.5(\rho_{v,\text{web}})]$ $(\rho_v)_{\text{provided}} < (\rho_h)_{\text{provided}}$
ii)	Intermediate walls	$(\rho_h)_{\min} = 0.0025$ $(\rho_{v,\text{be}})_{\min} = 0.0080$ $(\rho_{v,\text{web}})_{\min} = 0.0025$ $(\rho_{v,\text{net}})_{\min} = 0.0025 + 0.01375 \left(\frac{t_w}{L_w}\right)$
iii)	Slender walls	$(\rho_h)_{\min} = 0.0025 + 0.5 \left(\frac{h_w}{L_w} - 2\right) (\rho_h - 0.0025)$ $(\rho_{v,\text{be}})_{\min} = 0.0080$ $(\rho_{v,\text{web}})_{\min} = 0.0025$ $(\rho_{v,\text{net}})_{\min} = 0.0025 + 0.01375 \left(\frac{t_w}{L_w}\right)$

6. Retaining wall : 0.12 % of total cross sectional area in each direction

7. Water retaining structures : IS 3370 :2009

For tanks any dimension not exceeds 15m: 0.24 % of surface zone in each direction

For tanks with any dimension more than 15m: 0.35 % of surface zone in each direction

AGGREGATES

Selected aggregates of proper sizes shall conform to IS: 383.

DURABILITY OF CONCRETE

Minimum recommended Grade of Concrete for structural elements for exposed surface conditions is M30. Nominal covers shall not be less than 40 mm from durability point of view. This is applicable for all RCC elements exposed to environment. For the RCC elements sheltered within the façade envelope, the nominal covers shall not be less than 30 mm from durability point of view. Fire resistance period of all building is minimum 2 hours.

The minimum clear cover for various structural elements is to be as follows,

Table 8-1 Minimum Clear cover for various structural elements

1	Slab	(simply supported)	:	35mm
		(continuous)	:	25mm
2	Beams (Roof & floor)	(simply supported)	:	40mm
		(continuous)	:	30mm
3	Tie beam	Tie beam	:	40mm
4	Columns/Pedestals	(Main R/F)	:	40mm
5	Foundation	(Bottom)	:	50mm
		(Top and Side)	:	50mm

6	RCC wall	RCC wall	:	40mm
7	Water retaining structures		:	50mm

RCC LINTEL

RCC lintel and sill band shall be provided for all masonry in continuous length.

MINIMUM / MAXIMUM THICKNESS OF STRUCTURAL CONCRETE ELEMENTS

- Beam width 200 mm / 750 mm.
- Floor slabs, Roof slabs 125 mm / 300 mm.
- Columns 300 mm / 900 mm.
- Wall thickness (0.4% p 1.0%) 160 mm / 300 mm.

The following minimum / maximum thickness shall also be followed:

- Ground floor slab (non-suspended) 125mm / 300 mm.
- Footings (All types including raft foundations) 300 mm /as required.
- Liquid retaining structures 200 mm / 400 mm.
- Basement walls 200 mm / 400 mm.
- Parapets, Chajjas 125 mm / 200 mm.
- Cable/ Pipe trenches, under-ground pit 125 mm / 250 mm.
- Precast Trench Cover/ Floor Slab 100 mm / 250 mm.

CONSTRUCTION JOINT

Construction joints and shrinkage strips to be planned by the contractor, at design stage (as per IS code: 3414) itself and only be used in locations pre-approved by consultants. All construction joints of water retaining structures in RCC shall be made water tight using approved make water stops. Water stops shall be provided in all construction joints below ground level in addition to any joint which may be detailed on the drawing.

EXPANSION JOINT

To relieve the structure from temperature stresses, expansion joints are provided at several locations as per the requirements. As per BIS code requirement expansion joints are proposed if the length of the structure exceeds 45m. Depending upon geometry of building and for lateral load resisting system expansion joint may be at a distance larger than that recommended by IS codes. Gap for the expansion / separation joint shall be provided as per the provisions mentioned in IS 1893 part IV. The gap in between will be later filled by approved board & sealant with proper treatment. There shall be a dual column system with combined footing at the expansion joint locations.

PERMISSIBLE DEFLECTIONS

Permissible deflections shall be as per IS: 456 clause 23.2. Total deflection of various structural members shall be calculated as per ANNEX C of IS 456. Provisions of IS 1893 and IS 875 shall be followed for lateral deformations.

1. The final vertical deflection due to all loads including the effects of temperature, creep and shrinkage and measured from the as-cast level of the supports of floors, roofs and all other horizontal members should not normally exceed span/250.
2. The part deflection including the effects of temperature, creep and shrinkage should not normally exceed span/350 or 20 mm whichever is less.
3. Under wind load, the lateral sway at the top of building should not exceed height/500.

STOREY DRIFT

Storey Drift shall be check for not exceeding 0.004 times the storey height as per IS 1893-2002 clause 7.11.

SOFT STOREY

Soft story effect shall be check as per IS 1893-2002 clause 7.10.

TORSION EFFECT

Resulting torsion effect due to eccentricity between centre of mass and centre of rigidity shall be considered in design as per IS 1893-2002 clause 7.9

FACTOR OF SAFETY

The factor of safety against overturning and sliding and flotation shall be as follows:

- | | | |
|------------------------|---|---|
| a) Against Overturning | : | 1.4 as per clause 20.1 IS 456:2000 |
| b) Against sliding | : | 1.4 as per clause 20.2 IS 456:2000 |
| c) Against flotation | : | 1.2 as per clause 7.2 IS 3370 (part-1):2009 |

CRACK WIDTH

Various structural members shall be designed for crack width mentioned as below as per clause no. 35.3.2, IS 456:2000 & clause no. 4.4.1.2, IS 3370(Part-2):2009.

- For structural members exposure to serve exposure condition = 0.1mm
- For water retaining structures = 0.2 mm
- For members exposed to soil or ground water = 0.2 mm
- All other structural members = 0.3 mm

DESIGN LOADS

The various structures/ buildings for this project shall be designed for the following loads and also effects due to shrinkage, creep, temperature, etc, where applicable.

DEAD LOAD

The dead loads are calculated on the basis of unit weights of materials given in IS: 875 (Part 1). The dead load considered in the structural design shall consist of the full weight of all known fixed structural and architectural elements. The weight of fixed service equipment excluding their contents such as heating, ventilating and air conditioning systems and the weight of all process equipment including all fixtures

(conduit, cable tray, ductwork, etc. permanently attached to the structure) and attached piping but excluding their contents shall be considered in dead load. The data provided by the project architect and other service consultants will be used for the specific materials/ equipments.

Unless otherwise specified; the unit weight of materials will be used as follows.

Reinforced concrete	25.00 kN/m ³
Plain concrete	24.00 kN/m ³
Light weight concrete	12.00 kN/m ³
Concrete block work	18.00 kN/m ³
Brickwork	20.00 kN/m ³
Autoclaved Aerated Concrete Blocks	8.00 kN/m ³
Stone cladding	25.00 kN/m ³
Floor finishes	20.00 kN/m ³
Glass	23.50 kN/m ³
Structural steel	78.50 kN/m ³
Water	09.81 kN/m ³
Dry Soil	16.00 kN/m ³
Saturated Soil (Garden load with roots)	21.00 kN/m ³

Typical dead loads considered in the design are as follows:

Self weight of slabs, beams, columns & walls - As per sectional sizes of the members.

Additional dead loads

floor finishes at Typical floors -1.5 kN/m²

Water Proofing at Terrace (BBC waterproofing) -3.0 kN/m²

The effects due to provision of sunken slabs in kitchens and toilets and terrace gardens shall be considered as per Architectural or MEP drawings.

LIVE LOAD

All the live loads shall be as per IS: 875 (Part 2). In general, following loads reproduced from the code by the use/ occupancy of a building or structure shall be the minimum considered in the designs.

Table 8-2 Live Load Details

Loading Area	Load Intensity (KN/m ²)
All Rooms, Kitchen	2.00
Balconies, Corridors, passages, lobbies and staircases including fire escapes – as per the floor serviced (excluding stores)	3.00
Toilets and Bath Rooms	2.00
Accessible Roof	1.50

Loading Area	Load Intensity (KN/m ²)
Inaccessible Roof	0.75
Terrace Roof Slab (with Solar Panel)	3.00
Multipurpose Hall, Club House	5.00
Storage Area	5.00
Play area, Paved Area, Landscape/Lawn	5.00
Pantry	3.00
Lobby, Footpath, Utility Area	5.00
Swimming Pool Area	5.00
Car Parking Area/Ramp	5.00
Drive ways of Podium level	15.00
Planter Area	5.00
Electrical Meter room	5.00
Mechanical room	5.00
Pump house	5.00
DG room	10.00

In addition to the live/imposed loads specified above, loads by dynamic effect of machinery shall be considered. The loads due to the machinery and equipment shall be as specified by the manufacturer and if it exceeds to above then actual loads shall be considered. Resonant conditions shall be avoided by suitably proportioning the supporting structural members.

WIND LOAD (WL)

All buildings and structures shall be designed to withstand the forces of wind pressure, assumed in any horizontal direction with no allowance for the effect of shielding by other adjacent structures, in accordance with the appropriate provisions of IS: 875 (Part 3).

Basic Wind speed for Bhopal: $V_b = 39$ m/se
c

Design Wind Speed at any height : $V_z = K_1 K_2 K_3 V_b$ m/se c Clause 5.3

Where; K_1 = Probability factor = 1.0

K_2 = Terrain height & structure size factor

For Category 1 and Class of structures - Class C, Values of Table 2 of IS: 875-Part 3 to be referred.

K_3 = Topography factor = 1.0

Design Wind Pressure at any height : $P_z = 0.6 \times V_z^2$ N/m² Clause 5.4

Based on the above wind pressure and exposure of the building, further load calculations will be carried out with respect to profile of building as per IS: 875 (Part 3).

SEISMIC LOAD (SL)

All buildings, structures, foundations shall be designed to resist the effects of earthquakes in accordance with IS: 1893 - Criteria for Earthquake Resistant Design of Structures for Design Basis Earthquake. The structure is primarily column/ shear wall and beam framing system and since due considerations will be given to the major suggestions/ clauses from IS: 13920. The frames are to be designed to carry lateral loads but do not fulfill the requirements of 'dual systems' as per Table 7.

SEISMIC PARAMETERS

Seismic design forces shall be determined based upon the following parameters. Buildings of different materials of construction and lateral force resisting systems shall be investigated separately.

Table 8-3 Seismic Parameters

Item	Value	Reference
Seismic Zone:	Zone – II	Fig.1 - Map Showing Seismic Zones of India. (IS 1893 – Part 1)
Zone Factor (z):	0.1 (Low)	Table 2 (IS 1893-Part 1)
Importance Factor (I):	1.0	Table 6 (IS 1893-Part 1)
Response Reduction Factor (R):	4.0	Table 7 (IS 1893-Part 1) CL.No.6.4.2
Fundamental Natural Period (T _a)	$T_a = \frac{0.09}{\sqrt{d}}$	Clause No: 7.6.2 – IS: 1893 (Part 1).
Average Response Acceleration Coefficient (S _a /g): For Rocky or Hard soil	$\frac{1+15T}{25}$ 0.00 T 0.10 0.10 T 0.40 1.00 / T 0.40 T 4.00	Fig. 2 Response Spectra for Rock & Soil Sites for 5 percent damping.
Damping	0.05 for RCC Structure	Clause No: 7.8.2.1 –

Item	Value	Reference
Coefficient	0.02 for Steel Structure	IS: 1893 (Part 1).
Design Spectrum The design horizontal seismic coefficient (A_h)	$\frac{Z I S_a}{2 R g}$	Clause No: 6.4.2 – IS: 1893 (Part 1).
Design Seismic Base shear	$V_B = A_h W$	Clause No: 7.5.3 – IS: 1893 (Part 1).

Contribution of permanent dead loads and live loads as specified in IS: 1893 (Part 1); Clause No: 7.3 shall be considered while calculating nodal masses. Live load on the roof shall not be accounted in the calculation of nodal masses.

SEISMIC WEIGHT CALCULATION

The seismic weight of building includes all permanent rigidly attached structural and non-structural components of a building, such as walls, floors, roofs, total weight of permanent equipment etc. The contribution of live load to be considered in the seismic weight calculation shall be taken as per Clause 7.3.1 and as specified in Table – 8 of IS 1893 (Part 1).

PERMISSIBLE STRESSES

- a) Whenever seismic forces are considered along with other normal design forces, the permissible stresses in material shall be governed by the respective codes as per which the structure/ equipment is being designed.
- b) For the other provisions of the code Cl.No.6.3.5 of IS: 1893 (part-1) and Cl.No. 7.4 of IS: 1893 (Part-4) shall be followed.
- c) Earthquake loads shall not be considered to act simultaneously with wind.

METHOD OF SEISMIC DESIGN

- a) General

This document provides certain guidelines for the methods to be used for seismic analysis of structures/equipment.

- b) Method of Analysis

Dynamic Analysis by response spectrum method shall be used to analysis structures for earthquake forces. For all Structures recommendations as per IS: 1893 shall be followed.

DUCTILE DETAILING

The ductility details of reinforced concrete members shall be provided as per the provisions of IS: 13920 to avoid premature failure during earthquake.

IMPACT LOADS

- a) All structural framing and concrete foundations subject to vibration, impact, impulse, shock, etc., shall be designed to withstand the generated forces within the limits of acceptable stress, deflection, and/or amplitude of vibration.
- b) All structures supporting reciprocating equipment or rotating equipment with excessive imbalance shall be analyzed for both strength and response.
- c) All structures supporting moving or stationary equipment shall be designed for static loads plus an appropriate impact factor as defined by the equipment manufacturer, IS: 875, IS: 2974.

WHEEL LOAD

For any structure or pipeline below roads, IRC Class of loading for which the road has been actually designed will be considered.

SURCHARGE LOAD

Minimum surcharge of 10KN/m² and as per IRC whichever is higher shall be considered for design of all underground structures to take in to account the construction load and vehicular traffic in the vicinity of structure. The soil parameters and ground water table will be considered as per soil investigation report.

EARTH PRESSURE

Earth pressure for walls of basement/ tanks etc. with propped support condition will be calculated using coefficient of earth pressure at-rest. Earth pressure for cantilever walls like cable trenches will be calculated based on active earth pressure. Unit weight of soil shall be as per section 8.1. Other soil parameters such as cohesion and angle of internal friction shall be considered as per soil investigation report.

HYDROSTATIC PRESSURE

If envisaged, the ground water load shall be applied on the substructure as super imposed dead load in addition to the earth pressure. The dry density of soil shall be considered in this combination.

CONSTRUCTION LOADS

Loads produced by the materials of construction plus the equipment required to construct the facility (crane loads, rigging loads, earth moving equipment, etc.) as

applicable shall be considered. When the sequencing of construction will not permit the lateral force resisting system of the structure to be constructed first, the engineer shall make provisions for temporary lateral bracing and clearly identify these requirements on the design drawings and contract documents. The Contractor shall coordinate the sequence of building erection and the types and quantity of construction equipment to be used.

Any other loads like those of services; storage etc has to be obtained from time to time from the relevant consultants and is to be incorporated. The top slab of the lift shaft to be designed for lift loads as obtained from the manufacturer.

LOAD COMBINATIONS

Each element of a building or structure shall be provided with sufficient strength to resist the most critical effects resulting from the following combination of loads.

Load cases and load combination shall be as follow:

a) Static load cases

- 1) Dead load (DL)
- 2) Live load (LL)
- 3) Wind load in X direction (WLX)
- 4) Wind load in Y direction (WLY)
- 5) Seismic load (Spectra) in X-direction (EQX)
- 6) Seismic load (Spectra) in Y-direction (EQY)

(X and Y directions are mutually orthogonal in plan area, to define the direction of seismic forces with reference to building)

b) Load Combinations

The following Load Combinations have been considered for the analysis.

- 1) 1.5 DL
- 2) 1.5 (DL+ LL)
- 3) 1.2 (DL +LL+ WLX)
- 4) 1.2 (DL + LL – WLX)
- 5) 1.2 (DL + LL + WLY)
- 6) 1.2 (DL + LL – WLY)
- 7) 1.5 (DL + WLX)
- 8) 1.5 (DL – WLX)
- 9) 1.5 (DL + WLY)
- 10) 1.5 (DL – WLY)
- 11) 0.9 DL + 1.5 WLX
- 12) 0.9 DL -1.5 WLX

- 13) $0.9 DL + 1.5 WLY$
- 14) $0.9 DL - 1.5 WLY$
- 15) $1.2 (DL + LL + EQX)$
- 16) $1.2 (DL + LL - EQX)$
- 17) $1.2 (DL + LL + EQY)$
- 18) $1.2 (DL + LL - EQY)$
- 19) $1.5 (DL + EQX)$
- 20) $1.5 (DL - EQX)$
- 21) $1.5 (DL + EQY)$
- 22) $1.5 (DL - EQY)$
- 23) $0.9 DL + 1.5 EQX$
- 24) $0.9 DL - 1.5 EQX$
- 25) $0.9 DL + 1.5 EQY$
- 26) $0.9 DL - 1.5 EQY$

Load Combinations for Serviceability

- 1) $DL + LL$
- 2) $DL + 0.8 LL + 0.8 WLX$
- 3) $DL + 0.8 LL - 0.8 WLX$
- 4) $DL + 0.8 LL + 0.8 WLY$
- 5) $DL + 0.8 LL - 0.8 WLY$
- 6) $DL + WLX$
- 7) $DL - WLX$
- 8) $DL + WLY$
- 9) $DL - WLY$
- 10) $DL + 0.8 LL + 0.8 EQX$
- 11) $DL + 0.8 LL - 0.8 EQX$
- 12) $DL + 0.8 LL + 0.8 EQY$
- 13) $DL + 0.8 LL - 0.8 EQY$
- 14) $DL + EQX$
- 15) $DL - EQX$
- 16) $DL + EQY$
- 17) $DL - EQY$

The design shall be governed by worst load combinations, keeping in view the probability of

- Each load case acting together and Their disposition in relation to other loads and severity of stresses or deformations caused by combinations of the various loads is necessary to ensure the required safety and economy in the design of a structure.

The allowable stresses and soil bearing values shall not be increased for any condition of dead, live loads acting alone or in combination with each other.

CONCLUSIONS

Further detail design engineering and drawings will be developed based on the philosophy, method and statutory requirements described in this document.

8.2 electrical

1.0 General

- 1.1 The design criteria, given below has to be followed by the CONTRACTOR for designing of Electrical Power Distribution System/ sizing of electrical equipments for Plot No 22 & 23; however it is to be noted by the CONTRACTOR that, following this design criteria does not relieve the CONTRACTOR from adherence to the standards, regulatory requirements & best engineering practices.
- 1.2 The proposed Electrical Power Distribution System for Plot No 22 & 23 shall be designed to provide;
 - (a) Safety to Personnel and equipment during both operation and maintenance
 - (b) Reliability & Continuity of Service
 - (c) Minimal fire risk.
 - (d) Ease & flexibility of maintenance and operation.
 - (e) Protection of all electrical equipment through selective relaying system.
 - (f) Electrical supply to equipment and machinery within the design operating limits.
 - (g) Adequate provision for future extension and modification.
 - (h) Maximum inter-changeability of equipment.
 - (i) Fail safe feature.
 - (j) Energy efficient equipment/ system such that BEE Rating above 3 stars

(k) Suitability for applicable environmental factors

(l) Service Condition

- 1.3 All the components of the electrical system shall be sized to suit the maximum load under the most severe operating conditions. Accordingly, the maximum simultaneous consumption of power, required by continuously operating loads shall be considered and an additional margin shall be taken into account for intermittent service loads, if any. The amount of electrical power consumed by each area shall be calculated for its operation at the design capacity.
- 1.4 All equipment shall be designed to operate satisfactorily and meet the requirements specified in this specification under all site conditions where the equipment is proposed to be installed.
- 1.5 The equipment shall be designed and manufactured in accordance with the best engineering practices and shall be suitable for the intended purpose.
- 1.6 All the system and Equipment shall be designed with a reference ambient temperature of 45 Deg C
- 1.7 The CONTRACTOR shall furnish calculations after award of contract, establishing the adequacy of the sizes to meet the continuous and short time ratings as calculated for all the following equipments.

2.0 System Design Parameter:

- 2.1 The convenience outlets within Flat/ Dwelling Unit and at common utility and facility shall be provided for 6A (100W), 16A (1000W) and 20 A (1500W).
- 2.2 Voltage and Frequency variations at HT and LT level shall be $\pm 10\%$ and $\pm 3\%$ respectively.
- 2.2.1 In running condition, cumulative voltage drop at the last equipment in the topmost floor (Including HV and LV at 100% rated load) shall not exceed 6% (measured at load end) for the LV loads.
- 2.3 Voltage dip at the Motor terminals during motor starting of the highest rating motor with regular base load shall not exceed 15%.
- 2.4 Fault level for HT shall be considered as 25 kA for 1 sec.
- 2.5 The fault level for LT system at transformer terminal shall be calculated based on the transformer rating and its impedance. However, minimum short circuit rating of switchgear and cable withstand capacity shall be considered as 25kA/1 sec.
- 2.6 33kV System

a)	Nominal Voltage	33kV
b)	Maximum System Voltage	36kV.

c)	Rated Impulse Voltage withstand (peak)	70 kV
d)	Rated one-minute power-frequency withstand voltage (rms)	170kV
e)	Rated short- time current (1sec)	25kA.

2.7 415V System

a)	Nominal Voltage	415V
b)	Maximum System Voltage	1100V
c)	Rated Impulse Voltage withstand (peak)	-
d)	Rated one-minute power-frequency withstand voltage (rms)	3kV
e)	Rated short- time current (1 sec)	25kA.(Min)

2.8 Lighting, Air conditioning and other Miscellaneous Power outlets

a)	Nominal Voltage	240V
b)	Phases	1
c)	Frequency	50Hz
d)	Connection	3 wires(Phase, Neutral & Earth)

3.0 Estimation of Load/ Max Demand:

3.1 The following considerations are to be followed to arrive at the maximum electrical demand.

(a) Demand for each Flat/ Dwelling unit of 2 BHK and 3 BHK shall be calculated based on the Madhya Pradesh Supply Code 2013. The criteria shall be implemented on the Built Up Area (BUA) of each unit rather than Plot.

(b) Load Factor

(i) Flat/ Dwelling Unit loads	:	0.8
(ii) Motors (Fire Hydrant system)	:	0.9
(iii) Auxiliary load (Elevator, Crane/ Hoist, etc.)	:	0.9
(iv) Lighting load	:	1.0
(v) Miscellaneous Power loads	:	0.9
(vi) Watering Pump	:	0.9
(vii) Ventilation System	:	0.9

(c) Utilization Factor

- (i) Utilization of an individual system shall be considered based on the no of working and stand-by equipments – 50% for one working and one stand-by.
- (ii) Utilization for Lifts shall be considered as 50%.
- (iii) Utilization for garbage Chute control panel shall be considered based on the loading estimated at peak usage time.
- (iv) Utilization of Miscellaneous power outlets shall be considered as 30%.

(d) Power factor of Motors : As per the Manufacture's Data sheets

(e) Efficiency of Motors : As per the Manufacturer's Data sheets

(f) Overall Diversity for final Demand calculation shall be considered as 1.5.

4.0 Fault Level Calculations

4.1 Fault level at transformer secondary and at 415V LT panels shall be calculated based on the transformer rating and impedances of transformer and cables.

5.0 Power Factor Improvement:

- 5.1 For Residential Projects, Power factor improvement shall be provided for large lump loads like motor loads.
- 5.2 Capacitor rating shall be based on the system power factor (0.80 or actual, whichever is lesser - to be corrected for 0.99).
- 5.3 APFC Panel shall be sized considering following design criteria:
- (a) Optimum no of steps with minimum two (2) nos. of spare steps shall be considered
 - (b) Minimum steps of 5 kVAR and 10 kVAR bank in adequate nos. for fine regulation of power factor at low loads shall be considered. Balance capacity can be considered with 25 kVAR, 50 kVAR or 100 kVAR capacitor bank.
 - (c) Capacitor banks shall be All Poly Propylene (APP), double layer type.
 - (d) Where 2 X 100% redundant transformers are provided, for each bus section of the Main PCC panel, separate APFC panel shall to be provided.
 - (e) Rating of APFC panel shall be based on the required running load for each bus section & not on the total connected load basis. Number of stages / steps in a particular APFC panel shall be decided by the CONTRACTOR such that minimum two spare steps are provided.
 - (f) Other requirements of APFC panel & its components shall be as per requirement provided in this specification.
- 5.4 Scheme with Summation CT shall be provided to operate both the APFC while one of the transformers is in line.

6.0 Cable and Wire Sizing:

- 6.1 The CONTRACTOR shall ensure that cable and wires associated with the power distribution and control systems in all the installations throughout the Works are adequately rated for their desired use.
- 6.2 1.1 kV grade, multi-stranded copper/ Aluminium conductor, PVC/ XLPE insulated colour coded, inner and outer extruded FRLS PVC sheathed, galvanized steel round wire/ flat strip armoured cable laid on cable trays mounted on the ceiling/ columns, supported with steel structures shall be considered for connecting main PCC to individual Distribution Panels and Boards located on various individual floors.
- 6.3 Cables up to & including 4.0 sq.mm shall be Cu multi-stranded conductor with PVC insulation galvanized steel round wire armoured & cables including and beyond 6sqmm shall be Al multi-stranded conductor with XLPE insulation & galvanized steel flat strip armoured.

- 6.4 All control cables shall be 650 V grade copper conductors Halogen Free Fire Retardant or FRLS PVC insulated cables conforming to IS 1544- Part I. For cables above 7 cores, minimum two spare cores shall be considered.
- 6.5 All LT cable shall be conforming to IS 7098 Part I for XLPE cables and IS 1544 – Part I for PVC cables.
- 6.6 Only Copper conductor (ICPCI approved) multi-strand cable with PVC Insulated Fire Retardant (FR) having minimum oxygen index value 29% is to be used. FRLS PVC wires may be used in the wiring system in place of FR PVC wires if approved by the technical sanctioning authority.
- 6.7 All the cabling and conduits to the basement/ individual floors shall be laid through the electrical ducts provided in the building Core with access window on each floor/ staircase landing.
- 6.8 The following main aspects shall also be considered while deciding the final size of the cables/ wires -
- (a) Supply voltage and frequency
 - (b) All cables shall be selected to carry the corresponding full load current under site conditions.
 - (c) Route length and disposition of cables
 - (d) Maximum allowable temperature rise under normal full load condition based on the material of cable insulation (XLPE/ PVC).
 - (e) Maximum short circuit current duration (fault clearing time) and final temperature of cable during short circuit current flowing through the cable.
 - (f) Fault clearing time of the upstream circuit breaker;
 - (i) Cables from transformer secondary to Main Power Control Centre (PCC) incomer, fault clearing time shall be 1sec
 - (ii) Cables emerging from ACB outgoing of the PCC, fault clearing time shall be considered as 0.16 second (for Tie feeders if any it shall be 0.5 second)
 - (iii) For Cables emerging from MCCB outgoing of the PCC, fault clearing time shall be considered as 0.01 second
 - (g) CONTRACTOR to note that, the above fault clearing times are minimum to be considered. Actual fault clearing time shall be considered as per actual relay co-ordination.
 - (h) Appropriate de-rating factors as per cable manufacturer's catalogue and enlisted below shall be considered for sizing the cable:

- (i) Ambient Air Temperature (minimum 45⁰C).
- (ii) Ambient ground temperature (minimum 40⁰C to be considered)
Laid in Air / ducts/ directly in ground etc.
- (iii) Depth of cable burial (minimum 750 mm for LT and 900 mm/ 1200mm for 11kV/ 33KV HT)
- (iv) Thermal Resistivity of Soil (minimum 150⁰C Cm/ W to be considered)
- (v) No. of cables in a group-touching each other or separated by a distance
- (vi) No. of cable trays in tier
- (vii) Any other de-ration factors as applicable & as per Manufacturer's catalog.

- 6.9 Permissible voltage dips at the time of starting the corresponding motor/ load. CONTRACTOR to ensure adherence to the Criteria-2 mentioned above.
- 6.10 In running condition, cumulative voltage drop (Including HV and LV at 100% rated load) shall not exceed 6% (measured at load end) for the LV loads.
- 6.11 Prefabricated GI perforated cable trays shall be provided for laying cables main power distribution from PCC to individual panels and DBs. Bends and Tees shall be prefabricated and shall not be fabricated at site.
- 6.12 Separate trays shall be provided for HV, LV, Control and ICT cables laid with a gap of minimum 300mm between tray bottom/ edge to tray bottom/ edge of the adjacent tray.
- 6.13 Bending radius of 12D and 15D shall be provided for LV & Control Cables and HV cables respectively where D is the diameter of the cable.
- 6.14 RCC pipes shall be provided where cables need to cross the roads, drive ways and pathways. For HV cables, one cable shall be laid in one pipe section of minimum 150mm internal diameter. LV, control and ICT cables shall be laid in separate pipes similar to the trays. 300mm gap shall be provided between the pipes of each voltage level.

7.0 LV Switchgear Panels

7.1 System Description for LV Panels

- (a) Nominal System Voltage : 415 V
- (b) Highest System Voltage : 1.1 kV
- (c) Frequency : 50Hz ±3%

- (d) No. Of Phases : 3 Phase
- (e) Neutral Grounding : Solidly Grounded
- (f) System Configuration : 4 wire
- (g) Fault level : Minimum 25kA for 1 Sec or as per
system calculated fault level
- (h) Internal Arc withstands level : Rated fault level for 1 Sec.

Only for Floor Mounting Panels

- 7.2 All panels shall be provided with Aluminium bus where as all Distribution boards with incomers below and including 63A shall be provided with tinned copper bus bars.
- 7.3 All panels shall be Totally Type Tested panels as per IEC 61439 or equivalent IS standards. All the panels shall be Internal Arc tested as per IEC 61641 for fault rating equivalent to the system fault current at that location for 1 sec.
- 7.4 All panels shall be provided in free standing compartmentalized metal enclosure conforming to IP52 for indoor and IP55 for outdoor as per IS: 13947 (Part-I) and having Form 3B separation as per IS 8623 Part I.
- 7.5 Pump House and Fire Hydrant panels shall be separate and located in the pump house area. Both the panels shall be mounted on min 200 mm raised steel structures to avoid flooding.
- 7.6 The bus-bars shall be sized considering the following criteria:
 - (a) Sleeves made of insulating material on all bus bars.
 - (b) Design ambient temperature 45⁰C.
 - (c) Final temperature of the bus-bars complying with requirements of IS 8623 & IEC 60947.
 - (d) Bus bars being inside the panel; De- rating for enclosure and ventilation.
 - (e) Bus bar suitability for carrying rated current continuously. The current density (A/sqmm) of the bus bar shall not exceed 0.8 for Aluminium bus and 1.6 for Copper bus.
 - (f) Configuration of bus bars and Proximity effect
 - (g) The main bus shall be designed based on the load rating as well as the actual fault level for specified duration at the location of the Panel/ board with 10% tolerance.

- 7.7 Earth bus of the panel shall be sized suitable for the above fault level for the same duration.
- 7.8 Switchgear Sizing/ Selection:
- 7.8.1 Switchgear shall be sized/ selected considering the following:
- (a) Rating suitable for carrying full load current of the equipment.
 - (b) Suitability for Short Circuit Rating for specified duration.
 - (c) Switchgear for motors shall be suitable for motor duty application.
 - (d) Switchgear for all the motor feeders shall be Type-2 co-ordination.
- 7.8.2 Motor starter selection shall be done as follows:
- (a) Direct On Line (DOL) Starter – For motors rated up to 5.5 kW
 - (b) Star- Delta Starter - For motors rated above 5.5 kW to 45 kW
 - (c) Soft Starter – For all low/ medium voltage motors above 75 kW rating.
 - (d) DOL starter shall be provided for the main Fire Pump and Sprinkler pump unless otherwise advised by Chief Fire Officer/r.
 - (e) DOL starter shall be provided for Jockey pumps irrespective of the rating unless otherwise advised by Chief Fire Officer.
- 7.8.3 In-panel de-ration of minimum 20% or as provided in Manufacturer's catalogue, whichever is higher shall be considered.
- 7.8.4 Switchgear rating for individual capacitor bank shall be sized at 1.5 times the rated current rating.
- 7.9 ACBs shall be considered for switchgear ratings above 630A and MCCB shall be considered up to 630A. All ACBs and MCCBs shall be rated for Bus fault level with $I_{cs}=I_{cu}=I_{cw}=100\%$ for ACB and $I_{cs}=I_{cw}=100\%$ for MCCBs.
- 7.10 Appropriate Electro-Mechanical Interlock (EMI) shall be provided between two transformer incomers.
- 7.11 Miniature Circuit Breaker (MCB) shall be considered where fault level is below 15kA
- 7.12 Cascading of Switchgears
- (a) Cascading of Switchgears may be considered for panels where the fault level is greater than 15 kA based on published charts of switchgear manufacturers.
 - (b) MCBs shall be provided at all the Flat Distribution Board (FDB) Outgoings feeders on the Metering panels. If the fault level at the Metering panel is

more than 15 kA, Cascading of switchgear shall be implemented for the selection of the Switchgears at the panel incomer as per published charts of the manufacturers to limit the let through energy in case of a fault. However, the panel Main bus and the outgoing cables shall be sized for the actual fault level (kA).

7.13 The Main Power Control Centre (PCC) and DG Panel shall be provided with Microprocessor based overload (OL), Short circuit (SC) and Earth fault (EF) (Inbuilt) release at the panel incomer. All the outgoing MCCBs at PCC, DG panel and the incomers of all the Metering Panels and Common Utility panels shall be provided with Thermal magnetic OL and SC release. The Fire Hydrant Panel

7.14 Motor feeders shall have the following protection and components;

7.14.1 Motors rating less than 15 kW

- (a) Overload protection by three phase thermal (bimetal) relay.
- (b) Single phasing preventer.

7.14.2 Motors rating above 15 kW & up to 132kW

- (a) Electronic motor protections relay providing the following protection for
- (b) Overload;
- (c) Earth fault;
- (d) Phase currents out of balance.
- (e) Single phasing preventer.

7.15 415V Motor Starters – Following type of starters shall be provided for all low/ medium voltage motors;

- (a) DOL Starters for motor feeders below and equal to 5.5 kW
- (b) Star-Delta Starters for motor feeders greater than 5.5kW & equal to 45kW
- (c) Soft Starter – for motor feeders greater than 45 kW rating
- (d) Starters for Fire Hydrant pumps including Main and Sprinkler pumps shall be provided as per TAC guidelines or as per recommendations of Chief Fire Officer of the State.

7.16 20% spare capacity shall be considered on each bus/ panel for future.

8.0 Earthing & Lightning Protection system

8.1 The earth electrode system shall comprise one or more earth electrodes, earthing network, mesh or a combination of these in order to obtain the required earth electrode resistance.

8.2 Latest version of following standards and codes shall be referred to for designing the Earthing and Lightning protection system;

- a) IS 3043- 1987, : Code of practice for Safety Earthing
(Reaffirmed in 2006)
- b) IS/ IEC 62305- 2013 : Code of Practice for the protection of buildings and allied structures against lightning.
- c) CEA guidelines 2010 : Measures related to safety & electric supply.
- d) IEEE 80-2000-2013 IEEE Guide for Safety in AC Substation
- e) CPWD Specifications - 2013 General Specifications for Electrical Works Part I - Internal

8.3 Soil Resistivity

8.3.1 The Contractor shall undertake the soil resistivity measurements at site and select suitable type of conductors. However for bidding purpose soil resistivity shall be considered as 100 ohm-meter (approx.). If any major changes in soil resistivity after actual measurement during detailed engineering, shall be adjusted accordingly.

8.3.2 Measurement of soil resistivity at site shall be carried out by Wenner's four electrode method as per IS: 3043 – 1987 atleast at two suitable locations minimum 50m apart from each other within the plot.

8.4 Size of Earthing Conductors

8.4.1 The earthing conductor sizes shall be calculated as per IS: 3043. Following factors will be considered for sizing the earthing conductor.

- a) Design Ambient : 500°C
Temperature
- b) Allowable temperature rise : 50°C
- c) For steel welded joints : 1.0 seconds
Fault clearing time
- d) Overall earthing resistance
of the grid for the following

installtions

- | | |
|---|-------------------|
| i) HV Substations | Less than 1 Ohms |
| ii) Residential Complexes | Less than 10 Ohms |
| e) Time factor for calculating maximum allowable Step and touch potential | 1 seconds |

8.4.2 The maximum values of earth fault current for the design of the earthing system will be considered based on system requirement as follows:

- | | |
|------------------|---|
| (a) 33 kV system | : 25 kA for 1 sec |
| (b) 415 V system | : 30 kA for 1 sec (will be decided as per actual fault level calculation) |

8.4.3 The calculated size shall be suitably (depending on the resistivity of soil) increased to account for the loss of material due to corrosion in soil.

8.5 Equipment Earthing

- (a) GI Plate Earth electrode as specified in IS 3043 shall be provided for the earthing of non-current carrying parts and enclosures of all electrical equipment such as LV switchboards, motors, Lighting Distribution Boards, local control stations, cable trays, socket outlets, steel structural supports etc.
- (b) A ring/ grid earthing network shall be provided, laid buried 600mm deep in the ground in the set back area along the Plot boundary connecting all the dedicated Earth electrodes for all equipments and systems.
- (c) A similar grid shall be laid within the Landscape Podium slab between the buildings embedded in the RCC slab with connecting Risers at every building, as required, for connecting to the lightning downcomers and equipments. The Slab earth grid shall be extended till the set back area at four corners to connect to the dedicated Earth electrodes as well to the Set back earth Grid.
- (d) Materials used for earth electrodes shall be designed to suit the ground conditions and shall be galvanized.
- (e) One dedicated GI plate electrode shall be provided for each elevator; two dedicated GI plate electrode shall be provided for each metering panel.
- (f) Earthing network shall also be connected/ formed through the cable trays **laid within the building**. Single or double run GI strips shall be laid on the cable tray depending upon whether it will be connected to the earth network ahead or its going to return back to the origin point respectively. The strips shall be welded to the cable tray at every 10m interval. For

multi tier trays, the strip can be laid in one tray and connected to all at 10 M interval. Minimum size of Galvanised Steel Strip shall be 25X3 mm.

(g) Independent earth wire of size same as Phase conductor shall be laid along with FR PVC power cable in the conduit from metering panel till Flat unit Feeder DB. Earthing requirements for Conduit wiring for Sub main, circuit and point wiring shall be carried out as per CPWD guidelines.

8.6 Earth pits & Earthing conductor shall be laid around the building with a minimum clear distance of 300mm with respect to the other utilities and atleast 1500mm from the building plinth.

8.7 Lightning Arrestor

8.7.1 The need for lightning protection system shall be established by calculating the risk factor value of each building, structure etc. as per methodology/ procedure prescribed in IS/IEC 62305 - 2010. This will be provided for building(s) whose risk factor is exceeding the limiting values. The Risk factor shall be evaluated for Level 3 risk.

8.7.2 If found necessary, air termination system comprising of horizontal roof conductors shall be provided. The horizontal mesh shall be provided as per IEC 62305 - 2010 above the roof. The down conductors for this system shall be fixed and run along the outer surface of the building and connected to the earth electrodes.

8.7.3 The function of the air-termination systems of a lightning protection system is to prevent that direct lightning strikes damage the volume to be protected. They must be designed to avoid uncontrolled lightning strikes to the building / structure to be protected. Air-termination systems can consist of the following components and can be combined with each other as required;

(a) Roof conductor / rods / Meshed conductors / Air termination

(b) Down conductors

(c) Earth termination

8.7.4 All connection between the conductors shall be welded/brazed type. Metallic pipe, conduit, structures shall be bonded to lightning protection conductors to prevent the side flashover. But no metallic pipe, conduit, structure shall be used as air termination conductor or down conductor.

8.7.5 Earth pits provided for down comers of lightning protection will be connected with general earth pits through earth strips below ground to reduce the overall earthing resistance of the grid.

9.0 Illumination System

9.1 Latest version of related IS Standards and National Lighting Code (NLC) shall be referred for designing Illumination for different areas.

- 9.2 All lighting design shall be carried out on Dialux Version 4.12 Software. Soft copies of Dialux files for each calculation shall be submitted for review.
- 9.3 Lux level of different areas shall be as prescribed in per IS standards and NLC.
- 9.4 The basis of design shall be based on the following lighting engineering criteria:
- (a) Lighting lux level.
 - (b) Luminance distribution.
 - (c) Glare restriction.
 - (d) Direction of incidence of light and shadow effect.
 - (e) Colour appearance and colour rendering of the light source.
- 9.5 The lighting installation can satisfy the requirements if all the quality criteria as prescribed above is followed and executed.
- 9.6 The illumination levels for different areas are chosen as per recommendation of IS and other governing bodies.
- 9.7 Selection of Luminaire

Following luminaires shall be provided for various areas;

S. No.	AREA	TYPE OF LIGHT FITTINGS	Lux
a)	Utility Areas of Each Tower like Substation, Pump House, Ventilation Rooms and Metering rooms	2X 18W LED batten	200
b)	Lower and Upper ground Parking	2X18W LED batten	50
c)	Common areas – Entrance and floor Lobby,	1X20 W LED Surface mounted decorative down lighter fitting with polycarbonate cover	100
d)	Staircase	1X10 W LED Surface mounted decorative down lighter fitting with polycarbonate cover	100
e)	Street lighting	1X40 W LED fitting with polycarbonate cover	10
f)	Multipurpose Area	LED Batten type fitting	200

S. No.	AREA	TYPE OF LIGHT FITTINGS	Lux
g)	Landscape & Walking Pathway	1X10 W LED bollard with Polycarbonate Covers ;	10
h)	Drive way on the landscape podium	LED Post of lanterns	10

9.8 Lighting Design for Residential Buildings

9.8.1 Following factors shall be considered while arriving at the utilization factor to determine the number of fixtures for each area/buildings.

9.8.2 Maintenance Factor

(a) Indoor Area Lighting with LED Luminaire : 0.8

(b) Outdoor Area Lighting with LED Luminaire : 0.8

9.8.3 Default Reflection factor for Indoor Lighting to be considered are as follows;

(a) Ceiling : 0.5

(b) Walls : 0.3

(c) Floors : 0.1

9.8.4 However Reflection factor can be selected based on the Colour of the wall and Ceiling as given below;

(a) White and very light colours : 0.7

(b) Light colours : 0.5

(c) Middle tints : 0.3

(d) Dark colours : 0.1

9.8.5 Utilization factor considering the room index at applicable surface reflection factors.

9.8.6 The working plane shall be considered at 0.75 m from the floor level.

9.8.7 Uniformity factor shall be considered as per National Lighting code/NBC/IS code.

9.9 The power supply for lighting shall be distributed from Lighting Distribution Boards located on the same floor except common areas of each tower like floor lobbies, staircase and terrace.

9.10 For street lighting, cabling shall be done with 4C armoured cable such that alternate fixtures are different phases.

- 9.11 Emergency Lighting at substation and other common utility buildings shall be supplied through Non-Maintained luminaries having inbuilt battery source for minimum 3 Hrs duration.

8.3 ventilation

Basis of Design: Ambient Conditions:

Outside design conditions considered for Bhopal in summer are:

- a) Dry Bulb 41.7 °C
- b) Wet Bulb 22.0 °C

Ventilation system shall be designed in line with IGBC Green home standards

1. All toilet areas lesser than 50 Sq.ft shall be ventilated with air quantity of 50 CFM and toilets higher than 50 Sq.ft area shall be ventilated 1CFM/Sq.ft.
2. All kitchen areas shall be ventilated with air quantity of 100 CFM.
3. All three phase fans used either for ventilation or for fire emergency shall be provided with energy efficient motor of EFF1 class.
4. All Pump rooms, Meter room & Substations etc will be ventilated based on 20 ACPH as per NBC.
5. All lift wells shall be provided with Pressurization system, consisting of supply air fans installed on roof top. These fans shall be connected to supply air ducts which are connected to the lift well portion above terrace level. Fans shall be sized for lift well, and/or to maintain minimum positive pressure of 50 Pa across the lift door. These dampers shall be interlocked with fan motor and shall open upon getting signal from the smoke sensor upon sensing of smoke in corridors/common passengers/ lift lobby.

6. SYSTEM DESCRIPTION

Mechanical ventilation system is proposed plot 22 & 23 in Phase- 1 development.

All lift wells shall be provided with Pressurization system, consisting of supply air fans installed on roof top. These fans shall be connected to supply air ducts which are connected to the lift well portion above terrace level. Fans shall be sized for lift well, and/or to maintain minimum positive pressure of 50 Pa across the lift door. Supply air fans serving lift well shall be provided with motorized damper at fan discharge to prevent humid

fresh air entering into the system. These dampers shall be interlocked with fan motor and shall open upon getting signal from the smoke sensor upon sensing of smoke in corridors/common passengers/ lift lobby.

All Pump rooms, Meter room & Substations are provided with wall mounted propeller fans. The exhaust air is drawn at 20 ACPH by exhaust fan and the supply air will be supplied through fresh air louvers.

7. OPERATION PHILOSOPHY

a) The lift well pressurization system is provided with dedicated emergency power backup. In case of normal power failure or in case of fire hazards, these systems operate on emergency power backed by DG Sets.

b) In the event of fire, the following strategy shall be used -.

The smoke detector located in every zone, shall sense the smoke and sends a signal to the fire panel which in turn sends a signal to the tube axial fans located on terrace to operate in fire mode.

For Toile, Kitchen, Pump rooms, Meter room & Substations ventilation system will be ON/OFF based on user requirement.

8.4 fire fighting

8.4.1 DESIGN BASIS

The fire fighting arrangement shall be designed as per the requirement of local guidelines, National Building Code (NBC) & engineering design standard.

8.4.1.1 INTRODUCTION

- (i) Type of the Building -- Group A + D (Residential Building +Assembly Building)
- (ii) Max. Heights of buildings -- Plot -22 Above 45 m and not exceeding 60 m height
-- Plot -23 Below 45 m (Categories as per NBC)

1.1 TYPE OF SYSTEMS PROPOSED

Following are the various Fire Protection systems proposed,

- Fire pump house & Static water storage tanks in basement/LG floor level.
- Fire Pumps & Accessories
- External Fire Hydrants
- Wet Riser System
- Fire Sprinkler System
- Portable Fire extinguishers
-

1.2 FIRE WATER STORAGE

- One (1) no. 200cum capacity static fire water storage tank at basement /LG floor level and terrace level fire water storage tanks of capacity 10 cum at each buildings respectively to be provided to cater the NBC requirement.
- Fire department connection shall also be provided in the ground level of each building. These shall comprise of 4 Nos. 63 mm dia male outlets capable of directly feeding the ring mains through inbuilt non return valves or directly filling the static fire storage tanks. These shall be mounted in specially identified boxes.

1.3 FIRE WATER PUMPS

- Electric & diesel motor driven pumps as mentioned below.

Sl. No.	Name	Qty.	Parameter
PLOT-22			
(i)	Sprinkler pump Electric Motor driven	1	2280 LPM @ 100mWC total head
(ii)	Hydrant pump Electric Motor driven	1	2280 LPM @ 100 mWC total head
(iii)	Diesel engine driven pump (standby) (heat exchanger type)	1	2280 LPM @ 100 mWC total head
(iv)	Electric Motor driven (Jockey pump)	2	180 LPM @ 100mWC total head
PLOT-23			
(i)	Sprinkler pump Electric Motor driven	2	2280 LPM @ 100mWC total head
(ii)	Hydrant pump Electric Motor driven	2	2280 LPM @ 100 mWC total head

Sl. No.	Name	Qty.	Parameter
(iii)	Diesel engine driven pump (standby) (heat exchanger type)	2	2280 LPM @ 100 mWC total head
(iv)	Electric Motor driven (Jockey pump)	4	180 LPM @ 100 mWC total head

- All pumps are connected to IBMS through Fire alarm system for monitoring.
- Electrical pumps shall provide adequate flow to cater the requirement of sprinkler & hydrant system. Diesel engine driven fire pumps shall be provided for ensuring operation & performance of the system in case of total electrical power failure. Jockey pump shall compensate for pressure drop and line leakage in the hydrant and sprinkler installation.
- Individual suction lines shall be drawn from the fire reserve tanks and connected to fire suction header. The electric fire pumps, diesel engine driven fire pumps and the jockey pumps shall draw from this suction header.
- The sprinkler pump shall be isolated from the main discharge header by a non return valve so that the hydrant pump can also act as standby for the sprinkler system. The ring main shall remain pressurized at all times and Jockey pumps shall make up minor line losses. Automation required to make the system fully functional shall be provided.
- Fire pump room will be located in the basement level of utility building. The maintenance of the pumps/motor shall be done at the maintenance space available in the pump room itself.
- Pump starts automatically as per the preset pressure mentioned below by means of a pressure switch through MCC cum instrument control panel.

S. No.	Description	Set Pressure (in kg/cm ²)
	Main Jockey pump starts	.0 (kg)
	Jockey pump stops	.0 (kg)
	In the event of Fire:	
	Hydrant Pump starts	.5 (kg)

S. No.	Description	Set Pressure (in kg/cm²)
	Sprinkler Pump starts	.5 (kg)
	Standby pump starts	.0 (kg)

- MCC cum instrument control panel shall be provided with necessary hardware/software for integration with BMS for monitoring.
- MCC cum instrument control panel shall be provided with microprocessor based Alarm annunciator, indicators, hooters, switches, control modules etc. and its required hardware/software to monitor in BMS.
- Logic for operation of pumps shall be developed in MCC cum instrument control panel.

1.4 Sprinkler System

- (i) Sprinkler System shall be provided in LG & U.G floors area, and in all buildings which height is more than 45 meter.
- (ii) Pendant/Upright/Sidewall type sprinklers shall be used with a center to center spacing of 3 meters.
- (iii) Pendent sprinklers shall be provided at LG & UG floors and for any false ceiling areas in Lobbies/common areas etc. which are greater than 800mm in height.
- (iv) The sprinklers shall be automatically activated at 68 Deg.C by breaking of the glass bulb in the event of fire.
- (v) The sprinkler line shall be always pressurized. Sprinkler pump shall have the backup of main electrical and diesel engine driven fire pumps.
- (vi) Necessary accessories such as Alarm Valves, Flow Switches, Inspector's Test Valve Assembly, and Annunciation Panel etc. shall be provided as per the requirements.

1.5 FIRE HYDRANT SYSTEM

- A ring main at LG ceiling with isolation valves.
- Wet risers
- Landing Hydrants with hose reel on all floors near staircases inside the dedicated Shaft.
- Fire Brigade Inlet connection for filling wet riser system.

1.6 WET RISER SYSTEM

- Wet riser cum down comer for every 1000 sq.mts floor area for all buildings.
- Single headed Landing Hydrants on all floors below 45 meter and above 45 meter with double-headed hydrant valve, 2 x 15Mts. of fire hoses, Hose reel with 40 Mts. Rubber hose and nozzle.

1.7 YARD HYDRANTS

- Yard Hydrants at every 45m of periphery of the Building with Single headed Hydrant valve, 2 x 15 Mts. long fire hoses and Branch pipe with Nozzle.

1.8 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers conforming to IS: 15683 shall be provided at locations mentioned below,

- Dry chemical powder type fire extinguisher for main switch board room, generator room, pump room, AHU rooms and lift machine room.
- Water expelled carbon-dioxide type fire extinguisher located near each staircase landing on every floor and office areas.
- Carbon dioxide type fire extinguishers for electrical panel room, pump room, lift machine room and office areas.
- Mechanical foam type fire extinguishers at D.G. Rooms, Firewater pump house and near oil filled Transformers.
- ABC type extinguishers are provided one for every 8 car parks.

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

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

a.	Piping System	Piping system conforming to 1) MS Class 'C' Pipes for hydrant & sprinkler system IS:1239 up to 150 mm dia & IS : 3589 (6.35mm thk.) for above 150 mm dia 2) IS : 10221 – coating & wrapping of underground pipe
b.	Fire water static Storage	Fire water static storage has been provided in accordance to NBC requirement & in consultation with local CFO.

c.	Fire Pumping system	Pumping system as mentioned above.
d.	Hydrant system	External hydrant complete with canvas hose & branch pipe housed in external type cabinet. Internal hydrant complete with hose reel branch pipe & canvas hose housed in shaft having
e.	Sprinkler system	Sprinkler rating and type shall be selected for respective areas (IS 15105 : 2002)
f.	Hand held fire extinguishers	Strategically placed at designated areas maximum travel distance 15 mtr. to reach the nearest extinguisher.

8.4.2 FIRE FIGHTING PUMPING HEAD CALCULATION FOR FIRE FIGHTING PUMPS:

• Height of Building from Ground Level to Terrace	= 49 m	
• Plant room Pumps are located and Level	= 4.2 m	
• Minimum pressure required at the farthest landing valve Kg/Sq.cm	= 3.5	
		= 35 m
• Height of last landing valve from Terrace	= 1.0 m	
• Friction losses in pipe & Fitting	= 10 m	
• Pumping Head	=	
50.0+10.0+35+1.0+10+4.2		= 99.2M
	Say	= 100 M

FIRE FIGHTING WORKS

CONSOLIDATED LIST OF BIS STANDARDS APPLICABLE

S.No	ISI No.	Description
1.	SP 7: Part IV - 2005	National building code – Fire protection
2.	IS: 1239 –1990 (Part I & II)	Specifications for mild steel tubes, tubulars and other rought steel fittings.
3.	IS: 3589 -2001	Specifications of steel pipes for water and sewage (168.3 to 2540mm outside diameter)
4.	IS: 778 -1984	Specifications for copper alloy gate, globe and check valves for water works purposes
5.	IS: 13039 – 1991	Code of Practice for External Hydrant System Provision and Maintenance.
6.	IS: 14846 -2000	A specification for sluice valves for water works purposes (50 to 1200 mm size).
7.	IS: 5312 – 1984	Specifications for swing check type reflux (Non-

		return) valve.
8.	IS: 5290 – 198	Specifications for landing valves.
9.	IS: 884 – 1985	Specifications for first-aid hose reel for fire fighting.
10.	IS: 901 – 1988	Specification for Coupling, Double Male and Double Female Instantaneous Pattern for Fire Suppression.
11.	IS: 902 – 1992	Specification for Suction Hose Coupling for Fire Suppression.
12.	IS: 903 – 1993	Specifications for fire hose delivery couplings branch pipe, nozzles and nozzles spanner.
13.	IS: 904 – 1983	Specifications for Two-way and Three-way Suction Collecting Heads for Fire Suppression.
14.	IS: 905 – 1980	Specifications for Delivery Breechings, Dividing and collecting, Instantaneous Pattern for Fire Suppression.
15.	IS: 2190 – 1992	Code of practice for selection, installation and maintenance of portable first-aid fire extinguishers.
16.	IS: 2546 – 1974	Specifications for Galvanized Mild Steel Fire Bucket.
17.	IS: 2871 – 1983	Specifications for Branch Pipe, Universal for Fire Suppression
18.	IS: 9972 – 1981	Specifications for Automatic Sprinkler Heads.
19.	IS: 15105 – 2002	Design and Installation of Fixed Automatic Sprinkler Fire Extinguishing System.
20.	IS: 2878 – 1986	Specifications for fire extinguisher Carbon-dioxide type
21.	IS: 3844 – 1989	Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises.
22.	IS: 2189 – 1999	Code of practice for selection and maintenance of automatic fire detection and alarm system.
23.	IS: 9668 – 1999	Code of practice for provision and maintenance of water supplies for firefighting.
24.	IS: 1538 – 1993	Specifications for cast iron fittings for pressure pipes for water, gas and sewage.
25.	TAC Manual- 1998 Twelfth edition	Tariff advisory committee's Manual for fire hydrant system.
26.	TAC Manual- 1998 Second edition	Tariff advisory committee's Manual for sprinkler system (Sprinkler regulations).
27.	I.S:15683	Portable Fire Extinguishers-Performance & construction – Specification.

8.5 plumbing

8.5.1 INTRODUCTION

The proposed “SMART CITY” is a development of project consists of residential and assembly buildings, Community building and other small public facilities areas. plot no 22-consisting three no’s of towers, out of two tower height is LG+UG+14th floors ,and remain Tower height is LG+UG+13th floors with consisting F –types of units ,LG & UG floors shall accommodate parking & various services facilities. Plumbing and fire protection water tanks, pump room be located at LG floors. The Project is being developed by Bhopal Smart city Development Corporation. Ltd. Proposed project shall be designed to achieve minimum rating as per IGBC.

8.5.2 SCOPE OF WORK

This report is intended to cover engineering and technical details relating to the following heads in Plumbing and Fire suppression services:

(a) **External Water Supply**

- Sourcing
- Storage
- Pumping & Distribution system

(b) **Internal Plumbing Works**

- Internal water supply
- Hot water supply
- Soil, waste and rain water pipes
- Disposal to 1st manhole

(c) **Sewerage System**

- Conveyance
- Disposal to external sewerage system
- Reuse of treated water from STP for
 - Flushing of Toilets
 - Horticulture Purpose

(d) **Storm Water Drainage System**

- Collection
- Conveyance
- Rain water harvesting for recharging aquifer and disposal of average fall of one day storm water based on IGBC requirement.

(e) **Garden Hydrant System**

- Based on IGBC-Garden Hydrant system consisting variable frequency drive pumps, and moisture sensor controller, Time based controller and pressure regulating device with drip irrigation.

8.5.3 DESIGN CONSIDERATION

Occupants comfort, sustainable development and ease in maintenance are the main considerations for the scheme.

- There shall be enough potable water on continuous basis to every usage points.
- Proper use of treated effluent from the BSCDCL existing centralize recycle water line outside plot wherever possible to achieve minimal use of fresh water.
- Quick disposal of rainwater without stagnation and flooding and maximum use of storm water to recharge the aquifer.
- Minimize the energy requirements by using variable frequency driven pumping system.
- Reliable fire suppression system.
- Evolve a cost effective, Maintenance friendly and functionally efficient system.
- Minimize adverse impact on environment.

8.5.3.1 Green Building Compliance

- Following measures will be taken to comply with Green Building Certification:
- Variable frequency driven pumping system wherever possible and required.
- Use of dual flush cistern water closet 2/4, sensor operated flush for urinals and taps for Common toilets and low flow faucets along with flow regulator in toilets and kitchen.
- Rain water harvesting to recharge aquifer.
- Pressure reducing valve.
- Drip Irrigations.

8.5.4 SALIENT FEATURES OF PROJECT

Salient Features of The Site

(a)	Type of Building	Mix land use
(b)	Height of Buildings for plot no-22	Side Towers - F Type- LG+UG+14 th Floor
		Front Tower- F Type- LG+UG+13 th Floor
(b)	Height of Buildings for plot no-23	Towers - G Type- LG+UG+11 th Floor
(e)	Category of the Building (As Per NBC)	Residential + Assembly Building
(f)	Total No. of Floors	Plot No-22
		Side 2 Tower- F Type- LG+UG+14 th Floor.
		Front Tower- F Type- LG+UG+13 th Floor.
		Towers - G Type- LG+UG+11 th Floor

8.5.5 WATER SUPPLY SYSTEM

8.5.5.1 Design Calculations

The scheme has been designed considering 5 persons per dwelling unit for Residential, 1 person per 3 sqm for assemble area.

Detailed water calculations are given below in Table-1

TABLE-1 (WATER REQUIREMENT)

PLOT NO-22						
S. No.	Occupancy	Description	Units/Area	Total Population	Total Water requirement	
					LPCD	LPD
1.	Tower-F	328 units	5 person/unit	1640	150	246,000
	Visitors	-	10% of total population	164	15	2460
2.	Community building (Visitors)	-	LUMPSUM		15	50000
	Staff	-	5% of total population	15	45	675
Total Water requirement						300 KL
Say						300 KL

TABLE- 2 (WASTE WATER CALCULATIONS)

Total Water Requirement	300 KLD
• Fresh(70% of Total water)	200 KLD
• Flushing (30% of Total water)	100 KLD

5.2 TABLE-3 (U.G WATER TANKS)

S.no.	Description	Round-off
A.	DOMESTIC WATER	
1.	Domestic Water Requirement	Say 200 KL/DAY
	Total Domestic water	Say 200 KL/DAY
B.	RECYCLED WATER	
1.	Flushing Water Requirement	Say 100 KL/DAY
2.	Gardening and Landscape @ 3 Liters per day per sqm	Say 15 KL/DAY
	TOTAL	Say 115 KL/DAY

II- OVERHEAD STORAGE

TABLE-4

S.N	TOWER	Daily Demand		Over Storage (1/2 Day Demand)		Soft water Demand in KL
		Domestic in KL	Flushing in KL	Domestic in KL	Flushing in KL	
1.	Tower LG+UG+14 Floors.	28	14	14	7	-
2.	Tower LG+UG+13Floors.	26	13	13	6.5	-

TABLE-5 (WATER REQUIREMENT)

PLOT NO-23

S. No.	Occupancy	Description	Units/Area	Total Population	Total Water requirement	
					LPCD	LPD
1.	Tower-G	352 units	5 person/unit	1760	150	264,000
	Visitors	-	10% of total population	176	15	2640
2.	Community building (Visitors)	-	LUMPSUM		15	50000
	Staff	-	5% of total population	15	45	675
Total Water requirement						316 KL
Say						325 KL

TABLE- 6 (WASTE WATER CALCULATIONS)

Total Water Requirement	325 KLD
• Fresh(70% of Total water)	216 KLD
• Flushing (30% of Total water)	97.5 KLD

TABLE-7 (U.G WATER TANKS)

S.no.	Description	Round-off
A.	DOMESTIC WATER	
1.	Domestic Water Requirement	Say 225 KL/DAY
	Total Domestic water	Say 225 KL/DAY
B.	RECYCLED WATER	
1.	Flushing Water Requirement	Say 100 KL/DAY
2.	Gardening and Landscape @ 3 Liters per day per sqm	Say 15 KL/DAY
	TOTAL	Say 115 KL/DAY

OVERHEAD STORAGE**TABLE-4**

S.N	TOWER	Daily Demand		Over Storage (1/2 Day Demand)		Soft water Demand in KL
		Domestic in KL	Flushing in KL	Domestic in KL	Flushing in KL	
1.	Tower LG+UG+11 Floors.	24	12	12	6	-

8.5.6 SOURCE

- (a) Water connection from BSCDCL authority water main for all potable application.
- (b) Tanker supply as standby source for all potable application as alternate source.
- (c) Treated effluent from BSCDCL authority water main for all non-portable application such as flushing, irrigation.

8.5.7 WATER DISTRIBUTION SYSTEM

8.5.7.1 *Domestic Water Supply and Distribution System*

Water from BSCDCL authority main will be brought to the underground static fire tank and allow it to overflow into the domestic water tank. The domestic water shall be stored in the domestic water tank. Each tank will be in two compartments to facilitate cleaning and uninterrupted supply.

Stored and disinfected water from the underground domestic storage tank will be pumped to overhead water tank through one sets of VFD pumps. Pipe line will be laid at LG ceiling up to the tower blocks and through the shaft this will be connected to the overhead fire tank and overflow from the overhead fire tank will be connected to overhead domestic storage tank. Motorized valve with level sensing probes in domestic overhead tank and control panel will be provided to shut-off the valve when domestic overhead tank is full and to open the valve when water level is low in overhead domestic tank. A bypass arrangement will be made to the motorized valve to facilitate maintenance of the motorized valve. Another bypass connection will be made directly to the down take line along with a NRV and manually operated lockable valve to ensure uninterrupted supply to all wet areas during the cleaning of overhead tank.

Water distribution at each floors will be gravitational, Above three floor will be boosted from terrace and all floors down below will be fed by gravity. Bucket or Y strainer will be provided with bypass arrangement at tank outlet to check solid particles and to ensure proper performance of the faucets.

Pressure Reducing Valve (PRV) will be provided where static head of water exceeding more than 2.5 kg/sq. cm. PRV will be provided at the branch line feeding to toilet/ kitchen after the control valve.

8.5.8 Flushing Water Supply & Distribution System

Treated water from exiting BSCDCL main will be stored in flushing water tank.

Water will be pumped from flushing UGT to OHWT with VFD arrangement, and controlled through Motorized valve with level sensing probes and control panel will be provided to shut-off the valve when flushing overhead tank is full and to open the valve when water level is low in overhead flushing water tank. A bypass arrangement will be made to the motorized valve to facilitate maintenance of the motorized valve. Another bypass connection will be made directly to the down take line along with a manually operated lockable valve to ensure uninterrupted supply to all wet areas during the cleaning of overhead tank.

PRV will be provided where static head of water is exceeding more than 2.5 kg/sq. cm and this PRV will be provided at the branch line feeding to toilet after the control valve.

8.5.8.1 *Water Demand of Irrigation, Soft Water & Distribution System*

Water demand for irrigation system shall be met from the BSCDCL main and stored in tank of variable speed pump of adequate capacity will be installed. These pumps will be controlled by pressure sensing system.

8.5.8.2 *Location of Under Ground Tank & Pump Room*

Pump Room is Located in LG floor level.

8.5.9 MATERIALS FOR WATER SUPPLY

- | | | |
|---|---|--|
| Authority Connection to UGT | – | DI-K-7 conforming to IS:8329 / 2000- |
| Water Supply Pumping Main | – | GI Pipe –Class-C conforming to IS: 1239 with malleable iron fittings. |
| Terrace floor rings main for down take - 1239 | - | GI Pipe – Class-C conforming to IS: 1239
With malleable iron fittings |
| Piping in shaft for down takes | – | CPVC SDR-11& schedule-40 for Hot Water & Cold |
| Piping for irrigation | - | HDPE |
| Valves
50mm dia. | – | up to 40 mm dia. Brass Ball Valve and
and above butterfly Valve conforming to IS: 13095 |
| Insulation to hot water piping | – | Polyolefin extruded pipe section. |

8.5.10 SEWERAGE SYSTEM

8.5.10.1 *Internal Drainage*

The soil and waste shall be carried down in two stack vented pipes. Two pipes drainage systems shall be adopted as per IS standard. The sanitary, waste & vent system shall be water tight and gas tight designed to prevent escape of foul gas and odour from various fixtures. Provision of Maxi vents and Maxi filtra shall be made for hygiene, safety considerations, and to avoid entry of foul smell into occupied areas.

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

It is proposed to use CI pipe IS:3989 for all vertical & horizontal soil drainage, for terrace rain water down take proposing SWR pipe 13592 for first floors avoiding thrust of rain water that will be replaced with CI pipe . The soil & waste piping shall be under-sunken and the horizontal header shall be

subsequently connected to the vertical stack located inside the associated pipe shaft which shall be coordinated carefully with other services and in consultation with Architect. Care shall be taken to avoid pipe runs in electrical switch rooms, PABX rooms and other critical areas.

Provision for cleaning and Roding eyes shall be made at strategic locations to allow the system maintenance. Provision of drip tray is also proposed for critical areas to avoid dripping of leaking pipes.

8.5.10.2 *Sunken Slab Requirement*

We are proposing all balcony & toilet to sink by 100 & 400 mm respectively. Main drain pipe will be laid under the sunk..

8.5.10.3 *External Sewerage System*

Sewer line will be laid around the periphery of the buildings. Internal waste water line will be connected to this sewer line through manholes. Sewer line will be laid at adequate depth and manholes will be provided at maximum of 30 meter distance to facilitate cleaning. Entire sewage generated from the building will be connected to the existing BSCDCL network outside plot boundary.

8.5.10.4 *Material for the sewerage system.*

Proposed RCC Pipe NP2/NP3 as per IS-458.and provides bedding accordingly the required strength of pipe for particular condition.

8.5.10.5 *Manholes*

The manholes shall be constructed of brick masonry as per CPWD specifications and sizes will:-

Type 'A' - Circular Manhole of size 900 mm dia. Up to 1499 mm depth.

Type 'B' - Circular Manhole of size 1200 mm dia. From 1500 mm depth to 2349mm depth.

Type 'C' - Circular Manhole of size 1500mm dia. Beyond 22350 mm depth and beyond.

8.5.10.6 *Manhole Covers*

Heavy duty SFRC Manhole cover with frame conforming to IS: 12592 shall be provided, as required.

8.5.11 RAIN WATER / STORM WATER DRAINAGE AND RAIN WATER HARVESTING ARRANGEMENT

- a) Rain water from the roof top of buildings and balcony will be drained out to the rain water stacks located at strategic positions within the shaft or at exposed positions as directed by the building Architect or as per building profile. These vertical pipes will be brought up to LG floor ceiling and diverted to the external storm water line along the ceiling. Another option is to dispose rain water from the building to the drain at ground level in case adequate filling is available over the extended basement.

It is anticipated that occupants may use the balcony adjoining to the kitchen for keeping washing machine and they may dispose waste water from the washing machine to this balcony drain.

At surface level storm water drain along with road gully/catch basin will be located at strategic location depending upon the landscaping and ground levels. Water collected through this storm water drain along with rain water from the roof will be diverted to rain water harvesting arrangement.

- b) Due to urbanization of the land and sharp growth in population and thus increase in water demand for various uses, the fresh water is becoming scarce in most regions. In certain areas due to almost total dependency on the ground water and over extraction aquifer is depleting in an alarming way. Saline water intrusion into the aquifer has been witnessed in many developed areas. Also due to increase in paved surface/roof areas, the amount of natural percolation of rain water is reducing.
- c) Therefore, it has become very necessary to harvest the rain water as maximum as possible (Accordingly-IGBC) and either store the harvested water for use or use the harvested water for recharging aquifer. The drainage system needs to be planned with a view to incorporate rainwater harvesting to recharge the aquifer. Ministry of Environment and Forest has made it mandatory to harvest the rain water. The drainage system needs to be planned with a view to incorporate rainwater harvesting principles, as detailed in the following sections.

8.5.11.1 *Design Parameters.*

MOEF/ State Environment Impact Assessment Authority (SEIAA) recommends 15 minute holding capacity based on 77 mm rain fall per hour. Therefore, we have considered rainwater harvesting arrangement based on 77 mm rain fall. However storm water drainage line will be designed for 77 cm/hr rainfall.

Runoff Co-efficient for various surfaces are:

- a) Terraces & rooftop - 80%
- b) Road and paved surfaces - 70%
- c) Landscaped areas, gardens, parks etc. - 20%

MOEF/ SEIAA recommend one injection bore hole per every acre of developments. In this scheme there will be rain water retention tanks. As directed by the CGWB depth of these bore holes will be 5 meter short of the water table prevailing at the site. Proper de-silting and oil separation arrangement will be made before connecting storm water line to the harvesting arrangement as per the guidelines of MOEF/SEIAA/CGWB. Surplus/ Excess water from the harvesting arrangement will be allowed to overflow into the storm water drain of BSCDCL Authority drain.

8.5.11.2 *Lower Ground Drainage*

Adequate number of drain channel will be provided at parking level to collect wash water from the parking area. These drains will be covered with MS grating of proper strength. All channels directly connected with catch basin, if at some location due to levels different not possible at where provide Sumps with non-clog open impeller pumps will be provided in adequate number depending on drain channel layout. Channels will be interconnected for proper functioning during the failure of a particular set of pumps in a sump. Collected water in the sump will be pumped to the external storm water line. Both pumps in the sump will be working during emergency.

8.5.11.3 *Subsoil Drainage.*

It is assumed that extensive plantation is planned over the ground floor, if some where planning is done above structure slab so for avoiding seepage. Therefore, it will be necessary to provide well designed subsoil drainage over the area to drain out the percolated water. We are proposing 20mm thick PVC drain cell along with 150 GSM geo textiles for this purpose. PCC screed will be laid at Basement roof where plantation is proposed to slop towards the drain out point. This drain out points will be located 25 meter apart or as per site condition. Drain out from these points will be connected to the basement drain

8.5.12 INTERNAL PLUMBING SYSTEM

8.5.12.1 Details of System

1.	System Designed	Two Pipe System
2.	Soil/Waste & Vent Pipe	
(a)	All main soil / waste pipes and branches	150/110 mm CI PIPE for sewer-Conforming to IS: 3989 and for Rain water- SWR 13592 type –B.
(b)	Vent Pipes	75 mm CI PIPE–Conforming to IS: 3989
(c)	Wash Basin waste connection to floor traps.	40mm GI pipe Conforming to IS: 1239
(e)	Floor Drain	63/50mm GI pipe Conforming to IS: 1239
(f)	Piping at Basement/ LG Ceiling Level	150 mm CI PIPE–Conforming to IS: 3989
(g)	External Sewerage Pipe up to 200 mm dia - Above 200 mm dia	RCC pipe Class NP2/NP3 conforming to IS:458
(h)	Manhole Covers	Heavy Duty SFRC cover Conforming to IS: 12592
3.	Rain Water Pipe	
(a)	Piping for Rainwater & Balcony Drain	150/110mm SWR PIPE–Conforming to IS: 13592
(b)	Rainwater Piping at Ceiling	150/110mm CI PIPE–Conforming to IS: 3989
(c)	External Storm Water Pipe	RCC Pipe Class NP2/NP3 Conforming to IS:458.
(d)	Manhole Covers	Heavy Duty SFRC cover Conforming to IS: 12592
(e)	Piping for Subsoil Drainage	75/110mm OD uPVC 6 Kg/Sq.cm Conforming to IS: 4985

8.5.12.2 Sanitary Fixtures and Faucets

- Sanitary fixtures shall be provided as decided by the Client/ Architect.

PLOT NO-22

1. DOMESTIC WATER SUPPLY TRANSFER PUMPS CALCULATION FOR PLOT- 22

Total Domestic water Requirement	= 200 KLD
Discharge of Pumps on 4 hour working	= 50 KL/Hr
Nos of Pumps	= 3 Nos (2 W + 1 S)
Discharge of one pump	= 25 KL/Hr
Say	= 25 KL/Hr

2. FLUSHING WATER SUPPLY TRANSFER PUMPS CALCULATION

Total Flushing water Requirement	= 100 KLD
Discharge of Pumps on 6 hour working	=25KL/Hr
Nos of Pumps	= 3 Nos (2 W + 1 S)
Discharge of one pump	= 12.5 KL/Hr
Say	= 12.5 KL/Hr

3. IRRIGATION WATER TRANSFER PUMPS CALCULATION

Total water Requirement	= 15 KLD
Discharge of Pumps on 1 hour working	= 5 KL/Hr
Nos of Pumps	= 2 Nos (1 W + 1 S)
Discharge of one pump	
Say	= 200 lpm

PLOT NO-23

4. DOMESTIC WATER SUPPLY TRANSFER PUMPS CALCULATION FOR PLOT- 23

Total Domestic water Requirement	= 225 KLD
Discharge of Pumps on 4 hour working	= 56 KL/Hr
Nos of Pumps	= 3 Nos (2 W + 1 S)
Discharge of one pump	= 26 KL/Hr
Say	= 25 KL/Hr

5. FLUSHING WATER SUPPLY TRANSFER PUMPS CALCULATION

Total Flushing water Requirement	= 100 KLD
Discharge of Pumps on 6 hour working	=25KL/Hr
Nos of Pumps	= 3 Nos (2 W + 1 S)
Discharge of one pump	= 12.5 KL/Hr
Say	= 12.5 KL/Hr

6. IRRIGATION WATER TRANSFER PUMPS CALCULATION

Total water Requirement	= 15 KLD
Discharge of Pumps on 1 hour working	= 5 KL/Hr
Nos of Pumps	= 2 Nos (1 W + 1 S)
Discharge of one pump	
Say	= 200 lpm

REFERENCE STANDARDS:

The design and planning of Plumbing System shall be done keeping in view the following codes and standards relevant to this specification:

1. Pipes and Fittings

IS : 458	Specification for precast concrete pipes (with and without reinforcement)
IS : 651	Salat glazed stone ware pipes and fittings.
IS : 1239 (Part 1)	Mild steel, tubes, tubulars and other wrought steel fittings : Part 1 Mild Steel tubes.
IS : 1239 (Part 2)	Mild Steel tubes, tubulars and other wrought steel fittings : Part 2 Mild Steel tubulars and other wrought steel pipe fittings.
IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.

IS : 1538	Cast Iron fittings for pressure pipes for water, gas and sewage.
IS : 1729	Sand Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 1879	Malleable cast iron pipe fittings.
IS : 1978	Line pipe
IS : 1979	High test line pipe.
IS : 2501	Copper tubes for general engineering purposes
IS : 2643 (Part 1)	Dimensions for pipe threads for fastening purposes : Part 1 Basic profile and dimensions.
IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes : Part 2 Tolerances.
IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes : Part 3 Limits of sizes.
IS : 3468	Pipe nuts.
IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).
IS : 3989	Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4346	Specifications for washers for use with fittings for water services.
IS : 4711	Methods for sampling steel pipes, tubes and fittings.
IS : 6392	Steel pipe flanges
IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage.

2. **Valves**

IS : 778	Specification for copper alloy gate, globe and check valves for water works purposes.
IS : 780	Specification for sluice valves for water works

purposes (50 mm to 300 mm size).

IS : 1703 Specification copper alloy float valves (horizontal plunger type) for water supply fittings.

IS : 2906 Specification for sluice valves for water works purposes (350 mm to 1200 mm size)

IS : 3950 Specification for surface boxes for sluice valves.

IS : 5312 (Part 1) Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.

IS : 5312 (Part 2) Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.

IS : 12992 (Part 1) Safety relief valves, spring loaded : Design

IS : 13095 Butterfly valves for general purposes.

3. **Sanitary Fittings**

IS : 771 (Part 1 to 3) Specification for glazed fire clay sanitary appliances.

IS : 774 Specification for flushing cistern for water closets and urinals (other than plastic cistern)

IS : 775 Specification for cast iron brackets and supports for wash basins and sinks

IS : 781 Specification for cast copper alloy screw down bib taps and stop valves for water services.

IS : 1700 Specification for drinking fountains.

IS : 2548 (Part 2) Specification for plastic seats and covers for water closets : Part 1 Thermoset seats and covers.

IS : 2556 (Part 1) Specification for vitreous sanitary appliances (Vitreous china) : Part 1 General requirement.

IS : 2556 (Part 2) Specification for vitreous sanitary appliances (vitreous china) : Part 2 Specific requirements of wash-down water closets.

IS : 2556 (Part 3) Specification for vitreous sanitary appliances (vitreous china) : Part 3 Specific requirements of squatting pans.

- IS : 2556 (Part 4) Specification for vitreous sanitary appliances (vitreous china) : part 4 specific requirements of wash basins.
- IS : 2556 (Part 6 Sec 2) Specification for vitreous sanitary appliances (vitreous china) : part 6 Specific requirements of urinals, section 2 half stall urinals.
- IS : 2556 (Part 6 Sec 4) Specification for vitreous sanitary appliances (vitreous china) : Part 6 specific requirements of urinals, section 4 partition slabs.
- IS : 2556 (Part 6 Sec 5) Specification for vitreous sanitary appliances (vitreous china) : Part 6 Specific requirements of urinals, section 5 waste fittings.
- IS : 2556 (Part 6 Sec 6) Specification for vitreous sanitary appliances (vitreous china) : Part 6 Specific requirements of urinals, section 6 water spreaders for half stall urinals.
- IS : 2556 (Part 7) Specification for vitreous sanitary appliances (vitreous china) : Part 7 Specific requirements of half round channels.
- IS : 2556 (Part 8) Specification for vitreous sanitary appliances (vitreous china) : Part 8 Specific requirements of siphoning wash down water closets.
- IS : 2556 (Part 11) Specification for vitreous sanitary appliances (vitreous china):Part 11 Specific requirements for shower rose.
- IS : 2556 (Part 12) Specification for vitreous sanitary appliances (vitreous china) : Part 12 Specific requirements of floor traps.
- IS : 2556 (Part 15) Specification for vitreous sanitary appliances (vitreous china) : Part 15 Specific requirements of universal water closets.
- IS : 2692 Specification for ferrule for water services
- IS : 2717 Glossary of terms relating to vitreous enamelware and ceramic metal systems
- IS : 2963 Specifications for waste plug and its accessories for sinks and wash basins.
- IS : 3311 Specification for waste plug and its accessories for

sinks and wash basins.

- IS : 5961 Specification for cast iron gratings for drainage purposes.
- IS : 6249 Specification for gel-coated glass fibre reinforced polyester resin bath tubs.
- IS : 6411 Specification for gel-coated glass fibre reinforced polyester resin bath tubes.
- IS : 8931 Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services.
- IS : 9758 Specification for flush valves and fitting for water closets and urinals.

4. **Water Quality**
Tolerance

- IS : 3025 (Parts 1 to 44) Method of sampling and test (physical and chemical) for water and waste water.
- IS : 4764 Tolerance limits for sewage effluents discharged into inland surface waters.
- IS : 10500 Drinking Water

5. **Pumps & Vessels**

- IS : 1520 Specification for horizontal centrifugal pumps for clear cold fresh water.
- IS : 2002 Steel plates for pressure vessels for intermediate and high temperature service including boilers.
- IS : 2825 Code for unfired pressure vessels.
- IS : 4648 (Part 1) Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining.
- IS : 5600 Specification for sewage and drainage pumps
- IS : 8034 Specification for submersible pump sets for clear, cold, fresh water.
- IS : 8418 Specification for horizontal centrifugal self priming

pumps.

6. **General**

SP : 6 (1)	Structural Steel Sections
IS : 325	Three Phase Induction Motors
IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 779	Specification for water meters (domestic type).
IS : 782	Specification for caulking load.
IS : 800	Code of practice for general construction in steel
IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.
IS : 1172	Code of Basic requirements for water supply drainage and sanitation.
IS : 1367 (Part 1)	Technical supply conditions for threaded steel fasteners : Part 1 introduction and general information.
IS : 1367 (Part 2)	Technical supply conditions for threaded steel fasteners : Part 2 product grades and tolerances.
IS : 1726	Specification for cast iron manhole covers and frames.
IS : 1742	Code of practice for building drainage.
IS : 2064	Selection, installation and maintenance of sanitary appliance code of practice.
IS : 2065	Code of practice for water supply in buildings.
IS : 2104	Specification for water meter for boxes (domestic type)
IS : 2373	Specification for eater meter (bulk type)
IS : 2379	Colour code for identification of pipe lines.
IS : 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.

IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.
IS : 3114	Code of practice for laying of cast iron pipes
IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system : Part 1 manholes.
IS : 4127	Code of practice for laying glazed stoneware pipes.
IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5455	Cast iron steps for manholes.
IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
IS : 7558	Code of practice for domestic hot water installations.
IS : 8321	Glossary of terms applicable to plumbing work.
IS : 8419 (Part 1)	Requirements for water filtration equipment : Part 1 Filtration medium sand and gravel.
IS : 8419 (Part 2)	Requirements for water filtration equipment : Part 2 under drainage system.
IS : 9668	Code of practice for provision and maintenance of water supplies and fire fighting.
IS : 9842	Preformed fibrous pipe insulation.
IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.
IS : 10446	Glossary of terms relating to water supply and sanitation.
IS : 11149	Rubber Gaskets

IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings..
IS : 12183 (Part 1)	Code of practice for plumbing in multistoried buildings : Part 1 water supply.
IS : 12251	Code of practice for drainage of building basements.
IS : 5572	Code of practice for sanitary pipe work.
BS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages.
BS : 8301	Code of practice for building drainage.
BSEN : 274	Sanitary tap were, waste fittings for basins, bidets and baths. General technical specifications.

7. **Electrical**

IS : 1646	Electrical installation fire safety of buildings (general) Code of practice.
IS : 732	Code of practice for electrical wiring and installation.
IS : 694	PVC insulated Electric cable for working voltage up to and including 1100 volts.
IS : 1885	Glossary of items for electrical cables and conductors
IS : 1554 (Part - I)	PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.
IS : 7098 (part 1)	Specifications for cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100 volts.
IS : 10810	Methods of test for cables.
IS : 8130	Conductors for insulated electric cables and flexible cords
IS : 8623 - (Part – I,II,III)	Specification for low voltage switches and control gare assembly
IS : 5578 & 11353-	Marking and arrangement of bus bars

IS : 5133 (Part -I)	Boxes for the enclosure of electrical accessories.
IS : 2147	Degree of protection provided by enclosures for LV switchgear and control gear.
IS : 13947 (Part-I,II,III)	General requirement for switchgear and control gear for voltage not exceeding 1000 Volts.
IS : 13947 (Part-II)	Air Circuit Breakers
IS : 13947	Moulded Case Circuit Breakers
IS : 8828 -	Miniature Circuit Breakers
IS : 12640	Earth Leakage Circuit Breakers
IS : 9537 -	Specification of conduits for electrical installation
IS : 3480	Flexible steel conduits for electrical wiring.
IS : 14768	Conduit fittings for electrical installation.
IS : 1293	Three pin plugs and sockets outlets rated voltage up to and including 250 volts and rated current upto and including 160 amps
IS : 4615	Switch socket outlets.
IS : 2551-	Danger notice plate.
IS : 3043	Code of practice for earthing.
IS 15652 : 2006	Rubber mat for electrical insulation.
IS : 5216 (Part-I)	Guide for safety procedures and practices in electrical work.

8.6 ict

DESIGN CRITERIA

1. CCTV SURVEILLANCE SYSTEM

Criteria for selecting CCTV cameras and CCTV system components considering the various areas of the plot 22 & 23 shall be as follows:

Type of device	Area
CCTV Monitors	Surveillance Room
NVR(Network Video Recorder)	Surveillance Room
Ethernet switches	a) Lower ground floor b) Upper ground floor of both plots 22 & 23.
Indoor fixed IP Dome Cameras	a) Lower ground floor b) Upper ground floor of both plots 22 & 23.

2. **ACCESS CONTROL SYSTEM**

Criteria for selecting ACS and ACS system components considering the various areas of the plot 22 & 23 shall be as follows:

Type of device	Area
ACS Client PC	Security Cabin at entry & exit gate
Boom Barriers	at Entry & Exit gate
Long range Reader	at Entry & Exit gate
Access reader interface controller	Security Cabin at entry & exit gate

3. **FIRE DETECTION & ALARM SYSTEM**

Criteria for selecting detectors and devices considering the various areas of the

Plots 22 & 23 shall be as follows:

Type of detector/ devices	Area/ Environmental conditions
Fire Alarm Control Panels : a) Main Fire alarm panel b) Repeater panel	a) Surveillance Room b) Security Cabin
Addressable Dual Optical thermal Sensor	a) Lower ground floor b) Upper ground floor of both plots 22 & 23.
Manual call point	At Lift lobby/staircase areas of all floors of both plots 22 & 23.
Hooter with strobe	At Lift lobby/staircase areas of all floors of both plots 22 & 23.

This tabular gives you an overview of system design and system components in typical fire detection & Alarm system.

4. **VIDEO DOOR PHONE**

Criteria for selecting devices considering the various areas of the Plots 22 & 23 shall be as follows:

Type of device	Area
Main gate Guard Unit	Security Cabin at entry
Resident unit consisting of monitor unit (inside the flat) and the door/camera unit (outside the flat)	at each flat of each floor except lower & upper ground floor.
Client PC for VDP application software	Security Cabin at entry

This tabular gives you an overview of system design and system components in typical video door phone system.

5. **GIGABIT PASSIVE OPTICAL NETWORK (GPON)**

Criteria for selecting devices considering the various areas of the Plots 22 & 23 shall be as follows:

Type of device	Area
Optical Line Terminal (OLT) Equipment	Security Cabin at entry gate
A Common 1x1:16 splitter	For 3floors per a wing is considered for VDP, IPTV, Internet and Intercom services.
Optical Network Terminal (ONT) Equipment	At each flat of each floor except lower & upper ground floor.
Client PC/Server for GPON application software	Security Cabin at entry

This tabular gives you an overview of system design and system components in typical GPON system.

8.7 storm water

General

The main objective of this report is to form the prefeasibility and design basis of storm water drainage system for a Bhopal Smart City-Area Based Development (ABD). This involved planning an integrated Storm-water management for Area Based Development (ABD) in harmony with flood management, conceptualizing and finalizing the storm water drainage system, including the outfalls.

Presently entire site consists of various land use land cover (LULC). Land cover like Green Area (Loamy), residential and commercial areas, unpaved area along the road, lawns and parks found in significant amount on site. After development of the whole site maximum land cover may changes to paved area resulting in to the post development flow of runoff. To take care of additional flow attenuation structure like retention ponds, detention & rain water harvesting structures are proposed in ABD area. Further in excess flow due to development will be addressed at each parcel level by means of Rainwater harvesting system. This will subsequently increase ground water potential and reducing the flash flood in each parcel.

Bhopal Smart City – ABD project area is of 148.67 Ha consisting of North TT nagar and South TT Nagar areas. The project area is located at a higher elevation of RL 540m and is sloping on all sides. It is observed from Figure No.1-1, the level difference was about 35m; there are two existing nallah that runs along North West boundary and South boundary respectively namely Banganga nallah and Panchsheel nallah. The northern part of the project area is sloping towards Banganga Nala. The rest of the slopes towards the Bada Nala / Panchsheel Naala (refer Figure No.1-2). The flood level or High Tide level or low tide level of this nallah will govern the disposal mechanism.

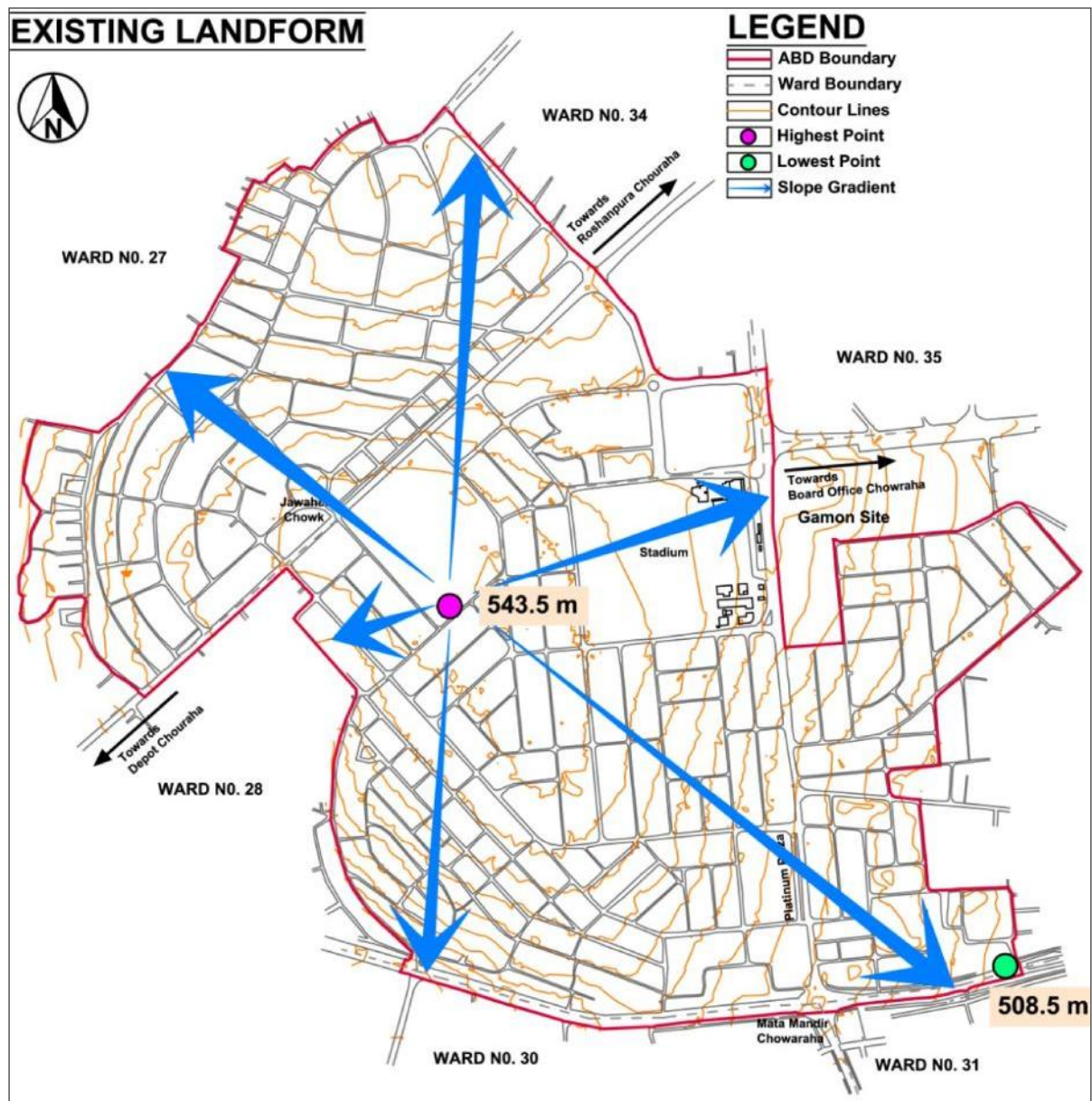


Figure 1-1: Land Form Analysis

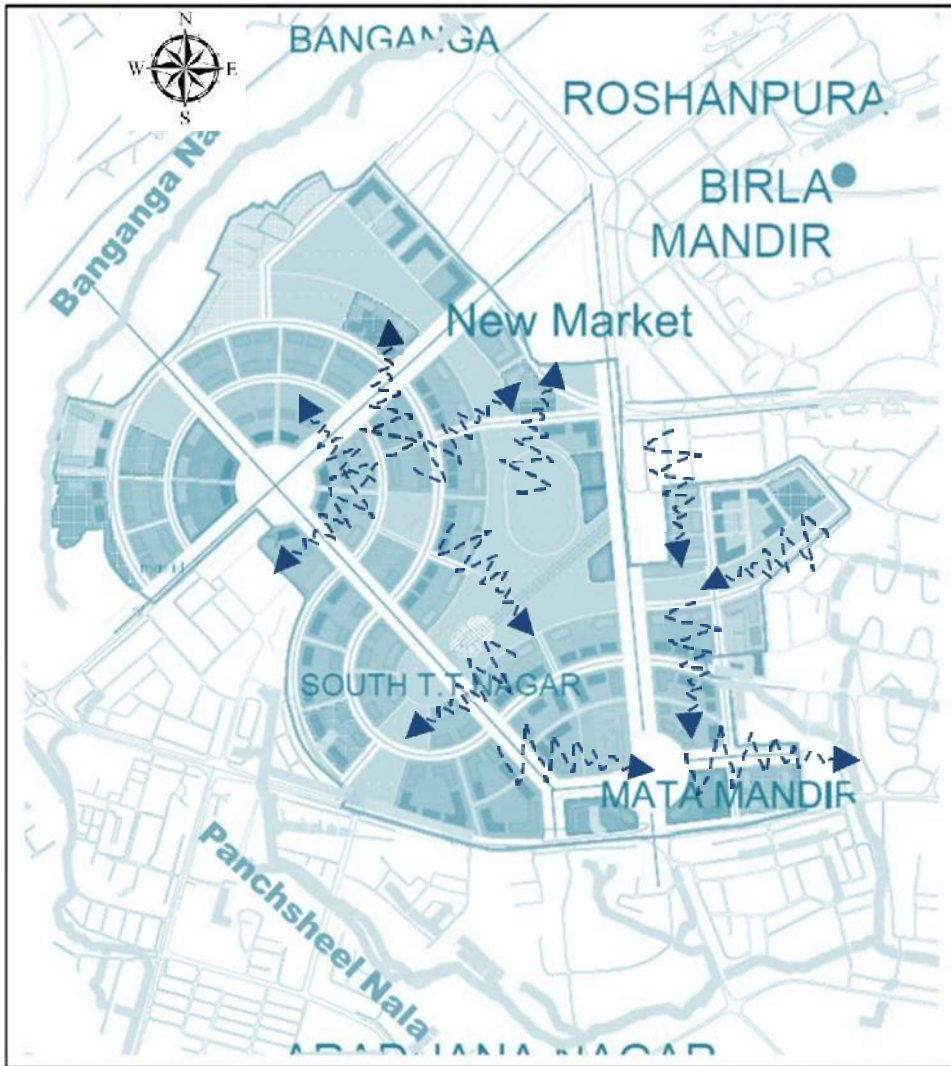


Figure 1-2: Surrounding drainage Features of project area and Runoff Flow Direction

Topography

Area around the Model school is located at higher elevation of RL 541.96 within the project boundary. The area above the Badbadha road is sloping towards the North-west direction. The ground elevation varies from 541.96m to 518.00 m (near Palash residency). The area below the model school is sloping toward the south-west Direction. The ground elevation varies from 541.96m to 517.00 m. The area towards the right of New Market road is sloping towards south east direction. The Digital Elevation Model of the terrain of project area is shown in **Error! Reference source not found.**

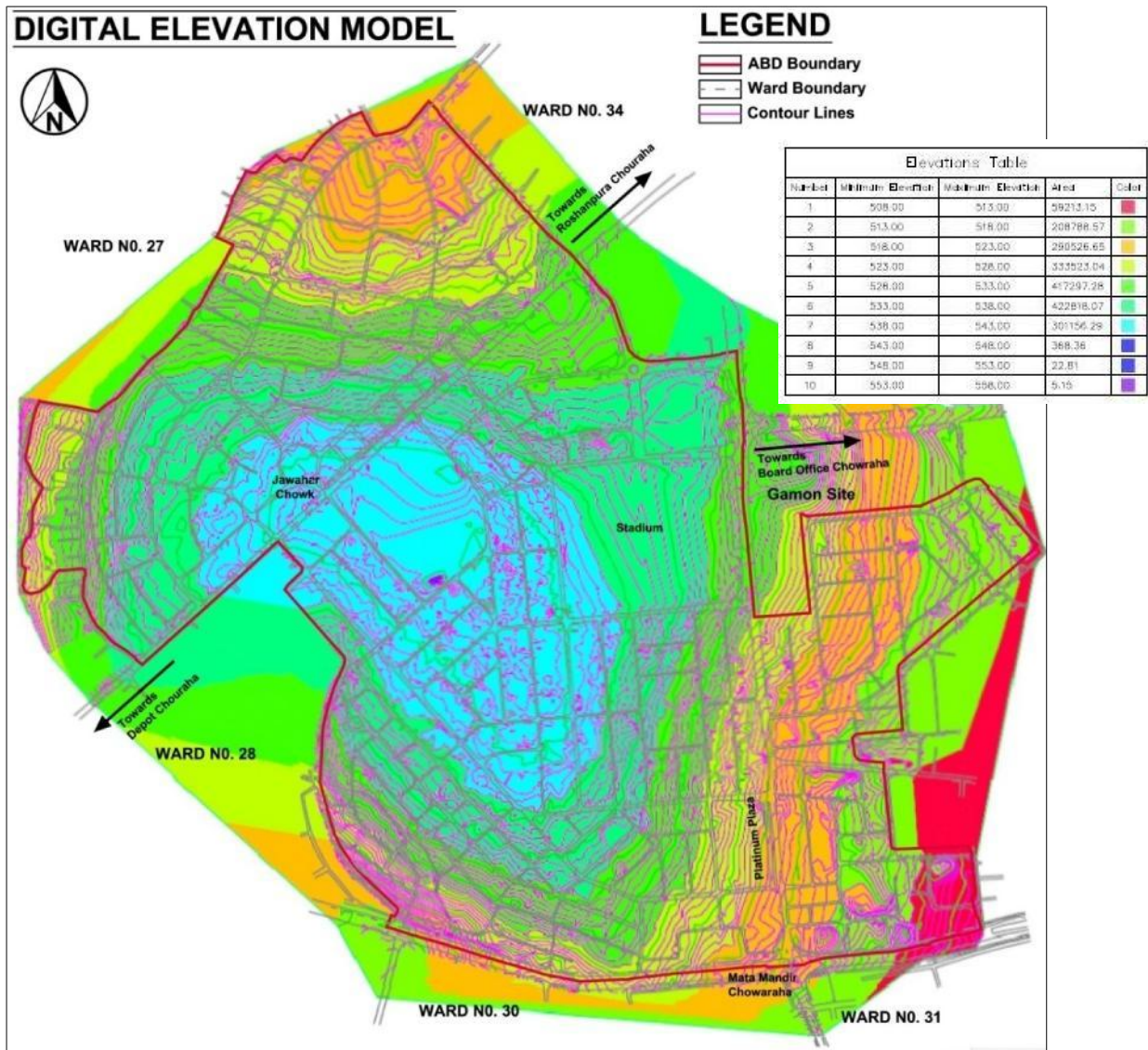


Figure 1-3: Digital Elevation Model of ABD Area

Rainfall

The annual normal rainfall of the region is 1146 mm. The maximum rainfall occurs during the monsoon period i.e. from June to September. August is the wettest month having the normal rainfall of 363 mm followed by July with a normal rainfall of about 354.10mm.

Catchment Area

The Total Catchment area that contributes is about 405 acres, of which 30 acres of external catchment is flowing towards the project area. This includes area between Rangmahal chowk and Roshanpura Square till Banganga.

The project area contributes to two main drains

- Banganga Catchment
- Bada Nala/ Panchsheel Catchment

Banganga Catchment:-

Banganga catchment covers an area of 3.19 sq km; the natural drain starts form Gomanthika campus near Depot intersection and crosses through low lying areas of TT Nagar before out falling into lower Lake. The Banganga generally crosses

through low lying areas and Banganga slum. Low lying area adjacent to the drain used to get flooded during monsoon. About 42 ha of project area contributes to this catchment

Bada Nala/ Panchsheel drain:

Bada Nala Catchment starts from TT Nagar South near P&T intersection and crosses through gitanjali complex, aradhna nagar, panchsheel nagar and other residential area before outfalling into Shahpura Lake. It is unlined up to U/S of culvert near P&T bus stop.

Both the Primary drains lie outside the project area. The alignment of primary drains lying outside the project boundary is shown in Figure 1-4.



Figure 1-4: Drainage pattern in ABD Area

hydraulic / hydrologic design criteria

The frequency of storm for which the system is to be designed depends on the importance of the area to be drained. Commercial and industrial areas have to be designed critically so that they are subjected to less frequent flooding. It is necessary to provide sufficient capacity to prevent frequent flooding of the drainage area. The Manual on Sewerage and Sewage treatment by CPHEEO and IRC SP: 50-1999 recommend a return period of once in 2 year for designing the urban drainage system.

Well planned urban drainage particularly for township in brown field is somewhat new in India. Hence it was decided that the design stormwater management of the ABD area is done by considering 5 year return period and 88.22mm/hr rainfall intensity than that provided in CPHEEO and IRC practices.

computation of rainfall intensity

It has been observed that shorter the duration of critical rainfall, greater would be the expected average intensity during that period. The critical duration of rainfall is the one which produces maximum runoff. This duration is equal to the time of concentration, since shorter period do not allow the whole area to contribute, and longer duration will give smaller average rainfall intensity.

The annual normal rainfall of the region is 1146 mm. The entire storm water drainage system has been designed for a return period of 5 years with 5 minutes minimum time of concentration restricting to a maximum velocity of 3.0m/s. For generation of IDF curves, Past 26 years rainfall data received from BMC.

IDF curve attached below gives variation of intensity (mm/hr) for different return periods ranging from Twice in one year to ones in 5 years for various durations of rainfall.

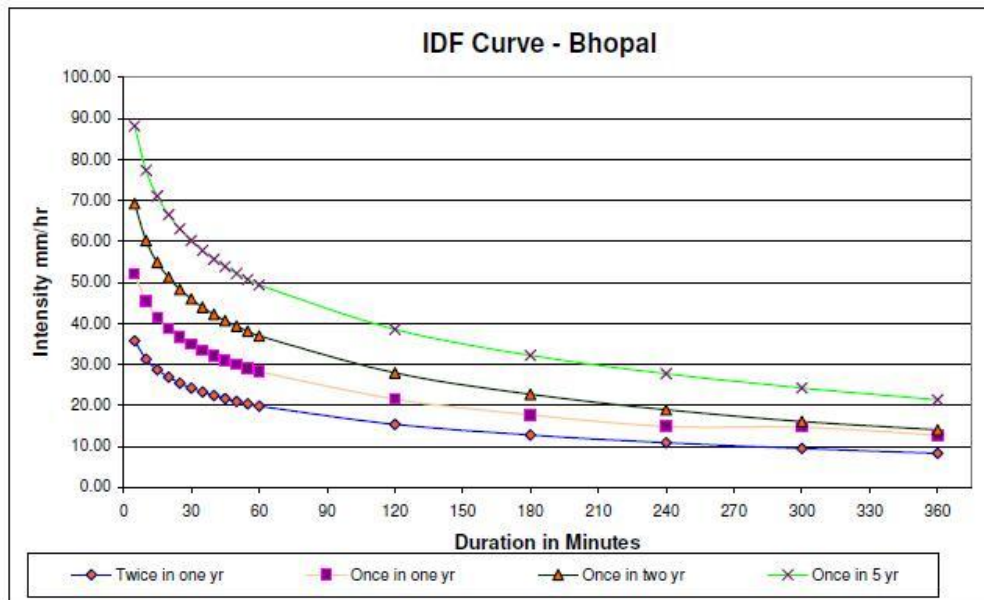


Figure 1-5: Duration - Frequency Curve for Bhopal City

Table 1-1 Rainfall intensity mm/hr against the duration in min

Duration in Minutes	Intensity of Rainfall, mm/hr			
	1/2 yr	1-yr	2-yr	5-yr
5	35.77	52.10	69.22	88.22
10	31.32	45.44	60.22	77.39
15	28.72	41.54	54.95	71.05
20	26.87	38.78	51.22	66.56
25	25.44	36.63	48.32	63.07
30	24.27	34.88	45.95	60.22
35	23.28	33.40	43.95	57.81
40	22.42	32.11	42.21	55.72
45	21.67	30.98	40.68	53.88
50	20.99	29.97	39.32	52.24
55	20.38	29.05	38.08	50.75
60	19.82	28.21	36.95	49.39
120	15.37	21.55	27.95	38.55
180	12.77	17.65	22.68	32.21
240	10.92	14.89	18.94	27.72
300	9.49	14.65	16.05	24.23
360	8.32	12.74	14.04	21.38

TIME OF CONCENTRATION

Time of Concentration is the time required for the rain water to flow over the ground surface from the extreme point of the drainage basin and reach the point under consideration. Time of concentration (t_c) is equal to inlet time (t) plus the time of flow in the drainage pipe (t_f). The inlet time is dependent on the distance of the farthest point in the drainage basin to the inlet manhole, the shape, characteristics and topography of the basin.

The Kirpich's equation is used for calculating time of concentration for each length of drain design which is stated as follows:

$$t_c = 0.0195 L^{0.77} S^{-0.382}$$

t_c = time of concentration in minutes

S = Slope from critical point to drain level

L = Distance of critical point to drain along the water course in m

T_c generally vary from 5 to 30 minutes.

In highly developed sections, the inlet time may be as low as 3 minutes (as per IRC: SP: 13). For the project area, the time of concentration of 10-30 min is used for different sub - catchments based on the calculations done considering the surface overflow time and travel time in plot drain. Following are the generalized t_c (time of concentration) for various sizes of sub-catchments:

Table 1-2: T_c for variable sub-catchment i.e. plot sizes

Sr. No.	Sub – Catchment Area (ha)	T_c (Time Concentration mins)	of in
1	< 1	7	
2	1-3	15	
3	3-4.5	20	

Sr. No.	Sub – Catchment Area (ha)	Tc (Time Concentration mins)	of in
4	>4.5	25	

estimation of storm runoff

The rational formula for relationship between peak runoff and rainfall is given below:

$$Q = k * C * I * A$$

Is a simple steady state water balance equation. If, for, a catchment of A square kilometres, the intensity is I mm/hr, the I volumetric intensity is. $A * I * 1000$ cubic meter per hour, or $0.28 * A * I$ cubic meter per second. With a runoff coefficient of C, the runoff will be

$$Q = 0.28 * C * I * A$$

Whereas Q is in cubic meter per second.

Runoff coefficient “C”, in CIA is the portion of the precipitation that makes its way to the drain, in storms. Its value depends on a large number of factors such as permeability of the surface, type of ground cover, the type of soils (curve number), the depth of the soil, , the topography, the geology, the antecedent conditions indicating the wetness of the soil structure from the earlier events, and duration of storm.

For the design and planning of the storm water disposal arrangements, reasonably wet antecedent conditions are assumed. If full data of soils is not available, standardized values are assumed. The weighted runoff coefficient for the project site is estimated based on standard texts and literature, and is shown in

Table 1-3: "C" values are used for various land use

Land use Type	C Value
Watertight pavement Surface (concrete or bitumen), steep bare rock	0.90
Green Area(Loamy)	0.30
Green Area(Sandy)	0.20
Unpaved Area along roads	0.30
Lawns and parks	0.15
Flat Built-up area with about 60 percent area impervious	0.55
Moderately steep built-up area with about 70 percent area impervious	0.80

(Source: C value for each land use as per Table-4.4 IRC: SP50-1999)

HYDRAULIC DESIGN OF drain sections:

Design formula

Manning's formula would be employed for design of gravity system

$$V_f = \frac{1}{N} \times R^{2/3} \times S^{1/2}$$

$$Q_f = V_f \times A$$

Where,

Q_f - Flow rate when pipe flows full; in m³/s

V_f - Velocity of the flow, in m/s

A - Cross sectional area of pipe in m²

N - Manning's roughness coefficient when pipe is full.

R - Hydraulic radius in m = A / P ; (P is Wetted Perimeter)

S - Slope of Hydraulic gradient

All the drains are designed 85% full.

Manning's n value for various materials is used as per CPHEEO Manual as shown in below

Table 1-4: Average Manning's coefficient roughness for various materials

Type of surface	Manning's 'n'
Cement concrete pipes	
a) Good Condition	0.013
b) Fair Condition	0.015
Brick pitched drain	0.017
Plastered brick surface	0.015
Plastered brick surface with neat cement finish	0.013
Dry rubble masonry	0.033
Dressed ashler surface	0.015
Dry stone pitching	0.020
Kutcha drain	0.025
Earth	
a) in ordinary condition	0.025
b) with stones and weeds	0.030
c) in poor condition	0.035

(Source: IRC: SP: 50 Table-4.3 and CPHEEO, 2013 Table 3.11)

The values highlighted in above table are used in the present study.

MINIMUM AND MAXIMUM VELOCITIES

While deciding the drain sections it is also required to keep in view the velocity in the drain. Drains are designed to achieve a minimum self-cleaning velocity of 0.60 m/sec as per CPHEEO at the design flow and a limiting maximum velocity up to 3.0 m/sec as per standard engineering practice.

MINIMUM FREE BOARD

With reference to clause 4.9.3 of IRC -SP 50(b), free board adopted for drain varies from 100 mm to 300mm based on the bottom width of drain.

Table 1-5: Free Board Criteria for Storm water drainage

Sr.No.	Drain Width (M)	Free Board (M)
1	< 0.3	0.1
2	0.3 to 0.9	0.15
3	0.9 to 1.5	0.3
4	> 1.5	Depends on discharge

(Source: IRC : SP-50-1999)

DESIGN SOFTWARE

Hydraulic design of storm water drain is modelled by using computer modelling software **Bentley Systems Storm CAD V8i**. The storm water drains are provided on both the sides of the road to collect the discharge from plots and road surface.

Steps for Developing Storm Water Network Model

The following steps will be followed to carry out the design storm water network,

- The storm water network model for project area will be developed and analysed using Bentley's Storm-CAD -V8i program.
- The contour map for the above mentioned area will be brought into Storm-CAD background and drainage network of minor and major catchments shall be carried out.
- Data inputs for catchment areas, runoff coefficients, time of concentration, IDF curves, shape, size and material of drains, topographic model etc, will be provided.
- Hydraulic design and analysis of entire storm water network done for 5 year return period considering rainfall intensity more than 88 mm/hr

Design Criteria for Storm Water Drain

Surface drains are considered as far as possible. Hume pipes/ Box culverts will be considered at some locations like road crossing / adverse slope etc.

Surface drains will be covered. Boundary catchment drains may be uncovered.

Rectangular section shall be provided for surface drains.

Minimum size of internal drains will be 300 mm X 300 mm.

Disposal Scheme

The HFL of the trunk drain in which proposed drainage system (drains along the internal roads) is discharging should be lower than the IL of the incoming drain. The proposed layout of the storm water drainage scheme is planned along the sides of the main arterial roads and peripheral boundary. Individual plot developer is expected to connect their internal drains to these main drains planned for the project area.

location of outfall

There are multiple possible out fall locations identified for the project area

- 1) Outfall-1: Discharge of storm water into Banganga nallah flowing towards lower lake along the northeast site boundary.

Table 1-8: Outfall and flow from outfall

Sr. No.	Free Outfall No.	Flow Cum/sec.	% Flow
1	O1	7.228	32.14873

RAIN WATER HARVESTING SYSTEM

The development of 148.67 Ha of ABD area will turn into integrated urban place which results in to an inevitable rise in site impermeability. Storm events will result in increased overland runoff for the same catchment area and lag time to peak flooding will significantly decrease. The natural annual recharge to existing aquifers on site will also reduce substantially.

Rainwater harvesting is a technology used to collect, convey and store rain water for later use from relatively clean surfaces such as a roof, land surface or rock catchment. The water is generally stored in a rainwater tank or directed to recharge groundwater. Rainwater infiltration is another aspect of rainwater harvesting playing an important role in storm water management and in the replenishment of the groundwater.

The practice of collecting rainwater from rainfall events can be classified into two broad categories: roof-based and land-based. Roof-based rainwater harvesting refers to collecting rainwater runoff from roof surfaces which usually provides a much cleaner source of water that can be also used as non-potable used after suitable treatment. Land-based rainwater harvesting occurs when runoff from land surfaces and road surfaces is collected in furrow dikes, ponds, tanks and reservoirs.

RAIN WATER HARVESTING DESIGN CONSIDERATIONS

Rainwater Harvesting, which implies conservation of rainwater is a tradition-renewed scientific technology applied to augment the groundwater both quantitatively and qualitatively. Three most important components, which need to be evaluated for designing the rainwater harvesting structure, are:

- Hydrogeology of the area including nature and extent of aquifer, soil cover, topography, depth to water levels and chemical quality of ground water.
- Area contributing for runoff i.e. how much area and land use pattern, whether industrial, residential or green belts and general built up pattern of the area.

- Hydro-meteorological characters like rainfall duration, general pattern and intensity of rainfall.

8.8 STP (Not in Scope)

1.2 Package STP Unit

Package STP is a combination units employed for sequential treatment of biodegradation, clarification and storage consisting of Aerobic bioreactor (oxygenated system) and plate settler. It has a hopper- bottomed geometry for thickening the separated sludge. The subsequent unit is a compartmentalized Treated Water tank, which stores treated sewage and is further pumped to tertiary system for purification.

The unit is provided with return biological sludge system for maintaining the desired microbial concentration in the oxygenated chamber.

The treatment plant shall comprise of the unit processes that are listed below namely:

1.3 Dewatered Sludge Quality Requirements

The dewatered sludge quality requirements to be met are listed below:

Treated Sludge Quality Requirements (Dewatered Sludge)				
Parameter		Units	For each STP	
Minimum	sludge TSS (dry solids)	% w/w	20%	

1.4 Treatment Process

The treatment process for STP under this contract is open. Bidder is free to adopt and use appropriate treatment process/technology for this project: However the technology selected should be such that the treatment parameters should meet the treated sewage standards as stipulated in the tender document. The treatment technology should also include sludge treatment and its safe disposal. Contractor shall provide a complete, fully functional facility designed for proper, easy, operation and to meet the stated performance requirements. This shall include any and all additional, ancillary, supporting, or other processes, components, equipment, or other items necessary to achieve these objectives, regardless of whether such items are explicitly listed in these bid documents or not.

The design/sizing criteria, minimum number of units, and other requirements for the various unit processes and components are listed below.

Minimum Number of Units or Modules to be Provided for Unit Processes		
Unit Process	STP Design Average Capacity =0.500 (MLD)	
	Number of Units (W=Working S=Standby)	
	W	S
Mechanical Screens	1	0
Manual Screens	0	1
Grit Removal (Mechanical)	1	0

Grit Removal (Manual)	0	1
Parshall Flume	1	0
Aeration/Biological Process Tank	2	0
Chlorination with baffle	1 (Two compartments)	0
Gravity Thickening	1	0
Sludge Dewatering	1	1
Plant Specific units depending on the Process proposed in this Bid		
Primary Clarification	2	0
Anaerobic tank	2	0
Anoxic Tank	2	0
Secondary Clarification	2	0
Primary Sludge Pumping	1	1
RAS/WAS Pumping	1	1
Flash Mixing Tank	1	0
Flocculation Chamber	1	0
Clarifier or Clariflocculator	1	0
Sand Filters and other units	As per CPHEEO	
Other tertiary Treatment Unit	As per design	

1.5 Process and Facilities Description

This Process and Facilities description is intended to provide a general indication of the various unit processes and type of facilities that the Contractor shall be required to design, construct, and operate, and applies to all STP in this contract unless specifically indicated otherwise. The Contractor shall use this description together with other specific information for each STP provided elsewhere in these bid documents, including but not limited all of which are integral to this Process and Facilities Description and are incorporated herein by reference.

The Bidder shall submit plant layout, process calculations, hydraulic calculations, hydraulic flow diagram, P&ID, mass balance calculations, electrical load list etc. along with technical bid for his proposed technology to illustrate the offer submitted with all technical details.

1.5.1 Receiving Chamber:

Gravity Sewer will discharge raw sewage into Receiving Chamber from where it shall be taken into downstream Coarse Screens. The function of the Receiving Chamber is to reduce the incoming velocity.

1.5.2 Coarse Screening

Adequate Nos. of Manual Coarse Screens shall be provided upstream of Wet Well for removal of floating and oversized material coming with the sewage.

The Coarse Screens shall screen out most of the medium & large floating and oversized material such as plastic rags, debris, weeds, paper, cloth, rags etc which could clog the waste water pump impellers. The Coarse Screens shall be inclined Bar Screen of stainless steel flats and shall be of sturdy design to take care of all sorts of materials envisaged in the gravity sewer. The screening material as collected will drop into a wheelbarrow for its disposal.

1.5.3 raw sewage collection tank/equilization tank:

Screened sewage after Coarse Screening shall enter into raw sewage collection tank/equalization tank. The capacity of the tank is such that adequate detention time is available during average and peak flow conditions. The effective liquid volume shall be provided below the invert level of the incoming sewer after leaving provision for freeboard. Also an additional depression shall be provided to ensure adequate submergence of Pumps. Pumping Station shall have a Room adequate for installing Electrical Panels. Suitable arrangement shall be provided for lifting of Pumps. Suitable combination of Submersible Pumps shall be provided to cater the pumping requirements at average and peak flow conditions. Based on incoming flow conditions, adequate nos. of Pumps shall start / stop automatically to cater the pumping requirements.

1.5.4 Primary Treatment Units

1.5.4.1 *Inlet Chamber*

Pumped sewage shall be provided at the STP location outside the plant boundary. The Contractor for this contract shall connect the incoming line to the inlet chamber of the STP, construct the inlet chamber and coordinate the exact location of such chamber with GUDC. The MWL in the inlet chamber will be decided based on plant hydraulics with respect to HFL in the receiving water body. However, the Contractor shall be fully responsible for proper coordination to ensure proper alignments and interfaces and for proper implementation of all connections.

1.5.4.2 *Fine Screens*

The fine Screens shall receive sewage from the upstream inlet chamber. The screenings removed by the screens shall be discharged at the appropriate elevation above ground on to a conveyor. A belt conveyor positioned above ground level shall convey the screenings through a galvanized steel chute to a trolley positioned at ground level.

1.5.4.3 *Grit Basins and Grit Washers and Classifiers*

A complete grit removal facility shall be provided, with integrated fats, oil, and grease (FOG) removal. All equipment and components (including but not limited to conveyors, pumps, and blowers) necessary for a fully functional system shall be provided regardless of whether or not such items are specifically listed or described in the bid document. Dewatered grit shall be collected in a trolley positioned at ground level below the Grit Classifier discharge. De-gritted sewage shall exit the Grit Basins over the outlet weir. Liquid streams from grit washers and classifiers shall be returned to the de-gritted sewage stream or to the Plant Drain Pump Station. Any FOG skimming's removed shall be routed to the sludge storage tanks or safely disposed off. Each Mechanism shall be provided with Organic return pumps. This shall be suitably located to return organics back to Grit Chamber. The de-

gritted sewage shall flow through open channels from the grit separators and confluence into a single channel of suitable width for provision of Parshall flume. Bypass facility for degrittied sewage shall be provided. Separate land for grit conveyance shall be indicated in the layout.

1.5.5 Secondary Treatment Units

Secondary treatment processes included but not limited to the following options shall be considered for organic removal along with Biological Nutrient Removal (BNR) to achieve the treated sewage quality specified in section 2.6.

1. Modified Activated Sludge Process (MASP)
2. A2O Process (without coagulant dosing system)
3. Modified Ludzack Ettinger (MLE) Process (with coagulant dosing system)
4. Sequential Batch Reactor (SBR) (optional coagulant dosing system)
5. Moving Bed Bio-reactor (MBBR) (with pre-anoxic tank and additional coagulant dosing system)
6. Membrane Bio-reactor (MBR) (with coagulant dosing system)

Please note that multi-stacking of units on one another, in any treatment technology, shall not be acceptable. All the units should be on the ground floor except admin and laboratory, which can be accommodated in a building unit.

1.5.5.1 Primary Clarifiers

Primary Clarifiers shall be provided wherever ASP process is proposed by the bidder, for removal of suspended solids from fine-screened and de-gritted sewage.

1.5.5.2 Primary Sludge Pump Station

The primary sludge sump shall receive the sludge from primary clarifier by gravity. The primary sludge pumps (Minimum 1W+1S) shall pump the sewage to gravity sludge thickener.

1.5.5.3 Anaerobic Tank

Sewage from Primary Clarifier shall flow by gravity into Anaerobic Tanks through a channel and distributed by a distribution chamber. Anaerobic tank shall be designed for biological phosphorus removal as per the tender specifications.

1.5.5.4 Anoxic Tank

Sewage from Anaerobic Tank shall flow by gravity into Anoxic Tank via appropriate isolation gates. Anoxic Tank shall be designed for biological nitrogen removal as per the tender specifications.

1.5.5.5 Aeration Basin Influent Channel

Influent after fine screen and Grit chamber shall flow by gravity to the Aeration Basin Influent Channel from where it shall be distributed to the aeration basins. Appropriate isolation gates and/or valves shall be provided to allow isolation of each basin. A bypass mechanism shall be designed and constructed such that channel contents will be bypassed around the aeration basins only if inflow to the channel exceeds the combined peak hydraulic

design capacity of all aeration basins in service. The bypass flow shall be routed to the receiving water body via the plant outfall pipe.

1.5.5.6 *Aeration Basins*

The top-of-wall of aeration basins weir elevation shall be such that system should work on a gravity influent condition. No Equalization Tanks or flash filling are acceptable.

For nutrient removal, coagulant dosing system for phosphorus removal and/or tertiary treatment by filtration shall have to be opted, wherever applicable.

Each aerobic basin shall have a separate diffuser grid supplied by a separate air drop pipe with the air flow controlled by a separate valve and measured by a separate flow meter. All systems shall use Dissolved Oxygen with VFD driven Blower. Stub walls shall be incorporated into the structural design of the aeration basins to allow easy addition of the extra partition wall in the future if needed. The RAS piping/channelling shall also be designed such that potential future piping and valve modifications necessary to match the potential future zone modifications described above can be accomplished with ease and minimal disruption. Mechanical surface aerators are not acceptable. In case of any other type of Aeration Equipment one total set of the equipment should be provided as standby. Diffused aeration shall be of retrievable type.

The aeration shall be provided primarily for biological treatment. The aeration equipment shall also to provide adequate mixing arrangement in the aeration tank to keep the solids in suspension. For diffused aeration, the air volume for mixing shall be not less than 1.8-2.7 m³/hr/m² of floor area.

SBR Basins

SBR process shall be designed to treat peak flow sewage for organic load reduction along with built-in nitrification-denitrification and biological phosphorus removal. SBR designs shall strictly comply with the minimum sizing and all other requirements specified in the bid documents. Process air blowers as well as air piping and valves for SBRs shall be configured such that one or more blowers are dedicated to each SBR basin that is in the aeration phase at any given time. The discharge from any given blower shall be routed to no more than a single SBR basin at any given time. In case of any other type of Aeration Equipment one total set of the equipment should be provided as standby.

For SBR process, the recirculation of activated sludge (RAS) may or may not be provided depending upon bidder's design/proposal.

No. of WAS (waste activated sludge) pumps shall be minimum 1W+1S for each basin.

MBR Basins

For STPs with MBRs shall be designed to treat peak flow sewage for organic load reduction along with BNR, the Aeration Basin shall house the membrane filtration modules. The MBR basins shall be fully covered with solid non-skid GRP cover plates. The design shall provide for easy isolation of each MBR basin and shall include all required facilities for complete, fully automated clean-in-place (CIP) functionality. An electric overhead bridge crane shall be provided for easy removal of the membrane modules. The crane shall provide adequate vertical clearance to safely lift the membrane modules above all piping, equipment, or other items that may be located in the travel path from the module location in the tank to an adequately-sized adjacent membrane

“lay-down” area designated for membrane maintenance. The crane coverage shall include the entire MBR basin area plus the lay-down area.

The sludge from MBR basins shall continuously overflow into an adequately-sized common structure that shall serve as the wet well for RAS pumps.

An MBR building shall be provided. This building shall house all MBR-related equipment such as Scour Air Blowers, Permeate/Back pulse Pumps, and RAS Pumps.

In addition, the MBR Equipment building shall house all equipment necessary for all types/modes of membrane cleaning.

The Process Air Blowers for MBRs may be housed in the MBR building or a separate building.

In addition to fine screen, the drum screen upstream of MBR tank shall be provided.

Drum Screens clear openings for MBR: 1 to 2 mm

MBBR Basins

The bioreactor shall be designed to treat the peak flow sewage for organic load reduction along with BNR using an integrated fixed Film Activated Sludge system using free floating/moving cylindrical biomass carriers having more than 7years of life. The media/carriers shall be kept in suspension at any time by diffused aeration. MBBR tanks shall be aerobic stage for BOD removal.

The recirculation of activated sludge (RAS) may be provided depending upon bidder’s design/proposal. The MBBR bio reactor shall be suitably sized to achieve the desired treated sewage quality. The shape of the reactor can be circular or Square or rectangular as per the bidders design, the shape should be so fixed so that it is suited for a compact and operationally flexible layout

Reactor Media shall be as per bidder’s patented design but compatible with other media types for future operations considering about 20% variation in specific surface area. The media shall have a specific gravity of equal to or less than that of the waste water and be suitable of providing axial rotation in all planes as well as ensuring aeration to all surfaces. Aeration should be done through fine or coarse bubble diffusers.

Media Trap made from SS 304 (wedge wire screens) or superior material as approved by Employer shall be provided to ensure that media does not escape to the downstream unit. The size of the screens will be governed by the size of the bio-carriers. The entry and exit of waste water shall be at opposite ends both in horizontal &vertical plane. The reactor dimensions, media quantity shall be adequate for providing adequate sufficient surface area for maintaining the biomass required for degradation and air required as required to achieve the quality. The aeration system shall be provided for sufficient oxygen supply for the effective biodegradation in aerobic reactors.

The level of dissolved oxygen in the Aerobic reactors shall be maintained minimum at 2.0 mg/l or above to facilitate the required biodegradation.

Blowers, piping, valves and other equipment to maintain air flow to the aerobic reactors must suit the needs of the media circulation and aeration of MBBR system. All systems and process equipment as necessary to meet the performance requirements will be provided by the Contractor.

1.5.5.7 *secondary clarification*

For STPs other than SBRs or MBRs, Tube Settler/Plate Settler shall be provided to separate mixed liquor solids from the treated liquid phase. Tube Settler/Plate Settler for Secondary Clarification stage is not acceptable.

1.5.5.8 *Return Activated Sludge (RAS) Pump Station*

For all STPs other than SBRs, RAS pumps shall be provided to return settled sludge from the Secondary Clarifiers or membrane-separated sludge from the MBR basins back to the Aeration Basins. A valve-controlled and metered tapping shall be provided from the RAS pump discharge header to withdraw Waste Activated Sludge (WAS) to solids processing unit. No separate WAS pumps shall be provided.

1.5.6 Tertiary Treatment Units

To get the desired reusable quality treated sewage tertiary treatment is required.

1.5.6.1 *Coagulation & Flocculation*

STPs where phosphorus is treated by physico-chemical process, Flash Mixer along with complete coagulant dosing system, followed by Flocculation and Clarifier as separate units or combined clari-flocculator shall be provided as per specifications.

1.5.6.2 *Rapid Sand Filtration*

Sand filters shall be provided for further reduction in SS and/ or residual organics. Filtration system should be designed such that filtration rate shall be within the acceptable range as per CPHEEO while operating at average as well as peak flow rate. Filtration system shall include feed tank, feed pumps, filter beds with under-drain system as per design specifications along with pipe gallery, platform and necessary piping, valves/ Gates, gauges/ meters etc as per design and required for filter operation.

Pressure Sand Filters (PSF) shall be preferred for STP capacities less than 10MLD and Cloth Media Disk Filtration is also acceptable or any other proven technology.

Contractor to show calculation for filter operation during average and peak flows without exceeding filtration rate. The inlet and outlet control arrangement to RSF shall be designed to permit 100% over load for emergency occasion.

Shape, size and quality of filter sand shall satisfy the following norms.

(a) Sand shall be of hard and resistant Quartz or quartzite and free of clay Fine particles soft grains and dirt of every description.

(b) Effective size shall be 0.45 to 0.70 mm.

(c) Ignition loss should not exceed 0.7 percent by weight.

(d) Uniformity coefficient shall not be more than 1.7 nor less than 1.3

- (e) Soluble fraction in hydrochloric acid shall not 5% weight.
- (f) Silica content should be not less than 90%
- (g) Specific gravity shall be in the range between 2.55 to 2.65.
- (h) Wearing loss shall not exceed 3%.

IS: 8419 (Part-1)1977 entitled filtration media sand and gravel may be referred for details.

For backwash purpose air scouring followed by backwash with wash water shall be provided. For back washing of filters, a back wash water tank should be constructed or provided on chemical house/ filter gallery which shall be filled with filtered water by backwash pumps. It must be able to back wash for minimum 10 minutes for minimum 2 units. The back wash head should be 9 to 10 m from bottom of tank to under drain of filter with necessary sluice valve. Wash water pumps with valves, piping etc., shall be per design and requirement. Air scours system with Air blowers, valves, piping etc., as per design and requirement.

Dirty Backwash water from filters shall be collected in waste water collection tank and pumped back to STP head works.

UF System or Cloth Media Disc Filtration shall be provided to get the desired quality sewage for Reuse.

1.5.6.3 *UV Tanks*

UV System Tanks shall be provided for disinfection of treated sewage from the secondary and/ or tertiary treatment as per design. The UV units are envisaged for tertiary treatment of treated sewage.

UV units shall be floor mounted with closed pipe connections. UV unit shall be designed for effective design flow rate. UV units shall be oriented horizontally and shall be designed to operate continuously for 10,000 hrs as minimum without any need of maintenance or replacement.

1.5.6.4 *Chlorination System*

A complete Chlorination system with necessary safety accessory and controls shall be provided as per IS code.

1.5.7 *Sludge Handling, Treatment and Disposal*

1.5.7.1 *Sludge sump and Pump Station*

Thickened sludge sump shall be provided for the collection of sludge from biological treatment unit. The sump shall be equipped with Agitator assembly to facilitate mixing of sludge content. Thickened sludge pump station and pumps shall be provided for pumping of thickened sludge from the sump to the dewatering unit.

1.5.7.2 *Dewatering Building*

A Dewatering building shall be provided along with mechanical dewatering units (centrifuge/filter press/ bag filter/ screw press/ combi-machine) and all associated/ancillary equipment, including feed pumps, a complete polymer dosing system, dewatered sludge conveyors, sludge storage/loading hoppers and truck access and loading facilities. Sizing of the dewatering unit all related equipment shall be based on the operating schedule. Dewatering Unit shall be

capable of handling sludge consisting of minimum 0.8 to 1% solids by weight. The dewatered cake shall be based on minimum consistency of 20% to 25% by weight dry solids.

1.5.7.3 *Treated Sewage reuse*

The treated sewage, post chlorination shall be conveyed to the disposal point as per site condition to nearest receiving water body not exceeding length of 500 meters.

1.5.8 Treated Waste Water Tank

The treated waste water shall be stored in Treated Water Tank for Irrigation and other purpose. The treated water tank shall have minimum 12 hours detention time.

1.5.9 Instrumentation and Automation

SCADA based Instrumentation and Automation System shall be installed for proposed plant for various treatment units.

1.5.10 Administration, Laboratory, Maintenance, and Other Related Buildings/Facilities

An administration building, a laboratory, a maintenance workshop, a storage facility, a guard house, and other miscellaneous buildings and related equipment and furnishings shall be provided as needed for a fully functional facility.

All units shall be interconnected by RCC overhead walkways, min. 1.2 m wide with handrail and RCC staircase.

All units/ buildings shall be independent with a minimum 3 m distance apart.

All the treatment units should be on the ground floor (no multi-stacking) except admin and laboratory, which can be accommodated in a building unit.

1.6 DESIGN CRITERIA

Biological Process Requirements:

Biological Processes – Design Requirements					
Treatment Processes	SRT (d)	F/M (Kg BOD / Kg MLVSS. D)	MLSS (mg/L)	Aeration Tank HRT (hr)	RAS (% of influent)
EA	10 to 26	0.10 to 0.18	3000 to 5000	12 to 24	0.25 to 1.00
ASP (Conventional)	05 to 08	0.30 to 0.4	1500 to 3000	4 to 6	0.25 to 0.5
MBBR	Designed based on 0.8 – 1.2 Kg BOD / m ³ .d				
	Min. HRT of 4 hrs				
	Volume of MBBR Media – Min. 33% and Max. 50%				
SBR Continuous Flow and Intermittent Decant	15-20	0.05-0.08	3000-4000	Min 14	As per Bidders Design
SBR Intermittent Flow and Intermittent Decant	4-20	0.05-0.3	3500-5000	Min 14	
MBR	5 to 20	0.1 to 0.4	5000-20000	Min 6	0.5 to 2.00

SEWAGE TREATMENT PLANT (STP)		
Items	Unit	Values
Receiving Chamber		
Design flow	-	Peak flow
HRT	sec	30
Min. no. of unit	No.	1
Coarse Screen Channels (Working)		
Design flow	-	Peak flow
Screen type	-	Bar screen/ Mat screen/ Step screen/ escalator type with mechanical cleaning.
MOC – Channel	-	RCC
MOC – Screens (all screen components)	-	SS 316
Angle of inclination of screen	deg.	As per CPHEEO Manual
Max SWD at peak flow	M	
Approach velocity in channel	m/sec	
Velocity through openings at peak flow	m/sec	
Velocity through openings at average flow	m/sec	
Minimum Bar thickness	mm	
Clear spacing between bars	mm	
Coarse Screen Channels (Standby)		
Design flow	-	Peak flow
Screen type	-	Bar screen with Manual cleaning
MOC – Channel	-	RCC
MOC – Screens (all screen components)	-	SS 316
Angle of inclination of screen	deg.	As per CPHEEO Manual
Max SWD at peak flow	M	
Approach velocity in channel	m/sec	
Velocity through openings at peak flow	m/sec	
Velocity through openings at average flow	m/sec	
Minimum Bar thickness	mm	
Clear spacing between bars	mm	
Raw Sewage Sump (Wet Well)		
Design flow	-	Peak flow
HRT	Minutes	5 (Peak Flow)
Min. no. of unit	No.	1

Minimum SWD	M	As per bidders design with additional submergence for submersible pumps below wet well floor as recommended by pump manufacturer.
Equalization Tank		
Design flow	-	Peak flow
HRT	Minutes	As per design requirements
Min. no. of unit	No.	1
Minimum SWD	M	As per bidders design with additional submergence for submersible pumps below wet well floor as recommended by pump manufacturer.
Raw Sewage Transfer Pumps		
Type of Pump	-	Submersible Non-clog type
Number of Pumps	No.	As per CPHEEO Manual
Capacity of each pump	M ³ /hr	As per Design
Head	M	As per CPHEEO Manual
Inlet Chamber		
Design flow	-	Peak flow
HRT	sec	60
Min. no. of unit	No.	1
Fine Screen Channels (Working)		
Design flow	-	Peak flow
Screen type	-	Bar screen/ Mat screen/ Step screen/ escalator type with mechanical cleaning
MOC – Channel	-	RCC
MOC – Screens (all screen components)	-	SS 316
Angle of inclination of screen	deg.	As per CPHEEO Manual
Max SWD at peak flow	M	
Approach velocity in channel	m/sec	
Velocity through openings at peak flow	m/sec	
Velocity through openings at average flow	m/sec	
Clear spacing between bars	mm	6
Fine Screen Channels (Standby)		
Design flow	-	Peak flow
Screen type	-	Bar screen with Manual cleaning
MOC – Channel	-	RCC

MOC – Screens (all screen components)	-	SS 316
Angle of inclination of screen	deg.	As per CPHEEO Manual
Max SWD at peak flow	M	
Approach velocity in channel	m/sec	
Velocity through openings at peak flow	m/sec	
Velocity through openings at average flow	m/sec	
Clear spacing between bars	mm	10
Grit Basins		
Design flow	-	Peak flow
Type	-	Mechanical Detritor or Vortex or Aerated Type with center drive, full diameter scraper
MOC – Equipment/Mechanism	-	SS 304
Design particle dia (sp gr – 2.65)	mm	0.10
Max Design SOR at peak flow	m ³ /m ² /day	As per CPHEEO Manual
Min HRT at peak flow	sec	60
Organic return pump and organic wash pump	-	To be provided as per requirement (for each Detritor type grit chamber separately)
Grit Washer and Classifier		
Type	-	Reciprocating rake mechanism or screw conveyor
Aerated Grit Chamber		
Transverse velocity at surface	m/s	0.6-0.8
Depth-to-width ratio	-	1.5:1 to 2:1
Air supply	-	4.6-7.7 l/m/s of length 0.3-0.4 m ³ /m ³
Detention time at peak flow	Min.	3-5
Quantity of grit	ml /m ³	7.5-75
Max Design SOR at peak flow	m ³ /m ² /day	1,555
Vortex- Type Grit Chamber		
Minimum Velocity	m/s	0.15
Detention Time @ peak flow	sec	20-30
Parshall Flume		
Min No of Units	No.	1
MOC	-	RCC
Design flow	-	Peak flow
Minimum freeboard	m	0.5
Size	-	As per CPHEEO
Primary Clarifiers		

Drive type	-	Center-column supported with center drive. Peripheral drive or bridge-supported not allowed.
MOC – Structure	-	RCC
Conical bottom minimum slope	-	1 to 12
MOC – Center column	-	MS Epoxy coated
MOC – Bridge	-	MS Enamel painted
MOC – Mechanism	-	MS Epoxy coated
Max SOR at average flow	m ³ /m ² /day	As per CPHEEO Manual
Max SOR at peak flow	m ³ /m ² /day	
Max SLR at average flow	Kg/m ² /day	
Max SLR at peak flow	Kg/m ² /day	
Max Weir loading at average flow	cum/day/m	
Minimum SWD	m	
Scum removal	-	To be provided by bidder
Primary Removals and Primary Sewage Characteristics		
BOD Removal	%	As per CPHEEO Manual
TSS Removal	%	As per CPHEEO Manual
Anaerobic Basin		
MOC – Structure	-	RCC
Min SWD	m	5
Min Freeboard	m	0.5
Min HRT at Average flow	Hrs	As per CPHEEO Manual
Anoxic Basin		
MOC – Structure	-	RCC Tank equipped with mixers
Min SWD	m	5
Min Freeboard	m	0.5
Min HRT at Average flow	Hrs	As per CPHEEO Manual
Aeration Basin (Refer Table above for Biological Process requirements)		
MOC – Structure	-	RCC
Min SWD	m	5
Min Freeboard	m	0.5
Specific sludge yield	kg sludge production/ kg BOD	As per CPHEEO Manual
Min HRT at Average flow	Hrs	
Recycle Configuration		
Hydraulic design of wet well	-	Minimum HRT 30 Min for upto flow of 75% of return sludge capacity
RAS Ratio ® – hydraulic design	-	As per CPHEEO Manual
Aeration System		
BOD oxidation oxygen requirement	kg/d	1 to 1.2 x Inlet BOD load avg.

Type of Aeration	-	* Type of Aeration- Diffused Aeration or Aspirator Aeration.
*Note- - The proposed aeration system shall be in successful operation in STP since last three (3) years in India.		
Diffused Aeration System		
Max Alpha Factor,	-	0.6
Max Beta Factor,	-	0.95
Max Fouling factor, F	-	0.8
Oxygen demand peaking factor	-	1.0
Aeration system sizing basis liquid temperature	-	Max liquid temp
Aeration system sizing basis air temperature	-	Max air temp
Aerobic basin DO (min)	mg/L	2
Diffuser type	-	Fine bubble diffuser (Disc or Tube type) Coarse bubble diffusers are acceptable for MBBR process only
Diffuse Installation	-	Retrievable
Diffuser material	-	EPDM or silicone elastomer with anti-microbial coating
Min no of diffusers – Uninstalled shelf spares	%	10
Max. SOTE per unit diffuser submergence at peak air flow (for design calculations)	%/m	5
Process Air Blowers		
Blower type	-	Rotary lobe PD with Variable frequency drive (VFD) with acoustic enclosure
Capacity	%	110 (All systems shall use Dissolved Oxygen/Oxygen Uptake Rate control with VFD driven Blower)
No of blowers – Working	Min.	1
No of blowers – Standby	Min.	1
Process Air Blower Building		
Structure	No.	1
MOC – Roof, columns, beams	-	RCC
Aspirator Aerator		
Capacity	%	110
Aerobic basin DO (min)	mg/L	2
Max Alpha Factor,	-	0.85

Max Beta Factor,	-	0.95
Oxygen Transfer Efficiency	Kg O ₂ /kWh	1.2 to 2.4
Mixing Power Requirement	W/m ³	15-26
MBBR Basin		
BOD Loading	Kg BOD / m ³ .d	As per CPHEEO Manual
Aerobic HRT (Min.)	hrs	
Water Depth (Minimum)	m	
MBBR Media		
% of MBBR Media required	%/volume of MBBR Tank	As per CPHEEO Manual
MBBR Surface Area	m ² /m ³	
Shape	-	
MOC	-	PE/ PU PP/UPVC (Only virgin plastic)
Corrugation	-	One side (Inside)
Min. expected life	years	7
MBBR media supplier	-	World Water Works, Headworks International, Anox Kaldness, Thermax Ltd., Aqwise, Cooldeck or equivalent quality media with submission of credential and end user certificate
Secondary Clarifiers/Tube Settler		
Type	-	Circular, center-column supported with center drive, and center or peripheral feed. Peripheral drive or bridge-supported not allowed. Rectangular Tube settler with bottom cone & sludge removal arrangement.
Sludge and scum removal	-	Center sludge hopper sized per most rigorous published criteria. Full-radius scum baffle with beach-type skimmer. Hopper sized bottom with sludge removal arrangement.
MOC – Structure	-	RCC
Conical bottom minimum slope	-	1 to 12
MOC – Center Column	-	MS Epoxy coated
MOC – Bridge	-	MS Enamel painted
MOC – Scraper and Skimmer	-	MS Epoxy coated
Max SOR at average flow	m ³ /m ² /day	As per CPHEEO Manual
Max SOR at peak flow	m ³ /m ² /day	

Max SLR at average flow	Kg/m ² /day	
Max SLR at peak flow	Kg/m ² /day	
Max Weir loading at average flow	cum/day/m	
Clarifier SWD	m	As per CPHEEO
SBR Basins		
SBR Basin	No.	2 (minimum)
MOC – Structure	-	RCC
Max. SWD	m	As per CPHEEO
Min Freeboard	m	0.50
Cycle time	hrs	As per CPHEEO Manual
Min. Aeration time, Settling time and Decant time	hrs	As per CPHEEO Manual
Min. HRT	hrs	14
Decanting mechanism	-	Swing down / float type
Decanting depth shall be designed to meet the specified performance standards for treated sewage. Any shortfall in meeting the performance standards due to decanting depth observed during commissioning and operation of the plant shall be corrected by successful bidder at his own risk and cost.		
No. of RAS pumps	per basin	1 W+1 S
Selector Zone HRT.	Min	As per CPHEEO Manual
Specific Sludge Yield (for all technologies)	Kg sludge production / kg BOD	
MBR Basins		
Membrane Type	-	Flat sheet, Hollow yarn membrane
Membrane Material	-	PVDF /PS/PES
Membrane in Tank	-	Immersed in Bioreactor (side stream is not allowed)
Flux	LMH	As per CPHEEO Manual
Diffusers in Bioreactor	-	Fine Bubble diffused aeration
Diffusers in MBR Tank	-	Fine Bubble diffused aeration
Applied Vacuum	Kpa	5 to 30
Chemicals for Membrane cleaning	-	NaOCl and Citric Acid
Type of cleaning	-	CIP (cleaning in place)
Flash Mixer		
Detention time	sec	As per CPHEEO Manual
Velocity Gradient	s ⁻¹	
Mixing Mechanism	-	Mechanical as per IS 7090- 1985
Flocculator		
Detention time	min.	As per CPHEEO Manual
Velocity gradient	s ⁻¹	
Mixing Mechanism	-	Mechanical as per IS 7090- 1985 (Type C)
Total Area of Paddles	-	As per CPHEEO Manual

Max. Peripheral velocity of blades	m/sec	
Surface loading rate	liters/hour/sq.m	
SWD	m	
Filtration System		
Type	-	Pressure Sand Filters for STP capacities less than 10MLD Rapid Sand Gravity Filters with shed for capacity above 10MLD only. Cloth media disk filtration is acceptable or any other proven technology
Rapid Filtration		
Filtration rate	M ³ /m ² /h	As per CPHEEO
Area per bed	M ² / individual bed	
No. of beds	-	Minimum 2 Nos of beds shall be provided.
Min. depth of water over sand top	m	2 m (Without free board).
Min. Free board	m	0.5
Depth of Sand media	m	As per CPHEEO
Depth of Gravel media	m	As per CPHEEO
Area of orifices	-	0.3% filter bed area The perforations vary from 5 to 12 mm. In diameter and should be staggered at a slight angle to the vertical axis of pipe.
Area of laterals	-	2 x Area of Orifices
Area of Manifold	-	1.5 x Area of laterals
The inlet and outlet arrangement to RSF	-	designed at 100% over load to permit for emergency occasion
Wash Water Tank	-	Separate O/H wash water cum service water tank suitable for backwashing minimum 2 Nos. of filter beds at a time with 8 to 10 Mtr. Head
Wash Water Pumps	-	100% standby Rate 36m ³ /m ² /h or 600LPM per Sq.m. for 10min
Air Blowers	-	Rate 45-50 m ³ /h per sq.m of free air flow at 0.35 to 0.4 Kg/sq.m for 5min at the under drains (100% standby)
Wash Water Recycle Pumps	-	2 x 100 % capacity pumps suitable to empty the wash water collection tank in 4 hours
Chlorine Contact Tanks		

MOC	-	RCC
Min HRT at Average flow	min	30
Min effective L/W ratio		40
SWD/Pass Width ratio	-	1
Min freeboard	m	0.5
Feed Sump & Pump (Dewatering Influent, DWI)		
Min no of Sumps	No.	1
MOC – Roof, columns, beams	-	RCC
Min. HRT	hrs	10
Type of Mixing	-	Coarse bubble/Mechanical mixers
Operation schedule	hrs/day	12
	days/week	6
Min no of pumps – Working	No.	1
Min no of Pumps – Standby	No.	1
Type of Pump	-	Progressing Cavity
Mechanical Dewatering Unit		
Min no of units – Working	No.	1
Min no of units – Standby	No.	1
Type of Sludge dewatering Equipment	-	As per bidder proposal Centrifuge/belt Filter press Auto operated with minimum sludge man contact Bag Filter is acceptable only for plant capacity below 3MLD
Min dewatered sludge (DWSL) TSS required	% w/w	20%
Min solids capture required	%	90%
Polymer System		
Type	-	Dry polymer / Liquid polymer
Minimum polymer dose	kg/ton solids dry	2
Note: Provision for dosing Dewatering Polyelectrolyte (DWPE) shall be made in thickener as well as dewatering facility.		
Dry Polymer Storage		
Type	-	Covered bin
MOC	-	GRP
Minimum storage period	days	30
Polymer Batch Tanks		
MOC	-	GRP/ HDPE
Poly solution strength	% w/w	0.10%
Min no of tanks – Working	tank	1
Min no of tanks – Standby	tank	1

Polymer Tank Mixers		
Min no of mixers per tank	No.	1
MOC - Impeller and shaft	-	SS316
Type	-	Turbine
Polymer Metering Pumps		
Type of Pump	-	Hydraulic double diaphragm
Min no of pumps – Working	No.	1
Min no of pumps – Standby	No.	1
Dewatering Facility Building		
Min no of units	No.	1
No of levels	No.	2
MOC - Roof, columns, beams	-	RCC

8.9 solid waste management

The quantity of solid waste generated from the plots 21, 22 & 23 is estimated as per guidelines given by CPHEEO Manual on Municipal Solid Waste management, by using the municipal refuse generation rates.

- Refuse generation rate from occupants is considered as 0.4 kg per capita per day
- Refuse generation rate for floating population is considered as 0.25 kg per capita per day
- Refuse generation rate from utilities & road is considered as 0.5 kg per capita per day
- Refuse generation rate per unit in residential building is considered 2.5kg per apartment per day
- Street sweepings is considered to be 0.05 kg per capita per day
- Garden waste is considered to be 15 kg per acre per day

Table 4: Population of Government Housing

Sr. No.	Plot	No. of Units	No. of Floors	Total waste generation (T/Day)	Dry waste (T/Day)	Wet Waste (T/Day)
1	22	328	14	0.82	0.49	0.32
2	23	352	11	0.88	0.52	0.35
	Total			1.70	1.01	0.67

The quantity of solid waste generation in the Govt Housing plots is shown in Table 1

Table 5: Area required for the Centralized Collection Station

Unit	Area Required
Waste Collection Station	14.5 X 14.5 m ²

SECTION-8.

ENVIRONMENT HEALTH AND SAFETY REQUIREMENTS (EHS POLICY)

ENVIRONMENT, HEALTH & SAFETY POLICY

SPECIFICATION FOR ENVIRONMENT, HEALTH & SAFETY POLICY (EHS) MANAGEMENT

CONTENTS

CLAUSE NO.	TITLE
1.0	SCOPE
2.0	REFERENCES
3.0	REQUIREMENT OF ENVIRONMENT, HEALTH & SAFETY
3.1	MANAGEMENT RESPONSIBILITY
3.2	HOUSE KEEPING
3.3	ENVIRONMENT ,HEALTH & SAFETY
4.0	DETAILS OF EHS MANAGEMENT SYSTEM BY CONTRACTOR
4.1	ON AWARD OF CONTRACT
4.2	DURING JOB EXECUTION

1.0 SCOPE: This specification established the Environment, Health and Safety (EHS) management requirement to be complied with by the Contractors during construction. Requirements stipulated in this specification shall supplement the requirements of EHS Management given in relevant Act (s) / legislations. General Conditions of Contract (GCC), Special Conditions of Contract (SCC) and Job Specifications. Where different documents stipulate different requirements, the most stringent shall be adopted.

2.0 REFERENCES: This document should be read in conjunction with following:

- General Conditions of Contract (GCC)
- Special Conditions of Contract

(SCC)

- Job specifications

3.0 REQUIREMENTS OF ENVIRONMENT, HEALTH & SAFETY (EHS) MANAGEMENT SYSTEM TO BE COMPLIED BY BIDDERS

3.1 MANAGEMENT RESPONSIBILITY

3.1.1 The Contractor should have a documented EHS policy to cover commitment of their organization to ensure health, safety and environment aspects in their line of operations.

3.1.2 The EHS management system of the Contractor shall cover the EHS requirements including but not limited to what is specified under Para 1.0 and para 2.0 above.

3.1.3 Contractor shall be fully responsible for planning and implementing EHS requirements. Contractor as a minimum requirement shall designate / deploy the following to co-ordinate the above :

No. of workers deployed

Up to 250 - Designate one safety supervisor

Above 250 & up to 500 - Deploy one qualified and experienced safety Engineer /officer

Above 500-One additional safety (for every 500 or less) engineer/officer as above.

Contractor shall indemnify & hold harmless Owner / BSCDCL & either representatives free from any and all liabilities arising out of non – fulfillments of EHS requirements.

3.1.4 The Contractor shall ensure that the Environment, Health & Safety (EHS) requirements are clearly understood & faithfully implemented at all levels at site.

3.1.5 The Contractor shall promote and develop consciousness for Safety , Health and Environment among all personnel working for the Contractor. Regular awareness, program site meetings shall be arranged on EHS activities to cover hazards involved in various operations during construction.

3.1.6 Arrange suitable first aid measures such as First Aid Box, trained personnel to give First Aid, Stand by Ambulance or Vehicle and install fire protection measures such as : adequate number of steel buckets with sand and adequate fire extinguishers to the satisfaction of BSCDCL/Owner.

3.1.7 The Contractor shall evolve a comprehensive planned and documented system for implementation and monitoring of the EHS requirements. This shall be submitted to BSCDCL/Owner for approval. The monitoring for implementation shall be done by regular inspections and compliance to the observations thereof. The Contractor shall get similar EHS requirements implemented at his sub-contractor(s) work site/office. However, compliance of EHS requirements shall be the sole responsibility of the Contractor. Any review / approval by BSCDCL/Owner shall not absolve contractor of his responsibility / liability in relation to all HSE requirements.

3.1.8 Non-Conformance on EHS by Contractor (including his Sub-contractors) as brought out during review/audit by BSCDCL/Owner representatives shall be resolved forthwith by Contractor. Compliance report shall be provided to BSCDCL/Owner.

3.1.9 The Contractor shall ensure participation of his Resident Engineer / Site-in-Charge in the Safety Committee / EHS Committees meetings arranged by BSCDCL/Owner. The compliance of any observations shall be arranged urgently. He shall assist BSCDCL/Owner to achieve the targets set by them on EHS during the project implementation.

3.1.10 The Contractor shall adhere consistently to all provisions of EHS requirements. In case of non-compliance or continuous failure in implementation of any of EHS provisions; BSCDCL/Owner may impose stoppage of work without any Cost & Time implication to Owner and/or impose a suitable penalty for non-compliance with a notice of suitable period, up to a cumulative limit of 1.0% (one percent) of Contract Value with a maximum limit of Rs. 10 lakhs. This penalty shall be in addition to all other penalties specified else where in the contract. The decision of imposing stoppage work, its extent & monetary penalty shall rest with BSCDCL/Owner & binding on the Contractor.

3.1.11 All fatal accidents and other personnel accidents shall be investigated by a team of Contractor's senior personnel for root cause & recommend corrective and preventive actions. Findings shall be documented and suitable actions taken to avoid recurrences shall be communicated to BSCDCL/Owner. Owner / BSCDCL shall have the liberty to independently investigate such occurrences and Contractor shall extend all necessary help and co-operation in this regard.

3.2 HOUSE KEEPING

3.2.1 Contractor shall ensure that a high degree of house keeping is

maintained and shall ensure inter alia the followings wherever applicable:

a. All surplus earth and debris are removed/disposed off from the working areas to identified location(s).

b. Unused/Surplus Cables, Steel items and steel scrap lying scattered at different places within the working areas are removed to identified location(s).

c All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from work place to identified location(s).

d. Roads shall be kept clear and materials like: pipes, steel, sand boulders, concrete, chips and bricks etc. shall not be allowed on the roads to obstruct free movement of men & machineries.

e. Fabricated steel structural, pipes & piping materials shall be stacked properly for erection.

f. Water logging on roads shall not be allowed.

g. No parking of trucks / trolleys, cranes and trailers etc. shall be allowed on roads which may obstruct the traffic movement.

h. Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.

i. Trucks carrying sand, earth and pulverised materials etc. shall be covered while moving within the premises.

j. Only properly designed steel scaffolding materials to be used for working at heights more than 3.0M . Double scaffolding using wooden ballis may be allowed for working at height less than 3.0M

3.3 ENVIRONMENT, HEALTH AND SAFETY

3.3.1 The Contractor shall provide safe means of access to any working place including provisions of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen, and, BSCDCL/Owner. Contractor shall ensure deployment of appropriate equipment and appliances for adequate safety and health of the workmen and protection of surrounding areas.

3.3.2 The Contractor shall ensure that all their staff and workers including their sub-contractor(s) shall wear Safety Helmet and Safety shoes. Contractor shall also ensure use of safety belt, protective goggles, gloves etc. by the personnel as per job requirements. All these gadgets shall conform to relevant

IS specifications or equivalent.

3.3.3 Contractor shall ensure that a proper Safety Net System shall be used at appropriate locations. The safety net shall be located not more than 30 feet (9.0 metres) below the working surface at site to arrest or to reduce the consequences of a possible fall of persons working at different heights.

3.3.4 Contractor shall ensure that flash back arrester shall be used while using

Gas Cylinders at site. Cylinders shall be mounted on trolleys.

3.3.5 The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health for driving of vehicles, handling and erection of materials and equipments. All lifting equipments shall be tested certified for its capacity before use. Adequate and suitable lighting at every work place and approach there to, shall be provided by the Contractor before starting the actual operations at night.

3.3.6 Hazardous and/or toxic materials such as solvent coating, or thinners shall be stored in appropriate containers.

3.3.7 All hazardous materials shall be labelled with the name of the materials, the hazards associated with its use and necessary precautions to be taken.

3.3.8 Contractor shall ensure that during the performance of the work, all hazards to be health of personnel, have been identified, assessed and eliminated.

3.3.9 Chemical spills shall be contained & cleaned up immediately to prevent further contamination.

3.3.10 All personnel exposed to physical agents such as ionizing radiation, ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with the type of exposure involved.

3.3.11 Where contact or exposure of hazardous materials could exceed limits or could otherwise have harmful affects, appropriate personal protective equipments such as gloves, goggles, aprons, chemical resistant clothing and respirator shall be used.

A Crèche where 10 or more female workers are having children below the age of 6 years.

Reasonable Canteen facilities are made available at appropriate location

depending upon site conditions.

3.3.13 Suitable facilities for toilet, drinking water, proper lighting shall be provided at site and labour camps, commensurate with applicable Laws / Legislation.

3.3.14 Contractor shall ensure storage and utilization methodology of materials that are not detrimental to the environment. Where required Contractor shall ensure that only the environment friendly materials are selected.

3.3.15 All persons deployed at site shall be knowledgeable of and comply with the environmental laws, rules & regulations relating to the hazardous materials substances and wastes. Contractor shall not dump, release or otherwise discharge or dispose off any such materials without the express authorization of BSCDCL/Owner.

4.0 DETAILS OF EHS MANAGEMENT SYSTEM BY CONTRACTOR

4.1 On Award of Contract

The Contractor shall prior to start of work submit his Safety Health and

Environment Manual or procedure and EHS Plans for approval by BSCDCL/Owner. The Contractor shall participate in the pre-start meeting with BSCDCL/Owner to finalise EHS Plans including the following :

1. Job procedure to be followed by Contractor for activities covering. Handling of equipment, Scaffolding, Electric Installation, describing the risks involved, actions to be taken and methodology for monitoring each activity.
2. BSCDCL/Owner review / audit requirement.
3. Organization structure along with responsibility and authority records / reports etc. on EHS activities.

4.2 During job execution

4.2.1 Implement approved Environment, Health & Safety management procedure including

but not limited to as brought out under para 3.0. Contractor shall also ensure to:

1. Arrange workmen compensation insurance, registration under ESI Act, third party liability insurance etc., as applicable.
2. Arrange all HSE permits before start of activities (as applicable) like hot work, confined space, work at heights, storage of chemical / explosive materials and its use and implement all precautions mentioned therein.

3. Submit timely the completed checklist on EHS activities, Monthly EHS report, accident reports, investigation reports etc. as per BSCDCL/Owner requirements. Compliance of instructions on EHS shall be done by Contractor and informed urgently to BSCDCL/Owner.
4. Ensure that Resident Engineer / Site-in-Charge of the Contractor shall attend all the Safety Committee / EHS meetings arranged by BSCDCL/Owner. Only in case of his absence from site that a second senior most person shall be nominated by him in advance and communicated to BSCDCL/Owner.
5. Display at site office and work locations caution boards, list of hospitals, emergency services available.
6. Provide posters, banners for safe working to promote safety consciousness.
7. Carryout audits / inspection at sub contractor works as per approved EHS
8. Document and submit the reports for BSCDCL/Owner review.
9. Assist in EHS audits by BSCDCL/Owner, and submit compliance report.
10. Generate & submit HSE records / report as per EHS Plan
11. Appraise BSCDCL/Owner on EHS activity

**SECTION-9
Bill of
Quantities**

**(Attached
Separately in
Excel formet
19 sheets
including
Abstract)**

SECTION-10 Drawings

**(Attached
Separately in
pdf format 88
pages)**