

**Request for Qualification cum Request for
Proposal (RFQ cum RFP)**

for

**Design, Procurement, Construction, Testing and
Commissioning of 37M ROW Road with storm water
drains, Potable water, recycle water, electrical and
effluent network with all allied works, including Defect
Liability Period (DLP) for 4 years at AURIC Bidkin Industrial
Area, Chhatrapati Sambhajnagar, Maharashtra on EPC
Basis**

VOLUME 1

PART 1 INSTRUCTION TO BIDDERS (ITB)

August 2025

Managing Director

**Maharashtra Industrial Township Limited
Udyog Sarathi, MIDC Office, Marol Industrial Area,
Andheri (East), Mumbai, Maharashtra State, India - 400093**

Maharashtra Industrial Township Limited

Notice Inviting RFQ cum RFP

Dated: 29th August 2025

“Maharashtra Industrial Township Limited” is a special purpose vehicle formed with the equity participation of Central and State Government for procurement and construction of trunk infrastructure in Shendra-Bidkin Industrial Area (SBIA) near Aurangabad in Maharashtra.

The Maharashtra Industrial Township Limited (MITL) represented by Managing Director, invites bids from eligible contractors for the following project in the prescribed bid forms and proforma enclosed herewith through the e-Procurement site, for the Scope of Work described in the Bidding Documents. The details of the tender are given below:-

1.	Tender No.	MITL/SBIA/2025-26/005
2.	Name of Work	Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis
3.	Location	Bidkin Industrial Area (BIA)
4.	Tender Fee	Rs.1,00,000 (Rupees One Lakh Only) excluding applicable taxes. With GST @18% is Rs. 1,18,000/-
5.	Bid Security	Rs. 1,45, 00, 000 /- (Rupees One Crore and Fourty -five Lakhs Only)
6.	Construction Period	18 months from the date of issue of LOA
7.	Defect Liability Period	4 years (from completion of work)
8.	Address for Correspondence	Managing Director, Maharashtra Industrial Township Limited Udyog Sarathi, MIDC Office, Marol Industrial Area, Andheri (East) Mumbai, Maharashtra State, India – 400093
9.	Details for Downloading Tender Document	The complete RFQ cum RFP document can be viewed/downloaded from website of https://aitl.eproc.in , www.auric.city from 29 th August 2025 to 18 th September 2025 (up to 1500 hrs. IST)
10.	Submission of Bid	Bid must be submitted online only at (https://aitl.eproc.in) on or before (up to 18 th September 2025, 1500 hours IST). Applications received online shall be opened on 18 th September 2025 (at 16.30 hours IST)

11.	Email address for Pre Bid Queries	Mr. Sagar Paraswar (Manager Infrastructure, HQ) E- Mail- Sagar.paraswar@auric.city Mr. Anil Patne (Deputy General Manager Infra) E- Mail - Anil.patne@auric.city
12.	Email Address for site visit	Mr. Anil Patne (DGM Infra) E- Mail - Anil.patne@auric.city Mobile Number – 8380070011
13.	Help Desk for any support in online bid submission	E-mail – aitlsupport@c1india.com Mr. Sachin Toraskar - +91-124-4302000 Ext: 200

DISCLAIMER

This RFQ cum RFP is not an Agreement and is neither an offer nor invitation by the Employer to the prospective Bidders or any other person. The information contained in this Request for Qualification cum Request for Proposal document (the "RFQ cum RFP") or subsequently provided to Bidder(s), whether verbally or in documentary or any other form by or on behalf of the Employer or any of its employees or advisors, is provided to Bidder(s) on the terms and conditions set out in this RFQ cum RFP and such other terms and conditions subject to which such information is provided.

The purpose of this RFQ cum RFP is to provide interested parties with information that may be useful to them in making their financial offers (BIDs) pursuant to this RFQ cum RFP. This RFQ cum RFP includes statements, which reflect various assumptions and assessments arrived at by the Employer in relation to the Project. Such assumptions, assessments and statements do not purport to contain all the information that each Bidder may require. This RFQ cum RFP may not be appropriate for all persons, and it is not possible for the Employer, its employees or advisors to consider the objectives, financial situation and particular needs of each party who reads or uses this RFQ cum RFP. The assumptions, assessments, statements and information contained in the Bidding Documents, especially the Preliminary Design details/ information, may not be complete, accurate, adequate or correct. Each Bidder should, therefore, conduct its own investigations and analysis and should check the accuracy, adequacy, correctness, reliability and completeness of the assumptions, assessments, statements and information contained in this RFQ cum RFP and obtain independent advice from appropriate sources.

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

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

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

The Employer may in its absolute discretion, but without being under any obligation to do so, update, amend or supplement the information, assessment or assumptions contained in this RFQ cum RFP. The issue of this RFQ cum RFP does not imply that the Employer is bound to select a Bidder or Contractor, as the case may be, for the Project and The Employer reserves the right to reject all or any of the Bidders or BIDs without assigning any reason whatsoever.

The Bidder shall bear all its costs associated with or relating to the preparation and submission of its BID including but not limited to preparation, copying, postage, delivery fees, expenses associated with any demonstrations or presentations which may be required by The Employer or any other costs

incurred in connection with or relating to its BID. All such costs and expenses shall remain with the Bidder and the Employer shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by a Bidder in preparation or submission of the BID, regardless of the conduct or outcome of the Bidding Process.

Nothing in this RFQ cum RFP shall constitute the basis of a contract which may be concluded in relation to the Project nor shall such documentation/information be used in construing any such contract. Each Bidder must rely on the terms and conditions contained in any contract, when, and if, finally executed, subject to such limitations and restrictions which may be specified in such contract.

The Bidders are prohibited from any form of collusion or arrangement in an attempt to influence the selection and award process of the Bid. Giving or offering of any gift, bribe or inducement or any attempt to any such act on behalf of the Bidder towards any officer/employee of Employer or to any other person in apposition to influence the decision of the Employer for showing any favour in relation to this RFQ cum RFP or any other contract, shall render the Bidder to such liability/penalty as the Employer may deem proper, including but not limited to rejection of the Bid of the Bidder and forfeiture of its Bid Security.

Laws of the Republic of India are applicable to this RFQ cum RFP.

Each Bidder's procurement of this RFQ cum RFP constitutes its agreement to, and acceptance of, the terms set forth in this Disclaimer. By acceptance of this RFQ cum RFP, the recipient agrees that this RFQ cum RFP and any information herewith supersedes documents(s) or earlier information, if any, in relation to the subject matter hereto.

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1. INTRODUCTION

1.1 Project Information

1.1.1 Background

The Government of India is developing the Delhi Mumbai Industrial Corridor (DMIC) Project, as a global manufacturing and investment destination by utilising the high capacity 1,504 km long Western Dedicated Freight Corridor (WDFC) as the backbone. The DMIC project is being implemented jointly by the Government of India and the respective State Governments. Investment Regions/Industrial Areas have been identified for development, across six states namely Gujarat, Haryana, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.

A SPV has been formed as a joint venture between Government of India (GoI) and Government of Maharashtra (GoM) under the name "Maharashtra Industrial Township Limited (MITL)". The share of GOI through DMIC Trust is 49% and the remaining 51% is held by GoM through Maharashtra Industrial Development Corporation (MIDC). MIDC has notified 101 sq km of area for industrial development under SBIA.

The master plan of Shendra Bidkin Industrial Area (SBIA) comprises two parts viz. Part-I and Part-II. The Part-I consists of total area of 40.18 sq km, which is further divided into two parts, viz. Phase-I and Phase-II.

Phase-I namely the Shendra Region covers an area of 8.39 sq km located north of Jalna Road adjoining existing MIDC Shendra Industrial Park.

Phase-II of Part-I namely the Bidkin Region, which includes the remaining area of 31.79 sq km located near Bidkin which is further divided in to 3 sectors and out of which sector A is completely developed with various trunk infrastructure.

As a part of development of the Bidkin Area, The Maharashtra Industrial Township Limited (MITL), (the "Employer") intends to carry out Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis

The Scope and brief particulars of the Project are as follows:

- 1) Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis. (TCS and plan attached)
- 2) Construction of asphalt speed breakers in the developed phase. (Drawing attached)

The successful bidder shall conduct Electronics Total Station (ETS) survey and Establish permanent benchmarks at regular intervals with reference to the GTS/DGPS in order to execute the work.

The successful bidder (the "Contractor") shall be responsible for Designing, Engineering, Procurement, testing, commissioning and Construction of the Project under and in accordance with the provisions of an Engineering, Procurement and Construction contract (the "EPC Agreement") to be entered into between the Contractor and the Employer in the form provided by the Employer as part of the Bidding Documents pursuant hereto.

The Contractor shall also be responsible for the operation and maintenance of the Project in/during the Defects Liability Period. The scope of work will broadly include survey, investigations, Infrastructure Works for Roads, drains, Water Supply, effluent & Power Systems at AURIC Bidkin Industrial Area, Chh. Sambhajnagar, Maharashtra on EPC Basis including testing, commissioning of the Project during the Defects Liability Period, which is 4 (Four) years

The Following are the Key Component to be designed, procured and developed by the successful bidder but not limited to:

(a) Roads:

- Earthwork for Construction of Total RoW
- Construction of embankment

For Main carriageway:

- Construction of Sub-grade
- Construction of Granular Subbase (GSB)
- Construction of Wet Mix Macadam (WMM)
- Providing and laying of Dense Bituminous macadam (DBM)
- Providing and laying bituminous tack coat over DBM with emulsion
- Providing and laying Bituminous concrete (BC)
- Construction of kerb on both side of median
- Signages and Road markings

For Sidewalk:

- Construction of Granular Subbase (GSB)
- Sand bedding
- Laying of Paver blocks

Other Works:

- Construction of suitable Table tops as per IRC and other relevant codes at the Junctions of all roads
- Providing street lighting & other miscellaneous works

(b) Storm Water Network:

- Design of Storm water drain considering the near by area as a catchment
- Earthwork excavation for laying pipes/ Foundation of Structures
- Laying of Sand bedding/filling with stone dust in trenches
- Providing PCC levelling course below drains

- Supply & Laying of RCC Precast Pipe of dia 1200mm
- Supply & Laying of RCC 1500mm dia Manhole including benching & SFRC Covers

(c) Setting out & Geo Tagging:

The Contractor shall be responsible for the accurate setting-out of the Works in relation to original site coordinates, lines and levels of reference. Detailed site survey and site visit is expected to be carried out by prospective bidder before bidding

The checking of any setting-out or of any line or level by the Engineer – in – charge shall not in any way relieve the Contractor of his responsibility for the accuracy thereof and Contractor shall carefully protect and preserve all bench-marks, sight-rails, pegs and other items used in setting-out the Works. The Contractor shall give to the Engineer – in – charge not less than 48 hours' notice of his intention to set out or give levels for any part of the Work so that timely arrangement may be made for checking and issuing instructions.

CLAUSE OF GEO-TAGGING

Following condition of Geo-tagging of the proposed site shall be completed by the Bidders.

1. It shall be binding for all bidders/contractors before filling the tender to inspect the work site and other important site location for ascertaining the scope of work, tender provision, resources available and difficulties/restrictions of site.
2. A fixed period of 5 days from the next day of tender published date is declared for the above field visit geo tagging.
3. As per the table below 3 (Three) site locations for geo-tagging is fixed for effective site visit.
4. The Latitude and Longitude (Co-ordinates) of the said 3 locations is stated in the table below. Kindly take a note that during the field visit with the bidder/agency intending to participate in the tender, MITL representative will not be present to guide them or make available the physical documents. MITL will not insist physical documents from the bidder.
5. The said Geo tagging has to be done by the bidder/contractor himself or his authorized representative. It is mandatory for the bidder/contractor or his authorized representative to upload the self-attested Geo tagging certificate with the date and time of the visit for the said 3 locations on MITL E-proc portal.
6. The draft certificate of Geo tagging to be filled & upload under the Annexure IX by the bidder/contractor on MITL E-proc portal. The certificate copy is enclosed in the Vol 1 Part 5, "Tender Forms" document. Physical copy of Geo tagging certificate will not be accepted.
7. The Bidder/ contractor should upload the above Geo tagging certificate for said 3 locations under Geo Tagging on MITL E-proc portal. The bidders who will upload the Geo tagging certificate only those will be eligible for further tender process of submission of technical & financial bid. The bidders who have not uploaded the Geo

tagging certificate in the e-proc portal as per the time limit stated in Sr.no 2 above, will not be able and eligible for further tender submission process.

8. Having done the above procedure of Geo tagging, Contractor is not entitled for any claim for not having sufficient quantity/expected quality of construction materials, minerals at the field site, non-availability of labors & for extra lead due to for bringing material from extra lead distance, non-availability of construction materials/materials, etc. for similar items.

Name of Work: - Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis

Location Co-ordinates of Work Site are as follows

Sr. No.	Latitude	Longitude
1	19.672580	75.344301
2	19.671339	75.345467
3	19.685929	75.344438

Note:- Geo Tagged Photo of Location shall include-

1. Latitude
2. Longitude
3. Date & Time
4. Location No.
5. Contractor/ Representative Geo Tag Photo.

(d) Electrical Network:

- Only electrical poles for the street light along the road.
- Supply and installations of Feeder pillars, cables and other accessories required for street light.

(e) Potable & Recycle Network:

- Earthwork excavation for laying pipes/ Foundation of Structures
- Laying of Sand bedding/filling with stone dust in trenches
- Supply & laying of HDPE pipes of various dia. as per drawing
- Supply & fixing of valves at locations as per drawing
- Providing property connections to the plots
- Hydro testing of pipe line
- Testing & Commissioning of network
- Supply installation testing & commissioning (SITC) & fixing of water meters as per the specifications mentioned in the as stated in the table below:

Sr no.	Water Meter Diameter	Numbers
1	20 MM	200
2	32 MM	200
3	50 MM	100
4	100 MM	10

- Along with SITC of water meters the contractor also has to develop the dashboard for monitoring water supply as per MITL requirement.

(f) Industrial Effluent network:

- Earthwork excavation for laying pipes/ Foundation of Structures
- Laying of Sand bedding/filling with stone dust in trenches
- Providing PCC levelling course below manholes
- Supply & Laying of HDPE pipe as per drawing
- Providing property connections to the plots
- Supply & Laying of RCC Manhole including benching & SFRC Covers
- Testing & commissioning of the network

(g) Defect Liability:

In Defect Liability Period Operation & Maintenance shall be carried out, of the Roads, Sewerage/Effluent, Electrical and Storm Water Drainage Infrastructure and other infrastructure. The DLP is for 4 years from the date of completion of works.

(h) Drawings and Technical Specifications:

The prospective bidders to refer the indicative tender drawings enclosed and technical specifications stated in the RFP/RFQ, for better understanding of scope of works.

1.2 Brief description of Bidding Process

- 1.2.1 The Employer has adopted a **single stage two-part process** (collectively referred to as the "Bidding Process") for selection of the Bidder for award of the Project. Under this process, the Bid shall be invited under two parts viz. Technical Bid and Financial Bid.
- 1.2.2 The Bidder has to compile and submit his Bid in accordance to requirements detailed in Clause 5 [Submission of Bids] of ITB
- 1.2.3 Eligibility and qualification of the Bidder will be first examined based on the details submitted under First Part i.e. Technical Bid with respect to eligibility and qualifications criteria prescribed in this RFQ cum RFP.
- 1.2.4 Prior to making an Application, the Bidder shall pay Tender Fee to the Employer as indicated in the clause 4.5 [Bid Validity] of the ITB. The Financial Bid under the second part shall be

opened only for only the Bidders who's Technical Bids are found to be responsive to the eligibility and qualifications requirements as per this RFQ cum RFP.

- 1.2.5 In the Bid Stage, the aforesaid qualified Bidders, including their successors (the "Bidders"), are being called upon to submit their Financial offers (the "BIDs") in accordance with the terms specified in the Bidding Documents. The Bid shall be valid for a period of 180 days from the Bid Due Date.
- 1.2.6 Bidders are advised to examine the Project in greater detail, and to carry out, at their cost, such studies as may be required for submitting their respective BIDs for award of the Contract including implementation of the Project.
- 1.2.7 The Bidders can visit site, raise pre-bid queries and attend pre-bid meeting prior to Bid submission.

1.3 **Schedule of Bidding Process**

The Employer shall endeavour to adhere to the following schedule:

Sl. No.	Event Description	Date
i.	Date of availability of RFQ cum RFP	29 th August 2025
ii.	Last date for receiving queries	02 nd Sept 2025
iii.	Pre-Bid meeting (If any bidder intends to attend online prebid meeting through MS team platform, the prospective bidder shall request through email for acceptance of his online attendance via MS team)	03 rd Sept 2025@ 11:30 Hrs
iv.	Bid Due Date (BDD)	18 th September 2025 @ 1500 Hrs
v.	Physical submission of bid security/ POA /etc	18 th September 2025 @ 1500 Hrs
vi.	Opening of Technical Bids	18 th September 2025 @ 16:30 Hrs
vii.	Declaration of eligible/ qualified bidder	22 nd September 2025 (tentatively)
viii.	Opening of Financial Bid	Will be communicated to qualified bidders
ix.	Validity of BID	180 days from BDD
x.	Signing of Contract	Within 10 days from LOA

1.4 Pre-bid Meeting and Pre-bid Clarifications

- 1.4.1 Pre-Bid meeting of the Bidders is stated in the above table at the designated date, time and place. A maximum of two representatives of each Bidder shall be allowed to participate on production of the Employer letter from the Bidder.
- 1.4.2 The Bidder or its official representative can attend pre-bid meeting, which will take place at the venue indicated in Contract Data Sheet or via online mode.
- 1.4.3 The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage and thus the Bidders will be free to seek clarifications and make suggestions for consideration of the Employer. The Employer shall endeavour to provide clarifications and such further information as it may, in its sole discretion, consider appropriate for facilitating a fair, transparent, and competitive Bidding Process.
- 1.4.4 The Bidder is requested to submit any questions or queries by email, to the address provided in Contract Data Sheet. The questions or queries should reach the Employer not later than date specified before the date of pre-bid meeting.
- 1.4.5 The envelopes/communication shall clearly bear the following identification/Title: "Queries/Request for Additional Information: RFQ cum RFP for Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis.
- 1.4.6 The questions raised and the responses given, will be shall be uploaded on to the eProcurement portal including a description of the inquiry but without identifying its source. Any modification of the bidding documents which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum and not through the minutes of the pre-bid meeting.
- 1.4.7 Bidders are advised to attend the pre-bid meeting. However, non-attendance at the pre-bid meeting will not be a cause for dis-qualification of a Bidder. Bidders who do not attend the pre-bid meeting assume the responsibility to comply with modifications to the Bidding documents and which are communicated through an Addendum.

1.5 Site Visit

- 1.5.1 The Bidder is advised to visit and examine the Project site and its surroundings and obtain for itself on its own responsibility all the information like site conditions, traffic, location, surroundings, potential developments during the construction period of the project, climate, availability of power, water and other utilities for construction, access to site, handling and storage of materials, weather data, applicable laws and regulations, and any other matter considered relevant by them that may be necessary for preparing the bid and entering into a contract for construction of the works. The costs of visiting the proposed site shall be at the bidder's own expense. Bidder can contract Employers personnel stated in

Volume 1 Part 2" Contract Data Sheet" (Sr.no 29) for conducting their site visit.

1.5.2 The Bidder and any of its personnel or agents will be granted permission by the Employer to enter upon its premises and lands for the purpose of such inspection, but only upon the express condition that the bidder, its personnel and agents, will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of the inspection.

1.5.3 The Employer may conduct a Site Visit concurrently with the Pre-Bid Meeting.

1.6 Corrupt or Fraudulent Practices

1.6.1 The Bidders and their respective officers, employees, agents and advisers shall observe the highest standard of ethics during the Bidding Process and subsequent to the issue of the LOA and during the subsistence of the Agreement. Notwithstanding anything to the contrary contained herein, or in the LOA or the Agreement, the Employer may reject a BID, withdraw the LOA, or terminate the Agreement, as the case may be, without being liable in any manner whatsoever to the Bidder, if it determines that the Bidder or the Contractor, as the case may be, directly or indirectly or through an agent, engaged in corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice in the Bidding Process. In such an event, the Employer shall be entitled to forfeit and appropriate the BID Security or Performance Security, as the case may be, as Damages, without prejudice to any other right or remedy that may be available to the Employer under the Bidding Documents and/ or the Agreement, or otherwise.

1.6.2 Without prejudice to the rights of the Employer under Clause 1.6.1 hereinabove and the rights and remedies which the Employer may have under the LOA or the Agreement, or otherwise if a Bidder or Contractor, as the case may be, is found by the Employer to have directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice during the Bidding Process, or after the issue of the LOA or the execution of the Agreement, such Bidder or Contractor shall not be eligible to participate in any tender or RFP issued by the Employer

1.6.3 The following terms shall have the meaning hereinafter respectively assigned to them:

"Corrupt practice" means

- i. the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the actions of any person connected with the Bidding Process (for avoidance of doubt, offering of employment to or employing or engaging in any manner whatsoever, directly or indirectly, any official of the Employer who is or has been associated in any manner, directly or indirectly, with the Bidding Process or the LOA or has dealt with matters concerning the Agreement or arising therefrom, before or after the execution thereof, at any time prior to the expiry of one year from the date such official resigns or retires from or otherwise ceases to be in the service of the Employer, shall be deemed to constitute influencing the actions of a

person connected with the Bidding Process); or

- ii. save and except as permitted under Clause 2.2.1 of this RFQ cum RFP, engaging in any manner whatsoever, whether during the Bidding Process or after the issue of the LOA or after the execution of the Agreement, as the case may be, any person in respect of any matter relating to the Project or the LOA or the Contract Agreement, who at any time has been or is a legal, financial or technical adviser of the Employer in relation to any matter concerning the Project;

“Fraudulent practice” means a misrepresentation or omission of facts or suppression of facts or disclosure of incomplete facts, in order to influence the Bidding Process;

“Coercive practice” means impairing or harming, or threatening to impair or harm, directly or indirectly, any person or property to influence any person's participation or action in the Bidding Process;

“Undesirable practice” means (i) establishing contact with any person connected with or employed or engaged by the Employer with the objective of canvassing, lobbying or in any manner influencing or attempting to influence the Bidding Process; or (ii) having a Conflict of Interest;

“Restrictive practice” means forming a cartel or arriving at any understanding or arrangement among Bidders with the objective of restricting or manipulating a full and fair competition in the Bidding Process.

2. GENERAL

2.1 Scope of Bid

- 2.1.1 Maharashtra Industrial Township Limited (MITL), (the "Employer") invites Bids for Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis. (as defined in these documents and referred to as "the Project".) The successful Bidder will be expected to complete the Works, including Investigation, Drawing, design, Construction, Testing and Commissioning as detailed in the **Volume 2: Technical Specifications** by the intended completion date specified in the **Contract Data Sheet**.

2.2 Eligible Bidders

- 2.2.1 This Invitation to Bid is open to bidders meeting eligibility for their qualification hereunder:

1. The Bidder should be a **single entity** to implement the Project. The term Bidder used herein would apply to single entity.
2. A Bidder may be a sole proprietorship, LLP, a company incorporated under the Indian Companies Act, 1956/2013.
3. A 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.
4. The Bidder firm shall be profit (net) making firm and shall have made profit at least in three financial years out of the last five financial years (01-04-2019 to 31-03-2024) prior to submitting the Bid. The Bidder should submit attested copies of CA report.

- 2.2.2 The Bidder **shall not** be falling under any one of the following criteria:

- a constituent of one Bidder is also a constituent of another Bidder
- Bidder has the same legal representative for purposes of this Bid as any other Bidder
- Bidder has a relationship with another Bidder directly or through common third party/ parties, that puts either or both of them in a position to have access to each other's information about, or to influence the Bid of either or each other;
- Such Bidder or any of its Member thereof has participated as a consultant to the Employer in the preparation of any documents, Design or Technical specifications of the Project.

- 2.2.3 A Bidder shall be liable for disqualification if any legal, financial or technical adviser of the Employer in relation to the Project is engaged by the Bidder, or any of its Members, as the case may be, in any manner for matters related to or incidental to the Project. This disqualification shall not apply where such adviser was engaged by the Bidder, its Member in the past but its assignment expired or was terminated 6 (six) months prior to the date

of issue of this RFQ cum RFP.

2.2.4 Without prejudice to the satisfaction of the above requirements and any other prerequisites as per the terms of this RFP by the Bidder, a Bid may still be disqualified if it has, in the sole and exclusive opinion of the Employer:

1. Made any misleading or false representation or deliberately suppressed the information in the technical schedules/enclosures required to be submitted with /in support/as a clarification with respect to its Bid; and/or
2. Has been black-listed/debarred by any government/semi-government department/ public sector company in India or in any other foreign country; and/or
3. Has a record of poor performance such as abandoning work, not properly completing the contract, or financial failures/weaknesses; and/or
4. Engaged in Fraud & Corrupt practices as mentioned under this RFQ cum RFP

2.2.5 Each Bidder shall provide a statement that it complies with Clause 2.3 in all respects and provide such further evidence of their eligibility satisfactory to the Employer as the Employer shall reasonably request.

2.3 Qualification of the Bidder

2.3.1 All bidders shall include the following information and documents with their Bids in duly completed Tender Forms in the order specified in Clause 5.1 [Sealing and Marking of Bids].

- Document defining the constitution or legal statutes, place of registration and principal place of business
- Written power of attorney of the signatory of the Bid to commit the Bidder
- Reports on the financial standing of the Bidder, such as profit and loss statements and auditor's reports for the past five years (01-04-2018 to 31-03-2023).
- Evidence of adequacy of working capital for this contract (access to line of credit and availability of other financial resources);
- Information regarding any litigation, or arbitration resulting from contracts executed by the Bidder in the last 5 years or currently under execution. The information shall include the names of the parties concerned, the disputed amount, cause of litigation and matter in dispute
- Experience in works of a similar nature and details of work carried out during the qualifying period
- The credentials to meet following Qualification Criteria clause from the Client/Employer. No self - certification will be accepted.

2.3.2 Joint venture or Consortium are not allowed to bid.

2.3.3 To be eligible for pre-qualification and evaluation of the bid, an Applicant shall fulfil the following conditions of eligibility:

In this the **‘Similar Works’** or **‘Similar Project’** will mean Construction of infrastructure development project of industrial parks/townships/Roads/ pipeline works/bridges during the last five financial years i.e. from 01-04-2019 to 31-03-2024. These projects should be on EPC basis comprising road works.

1. Financial Capacity:

- i. **Minimum Value of Work:** The bidder shall have satisfactorily done at least one similar work of value not less than Rs. 120 Crores **OR** at least Two similar works of value no less than Rs. 73 Cr **OR** at least Three similar works of value no less than Rs. 60 Cr during **last 5 years** (i.e. from 01-04-2019 to 31-03-2024) for any Central/State Government department (or) Central/State Autonomous Body (or) Central/State Public Sector (or) Govt undertaking(or) private entity/company.

Bidder should furnish information as required in ITB Vol 1, Part 5, ANNEXURE V: TECHNICAL CAPACITY to demonstrate compliance with the criteria of having executed and commissioned at least one similar project as defined above.

- i. **Minimum Annual Financial Turnover:** The bidder shall have achieved a minimum annual financial turnover of **Rs. 80 Crore** (Rupees Eighty crore only) in any one year during the last five financial years (i.e. from 01-04-2019 to 31-03-2024) preceding the date of submission of bid; Bidder should furnish information as required in ITB Vol 1, Part 5, ANNEXURE III FINANCIAL CAPACITY QUALIFICATION INFORMATION
- ii. **Net Worth:** The Bidder shall have a minimum Net Worth of **Rs. 30 Crores** (Rupees Thirty Crore only) as on 31st March 2024. Bidder should furnish information as required in ITB Vol 1, Part 5, ANNEXURE III FINANCIAL CAPACITY QUALIFICATION INFORMATION
- iii. **Liquid Assets / Credit Facilities/Solvency certificate:** The bidder shall have Liquid Assets / Credit Facilities/ Solvency of not less than **Rs. 20 Crores** (Rupees Twenty crore only) as on the date of submission of the bid. Bidder should furnish information as required in ITB Vol 1, Part 5, ANNEXURE IV Bank Certificate for lines of Credit
- iv. **Litigation History:** Bidder's shall submit litigation till the date of submission of bid). Bidder shall submit along with Bid details of all pending litigations as per ANNEXURE VI: LITIGATION/ ARBITRATION HISTORY
- v. The Bidder should be financially sound and should not have applied for Corporate Debt Restructuring (CDR) during last 5 Financial Years

2. Technical Capacity – Project Works:

- i. The Bidder must demonstrate successful completion of at least one similar project in last five year. Bidder should furnish information as required in ITB Vol 1, Part 5, ANNEXURE V TECHNICAL CAPACITY – PROJECT QUALIFICATION INFORMATION
- ii. The Bidder must have adequate engineering capacity and staff on their Payroll with relevant expertise and experience in the Design and Construction of similar

Projects. Bidder should furnish information as required in ITB Vol 1, Part 5, ANNEXURE VIII – ENGINEERING AND CONSTRUCTION CAPACITY.

- iii. The Bidder must have adequate Plant Machinery and Equipment pertaining to civil construction either owned or leased. Bidder should furnish information as required in ITB Vol 1, Part 5, ANNEXURE VIII – ENGINEERING AND CONSTRUCTION CAPACITY.

2.3.4 Bidders shall submit satisfactory performance certificates in support of each quoted reference along with the copy of work/purchase order. The certificate should be signed by an officer not below the rank of Executive Engineer in case of municipal/government client or the rank of General Manager in case of public/private sector. The certificate should include the details of Name, location and brief scope of project, technology provided, Project value, flow details.

2.3.5 Ongoing projects or the projects which are yet to be commissioned shall not be considered for evaluation.

2.4 One Bid per Bidder

Each bidder shall submit only one Bid. A Bidder who submits or participates in more than one Bid will be disqualified. No firm can be a subcontractor while submitting a Bid individually in the same Bidding process. A firm, if acting in the capacity of a subcontractor in any Bid, may participate in more than one Bid in that capacity.

2.5 Cost of Bidding

The Bidder shall bear all costs associated with the preparation and submission of its Bid and the Employer will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the Bidding process.

3. BIDDING DOCUMENTS

3.1 Content of Bidding Documents

Each Bidder shall submit only one Bid. A Bidder who submits or participates in more than one Bid will be disqualified. No firm can be a subcontractor while submitting a Bid individually in the same Bidding process. A firm, if acting in the capacity of a subcontractor in any bid, may participate in more than one bid in that capacity.

3.1.1 This RFQ cum RFP comprises the Disclaimer set forth hereinabove, the contents as listed below, and will additionally include any Addenda issued in accordance with clause 3.2.

- Invitation for Bids
- Instructions to Bidders and Conditions of Contract
- General/Technical Specifications
- Tender Indicative Drawings

3.1.2 The Draft Contract Agreement provided by the Employer as part of the Bid Document shall be deemed to be part of this RFQ cum RFP.

3.1.3 The Bidder is expected to carefully examine the contents of the Bidding documents. Failure to comply with the requirements of Bid submission will be at the Bidder's own risk. The Bids which are not substantially responsive to the requirements of the Bidding documents will be rejected.

3.1.4 Bidders are informed that the site investigation information which may be provided is only for Bidder's information and the Employer does not warrant either its accuracy or sufficiency. The Bidder is responsible to inspect and examine the site, its surroundings and other available information and data, and to have satisfied himself, so far as practicable, before submitting the bid as to the form and nature of the site, the hydrological and climatic conditions, the extent and nature of works, the means of access to the site and the accommodation he may require, and all other risks, contingencies and circumstances which may influence or affect the Bid. Bidders are also advised to carry out any additional survey or investigations that may deem to be appropriate or necessary before submitting the Bid.

3.1.5 The terms Bid and Tender and their derivatives (Bidder/Tenderer, Bid/Tender, Bidding/Tendering, etc) throughout these Bidding documents are synonymous and day means calendar day. Singular also means plural.

3.2 Clarification of Bidding Documents

3.2.1 Bidders requiring any clarification on the RFQ cum RFP may notify the Employer in writing or by e-mail. They should send in their queries on or before the date mentioned in the Schedule of Bidding Process specified in Clause 1.3. The Employer shall endeavour to respond to the queries within the period specified therein, but no later than 5 (five) day

prior to the **Bid Due Date**. The responses will be published as stated in the ITB. The Employer will publish the reply to all the queries in the e-proc website without identifying the source of queries.

- 3.2.2 The Employer shall endeavour to respond to the questions raised or clarifications sought by the Bidders. However, the Employer reserves the right not to respond to any question or provide any clarification, in its sole discretion, and nothing in this Clause shall be taken or read as compelling or requiring the Employer to respond to any question or to provide any clarification.
- 3.2.3 The Employer may also on its own motion, if deemed necessary, issue interpretations and clarifications to all Bidders. All clarifications and interpretations issued by the Employer shall be deemed to be part of the Bidding Documents. Verbal clarifications and information given by the Employer or its employees or representatives shall not in any way or manner be binding on the Employer.

3.3 **Amendment of Bidding Documents**

- 3.3.1 At any time prior to the deadline for submission of bids, the Employer may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding documents by issuing addenda.
- 3.3.2 Any addendum thus issued shall be part of the Bidding documents pursuant to clause 3.2.3 and shall be communicated in writing or by fax or published on portal to all Bidders. Prospective Bidders shall acknowledge receipt of each addendum by fax to the Employer within one working day of receipt. Even though the same is not acknowledged within the specified time it shall be deemed that the addendum is received by the Bidder.
- 3.3.3 In order to afford the Bidders a reasonable time for taking an Addendum into account, or for any other reason, the Employer may, in its sole discretion, extend the Bid Due Date.

4. PREPARATION OF BIDS

4.1 Language of Bid

The Bid and all related correspondence and documents in relation to the Bidding Process shall be in English language. Supporting documents and printed literature furnished by the Bidder with the Bid may be in any other language provided that they are accompanied by translations of all the pertinent passages in the English language, duly authenticated and certified by the bidder. Supporting materials, which are not translated into English, may not be considered. For the purpose of interpretation and evaluation of the Bid, the English language translation shall prevail.

4.2 Documents Comprising the Bid

4.2.1 The Bid submitted by the Bidder shall comprise two parts with one containing the Technical Proposal and the other containing Financial Proposal, both submitted at the same time.

4.2.2 The Technical Proposal shall comprise General Requirements, Employer's Requirements covering the fully completed Technical Specifications, Indicative Tender Drawings and any other relevant document. Without limiting the generality of the foregoing, the Technical Proposal shall contain following:

- Bid Security in the form of Original Bank Guarantee from a Scheduled/Nationalised bank as specified in Appendix A of tender document;
- Power of Attorney for authorized signatory for this bid;
- Bid Form for Technical Proposal, signed by the authorized signatory;
- All pages of Tender and Appendix to Tender, signed by the authorized signatory;
- Any other information/data required to be submitted in the Technical Proposal by the bidders in accordance with these Instructions to Bidders.

4.2.3 The Financial Proposal shall be comprised of the fully completed Price Bid as per instruction given on Procurement website indicating capital cost and year wise O&M with breakup.

Without limiting the generality of the foregoing, the Financial Proposal shall contain the following:

- Bid Form for Financial Proposal; signed by the authorized signatory;
- Schedule of Prices and Schedule of Payments;
- Any other materials required to be completed and submitted by bidders in accordance with these Instructions to Bidders.
- The Financial Proposal shall be completed as per the itemized break down detailed in the price schedules. A Lump-sum price without the detailed breakdown will be deemed as a non-responsive bid and the Bid will be rejected.

- 4.2.4 The Bid Form, Appendix to Bid and unit rates and price shall be filled-in without exception, subject to extensions thereof in the same format and to the provisions of Clause 4.6 regarding the alternative forms of bid security.

4.3 Bid Prices

- 4.3.1 Unless otherwise specified in Employer's Requirements, Bidders shall quote for the entire facilities such that the total Bid price covers all the Contractor's obligations mentioned in or to be reasonably inferred from the Bidding documents in respect of the Design, preparation of Construction Documents, manufacture, including Procurement and subcontracting (if any), delivery, Construction, Installation, completion of the facilities and O & M works in DLP period. This includes all requirements under the Contractor's responsibilities for inspecting, testing, pre-commissioning, commissioning and trial run of the facilities and, where so required by the bidding documents, the acquisition of all permits, approvals and licences, etc., operation and maintenance during Defect Notification Period and training services and such other items and services as may be specified in the Bidding Documents, all in accordance with the requirements of the Conditions of Contract. The price bid shall include the cost of pre- despatch inspections and testing by the Employer's personnel or any authorized person/agency whether inside country or outside the country.
- 4.3.2 The quoted rates shall be for finished work and shall be inclusive of all costs including manufacturing, supply, transportation and safe storage of equipment and materials at site, cost of insurance and protection of the Works, accommodation and sanitation of the Workers, protection of workmen, working notices, temporary works, drainage facilities and/or detour, sign boards, public protection including providing security personnel, barricades and lighting, etc., incidental costs, taxes, duties, work contract tax, levies, royalties, custom duties and charges of any kind whatsoever, payable on the components or the complete works and satisfactory performance of the bidder's obligations under this contract.
- 4.3.3 The quoted prices for the works during trial run, commissioning, defect notification period and O&M in DLP period shall including cost of all materials, repairs, staff, labour etc. to upkeep the project works in perfect condition and to the desired standards and quantity.
- 4.3.4 The bidder has to quote in a way that his prices shall include for all the liabilities and Contractual obligations including all taxes, duties, levies, cess etc. wherever payable and applicable on the date of submission of their bids whether separately specified or not.
- 4.3.5 The Bidder shall give a break-up of prices in the manner and detail called for in the Schedule of Prices. The Bidder shall fill unit rates and prices for all items of the Works described in the Schedule of Prices. Items against which no rate or price is entered by the bidder will not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices in the Schedule of Prices.
- 4.3.6 The Bidders shall fill in the prices for all items of the Works as applicable and no alteration or addition shall be made to the Schedule by the bidders. Quoted rates must typed out clearly and legibly in both figures and words against each item of the Works. The Employer

reserves the right to reject any incomplete or not fulfilling the conditions of quoting the rates in figures and words, without assigning any reason thereof.

4.3.7 The Bidder shall be familiar with the Tax laws of India. In the various Schedule of Prices, Bidders shall give required details and breakdown of their prices including all duties, taxes and other levies and charges payable by the Contractor under the Contract, as of the date 28 days prior to the deadline for submission of bids as under:

1. Civil Works, including site investigations, layout Design, detailed Design as applicable, all services, labour, materials, consumables, and all matters and things of whatsoever nature, including transportation, provision of as-built drawings and operation and maintenance manuals, etc., as described in the bidding documents and as necessary for the proper execution and completion of the Civil Works in accordance with the requirements of the Contract.
2. Electro Mechanical Equipment shall be quoted separately and shall include rates or prices, as applicable, for all matters and things whatsoever required in connection with the manufacture / fabrication, independent inspection, supply, delivery, testing, installation, commissioning, trial run, provision of as-built drawings and operations and maintenance manuals, etc., as described in the bidding documents and as necessary for the proper execution and completion of the pumping station and electro mechanical equipment and performance of the facility in accordance with the requirements of the Contract. Electromechanical equipment, whether manufactured from outside or within the country, shall be quoted on the basis of its installed cost, inclusive of transportation, all taxes, duties, levies, royalties, custom duties and charges of any kind whatsoever.
3. Other Works and Services shall be quoted separately, in accordance with the requirements of the Bidding documents, and shall include rates or prices, as applicable, for all services, labour, materials, consumables, contractor's equipment, temporary works, and all matters or things whatsoever required as necessary for their proper completion or performance in accordance with the requirements of the Contract.
4. The tenderers are required to sign the Letter of Tender at specified places, and the conditions attached with tender. All the signed documents shall be submitted (scanned copy) as a part of the tender at the time of tendering. Tender not so signed shall be liable for rejection.

4.3.8 The rates and prices quoted by the bidder are subject to adjustment during the performance of the Contract in accordance relevant clause indicated in Conditions of Contract.

4.3.9 The supplementary Price Proposal, if applicable should only contain the changes in price resulting from the changes in the Technical Proposals. Bidders shall note that supplementary price Bid shall include price variation (increase or decrease, as the case may be) of individual affected items, resulting from corresponding changes in Technical proposal, and it is not enough to give the overall increase or decrease in price of affected items as a whole. Bidders should note that, if Employer, during the evaluation of the price

proposals, considers that the changes in price are unrealistic in comparison with the original price proposal, the original / supplementary / both Bids are liable to be rejected.

4.4 Currencies of Bid and Payment

4.4.1 The unit rates and the prices shall be quoted by the bidder in Indian Rupees (INR).

4.4.2 Payment of the Contract Price shall be made only in Indian Rupees (INR).

4.5 Bid Validity

4.5.1 Bids shall remain valid for a period of not less than 180 days from the Bid Due Date.

4.5.2 In exceptional circumstances, prior to expiry of the original Bid validity period, the Employer may request that the Bidders to extend the period of validity for a specified additional period. The request and the responses thereto shall be made in writing or by e-mail. A bidder may refuse the request without forfeiting its bid security. A bidder agreeing to the request will not be required or permitted to modify its bid, but will be required to extend the validity of its bid security for the period of the extension, and in compliance with Clause 4.6 in all respects.

4.6 Bid Security

4.6.1 A Bidder is required to deposit, along with its Bid, a Bid security as indicated in Contract Data Sheet (the "Bid Security"), refundable after signing of contract with successful bidder. Bid Security in the case of the Selected Bidder whose shall be retained till the Bidder has provided a Performance Security under the Agreement.

4.6.2 The Bidders will have to provide BID Security in the form of a bank guarantee/Demand Draft issued by any Nationalised / Scheduled Bank, approved by RBI, located in India, in favour of:

**Managing Director,
Maharashtra Industrial Township Limited
Udyog Sarathi, MIDC Office,
Marol Industrial Area, Andheri (East)
Mumbai – 400 093**

Bidders are required to scan the original BG and upload the same in the e-tendering portal of Employer along with technical proposal of BID. Original BG will have to be submitted to the Employer's as per clause 5 [*Submission of Bids*].

Any Bid not accompanied by the Bid Security will be rejected. Employer, if desired, will get the Bank Guarantee submitted for Bid Security verified from the bank. In case the verification reveals that the submitted Bank Guarantee is fraudulent, Employer reserves the right to reject the BID.

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 Employer and the Bidder from time to

time. The format of the bank guarantee shall be in accordance with the sample form of bid security included in this document.

4.6.3 Bank Details of Employer required for Bid Security Bank Guarantee:

Beneficiary Name: Maharashtra Industrial Township Limited

Address: Udyog Sarathi, MIDC Office, Andheri (E), Mumbai – 93

Name of the Bank: Bank of India.

Branch address: Chakala Branch

Account No: 006720110000968

IFSC Code: BKID0000067

4.6.4 The Bid shall be summarily rejected if it is not accompanied by the BID Security.

4.6.5 The Bid securities of unsuccessful Bidders will be returned as promptly as possible after signing of agreement with successful bidder.

4.6.6 The Bid security of the successful Bidder will be returned when the Bidder has signed the Agreement and furnished the required performance security.

4.6.7 The Bid security may be forfeited:

- if the Bidder withdraws its Bid during the period of bid validity; or
- if the Bidder does not accept the correction of its bid price in case of any arithmetic errors
- in the case of a successful Bidder, if it fails within the specified time limit to:
 - iv. sign the Agreement, or
 - v. furnish the required performance security, or
- if the Bidder is determined, at any time prior to the award of contract, to have engaged in corrupt or fraudulent practices in competing for the Contract; or in giving effect to any other provisions given in the Instructions to Bidders.

4.7 **Alternative Proposals by Bidders**

Alternative proposals will not be considered.

4.8 **Format and Signing of Bid**

4.8.1 The Bidder shall provide all the information sought under this RFQ cum RFP. The Employer will evaluate only those BIDs that are received online in the required formats and complete in all respects and Bid Security, processing fee and POA are received in hard copies. Incomplete and/or conditional Bids shall be liable to rejection.

4.8.2 The Bid shall be typed or written in indelible ink and shall be signed and sealed by a person or persons duly authorized to sign on behalf of the bidder who shall also initial each page, in blue ink. All pages of the bid and all entries where amendments have been made shall

be initialled by the person or persons signing the bid.

- 4.8.3 The Bid shall contain no alterations, omissions or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the bidder, in which case such corrections shall be numbered and initialled by the person or persons signing the Bid.

5. SUBMISSION OF BIDS

5.1 Sealing and Marking of Bids

- 5.1.1 The Bidder shall submit the Technical and Financial Bid online through e-procurement portal. Bidder's technical proposal shall comprise of the following documents in the same order as per the format provided in Vol 1 Part 5 [Forms of Tender], Vol 2 Part 2[Technical Schedules], Vol 2 along with supporting documents as appropriate. All pages of the document should have Bidder's initial or signature.

Technical Bid

- Bid Security
- Annexure I: Form of Bid
- Annexure II: Power of Attorney for Signing the Bid
- Annexure III: Financial Capacity Qualification Information
- Annexure IV: Bank Certificate for Access to Lines of Credit
- Annexure V: Technical Capacity – Project Qualification Information & Value of Similar Work
- Annexure VI: Litigation/ Arbitration History
- Annexure VII: List of Deviations
- Annexure VIII: Engineering and Construction Capacity
- Annexure IX: Geo Tagging Certificate

Financial Bid

- Appendix A: Form of Bid security (From Nationalised/schedule Bank in India)
- Appendix B: Form of Performance security (From Nationalised/schedule Bank in India)

- 5.1.2 The following document supporting the Bid shall be submitted (physically in a separate envelope) marked as "Enclosures of the Technical Bid". The documents shall include:

- **Original Bid Security** for amount indicated in Notice Inviting RFQ cum RFP in the form of Demand Draft or Original Bank Guarantee in the prescribed format.
- **Original Power of Attorney** for signing the Bid as per format at Annexure II

- 5.1.3 The envelope containing enclosures of the Bid shall clearly bear the name and address of the Bidder and following identification:

Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Electrical and effluent network with

all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis.

In addition, the Bid Due Date should be indicated on the right-hand corner of each of the envelopes.

- 5.1.4 The envelope containing Enclosures of the Bid shall be addressed to Employer at the address indicated in Contract Data Sheet
- 5.1.5 If the envelope is not sealed and marked as instructed above, the Employer assumes no responsibility for the misplacement or premature opening of the contents of the Bid submitted and consequent losses, if any, suffered by the Bidder.
- 5.1.6 Bids submitted by fax, telex, telegram or e-mail shall not be entertained and shall be rejected.
- 5.1.7 Technical proposal shall contain only technical information and no price information shall be included in the Technical proposal. Failure to do this the bid will be considered non-responsive and will be rejected.
- 5.1.8 Only the information provided in 'Technical Bid' though online submission will be considered for evaluation. The information provided in 'Enclosures of the Bid' including additional information, if any will be for information purpose only. The information provided in 'Enclosures of the Bid' will not be used in lieu of missing information in the Technical Bid.

5.2 **Deadline for Submission of Bids**

- 5.2.1 Technical and Financial Bid comprising of the document listed at clause 5.1.1 of the ITB shall be submitted online through e-procurement portal on or before **Bid Due Date** indicated in **Contract Data Sheet**.
- 5.2.2 Documents listed at Clause 5.1.2 of the ITB shall be physically submitted on or before the Bid Due Date, at the address provided in Clause 5.1.4 in the manner and form as detailed in RFQ cum RFP. A receipt thereof should be obtained from the person specified in Clause 5.1.4.
- 5.2.3 The bid submission would be considered to be complete only upon successful completion of both the online submission of the Technical and Financial Bid and physical copy submission of 'Enclosures of the Bid' before the Bid Due Date and Time indicated in **Contract Data Sheet**.
- 5.2.4 The Employer may, at its discretion, extend the deadline for submission of bids by issuing an addendum in accordance, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

5.3 **Late Bids**

Bids/ Enclosures of the Bid received physically as stated under clause 5.1.2 by the Employer

after the specified time on the BID Due Date shall not be eligible for consideration and shall be summarily rejected and will be returned unopened to the bidder.

5.4 **Modification and Withdrawal of Bids**

- 5.4.1 The Bidder may modify, substitute or withdraw its BID after submission, provided that written notice of modification, substitution or withdrawal is received by the Employer prior to BID Due Date. No BID shall be modified, substituted or withdrawn by the Bidder on or after the BID Due Date and Time.
- 5.4.2 For modification of e-BID, Bidder has to detach its old BID from e-procurement portal and upload / resubmit digitally signed modified BID. For withdrawal of BID, bidder has to click on withdrawal icon at e-procurement portal and can withdraw its e-BID. Before withdrawal of a BID, it may specifically be noted that after withdrawal of a BID for any reasons, Bidder cannot re-submit e-BID again.
- 5.4.3 Any alteration/modification in the BID or additional information supplied subsequent to the BID Due Date, unless the same has been expressly sought for by the Employer, shall be disregarded.

6. BID OPENING AND EVALUATION

6.1 Bid Opening

- 6.1.1 The Employer shall open the Enclosures of the Technical Bids indicated in Clause 5 [Submission of Bids], in the presence of the Bidders who choose to attend. "If for any reason, the opening could not be done on Bid Due Date, the new date and the time of opening shall be communicated separately".
- 6.1.2 Technical Bids of those Bidders, who have not submitted their Bid online, shall not be considered for opening and evaluation.
- 6.1.3 The Employer will subsequently examine and evaluate Technical Bids in accordance with the provisions set out in Clause 2.3 [*Eligible Bidders*] and Clause 2.4 [*Qualification of the Bidder*]
- 6.1.4 Bidders are advised that qualification of Bidders will be entirely at the discretion of the Employer. Bidders will be deemed to have understood and agreed that no explanation or justification on any aspect of the Bidding Process or selection will be given.
- 6.1.5 To facilitate evaluation of Technical BIDs, the Employer may, at its sole discretion, seek clarifications in writing from any Bidder regarding its Technical BID. Such clarification(s) shall be provided within the time specified by the Employer for this purpose. Any request for clarification(s) and all clarification(s) in response thereto shall be in writing.
- 6.1.6 If a Bidder does not provide clarifications sought under Clause 6.1.5 above within the prescribed time, its Bid may be liable to be rejected. In case the Bid is not rejected, the Employer may proceed to evaluate the Bid by construing the particulars requiring clarification to the best of its understanding, and the Bidder shall be barred from subsequently questioning such interpretation of the Employer.
- 6.1.7 The Employer reserves the right to reject any Technical BID which is non-responsive as per clause no 6.4 [*Examination of Bids and Determination of Responsiveness*] and no request for alteration, modification, substitution or withdrawal shall be entertained by the Employer in respect of such BID
- 6.1.8 Any information contained in the Bid shall not in any way be construed as binding on the Employer, its agents, successors or assigns, but shall be binding on the Bidder if the Project is subsequently awarded to him on the basis of such information.
- 6.1.9 The Employer reserves the right not to proceed with the Bidding Process at any time without notice or liability and to reject any or all Bid(s) without assigning any reasons.
- 6.1.10 If any information furnished by the Bidder is found to be incomplete, or contained in formats other than those specified herein, the Employer may, in its sole discretion, exclude the relevant project from computation of the Eligible Score of the Bidder.
- 6.1.11 In the event that a Bidder claims credit for an Eligible Project, and such claim is determined

by the Employer as incorrect or erroneous, the Employer shall reject such claim and exclude the same from computation of the Eligible Score, and may also, while computing the aggregate Experience Score of the Bidder, make a further deduction equivalent to the claim rejected hereunder. Where any information is found to be patently false or amounting to a material misrepresentation, the Employer reserves the right to reject the Bid.

- 6.1.12 The Employer will get the BID security verified from the issuing authority and after due verification, the Authority will evaluate the Technical BIDs for their compliance to the eligibility and qualification requirements pursuant to Clause 2.3 [*Eligible Bidders*] and Clause 2.4 [*Qualification of the Bidder*] of this RFQ cum RFP.
- 6.1.13 After evaluation of Technical Bids, the Employer will publish a list of technically responsive Bidders whose financial Bids shall be opened. The Employer shall notify other Bidders that they have not been technically responsive. The Employer will not entertain any query or clarification from Applicants who fail to qualify.
- 6.1.14 The Employer shall inform the venue and time of online opening of the Financial Bids to the technically responsive Bidders through e-procurement portal of the Employer and e-mail. The Employer shall online open the Financial Bids on date and time to be informed in this clause in the presence of the authorised representatives of the Bidders who may choose to attend. The Employer shall publicly announce the Bid Price quoted by the technically responsive Bidder. The Employer shall prepare a record of opening of Financial Bids.

6.2 Process to be Confidential

Information relating to the examination, clarification, evaluation and comparison of Bids and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process until the award of the successful Bidder is announced. Any effort by a Bidder to influence the Employer's processing of Bids or award decisions may result in rejection of the Bidder's Bid.

6.3 Clarification of Bids and Contacting Employer

- 6.3.1 To facilitate evaluation of Bids, the Employer may, at its sole discretion, seek clarifications from any Bidder regarding its Bid. Such clarification(s) shall be provided within the time specified by the Employer for this purpose. Any request for clarification(s) and all clarification(s) in response thereto shall be in writing but no change in the price or substance of the bid shall be sought, offered or permitted, except to get additional information to fully understand the proposals of the bidder and to confirm that the requirements of the bidding documents will be met.
- 6.3.2 The request shall be answered promptly within the time stipulated in the request. Failure to respond promptly may result in the Technical proposal being deemed not to be substantially responsive.
- 6.3.3 In case the Bid is not rejected, the Employer may proceed to evaluate the Bid by construing

the particulars requiring clarification to the best of its understanding, and the Bidder shall be barred from subsequently questioning such interpretation of the Employer.

6.4 Examination of Bids and Determination of Responsiveness

6.4.1 Prior to evaluation of Bids, the Employer shall determine whether each Bid is responsive to the requirements of the RFP and has been properly signed.

6.4.2 A substantially responsive Bid is one which conforms to all the terms, conditions and specifications of the Bidding documents, without material deviation or reservation. The material deviation or reservation would be implied by any of the following assumption/condition/criteria.

- which affects the scope, quality or performance of the works in any substantial way; which is inconsistent with the Bidding documents and/or limits the Employer's rights or the Bidder's obligations under the Contract in any substantial way; whose rectification would unfairly affect the competitive position of other Bidders presenting substantially responsive bids.

6.4.3 The prerequisite condition for determining substantial responsiveness of the Bid are:

- it is received by the Bid Due Date including any extension thereof
- it is accompanied by the Bid Security for the required value as per the format
- it contains all the information and documents (complete in all respects) as requested in this RFQ cum RFP;
- it contains certificates from its statutory auditors in the formats specified;
- it does not contain any condition or qualification; and
- it is not non-responsive in terms hereof.

6.4.4 The Employer reserves the right to reject any Bid which is non-responsive and no request for alteration, modification, substitution or withdrawal shall be entertained by the Employer in respect of such Bid.

6.5 Correction of Errors

Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows:

- where there is a discrepancy between the rates in figures and in words, the lower of the two will govern; and
- where there is a discrepancy between the unit and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.

6.5.1 The amount stated in the Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and, with the concurrence of the Bidder, be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount the Bid will be rejected, and the Bid security may be forfeited in accordance with Bid

Security Clause.

6.6 Evaluation and Comparison of Technical Proposals

- 6.6.1 The 'Enclosure of the Bid' will be opened in the presence of Bidder's authorized representatives who are present during the opening of the said part.
- 6.6.2 Evaluation of technical proposal documents will be taken up only for those Bids which are determined as substantially responsive Bid. Prior to detailed evaluation of the documents, Employer shall examine the documents to determine whether they are complete, whether the documents have been properly signed, and whether the Bids are generally in order.
- 6.6.3 The information contained in the technical proposal shall prevail during technical and financial evaluation of Bids and shall be binding on the contractor post award of work. In case any data / information is missing from the above listed documents and is likely to have financial implication, Employer reserves the right to load the financial Bid submitted by the Bidder.
- 6.6.4 If the information given in the technical proposal is determined to be incomplete by Employer, the Employer reserves the right to reject the Bid without assigning any reason thereof.

6.7 Clarification of Technical Proposals

- 6.7.1 Employer may conduct clarification meetings with each or any Bidder to discuss any matters, technical or otherwise, where Employer requires amendments or changes to be made to the Technical Proposal or conditions required to bring all the Bidders at par.
- 6.7.2 Where amendments or changes are required by Employer, Bidders will be requested in writing to adjust their Technical Proposals accordingly and submit a revised Technical Proposal and supplementary price proposal within the time and date to be decided later on.

6.8 Evaluation and Comparison of Price Proposals

- 6.8.1 Employer will evaluate and compare only the Bids determined to be substantially responsive in accordance with above mentioned clause.
- 6.8.2 In evaluating the Bids, the Employer will determine for each Bid the evaluated Bid Price by adjusting the Bid Price as follows:
- Making any correction for errors pursuant to Correction of Errors; or
 - Making an appropriate adjustment for any other acceptable variations, deviations; and
 - Making appropriate adjustments to reflect discounts or other price modifications offered in accordance with Correction of Errors clause.
- 6.8.3 The Employer reserves the right to accept or reject any variation, deviation offer. Variations, deviations, and other factors, which are in excess of the requirements of the Bidding documents or otherwise result in unsolicited benefits shall not be taken into

account in Bid evaluation.

- 6.8.4 The estimated effect of the price adjustment conditions under will not be taken into account for Bid evaluation.

7. AWARD OF CONTRACT

7.1 Award Criteria

Subject to Clause 7.2, the Employer will award the Contract to the Bidder whose Bid has been determined to be substantially responsive to the Bidding documents and who has offered the Lowest Evaluated Bid Price provided that such bidder has been determined to be (i) eligible in accordance with the provisions of clause 2.3; (ii) qualified in accordance with the provisions of Clause 2.4; and has submitted substantially responsive Technical Proposals in accordance with clause 6.4.

7.2 Employer's Right to Accept any Bid and to Reject any or all Bids

Notwithstanding Clause 7.1, the Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to award of Contract, without thereby incurring any liability to the affected bidder or bidders or any obligation to inform the affected bidder or bidders of the grounds for the Employer's action.

7.3 Notification of Award

7.3.1 Prior to expiry of the period of bid validity prescribed by the Employer, the Employer will notify the successful bidder by email or fax confirmed by registered letter that its bid has been accepted. This letter (hereinafter and in the Conditions of Contract called the "Letter of Award" (LOA) shall name the sum which the Employer will pay the Contractor in consideration of the execution, completion, and Operation and Maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Conditions of Contract called "the Contract Price").

7.3.2 The notification of award will constitute the formation of the Contract.

7.3.3 Upon furnishing by the successful Bidder of a performance security, the Employer will promptly notify the other Bidders that their Bids have been unsuccessful.

7.4 Signing of Agreement

7.4.1 At the same time that the Employer notifies the successful Bidder that its Bid has been accepted, the Employer will send the Bidder the Form of Agreement provided in the Bidding documents, incorporating all agreements between the parties.

7.4.2 Within 28 days of receipt of the Form of Agreement, the successful bidder shall sign the Form and return it to the Employer.

7.5 Performance Security

- 7.5.1 The successful bidder upon receipt of Letter of Award shall furnish to the Employer performance security in prescribed format for an amount specified in the Contract Data Sheet in accordance with the Conditions of Contract. The Performance Security shall be submitted by the successful bidder within stipulated time as indicated in Contract Data Sheet.
- 7.5.2 Failure of the successful bidder to comply with the requirements of Clauses 7.4 and 7.5 shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security.

Performance Security - The Contractor shall provide the Performance Security for a period of 66 months (from schedule completion date) with additional claim period of 1 year. BG should provide for encashment at Mumbai Branch of Bank. BG must be on Nationalised/Schedule Bank

Extension of Performance Security - The Contractor may initially provide the Performance Security for a period of 66 months ; provided that it shall procure the extension of the validity of the Performance Security, as necessary, at least 2 (two) months prior to the date of expiry thereof. Upon the Contractor providing an extended Performance Security, the previous Performance Security shall be deemed to be released and the Employer shall return the same to the Contractor within a period of 7 (seven) business days from the date of submission of the extended Performance Security.

Release of Performance Security - The Employer shall return the Performance Security to the Contractor within 60 (sixty) days of the later of the expiry of the Maintenance Period or the Defects Liability Period under this Agreement. Notwithstanding the aforesaid, the Parties agree that the Employer shall not be obliged to release the Performance Security until all Defects identified during the Defects Liability Period have been rectified.

**Request for Qualification cum Request for
Proposal (RFQ cum RFP)**

for

**Design, Procurement, Construction, Testing and
Commissioning of 37M ROW Road with storm water
drains, Potable water, recycle water, electrical and
effluent network with all allied works, including Defect
Liability Period (DLP) for 4 years at AURIC Bidkin Industrial
Area, Chhatrapati Sambhajinagar, Maharashtra on EPC
Basis**

VOLUME 1

PART 2 CONTRACT DATA SHEET

August 2025

**Managing Director
Maharashtra Industrial Township Limited
Udyog Sarathi, MIDC Office, Marol Industrial Area,
Andheri (East), Mumbai, Maharashtra State, India - 400093**

Contents

1. CONTRACT DATA SHEET 2

1. CONTRACT DATA SHEET

Condition	Reference Clause	Data
1. Name of Works	Vol 1 Part 1 ITB Clause 2.1	Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis
2. Employer's Name and Address	Vol 1 Part 4 Conditions of Contract Clause 1.1.38	Managing Director, Maharashtra Industrial Township Limited Udyog Sarathi, MIDC Office, Marol Industrial Area, Andheri (East) Mumbai, Maharashtra State, India – 400093
3. Contractor's Name and Address	Vol 1 Part 4 Conditions of Contract Clause 1.1.26	[to be filled by the intending bidder]
4. Bid Due Date and Time	Vol 1 Part 1 ITB Clause 5.2 [Deadline for Submission of Bids]	18 th September 2025 @ 1500 Hrs
5. Amount of Bid Security	Vol 1 Part 1 ITB Clause 4.6 [Bid Security]	Rs. 1,45,00,000/- (Rupees One Crore and Forty-five Lakhs Only)
6. Date and Venue of Pre-bid Meeting	Vol 1 Part 1 ITB Clause 1.4 [Pre-bid Meeting and Pre-bid Clarifications]	<p>03rd September 2025 @ 11.30 Hrs</p> <p>Venue:</p> <p>Maharashtra Industrial Township Limited 3rd Floor, MIDC Samruddhi Venture Park MIDC Central Road, Andheri (E) Mumbai 400 093</p> <p>If any bidder intends to attend online prebid meeting through MS team platform, the prospective bidder shall request through email for acceptance of his online attendance via MS team.</p>
7. Address for Correspondence and Pre-bid Queries	Vol 1 Part 1 ITB Clause 1.4 [Pre-bid Meeting and Pre-bid Clarifications] and	Same as Employer name and address indicated above.

Condition	Reference Clause	Data
	Clause 5 [Submission of Bids]	
8. Time for Completion of EPC of the Works	Vol 1 Part 1 ITB Clause 2.1 and Vol 1 Part 4 [Conditions of Contract] Clause 4.4 and Clause 4.5	18 months from date of issuance of Letter of Award (LOA).
9. Defects Liability Period	Vol 1 Part 4 Conditions of Contract Clause 1.1.31	4 year from the date of final Completion date.
10. Total Contract Period	Vol 1 Part 4 Conditions of Contract	Minimum 66 months from the date of Letter of Award. (18 months + 48 Months) = 66 months
11. Project Start date	Vol 1 Part 4 [Conditions of Contract] Clause 7.1	Date of issue of Letter of Award by the Employer.
12. Site Possession Date	Vol 1 Part 4 Conditions of Contract	Date of issue of Letter of Award by the Employer.
13. Project Plan and Schedule	Conditions of Contract Clause 4.1 Obligations prior to commencement of Works	The Contractor -shall submit project plan and schedule within 15 days of from the date of issue of Letter of Award.
14. Date of Submission of Designs -Basic Engineering Package	Vol 1 Part 4 [Conditions of Contract] Clause 4.3 and Vol 2 Part 1 [General Requirements] Clause 4.2	Within 60 days the from the date of issue of Letter of Award by the Employer
15. Performance Security Amount	Vol 1 Part 1 ITB Clause - 7.5 [Performance Security]	The amount of Performance Guarantee shall be equal to 5% of the Contract Price and it shall be valid till 60 days after the completion of the DLP period.
16. Time for submission of Performance Security	Vol 1 Part 1 ITB Clause - 7.6 [Advance Payment and Security]	Within 15 days from date of issue of Letter of Award.
17. Time for submission of Advance payment Bank guarantee	Vol 1 Part 4 [Conditions of Contract] Clause 9.4	The Employer shall make (the "Advance Payment"), equal in amount to 10 (ten) percent of the Contract Price, for mobilization expenses and for acquisition of

Condition	Reference Clause	Data
		<p>equipment etc. with an interest of @12% per annum</p> <p>The Contractor may apply to the Employer for the installment of the Advance Payment at any time after signing of the Contract Agreement, along with an irrevocable and unconditional guarantee from a Bank for an amount equivalent to 112% (one hundred and twelve per cent) of such installment, substantially in the form provided at Appendix-C of Vol1 Part 5.</p>
18. Normal Working Hours	Vol 1 Part 4 [Conditions of Contract] Clause 5.3	<p>EPC Works - Normal hours during which work will be permitted to be carried out at the Site shall be between 08:00 HRS to 18:00 HRS, Monday to Saturday, excluding gazetted and national holidays. The Contractor shall be responsible to obtain the written consent of the Employer's Representative if he desires to work outside these times during the execution of work till completion of Testing and Commissioning.</p> <p>Operation and Maintenance– Normal hours shall be carried out 24 hours a day, 7 days a week, for all days of the year including national holidays.</p>
19. Delay damages		
a) Rate of delay damages	Vol 1 Part 4 [Conditions of Contract] Clause 7.3	Contractor shall pay Damages to the Employer of a sum calculated at the rate of 0.05% (zero point zero five percent) of the Contract Price for delay of each day reckoned from the date specified in accepted base line schedule and until works are completed.
b) Maximum LD	Vol 1 Part 4 [Conditions of Contract] Clause 7.3	10% of accepted Contract Price.
20. Percentage of retention for the Works	Vol 1 Part 4 [Conditions of Contract] Clause 3.6	6% (six percent) of the amount of all Interim Payment Certificates for the Works Contract portion of the Contract, excluding any Provisional Sums.

Condition	Reference Clause	Data
21. Limit of Retention Money for the Works	Vol 1 Part 4 [Conditions of Contract] Clause 3.6	5% (five percent) of the Works Contract Price, excluding any Provisional Sums.
22. Penalty for not employing Project Manager and other Key Personnel till the date of employment of the personnel	Vol 1 Part 5 Particular Conditions of Contract for Operations and Maintenance	Total 10% of the billed claimed in the respective month will be deducted from each bill till the contractor personnel is appointed
23. Minimum insurance to be provided by the Contractor during the EPC and DLP period of the Works	Vol 1 Part 4 [Conditions of Contract] Clause 13.2	Not less than 2% of the accepted Contract price
24. Validity of Insurance Policies as defined in Contract Clauses	Vol 1 Part 4 [Conditions of Contract] Clause 13.2	All the insurances shall be taken from Directorate of Insurance Maharashtra State All the insurances shall be valid throughout the period of Contract including Operation and Maintenance Period.
25. Periods of submission of insurance: <ul style="list-style-type: none">evidence of insuranceRelevant policies	Vol 1 Part 4 [Conditions of Contract] Clause 13	<ul style="list-style-type: none">15 days from date of Letter of Award30 Days after from date of Letter of Award
26. Maximum total liability of the Contractor to the Employer	Vol 1 Part 4 [Conditions of Contract] Clause 12.6	Equal to accepted Contract Price
27. Project Milestones	Vol 1 Part 4 [Conditions of Contract] Clause 4.3	Financial Milestones as percentages of contract value
a	Milestone No. 1 - 25 % of the contract price	In 06 (Six) months from the start date
b	Milestone No. 2 - 75 % of the contract price	In 12 (Twelve) months from the start date
c	Milestone No. 3 - 100 % of the contract price	In 18 (Eighteen) months from the start date
28. Email address for Pre Bid Queries		Mr. Sagar Paraswar (Manager Infrastructure) E- Mail- Sagar.paraswar@auric.city

Condition	Reference Clause	Data
		Mr. Anil Patne (DGM Infra & Development) E- Mail - Anil.patne@auric.city
29. Contact & Email Address for site visit		Mr. Anil Patne (DGM Infra & Development) E- Mail - Anil.patne@auric.city Mobile Number – 8380070011

**Request for Qualification cum Request
for Proposal (RFQ cum RFP)**

for

**Design, Procurement, Construction, Testing and
Commissioning of 37M ROW Road with storm water
drains, Potable water, recycle water, Firefighting
network, electrical and effluent network with all
allied works, including Defect Liability Period (DLP)
for 4 years at AURIC Bidkin Industrial Area,
Chhatrapati Sambhajnagar, Maharashtra on EPC
Basis**

VOLUME 1

PART 3 CONTRACT AGREEMENT

August 2025

**Managing Director
Maharashtra Industrial Township Limited
Udyog Sarathi, MIDC Office, Marol Industrial Area,
Andheri (East), Mumbai, Maharashtra State, India - 400093**

FORM OF CONTRACT AGREEMENT

This Agreement made this day of _____, 2025, Maharashtra Industrial Township Limited, represented by the Managing Director, Maharashtra Industrial Township Limited, Udyog Sarathi, MIDC Office, Marol Industrial Area, Andheri (East), Mumbai, Maharashtra State, India – 400093, India, (hereinafter called "the Employer") of the one part and _____ of (hereinafter called "the Contractor") of the other part. Whereas the Employer desires that the Works known as the **"Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Firefighting network, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis"** should be designed and executed by the Contractor, and has accepted a Bid by the Contractor for the design, execution and completion of such Works and the remedying of any defects therein.

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement:
 - a) the Contract Agreement;
 - b) the Letter of Award;
 - c) Corrigendum / addendums / Response to Pre-bid queries
 - d) the Bid (the accepted Price Proposal)
 - e) Contract Data sheet;
 - f) the Employer's Requirements;
 - g) the Particular Conditions of Contract for O&M;
 - h) the Conditions of Contract,
 - i) the Indicative Tender Drawings;
 - j) the technical Specifications
 - k) the Schedules and Datasheets;
 - l) the Bidder's Technical Proposal, drawings /datasheets
 - m) any other document forming the part of the Contract
3. In consideration the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to design, execute and complete the Works and remedy any defects therein and operate and maintain the constructed facility, in conformity in all respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor, in consideration of the design, execution and completion of the Works and the remedying of defects therein and operate and maintain, in DLP period for the Constructed facility, the Contract Price Rs (In Words

_____) including taxes or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

In Witness whereof the parties hereto have caused this Agreement to be executed the day and year first before written in accordance with their respective laws.

Authorized signature of contractor seal (if any)
in the presence of:

Name: _____

Signature: _____

Address: _____

Authorized signature of Employer seal (if any)
in the presence of:

Name: _____

Signature: _____

Address: _____

**Request for Qualification cum Request for
Proposal (RFQ cum RFP)**

for

**Design, Procurement, Construction, Testing and
Commissioning of 37M ROW Road with storm water
drains, Potable water, recycle water, Firefighting network,
electrical and effluent network with all allied works,
including Defect Liability Period (DLP) for 4 years at AURIC
Bidkin Industrial Area, Chhatrapati Sambhajanagar,
Maharashtra on EPC Basis**

VOLUME 1

PART 4 CONDITIONS OF CONTRACT

August 2025

Managing Director

**Maharashtra Industrial Township Limited
Udyog Sarathi, MIDC Office, Marol Industrial Area,
Andheri (East), Mumbai, Maharashtra State, India - 400093**

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1. GENERAL PROVISIONS

1.1 Definitions

In this Agreement, the following words and expressions shall, unless repugnant to the context or meaning thereof, have the meaning hereinafter respectively assigned to them:

- 1.1.1 **"Accounting Year"** means the financial year commencing from the first day of April of any calendar year and ending on the thirty-first day of March of the next calendar year.
- 1.1.2 **"Advance Payment"** shall have the meaning set forth in the recitals.
- 1.1.3 **"Affected Party"** shall have the meaning set forth in the recitals.
- 1.1.4 **"Affiliate"** means, in relation to either Party {and/or Members}, a person who controls, is controlled by, or is under the common control with such Party {or Member} (as used in this definition, the expression "control" means, with respect to a person which is a company or corporation, the ownership, directly or indirectly, of more than 50% (fifty per cent) of the voting shares of such person, and with respect to a person which is not a company or corporation, the power to direct the management and policies of such person, whether by operation of law or by contract or otherwise).
- 1.1.5 **"Agreement"** means this Agreement, its Recitals, the Schedules hereto and any amendments thereto made in accordance with the provisions contained in this Agreement.
- 1.1.6 **"Applicable Laws"** means all laws, brought into force and effect by GOI or the State Government including rules, regulations and notifications made there under, and judgments, decrees, injunctions, writs and orders of any court of record, applicable to this Agreement and the exercise, performance and discharge of the respective rights and obligations of the Parties hereunder, as may be in force and effect during the subsistence of this Agreement.
- 1.1.7 **"Applicable Permits"** means all clearances, licenses, permits, authorizations, no objection certificates, consents, approvals and exemptions required to be obtained or maintained under Applicable Laws in connection with the construction, operation and maintenance of the Project Works during the subsistence of this Agreement.
- 1.1.8 **"Appointed Date"** means that date of issue of Letter of Award (LOA).
- 1.1.9 **"Arbitration Act"** means the Arbitration and Conciliation Act, 1996 and shall include modifications to or any re-enactment thereof, as in force from time to time.
- 1.1.10 **"Bank"** means a bank incorporated in India and having a minimum net worth of Rs. 1,000 crores (Rupees one thousand crore) or any other bank acceptable to the Employer.
- 1.1.11 **"Bank Rate"** means the Repo rate of interest announced by the Reserve Bank of India for all its lending operations on the Base Date.

- 1.1.12 **"Base Date"** means the last date of that calendar month, which date precedes the Bid Due Date by at least 28 (twenty-eight) days.
- 1.1.13 **"Bid"** means the documents in their entirety comprised in the bid submitted by the [selected bidder/Consortium] in response to the Request for Qualification cum Request for Proposals in accordance with the provisions thereof.
- 1.1.14 **"Bid Security"** means the Bid Security provided by the Contractor to the Employer in accordance with the Request for Proposal, and which is to remain in force until substituted by the Performance Security.
- 1.1.15 **"Change in Law"** means the occurrence of any of the following after the Base Date:
- a) the enactment of any new Indian law.
 - b) the repeal, modification or re-enactment of any existing Indian law;
 - c) the commencement of any Indian law which has not entered into effect until the Base Date.
 - d) a change in the interpretation or application of any Indian law by a judgments of a court of record which has become final, conclusive and binding, as compared to such interpretation or application by a court of record prior to the Base Date; or
 - e) any change in the rates of any of the Taxes or royalties that have a direct effect on the Project.
- 1.1.16 **"Change of Scope"** shall have the meaning set forth in the recitals;
- 1.1.17 **"Change of Scope Notice"** shall have the meaning set forth in the recitals;
- 1.1.18 **"Change of Scope Order"** shall have the meaning set forth in the recitals;
- 1.1.19 **"Completion Certificate"** shall have the meaning set forth in the recitals;
- 1.1.20 **"Consortium"** means the consortium of entities which have formed a joint venture for implementation of this Project;
- 1.1.21 **"Construction"** shall have the meaning set forth in the recitals;
- 1.1.22 **"Construction Period"** means the period commencing from the Letter of Award and ending on the date of the Completion Certificate;
- 1.1.23 **"Contract"** means the Contract Agreement, the Letter of Award, the Form of Bid, Conditions of Contract, Contract Data Sheet, Employer's Requirements, General Specifications, Schedules and Datasheets, Indicative Tender Drawings and the further documents (if any) which are listed in Contract Agreement or in the Letter of Award,
- 1.1.24 **"Contract Price"** means the amount specified in the recitals;
- 1.1.25 **"Contractor"** means the person(s) named as contractor in the Form of Bid whose tender has been accepted by the Employer and the legal successors in title to this person(s);

- 1.1.26 **“Contractor’s Personnel”** means the Contractor’s Representative and all personnel who may include the staff, labour, other employees of the Contractor, personnel utilised by contractor on Site, and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works.
- 1.1.27 **“Subcontractor”** means any person appointed by Contractor for design, execution, operation, maintenance of any part of the Works; and the legal successors in title to each of these persons.
- 1.1.28 **“Contractor Default”** shall have the meaning set forth in the recitals;
- 1.1.29 **“Damages”** shall have the meaning set forth in the recitals;
- 1.1.30 **“Defect”** means any defect or deficiency in Construction of the Works or any part thereof, which does not conform with the Specifications and Standards, and in the case of Maintenance, means any defect or deficiency which is specified in Schedule E;
- 1.1.31 **“Defects Liability Period”** shall have the meaning set forth in the recitals;
- 1.1.32 **“Dispute”** shall have the meaning set forth in the recitals;
- 1.1.33 **“Dispute Resolution Procedure”** means the procedure for resolution of Disputes set forth in the recitals;
- 1.1.34 **“Drawings”** means all of the drawings, calculations and documents pertaining to the Project Works as set forth in Schedule-I, and shall include ‘as built’ drawings of the Project Works;
- 1.1.35 **“Document”** or **“Documentation”** means documentation in printed or written form, or in tapes, discs, drawings, computer programmes, writings, reports, photographs, films, cassettes, or expressed in any other written, electronic, audio or visual form;
- 1.1.36 **“Emergency”** means a condition or situation that is likely to endanger the safety or security of the individuals on or about the Project Works, including Users thereof, or which poses an immediate threat of material damage to any of the Project Assets;
- 1.1.37 **“Employer”** means the entity/person named as employer in the Contract Data sheet and the legal successors in title to this person.
- 1.1.38 **“Employer Default”** shall have the meaning set forth in the recitals;
- 1.1.39 **“Employer’s Engineer” / “Engineer” / “Engineer In-charge”** means the person appointed by the Employer from time to time to act as his technical representative;
- 1.1.40 **“Employer’s Personnel”** means such person or persons as may be authorized in writing by the Employer to act on its behalf under this Agreement and shall include any person or persons having Employer to exercise any rights or perform and fulfil any obligations of the Employer under this Agreement;
- 1.1.41 **“Encumbrances”** means, in relation to the Project Works, any encumbrances such as mortgage, charge, pledge, lien, hypothecation, security interest, assignment, privilege or

priority of any kind having the effect of security or other such obligations, and shall include any designation of loss payees or beneficiaries or any similar arrangement under any insurance policy pertaining to the Project Works, where applicable herein but excluding utilities referred to in the recitals;

- 1.1.42 **“EPC”** means Engineering, Procurement and Construction;
- 1.1.43 **“DBO”** means Design Build and Operate
- 1.1.44 **“Final Payment Certificate”** shall have the meaning set forth in the recitals;
- 1.1.45 **“Final Payment Statement”** shall have the meaning set forth in the recitals;
- 1.1.46 **“Force Majeure”** or **“Force Majeure Event”** shall have the meaning ascribed to it in the recitals;
- 1.1.47 **“GOI”** or **“Government”** means the Government of India;
- 1.1.48 **“Good Industry Practice”** means the practices, methods, techniques, designs, standards, skills, diligence, efficiency, reliability and prudence which are generally and reasonably expected from a reasonably skilled and experienced contractor engaged in the same type of undertaking as envisaged under this Agreement;
- 1.1.49 **“Government Instrumentality”** means any department, division or subdivision of the Government or the State Government and includes any commission, board, Employer, agency or municipal and other local Employer or statutory body including panchayat under the control of the Government or the State Government, as the case may be, and having jurisdiction over all or any part of the Project Works or the performance of all or any of the services or obligations of the Contractor under or pursuant to this Agreement;
- 1.1.50 **“Indemnified Party”** means the Party entitled to the benefit of an indemnity pursuant to the recitals;
- 1.1.51 **“Indemnifying Party”** means the Party obligated to indemnify the other Party pursuant to the recitals;
- 1.1.52 **“Indirect Political Event”** shall have the meaning set forth in the recitals;
- 1.1.53 **“Insurance Cover”** means the aggregate of the maximum sums insured under the insurances taken out by the Contractor pursuant to Clause 13, and includes all insurances required to be taken out by the Contractor under relevant sub clauses of Clause 13 but not actually taken, and when used in the context of any act or event, it shall mean the aggregate of the maximum sums insured and payable or deemed to be insured and payable in relation to such act or event;
- 1.1.54 **“Intellectual Property”** means all patents, trademarks, service marks, logos, get-up, trade names, internet domain names, rights in designs, blue prints, programmes and manuals, drawings, copyright (including rights in computer software), database rights, semiconductor, topography rights, utility models, rights in know-how and other intellectual property rights, in each case whether registered or unregistered and including

applications for registration, and all rights or forms of protection having equivalent or similar effect anywhere in the world;

- 1.1.55 **“Interim Payment Certificate”** or **“IPC”** means the interim payment certificate issued by the Employer’s Engineer for payment to the Contractor in respect of Contractor’s claims for payment raised in accordance with the provisions of this Agreement;
- 1.1.56 **“LOA”** or **“Letter of Award”** means the letter of award referred to in Recital (E);
- 1.1.57 **“Material Adverse Effect”** means a material adverse effect of any act or event on the ability of either Party to perform any of its obligations under and in accordance with the provisions of this Agreement and which act or event causes a material financial burden or loss to either Party;
- 1.1.58 **“Materials”** are all the supplies used by the Contractor for incorporation in the Works or for the maintenance of the Project Works;
- 1.1.59 **“Non-Political Event”** shall have the meaning set forth in the recitals;
- 1.1.60 **“Parties”** means the parties to this Agreement collectively and **“Party”** shall mean any of the parties to this Agreement individually;
- 1.1.61 **“Performance Security”** shall have the meaning set forth in the recitals;
- 1.1.62 **“Plant”** means the apparatus and machinery intended to form or forming part of the Works;
- 1.1.63 **“PMNC”** shall mean Project/Program Management Consultant appointed by Employer
- 1.1.64 **“Political Event”** shall have the meaning set forth in the recitals;
- 1.1.65 **“Programme”** shall have the meaning set forth in the recitals;
- 1.1.66 **“Project”** / **“Facility”** means the Construction and Maintenance of the Project Works in accordance with the provisions of this Agreement, and includes all works, services and equipment relating to or in respect of the Scope of the Project;
- 1.1.67 **“Project Assets”** means all physical and other assets relating to (a) tangible assets such as civil works and equipment including foundations, civil tanks and structures, buildings, process control hardware and software, electro-mechanical equipment, piping, valves, electrical equipment and motor control centres, field instruments and control system, drainage works (b) Project Facilities situated on the Site;
- 1.1.68 **“Project Completion Date”** means the date on which the Provisional Certificate is issued and in the event no Provisional Certificate is issued, the date on which the Completion Certificate is issued;
- 1.1.69 **“Project Completion Schedule”** means the progressive Project Milestones set forth in contract data sheet
for completion of the Project Works on or before the Scheduled Completion Date;

- 1.1.70 **“Project Works”** or **“Works”** means the Site comprising **“Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Firefighting network, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis”** project and all Project Assets, and its subsequent development and augmentation in accordance with this Agreement
- 1.1.71 **“Quality Assurance Plan”** or **“QAP”** shall have the meaning set forth in the recitals;
- 1.1.72 **“Re.”, “Rs.”** or **“Rupees”** or **“Indian Rupees”** means the lawful currency of the Republic of India;
- 1.1.73 **“Retention Money”** shall have the meaning set forth in Clause 3.6;
- 1.1.74 **“Right of Way”** means the constructive possession of the Site free from encroachments and encumbrances, together with all way leaves, easements, unrestricted access and other rights of way, howsoever described, necessary for construction and maintenance of the Project Works in accordance with this Agreement;
- 1.1.75 **“Scheduled Completion Date”** shall have the meaning set forth in the recitals;
- 1.1.76 **“Scope of the Project”** shall have the meaning set forth in Clause 1.6; **“Section”** means a part of the Project Works;
- 1.1.77 **“Site”** shall have the meaning set forth in Clause 1.7;
- 1.1.78 **“Specifications and Standards”** means the specifications and standards relating to the quality, quantity, capacity and other requirements for the Project Works, as set forth in Volume 2 - Employer’s Requirements, Volume 3 - General Specifications, Volume 4- Schedules, Volume 5 -Tender Drawings, other relevant parts of the tender and any modifications thereof, or additions thereto, as included in the design and engineering for the Project Works submitted by the Contractor to, and expressly approved by the Employer;
- 1.1.79 **“Subcontractor”** means any person or persons to whom a part of the Works or the Maintenance has been assigned for completion/execution/operation by the Contractor and the permitted legal successors in title to such person, but not an assignee to such person;
- 1.1.80 **“Taxes”** means any Indian taxes including GST (Goods and service tax), excise duties, customs duties, value added tax sales tax, local taxes, cess and any impost or surcharge of like nature (whether Central, State or local) on the goods, Materials, equipment and services incorporated in and forming part of the Project Works charged, levied or imposed by any Government Instrumentality, but excluding any interest, penalties and other sums in relation thereto imposed on any account whatsoever. For the avoidance of doubt, Taxes shall not include taxes on corporate income;

- 1.1.81 **“Termination”** means the expiry or termination of this Agreement as per Clause 11 [Termination];
- 1.1.82 **“Termination Notice”** means the communication issued in accordance with this Agreement by one Party to the other Party terminating this Agreement;
- 1.1.83 **“Termination Payment”** means the amount payable by either Party to the other upon Termination in accordance with Clause 11.8 [Termination Payment] ;
- 1.1.84 **“Tests”** means the tests set forth in Part 1 of Volume 2- Employer’s Requirements to determine the completion of Works in accordance with the provisions of this Agreement;
- 1.1.85 **“Time Extension”** shall have the meaning set forth in Clause 4.6 [Extension of time for completion];
- 1.1.86 **“User”** means a person who uses or intends to use on the Project Works or any part thereof;
- 1.1.87 **“Valuation of Unpaid works”** shall have the meaning set forth in the recitals;

1.2 Order of Precedence

The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:

- a) the Contract Agreement (if any),
- b) the Letter of Award,
- c) the Form of Bid,
- d) the Contract Data Sheet,
- e) the Employer’s Requirements/Particular Conditions of Contract,
- f) the Conditions of Contract,
- g) the Indicative Tender Drawings,
- h) General Specifications and
- i) the Schedules and any other documents forming part of the Contract.

If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

1.3 Employer's Use of Contractor's Document

- 1.3.1 Contractor shall retain the copyright and other intellectual property rights in the Contractor’s Documents and other design documents made by (or on behalf of) the Contractor.

1.3.2 The Contractor shall be deemed (by signing the Contract) to give to the Employer a non-terminable transferable non-exclusive royalty-free licence to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This licence shall:

- a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works,
- b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and
- c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by the Contract, including replacements of any computers supplied by the Contractor.

1.3.3 All the rights to the Construction Documents and other design documents are to be assigned to the Employer.

1.4 Contractor's Use of Employer's Document

1.4.1 Employer shall retain the copyright and other intellectual property rights in the Specification, the Drawings and other documents made by (or on behalf of) the Employer. The Contractor may, at his cost, copy, use, and obtain communication of these documents for the purposes of the Contract. They shall not, without the Employer's consent, be copied, used or communicated to a third party by the Contractor.

1.5 Confidentiality

1.5.1 The Parties shall treat the details of this Agreement as private and confidential, except to the extent necessary to carry out obligations under it or to comply with Applicable Laws. The Contractor shall not publish, permit to be published, or disclose any particulars of the Works in any trade or technical paper or elsewhere without the previous agreement of the Employer.

1.6 Scope of the Project

1.6.1 Under this Agreement, the scope of the Project (the "Scope of the Project") shall mean and include the relevant section described in the Volume 1, Part 1 Instructions to the bidders, section 1.1 project information.

1.7 Site

1.7.1 The site of the Project Works (the "Site") shall comprise the site described in Volume-1-Part-1-Instruction to Bidders, Section 1.1 Project Information in respect of which the Right of Way shall be provided by the Employer to the Contractor. The Employer shall be responsible for:

- a) acquiring and providing land on the Site in accordance with the land use plan finalized by the Employer, free from all encroachments and encumbrances, and free access thereto for the execution of this Agreement; and
- b) obtaining licenses and permits for environment clearance for the Project Works.

1.8 Inspections and Audit

- 1.8.1 The Employer or any representative authorized by the Employer in this behalf may inspect and review the progress and quality of the construction of Project Works and issue appropriate directions to the Employer's Engineer and the Contractor for taking remedial action in the event the Works are not in accordance with the provisions of this Agreement.
- 1.8.2 At any time during construction, the Employer may appoint an external technical auditor to conduct an audit of the quality of the Works. The findings of the audit, to the extent accepted by the Employer, shall be notified to the Contractor and the Employer's Engineer for taking remedial action in accordance with this Agreement. The Contractor shall provide all assistance as may be required by the auditor in the conduct of its audit hereunder. Notwithstanding anything contained in this Clause 1.8, the external technical audit shall not affect any obligations of the Contractor or the Employer's Engineer under this Agreement.

2. THE ENGINEER

2.1 Appointment of the Employer's Engineer

- 2.1.1 The Employer (MITL) may appoint a consultant to be the engineer (herein referred as the "Employer's Engineer or Engineer-in-charge").
- 2.1.2 The Employer's Engineer may exercise the authority attributable to the Engineer as specified or implied from the Contract. However, under no circumstances the Employer's Engineer shall have authority to modify or amend the Contract.
- 2.1.3 Except as otherwise stated in these Conditions, whenever carrying out duties or exercising authority, specified in or implied by the Contract, the Engineer shall be deemed to act for the Employer;
- 2.1.4 Except as otherwise stated in these Conditions, the Engineer has no authority to relieve the contractor of any duties, obligations or responsibilities under the Contract;
- 2.1.5 Except as otherwise stated in these Conditions, any approval, consent, test, inspection, authorisation or absence of approval shall not relieve the Contractor from any responsibility he has under the Contract, including responsibility for errors, defect liability, omissions, discrepancies and non-compliances.
- 2.1.6 The staff of the Employer's Engineer shall include suitably qualified engineers and other professionals who are competent to assist the Employer's Engineer to carry out its duties.

2.2 Duties and Authority of the Employer's Engineer

- 2.2.1 The Employer's Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract. The Employer's Engineer shall perform the duties and exercise the Authority in accordance with the provisions of this Agreement.

2.3 Delegation by the Employer's Engineer

- 2.3.1 The Employer's Engineer may, by order in writing, delegate any of his duties and responsibilities to qualified representative or may revoke any such delegation, under intimation to the Employer and the Contractor. The representative may include site engineer and/or independent inspectors who are accountable to Engineer-in-charge, Provided, however, that the Engineer-in-charge shall be responsible and liable for all actions and omissions of such personnel.
- 2.3.2 Any failure of the Engineer-in-charge to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Employer to reject the work, Plant or Materials, which is not in accordance with the provisions of this Agreement and the Specifications and Standards.

2.4 Instructions of the Employer's Engineer

- 2.4.1 The Employer's Engineer at any time may issue instructions and additional or modified Drawings to the Contractor that may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract. The Contractor shall take such instructions from the Employer's Engineer, or from its representative to whom appropriate Authority has been delegated under Clause 2.3. Any instructions from employers engineer to the contractor which has financial impact on the work shall be carried out only after the permission/approval of MITL management
- 2.4.2 The instructions issued by the Employer's Engineer shall be in writing. All approvals/rejections of materials any plant visit etc carried out by the engineer or any changes w.r.t the scope of work shall be communicated to employer and approved by the employer.
- However, if the Employer's Engineer issues any oral instructions to the Contractor, it shall confirm in writing the oral instructions within 2 (two) working days of issuing them.
- 2.4.3 In case the Contractor does not receive the confirmation of the oral instruction within the time specified in Clause 2.4.2, the Contractor shall seek the written confirmation of the oral instructions from the Employer's Engineer. The Contractor shall obtain acknowledgment from the Employer's Engineer of the communication seeking written confirmation. In case of failure of the Employer's Engineer or its delegated assistant to reply to the Contractor within 2 (two) days of the receipt of the communication from the Contractor, the Contractor may not carry out the instruction.

- 2.4.4 In case of any dispute on any of the instructions issued by the delegated representative, the Contractor may refer the dispute to the Employer's Engineer, who shall then confirm, reverse or vary the instructions within 5 (five) business days of the dispute being referred.

2.5 **Determination by the Employer's Engineer**

- 2.5.1 The Employer's Engineer shall consult with each Party in an endeavour to reach agreement wherever this Agreement provides for the determination of any matter by the Employer's Engineer. If such agreement is not achieved, the Employer's Engineer shall make a fair determination in accordance with this Agreement having due regard to all relevant circumstances. The Employer's Engineer shall give notice to both the Parties of each agreement or determination, with supporting particulars.
- 2.5.2 Each Party shall give effect to each agreement or determination made by the Employer's Engineer in accordance with the provisions of this Agreement. Provided, however, that if any Party disputes any instruction, decision, direction or determination of the Employer's Engineer, the Dispute shall be resolved in accordance with the Dispute Resolution Procedure.

2.6 **Remuneration of the Employer's Engineer**

The remuneration, cost and expenses of the Employer's Engineer shall be paid by the Employer.

2.7 **Termination of the Employer's Engineer**

The Employer may, in its discretion, replace the Employer's Engineer at any time, in accordance with Clause 2.1.

3. **THE CONTRACTOR**

3.1 **Contractor's General Obligations**

- 3.1.1 The Contractor shall design, execute and complete the Works and subsequently operate and maintain it in DLP period in accordance with the Contract and as per the Engineer-in-charge's/employer's instructions. The Contractor shall also remedy any defects whatsoever in the Works to the satisfaction of Engineer-in-charge/employers and in accordance with the Contract.
- 3.1.2 The Contractor shall provide the Plant, Equipment, Services and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects.
- 3.1.3 The Contractor shall be responsible for the adequacy, stability and safety of all Site operations and of all methods of construction. Except to the extent specified in the Contract, the Contractor shall be responsible for all Contractor's Documents, Temporary

Works, and such design of each item of Plant and Materials as is required for the item to be in accordance with the Contract.

- 3.1.4 The Contractor shall, whenever required by the Engineer/employer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Engineer/employer.
- 3.1.5 If the Contract specifies that the Contractor shall design any part of the Permanent Works, then unless otherwise stated in the Particular Conditions:
- a) the Contractor shall submit to the Engineer the Contractor's Documents for this part in accordance with the procedures specified in the Contract;
 - b) these Contractor's Documents shall be in accordance with the Specification and Drawings, shall be written in the language for communications as specified, and shall include additional information required by the Engineer-in-charge to add to the Drawings;
 - c) the Contractor shall be responsible for this part and it shall, when the Works are completed, be fit for such purposes for which the part is intended as are specified in the Contract; and
 - d) prior to the commencement of the Tests on Completion, the Contractor shall submit to the Engineer-in-charge/employer the "as-built" documents and DLP operation and maintenance manuals in accordance with the Specification and in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and repair this part of the Works. Such part shall not be considered to be completed for the purposes of taking-over until these documents and manuals have been submitted to the Engineer-in-charge/employer for review and approval thereof.

3.2 Performance Security

- 3.2.1 The Contractor shall, for the performance of its obligations hereunder during the EPC/Construction Period, provide to the Employer, within time limit specified in the Contract Data Sheet, an irrevocable and unconditional guarantee from a nationalised/scheduled Bank in the format set forth in Tender Forms for an amount equal to a percentage of the Contract Price as specified in the Contract Data Sheet.
- 3.2.2 The Performance Security shall be valid and enforceable the Contractor has executed and completed the Works and remedied any defects or until 60 (sixty) days after the Defects Liability Period. The claim period shall be further 180 days after the date of expire of Performance Security. The Performance Security shall be payable at Mumbai branch of nationalised/scheduled bank only.
- 3.2.3 Until such time the Performance Security is provided by the Contractor pursuant hereto and the same comes into effect, the Bid Security shall remain in force and effect, and upon such provision of the Performance Security, the Employer shall release the Bid Security to the Contractor. Notwithstanding anything to the contrary contained in this

Agreement, the Parties agree that in the event of failure of the Contractor to provide the Performance Security in accordance with the provisions of this Clause 3.2 and Vol 1, Part 1, ITB Clause 7.5 [Performance Security] and within the time specified therein or such extended period as may be provided by the Employer, in accordance with the provisions of Clause , the Employer may encash the Bid Security and appropriate the proceeds thereof as Damages, and thereupon all rights, privileges, claims and entitlements of the Contractor under or arising out of this Agreement shall be deemed to have been waived by, and to have ceased with the concurrence of the Contractor, and this Agreement shall be deemed to have been terminated by mutual agreement of the Parties.

- 3.2.4 In the event the Contractor fails to provide the Performance Security within 10 (ten) days of this Agreement, it may seek extension of time for a period not exceeding 20 (twenty) days on payment of Damages for such extended period in a sum calculated at the rate of 0.05% (zero point zero five per cent) of the Contract Price for each day until the Performance Security is provided.

3.3 Extension of Performance Security

- 3.3.1 The Contractor shall initially provide the Performance Security for a period of 2 (two) years; provided that it shall procure the extension of the validity of the Performance Security, as necessary, at least 28 days prior to the date of expiry thereof.
- 3.3.2 If the terms of the Performance Security specify its expiry date, and the Contractor has not become entitled to receive the Performance Certificate by the date 2 months prior to the expiry date, the Contractor shall extend the validity of the Performance Security until the Works have been completed and any defects have been remedied.
- 3.3.3 Upon the Contractor providing an extended Performance Security, the previous Performance Security shall be deemed to be released and the Employer shall return the same to the Contractor within a period of 7 (seven) business days from the date of submission of the extended Performance Security.

3.4 Appropriation of Performance Security

- 3.4.1 Upon occurrence of a Contractor's Default, the Employer shall, without prejudice to its other rights and remedies hereunder or in law, be entitled to encash and appropriate the relevant amounts from the Performance Security as Damages for such Contractor's Default.
- 3.4.2 Upon such encashment and appropriation from the Performance Security, the Contractor shall, within 30 (thirty) days thereof, replenish, in case of partial appropriation, to its original level the Performance Security, and in case of appropriation of the entire Performance Security provide a fresh Performance Security, as the case may be, and the Contractor shall, within the time so granted, replenish or furnish fresh Performance Security as aforesaid failing which the Employer shall be entitled to terminate the Agreement in accordance with Clause titled 'Termination'. Upon replenishment or furnishing of a fresh Performance Security, as the case may be, as aforesaid, the Contractor shall be entitled to an additional Cure Period of 30 (thirty) days for remedying

the Contractor's Default, and in the event of the Contractor not curing its default within such Cure Period, the Employer shall be entitled to encash and appropriate such Performance Security as Damages, and to terminate this Agreement in accordance with Clause 11 titled 'Termination'.

3.5 Release of Performance Security

- 3.5.1 The Employer shall return the Performance Security to the Contractor within 60 (sixty) days of the later of the expiry of Defects Liability Period under this Agreement. Notwithstanding the aforesaid, the Parties agree that the Employer shall not be obliged to release the Performance Security until all Defects identified during the Defects Liability Period have been rectified to the satisfaction of the employer.

3.6 Retention Money

- 3.6.1 The Employer shall retain from each payment due to the Contractor the proportion as stated in the Contract Data until Completion of the whole of the Works under Construction Contract thereof as guarantee money for performance of the obligations of the Contractor during the Construction Period (the "Retention Money") subject to the condition that the maximum amount of Retention Money as stated in the Contract Data Sheet.
- 3.6.2 Upon occurrence of a Contractor's Default, the Employer shall, without prejudice to its other rights and remedies hereunder or in law, be entitled to appropriate the relevant amounts from the Retention Money as Damages for such Contractor's Default.
- 3.6.3 The Contractor may, upon furnishing an irrevocable and unconditional bank guarantee substantially in the form provided Tender Forms, require the Employer to refund the Retention Money deducted by the Employer under the provisions of Clauses 3.6.1 and Clause 11.7 [Valuation of Unpaid Works]. Provided that the refund hereunder shall be made in tranches of not less than 1% (one per cent) of the Contract Price.
- 3.6.4 The Parties agree that in the event of Termination of this Agreement, the Retention Money and the bank guarantees specified in this Clause 3.6 shall be treated as if they are Performance Security and shall be reckoned as such for the purposes of Termination Payment under Clause 11.8.

3.7 Site Data

- 3.7.1 The Employer shall have made available to the Contractor for his information, prior to the Base Date, all relevant data in the Employer's possession on sub-surface and hydrological conditions at the Site, including environmental aspects. The Employer shall similarly make available to the Contractor all such data which come into the Employer's possession after the Base Date. The Contractor shall be responsible for interpreting all such data.
- 3.7.2 The Contractor shall be deemed to have obtained all necessary information as to risks, contingencies, site conditions and other circumstances which may influence or affect the Tender or Works. To the same extent, the Contractor shall be deemed to have inspected

and examined the site, its surroundings, the above data and other available information, and to have been satisfied before submitting the Tender as to all relevant matters, including (without limitation):

- a) the form and nature of the Site, including sub-surface conditions,
- b) the hydrological, geotechnical, topographical and climatic conditions,
- c) the extent and nature of the work and goods necessary for the execution and completion of the works and the remedying of any defects,
- d) the Laws, procedures and labour practices of the Country, and
- e) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.

3.8 Electricity, Water and Gas

The Contractor shall be responsible for procuring of all Power, Water and other services that it may require during construction and testing.

Contractor shall arrange and provide at his own cost electric connection of suitable load from local electricity supply agency and will also keep ready Generators of adequate capacity as stand by arrangement in case of electric failure during construction for running pump sets, vibrators, mixer, needle sets and other electrically operated Construction equipment etc. at his own cost.

The cabling for electric connection for Construction and testing shall be arranged by the Contractor himself at his own cost. The non-availability /sanction of electric connection shall be no excuse for delay in completion of work.

For operating this scheme, permanent Power connection shall be obtained by the Contractor as per the requirement from local electricity supply agency. Contractor shall liaison for getting permission from MSEDCL / electrical inspector and all cost of liaising and other miscellaneous expenses shall be borne by Contractor on this account.

For permanent connection, all the statutory deposits/fees as required by the local electricity supply agency shall be paid by Employer directly. Approval and execution of entire permanent electrical installation including H.T. Side shall be carried out by the Contractor at his own cost. Contractor shall carry out survey work and shall carry out installation of overhead transmission line / underground cable from MSEDCL substation / MSEDCL source to 11 KV RMU / switchyard, as applicable. Only the statutory charges to be paid to MSEDCL shall be directly paid by MITL.

The Water required for all purposes including construction, testing and commissioning purpose shall be arranged by Contractor at his cost.

If the quality of ground water is not as per standards or if contractor makes his own arrangement for construction and drinking purposes, he will ensure that the quality of water conforms to relevant BIS standards as applicable according to the use to which the water is being put to. The quality of water shall be got tested as per BIS by the Contractor at his own cost at a laboratory approved by Engineer-in-Charge.

3.9 Employer's Equipment and Free Issue Material

Employer does not have provision for any equipment or free issue material.

3.10 Progress Reports

3.10.1 During the Construction Period, the Contractor shall, no later than 10 (ten) days after the close of each month, furnish to the Employer and the Engineer-in-charge a monthly report on progress of the Works and shall promptly give such other relevant information as may be required by the Engineer-in-charge. Soft copies of the reports also to be submitted.

3.10.2 Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

3.10.3 Each report shall include:

- a) charts and detailed descriptions of progress, including each stage of design, Contractor's Documents, procurement, manufacture, delivery to Site, construction, erection and testing; and including these stages for work by each nominated Subcontractor,
- b) photographs/video (drone video) showing the progress on the Site and status of work/manufacture;
- c) for the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of:
 - i. commencement of manufacture,
 - ii. Contractor's inspections,
 - iii. tests, and
 - iv. shipment and arrival at the Site;
- d) copies of quality assurance documents, test results and certificates of Materials;
- e) list of claims by any party;
- f) Comparisons of actual and planned progress, with details of any events or anticipated risks that may inhibit the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome delays.
- g) safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations;

3.11 Security of the Site

Unless otherwise stated:

- a) the Contractor shall be responsible for keeping unauthorised persons off the Site, and

- b) authorised persons shall be limited to the Contractor's Personnel and the Employer's Personnel; and to any other personnel notified to the Contractor, by the Employer or the Engineer, as authorised personnel of the Employer's other contractors on the Site.

3.12 Fossils

All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest found on the Site shall be placed under the care and authority of the Employer. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.

The Contractor shall, upon discovery of any such finding, promptly give notice to the Engineer, who shall issue instructions for dealing with it. If the Contractor suffers delay and/or incurs Cost from complying with the instructions, the Contractor shall give a further notice to the Engineer and shall be entitled subject to claims for:

- a) an extension of time for any such delay, if completion is or will be delayed, and
- b) payment of any such Cost, which shall be included in the Contract Price.

4. DESIGN AND CONSTRUCTION OF THE PROJECT WORKS

4.1 Obligations prior to commencement of Works

4.1.1 Within 15 (fifteen) days of the Letter of Award, the Contractor shall:

- a) appoint its Project Manager (the "Project Manager"), duly authorized to deal with the Employer in respect of all matters under or arising out of or relating to this Agreement;
- b) appoint a Design Manager (the "Design Manager") who will head the Contractor's Design unit and shall be responsible for surveys, investigations, collection of data, and preparation of basic and detailed Designs and Drawings;
- c) undertake and perform all such acts, deeds and things as may be necessary or required before commencement of Works under and in accordance with this Agreement, the Applicable Laws and Applicable Permits;
- d) the Contractor within stipulated time as indicated in Contract Data Sheet, shall submit to the Employer and the Engineer-in-charge a project plan and schedule for the Works (the "Programme"), developed using networking techniques giving the following details:
 - 1. Contractor's organization for the Project, the general methods and arrangements for Design and Construction, Environmental Management Plan, Quality Assurance Plan including Design Quality Plan, Safety Plan covering Safety of users and workers during Construction, Contractor's key personnel and equipment.

2. Programme for completion of all stages of Construction and Project milestones.
The Programme shall include:

- a. the order in which the Contractor intends to carry out the Works, including the anticipated timing of design, Supply, Installation, Erection, Testing, Commissioning of all equipment and various packages and stages of Works;
- b. the periods for reviews;
- c. the sequence and timing of inspections and tests specified in this Tender.
- d. The Contractor shall submit a revised programme whenever the previous programme is inconsistent with the actual progress or with the Contractor's obligations.

3. Monthly Cash Flow Forecast

4.1.2 The Contractor shall appoint a qualified safety Officer with minimum 8 years' experience to carry out safety audit at the design stage of the Project Works in accordance with the Applicable Laws and Good Industry Practice.

4.1.3 The safety audit shall be carried out by the Safety officer in respect of all such design details that have a bearing on safety of Users as well as pedestrians and animals involved in or associated with accidents. The recommendations of the Safety Officer shall be incorporated in the design of the Project Works and the Contractor shall forward to the Employer's Engineer a certificate to this effect together with the recommendations of the Safety Officer.

4.2 **Design and Drawings Obligations**

4.2.1 The Contractor shall carry out, and be responsible for, the complete Design of the Works including basic Engineering, detailed Engineering and Construction Drawings. Design shall be prepared by qualified designers/professionals who comply with the criteria stated in the Employer's Requirements or as directed by Engineer-in-charge. The Contractor undertakes that the designers shall be available to attend discussions with the Engineer-in-Charge at all reasonable times during the Contract Period.

4.2.2 Contractor shall be responsible for approval of Design, Construction documents and drawings from Employer or any agency or consultant appointed by Employer for this purpose. No extra payment or charges shall be paid to contractor for this purpose.

4.2.3 The Contractor is required to study the Employer's Design criteria, specifications etc., as included in the Bid documents to confirm their correctness in its bid and to assume full responsibility for them.

4.2.3 The Contractor shall appoint a proof check consultant (the "Proof Consultant") after proposing to the Employer a panel of three names of qualified and experienced firms from whom the Employer may choose one to be the Proof Consultant. Provided, however, that if the panel is not acceptable to the Employer and the reasons for the same are furnished to the Contractor, the Contractor shall propose to the Employer a revised panel of three names from the firms empanelled as proof consultants by the Employer for obtaining the consent of the Employer. The Contractor shall also obtain the consent of the Employer

for two key personnel of the Proof Consultant who shall have adequate experience and qualifications in similar projects. The Employer shall, within 15 (fifteen) days of receiving a proposal from the Contractor hereunder, convey its decision, with reasons, to the Contractor, and if no such decision is conveyed within the said period, the Contractor may proceed with engaging of the Proof Consultant.

The Proof Consultant shall:

- a) evolve a systems approach with the Design Manager so as to minimize the time required for final designs and Construction Drawings; and
- b) Proof Check the detailed calculations, drawings and designs which have been approved by the Design Manager.

4.3 Submission of Design Calculations, Drawings and Documents

- 4.3.1 As per the date indicated in the Contract Data Sheet or as approved by the Engineer-in-Charge, the Contractor shall submit 3 (three) hard copies along with workable soft copies each of Design Calculations, Drawings and Other Documents as indicated in Volume 3, Part 1 [General Requirements] of the tender document to the Engineer-in-Charge for approval.
- 4.3.2 The Contractor shall incorporate all necessary comments of the Engineer-in-Charge or consultant appointed by Employer, if any, and shall re-submit further 3 (three) copies each of the revised design and drawings within 14 (fourteen) days for final approval of the Engineer-in-Charge.
- 4.3.3 Design calculations and drawings shall be submitted in sequence as per schedule to be drawn and agreed upon mutually, immediately after submission of the general arrangement drawing. The entire process of submission of all such documents by the Contractor in initial copies and final copies after approval of the Engineer-in-Charge shall be completed within 30 days from the date of LOA.
- 4.3.4 By submitting the Drawings for review to the Engineer-in-charge, the Contractor shall be deemed to have represented that it has determined and verified that the tender design/drawing and engineering, site conditions, including field data/construction criteria related thereto, are in conformity with the Scope of the Project, the Specifications and Standards and the Applicable Laws;
- 4.3.5 It is mandatory for the contractor to comply with all the contract conditions and the design review comments provided by the Engineer-in-Charge. In the event the Contractor fails to address/resolve the issue highlighted by Engineer-in-charge and/or redesign/reengineer the proposed design/report/calculations, and/or revise and resubmit such design/Drawings/report/calculations for review and approval by Engineer-in-charge, as aforesaid, immediately after being brought to notice of contractor, it would tantamount to default of contractual condition by the contractor. In such a case, the Engineer-in-charge may withhold the payment for the affected works and/or initiate disciplinary action in accordance with the relevant provisions of tender. If the Contractor disputes any decision, direction or determination of the Engineer-in-charge hereunder, the Dispute shall be resolved in accordance with the Dispute Resolution Procedure;
- 4.3.6 Any review and/or observation of the Engineer-in-charge and/or its delay/failure to review and/or convey its observations on any Design and/or Reports, and/or Calculations and/or Drawings shall not relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Engineer-in-charge or the Employer be liable for the same in any manner; and if errors, omissions, ambiguities, inconsistencies, inadequacies or other Defects are found in the Design/Reports/Calculations/Drawings, they and the construction works shall be corrected at the Contractor's cost.

- 4.3.7 The Contractor shall be responsible for delays in submitting the Drawing as set forth in Volume 3, Part 1 [General Requirements] caused by reason of delays in surveys and field investigations, completion of design/engineering/drawing as per comments provided by Engineer-in-charge and shall not be entitled to seek any relief in that regard from the Employer;
- 4.3.8 The Contractor warrants that its Designers, including any third parties engaged by it, shall have the required experience and capability in accordance with Good Industry Practice and approval of Employer and it shall indemnify the Employer and Consultant appointed by Employer against any damage, expense, liability, loss or claim, which the Employer might incur, sustain or be subject to arising from any breach of the Contractor's design responsibility and/or warranty set out in this Clause. Engineer-in-charge shall have the right to instruct the contractor to change its designer for inadequate\poor quality of drawings/design or failure to comply with the comments on design\drawings\calculations or failure to respond to comments within 5 working days. The Engineer-in-charge may withhold the payment for the affected works and/or initiate disciplinary action in accordance with the relevant provisions of tender in case of noncompliance by the contractor. If the Contractor disputes any decision, direction or determination of the Engineer-in-charge hereunder, the Dispute shall be resolved in accordance with the Dispute Resolution Procedure;
- 4.3.9 Contractor shall be solely responsible for any delays or consequential damages arising out of delay in approval of design\drawings owing to iterations\revisions in the design\drawings for complying with the tender conditions as per the comments provided by Engineer-in-charge.
- 4.3.10 Any cost or delay in construction arising from review by the Engineer-in-charge shall be borne by the Contractor.
- 4.3.11 Engineer-in-charge shall have the right to demote/degrade the approval code of any design/drawing at any point in time in case Engineer-in-charge's comments are not addressed/resolved or in case any deviation from contract specifications/requirements
- 4.3.12 Contractor shall ensure that all the drawings/designs/reports submitted to Engineer in charge for review and approval should be legible with minimum font size of 10 pt at 100% without any size reduction, clear, described in grammatically correct English language. Engineer in charge shall have the right to reject a drawing for failure\delay by contractor in complying with the aforesaid norms.
- 4.3.13 Works shall be executed in accordance with the Drawings provided by the Contractor in accordance with the provisions of this Clause 4.2 and the comments/observations of the Engineer-in-charge thereon as communicated. Such Drawings shall not be amended or altered without prior written notice to the Engineer-in-charge. If a Party becomes aware of an error or defect of a technical nature in the design or Drawings, that Party shall promptly give notice to the other Party of such error or defect.

- 4.3.14 Within 30 (thirty) days of the Project Completion Date, the Contractor shall furnish to the Employer and the Engineer-in-charge a complete set of as built drawings, in 2 (two) hard copies and soft copy as may be acceptable to the Employer, reflecting the Project Works as actually designed, engineered and constructed, including an as built survey illustrating the layout of the Project Works and setback lines, if any, of the buildings and structures forming part of Project Facilities.

4.4 Construction of the Project Works

- 4.4.1 The Contractor shall construct the Project Works as specified in Schedules and Datasheets in conformance to Volume 3 Employer's Requirements. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the Works. The Contractor agrees and undertakes that the construction shall be completed within the Time for Completion of Works as indicated in Contract Data Sheet, including any extension thereof.

4.5 Scheduled Completion date

- 4.5.1 The Scheduled Completion Date for the Part 1 - EPC of the Works shall occur on the last day of Time for Completion of Part 1 - EPC of the Works as indicated in the Contract Data Sheet.
- 4.5.2 On or before the Scheduled Completion Date, the Contractor shall have completed Part 1 - EPC of the Works in accordance with this Agreement.

4.6 Extension of time for completion

- 4.6.1 Without prejudice to any other provision of this Agreement for and in respect of extension of time, the Contractor shall be entitled to extension time for Completion of Works (the "Time Extension") to the extent that completion of any Project Milestone is or will be delayed by occurrence of any of the following conditions, namely:
- a) delay by Employer in providing access to site;
 - b) change of Scope (unless an adjustment to the Scheduled Completion Date has been agreed under Clause 4.9);
 - c) occurrence of a Force Majeure Event;
 - d) any delay, impediment or prevention caused by or attributable to the Employer, the Employer's personnel or the Employer's other contractors on the Site; and
 - e) any other cause or delay which entitles the Contractor to Time extension in accordance with the provisions of this Agreement.

- 4.6.2 The Contractor shall, no later than 15 (fifteen) business days from the occurrence of an event or circumstance specified in Clause 4.5.1, inform the Engineer-in-charge by notice in writing, with a copy to the Employer, stating in reasonable detail with supporting particulars, the event or circumstances giving rise to the claim for Time Extension in accordance with the provisions of this Agreement. Provided that the period of 15 (fifteen) business days shall be calculated from the date on which the Contractor became aware, or should have become aware, of the occurrence of such an event or circumstance.

Provided further that notwithstanding anything to the contrary contained in this Agreement, Time Extension shall be due and applicable only for the Works which are affected by the aforesaid events or circumstances and shall not in any manner affect the Project Completion Schedule for and in respect of the Works which are not affected hereunder.

- 4.6.3 In the event of the failure of the Contractor to issue to the Engineer-in-charge a notice in accordance with the provisions of Clause 4.6.2 within the time specified therein, the Contractor shall not be entitled to any Time Extension and shall forfeit its right for any such claims in future. For the avoidance of doubt, in the event of failure of the Contractor to issue notice as specified in this Clause 4.6, the Employer shall be discharged from all liability in connection with the claim.

- 4.6.4 The Engineer-in-charge shall, on receipt of the claim in accordance with the provisions of Clause 4.6.2, examine the claim expeditiously within the time frame specified herein. In the event the Engineer-in-charge requires any clarifications to examine the claim, the Engineer-in-charge shall seek the same within 15 (fifteen) days from the date of receiving the claim. The Contractor shall, on receipt of the communication of the Engineer-in-charge requesting for clarification, furnish the same to the Engineer-in-charge within 10 (ten) days thereof. The Engineer-in-charge shall, within a period of 60 (sixty) days from the date of receipt of such clarifications, forward in writing to the Contractor its determination of Time Extension.

Provided that when determining each extension of time under this Clause 4.6, the Engineer-in-charge shall review previous determinations and may increase, but shall not decrease, the total Time Extension.

- 4.6.5 If the event or circumstance giving rise to the notice has a continuing effect:

- a) a fully detailed claim shall be considered as interim;
- b) the Contractor shall, no later than 10 (ten) days after the close of each month, send further interim claims specifying the accumulated delay, the extension of time claimed, and such further particulars as the Engineer-in-charge may reasonably require; and
- c) the Contractor shall send a final claim within 30 (thirty) days after the effect of the event or the circumstance ceases.

Upon receipt of the claim hereunder, the Engineer-in-charge shall examine the same in accordance with the provisions of Clause 4.6.4 within a period of 60 (sixty) days of the receipt thereof.

4.7 **Incomplete Works**

In the event the Contractor fails to complete the Works in accordance with the Project Completion Schedule, including any Time Extension granted under this Agreement, the Contractor shall endeavour to complete the balance work expeditiously and shall pay Damages to the Employer in accordance with the provisions for delay of each day until the Works are completed in accordance with the provisions of this Agreement. Recovery of Damages under this Clause shall be without prejudice to the rights of the Employer under this Agreement including the right to termination under Clause 11 [Termination].

4.8 Change of Scope

4.8.1 The Employer may, notwithstanding anything to the contrary contained in this Agreement, require the Contractor to make modifications to the Works ("Change of Scope") before the issue of the Completion Certificate either by giving an instruction or by requesting the Contractor to submit a proposal for Change of Scope involving additional cost or reduction in cost. Any such Change of Scope shall be made and valued in accordance with the provisions of this Clause 4.8

4.8.2 Change of Scope shall mean:

1. change in specifications of any item of Works; and/or
2. any additional work, Plant, Materials or services which are not included in the Scope of the Project

4.8.3 For the avoidance of doubt, the Parties agree that the Contractor shall not undertake any Change of Scope without the express consent of the Employer, save and except any Works necessary for meeting any Emergency.

4.8.4 In the event of the Employer determining that a Change of Scope is necessary, he will issue to the Contractor a notice specifying in reasonable detail the works and services contemplated there under (the "Change of Scope Notice").

4.8.5 Upon receipt of a Change of Scope Notice, the Contractor shall, with due diligence, provide to the Employer and the Employer's Engineer such information as is necessary, together with preliminary documentation in support of:

- a) the impact, if any, which the Change of Scope is likely to have on the Project Completion Schedule if the works or services are required to be carried out during the Construction Period; and
- b) the options for implementing the proposed Change of Scope and the effect, if any, each such option would have on the costs and time thereof, including the following details:
 - i. break down of the quantities, unit rates and cost for different items of work;
 - ii. proposed design for the Change of Scope; and
 - iii. proposed modifications, if any, to the Project Completion Schedule of the Project Works

4.8.6 Contractor's quotation of costs for the Change of Scope shall be determined on the following principles:

- a) the latest available edition of MIDC Schedule of Rates applicable to Nanded Region & Aurangabad, PWD SSR rates will be adopted for the valuation of any works which are not already covered by the items included in Price Schedules. Payments for the Variations Items shall be made in INR only.
- b) In the event that items are not covered in the MIDC Schedule of rates applicable to Nanded Region, then the latest edition of the Maharashtra Water Supply and Sewerage Board rates applicable for Aurangabad and then the schedule of rates related to Aurangabad PWD SSR will be used in that order.
- c) The market rates substantiated with 3 quotations, followed by work order and/or Tax Invoice shall be considered only when the executed variation items are not covered under Price Schedule or the above referred schedule of rates. A fixed percentage of 15% shall be added to cover the Contractor's Overhead and Profit for the rates evaluated under this category

For the avoidance of doubt, the Parties expressly agree that, subject to the provisions of Clause 4.8, the Contract Price shall be increased or decreased, as the case may be, on account of Change of Scope.

4.8.7 Upon reaching an agreement, the Employer shall issue an order (the "Change of Scope Order") requiring the Contractor to proceed with the performance thereof.

4.8.8 Payment for Change of Scope shall be made in accordance with the payment schedule specified in the Change of Scope Order.

4.9 Restrictions to Change of Scope

4.9.1 No Change of Scope shall be executed unless the Employer has issued the Change of Scope Order save and except any Works necessary for meeting any Emergency.

4.9.2 Notwithstanding anything to the contrary in this Clause 4, no change made necessary because of any default of the Contractor in the performance of its obligations under this Agreement shall be deemed to be Change of Scope, and shall not result in any adjustment of the Contract Price or the Project Completion Schedule.

4.10 Power of the Employer to undertake works

4.10.1 In the event the Parties are unable to agree to the proposed Change of Scope in accordance with Clause 4.8, the Employer may, after giving notice to the Contractor and considering its reply thereto, award such works or services to any third party or agency as deemed suitable.

4.10.2 It is also agreed that the Contractor shall provide assistance and cooperation to the person or agency who undertakes the works or services hereunder, and will be responsible for rectification of any Defects and/ or maintenance of works carried out by other agencies.

- 4.10.3 Notwithstanding anything contrary to this Clause 4.10, it will be Contractor's obligation to construct and maintain the Project Works in accordance with this Agreement.

5. STAFF AND LABOUR

5.1 Persons in the Service of Employer

The Contractor shall not recruit, or attempt to recruit, staff and labour from amongst the Employer's Personnel.

5.2 Labour Laws

The Contractor shall comply with all the relevant labour Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration and emigration, and shall allow them all their legal rights.

The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.

5.3 Working Hours

No work shall be carried out on the Site on locally recognised days of rest, or outside the normal working hours as indicated in Contract Data Sheet, unless:

- a) otherwise stated in the Contract,
- b) the Engineer-in-charge gives consent, or
- c) the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer-in-charge

5.4 Facilities for Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel.

The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

- a) Within 30 days of award of work the contractor shall provide the site office with independent soundproof air-conditioned cabins for use by Engineer-in-Charge/employer and consultant and its staff appointed by Employer. The site office should have at least one meeting room (min 10-person seating capacity in each), pantry and toilet facilities. The site office shall include necessary furniture, required office equipment i.e. Fax, photocopy, computer with colour laser printer of latest configuration/software and broadband internet connections for use by Engineer-in-Charge and consultant and its staff appointed by Employer.

- b) The location and layout of site offices shall be got approved from the Engineer-in-charge before providing the same.
- c) The Contractor has to arrange for the land required for site office and store area at nearest location to the site at its own cost.
- d) The Contractor shall appoint a duly qualified safety officer who shall be stationed at the site from the time the contractor mobilizes. These personnel or a suitable replacement, if required, and for which prior permission of Employer is to be obtained, shall be stationed at site till the end of the contract period.
- e) The Contractor shall provide electricity, water and telephone connections to the site office at his own cost along with other required facilities.
- f) Running expenses of the site office shall be borne by the Contractor.
- g) The Contractor shall not use any part of the project site or any adjoining/nearby site for labour camp or for accommodation/housing of any labour without the written permission of Engineer-in-Charge.

5.5 Contractor's Superintendence

Throughout the execution of the Works, and as long thereafter as is necessary to fulfil the Contractor's obligations, the Contractor shall provide all necessary superintendence to plan, arrange, direct, manage, inspect and test the work.

Superintendence shall be given by a sufficient number of persons having adequate knowledge of the language for communications and of the operations to be carried out (including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents), for the satisfactory and safe execution of the Works.

Contractor shall appoint a Planning Engineer at project site with computer having M.S. Project

and CAD facility. The role and purpose of the Engineer shall be mainly to maintain weekly reporting to Employer (besides monthly Progress Report) on an approved format through E-mail facility kept by the Contractor at site. Also, CAD drafting facility is required to incorporate necessary details/variation on drawings or the As-built drawings time -to-time during construction process and to avoid any discrepancies therein.

Contractor shall appoint a Quality Control Manager and team, responsible for conducting daily inspections, preparation of QAP, preparation of work method statements, compliance of site quality observations and NCRs, reports, co-ordinating for third party testing, submission of monthly quality report etc. in co-ordination with PMNC / Employer Engineer.

5.6 Measures against Insects and Pest Nuisance

The Contractor shall at all times take the necessary precautions to protect all staff and labour employed on the Site from insect and pest nuisance, and to reduce the dangers to health and general nuisance occasioned by the same. The Contractor shall provide his

staff and labour with suitable prophylactics for the prevention of malaria and take steps to prevent the formation of the stagnant pools of water. The Contractor shall comply with all the regulations of the local health authorities and shall arrange to spray thoroughly with approved insecticide in all.

5.7 **Epidemics**

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government, or the local medical or sanitary authorities, for the purpose of dealing with and overcoming the same.

5.8 **Burial or Cremation of the Dead**

The Contractor shall make all necessary arrangements for the transport, to anyplace as required for burial/cremation, of any of his expatriate employees or members of their families who may die at the works. The Contractor shall also be responsible, to the extent required by local regulations, for making any arrangements with regard to burial/cremation of any of his local employees who may die while engaged upon the Works.

5.9 **Alcoholic Liquor or Drugs**

The Contractor shall not, otherwise than in accordance with the Laws of the Country import, sell, gift, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale gift, barter or disposal by Contractor's Personnel.

5.10 **Arms and Ammunition**

The Contractor shall not give, barter or otherwise dispose of to any person or persons, any arms or ammunition of any kind or permit or allow Contractor's personnel to do so.

5.11 **Festivals and Religious Customs**

The Contractor shall respect the Country's/Locally recognized festivals, days of rest and religious or other customs.

5.12 **Foreign Staff and Labour**

The Contractor may import any personnel who are necessary for the execution of the Works. The contractor must ensure that these personnel are provided with the required residence visas and work permits. The Contractor shall be responsible for the return to the place where they were recruited or to their domicile of imported Contractor's Personnel. The Contractor shall be responsible for such personnel who are to return until they shall have left the Site or, in the case of foreign nationals who have been recruited outside the country, shall have left it.

6. QUALITY MANAGEMENT

6.1 Quality of Materials and Workmanship

The Contractor shall ensure that all the Construction, Materials and workmanship are in accordance with the requirements specified in this Agreement, Employer's Requirements, General Specifications and Standards and Good Industry Practice.

6.2 Quality Control System

The Contractor shall establish a quality control mechanism to ensure compliance with the provisions of this Agreement (the "Quality Assurance Plan" or "QAP").

The Contractor shall, within 15 (Fifteen) days of the Appointed Date, submit to the Engineer-in-charge its Quality Assurance Plan which shall include the following:

- a) Organization including Quality Control Manager and Engineers, duties and responsibilities, procedures, inspections and documentation;
- b) Quality control mechanism including sampling and testing of Materials, test frequencies, standards, acceptance criteria, testing facilities, reporting, recording and interpretation of test results, approvals, check list for site activities, and proforma for testing and calibration in accordance with the Indian standards, relevant specifications and Good Industry Practice; and
- c) Internal quality audit system.

The Contractor shall procure all documents, apparatus and instruments, fuel, consumables, water, electricity, labour, materials, samples, and qualified personnel as are necessary for examining and testing the Project Assets and workmanship in accordance with the Quality Assurance Plan.

The cost of testing of Construction, Materials and workmanship under this clause 6 shall be borne by the Contractor.

As a part of process all materials to be part of permanent works shall be inspected by Contractor along with MITL/Employers Engineer before dispatch and the contractor to detect any damage after delivery at site.

The Contractor shall not interfere in any way with any existing works, whether the property of the Employer or of a third party, whether or not the position of such works is indicated to the Contractor by the Engineer, except where such interference is specifically described as part of the Works, either in the Contract or in an instruction from the Engineer. He shall also be expected to seek independently the approval from such a 'Third party' in case the need for interference arises. All material shall comply with appropriate Standard Specifications unless otherwise required hereinafter.

The Contractor shall, before placing any order of materials, manufactured articles or machinery for incorporation in the Works, submit for the approval of the Engineer the names of the suppliers from whom he proposes to obtain such materials, manufactured articles or machinery, together with a list of the same, giving the origin, quality, weight,

strength, description and other relevant details. No materials, manufactured articles or machinery shall be ordered or obtained from any suppliers which the Engineer has not approved in writing.

All materials shall be delivered to the Site a sufficient period of time before they are required for use in the Works, to enable the Engineer to take such samples as he may wish for testing and approval.

Notwithstanding the fact that approval has been given to the source of supply, the Engineer may forbid the use of any materials if, upon delivery, they are found to be defective, or he considers them unsuitable for incorporation in the Works. Such rejected materials shall be removed from the site forthwith.

The Contractor may propose alternative materials of equivalent quality to those specified, and subject to the approval, such materials may be used in the Works.

The Contractor shall have no claim against the Employer in respect of any financial loss which he may suffer as a result of the rejection of any such materials, and he shall also bear the cost of removing them from the Site.

The Engineer shall have the right to inspect materials and plant for the permanent works during the course of manufacture. The Contractor shall arrange for the right of access to manufacturing premises for the Engineer and his staff during normal working hours. The Engineer shall be given sufficient notice by the Contractor to allow him to observe the testing of any materials for the works at the place of manufacture. The Engineer shall also be given the opportunity to inspect any material or plant in their completed state prior to packing for transport to the site.

If requested by the Engineer, the Contractor shall provide to the Engineer copies of orders for the supply of goods or materials required in connection with the works.

Material such as all type of pipes (of all sizes) & other equipment like pump, motor including power equipment like transformers, switch gear, cables, panels etc., all type of valves (of all sizes), flow meters any other materials as per requirements which are supplied by the contractor under this contract are subject to approved Third party inspection. The charges for such inspection shall be paid by the contractor. All the arrangements for inspection i.e. measuring tools, testing equipment and tools, labour required for handling materials during testing etc. shall be made available / arranged by the manufacturer /Vendor / contractor in their premises at their own costs. These costs shall be deemed included in contractor's price bid and nothing extra shall be paid to the said account. If any particular testing facility is not available at the premises /location of Factory, then the test shall be arranged by the factory owner /Vendor at his own cost at other locations / test laboratory. All expenses in this regard shall also have to be borne by the contractor/ manufacturer/vendor /contractor only. If the material inspected fails during test on no fault of the inspecting agency, fees are payable to the inspecting agency for the said inspection and for any further re-inspection of the same material.

The name of the agency for third party inspection shall be informed to Employers Engineer.

If it is subsequently observed that there are defects in the quality of material, the contractor shall replace the material without any extra cost. In addition to third party inspection, the Employers Engineer or his representative may conduct inspection intermittently.

Third Party Inspection Report: The third party inspection report merely in the certificate form stating that pipes/valves/specials or any other material inspected are found satisfactory will not be accepted, but it should be in the form of detailed report stating the parameters checked & observations made with comments of the Inspecting Officer in accordance with the respective Specifications/detailed item wise specifications / as per Tender notice.

6.3 Methodology

The Contractor shall, at least 15 (fifteen) days prior to the commencement of the construction, submit to the Engineer-in-charge for review and approval the methodology with detailed risk assessment proposed to be adopted for executing the Works and measures for ensuring safety.

6.4 Inspection and Technical Audit by the Employer

The Employer or any representative authorized by the Employer in this behalf may inspect and review the progress and quality of the construction of Project Works and issue appropriate directions to the Engineer-in-charge and the Contractor for taking remedial action in the event the Works are not in accordance with the provisions of this Agreement.

6.5 External Technical Audit

At any time during construction, the Employer may appoint an external technical auditor to conduct an audit of the quality of the Works. The findings of the audit, to the extent accepted by the Employer, shall be notified to the Contractor and the Engineer-in-charge for taking remedial action in accordance with this Agreement. The Contractor shall provide all assistance as may be required by the auditor in the conduct of its audit hereunder. Notwithstanding anything contained in this Clause 6.5, the external technical audit shall not affect any obligations of the Contractor or the Engineer-in-charge under this Agreement.

6.6 Inspection of Construction Records

The Employer shall have the right to inspect the records of the Contractor relating to the Works.

The Contractor shall hand over to the MITL\Employer's Engineer a copy of all its quality control records and documents before the Completion Certificate is issued.

6.7 Inspection

The Engineer-in-charge and its authorized representative shall at all reasonable times:

- a) have full access to all parts of the Site and to all places from which natural Materials are being obtained for use in the Works; and
- b) during production, manufacture and construction at the Site and at the place of production, be entitled to examine, inspect, measure and test the Materials and workmanship, and to check the progress of manufacture of Materials.

The Contractor shall give the Engineer-in-charge and its authorized agents access, facilities and safety equipment for carrying out their obligations under this Agreement.

For the avoidance of doubt, such inspection or submission of Inspection Report by the Engineer-in-charge shall not relieve or absolve the Contractor of its obligations and liabilities under this Agreement in any manner whatsoever.

6.8 Samples

The Contractor shall submit the following samples of Materials and relevant information to the Engineer-in-charge for pre-construction review:

- a) manufacturer's test reports and standard samples of manufactured Materials; and
- b) samples of such other Materials as the Engineer-in-charge may require.

6.9 Tests

For determining that the Works conform to the Specifications and Standards, the Engineer-in-charge shall require the Contractor to carry out or cause to be carried out tests, at such time and frequency and in such manner as specified in this Agreement, and in accordance with Good Industry Practice for quality assurance. The test checks by the Engineer-in-charge shall comprise at least 20 (twenty) percent of the quantity or number of tests prescribed for each category or type of test for quality control by the Contractor.

In the event that results of any tests conducted under this Clause 6.9 establish any Defects or deficiencies in the Works, the Contractor shall carry out remedial measures and furnish a report to the Engineer-in-charge in this behalf. The Engineer-in-charge shall require the Contractor to carry out or cause to be carried out tests to determine that such remedial measures have brought the Works into compliance with the Specifications and Standards, and the procedure shall be repeated until such Works conform to the Specifications and Standards. For the avoidance of doubt, the cost of such tests and remedial measures in pursuance thereof shall be solely borne by the Contractor.

6.10 Examination of Work Before Covering Up

In respect of the work which the Engineer-in-charge is entitled to examine, inspect, measure and/or test before it is covered up or put out of view or any part of the work is placed thereon, the Contractor shall give notice to the Engineer-in-charge whenever any such work is ready and before it is covered up. The Engineer-in-charge shall then either

carry out the examination, inspection or testing without unreasonable delay, or promptly give notice to the Contractor that the Engineer-in-charge does not require to do so. Provided, however, that if any work is of a continuous nature where it is not possible or prudent to keep it uncovered or incomplete, then Contractor shall notify the schedule of carrying out such work to give sufficient opportunity, not being less than 3 (three) business days' notice, to the Engineer-in-charge to conduct its inspection, measurement or test while the work is continuing. Provided further that in the event the Contractor receives no response from the Engineer-in-charge within a period of 3 (three) business days from the date on which the Contractor's notice hereunder is delivered to the Engineer-in-charge, the Contractor shall be entitled to assume that the Engineer-in-charge would not undertake the said inspection.

6.11 **Rejection**

If, as a result of an examination, inspection, measurement or testing, any Plant, Materials, design or workmanship is found to be defective or otherwise not in accordance with the provisions of this Agreement, the Engineer-in-charge shall reject the Plant, Materials, design or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the Defect and ensure that the rejected item complies with the requirements of this Agreement.

If the Engineer-in-charge requires the Plant, Materials, design or workmanship to be retested, the tests shall be repeated under the same terms and conditions, as applicable in each case. If the rejection and retesting cause the Employer to incur any additional costs, such cost shall be recoverable by the Employer from the Contractor; and may be deducted by the Employer from any monies due to be paid to the Contractor.

6.12 Remedial work

6.12.1 Notwithstanding any previous test or certification, the Engineer-in-charge may instruct the Contractor to:

- a) remove from the Site and replace any Plant or Materials which are not in accordance with the provisions of this Agreement;
- b) remove and re-execute any work which is not in accordance with the provisions of this Agreement and the Specification and Standards; and
- c) Execute any work which is urgently required for the safety of the Project Works, whether because of an accident, unforeseeable event or otherwise; provided that in case of any work required on account of a Force Majeure Event, the provisions of Clause 14 shall apply.

If the Contractor fails to comply with the instructions issued by the Engineer-in-charge under this Clause 6.12.1, within the time specified in the Engineer-in-charge's notice or as mutually agreed, the Engineer-in-charge may advise the Employer to have the work executed by another agency. The cost so incurred by the Employer for undertaking such work shall, without prejudice to the rights of the Employer to recover Damages in accordance with the provisions of this Agreement, be recoverable from the Contractor and may be deducted by the Employer from any monies due to be paid to the Contractor.

6.13 Royalties

6.13.1 Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for:

- a) natural Materials obtained from outside the Site, and
- b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract.

6.14 Delays during construction

6.14.1 In the event the Contractor does not achieve any of the Project Milestones or the Engineer-in-charge shall have reasonably determined that the rate of progress of Works is such that Completion of the Project Works is not likely to be achieved by the end of the Scheduled Completion Date, it shall notify the same to the Contractor, and the Contractor shall, within 15 (fifteen) days of such notice, by a communication inform the Engineer-in-charge in reasonable detail about the steps it proposes to take to expedite progress and the period within which it shall achieve the Project Completion Date.

6.15 Suspension of unsafe Construction Works

- 6.15.1 Upon recommendation of the Engineer-in-charge to this effect, the Employer may by notice require the Contractor to suspend forthwith the whole or any part of the Works if, in the reasonable opinion of the Engineer-in-charge, such work threatens the safety of the Users and pedestrians.

The Contractor shall, pursuant to the notice under this Clause 6.15.1, suspend the Works or any part thereof for such time and in such manner as may be specified by the Employer and thereupon carry out remedial measures to secure the safety of suspended works, the Users and pedestrians. The Contractor may by notice require the Engineer-in-charge to inspect such remedial measures forthwith and make a report to the Employer recommending whether or not the suspension hereunder may be revoked. Upon receiving the recommendations of the Engineer-in-charge, the Employer shall either revoke such suspension or instruct the Contractor to carry out such other and further remedial measures as may be necessary in the reasonable opinion of the Employer, and the procedure set forth in this Clause 6.15.1, shall be repeated until the suspension hereunder is revoked.

Subject to the provisions of Clause 14 [Force Majeure], all reasonable costs incurred for maintaining and protecting the Works or part thereof during the period of suspension (the “**Preservation Costs**”), shall be borne by the Contractor; provided that if the suspension has occurred as a result of any breach of this Agreement by the Employer, the Preservation Costs shall be borne by the Employer.

If suspension of Works is for reasons not attributable to the Contractor, the Engineer-in-charge shall determine any Time Extension to which the Contractor is reasonably entitled.

7. COMMENCEMENT, DELAYS AND SUSPENSION

7.1 Commencement of Work

The commencement date shall be within the time specified in the Contract Data Sheet.

7.2 Time for Completion

The Contractor shall complete the whole of the Works, and each Section complete in itself (if any), within the Time for Completion for the Works or Section (as the case may be), including:

- a) achieving the passing of the Tests on Completion, and
- b) completing all work which is stated in the Contract as being required for the Works or Section to be considered to be completed for the purposes of taking over.

7.3 Delay Damages

- 7.3.1 If the Contractor fails to comply with time for completion of project, the Contractor shall subject to penalty as specified per delay damages to the Employer for this default. These delay damages shall be the sum stated in the Contract Data Sheet, which shall be paid for every day which shall elapse between the relevant Time for Completion and the date stated in the completion /Taking-Over Certificate. However, the total amount due under this Sub-Clause shall not exceed the maximum amount of delay damages as stated in the Contract Data Sheet.
- 7.3.2 These delay damages shall be the only damages due from the Contractor for such default, other than in the event of termination prior to completion of the Works. These damages shall not relieve the Contractor from his obligation to complete the Works, or from any other duties, obligations or responsibilities which he may have under the Contract.

7.4 Suspension of Work

- 7.4.1 The Engineer-in-charge may at any time instruct the Contractor to suspend progress of part or all of the Works. The Engineer-in-charge may also notify the cause for the suspension.
- 7.4.2 During such suspension, the Contractor shall protect, store and secure such part or the Works against any deterioration, loss or damage.
- 7.4.3 The Contractor shall not be entitled to an extension of time for, or to payment of the Cost incurred in, making good the consequences of the Contractor's faulty design, workmanship or materials, or of the Contractor's failure to protect, store or secure.

7.5 Tests on Completion

- 7.5.1 At least 15 (fifteen) days prior to the likely completion of the Project Works, or a Section thereof, the Contractor shall notify the Engineer-in-charge of its intent to subject the Project Works or a Section thereof, to Tests. The date and time of each of the Tests shall be determined by the Contractor in consultation with the Engineer-in-charge and notified to the Employer who may designate its representative to witness the Tests.
- 7.5.2 Contractor shall submit the testing plan and procedure for Engineer-in-charge's approval one months before the scheduled tests.
- 7.5.3 Provisioning of all electricity, equipment, fuel, instruments, labour, materials, water and suitably qualified and experienced staff for the execution of EPC works shall be made available by the Contractor.
- 7.5.4 Contractor shall carry out the tests properly and maintain formal test records of start, duration, finish, test pressure, witness along with weather conditions and observations.

- 7.5.5 The Engineer-in-charge shall witness, observe, monitor and review the Tests conducted by the Contractor and review the results of the Tests to determine compliance of the Project Works or a Section thereof, with Specifications and Standards.
- 7.5.6 If it is reasonably anticipated or determined by the Engineer-in-charge during the course of any Test that the performance of the Project Works or Section or any part thereof, does not meet the Specifications and Standards, it shall have the right to suspend or delay such Test and require the Contractor to remedy and rectify the Defect or deficiencies.
- 7.5.7 For the avoidance of doubt, it is expressly agreed that the Engineer-in-charge may require the Contractor to carry out or cause to be carried out additional Tests, in accordance with Good Industry Practice, for determining the compliance of the Project Works or Section thereof with the Specifications and Standards.

7.6 Delayed Tests

- 7.6.1 If the Tests on Completion are being unduly delayed by the Contractor, the Engineer may by notice require the Contractor to carry out the Tests within 21 days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Engineer.
- 7.6.2 If the Contractor fails to carry out the Tests on Completion within the period of 21 days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

7.7 Retesting

- 7.7.1 If the Works, or a Section, fail to pass the Tests on Completion, the Engineer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions.

7.8 Failure to Pass Tests on Completion

- 7.8.1 In the event Tests on Completion demonstrate that the Work has failed to pass Tests on Completion, the Contractor shall have 3 months from the date of expiry of the relevant Time for Completion (unless such period is extended in accordance with this Contract) to achieve Required Output Standards or, at a minimum, the minimum permissible Output Standards from the facilities.
- 7.8.2 If the Works, or a Section, again fail to pass the Tests on Completion repeated under Clause 7.7 [Retesting], the Engineer shall be entitled to:
- order further repetition of Tests on Completion.
 - reject the Works or Section (as the case may be) if the failure deprives the Employer of substantially the whole benefit of the Works or Section.

7.9 Liquidated Damages

- 7.9.1 In the event that the Works fail to pass any or all of the Tests on Completion as defined in Vol 3 Part 1 - General Requirements, then the Employer shall levy Liquidated Damages, based on the extent of such failure, in accordance with the following formulae, subject to the condition that the total amount of Delay Damages for Works and/or Liquidated Damages for failure to pass the Tests on Completion shall not exceed the Maximum Amount of Delay Damages as defined in this Contract Data Sheet.

8. EMPLOYER'S TAKING OVER/COMPLETION CERTIFICATE

8.1 Taking Over/Completion Certificate

- 8.1.1 The Employer shall take over the Site and the Works within seven days of the Engineer making a presentation to the management and taking the consent for issuing a certificate of Completion.

The Employer shall be deemed to have taken over the Construction Works on the date when the commissioning of the scheme after the Tests on Completion would have been completed and duly informed by the Contractor to the Employer in writing unless refuted by the Employer within 14 days.

- 8.1.2 Contractor shall carry out the Operation and Maintenance during Defect Liability Period without any additional cost to Employer.

9. CONTRACT PRICE AND PAYMENT

9.1 The Contract Price

9.1.1 Payment for the Works shall be made on a lump sum basis according to four major work categories as follows:

1. Design and documentation, including all necessary Designs and documentation required for the Works;
2. Civil construction works, Installation, Testing, Commissioning and other services required for the different plant components in accordance with the payment units as set out in the Schedule of Prices and/or as proposed by the Contractor and approved by the Engineer;
3. Plant and Equipment, whether manufactured or fabricated outside or within the Employer's country, including supply of all electro-mechanical, electrical and instrumentation equipment, etc., for the different plant components according to the payment units as set out in the Schedule of Prices and/or as proposed by the Contractor and approved by the Engineer; and
4. Operation and Maintenance in DLP period of the constructed facilities after completion and acceptance of Design Build part of the Works.

9.1.2 The Contract Price shall be adjusted for changes in the cost of labour and materials in accordance with;

9.1.3 The Contractor shall pay all the duties, fees and taxes including GST in consequence of his obligations under the Contract, and the Contract Price shall not be adjusted for such costs;

9.1.4 Any quantities which may be set out in the Schedule are only estimated quantities and are not to be taken as the actual and correct quantities of the Works to be executed by the Contractor in fulfilment of his obligations under the Contract. The Contractor is responsible to assess the exact requirements and quantities for all items for the purpose of quoting his rates, and no variation in rates will be allowed on account of any variation in the estimated quantities unless specifically provided elsewhere in the Bid Document.

9.1.5 Any quantities, prices or rates of payment per unit quantity which may be set out in the Schedule are only to be used for the purposes stated in the Schedule and may be inapplicable for other purposes.

9.1.6 The cost of any taxes incurred in India on the supply of Plant and equipment listed under specific Schedules of Schedule of Prices, whether manufactured or fabricated outside or within the Employer's country, shall be reimbursed at actual cost, not at the estimated cost listed in the Schedule of Prices."

- 9.1.7 Progressive payments shall be made for the work completed by the Contractor in accordance with the provisions of Clause 10.2 [Payment Schedule for Interim Valuation].”

9.2 **Payment Schedule for Interim Valuation**

- 9.2.1 Prior to commencing construction of the Works, the Contractor shall submit a Bill of Principal Quantities of the Permanent Works (here in referred as “BPQPW”) including provision for construction, installation, testing, trial run and commissioning together with such supporting information and calculations as the Engineer may reasonably require.
- 9.2.2 The BPQPW shall include the anticipated final quantities of the principal items of Permanent Works, which shall have been priced using all-in rates such that the total amount equals the Accepted Contract Amount.
- 9.2.3 The BPQPW shall not contain priced items for design (other than as may be specified in the Schedule of Prices) or for Temporary Works; the value of each element of such work, and of any other work elements not described in the BPQPW, shall each be included in the rates for Permanent Works to be constructed after such element is carried out.
- 9.2.4 The BPQPW shall be subject to the approval of the Engineer, who may require the Contractor to revise and reissue the BPQPW at any time before taking-over to reflect Variations or if the Engineer determines that the BPQPW will not fully represent the Permanent Works at taking-over. If the total amount of the BPQPW at any time differs from the Contract Price, the Contract Price shall prevail.
- 9.2.5 During the Time for Completion of EPC of the Works, the Contract Price for the purpose of sub-paragraph (a) of Clause 10.3 [Application for Interim Payment Certificates] shall not exceed the amount calculated from the current BPQPW, based on the quantities of Permanent Works which have been constructed in accordance with the Contract. The Contractor's interim statement shall be in the same form as that of the current BPQPW and shall be accompanied by the Contractor's signed statement that the current BPQPW attached thereto (including anticipated final quantities) and the as-constructed quantities are all correct; each such statement shall also be accompanied by a Construction Certificate, signed by the Contractor's Representative, certifying that the part of the Works constructed to date complies with the Contract. However, the Contractor may propose such lesser amount as is reasonable, supported with appropriate calculation on a similar basis to the procedure described in this Sub-Clause.
- 9.2.6 The above procedures notwithstanding, interim valuations for the purposes of determining payments to be made to the Contractor by the Employer will be subject to the conditions summarised in the following Table below to ensure successful completion of the Works and satisfactory performance of the Contractor's obligations under the Contract. The weightage percentages mean progressive monthly payments up to the limits indicated, based on milestone completed by the Contractor.

9.2.7

Sr. No	Item	% of weightage
1	Road Works	50.00%
	Site Clearance and Earth Work Excavation	24%
	Sub Base and Base Course	24%
	Bituminous works for Flexible Payment	33%
	Culverts, Bridges, Drainage and Protection Works and Junction	7%
	Traffic signs, markings and Apprentices and Street Lighting	9%
	Supply and fixing of boundary stones	1.10%
	Construction of plot entries and property connection	1.90%
2	Potable Water	5.00%
	Laying of the Rising mains (DI K7,K9) and distribution mains (HDPE) with specials including earthwork for cutting, filling, disposal of the surplus earth and also provision for murum bedding	70%
	Valves, Valve chambers, Thrust blocks and water service connections including water meter	30%
3	Recycled water	5.00%
	Laying of the pipelines (DI K7,K9) and distribution mains (HDPE) including earthwork for cutting, filling, disposal of the surplus earth and also provision for bedding	70%
	All types of valves including valve actuators and valve chambers and Thrust blocks.	20%
	Water connections with meters	10%
5	Storm Water Drainage	27.00%
	Manholes & Laying of RCC NP3 pipes	80%
	Cover Slabs	15%
	Laying of PVC pipes, Kerb inlets, Collecting chambers under grated inlets, Rain water harvesting Structures and outfall structures	5%
6	Industrial Sewerage	5.00%
	Earthwork excavation, filling and disposal of surplus earth, Dewatering with an inclusion of murum bedding	23%

	Providing and laying of HDPE & DWC pipes	39%
	Drop Manholes, Circular manholes and Property connection	38%
7	Electrical Network	7%
	Supply of electric poles and high mast	50%
	Installation, testing and commissioning of electric poles and high mast	50%
8	Submission and approval of “Data, Drawings and analysis of Surveys & Investigations” and “Designs, Drawings and Reports	1.00%

9.3 Application for Interim Payment Certificates

- 9.3.1 For payments relating to EPC Works, the Contractor shall submit a statement in four copies to the Engineer after the end of each month, in a form approved by the Engineer, showing the amounts to which the Contractor considers himself to be entitled together with supporting documents which shall include the detailed report on the progress during the month in accordance with Clause 3.10 [Progress Reports].
- 9.3.2 The statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed:
1. the estimated contract value, at base rates and prices, of the Contractor's Documents produced and the Works (including Variations) executed up to the end of the month.
 2. any amount to be deducted for retention, calculated by applying the percentage of retention stated in the Contract Data Sheet to the total of the above amounts, until the amount so retained by the Employer reaches the limit of Retention Money (if any) stated in the Contract Data Sheet;
 3. any amounts to be added and deducted for the advance payments and repayments in accordance with Clause 9.4 [Advance Payment];
 4. any other additions or deductions which may have become due in accordance with the Contract (including those under Clause 15 [Claims, Disputes and Arbitration]), other than under Sub-Clause 7.3 [Delay Damages]; and
 5. the deduction of the amounts certified in all previous Interim Payment Certificates.
- 9.3.3 Deleted – O&M Payment

9.4 Advance Payments

The Employer shall make (the "Advance Payment") equal in amount to 10 (ten) percent of the Contract Price, for mobilization expenses and for acquisition of equipment etc. This amount shall be an interest-bearing advance payment @12 % per annum

The Contractor may apply to the Employer for the instalment of the Advance Payment at any time after signing of the Contract Agreement, along with an irrevocable and unconditional guarantee from a Bank for an amount equivalent to 112% (one hundred and ten per cent) of such instalment, substantially the form for bank guarantee will be provided to the contractor on request to employer, to remain effective till the complete and full repayment thereof.

The recovery of all Advances shall commence in five equal instalments. The first instalment shall be deducted from 05th RA Bill or after completion of 1st milestone whichever is the earlier.

9.5 **Payment**

9.5.1 The Employer shall pay to the Contractor:

1. the amount certified in each Interim Payment Certificate within 60 days from the date on which the Engineer receives the Statement and supporting documents; and
2. the amount certified in the Final Payment Certificate within 90 days from the date of issue of the Certificate.

Payments shall be made in Indian Rupees, into a bank account nominated by the Contractor, in India.

9.6 **Payment of Retention Money**

9.6.1 The Contractor may, upon furnishing an irrevocable and unconditional Bank guarantee substantially in the form provided, and valid for 28 days beyond the end of Defect Liability Period, require the Employer to refund the Retention Money deducted by the Employer for each section. Provided that the refund hereunder shall be made in tranches of not less than 1% (one per cent) of the Contract Price. At the request of the Contractor, 50% of this Retention Money shall be released within 28 days of issue of Completion Certificate of that section and balance 50% will be retained without interest and shall be released within 28 days after expiry of Defect Liability Period of each that section.

9.6.2 The Contractor shall ensure that the guarantee is valid and enforceable until the Contractor has executed and completed the Works or Section and remedied any defects, as specified in the Performance Security in Clause 3.2, and shall be returned to the Contractor accordingly.

9.7 **Currencies of Payment**

The currency of account shall be the Local Currency i.e. INR (Indian National Rupees) and all payments made in accordance with the Contract shall be in Local Currency.

9.8 Change in laws

9.8.1 The Contract Price is subject to adjustment for any increase or decrease in Cost due to any significant change in the Laws of the Country (including the introduction of new Laws and the repeal or modification of existing Laws) made after the date of issue of Letter of Award, which affect the Contractor in the performance of obligations under the Contract.

9.8.2 If as a result of Change in Law, the Contractor suffers any additional costs in the execution of the Works or in relation to the performance of its other obligations under this Agreement, the Contractor shall, within 15 (fifteen) days from the date it becomes reasonably aware of such addition in cost, notify the Employer with a copy to the Engineer-in-charge of such additional cost due to Change in Law.

If as a result of Change in Law, the Contractor benefits from any reduction in costs for the execution of this Agreement or in accordance with the provisions of this Agreement, either Party shall, within 15 (fifteen) days from the date it becomes reasonably aware of such reduction in cost, notify the other Party with a copy to the Engineer-in-charge of such reduction in cost due to Change in Law.

The Engineer-in-charge shall, within 30 (thirty) days from the date of receipt of the notice from the Contractor or the Employer, determine any addition or reduction to the Contract Price, as the case may be, due to the Change in Law.

10. TERMINATION

10.1 Corrupt or Fraudulent Practices

10.1.1 The Employer may terminate this Contract, by not less than thirty (30) days' written notice of termination to the Contractor, in the case if the Contractor, in the judgment of the Employer has engaged in Corrupt or Fraudulent Practices in competing for or in executing the Contract.

For the purpose of this clause:

"Corrupt Practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the selection process or in contract execution.

"Fraudulent Practice" means a misrepresentation of facts in order to influence a selection process or the execution of a contract to the detriment of the Employer, and includes collusive practice among contractors (prior to or after submission of proposals) designed to establish prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.

10.2 Notice to Correct

If the Contractor fails to carry out any obligation under the Contract, the Engineer may issue a notice to the Contractor to make good the failure and to remedy it within a specified reasonable time.

10.3 Termination for Contractor Default

10.3.1 The Employer shall be entitled to terminate the Contract under any of the following conditions:

1. the Contractor fails to provide, extend or replenish, as the case may be complying with Clause 3.2 [Performance Security] or take adequate action as per notice under Clause 11.2 [Notice to Correct]
2. the Contractor abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract,
3. the Contractor does not achieve the latest outstanding Project Milestone due in accordance with the project schedule approved by Employer, subject to any Time Extension, and continues to be in default for 45 (forty-five) days;
4. the Contractor fails to rectify any Defect, the non-rectification of which shall have a Material Adverse Effect on the Project, within the time specified in this Agreement or as directed by the Engineer-in-charge;
5. the Contractor subcontracts the whole or any part of the Works or assigns the Contract or the Maintenance without prior consent of the Engineer-in-charge;
6. the Contractor becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events
7. the Contractor creates any Encumbrance in breach of this Agreement;
8. the Contractor has been, or is in the process of being liquidated, dissolved, wound-up, amalgamated or reconstituted in a manner that would cause, in the reasonable opinion of the Employer, a Material Adverse Effect;
9. any representation or warranty of the Contractor herein contained which is, as of the date hereof, found to be materially false or the Contractor is at any time hereafter found to be in breach thereof;
10. the Contractor submits to the Employer any statement, notice or other document, in written or electronic form, which has a material effect on the Employer's rights, obligations or interests and which is false in material particulars;
11. the Contractor has failed to fulfil any obligation, for which failure Termination has been specified in this Agreement;
12. the Contractor commits a default in complying with any other provision of this Agreement if such a default causes a Material Adverse Effect on the Project or on the Employer.

10.3.2 Save as otherwise provided in this Agreement, in the event that any of the defaults specified above shall have occurred, the Contractor shall be deemed to be in default of this Agreement (the “Contractor Default”), unless the default has occurred solely as a result of any breach of this Agreement by the Employer or due to Force Majeure.

10.3.3 Without prejudice to any other rights or remedies which the Employer may have under this Agreement, upon occurrence of a Contractor Default, the Employer shall be entitled to terminate this Agreement by issuing a Termination Notice to the Contractor; provided that before issuing the Termination Notice, the Employer shall by a notice inform the Contractor of its intention to issue such Termination Notice and grant 15 (fifteen) days to the Contractor to make a representation, and may after the expiry of such 15 (fifteen) days, whether or not it is in receipt of such representation, issue the Termination Notice.

10.4 Termination for Employer Default

10.4.1 In the event that any of the defaults specified below shall have occurred, and the Employer fails to cure such default within a Cure Period of 90 (ninety) days or such longer period as has been expressly provided in this Agreement, the Employer shall be deemed to be in default of this Agreement (the “Employer Default”) unless the default has occurred as a result of any breach of this Agreement by the Contractor or due to Force Majeure. The defaults referred to herein shall include:

- a) the Employer has failed to make payment of any amount due and payable to the Contractor within the period specified in this Agreement;
- b) the Employer has failed to provide, within a period of 180 (one hundred and eighty) days from the Award Date, the environmental clearances required for construction of the Project Works;
- c) the Employer repudiates this Agreement or otherwise takes any action that amounts to or manifests an irrevocable intention not to be bound by this Agreement; or
- d) the Engineer-in-charge fails to issue the relevant Interim Payment Certificate within 60 (sixty) days after receiving a statement and supporting documents.

Without prejudice to any other right or remedy which the Contractor may have under this Agreement, upon occurrence of an Employer’s Default, the Contractor shall be entitled to terminate this Agreement by issuing a Termination Notice to the Employer; provided that before issuing the Termination Notice, the Contractor shall by a notice inform the Employer of its intention to issue the Termination Notice and grant 15 (fifteen) days to the Employer to make a representation, and may after the expiry of such 15 (fifteen) days, whether or not it is in receipt of such representation, issue the Termination Notice.

10.5 Termination for Employer’s Convenience

10.5.1 Notwithstanding anything stated herein above, the Employer may terminate this Agreement for convenience. The termination shall take effect 30 (thirty) days from the date of notice hereunder.

10.6 Requirements after Termination

- 10.6.1 Upon Termination of this Agreement Contractor shall deliver to the Employer all Plant and Materials which shall have become the property of the Employer.
- 10.6.2 After termination of this Agreement for Contractor Default, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any Materials, Plant and Equipment, drawings and other design documents made by or on behalf of the Contractor.
- 10.6.3 Upon Termination of this Agreement for Contractor Default, the Contractor shall then vacate the Site within one week and deliver any required Goods, all Contractor's Documents and other design documents (including all relevant records, reports, Intellectual Property and other licenses pertaining to the Works, Maintenance, other design documents and in case of Termination occurring after the Provisional Certificate has been issued, the "as built" Drawings for the Works) made by or for him, to the Engineer-in-charge. However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice (i) for the assignment of any subcontract, and (ii) for the protection of life or property or for the safety of the Works. The contractor shall transfer and/or deliver all Applicable Permits to the extent permissible under Applicable Law.
- 10.6.4 Upon Termination of this Agreement for Contractor Default, the Employer shall then give notice that the Contractor's Equipment and Temporary Works will be released to the Contractor at or near the Site. The Contractor shall promptly arrange their removal, at the risk and cost of the Contractor. However, if by this time the Contractor has failed to make a payment due to the Employer, these items may be sold by the Employer in order to recover this payment. Any balance of the proceeds shall then be paid to the Contractor.

10.7 Valuation of Unpaid Works

10.7.1 After a notice of termination under Clause 11.3 [Termination for Contractor Default], the Employer may:

- a) Within a period of 45 (forty-five) days after Termination under applicable sub-clauses of clause 11, as the case may be, the Engineer-in-charge shall proceed in accordance with Clause 2.5 [Determination by the Employer's Engineer] to determine as follows the valuation of unpaid Works (the "Valuation of Unpaid Works"):
- b) value of the completed stage of the Works, less payments already made;
- c) reasonable value of the partially completed stages of works as on the date of Termination, only if such works conform with the Specifications and Standards; and
- d) value of Maintenance, if any, for completed months, less payments already made, and shall adjust from the sum thereof (i) any other amounts payable or recoverable, as the case may be, in accordance with the provisions of this Agreement; and (ii) all taxes due to be deducted at source.

The Valuation of Unpaid Works shall be communicated to the Employer, with a copy to the Contractor, within a period of 45 (forty five) days from the date of Termination.

10.8 Termination Payment

10.8.1 Upon Termination on account of Contractor's Default under Clause 11, the Employer shall:

- a) withhold further payments to the Contractor until the costs of execution, completion and remedying of any defects, damages for delay in completion (if any), and all other costs incurred by the Employer, have been established, and/or recover from the Contractor any losses and damages incurred by the Employer and any extra costs of completing the Works.
- b) encash and appropriate the Performance Security and Retention Money, or in the event the Contractor has failed to replenish or extend the Performance Security
- c) encash and appropriate the bank guarantee, if any, for and in respect of the outstanding Advance Payment and interest thereon; and pay to the Contractor, by way of Termination Payment, an amount equivalent to the Valuation of Unpaid Works after adjusting any other sums payable or recoverable, as the case may be, in accordance with the provisions of this Agreement.

10.8.2 Upon Termination on account of an Employer Default under Clause 11.4 [Termination for Employer Default] or Clause 11.5 [Termination for Employer's Convenience for Employer's convenience], the Employer shall:

- a) return the Performance Security and Retention Money forthwith;
- b) encash and appropriate the bank guarantee, if any, for and in respect of the outstanding Advance Payment; and
- c) pay to the Contractor, by way of Termination Payment, an amount equal to:
 - i. Valuation of Unpaid Works;
 - ii. the reasonable cost, as determined by the Engineer-in-charge, of the Plant and Materials procured by the Contractor and transferred to the Employer for its use, only if such Plant and Materials are in conformity with the Specifications and Standards;
 - iii. the reasonable cost of temporary works, as determined by the Engineer-in-charge; and

Termination Payment shall become due and payable to the Contractor within 45 (forty five) days of a demand being made by the Contractor to the Employer with the necessary particulars, and in the event of any delay, the Employer shall pay interest at the Base Rate plus 2% (two percent), calculated at quarterly rests, on the amount of Termination Payment remaining unpaid; provided that such delay shall not exceed 90 (ninety) days. For the avoidance of doubt, it is expressly agreed that Termination Payment shall constitute full discharge by the Employer of its payment obligations in respect thereof hereunder.

The Contractor expressly agrees that Termination Payment under this Clause 11 shall constitute a full and final settlement of all claims of the Contractor on account of Termination of this Agreement and that it shall not have any further right or claim under any law, treaty, convention, contract or otherwise.

10.9 Other Rights and Obligations of the Parties

Upon Termination for any reason whatsoever

- a) property and ownership in all Materials, Plant and Works and the Project Works shall, as between the Contractor and the Employer, vest in the Employer in whole; provided that the foregoing shall be without prejudice to Clause 11.8 [Termination Payment]
- b) risk of loss or damage to any Materials, Plant or Works and the care and custody thereof shall pass from the Contractor to the Employer; and
- c) the Employer shall be entitled to restrain the Contractor and any person claiming through or under the Agreement from entering upon the Site or any part of the Project except for taking possession of materials, stores, implements, construction plants and equipment of the Contractor, which have not been vested in the Employer in accordance with the provisions of this Agreement.

10.10 **Survival of Rights**

Notwithstanding anything to the contrary contained in this Agreement any Termination pursuant to the provisions of this Agreement shall be without prejudice to the accrued rights of either Party including its right to claim and recover money damages, insurance proceeds, security deposits, and other rights and remedies, which it may have in law or Agreement. All rights and obligations of either Party under this Agreement, including Termination Payments, shall survive the Termination to the extent such survival is necessary for giving effect to such rights and obligations.

11. **RISK AND RESPONSIBILITY**

11.1 **General indemnity**

The Contractor will indemnify, defend, save and hold harmless the Employer and its officers, servants, agents, Government Instrumentality and Government owned and/or controlled entities/enterprises, (the “Employer Indemnified Persons”) against any and all suits, proceedings, actions, demands and third party claims for any loss, damage, cost and expense of whatever kind and nature, whether arising out of any breach by the Contractor of any of its obligations under this Agreement or from any negligence under the Agreement, including any errors or deficiencies in the design documents, or tort or on any other ground whatsoever, except to the extent that any such suits, proceedings, actions, demands and claims have arisen due to any negligent act or omission, or breach or default of this Agreement on the part of the Employer Indemnified Persons.

11.2 **Indemnity by the Contractor**

Without limiting the generality of Clause 12 [Risk and Responsibility], the Contractor shall fully indemnify, hold harmless and defend the Employer and the Employer Indemnified Persons from and against any and all loss and/or damages arising out of or with respect to:

- d) bodily injury, sickness, disease or death, of any person whatsoever arising out of or in the course of or by reason of the Contractor’s design (if any), the execution and completion of the Works and the remedying of any defects, unless attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer’s Personnel, or any of their respective agents, and
- e) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss:
 - i. arises out of or in the course of or by reason of the Contractor’s design (if any), the execution and completion of the Works and the remedying of any defects, and

- ii. is attributable to any negligence, wilful act or breach of the Contract by the Contractor, the Contractor's Personnel, their respective agents, or anyone directly or indirectly employed by any of them
- f) failure of the Contractor to comply with Applicable Laws and Applicable Permits;
- g) payment of taxes required to be made by the Contractor in respect of the income or other taxes of the Sub-contractors, suppliers and representatives; or
- h) non-payment of amounts due as a result of Materials or services furnished to the Contractor or any of its Sub-contractors which are payable by the Contractor or any of its Sub-contractors.
- i) any demands, claims, suits or proceedings arising out of claims of infringement of any domestic or foreign patent rights, copyrights or other intellectual property, proprietary or confidentiality rights with respect to any materials, information, design or process used by the Contractor or by the Sub-contractors in performing the Contractor's obligations or in any way incorporated in or related to the Project. If in any such suit, action, claim or proceedings, a temporary restraint order or preliminary injunction is granted, the Contractor shall make every reasonable effort, by giving a satisfactory bond or otherwise, to secure the revocation or suspension of the injunction or restraint order. If, in any such suit, action, claim or proceedings, the Project Works, or any part thereof or comprised therein, is held to constitute an infringement and its use is permanently enjoined, the Contractor shall promptly make every reasonable effort to secure for the Employer a license, at no cost to the Employer, authorizing continued use of the infringing work. If the Contractor is unable to secure such license within a reasonable time, the Contractor shall, at its own expense, and without impairing the Specifications and Standards, either replace the affected work, or part, or process thereof with non-infringing work or part or process, or modify the same so that it becomes non- infringing.

11.3 Indemnity by the Employer

- 11.3.1 The Employer shall indemnify and hold harmless the Contractor, the Contractor's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of (1) bodily injury, sickness, disease or death, which is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (2) the matters for which liability may be excluded from insurance cover as described in relevant sub-clauses of Clause 13 [Insurance].

11.4 Notice and contest of claims

- 11.4.1 In the event that either Party receives a claim or demand from a third party in respect of which it is entitled to the benefit of an indemnity under this Clause 12 [Risk and Responsibility], (the "Indemnified Party") it shall notify the other Party (the "Indemnifying Party") within 15 (fifteen) days of receipt of the claim or demand and shall not settle or pay the claim without the prior approval of the Indemnifying Party, which approval shall not be unreasonably withheld or delayed. In the event that the Indemnifying Party wishes to contest or dispute the claim or demand, it may conduct the proceedings in the name of the Indemnified Party, subject to the Indemnified Party being secured against any costs involved, to its reasonable satisfaction.

11.5 Defence of claims

The Indemnified Party shall have the right, but not the obligation, to contest, defend and litigate any claim, action, suit or proceeding by any third party alleged or asserted against such Party in respect of, resulting from, related to or arising out of any matter for which it is entitled to be indemnified hereunder, and reasonable costs and expenses thereof shall be indemnified by the Indemnifying Party. If the Indemnifying Party acknowledges in writing its obligation to indemnify the Indemnified Party in respect of loss to the full extent provided by this Clause 12 [Risk and Responsibility], the Indemnifying Party shall be entitled, at its option, to assume and control the defence of such claim, action, suit or proceeding, liabilities, payments and obligations at its expense and through the counsel of its choice; provided it gives prompt notice of its intention to do so to the Indemnified Party and reimburses the Indemnified Party for the reasonable cost and expenses incurred by the Indemnified Party prior to the assumption by the Indemnifying Party of such defense. The Indemnifying Party shall not be entitled to settle or compromise any claim, demand, action, suit or proceeding without the prior written consent of the Indemnified Party, unless the Indemnifying Party provides such security to the Indemnified Party as shall be reasonably required by the Indemnified Party to secure the loss to be indemnified hereunder to the extent so compromised or settled.

If the Indemnifying Party has exercised its rights under Clause 12.4 [Notice and contest of claims], the Indemnified Party shall not be entitled to settle or compromise any claim, action, suit or proceeding without the prior written consent of the Indemnifying Party (which consent shall not be unreasonably withheld or delayed).

If the Indemnifying Party exercises its rights under Clause 12.4 [Notice and contest of claims], the Indemnified Party shall nevertheless have the right to employ its own counsel, and such counsel may participate in such action, but the fees and expenses of such counsel shall be at the expense of the Indemnified Party, when and as incurred, unless:

- a) the employment of counsel by such party has been authorized in writing by the Indemnifying Party; or
- b) the Indemnified Party shall have reasonably concluded that there may be a conflict of interest between the Indemnifying Party and the Indemnified Party in the conduct of the defense of such action; or
- c) the Indemnifying Party shall not, in fact, have employed independent counsel reasonably satisfactory to the Indemnified Party, to assume the defence of such action and shall have been so notified by the Indemnified Party; or
- d) the Indemnified Party shall have reasonably concluded and specifically notified the Indemnifying Party either:
 - i. that there may be specific defences available to it which are different from or additional to those available to the Indemnifying Party; or
 - ii. that such claim, action, suit or proceeding involves or could have a material adverse effect upon it beyond the scope of this Agreement:

Provided that if Sub-clauses (b), (c) or (d) of this Clause 12.4 shall be applicable, the counsel for the Indemnified Party shall have the right to direct the defense of such claim, demand, action, suit or proceeding on behalf of the Indemnified Party, and the reasonable fees and disbursements of such counsel shall constitute legal or other expenses hereunder.

11.6 Limitation of Liability

- 11.6.1 Notwithstanding anything to the contrary contained in this Clause 12 [Risk and Responsibility], neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract.
- 11.6.2 The total liability of the Contractor to the Employer, under or in connection with the Contract shall not exceed the sum stated in the Contract Data Sheet.
- 11.6.3 This Clause 12.6 [Limitation of Liability] shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.

12. INSURANCE

12.1 Insurance for Works and Maintenance

- 12.1.1 The Contractor shall effect and maintain at its own cost the insurances specified in Clause 12 and as per the requirements under the Applicable Laws.
- 12.1.2 Subject to the relevant provisions of Clause 13 [Force Majeure], the Employer and the Contractor shall, in accordance with its obligations as provided for in this Agreement, be liable to bear the cost of any loss or damage that does not fall within the scope of this Clause 13 [Insurance] or cannot be recovered from the insurers.
- 12.1.3 Subject to the exceptions specified in Clause 12.1.4 below, the Contractor shall, save and except as provided for in this Agreement, fully indemnify, hold harmless and defend the Employer from and against any and all losses, damages, costs, charges and/or claims with respect to:
- a) the death of or injury to any person; or
 - b) the loss of or damage to any property (other than the Works);

That may arise out of or in consequence of any breach by the Contractor of this Agreement during the execution of the Works or the remedying of any Defects therein.

12.1.4 Notwithstanding anything stated above in Clause 12.1.3, the Employer shall fully indemnify the Contractor from and against any and all losses, damages, costs, charges, proceedings and/or claims arising out of or with respect to

- a) the use or occupation of land or any part thereof by the Employer;
- b) the right of the Employer to execute the Works, or any part thereof, on, over, under, in or through any land;
- c) the damage to property which is the unavoidable result of the execution and completion of the Works, or the remedying of any Defects therein, in accordance with this Agreement; and
- d) the death of or injury to persons or loss of or damage to property resulting from any act or neglect of the Employer, its agents, servants or other contractors, not being employed by the Contractor Provided that, in the event of any injury or damage as a result of the contributory negligence of the Contractor, the Employer shall be liable to indemnify the Contractor from and against any and all losses, damages, costs, charges, proceedings and/or claims to the extent as may be proportionately determined to be the liability of the Employer, its servants or agents or other contractors not associated with the Contractor in such injury or damage.

12.1.5 Without prejudice to the obligations of the Parties as specified under Clauses 12.1.3 and 12.1.4, the Contractor shall maintain or effect such third party insurances as may be required under the Applicable Laws.

12.2 Insurance for Works and Contractor's Equipment

12.2.1 The Contractor shall effect and maintain at its own cost, from the Date of Letter of Award till the date of issue of the last Completion Certificate, the following insurances for a minimum amount as indicated in the Contract Data Sheet for any loss or damage occurring on account of Non Political Event of Force Majeure, malicious act, accidental damage, explosion, fire and terrorism:

- a) insurance of Works, Plant and Materials, replacement cost to cover any additional costs of and incidental to the rectification of loss or damage including professional fees and the cost of demolishing and removing any part of the Works and of removing debris of whatsoever nature; and
- b) Insurance for the Contractor's equipment and Documents brought onto the Site by the Contractor, for a sum sufficient to provide for their replacement at the Site.
- c) The Contractor shall effect and maintain at its own cost, from the Appointed Date till the date of issue of the last completion certificate and during the full 4 years O & M period from the issue of completion certificate, the following Insurances for any loss or damage occurring on account of Non Political Event of Force Majeure, malicious act, accidental damage, explosion, Fire, Terrorism and War and Riots Protection Insurance.

12.2.2 The insurance under Clause 12.2 above shall cover the employer and the contractor against all loss or damage from whatsoever cause arising other than risks which are not insurable at commercial terms.

“All risks of loss including theft of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other than the Exceptional Risks are the responsibility of the Contractor. Any loss not insured or not recovered (including policy excesses etc.) from insurers shall be borne by the Contractor. All insurances shall be in the joint name of contractor and the Employer. The contractor shall maintain a Contractors All Risk Policy (CAR) for the entire duration of the contract including O&M period for the entire facility” The Contractor shall also take additional covers (Add-On covers) insurance like Third Party Liability, Surrounding properties, Clearance and Removal of debris, Cross liability, Express Freight, Extended Maintenance Cover up to Final Takeover, etc. The sum insured for such Add-On covers shall be decided by the CONTRACTOR based on his assessment and risk involved in the contract. Risks to be covered by insurance shall not be limited merely to the items mentioned above. The CONTRACTOR shall arrange for insurance of any other risks he may deem prudent, but the expenses thereof shall be to the account of the contractor only full plant. If necessary, Transit and storage (all risks) insurance coverage for additional transit involved for sending equipment/material to Sub-Contractor/Fabricator’s shop for fabrication/ reprocessing and receiving back at site shall be taken.

The Contractor shall, save and except as provided for in this Agreement, fully indemnify, hold harmless and defend the Employer from and against any and all losses, damages, costs, charges and/or claims with respect to:

- (a) the death of or injury to any person; or
- (b) the loss of or damage to any property (other than the Works);

That may arise out of or in consequence of any breach by the Contractor of this Agreement during the execution of the Works or the remedying of any Defects therein.

Notwithstanding anything stated in above Clause, the Employer shall fully indemnify the Contractor from and against any and all losses, damages, costs, charges, proceedings and/or claims arising out of or with respect to

- (a) the use or occupation of land or any part thereof by the Employer;
- (b) the right of the Employer to execute the Works, or any part thereof, on, over, under, in or through any land;
- (c) the damage to property which is the unavoidable result of the execution and completion of the Works, or the remedying of any Defects therein, in accordance with this Agreement; and

(d) the death of or injury to persons or loss of or damage to property resulting from any act or neglect of the Employer, its agents, servants or other contractors, not being employed by the Contractor Provided that, in the event of any injury or damage as a result of the contributory negligence of the Contractor, the Employer shall be liable to indemnify the Contractor from and against any and all losses, damages, costs, charges, proceedings and/or claims to the extent as may be proportionately determined to be the liability of the Employer, its servants or agents or other contractors not associated with the Contractor in such injury or damage.

Without prejudice to the obligations of the Parties as specified under above Clauses, the Contractor shall maintain or effect such third party insurances as may be required under the Applicable Laws.

12.3 Insurance for Contractor's Defects Liability

The Contractor shall effect and maintain Insurance cover for the works from the date of issue of the Completion Certificate until the end of the Defects Liability Period for any loss or damage for which the Contractor is liable and arises from a cause occurring prior to the issue of Completion Certificate. The Contractor shall also maintain other insurances for maximum sums as may be required under the Applicable Laws and in accordance with Good Industry Practice.

12.4 Insurance to be in Joint Names

The Insurance under headings 13.2 and 13.3 above shall be in the joint names of the Contractor and the Employer.

12.5 Notice to the Employer

No later than 15 (fifteen) days after the date of this Agreement, the Contractor shall by notice furnish to the Employer, in reasonable detail, information in respect of the insurances that it proposes to effect and maintain in accordance with this Clause 13 [Insurance]. Within 15 (fifteen) days of receipt of such notice, the Employer may require the Contractor to effect and maintain such other insurances as may be necessary pursuant hereto, and in the event of any difference or disagreement relating to any such insurance, the Dispute Resolution Procedure shall apply.

12.6 Evidence of Insurance Cover

All insurances obtained by the Contractor in accordance with this Clause 13 [Insurance] shall be maintained with insurers on terms consistent with Good Industry Practice. Within 10 (ten) days from the Letter of Award, the Contractor shall furnish to the Employer notarized true copies of the certificate(s) of insurance, copies of insurance policies and premium payment receipts in respect of such insurance, and no such insurance shall be

cancelled, modified, or allowed to expire or lapse until the expiration of at least 45 (forty-five) days after notice of such proposed cancellation, modification or non-renewal has been delivered by the Contractor to the Employer. The Contractor shall act in accordance with the directions of the Employer. Provided that the Contractor shall produce to the Employer the insurance policies in force and the receipts for payment of the current premium. The Contractor shall ensure the adequacy of the insurances at all times in accordance with the provisions of this Agreement.

12.7 Remedy for failure to insure

If the Contractor shall fail to effect and keep in force all insurances for which it is responsible pursuant hereto, the Employer shall have the option to either keep in force any such insurances, and pay such premium and recover the costs thereof from the Contractor, or in the event of computation of a Termination Payment, treat an amount equal to the Insurance Cover as deemed to have been received by the Contractor.

12.8 Waiver of Subrogation

All insurance policies in respect of the insurance obtained by the Contractor pursuant to this Clause 13 [Insurance] shall include a waiver of any and all rights of subrogation or recovery of the insurers thereunder against, inter alia, the Employer, and its assigns, successors, undertakings and their subsidiaries, Affiliates, employees, insurers and underwriters, and of any right of the insurers to any set-off or counterclaim or any other deduction, whether by attachment or otherwise, in respect of any liability of any such person insured under any such policy or in any way connected with any loss, liability or obligation covered by such policies of insurance.

12.9 Contractor's Waiver

The Contractor hereby further releases, assigns and waives any and all rights of subrogation or recovery against, inter alia, the Employer and its assigns, undertakings and their subsidiaries, Affiliates, employees, successors, insurers and underwriters, which the Contractor may otherwise have or acquire in or from or in any way connected with any loss, liability or obligation covered by policies of insurance maintained or required to be maintained by the Contractor pursuant to this Agreement (other than third party liability insurance policies) or because of deductible clauses in or inadequacy of limits of any such policies of insurance.

12.10 Cross liabilities

Any such insurance maintained or effected in pursuance of this Clause 13 [Insurance] shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Employer as separately insured.

12.11 Accident or Injury to Workmen

Notwithstanding anything stated in this Agreement, it is hereby expressly agreed between the Parties that the Employer shall not be liable for or in respect of any damages

or compensation payable to any workman or other person in the employment of the Contractor or Sub-contractor, save and except as for death or injury resulting from any act, omission or default of the Employer, its agents or servants. The Contractor shall indemnify and keep indemnified the Employer from and against all such claims, proceedings, damages, costs, charges, and expenses whatsoever in respect of the above save and except for those acts, omissions or defaults for which the Employer shall be liable.

12.12 Insurance against Accident to Workmen

The Contractor shall effect and maintain during the Agreement such insurances as may be required to insure the Contractor's personnel and any other persons employed by it on the Project Site from and against any liability incurred in pursuance of this Clause 13 [Insurance]. Provided that for the purposes of this Clause 13.12, the Contractor's personnel/any person employed by the Contractor shall include the Sub-contractor and its personnel. It is further provided that, in respect of any persons employed by any Sub-contractor, the Contractor's obligations to insure as aforesaid under this Clause shall be discharged if the Sub-contractor shall have insured against any liability in respect of such persons in such manner that the Employer is indemnified under the policy. The Contractor shall require such Sub-contractor to produce before the Employer, when required, such policy of insurance and the receipt for payment of the current premium within 10 (ten) days of such demand being made by the Employer.

12.13 Application of Insurance Proceeds

The proceeds from all insurance claims, except for life and injury, shall be applied for any necessary repair, reconstruction, reinstatement, replacement, improvement, delivery or installation of the Project Works and the provisions of this Agreement in respect of construction of works shall apply mutatis mutandis to the works undertaken out of the proceeds of insurance.

12.14 Compliance with Policy Conditions

Each Party hereby expressly agrees to fully indemnify the other Party from and against all losses and claims arising from its failure to comply with conditions imposed by the insurance policies effected in accordance with this Agreement.

13. FORCE MAJEURE

13.1 Force Majeure

As used in this Agreement, the expression "**Force Majeure**" or "**Force Majeure Event**" shall mean occurrence in India of any or all of Non- Political Event, Indirect Political Event and Political Event, as defined in Clauses 14.2, 14.3 and 14.4 respectively, if it affects the performance by the Party claiming the benefit of Force Majeure (the "Affected Party") of

its obligations under this Agreement and which act or event (i) is beyond the reasonable control of the Affected Party, and (ii) the Affected Party could not have prevented or overcome by exercise of due diligence and following Good Industry Practice, and (iii) has Material Adverse Effect on the Affected Party.

13.2 Non-Political Event

A Non-Political Event shall mean one or more of the following acts or events:

- a) act of God, epidemic, extremely adverse weather conditions, lightning, earthquake, landslide, cyclone, flood, volcanic eruption, chemical or radioactive contamination or ionising radiation, fire or explosion (to the extent of contamination or radiation or fire or explosion originating from a source external to the Site);
- b) strikes or boycotts (other than those involving the Contractor, Subcontractors or their respective employees/representatives, or attributable to any act or omission of any of them) interrupting supplies and services to the Project works for a continuous period of 24 (twenty- four) hours and an aggregate period exceeding 10 (ten) days in an Accounting Year, and not being an Indirect Political Event set forth in Clause 14.3;
- c) any failure or delay of a Sub-contractor but only to the extent caused by another Non-Political Event;
- d) any judgement or order of any court of competent jurisdiction or statutory Employer made against the Contractor in any proceedings for reasons other than (i) failure of the Contractor to comply with any Applicable Law or Applicable Permit, or (ii) on account of breach of any Applicable Law or Applicable Permit or of any contract, or (iii) enforcement of this Agreement, or (iv) exercise of any of its rights under this Agreement by the Employer;
- e) the discovery of geological conditions, toxic contamination or archaeological remains on the Site that could not reasonably have been expected to be discovered through a site inspection;

13.3 Indirect Political Event

An Indirect Political Event shall mean one or more of the following acts or events:

- a) an act of war (whether declared or undeclared), invasion, armed conflict or act of foreign enemy, blockade, embargo, riot, insurrection, terrorist or military action, civil commotion or politically motivated sabotage;
- b) industry-wide or State-wide strikes or industrial action for a continuous period of 24 (twenty-four) hours and exceeding an aggregate period of 10 (ten) days in an Accounting Year;
- c) any civil commotion, boycott or political agitation which prevents construction of the Project Works by the Contractor for an aggregate period exceeding 10 (ten) days in an Accounting Year;
- d) any failure or delay of a Sub-contractor to the extent caused by any Indirect Political Event;

13.4 Political Event

A Political Event shall mean one or more of the following acts or events by or on account of any Government Instrumentality:

- a) change in Law, only if consequences thereof cannot be dealt with under and in accordance with the provisions of Clause 10.9 [Change in laws];
- b) compulsory acquisition in national interest or expropriation of any Project Assets or rights of the Contractor or of the Sub- Contractors;
- c) unlawful or unauthorized or without jurisdiction revocation of, or refusal to renew or grant without valid cause, any clearance, license, permit, authorization, no objection certificate, consent, approval or exemption required by the Contractor or any of the Sub-contractors to perform their respective obligations under this Agreement; provided that such delay, modification, denial, refusal or revocation did not result from the Contractor's or any Sub- contractor's inability or failure to comply with any condition relating to grant, maintenance or renewal of such clearance, license, authorization, no objection certificate, exemption, consent, approval or permit;
- d) any failure or delay of a Sub-contractor but only to the extent caused by another Political Event; or

13.5 Duty to Report Force Majeure Event

13.5.1 Upon occurrence of a Force Majeure Event, the Affected Party shall by notice report such occurrence to the other Party forthwith. Any notice pursuant hereto shall include full particulars of:

- a) the nature and extent of each Force Majeure Event which is the subject of any claim for relief under this Clause 14 [Force Majeure] with evidence in support thereof;
- b) the estimated duration and the effect or probable effect which such Force Majeure Event is having or will have on the Affected Party's performance of its obligations under this Agreement;
- c) the measures which the Affected Party is taking or proposes to take for alleviating the impact of such Force Majeure Event; and
- d) any other information relevant to the Affected Party's claim.

The Affected Party shall not be entitled to any relief for or in respect of a Force Majeure Event unless it shall have notified the other Party of the occurrence of the Force Majeure Event as soon as reasonably practicable, and in any event no later than 10 (ten) days after the Affected Party knew, or ought reasonably to have known, of its occurrence, and shall have given particulars of the probable material effect that the Force Majeure Event is likely to have on the performance of its obligations under this Agreement.

For so long as the Affected Party continues to claim to be materially affected by such Force Majeure Event, it shall provide the other Party with regular (and not less than weekly) reports containing information as required by Clause 14.5.1, and such other information as the other Party may reasonably request the Affected Party to provide.

13.6 Effect of Force Majeure Event on the Agreement

Upon the occurrence of any Force Majeure after the Letter of Award, the costs incurred and attributable to such event and directly relating to this Agreement (the "**Force Majeure costs**") shall be allocated and paid as follows:

- a) upon occurrence of a Non-Political Event, the Parties shall bear their respective Force Majeure costs and neither Party shall be required to pay to the other Party any costs thereof;
- b) upon occurrence of an Indirect Political Event, all Force Majeure costs attributable to such Indirect Political Event, and not exceeding the Insurance Cover for such Indirect Political Event, shall be borne by the Contractor, and to the extent Force Majeure costs exceed such Insurance Cover, one half of such excess amount shall be reimbursed by the Employer to the Contractor for the Force Majeure events; and
- c) upon occurrence of a Political Event, all Force Majeure costs attributable to such Political Event shall be reimbursed by the Employer to the Contractor.

For the avoidance of doubt, Force Majeure costs may include costs directly attributable to the Force Majeure Event, but shall not include debt repayment obligations, if any, of the Contractor.

Save and except as expressly provided in this Clause 14 [Force Majeure], neither Party shall be liable in any manner whatsoever to the other Party in respect of any loss, damage, cost, expense, claims, demands and proceedings relating to or arising out of occurrence or existence of any Force Majeure Event or exercise of any right pursuant hereto.

Upon the occurrence of any Force Majeure Event during the Construction Period, the Project Completion Schedule for and in respect of the affected Works shall be extended on a day for day basis for such period as performance of the Contractor's obligations is affected on account of the Force Majeure Event or its subsisting effects.

13.7 Termination Notice for Force Majeure Event

If a Force Majeure Event subsists for a period of 60 (sixty) days or more within a continuous period of 120 (one hundred and twenty) days, either Party may in its discretion terminate this Agreement by issuing a Termination Notice to the other Party without being liable in any manner whatsoever, save as provided in this Clause 14 [Force Majeure], and upon issue of such Termination Notice, this Agreement shall, notwithstanding anything to the contrary contained herein, stand terminated forthwith; provided that before issuing such Termination Notice, the Party intending to issue the Termination Notice shall inform the other Party of such intention and grant 15 (fifteen) days' time to make a representation, and may after the expiry of such 15 (fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the Termination Notice.

13.8 Termination Payment for Force Majeure Event

In the event of this Agreement being terminated on account of a Non- Political Event, the Termination Payment shall be an amount equal to the sum payable under Clause 11.7 [Valuation of Unpaid Works].

Provided that in the event Termination occurs during the Maintenance Period, the Employer's Engineer shall only determine the value of Works associated with Maintenance.

If Termination is on account of an Indirect Political Event, the Termination Payment shall include:

- a) any sums due and payable under Clause 11.7 [Valuation of Unpaid Works]; and
- b) the reasonable cost, as determined by the Employer's Engineer, of the Plant and Materials procured by the Contractor and transferred to the Employer for use in Construction or Maintenance, only if such Plant and Materials are in conformity with the Specifications and Standards;

If Termination is on account of a Political Event, the Employer shall make a Termination Payment to the Contractor in an amount that would be payable under Clause 11.8 [Termination Payment] as if it were an Employer Default.

13.9 Dispute Resolution

In the event that the Parties are unable to agree in good faith about the occurrence or existence of a Force Majeure Event, such Dispute shall be finally settled in accordance with the Dispute Resolution Procedure; provided that the burden of proof as to the occurrence or existence of such Force Majeure Event shall be upon the Party claiming relief and/or excuse on account of such Force Majeure Event.

13.10 Excuse from Performance of Obligations

If the Affected Party is rendered wholly or partially unable to perform its obligations under this Agreement because of a Force Majeure Event, it shall be excused from performance of such of its obligations to the extent it is unable to perform on account of such Force Majeure Event; provided that:

- a) the suspension of performance shall be of no greater scope and of no longer duration than is reasonably required by the Force Majeure Event;
- b) the Affected Party shall make all reasonable efforts to mitigate or limit damage to the other Party arising out of or as a result of the existence or occurrence of such Force Majeure Event and to cure the same with due diligence; and
- c) when the Affected Party is able to resume performance of its obligations under this Agreement, it shall give to the other Party notice to that effect and shall promptly resume performance of its obligations hereunder.

14. CLAIMS, DISPUTES AND ARBITRATION

14.1 Dispute Resolution

- 14.1.1 Any dispute, difference or controversy of whatever nature howsoever arising under or out of or in relation to this Agreement (including its interpretation) between the Parties, and so notified in writing by either Party to the other Party (the “Dispute”) shall, in the first instance, be attempted to be resolved amicably in accordance with the conciliation procedure set forth in Clause 15.2.

The Parties agree to use their best efforts for resolving all Disputes arising under or in respect of this Agreement promptly, equitably and in good faith, and further agree to provide each other with reasonable access during normal business hours to all non-privileged records, information and data pertaining to any Dispute.

14.2 Conciliation

In the event of any Dispute between the Parties, either Party may call upon the Employer’s Engineer, or such other person as the Parties may mutually agree upon (the “Conciliator”) to mediate and assist the Parties in arriving at an amicable settlement thereof. Failing mediation by the Conciliator or without the intervention of the

Conciliator, either Party may require such Dispute to be referred to the Managing Director of the Employer and the Chairman of the Board of Directors of the Contractor for amicable settlement, and upon such reference, the said persons shall meet no later than 7 (seven) business days from the date of reference to discuss and attempt to amicably resolve the Dispute. If such meeting does not take place within the 7 (seven) business day period or the Dispute is not amicably settled within 15 (fifteen) days of the meeting or the Dispute is not resolved as evidenced by the signing of written terms of settlement within 30 (thirty) days of the notice in writing referred to in Clause 15.1.1 or such longer period as may be mutually agreed by the Parties, either Party may refer the Dispute to arbitration in accordance with the provisions of Clause 15.3.

14.3 Arbitration

- 14.3.1 Any Dispute which is not resolved amicably by conciliation, as provided in Clause 15.2, shall be finally decided by reference to arbitration by a Board of Arbitrators appointed in accordance with Clause 15.3.2. Such arbitration shall be held in accordance with the Rules of Arbitration of the International Centre for Alternative Dispute Resolution, New Delhi (the "Rules"), or such other rules as may be mutually agreed by the Parties, and shall be subject to the provisions of the Arbitration Act. The venue of such arbitration shall be [Mumbai], and the language of arbitration proceedings shall be English.
- 14.3.2 There shall be a Board of three arbitrators, of whom each Party shall select one, and the third arbitrator shall be appointed by the two arbitrators so selected and in the event of disagreement between the two arbitrators, the appointment shall be made in accordance with the Rules.
- 14.3.3 The arbitrators shall make a reasoned award (the "Award"). Any Award made in any arbitration held pursuant to this Clause 15 [Claims, Disputes And Arbitration] shall be final and binding on the Parties as from the date it is made, and the Contractor and the Employer agree and undertake to carry out such Award without delay.
- 14.3.4 The Contractor and the Employer agree that an Award may be enforced against the Contractor and/or the Employer, as the case may be, and their respective assets wherever situated.
- 14.3.5 This Agreement and the rights and obligations of the Parties shall remain in full force and effect, pending the Award in any arbitration proceedings hereunder.
- 14.3.6 In the event the Party against whom the Award has been granted challenges the Award for any reason in a court of law, it shall make an interim payment to the other Party for an amount equal to 75% (seventy-five per cent) of the Award, pending final settlement of the Dispute. The aforesaid amount shall be paid forthwith upon furnishing an irrevocable Bank Guarantee for a sum equal to 120 % (one hundred and twenty per cent) of the aforesaid amount. Upon final settlement of the Dispute, the aforesaid interim payment shall be adjusted and any balance amount due to be paid or returned, as the case may be, shall be paid or returned with interest calculated at the rate of 10% (ten per cent) per annum from the date of interim payment to the date of final settlement of such balance.

14.4 Adjudication by Regulatory Employer, Tribunal or Commission

In the event of constitution of a statutory regulatory Employer, tribunal or commission, as the case may be, with powers to adjudicate upon disputes between the Contractor and the Employer, all Disputes arising after such constitution shall, instead of reference to arbitration under Clause 15.3 [Arbitration], be adjudicated upon by such regulatory authority, tribunal or commission in accordance with the Applicable Law and all references to Dispute Resolution Procedure shall be construed accordingly. For the avoidance of doubt, the Parties hereto agree that the adjudication hereunder shall not be final and binding until an appeal against such adjudication has been decided by an

appellate tribunal or court of competent jurisdiction, as the case may be, or no such appeal has been preferred within the time specified in the Applicable Law.

**Request for Qualification cum Request for
Proposal (RFQ cum RFP) for**

**Design, Procurement, Construction, Testing and
Commissioning of 37M ROW Road with storm water
drains, Potable water, recycle water, Firefighting network
electrical and effluent network with all allied works,
including Defect Liability Period (DLP) for 4 years at AURIC
Bidkin Industrial Area, Chhatrapati Sambhajanagar,
Maharashtra on EPC Basis**

VOLUME 1

PART 5 TENDER FORMS

August 2025

**Managing Director
Aurangabad Industrial Township Limited
Udyog Sarathi, MIDC Office, Marol Industrial Area,
Andheri (East), Mumbai, Maharashtra State, India - 400093**

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ANNEXURE I: FORM OF BID

To

Managing Director,
Maharashtra Industrial Township Limited,
Udyog Sarathi, MIDC Office,
Marol Industrial Area, Andheri (East),
Mumbai, Maharashtra, India – 400093

Sub: RFQ cum RFP dated [date] for selection of contractor for **“Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Firefighting network, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis”**

Dear Sir,

With reference to your RFQ cum RFP Document dated _____[date], we have examined the Instruction to bidders, Conditions of Contract, Employer's requirements, General Requirements, Indicative Tender Drawings and all relevant documents including addendum and clarifications. We have understood their contents and have not found any errors in them. We hereby submit our Technical Proposal for selection of contractor for the project **“Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Firefighting network, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis”**

We confirm the proposal to be unconditional and unqualified.

We are submitting our Proposal as a single entity _____[full name and address of bidder].

If negotiations are held during the period of validity of the Proposal, we undertake to negotiate in accordance with the RFQ cum RFP. Our Proposal is binding upon us, subject only to the modifications resulting from negotiations in accordance with the RFQ cum RFP.

We understand you are not bound to accept any Proposal you receive.

Further:

1. We acknowledge that Employer will be relying on the information provided in the Proposal and the documents accompanying the Proposal for selection of the Contractor, and we certify that all information provided in the Proposal and in the supporting documents is true and correct, nothing has been omitted which renders such information misleading; and all documents accompanying such Proposal are true copies of their respective originals.
2. This statement is made for the express purpose of appointment as the Contractor for the aforesaid Project.
3. We shall make available to Employer any additional information it may deem necessary or require for supplementing or authenticating the Proposal.

4. We acknowledge the right of Employer to reject our application without assigning any reason or otherwise and hereby waive our right to challenge the same on any account whatsoever.
5. We certify that in the last 5 (Five) years, we have neither failed to perform on any contract, as evidenced by imposition of a penalty by an arbitral or judicial authority or a judicial pronouncement or arbitration award against the Applicant, nor been expelled from any project or contract by any public authority nor have had any contract terminated by any public authority for breach on our part.
6. We declare that:
 - a) We have examined and have no reservations to the RFQ cum RFP, including any Addendum issued by the Authority;
 - b) We do not have any conflict of interest in accordance with the terms of the RFQ cum RFP;
 - c) We have not directly or indirectly or through an agent engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice, as defined in the RFQ cum RFP document, in respect of any tender or request for proposal issued by or any agreement entered into with Employer or any other public sector enterprise or any government, Central or State; and
 - d) We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf will engage in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice.
7. We understand that you may cancel the selection process at any time and that you are neither bound to accept any Proposal that you may receive nor to select the Contractor, without incurring any liability to the Applicants.
8. We declare that we are not a member of any other Bidder applying for selection as a Contractor.
9. We certify that in regard to matters other than security and integrity of the country, we have not been convicted by a court of law or indicted or adverse orders passed by a regulatory authority which would cast a doubt on our ability to undertake the Project or which relates to a grave offence that outrages the moral sense of the community.
10. We further certify that in regard to matters relating to security and integrity of the country, we have not been charge-sheeted by any agency of the Government or convicted by a court of law for any offence committed by us or by any of our affiliates. We further certify that we have not been barred by the central government, any state government, a statutory body or any public sector undertaking, as the case may be, from participating in any project or bid, and that any such bar, if any, does not subsist as on the date of this RFQ cum RFP.
11. We further certify that no investigation by a regulatory authority is pending either against us or against our affiliates or against our CEO or any of our Directors/ Managers/ employees.
12. We hereby irrevocably waive any right or remedy which we may have at any stage at law or howsoever otherwise arising to challenge or question any decision taken by Employer in connection with the selection of Contractor or in connection with the selection process itself in respect of the above mentioned Project.

13. We agree and understand that the proposal is subject to the provisions of the RFQ cum RFP document. In no case, shall we have any claim or right of whatsoever nature if the contract for the Project is not awarded to us or our proposal is not opened or rejected.
14. In the event of our being selected as the Contractor, we agree to enter into a Contract in accordance with the contract prescribed in the RFQ cum RFP. We agree not to seek any changes in the aforesaid form and agree to abide by the same.
15. We have studied RFQ cum RFP and all other documents carefully. We understand that except to the extent as expressly set forth in the Contract, we shall have no claim, right or title arising out of any documents or information provided to us by Employer or in respect of any matter arising out of or concerning or relating to the selection process including the award of contract.
16. The Financial Proposal is being submitted in a separate cover. This Technical Proposal read with the Financial Proposal shall be binding on us.
17. We agree and undertake to abide by all the terms and conditions of the RFQ cum RFP Document.

We remain,

Yours sincerely,

Authorized Signature [In full and initials]:

Name and Title of Signatory:

Name of Firm:

Address:

(Name and seal of the Applicant/Member in Charge)

ANNEXURE II: POWER OF ATTORNEY FOR SIGNING THE BID

Know all men by these presents, We, _____[name of organization and address of the registered office] do hereby constitute, nominate, appoint and authorise Mr / Ms _____[name], son/ daughter/ wife of _____[name], and presently residing at _____[address], who is presently employed with/ retained by us and holding the position of _____[designation] as our true and lawful attorney (hereinafter referred to as the -Authorised Representative)), with power to sub- delegate to any person, to do in our name and on our behalf, all such acts, deeds and things as are necessary or required in connection with or incidental to submission of our Proposal for and selection as contractor for **“Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Firefighting network, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis”**, to be developed by the Employer (the —Authority) including but not limited to signing and submission of all applications, proposals and other documents and writings, participating in pre-bid and other conferences and providing information/ responses to the Authority, representing us in all matters before the Authority, signing and execution of all contracts and undertakings consequent to acceptance of our proposal and generally dealing with the Authority in all matters in connection with or relating to or arising out of our Proposal for the said Project and/or upon award thereof to us until the entering into of the Contract with the Authority.

AND, we do hereby agree to ratify and confirm all acts, deeds and things lawfully done or caused to be done by our said Authorised Representative pursuant to and in exercise of the powers conferred by this Power of Attorney and that all acts, deeds and things done by our said Authorised Representative in exercise of the powers hereby conferred shall and shall always be deemed to have been done by us.

IN WITNESS WHEREOF WE, _____[name of organization], THE ABOVE NAMED PRINCIPAL HAVE EXECUTED THIS POWER OF ATTORNEY ON THIS _____[date in words] DAY OF [month] [year in yyyy' format].

For [name and registered address of organization]

[Signature]

[Name]

[Designation]

Witnesses:

1. [Signature, name and address of witness]

2. [Signature, name and address of witness]

Accepted

Signature]

[Name]

[Designation]

[Address]

Notes:

1. The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under seal affixed in accordance with the required procedure.
2. Wherever required, the Applicant should submit for verification the extract of the charter documents and other documents such as a resolution/power of attorney in favour of the person executing this Power of Attorney for the delegation of power hereunder on behalf of the Applicant.
3. For a Power of Attorney executed and issued overseas, the document will also have to be legalised by the Indian Embassy and notarised in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Applicants from countries that have signed The Hague Legislation Convention, 1961 are not required to be legalised by the Indian Embassy if it carries a conforming Apostille certificate.

ANNEXURE III : FINANCIAL CAPACITY QUALIFICATION INFORMATION

Certificate from the Statutory Auditor or Practicing CA Firm

S. No.	Financial Years	Annual turnover	Networth	Profit
1	2019-2020			
2	2020-2021			
3	2021-2022			
4	2022-2023			
5	2023-2024			

This is to certify that the _____[full name of company] [registered address] has shown Annual Turnover, Networth & Net Profit as above respective years and also it is certified that the company has not applied for Corporate Debt Restructuring (CDR) as on date of bid submission.

Signature of Authorized Signatory:

Name & Seal of the Statutory Auditor or Practicing CA Firm

Note:

1. In case the Contractor does not have a statutory auditor, it may provide the certificate from its Chartered Accountant.

ANNEXURE IV: BANK CERTIFICATE FOR ACCESS TO LINES OF CREDIT

This is to certify that M/s _____ is a reputed company with a good financial standing.

If the contract for the work, namely **“Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Firefighting network, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis”** is awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of Rs _____ to meet their working capital requirements for executing the above contract.

Sd/

Name of Bank

Senior Bank Manager

Address of the Bank

ANNEXURE V: TECHNICAL CAPACITY – PROJECT QUALIFICATION INFORMATION VALUE OF SIMILAR WORK

Bidder's Project References

Sl.	Project Name & Location	Project Start and Completion Date	Amount of Project	Client Name	Area of Project	Client Certificate Enclosed
1						Yes/No
2						Yes/No
3						Yes/No
4						Yes/No
5						Yes/No

Note: Bidder to provide relevant references meeting the qualification criteria as indicated under clause 2.3.3 in ITB.

ANNEXURE VI: LITIGATION/ ARBITRATION HISTORY

S. No.	Award for or Against Applicant	Name of Employee, Cause of Litigation and Matter in Dispute	Contract Value	Disputed Amount	Status of Litigation As on Bid Due Date
1					
2					
3					
4					

Note:

1. Bidder to provide litigation/arbitration history for last 7 years
2. Providing any false or misleading information, or hiding any information, may result in disqualification of the applicant

ANNEXURE VII: LIST OF DEVIATIONS

6.1 Deviations (if any)

S. No.	Tender Reference	Tender Condition	Bidder's Deviation	Bidder's Comment
1.				
2.				
3.				

ANNEXURE VIII: ENGINEERING AND CONSTRUCTION CAPACITY

ENGINEERING CAPACITY

S. No.	Name of Person	Designation	Qualification	Years of Relevant Experience	Area / Domain of Expertise	Proposed Role on the Project
1.						
2.						
3.						

Note: Contractor to indicate only the names of persons on permanent employment for at least last 02 years. Also, names of those persons should be indicated who will be directly associated / working on the Project.

CONSTRUCTION CAPACITY

S. No.	Name of Equipment	Numbers of Equipment proposed to be deployed on Project	Equipment Capacity	Age of equipment as on date of Bidding	Owned / Leased
1.					
2.					
3.					

Note: Contractor to indicate equipment only related to work specified in the Contract and proposed to be deployed on the Project. Details of the equipment to be deployed during the construction period shall be submitted by the Contractor for review and approval by Engineer In-charge. Not deploying the equipment at the project as stated in plan will invoke penalty charges by the employer.

ANNEXURE IX : CERTIFICATE OF GEO-TAGGING

1. Name of work:
2. Tender No:
3. Name of person visiting the site (companies representative):
4. Date of Visit:
5. Time of Visit_____to.....

I have uploaded Geo-tagged photos of all 3 locations as stated in the ITB Vol 1 Part 1 of tender document in the technical Envelope along with this Certificate on MITL E-proc. I have Visited/Studied scope of work, site conditions, verified provision in tender documents, resources available and difficulties/restriction of site in all respect.

(Signature & Stamp of contractor or
authorized representative stated in
the tender document)

To,
Managing
Director MITL,
Mumbai.

Note:

1. Kindly upload this certificate under geo tagging at MITL E-proc portal
2. This should be on the bidders letter head

Appendix A & B

APPENDIX A: FORM OF BID SECURITY (BANK GUARANTEE)

WHEREAS, _____ [Name of Bidder] (hereinafter called "the Bidder") has submitted his bid dated _____, 2022, [Date] for the **"Design, Procurement, Construction, Testing and Commissioning of 37M ROW Road with storm water drains, Potable water, Recycle water, Firefighting network, Electrical and effluent network with all allied works, including Defect Liability Period (DLP) for 4 years at AURIC Bidkin Industrial Area, Chhatrapati Sambhaji Nagar, Maharashtra on EPC Basis"**, under Tender No. _____ (hereinafter called "the Bid").

KNOW ALL PEOPLE by these presents that We _____ [Name of the Nationalised/scheduled Bank] of India _____ having our registered office at _____ (hereinafter called "the Bank") are bound unto the Managing Director, Maharashtra Industrial Township Limited, Udyog Sarathi, MIDC Office, Marol Industrial Area, Andheri (East), Mumbai, Maharashtra State, India – 400093, India, (hereinafter called "the Employer") in the sum of _____ for which payment will and truly to be made to the said Employer the Bank binds himself, its successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this _____ day of _____ 2023.

THE CONDITIONS of this obligation are:

1. if the Bidder withdraws or amends his Bid during the period of Bid validity specified in the Form of Bid; or
2. if the Bidder does not accept the correction of arithmetical errors of his bid price in accordance with the Instructions to Bidders in his Bid; or
3. if the Bidder, having been notified of the acceptance of his Bid by the Employer during the period of Bid validity:
 - a) fails or refuses to execute the Form of Contract Agreement in accordance with the Instructions to Bidders, if required; or
 - b) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders;
4. if the bidder is determined, at any time prior to the award of contract, to have engaged in corrupt or fraudulent practices in competing for the Contract; or
5. if it comes to notice that the information/documents furnished in its Proposal is incorrect, false, misleading or forged or
6. in giving effect to any other provisions given in the Instructions to Bidders.

We undertake to pay to the Employer up to the above amount upon receipt of its first written demand, without the Employer having to substantiate his demand, provided that in its demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or all of the above conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date occurring 180 days after the deadline for submission of bids as such deadline is stated in the Instructions to Bidders or as it may be extended

by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank not later than the above date.

DATE _____ SIGNATURE OF THE BANK _____

WITNESS _____ SEAL _____

[Signature, Name, and Address]

APPENDIX B: FORM OF PERFORMANCE SECURITY (BANK GUARANTEE)

To:

Managing Director,
Maharashtra Industrial Township Limited,
Udyog Sarathi, MIDC Office,
Marol Industrial Area, Andheri (East),
Mumbai, Maharashtra State, India – 400093

WHEREAS _____ [name and address of Contractor] (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute **"Detailed Survey, Investigations and Construction of 37M ROW Road with storm water drains, Potable water, recycle water, Firefighting network, electrical and effluent network with all allied works, including Defect Liability Period (DLP) and Performance based Operation & Maintenance (O&M) for 4 years at AURIC Bidkin Industrial Area, Aurangabad, Maharashtra on EPC Basis"** (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a nationalised/schedule bank in India for the sum specified therein as security for compliance with its obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the contractor such a Bank Guarantee;

NOW THEREFORE we agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, on behalf of the contractor, a total of upto _____ [amount of Guarantee] _____ [in words], such sum being payable in the types and proportion of currencies in which the Contract Price is payable, and we undertake to pay you, upon first written demand and without cavil or argument, any sum or sums within the limits of _____ [amount of Guarantee] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

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

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

This guarantee shall be valid until(the end of DLP period of 4 years).

Notwithstanding anything to the contrary contained herein-

- i. Our liability under this Guarantee shall not exceed Rs..... (Rupees)
- ii. This Bank Guarantee shall remain valid up to(expiry date of Bank Guarantee); and
- iii. We are liable to pay up to the guarantee amount only and only if we receive from you a written claim or demand not later than (claim period should be further one year after the expiry date).

iv. All your rights as well as our liability under this Bank Guarantee shall stand extinguished unless a written claim or demand is made under this guarantee on(Bank address in Mumbai, Maharashtra) not later than claim period should be further one year after the expiry date.

Signature and Seal of the Guarantor _____

Name of Bank _____

Address _____

Date _____

Request for Qualification cum Request for Proposal (RFQ cum RFP)

for

**Design, Procurement, Construction, Testing and
Commissioning of 37M ROW Road with storm water
drains, Potable water, recycle water, Firefighting network,
electrical and effluent network with all allied works,
including Defect Liability Period (DLP) for 4 years at AURIC
Bidkin Industrial Area, Chhatrapati Sambhajnagar,
Maharashtra on EPC Basis**

VOLUME 2 GENERAL SPECIFICATIONS

PART 2 GENERAL SPECIFICATIONS ROADS

August 2025

Managing Director
Aurangabad Industrial Township Limited
Udyog Sarathi, MIDC Office, Marol Industrial Area,
Andheri (East), Mumbai, Maharashtra State, India - 400093

1.1 Roadway Excavation.

MoRTH Clause 301 – Excavation for Road and drain

301.1 Scope

This work shall consist of excavation, removal and disposal of materials necessary for the construction of roadway, side drains and waterways in accordance with requirements of these Specifications and the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. The cut material may be taken away by the Contractor for re-use or disposal. Hence, the scope shall include the giving credit for suitable cut materials as also the salvage value and disposal of unsuitable cut materials in specified manner, trimming and finishing of the road to specified dimensions or as directed by the Engineer.

301.2 Classification of Excavated Material

301.2.1 Classification:

All materials involved in excavation shall be classified by the Engineer in the following manner:

a) Soil : This shall comprise topsoil, turf, sand, silt, loam, clay, mud, peat, black-cotton soil, soft shale or loose murrum, a mixture of these and similar material which yield to the ordinary application of pick, spade and/or shovel, rake or other ordinary digging equipment. Removal of gravel or any other modular material having dimension in any one direction not exceeding 75 mm shall be deemed to be covered under this Category.

b) Ordinary Rock (not requiring blasting) This shall include:

- i) rock types such as laterites, shales and conglomerates, varieties of limestone and sandstone etc., which may be quarried or split with crow bars, also including any rock which in dry state may be hard, requiring blasting but which, when wet, becomes soft and manageable by means other than blasting;
- ii) macadam surfaces such as water bound and bitumen/tar bound; soling or roads, paths, etc. and hard core; compact moorum or stabilized soil requiring grafting tool or pick or both and shovel, closely applied; gravel and cobble stone
- iii) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar below ground level, reinforced cement concrete which may be broken

up with crow bars or picks and stone masonry in cement mortar below ground level; and Section 300 Earthwork, Erosion Control and Drainage

- iv) boulders which do not require blasting found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material or dissimilar origin.

c) Hard Rock (requiring blasting)

This shall comprise:

- i) Any rock or cement concrete for the excavation of which the use of mechanical plant and/or blasting is required,
- ii) Reinforcement cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and
- iii) Boulders requiring blasting.

d) Hard Rock (using controlled blasting) :

Hard rock requiring blasting as described under (c) but where blasting is to be carried out in locations where built-up area, huts, abodes of people and livestock exist within 200 m.

e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason like people living within 20 m of blast sites etc. and excavation has to be carried out by chiselling, wedging or any other agreed method.

f) Marshy soil

This shall include soils like soft clays and peats excavated below the original ground level of marshes and swamps and soils excavated from other areas requiring continuous pumping or bailing out of water.

1.2 Cleaning and grubbing

Cleaning Road land including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth up to 300 mm, removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned, up to a lead of 1000 metres including removal and disposal of top organic soil not exceeding 150 mm in thickness.

MoRTH Clause 201 – Cleaning and Grubbing

Clause 201.1 Scope

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials with all leads and lights. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

1.3 Embankment & Subgrade

Providing and Construction of **Embankment** with approved materials from borrow areas complete as per Technical Specification **Clause 305** with all leads and lifts.

Construction of **Subgrade** with approved material satisfying the requirements of minimum soaked CBR value as indicated in the drawings including all leads and lifts complete as per Technical Specifications **Clause 305 of MoRTH** (Reproduced below).

MoRTH Clause 305 – Embankment Construction**305.1 General****305.1.1 Description:**

These Specifications shall apply to the construction of embankments including sub-grades, earthen shoulders and miscellaneous backfills with approved material obtained from approved source, including material from roadway and drain excavation, borrow pits or other sources. All embankments sub-grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these Specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

Table 1: Density Requirement of embankment and sub-grade materials

Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)
Sub grade and earthen shoulders	Not less than 98%
Embankment	Not less than 97%
Expansive Clays	Not allowed

Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)
a) Sub grade and 500 mm portion just below the sub-grade	Not less than 90%
b) Remaining portion of embankment	

Table 2: Compaction Requirements for Embankment and Sub-grade

Condition of Embankment	Type of Work Maximum laboratory dry unit weight when tested as per IS:2720 (Part 8)
Embankments up to 3 m height, not subjected to extensive flooding	Not less than 15.2 kN/cu.m
Embankments exceeding 3 m height or embankments of any height subject to long periods of inundation	Not less than 16 kN/ cu.m

1.4 Shoulders

Construction of **Earthen shoulders** including all leads and lifts complete as per drawing and Technical Specifications **Clause 408**.

MoRTH Clause 408 – Shoulder, Island and median

408.1 Scope

The work shall consist of constructing shoulder (hard/paved/earthen with brick or stone block edging) on either side of the pavement, median in the road dividing the carriageway into separate lanes and islands for channelizing the traffic at junctions in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

408.2 Materials

Shoulder on either side of the road may be of selected earth/granular material/paved conforming to the requirements of Clause 305/401 and the median may be of selected earth conforming to the requirements of Clause 305.

Median/Traffic islands shall be raised and kerbed at the perimeter and the enclosed area filled with earth and suitably covered with grass turf/shrubs as per Clause 307 and/or paved as per Clause 409.3.4 or 409.3.5.

408.3 Size of Shoulder

Shoulder/median dimension shall be as shown on the drawing or as directed by the Engineer.

1.5 Granular Sub Base

Construction of **Granular Sub-Base** by providing close graded material, spreading in uniform layers with motor grader on prepared surface, mixing by **Mix In Place Method** with rotator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per **clause 401**.

MoRTH Clause 401 –Granular Sub Base

401.1 Scope

This work shall consist of laying and compacting well-graded material on prepared sub grade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

401.2 Materials

401.2.1 The material to be used for the work shall be natural sand, crushed gravel, crushed stone, or combination thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and shall conform to the quality standards as prescribed in the specifications.

Table 400-1 prescribes four grading for **Granular Sub-Base (GSB)**. Grading I and II in Table 3 are well graded granular sub-base materials. These can be used at locations where drainage requirement are not predominant. Grading III and IV are gap graded and addresses to the concern of the drainage requirements. These can be used at location experiencing heavy rainfall, flooding etc. Cases where GSB is to be provided in two layers, it is recommended to adopt either grading III or grading IV for lower layer and either grading I or grading II for upper layer. Minimum thickness of lower layer at locations where drainage requirements are predominant shall not be less than 150 mm.

401.2.2 If the water absorption of the aggregates determine as per IS:2386 (part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate impact Value (AIV) (IS:5640)

401.3 Strength of Sub-Base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished. When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content.

Table 3: Grading for granular sub-base materials

IS Sieve Designation	Percentage by weight passing IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0mm	100	-	100	-	100	-
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	-	-	35-65	55-75
4.75 mm	25-55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20-40	30-50			10-20	10-25
0.8 mm	-	-	-	-	2-10	-
0.425 mm	10-15	10-15			0-5	0-8
0.0075 mm	<5	<5	<5	<5	-	0-3

1.6 Wet Mix Macadam Base

Providing, laying, spreading and compacting crushed graded stone aggregate as per MoRTH Table 400-12 & 400-13 of **Wet Mix Macadam** specifications including premixing the material with water to OMC in mechanical mixer (Pug mill) as per design mix, carriage of mixed material by tipper to site laying in uniform layers, with motor grader/F.E. loader/Paver Finisher, in sub-base/base course on a well prepared under-base and compacting with Vibratory Roller to achieve the desired density

including lighting, guarding, barricading and maintenance of diversion etc. (MoRTH specification : **Clause 406**).

MoRTH Clause 406 – Wet Mix Macadam Base

406.1 Scope

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared sub-grade/sub-base/base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75mm.

406.2 Materials

406.2.1 Aggregates

406.2.1.1 Physical requirements:

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 4(MoRTH table 400-12). If the water absorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

Table 4: Physical requirement of coarse aggregates for wet mix macadam for sub-base/Base courses

S. No.	Test	Test Method	Requirement
1.	Los Angeles	IS:2386(Part-4) or	40 percent (Max.)
	Abrasion Value or Aggregate Impact value	IS:2386(Part-4) IS:5640	30 percent (Max.)
2.	Combined Flakiness and Elongation indices (Total)	IS:2386(Part-4)	40 percent (Max.)

To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles are separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles

divided by total non-flaky particles. The values of flakiness index and elongation index so found are added up.

406.2.1.1 Grading requirements:

The aggregates shall conform to the grading given in table 5 (MoRTH Table 400-13)

Table 5: Grading requirements of Aggregate for Wet mix macadam

IS Sieve Designation	Per cent by weight passing the IS Sieve
	Grade 1 layer thickness $\geq 100\text{mm}$
53 mm	100
45 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.0 micron	8-22
75.00 micron	0-5

Material finer than 425mm micron shall have plasticity index (PI) not exceeding 6.

The final gradation approved within these limit shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

1.7 Primer Coat

Providing and applying **Primer coat** with bitumen emulsion on prepared surface of granular Base including clearing of road surface and spraying primer by table 6 (MoRTH 500-3) using mechanical means as per Morth clause 502 (Reproduced below)

MoRTH Clause 502 - Prime coat over Granular Base

502.1 Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix.

502.2 Materials

The bituminous material to be used as primer shall be such that it can penetrate about 10 mm deep into base course. Bitumen emulsion SS1 grade conforming to IS:8887/ASTM D2397 or medium curing cutback bitumen conforming to IS:2177 can be used as primer. Quantity of SS1 grade bitumen emulsion for various types of granular surface shall be as per Table 6.

Table 6: Quantity of bitumen emulsion for various types of granular surfaces

Type of surface	Rate of Spray (Kg/Sq.)
WMM/WBM	0.7-1.0
Mechanically Lime/cement stabilized soil bases, lime cement bases	0.9-1.2

1.8 Tack Coat

Providing and applying tack coat with bitumen emulsion conforming to IS: 8887, using emulsion pressure distributor including preparing the surface & cleaning with mechanical broom. On bituminous surface to be applied as per Table 7 (MoRTH 500-5) (Reproduced below).

MoRTH Clause 503 Tack coat

503.1 Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to existing bituminous, cement concrete or primed granular surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or instructed by the Engineer.

Table 7: Rate of application of Tack coat

Type of surface	Rate of Spray of binder in Kg/Sq.
WMM/WBM	0.7-1.0
Mechanically Lime/cement stabilized soil bases, lime cement bases	0.9-1.2

503.2 Materials

The binder used for tack coat shall be either Cationic bitumen emulsion (RS 1) complying with IS 8887/ASTM D 2397 or suitable low viscosity paving bitumen of VG 10 grade conforming to IS:73. The use of cutback bitumen RC:70 as per IS:217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer. The type and grade of tack coat shall be as specified in the Contract or as directed by the Engineer.

1.9 Dense Graded Bituminous Macadam

Providing and laying Dense graded bituminous macadam with not less than 50 mm compacted thickness with bitumen of grade and lime filler (percentage by weight of Aggregate) according to IRC 94. Prepared in Batch Type Hot Mix Plant of relevant capacity, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled and tandem vibratory rollers to achieve the desired compaction as per MoRTH specification clause No. 505 complete in all respects

MoRTH Clause 505 – Dense Bituminous Macadam

505.1 Scope

This clause specifies the construction of Dense Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. The work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer will be 50 to 100mm.

505.2 Materials

505.2.1 Bitumen: The bitumen for dense bituminous macadam shall comply with the Indian Standard Specification for viscosity graded bitumen, IS:73 modified bitumen complying with IS:15462 or as otherwise specified in the Contract. Guidelines for selection of viscosity graded bitumen and modified bitumen are given in Table 500-10 and Table 500-11 respectively.

505.2.2 Coarse Aggregates: The type and grade of modified bitumen recommended for heavy traffic roads in very hot climate. Coarse aggregate (505.2.2) shall satisfy the requirement specified in Table 8 (MoRTH Table 500-8).

Table 8: Physical requirement for coarse aggregate for Dense Bitumen Bituminous Macadam

Property	Test		Specification
Cleanliness (dust)	Grain size analysis	Max 5% passing .0075 mm sieve	IS:2386 Part I
Particle shape	Combined Flakiness and Elongation index*	Max 35%	IS:2386 Part I
Strength	Los angeles abrasion value , aggregate impact value	Max 35% Max 27%	IS:2386 Part IV
Durability	Soundness either : sodium sulphate or magnesium sulphate	Max 12% Max 18%	IS:2386 Part V
Water absorption	Water absorption	Max 2%	IS:2386 Part III
Stripping	Coating and stripping of bitumen aggregate mix	Maximum retained coating 95%	IS:6241
Water sensitivity	Retained tensile strength**	Min 80%	AASTHO 283

505.2.3 Fine Aggregates: Fine aggregate shall consist of crushed or naturally occurring mineral material , or a combination of the two , passing the 2.36mm sieve and retained on the 75 micron sieve. These shall be clean, hard, durable , dry and free from dust , and soft or friable matter , organic or other deleterious matter. Natural sand shall not be allowed in binder courses. However natural sand upto 50 present of the fine aggregate may be allowed in binder courses, The fine aggregate shall have a sand equivalent value is not less than 50 when tested in accordance with the requirement of IS:2720 (part 37) . The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4, when tested in accordance with IS:2720(part 5)

505.2.4 Filler: Filter shall consist of finely divided minerals matter such as rock dust , hydrate lime or cement approved by the Employers Engineer. The filter shall be graded within the limit indicated in Table 500-9.

505.2.5 Aggregate Grading and binder content: When tested accordance with IS 2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregate and filler for the particular mixture shall fall within the limits given in Table 9 (Morth Table 500-8) for grading.

Table: Compaction Requirements for Embankment and Sub-grade

Grading	1	2
Nominal Aggregate Size*	37.5 mm	26.5 mm
Layer thickness	75-100 mm	50-75mm

Grading	1	2
IS Sieve (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	95-100	100
26.5	63-93	90-100
19	-	71-95
13.2	55-75	56-80
9.5	-	-
4.75	38-54	38-54
2.36	28-42	28-42
1.18	-	-
0.6	-	-
0.3	7-21	7-21
0.15	-	-
0.075	2-8	2-8
Bitumen content % by mass of total mix	Min 4.0**	Min 4.5**

*The nominal maximum particle size is the largest specified sieve size upon which any of the aggregate is retained.

** Correspondent to specific gravity of aggregate being 2.7. In case aggregate have specific gravity more than 2.7 , the minimum bitumen content can be reduced proportionately further the region where highest daily mean air temperature is 30°C or lower and lowest daily air temperature is -10°C or lower , the bitumen content may be increased by 0.5 percent.

1.10 Bituminous Concrete

Providing and laying Bituminous concrete with required compacted thickness with bitumen of grade and lime filler (percentage by weight of Aggregate) according IRC 29 with prepared in Batch Type Hot Mix Plant of relevant TPH capacity, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, tandem vibratory rollers to achieve the desired compaction as per MORTH specification clause No. 508 complete in all respects:

MoRTH Clause 508 – Bituminous Concrete

508.1 Scope

This work shall consist of construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single layer of bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 25mm/40 mm/50 mm thick.

508.2 Material

508.2.1 Bitumen: The bitumen shall conform to Clause 505.2.1 of MoRTH

508.2.2 Coarse aggregates: The coarse aggregates shall be generally as specified in Clause

505.2.2, except that the aggregates shall satisfy the physical requirements of Table 9 and where crushed gravel is proposed for use as aggregate, not less than 95 percent by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

Table 9: Physical requirement for coarse aggregate for Bituminous Concrete

Property	Test		Specification
Cleanliness (dust)	Grain size analysis	Max 5% passing .0075 mm sieve	IS:2386 Part I
Particle shape	Flakiness index Elongation index	Max 15% Max 20%	IS:2386 Part I
Strength	Los Angeles abrasion value , aggregate impact value	Max 30% Max 24%	IS:2386 Part IV
Durability	Soundness either : sodium sulphate or magnesium sulphate	Max 12% Max 18%	IS:2386 Part V
Polishing	Polished stone value	Min 55	IS:2386 Part IV
Water absorption	Water absorption	Max 2%	IS:2386 Part III
Stripping	Coating and stripping of bitumen aggregate mix	Maximum retained coating 95%	IS:6241
Water sensitivity	Retained tensile strength	Min 80%	AASTHO 283

1.11 Kerb Stone

Supplying and laying cement concrete Kerb M20 grade mix for median/island complete as per drawing and MoRTH Specification Clause 409.

MoRTH Clause 409 – Cement Concrete Kerb and Kerb with Channel

409.1 Scope

This work shall consist of constructing cement concrete kerbs and kerbs with channel in the central median and/or along the footpaths or separators in conformity with the lines, levels and dimensions as specified in the drawings or as directed by the Engineer.

409.2 Materials

Kerbs shall conform to the specifications of IS: 1700 of these Specifications.

409.3 Type of Construction

Cast in situ kerb stones shall be used. Kerb detail as per IRC 86:1983

409.4 Equipment

A continuous kerb casting equipment of adequate capacity and controls, capable of laying the kerbs in required cross-sections and producing a well-compacted mass of concrete free of voids and honeycombs, shall be used.

409.5 Construction Operations

409.5.1 Kerb shall be laid on firm foundation of minimum 150 mm thickness of cement concrete of M 15 grade cast in-situ or on extended width of pavement. The foundation shall have a projection of 50 mm beyond the kerb stone. Before laying the foundation of lean concrete, the base shall be levelled and slightly watered to make it damp. Section 400 Sub-Bases, Bases (Non-Bituminous) and Shoulders

409.5.2 In the median portions in the straight reaches, the kerb shall be cast in continuous lengths. In the portions where footpath is provided and/or the slope of the carriageway is towards median (as in case of superelevated portion), there shall be sufficient gap/ recess left in the kerb to facilitate drainage openings.

409.5.3 After laying the kerbs and just prior to hardening of the concrete, saw cut grooves shall be provided at 5 m intervals up to FRL or as specified by the Engineer.

409.5.4 Kerbs on the drainage ends such as along the footpath or the median in superelevated portions shall be cast with monolithic concrete channels as indicated in drawings. The slope of the channel towards drainage pipes shall be ensured for efficient drainage of the road surface.

409.5. Vertical and horizontal tolerances with respect to true line and level shall be +6 mm.

409.6 Measurements for Payment Cement concrete kerb/kerb with channel shall be measured in linear metre for the complete item of work. Foundation of kerb, where separately provided shall be measured in linear metre for complete item of work.

1.12 Footpath

Provide cement concrete Paver block 60 mm thick as per IRC:SP: 63 in footpath & courtyard, jointed with neat cement slurry mixed with pigment to match the shade of tiles, including rubbing and cleaning etc. complete, on 20 mm thick bed of cement mortar 1:4 (1 cement: 4 coarse sand). Light shade pigment using white cement, all as per MoRTH clause 410 (Reproduced below)

MoRTH Clause 410 FOOTPATHS AND SEPARATORS

410.1 Scope

The work shall consist of constructing footpaths and/or separators at locations as specified in the drawings or as directed by the Engineer.

The lines, levels and dimensions shall be as per the drawings. The scope of the work shall include provision of all drainage arrangements as shown in the drawings or as directed by the Engineer.

410.2 Materials

The footpaths and separators shall be constructed with any of the following types:

- Cast-in-situ cement concrete of Grade M 20 as per Section 1700 of the Specifications.
- 60mm thick paver block including 20mm thick compacted bed of coarse sand above the 200mm WMM according IRC:SP:63.
- Grading of sand according below table 10 (MoRTH Table 400-16).

Table 10: Grading of Sand

IS Sieve Size	Percent Passing
9.52mm	100
4.75mm	95-100
2.36mm	80-100
1.18mm	50-95
600 micron	25-60
300 micron	10-30
150 micron	0-15

75 micron	0-10
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1.13 Road Furniture's

IRC 67 Retro Reflective Sign Board

Retro- reflectorised cautionary, mandatory and informatory sign should be as per **IRC :67** made of high intensity grade sheeting vide clause 801.3, fixed over aluminium sheeting, 1.5 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm firmly fixed to the ground by means of properly designed foundation with M15 grade cement concrete 45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing.

Retro-reflectorised sign as per **IRC:67** made of high intensity grade sheeting vide clause 801.3, fixed over aluminium sheeting, 2 mm thick with area not exceeding 0.9 sqm supported on a mild steel single angle iron post 75 x 75 x 6 mm firmly fixed to the ground by means of properly designed foundation with M15 grade cement concrete 45 x 45 x 60 cm, 60 cm below ground level as per approved drawing.

Delineators (road way indicators, hazard markers, object markers) should be 80-100 cm high above ground level, painted black and white in 15 cm wide strips, fitted with 80 x 100 mm rectangular or 75 mm dia circular reflectorised panels at the top, buried or pressed into the ground and conforming to **IRC-79** and the drawings.

Road stud 100x 100 mm should be die-cast in aluminium, resistant to corrosive effect of salt and grit, fitted with lense reflectors, installed in concrete or asphaltic surface by drilling hole 30 mm up to a depth of 60 mm and bedded in a suitable bituminous grout or epoxy mortar, all as per BS 873 part 4:1973.

IRC 35 Road marking and strips

The colour width and layout of road makings shall be in accordance with the Code of Practice for Road Markings with paints, IRC : 35, and as specified in the drawings or as directed by the Engineer-in-Charge.

General

(i) The thermoplastic material shall be homogenously composed of aggregate, pigment, resins and glass reflectorizing beads.

(ii) The thermoplastic compound shall be screened/extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.

(iii) The thermoplastic material shall conform to ASTM D36/BS-3262-(Part I).

(iv) The material shall meet the requirements of these specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/Contractor.

(v) Marking: Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

1. The name, trade mark or other means of identification of manufacturer.
2. Batch number
3. Date of manufacture
4. Colour (White or yellow)
5. Maximum application temperature and maximum safe heating temperature.

(vi) Sampling and Testing: The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Employers Engineer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

Preparation

(i) The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.

(ii) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

Application

Marking shall be done by fully /semi automatic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater and profile shoe heater, driven by experienced operator as specified in item. For locations where painting cannot be done by machine, approved manual methods

shall be used with prior approval of the Engineer-in-charge. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen. The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer or otherwise directed by the Employers Engineer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine. The pavement temperature shall not be less than 10°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint. Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed.

1.14 Potable & Recycle Water

Digging and preparing the trench

- a. The digging / excavation shall be carried out to correct lines and levels. During the progress of the work, whenever and wherever it is necessary, the bidder shall support the sides of the excavations by adequate and suitable sheeting, shoring, bracing or other approved means and warning lamps at night, if required. Such trench support material and equipment shall remain in place until backfilling operations have progressed to the point where the supports may be withdrawn without endangering persons or property. Shoring shall be removed without causing damage to the pipe. The bidder shall be responsible for the cost towards providing shoring and/ or sheeting in the pipe laying, if required in the price bid and no extra cost for the same shall be given. Dewatering, if required shall be done and no extra cost for the same shall be given by AITL.
- b. The area to be excavated and filled shall be cleared of fences, trees, plants, logs, bush, vegetation, slush, etc. and any other objectionable material. The material so cleared / removed and is not suitable for re-use shall be disposed off as approved by Employers Engineer.
- c. The trench bottom should be carefully examined for the presence of hard objects such as flints, rock, projections or tree roots. The same shall be cleared and depressions thus created shall be filled with sand and compacted.
- d. The trench should be minimum 150 mm wider on both sides of the pipe, which shall be practicable to work. The trench should not be dug too far in advance

of pipe laying and should be backfilled as soon as possible after pipe laying and testing is completed.

- e. Prior to laying the bedding for supporting the pipe, the trench bottom should be made to be reasonably uniform. Hand trimming should be carried out if necessary and any local hard or soft spots removed and filled and compacted well with imported soil/sand free from any stones/gravels etc.
- f. If the pipeline crosses any drain / river, road, rail etc., the HDPE potable water pipe should be encased within a RCC (NP4) bigger diameter pipe. The size of RCC pipe encasing shall be approved by Employers Engineer during the approval of drawings.
- g. If truck, lorries, motor cars, or other traffic is passing across the pipeline, concrete slabs 600 mm x 600 mm of suitable thickness and reinforcement should be laid about 2 m above the pipeline to distribute the load evenly.
- h. All pipes, ducts, cables, mains or other services exposed in the trench should be effectively supported as specified in relevant IS code of practice.
- i. The bidder shall ensure that the work is carried out as per the best engineering practices prevalent in the concerned field.
- j. All safety requirements and measures should be followed by the bidder during the entire construction period. The bidder shall carryout the insurance of it's employees working on this project.

Pipe bedding and surrounding (15 cm all around the pipe) for the pipeline

- a. After the trench has been dug and the trench bottom has been prepared, the bedding for the pipes should be prepared. The bedding and surround material shall be free draining coarse sand conforming to **IS: 2686 - 1977**. It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic material, etc, and shall not contain clay balls or pellets or silt and harmful impurities e.g. iron pyrites, alkalis, salts, coal, mica, shale or similar laminated materials in such form or in such quantities as to cause corrosion of metal or effect adversely hardening, strength, durability or the appearance of HDPE pipe.
- b. It is proposed to provide sand bedding only, however, if concrete bedding is required for some stretches of the sewer pipeline then it shall be done as per the recommendations of Employers Engineer *and* no extra cost shall be paid for same. The construction of concrete bedding shall be done as per relevant practice followed in CPWD specifications, pipe manufacturer's instruction manual and IS codes. All concreting work for bedding, haunching and surrounding shall be done in 1:3:6 concrete with stone aggregate of nominal size 20 mm. Where concrete would be in direct contact with the pipe or fittings, these should be wrapped with a compressible material, for example rubber sheet or foamed polyethylene sheet, to accommodate creep and prevent the occurrence of high local stress concentrations. The compressible material

should not contain substances which could attack the pipe, for example plasticizers.

- c. Sand Bedding should be rectangular in section and should extend laterally at least 15 cm beyond and on both sides of the projection of the barrel of the pipe. The thickness of the bedding below the barrel of the pipe should not be less than 15 cm. The line contact between the pipe and bedding shall be firm and free from overhangs.
- d. Concrete haunching will consist of concrete bed and full width of which will be carried up to the level of the horizontal diameter of the pipe. Splays from this level carried up on both sides of the pipe, from the full width of the bed to meet the pipe barrel tangentially.
- e. The encasing of the pipe with concrete shall be similar to haunching up to the horizontal diameter of the pipe and the top portion over this should be finished in a semi-circular form to give a uniform encasing for the top half of the pipe.
- f. The surface of the bedding shall follow the gradient of the pipeline.

Lowering and laying

- (i) Before proceeding with pipe laying, each pipe should be examined for any damage which may have occurred during loading, unloading or transportation. Any unacceptable pipes should be set aside and marked conspicuously. All trenches, when pipe laying is in progress, shall be kept dry.
- (ii) The program for pipe laying shall be submitted and the contractor shall get approval of the same from the Employers Engineer at the start of the contract. Any subsequent changes to the program shall be submitted one week in advance for approval of the Employers Engineer.
- (iii) Depending on the diameter of and SDR of pipe, the PE pipe in the horizontal plane can be laid to follow, the alignment of a road or footpath or a straight line. However there is a limit to the bending of PE pipes. The minimum advisable bend radius at which PE can be laid is dependent on the SDR of the pipe. To avoid any risk of kinking, buckling and overstressing the following minimum bend radii are recommended. These are for pipes without ovality at 20°C

Pipe SDR	Minimum Bend Radius
9	DN x 12
11	DN x 15
13.6	DN x 21
17 / 17.6	DN x 25
21	DN x 35
26	DN x 45

However, if the contractor has some other better source, and the pipe laid under that source has been in successful operations, the same can be proposed and client after verification and satisfaction may allow using the same.

- (iv) All pipes and fittings and specials shall be laid accurately to the required lines and grades and shall be uniformly supported along their entire lengths on the prepared sand or concrete bedding and / or haunching and / or encasing.
- (v) The provisions made in relevant IS: codes and manufacturers instruction manual and specifications shall be followed, specially for carrying out the following works:
 - a. Trench excavation and backfilling,
 - b. Dewatering of the trench,
 - c. Preparation of concrete pipe bedding, haunching and encasing,
 - d. Cutting of the pipe to fit-in-line.
 - e. Laying of pipeline near the manholes and buildings,
 - f. Alignment and grade of the pipeline,
 - g. Steep slope protection,
 - h. Pipeline entering built-up sections, etc.
- (vi) The interior of the pipe shall be clean and dry as the work progresses. Whenever pipe-laying operations are not in progress, the exposed end of the pipe shall be sealed with a plug or bulkhead fitted into the pipe bell, so as to exclude earth, water, or other material.
- (vii) The pipeline shall be suitably held down so that the pipe does not become buoyant in the event of the trench becoming flooded.
- (viii) The pipe shall be lowered into the trenches such that no part of any shoring is disturbed or damaged.

Cutting and Jointing (As per IS code provisions)

- (i) All joints shall be made as per relevant IS code, in practice, and manufacturer's installation manual or instructions. All joints shall be tested for their performance as per provisions made in relevant IS codes. Joints that show leakage will not be accepted. After backfilling and inspection, if groundwater infiltration is observed through joints into the laid water line, then such joints shall be sealed by the bidder at no extra cost to the owner.
- (ii) Pipe surfaces to be joined must be free of dust, dirt, oil, moisture and other foreign material. If required, use of chemical such as dichloro-methane, methyl ethyl-ketone or mechanical cleaner may be carried out.
- (iii) Jointing of pipes and fittings shall be done by Electro fusion/ Butt fusion welding to joint two ends of HDPE pipes. ISO 12176-1:1998 Plastics pipes and fittings - Equipment for fusion jointing polyethylene systems - Part 1: Butt

fusion and ISO 12176-2:2000 Plastics pipes and fittings - Equipment for fusion jointing polyethylene systems - Part 2: Electrofusion shall be followed for the same.

However to join HDPE with other pipe/valves mechanical joint compression fittings shall be used confirming to ISO 14236:2000 Plastics pipes and fittings - Mechanical-joint compression fittings for use with polyethylene pressure pipes in water supply systems.

Hydro testing Of HDPE Pipes

Hydro pressure testing shall be done on the completed pipe length for a minimum pressure of 1.5 times the designed pressure for retaining period of 4 hours, and as mentioned in IS 4984 -1995 including its latest amendments. The acceptance criteria for hydrostatic test are no permanent deformation of any part of the pipeline fitting or equipment's and there shall not be any leakage through any of the joints. The hydro testing shall be done in the presence of AITL representative/Employers Engineer and a report shall be made by the contractor and the same shall be signed by the contractors representative and Employers Engineer and submit the same to Employer after the successful completion of the hydro test.

All the necessary consumables, equipments, tools & tackles required for the testing & inspection shall be arranged by the contractor and no extra cost shall be paid for the same.

Hydro pressure testing has to be done for all the valves as per IS 13095 - 1991 including its latest, at the manufacturer's end and a report has to be submitted to Employer Engineer.

Side Filling and Backfilling

- i. After the pipes have been laid on specified prepared bedding and the required hydro testing of the pipeline is completed, side filling activity can be started.
- ii. No trench should be filled completely unless pipe has been tested for water tightness.
- iii. The material excavated from the trench may be suitable for backfilling and side filling provided that it is free of stones and other such objects. The material should be homogeneous and should comply the gradation recommended in relevant IS code.
- iv. The material used for side filling should be placed around the laid pipeline and thoroughly compacted by hand and watering in successive layers. This process should be carried out evenly on both sides of the pipe up to the centre line of the pipe in vertical direction and firmly compacted. Trench sheeting or timbering should be progressively withdrawn as this work proceeds.

- v. The next layer of side fill should be continued up to a height level with the top of the pipe (15 cm). This layer should be achieved by successively depositing and compacting thin layers of side fill until the required depth of side fill is obtained. It is advisable to leave the crown of the pipe / haunch / encasing exposed during this compaction.
- vi. The third layer should extend to a level of 15 cm above the top of the pipe and should be compacted with light ramers along with watering on either side of the pipe only. There should be no ramming on top of the sand layer laid over the pipe. On no account should any further material be tipped into the trench before the third layer has been completed. Filling and tamping should then proceed evenly so as to maintain an even pressure on both sides of the pipe.
- vii. The remaining portion of the trench shall be filled in with selected excavated material free from and topsoil vegetation or boulders and clods of earth. Backfilling shall be done in layers not exceeding 15 cm in thickness accompanied by adequate watering, ramming etc., so as to be compacted to 95% of the maximum dry density as per **Part 7 of IS : 2720**. The cost of conducting the relevant compaction test is deemed to be included in the contract value. Allowance shall be made for subsequent settlement likely to take place and therefore the surface of the refilled excavations shall be left slightly higher than the adjacent ground surface and be maintained by the bidder to a smooth even slope.
- viii. If excavated material is used for backfilling then it should be got approved by the Employers Engineer. The backfilling material should be homogeneous and comply the gradation recommended in relevant IS code, provided that the maximum particle size does not exceed 10% of the nominal pipe diameter or 60 mm, whichever is smaller (the bidder should verify and certify as per relevant IS code of practice). If suitable material is not available for filling from already excavated material, the bidder shall import material of approved quality as directed by owner's representative/ Employers Engineer.
- ix. Where there is a high ground water level or other similar wet conditions and concrete bedding has been proposed, dewatering shall be done until the concrete of bedding gets set and then back filling should be carried out quickly to avoid the floatation of pipes.
- x. Where trench supports are used in the construction of the trench, they should be carefully removed as each layer of back fill is laid.
- xi. During excavation and backfilling, the exposed end of the pipe should be blocked to prevent excavated material or backfill material from entering the pipe. A watertight plug or bulkhead shall also be installed and maintained in the most downstream manhole of the project throughout construction to prevent dirt, rocks, muddy water or other debris from entering the system. This plug or bulkhead shall not be removed until the entire pipeline has been installed, cleaned tested and accepted, unless directed by the Employers

engineer. In all cases, the open ends of the laid pipe shall be securely closed with carefully fitted stoppers, so as to prevent any earth or other substance from entering them.

Testing Of Pipes & Specials, Pipeline and Joints

All tests specified in this specification, relevant Indian Standards as per codes followed and manufacturer's instruction manual, applicable for HDPE pipes and specials, shall be carried out by the bidder / supplier at his own cost. Before commencing the factory testing of pipes and specials and fittings, notice period of 15 days shall be given so that AITL, that may appoint its representative for this purpose.

Certificate from the manufacture, certifying compliance to all tests for all lots and diameter of pipe needs to be submitted before transporting the pipe to site.

The under given test shall be carried out:

- (i) Resistance to internal pressure - Test method

The internal pressure test is standardized in ISO 1167. The test specifies a method for determination of the resistance to constant internal pressure at constant temperature.

- (ii) The Pipe notch test

The Pipe notch test is standardized in ISO 13479 as "Polyolefin pipes for the conveyance of fluids - Determination of resistance to crack propagation - Test method for slow crack growth on notched pipes (notch test)". The test simulates slow crack growth and record time to failure on notched pipes.

- (iii) The Small-scale steady-state test

The small-scale steady-state test (S4 test) is standardized in ISO 13477 "Thermoplastics pipes for the conveyance of fluids - Determination of resistance to rapid crack propagation (RCP)." The test simulates the phenomenon of RCP in plastic pipes and measure the determination of arrest or propagation of an initiated crack. In pipelines RCP, caused by a brittle crack, could undergo the length of several hundred meters almost at the sound of speed.

- 1.9.2 If any of the tests is found unsatisfactory, the AITL may reject any or all pipes and fittings and specials of that lot. The cost of carrying out all the tests in factory and at site shall not be paid separately and deemed to be included in the price bid by the contractor.
- 1.9.3 If any pipe, fitting and special, is / are found to be defective or not meeting the relevant standards and specifications than the same shall be rejected and the contractor shall replace the same by new ones, with no extra cost to AITL
- 1.9.4 Laying and Jointing of pipes and preparation of sand / concrete bedding, haunching, encasing, crossings, etc, at project site, shall be done strictly according to relevant IS

code, ISO code and CPWD specifications and any other relevant specifications mentioned here in the document.

Marking Of Pipes

The internal and outer diameter, length, wall thickness, tolerances and other dimensions of pipes shall be as per relevant clauses of **IS 4984:1995 (inc. all amendments)** and any amendments made to till date. Each straight length of pipe shall be clearly marked and should cover the following:

- (a) The manufacturers name and trade mark,
- (b) Outside diameter,
- (c) IS classification,
- (d) Stiffness class
- (e) Lot number / Batch number,

The color of the marking shall be such that it differs from the basic color of the pipe.

BIS LICENSE

The bidder shall ensure that the pipe manufacturer, providing the pipes and specials for this project, has a valid BIS license.

Transport, Storage and Handling

Transport

Vehicles for transporting HDPE pipes should have a clean flat bed, free from nails and other projections which might cause damage. When rigid bundles of pipes are being transported, in that case the overall height of the bundles should not exceed 2.5 m.

Side supports should not be less than 1.5 m apart; they should be flat and have no sharp or rough edges.

When transporting a mixed load of pipes, it is important that the larger, generally thicker-walled, and thus heavier, pipes are placed at the bottom. Pipes should not be allowed to overhang the vehicle.

Storage

Generally, similar requirements apply to storage of HDPE pipes as apply to their transport.

Pipes may be stored in loose stacks up to a maximum height to 2 m.

When pipes are stored outside in climates having high ambient temperatures (greater than 23 °C), the following is recommended:

- a) the height of the stacks should not exceed 1 m;
- b) all stacks should be shielded from continuous and direct sunlight and shall be arranged to allow the free passage of air around the pipes;
- c) specials & fittings should always be stored in boxes or sacks manufactured so as to permit the free passage of air.

When pipes are stacked in the form of rigid bundles, a maximum of three bundles having a height of 1 m each should be stacked on top of each other.

Handling

HDPE pipes are light in weight, they are therefore easy to handle. With reasonable care, damage to the pipes can be easily avoided.

Pipes should not be dragged along the ground nor should they be lowered on skids. Whenever mechanical handling techniques are used, all equipment coming into contact with the pipes should be made of a soft material. For example, textile slings and Hessian ropes may be used and it should be ensured that all metal hooks are covered.

While unloading pipes from vehicles, do not drop them on the ground. Pipes should always be carefully lowered onto the ground or stacked where they are to be stored.

Whenever pipes have been transported one inside another, the inner pipes should always be removed first and stacked separately.

Plot connection

Connection to the building shall be through a Electrofusion PP saddle and no direct connection shall be made on the HDPE pipe. This is necessary to prevent leakages and any contamination in the potable water network.

Disinfection of Water Mains

The mains intended for potable water supplies should be disinfected before commissioning them for use. Special care should be taken to ensure disinfection of new mains. Among possible sources of contamination are sewer drainage, contaminated soil in the trench, contamination from workmen or their equipment of both and unavoidable foreign material present in the trench during construction.

Education of crew members as to the need for avoiding contamination of the main during construction is fundamental. Contractors and workmen should be thoroughly familiar with all pertinent state and local requirements governing installation of mains. All sewers, water mains and other underground conduits should be located prior to construction, relocated if necessary, to prevent contamination during construction. Pipe should be strung on high ground. At all times when construction is not actually in progress, watertight plugs should be installed in all pipe openings. Gunny sack and rags are not adequate. Provision should be made to pump any other water that might collect in the trench. Special care should be taken to avoid contamination of valves, fittings, and pipe interiors, both before and during construction each of them should be inspected and, if necessary, cleaned before installation.

After pressure testing the main, it should be flushed with clean water at sufficient velocity to remove all dirt and other foreign materials in the constructed pipeline. When this process has been completed, disinfection (using, sodium hypochlorite) should proceed by one of the recommended methods as described in the following clauses 2.4.1 and 2.4.2.

Continuous Feed

In this method, water from the distribution system or other approved source and the chlorine is fed at constant rate into the new main at a concentration of atleast 20 mg/1. A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, chlorinator and if required, booster pump may be used. The chlorine residual should be checked at intervals to ensure that the proper level is maintained. Chlorine application should continue until the entire main is filled. All valves, hydrants, etc., along the main should be operated to ensure their proper disinfection. The water should remain in the main for a minimum of 24 hours. Following the 24 hours period no less than 10 mg/1 chlorine residual should remain in the main. The Contractor is requested to provide photo and take a record of the value of chlorine residual at starting point and after 24 hours before completion of work. The Employers Engineer shall jointly check the test at sites. If the value is insufficient, the disinfections work shall be repeated until satisfactory results are achieved. Waste chlorine residual water must be neutralized before it is discharged to any drainage, as per approval of Employers Engineer.

Slug Method

In this method a continuous flow of water is fed with a constant dose of chlorine (as in the previous method) but with rates proportioned to give a chlorine concentration of at least 300 mg/1. The chlorine is applied continuously for a period of time to provide a column of chlorinated water that contacts all interior surfaces of the main for a period of at least 3 hours. As the slug passes tees, crosses, etc., proper valves shall be operated to ensure their disinfection. This method is used principally for large diameter mains where continuous feed is impractical.

Regardless of the method used, it is necessary to make certain that backflow of the strong chlorine solution into the supplying line does not occur. Following the prescribed contact period, the chlorinated water should be flushed to waste until the remaining water has a chlorine residual approximating that throughout the rest of the system. Bacteriological tests as prescribed by the authorities should be taken, and if the results fail to meet minimum standards, the disinfecting procedure should be repeated and the results again tested before placing the main in service.

If continuous feed method is difficult to apply, Retention Method shall be considered as alternative way.

The area or pipe line to be disinfected shall be fed with chlorine solution from up stream under flowing water condition, and then the area shall be blocked after make sure to reaching more than 20 mg/1. The chlorine solution fed in the pipeline needs to wait for 1 day before starting measurement of residual chlorine. After 3 days later, the

chlorine residual value shall be tested at sampling points at up stream and at downstream near to end to check whether the value is in range or not.

The Contractor shall provide photo and take a record of the value of chlorine residual at starting point and after 24 hours before completion of work.

The Employers Engineer shall jointly check the test at sites. If the value is insufficient, the disinfection work shall be repeated until satisfactory results are achieved.

Waste chlorine residual water must be neutralized before it is discharged to any drainage, as approved by Employers Engineer.

Thrust Blocks

Thrust Blocks shall be provided, to counteract hydraulic thrust, at places wherever necessary by design as well as additional as directed by the Employer' Engineer. The Contractor shall indicate on his detailed drawings what thrust blocks are required to anchor pipe work supplied by him. Particular care shall be taken to ensure that pipe work thrusts are, as far as possible, not transmitted to machinery or other associated apparatus.

Puddle flanges shall be fitted to pipes where the structure through which they pass is required to take thrust resulting from the pipe. Puddle flanges shall also be fitted where a water barrier is required. All puddle flanges shall be clearly shown on the drawings and the resultant thrust clearly indicated. Puddle flanges shall only be fitted with the prior approval of the Employers Engineer.

Flexibility in Pipework

The Contractor shall provide flexibility in the pipework at joints in the main structures and shall submit proposals for the approval of the Employer's Engineer. Flexible joints or collars and cut pipes shall be allowed on all pipework where necessary to allow for some margin of error in the building work. Wherever possible, flexible joints shall be provided with tie bolts or other means to transfer longitudinal thrusts as a whole so that external anchorages may be kept to a minimum. Flexible joints shall also be provided for case of erection and future dismantling. Particular care shall be taken to ensure that pipework thrusts are not transmitted to machinery or associated apparatus. The Contractor shall indicate on his detailed drawings what thrust blocks are required.

All necessary supports, saddles, slings, fixing bolts and foundation bolts shall be supplied to support the pipe work and its associated equipment in an approved manner. Valve, meters, strainers, and other devices mounted in the pipe work shall be supported independently of the pipes to which they connect.

All brackets or other forms of supports, which can conveniently be so designed, shall be rigidly built up of steel by rivetting or welding in preference to the use of castings.

No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the Employers Engineer.

After the collars and boxes or other fitting have been fixed in position, the floors, walls and roof structure will be made good by the Contractor.

Flexible couplings and flange adaptors shall be of the Viking Johnson or similar approved pattern and be assembled in accordance with the manufacturer's instructions and protected, if buried or in chambers with Densomastic and Densotape wrapping applied in accordance with the manufacturers' instructions. Flexible joints shall be harnessed or tied where necessary.

Flanged Pipes

The gaskets used between flanges of pipes shall be EPDM of min 3 mm thk. The

Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternately. The practice of fully tightening the bolts one after another is highly undesirable. The bolts shall be of mild steel unless otherwise specified.

Special Foundation in Poor Soil

Where the bottom of the trench and sub grade is found to consist of material which is unstable to such a degree that in the opinion of the Engineer, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, a suitable foundation for the pipes, consisting of piling, timbers or other materials, in accordance with relevant drawings to be prepared by the Contractor and as instructed by the Employers Engineer shall be constructed.

Backfilling

On completion of the pipe laying operations in any section, for a length of about 100 m and while further work is still in progress, refilling of trenches shall be started by the Contractor with a view of restricting the length of open trenches. Pipe laying shall closely follow the progress of trench excavation and the Contractor shall not permit unreasonably excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. If the Employer's Engineer considers that the Contractor is not complying with any of the foregoing requirements, he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and refilling of trenches. Filling to a level of 300 mm above the crown of the pipe shall be done in accordance with the requirements of the clause on bedding. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipeline shall not be permitted unless the trench has been filled with the instructed bedding and surround material up to height of at least 300 mm over the top of the pipe except as may be necessary for tamping etc., during backfilling work.

The remaining portion of the trench shall be filled in with selected excavated material free from and topsoil, vegetation or boulders and clods of earth larger than 75 mm in size. Filling shall be done in layers not exceeding 150 mm in thickness accompanied by adequate watering, ramming etc., so as to be compacted to 90% of the maximum

dry density as per Part 7 of IS: 2720. The water contents of the soil shall be kept as near the optimum moisture content as possible. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place. The surface of the refilled excavations shall be left slightly higher than the adjacent ground and be maintained by the Contractor to a smooth even slope.

The Employer' Engineer shall, at all times, have powers to decide which portion of the excavated materials shall be used for filling and in which portion of the site and in what manner it shall be so used.

If suitable material for refilling is not available from already excavated material, the Contractor shall import material of approved quality as directed by the Employer' Engineer.

Regular measurement of the field dry density shall be taken by the Contractor at various levels in the backfilling as required by the Employer' Engineer.

No mechanical plant other than approved compacting equipment shall run over or operate within the trench until backfilling has reached its final level or the approval for the Employer' Engineer has been obtained.

Should any subsidence take place either in the filling of the trenches or near about it during the works the Contractor shall make good the same at his own cost.

Surplus excavated material shall be used to fill in any low spots above the pipeline which are identified on the Drawings or are instructed by the Employer's Engineer. Such material shall be evenly placed and compacted in layers not exceeding 200 mm thick after compaction. The method of compaction employed shall achieve not less than 90% maximum dry density as determined from IS: 2720 (Part 7). Unless approved of by the Employer' Engineer, the width of areas to be filled shall not exceed 20m.

1.15 Industrial Effluent Network

Sewer Pipes

Scope

This Specification covers the requirements for manufacturing, testing, supplying, lowering, laying, jointing, testing at work sites and commissioning of following pipes:

- HDPE pipes (as per IS 14333) up to 500 mm dia
- RCC pipes PE lined (as per IS 458) above 500 mm dia (however including the same size).

- DI pipe as per (IS 8329) with sulfate resistant cement lining has been proposed for rising main from pumping station as well as for drop connections.

Applicable Codes & Standards

The manufacturing, testing, supplying, jointing and testing at work sites of 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. However, other codes as approved by Employers Engineer but not specifically mentioned below pertaining to the use of RCC, DI, HDPE Pipes shall form part of these specifications

Table 11: Applicable Codes

IS Code	Description
IS: 458	Specification for Concrete Pipes (with and without Reinforcement).
IS: 3597	Method of Tests for Concrete Pipes.
IS: 432 Part I & II	Specification for mild steel and medium (tensile steel bars and hard drawn steel) wires for concrete reinforcement.
IS: 456	Code of Practice for Plain and Reinforced Concrete.
IS: 783	Code of Practice for Laying of Concrete Pipes.
IS: 516	Method for test for strength of concrete.
IS: 8329	Centrifugally cast (spun) Ductile Iron Pressure pipes for water, gas and sewage.
IS: 9523	Ductile iron fittings for pressure pipes for water, gas and sewage.
IS: 12288	Code of practice for use and laying of ductile iron pipes.
IS: 5382	Specification for Rubber Sealing Rings for Gas Mains, Water Mains and Sewers.
IS: 14333	Specification for High Density Polyethylene pipes (HDPE) and fittings for the use of Sewerage.
IS: 7634 Part 2	Code of practice for Laying and Jointing of High Density Polyethylene pipes (HDPE) piping system.
IS: 2530	Method of test for polyethylene moulding materials and polyethylene Compounds.
IS: 7328	High Density Polyethylene material for moulding and extrusion.
IS: 4905	Method for random sampling.

HDPE PE 80 PN 6 Pipes

Grade of Material

The High Density Polyethylene Pipes (HDPE) shall be of PE-80 PN6 grade. Material Grade, Minimum Required Strength and Maximum Allowable Hydrostatic Design Stress shall conform to the relevant clause of IS – 14333.

Color

The color of the pipe shall be black.

Manufacturing, Workmanship and Finish

General

- The method of manufacture of HDPE pipes shall be such that the internal and external surfaces of the pipes shall be smooth, clean and free from grooving and other defects. The ends shall be cleanly cut and shall be square with axis of the pipes.
- The Employers Engineer shall at all reasonable times have free access to the place where the pipes and fittings are manufactured for the purpose of examining and testing the pipes and fittings and of witnessing the test and manufacturing.
- All tests specified either in this specification or in the relevant Indian standards shall be performed by the supplier/contractor at his own cost and in presence of the Employers Engineer if he so desires. For this, sufficient notice before testing of the pipes and fittings shall be given to the Employers Engineer.
- If the test is found unsatisfactory, the Employer Engineer may reject any or all pipes of that lot.

Materials

The material used by the manufacturer of pipes should not constitute toxicity hazard, should not support microbial growth, should not give rise to unpleasant odour, cloudiness or discoloration of water. Pipe manufacturers shall obtain a certificate to this effect from the manufacturers of raw material by any reputed organization as per the satisfaction of the Employers Engineer.

Raw Material

- Raw material used to manufacture the HDPE pipes shall be 100% virgin PE compound or Natural black PE resin confirming to IS: 14333(latest version), IS: 7328 and ISO: 4427 for this a certification has to be given by the resin manufacturer as per IS: 14333 (latest version). The resin proposed to be used for manufacturing of the pipes should also comply with the following norms as per ISO: 9080.
- The resin should have been certified by an independent laboratory of international repute for having passed 10,000 hour long term hydrostatic strength (LTHS) test extrapolated to 50 years to show that the resin has a minimum MRS of over 10MPa. Internal certificate of any resin manufacturer will not be acceptable. The minimum required strength of material should not be lower than 6.30 MPa at 20 deg. Centigrade at 50 years.
- Certificate for having passed the full scale rapid crack propagation test as per ISO 13478. High density Polyethylene (HDPE) used for the manufacture of pipes shall conform to designation PEEWA-45-T-006 of IS: 7328. HDPE conforming to designation PEEWA-45-T-012 of IS: 7328 may also be used with the exception that melt flow rate (MFR) shall not exceed 1.10 g/10 min. In addition the material shall also conform to clause 5.6.2 of IS 7328.

- The specified base density shall be between 941.0kg/m³ and 946.0kg/m³ (both inclusive) when determined at 27°C according to procedure prescribed in IS: 7328. The value of the density shall also not differ from the nominal value by more than 3kg/m³ as per 5.2.1.1 of IS: 7328. The MFR of the material shall be between 0.41 and 1.10 (both inclusive) when tested at 190°C with nominal load of 5 kgf as determined by method prescribed in IS: 2530. The MFR of the material shall also be within $\pm 20\%$ of the value declared by the manufacturer.
- The resin shall be compounded with carbon black. The carbon black content in the material shall be within $2.5 \pm 0.5\%$ and the dispersion of carbon black shall be satisfactory when tested as per IS: 2530.

Anti-Oxidant

The percentage of anti-oxidant used shall not be more than 0.3% by mass of finished resin. The anti-oxidant used shall be physiologically harmless and shall be selected from the list given in IS: 10141.

Maximum Ovality of Pipes

The outside diameter of pipes, tolerance on the same and ovality of pipe shall be as given in IS 14333. Ovality shall be measured as the difference between maximum outside diameter and minimum outside diameter measured at the same cross section of the pipe, at 300 mm away from the cut end.

Dimensions and Tolerances

- The outside diameters of pipes, tolerance on the same and ovality of pipes shall be as given in relevant clause of I.S. 14333(latest version). No negative tolerances are allowed.
- The minimum & maximum wall thickness of pipe for the given grade of material, namely PE 80/100 and PN6 class shall be as given in IS: 14333.
- The length of straight pipe used shall be 6 m or as agreed by Employers Engineer.

Testing

The specimen of pipes for the following tests shall be selected in accordance with relevant clause of IS: 2530 and tests in accordance with the methods described in relevant clause of IS: 14333. Following tests shall be taken in consideration:

- Hydrostatic Test
- Reversion Test
- Density Test
- Melt Flow Test
- Carbon Black Content and Dispersion

Sampling and Inspection

- Three samples of the same size and same pressure rating selected at random shall be tested for compliance with the requirements of the type test for Internal Pressure Creep Rupture Test.
- In case, any of the samples fails in the type test, the testing authority, at its discretion, may call for fresh samples not exceeding the original number and subject them to type test again. In case of the sample fails in the repeat tests, the type of pipe shall not be approved.
- Acceptance tests are carried out on samples selected from a lot for the purpose of acceptance of the lot.
- A lot having satisfied dimensional and visual requirements shall be tested for hydraulic characteristics, reversion, density, MFR and Carbon Black content / dispersion requirements. The lot shall be considered to have met the requirements of these tests, if none of the samples tested fails.

Workmanship / Appearance

Pipes shall be free from all defect including indentations, delaminating, bubbles, pinholes, cracks, pits, blisters, foreign inclusions that due to their nature degree or extent detrimentally affect the strength and serviceability of the pipe. The pipe shall be as uniform as commercially practicable in colour opacity, density and other physical properties as per relevant IS Code or equivalent International Code. The inside surface of each pipe shall be free of scouring, cavities, bulges, dents, ridges and other defects that result in a variation of inside diameter from that obtained on adjacent unaffected portions of the surface. The pipe ends shall be cut clearly and square to the axis of the pipe.

Carting & Handling

During handling, transportation, storage and lowering of pipes & fittings, all sections shall be handled by such means and in such a manner that no distortion or damage is done to the section or to the pipes as a whole. Also, unless waived by the Employers Engineer, method statements shall be submitted by the Contractor for the approval of the Employers Engineer before the handling, transportation and laying of any pipes commences.

All pipes shall be handled and stored in compliance with the manufacturer's recommendations. Pipes and fittings / specials shall be transported from the factory to the central pipe store and unloaded there before being transported to Site. At every point of loading or unloading, all pipes and fittings shall be lifted using approved lifting tackle. Unloading by rolling down any form of inclined ramp will not be permitted. Pliable straps or slings shall be used to lift pipes. Rope, wire rope, hooks or chains shall not be allowed to come into contact with any pipe surface. All pipes shall be thoroughly inspected on arrival on site and immediately prior to installation. Any damage to the pipes shall be notified to the Employers Engineer for a decision as to the acceptability of the pipes, with or without repairs or remedial work. The final judgement will be taken by the Employers Engineer based on his judgement of the suitability of the items for the purpose intended.

The following procedures should be followed so as to eliminate potential damage to pipes & fittings and to maintain maximum safety during unloading, lifting and lowering of pipes:

- Pipes must not be stored or transported where they are exposed to heat sources likely to exceed 60°C.
- Pipes shall be stored such that they are not in contact with direct sunlight, lubricating or hydraulic oils, petrol, solvents and other aggressive materials.
- Scores or scratches to a depth of greater than 10% or more of wall thickness are not permissible; any pipes having such defects should be strictly rejected.
- PE pipes should not be subjected to rough handling during loading and unloading operations. Rollers shall be used to move, drag the pipes across any surface.
- Only polyester webbing slings should be used to lift heavy PE (>315mm) pipes by crane. Under no circumstances, chains, wire ropes and hooks be used on PE pipes.
- Pipes shall not be dropped to avoid impact or bump. If any time during handling or during installation, any damage, such as gouge, crack or fracture occurs, the pipe shall be repaired if so permitted by the competent authority before installation.
- Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set.
- Pipes manufactured at factory are to be carried to the site of work directly or stacked suitably and neatly along the alignment/road side/elsewhere near by the work site or as directed by the Employers Engineer.
- Damages during transit, handling, storage will be to the Contractor's account and replacement for such pipes has to be made by the Contractor without any extra cost as directed by the Employers Engineer.

Storage

- Black polyethylene pipes may be stored either under cover or in the open. It is suitably protected from ageing due to sunlight by the addition of the appropriate quantity and type of carbon black. .
- Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set.
- Storage of pipes in heated areas exceeding 30°C should be avoided.

Drop Manholes

When a branch sewer connects a main sewer, and where the difference in level between pipeline (peak flow level) of main line and the invert level of branch line is more than 600 mm or a drop of more than 600 mm is required to be given in the same sewer line and it is uneconomical or impractical to arrange the connection within 600 mm, a drop connection shall be provided for which a manhole, incorporating a vertical drop pipe from the higher sewer to the lower one.

The pipe shall be provided inside the shaft supported by brackets as per IS 4111. The diameter of the back drop should be at least as large as that of the incoming pipe. The drop pipe should terminate at its lower end with a plain or duck-foot bend turned so as to discharge its flow at 45 degrees or less to the direction of the flow in the main sewer. Adequate means for rodding should be provided for internal drops.

Flushing manholes

Where it is not possible to obtain self-cleaning velocities due to flatness of the gradient especially at the top end of branch sewer which receive very little flow, it is essential that some form of flushing device be incorporated in the system. The relevant Indian standard IS: 4111(part two) can be referred.

Flushing tanks shall be provided in such sections of the sewers where flow is never sufficient to generate self-cleaning velocity. They may be located at heads of sewers (main or branch) or even intermediate points of the sewers. Sufficient velocity shall be imparted in the sewer to wash away the deposited solid. The flush is usually effective up to a certain distance after which the imparted velocity gets dissipated.

Foot rests

Orange colour safety foot rest of minimum 6 mm thick plastic encapsulated shall be as per IS: 10910, on 12mm dia steel bar conforming to IS: 1786, having minimum cross section as 23mm x 25mm and over all minimum length 263 mm and width as 165mm with minimum 112mm space between protruded legs having 2mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138mm as per standard drawing and suitable to withstand the bend test and chemical resistance test as per specifications and having manufacture's permanent identification mark to be visible even after fixing, including fixing in manholes with 30x20x15cm cement concrete block 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) complete as per design.

Boning Staves and Sight Rails

In laying the pipes and fittings/ specials the centre for each manhole / chamber or pipeline shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 x 100 x 1800 mm) at each manhole/chamber or junction of pipelines at nearly equal distance from the peg and at sufficient distances there from to be well clear of all intended excavation, so arranged that a sight rail when fixed at a certain level against the post shall cross the centre line of the manhole/chamber or pipe lines. The sight rail shall not in any case be more than 30 m apart; intermediate rails shall be put up if directed by the Employers Engineer.

Boning staves of 75 mm x 50 mm size shall be prepared by Contractor in various lengths, each length being of a certain whole number of metres and with a fixed tee head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the cross piece must be fixed below the top-edge of the tee-head at a distance equal to the outside diameter of the pipe or the thickness of the concrete bed to be laid as the case may be. The top of cross pieces shall indicate different levels such as excavation for pipe line, top of concrete bed, top of the pipe etc. as the case may be.

The sight rail of size 250 mm x 40 mm shall be screwed with the top edge resting against the level marks. The center line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the center lines of any converging pipes. A line drawn from the top edge of one rail to the top edge of the next rail shall be vertically parallel with the bed of the pipe, and the depth of the bed of pipe at any intermediate point may be determined by letting down the selected boning staff until the tee head comes in the line of sight from rail to rail.

The post and rails shall be perfectly square and planed smooth on all sides and edges. The rails shall be painted white on both sides, and the tee-heads and cross-piece of the boning staves shall be painted black.

For the pipes converging to a manhole/chamber at various levels, there shall be a rail fixed for every different level. When a rail comes within 0.60 M of the surface of the ground, a higher sight-rail shall be fixed for use with the rail over the next point.

The posts and rails shall in no case be removed until the trench is excavated, the pipes are laid and the Employers Engineer gives permission to proceed with the backfilling.

Thrust blocks

The Contractor shall indicate on his detailed drawings what thrust blocks are required to anchor pipe work supplied by him. Particular care shall be taken to ensure that pipe work thrusts are, as far as possible, not transmitted to machinery or other associated apparatus.

Puddle flanges shall be fitted to pipes where the structure through which they pass is required to take thrust resulting from the pipe. Puddle flanges shall also be fitted where a water barrier is required. All puddle flanges shall be clearly shown on the drawings and the resultant thrust clearly indicated. Puddle flanges shall only be fitted with the prior approval of the Employers Engineer.

Wooden Shoring

Contractor shall suitably design polling boards, waling and struts to meet different soil conditions that might be encountered in excavating trenches/pits. The horizontal and vertical spacing of struts shall be such that not only the sides of trenches shall be prevented from collapse but also easy lowering of pipe in trenches shall be ensured without creating undue obstructions for the excavation of the work. Any inconvenience and/or delay that might be caused in lowering pipes in trenches, as a result of adopting improper spacing of struts by the Contractor, shall be his sole responsibility. No part of shoring shall at any time be removed by Contractor without obtaining permission from the Employers Engineer. While taking out shoring planks the hollows of any form must simultaneously be filled in with soft earth well rammed with rammers and with water.

Th places, where it is found absolutely necessary to do so to avoid any damage which may be caused to buildings, cables, gas mains, water mains, sewers etc. in close proximity of the excavation, by pulling out the shoring from the excavations. The Contractor shall not claim, on any reason whatsoever, for the shoring which may have been left in by him at his own discretion.

Steel Plate Shoring

Where tining road surfaces and other services. In such circumstances, the Contractor will be required to use steel trench sheeting or sheet piling adequately supported by timber struts, waling etc., as per the instructions, manner and method directed by the Employers Engineer. Contractor shall supply pitch, drive and subsequently remove trench sheeting or piling in accordance with other items of the Employer Engineer's Requirements.

Table 1: Relevant Indian Standards & Specifications

S. No.	Code or Standard	Description
1	Manual for Water Supply & Treatment	CPHEEO Manual for Water Supply & Treatment - 1999-MoUD, GoI
2	SP 7 (Part-9 Section-1) 1983	National Building Code of India
3	SP 35:1987	Hand book on water supply & drainage
4	IS 1172 :1993	Code of Basic requirements for water supply, drainage and sanitation
5	IS. 3370 Part I to IV	Code of practice for concrete structure for the storage of liquids
6	IS 456-2000	Code of Practice for plain and reinforced concrete
7	IS 1893-2002 part I to V	Criteria for earthquake -resistant design of structures
8	IS 13920-1993	Detailing of reinforced concrete Structures subjected to seismic forces
9	IS 1992-1969 / IS 6403-1971	Code for exploration to find the safe bearing capacity
10	IS 2309-1969	Code for Lighting arrestors
11	IS 875 part I to III,1987	Code of practice for design loads for building and structures
12	IS 7357	Code of practice for structural design of tanks
13	IS 1786-1985	High strength deformed steel bars and wires for concrete reinforcement
14	IS: 638	Specification for rubber and insertion jointing.
15	IS. 226-1975	Specification for Structural steel
16	IS: 9523	Ductile iron fittings for pressure pipes for water, gas and sewerage
17	IS: 1500	Code for Hardness test for DI pipes
18	IS 3764-1966	Safety code of Excavation Works and related Drilling Operations

S. No.	Code or Standard	Description
19	IS 11906:1986	Recommendations for cement mortar lining for cast iron, Mild steel and Ductile Iron pipes and fittings for transportation of water
20	IS 8062	Code of practice for cathodic protection for steel structures
21	IS 12288:1987	Code of practice for laying of ductile iron
22	IS 14846:2000	Sluice valves for water Works purposes (50 to 1200 mm size)
23	IS 2906:1990	Sluice valves for water Works purposes (350 to 1200 mm size)
24	IS 2685:1971	Code of practice for selection, installation and Maintenance of sluice valves
25	IS 3950:1979	Surface boxes for sluice valves
26	IS 5312	Swing check type reflux(non-return) valves for water Works purposes
27	IS 10446:1983	Glossary of terms relating to water supply and sanitation
28	IS 2951-1965	Recommendation for estimation of flow of liquids in closed conduits.
29	Advisory note on improving Urban Water Supply & Sanitation Services	Guidelines for preparation of DPRs for water supply system by MoUD, 2013
30	Is :4733-1972	Indian Standard Code: Methods of Sampling Test Sewage Effluent
31	IS: 6908-1975	Indian Standard Code: Sewage and Drainage
32	IS :7022 (PT 11)-i 979	Indian Standard Code: Glossary of Terms Relating to Water Sewage and Industrial Effluents PT II
33	IS:1538-(PT-XXIV)-1 982	Indian Standard Code: Pressure Pipes for Water. Gas and Sewage
34	IS 5600: 2002	Indian Standard Code: Pumps-sewage and Drainage-Specification
35	IS 5611 :1987	Indian Standard Code: Code of practice for waste stabilization ponds (facultative type) (first revision)
36	IS: 5600-1970	Indian Standard Code: Specification for Sewage and Drainage Building Elements
37	IS : 4764-1973	Indian Standard Code: Tolerance Limits for Sewage Effluents Discharged In to In land Surface Water
38	IS 6279 :1971	Indian Standard Code: Equipment for gnt removal devices
39	IS 6280:1971	Sewage screens

S. No.	Code or Standard	Description
40	IS 7232:1974	Indian Standard Code: Method for Imhoff cone test
41	IS 7784: Part 1 & 2: Sec 1 to 5	Indian Standard Code: Code of practice for design of cross drainage work Part 1 General features
42	IS 4111(Part 1):1986	Code of practice for ancillary Structures in sewerage system: Part I Manholes
43	IS 4111(Part 4):1968	Code of practice for ancillary Structures in sewerage system: Part 4 Pumping stations and pumping mains (rising mains)
44	IS 12251:1987	Code of practice for drainage of building
45	IS 12288:1987	Code of practice for use and laying of ductile iron
46	SP 35(S&T): 1987	Handbook on water supply and drainage with special emphasis on plumbing.
47	IS 458	Pre-cast Concrete Pipes (with and without reinforcement).
48	IS 651	Specification for Salt Glazed Stoneware Pipes and Fittings.
49	IS 783	Code of Practice for Laying Concrete Pipes
50	IS 1729	Cast Iron /Ductile Iron Drainage Pipes and Pipe Fittings Socket and Spigot Series for Over-ground Non-pressure Pipe Line.
51	IS 4885	Specifications for Sewer Bricks
52	IS 12592 (Part I & II)	Pre-cast Concrete Manhole Covers and Frames – Specifications
53	IS-8112: 2013	Specification for 43 grade ordinary Portland cement
54	IS-383: 1970	Specification for Coarse and Fine Aggregates From Natural Sources For Concrete
55	IS:3597 (1998)	Concrete Pipes: Methods of Test
56	IS: 783	Code of Practice for laying of Concrete Pipes
57	IS:376	Safety code for Excavation work
58	IS: 1077	Common Burnt Clay Building Bricks
59	IS:3102	Classification of Burnt Clay Bricks
60	IS: 395	Method of Sampling and Testing Clay Building Bricks
61	IS: 2212	Code of practice for brick work

1.16 Storm Water Network

1.4. Pipe Network for Storm Water System

A separate dedicated collection network is proposed for collection of storm water comprising of NP3 RCC pipes and for road crossing RCC NP4, as per IS 458.

Collection Network shall be planned considering natural topography and planned grade levels. The network are designed on the assumption that although silting might occur at minimum flow, however it should be flushed out during peak flows. Connection from the plot shall not be less than 250 mm OD HDPE/UPVC pipe.

1.5. Manhole Size, Depth and Type

The channels in manholes at junctions and bends shall be smooth with gradual transitions to avoid turbulence and deposition of solids. Manholes are usually constructed directly over the line. They shall be of concrete of appropriate grade can be circular, rectangular or square in shape. Manholes should be of such size that will allow necessary cleaning and inspection. As per IS-4111: 1986 "Circular type manholes are much stronger than rectangular and arch type manholes and thus these are favored over rectangular as well as arch type manholes". Therefore circular manholes shall be proposed on all storm water lines for all depths starting from 0.9m. Diameter of manhole varies with change in depth of manhole. Poly elastomeric flats footrest shall be proposed for entry into manholes as per clause 2.7 of Annexure I(D) of Schedule D of the said tender document.

Table 3: Manhole Sizing

Range of Depths, m	Maximum Dia Up to	Manhole Size
above 0.90 m and up to 1.65 m	500 mm	900 mm dia.
above 1.65 m and up to 2.30 m	600 mm	1200 mm dia.
above 2.30 m and up to 9.0 m	900 mm	1500 mm dia.
above 9.0 m and up to 14.0 m	1200 mm	1800 mm dia.

1.16.1 The inlet to the storm water system from the road side entry shall not be more than 15 m c/c duly grated with SS-304 gratings as per IRC 50:2013. However contractor is free to propose other type of grated inlets (SS-304 gratings) to storm water with approval of Employer Engineer. Typical storm water inlet are enclosed with bid document.

1.6. Spacing of Manholes

- As per IS - 4111: 1986, For inspection, cleaning and testing of manholes should be built at every change of alignment, gradient or diameter, at the head of all sewers and branches and at every junction.

- The storm water pipeline shall be in a straight line between two manholes.
- Maximum distance between service manholes should not be more than 30 m.
- Manhole spacing is limited to 30m, however for Outfall with no service connections the spacing can be increased, with approval of Employers Engineer.

Table 4: Manhole Spacing

Sewer size	Maximum Manhole spacing
Up to 600mm	up to 60 m
600mm to 900mm	90 m
900mm to 1200mm	120 m
1200mm to 1500mm	150 m

1.7. Cover Frame

- As per IS-4111: 1986, the size of manhole covers should be such that there should be clear opening of not less than 560 mm diameter for manholes exceeding 0.9 m depth.
- Manhole cover and frame will be SFRC (Steel Fiber Reinforced Concrete) conforming to the IS 12592.

Table 5: Manhole Cover Details as per IS 12592

Manhole Type	Load withstanding capacity	Suitable Locations
L.D (Light Duty)	2.50 MT	Footpaths, Two wheelers
M.D (Medium Duty)	10.00 MT	Light four wheelers
H.D (Heavy Duty)	20.00 MT	Heavy vehicles
E.H.D (Extra Heavy Duty)	35.00 MT	Heavy traffic roads

1.8. Boning Staves and Sight Rails

In laying the pipes and fittings/ specials the centre for each manhole / chamber or pipeline shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 x 100 x 1800 mm) at each manhole/chamber or junction of pipelines at nearly equal distance from the peg and at sufficient distances there from to be well clear of all intended excavation, so arranged that a sight rail when fixed at a certain level against the post shall cross the centre line of the manhole/chamber or pipe lines. The sight rail shall not in any case be more than 30 m apart; intermediate rails shall be put up if directed by the Employers Engineer.

Boning staves of 75 mm x 50 mm size shall be prepared by Contractor in various lengths, each length being of a certain whole number of metres and with a fixed tee head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the

cross piece must be fixed below the top-edge of the tee-head at a distance equal to the outside diameter of the pipe or the thickness of the concrete bed to be laid as the case may be. The top of cross pieces shall indicate different levels such as excavation for pipe line, top of concrete bed, top of the pipe etc. as the case may be.

The sight rail of size 250 mm x 40 mm shall be screwed with the top edge resting against the level marks. The center line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the center lines of any converging pipes. A line drawn from the top edge of one rail to the top edge of the next rail shall be vertically parallel with the bed of the pipe, and the depth of the bed of pipe at any intermediate point may be determined by letting down the selected boning staff until the tee head comes in the line of sight from rail to rail.

The post and rails shall be perfectly square and planed smooth on all sides and edges. The rails shall be painted white on both sides, and the tee-heads and cross-piece of the boning staves shall be painted black.

For the pipes converging to a manhole/chamber at various levels, there shall be a rail fixed for every different level. When a rail comes within 0.60 M of the surface of the ground, a higher sight-rail shall be fixed for use with the rail over the next point.

The posts and rails shall in no case be removed until the trench is excavated, the pipes are laid and the Employers Engineer gives permission to proceed with the backfilling.

1.9. RCC NP3 and NP4 Pipes

Manufacturing

General

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 clause of 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.

The RCC pipes and collars/rubber rings shall be systematically checked for any manufacturing defects by experienced supervisors so as to maintain a high standard of quality.

The Engineer shall at all reasonable times have free access to the place where the pipes and collars/rubber rings are manufactured for the purpose of examining and testing the pipes and collars/ rubber rings and of witnessing the test and manufacturing.

All tests specified either in this Employer's Engineer's Requirements or in the relevant Indian standards shall be performed by the supplier/contractor at his own cost and in presence of the Employers Engineer if desired. For this, sufficient notice before testing of the pipes and fittings shall be given to the Employers Engineer.

The outersurface of RCC pipes shall be 100% solid coal tar epoxy for both sewerage and storm water. However for sewerage RCC pipes shall be internally lined with PE of min. 2.5 mm thk. The lining shall be guaranteed by fusing each individual pipe liner with the next for continuity and long life.

If the test is found unsatisfactory, the Engineer may reject any or all pipes of that lot. The decision of the Engineer in this matter shall be final and binding on Contractor and not subject to any arbitration or appeal.

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 Employers Engineer before carrying to sites.

Cement

Cement used for the manufacture of RCC pipes and collars shall conform to relevant IS codes. The use of pozzolana as an admixture to Portland cement shall not be permitted.

Aggregates

Aggregates used for the manufacture of RCC pipes and collars shall conform to IS: 383. The maximum size of aggregate should not exceed one third the thickness of the pipe or 20mm, whichever is smaller.

Mixing and Curing Water

Water shall be clean, colourless 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.

Reinforcement

Reinforcement used for the manufacture of the RCC pipes and collars 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). Reinforcement cages for pipes and collars shall be as per relevant requirement of IS: 458.

Concrete

Concrete used for the manufacture of RCC pipes and collars 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 15 cm cubes in accordance with the relevant requirements of IS: 456 and IS: 516.

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.

Dimensions

The internal diameter, wall thickness and length of barrel and collar of pipes, 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 classes of pipes.

The tolerances regarding overall length, internal diameter of pipes or sockets and barrel wall thickness shall be as per relevant clause of IS: 458.

Workmanship and Finish

Pipes shall be straight and free from cracks. 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 3 mm in pipes upto 600mm diameter (inclusive), and 6 mm in pipes larger than 600 mm diameter.

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 the Engineer and the manufacturer or supplier.

The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or moulding. The pipes shall be free from local dents or bulges greater than 3 mm in depth and extending over a length in any direction greater than twice the thickness of barrel.

The deviation from straight in any pipe throughout its effective length, tested by means of rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameters 3 mm for every meter run.

Testing

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. Engineer reserve the right to attend all testing.

During manufacture, tests on concrete shall be carried out as per IS: 456. The manufacturer shall supply, when required to do so by the Engineer, the results of compressive tests of concrete cubes and split tensile tests of concrete cylinders made from the concrete used for the pipes. The manufacturer shall supply cylinders or cubes for test purposes required by the Engineer and such cylinders or cubes shall withstand the tests prescribed as per IS: 458. Every pressure pipe shall be tested by the manufacturer for the hydrostatic test pressure. For non-pressure pipes, 2 percent of the pipes shall be tested for hydrostatic test pressure.

The specimen of pipes for the following tests shall be selected in accordance with relevant clause of IS: 458 and tests in accordance with the methods described in IS: 3597.

- i) Hydrostatic test
- ii) Three edge bearing test
- iii) Absorption test
- iv) Visual Examination

Sampling and Inspection

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 the Employer's Engineer shall be ascertained on the basis of tests on pipes selected from it.

The number of pipes to be selected from the lot for testing shall be in accordance with Table 15 of IS: 458.

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 pipe be selected till the requisite number is obtained, or being the integral part of N/n where N is the lot size and n is the sample size.

All pipes selected shall be inspected by Engineer for dimensional requirements, finish and deviation from straight. A pipe failing to satisfy one or more of these requirements shall be considered as defective.

The number of pipes to be tested shall be in accordance with column 4 of Table 15 of IS: 458. These pipes shall be selected from pipes that have satisfied the requirements mentioned in the above clause.

A lot shall be considered as conforming to the requirements of IS: 458 if the following conditions are satisfied.

The number of defective pipes shall not be more than the permissible number given in column 3 of Table 15 of IS: 458.

All the pipes tested for various tests shall satisfy corresponding requirements of the tests.

In case the number of pipes not satisfying requirements of any one or more tests, one or two further samples of same size shall be selected and tested for the test or tests in which the 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 shall make decision of "fail or pass" at once. All cost for the test shall be borne by the Contractor.

Marking

The following information shall be clearly marked on each pipe:

- a) Internal and External diameter and length of pipe
- b) Class of pipe
- c) Date of manufacture and
- d) Name of manufacturer or his registered trade-mark or both.

2.4. Jointing

General

Jointing of RCC pipes shall be done as per the relevant IS standard. After jointing, extraneous material, if any, shall be removed from the inside of the pipe and the 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.

Spigot and Socket joint (Rigid)

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar which shall be rammed with caulking tool. This joint is used for low pressure pipe line.

Collar Joint (Rigid)

After laying the RCC pipes at proper alignment and gradient their abutting faces shall be coated with hot bitumen in liquid condition by means of a brush. The wedge-shaped groove in the end of the pipe shall then be filled with a tarred gasket in one length for each joint. The collar shall then be slipped over the end of the pipe and the next pipe butted well against the tarred gasket by suitable appliances approved by the Engineer so as to thoroughly compress the tarred gasket into the grooves, care being taken that the concentricity of the pipes and levels are not disturbed during this operation.

The collar shall then be placed symmetrically over the end of the two pipes and the space between the inside of the collar and the outside of the pipe filled with a mixture of cement and sand to withstand any stress and prevent any water leakage, tempered with just sufficient water to have a consistency of the semi-dry conditions, well packed and thoroughly rammed with caulking tools. The joints shall be finished off with a fillet sloping at 45° to the side of the pipe. The finished joints shall be protected and cured thoroughly as directed by the Employers Engineer. Any plastic solution or cement mortar that may have been squeezed into the inside of the pipe shall be removed so as to leave the inside of the pipe perfectly clean.

Flush Joint (Internal)

This joint shall be generally used for culvert pipes of 900 mm diameter and over. The ends of the pipes are specially shaped to form a self centering joint with an internal jointing space 13 mm wide. The finished joint is flush with both inside and outside with the pipe wall. The jointing space is filled with cement mortar mixed sufficiently dry to remain in position when forced with a trowel or rammer.

Flush Joint (External)

This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends. Each end shall be butted against each other and adjusted in correct position. The jointing space shall then be filled with cement mortar sufficiently dry and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

Spigot and Socket (Semi-flexible)

This joint is composed of specially shaped spigot and socket ends on the RCC pipes. A rubber ring shall be lubricated and then placed on the spigot which is forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and socket, stiff mixture of cement and mortar shall then be filled into the remaining annular space with a caulking tool.

Collar Joint (Semi-Flexible)

This joint is made up of a loose collar which covers two specially shaped pipe ends. Each end shall be fitted with a rubber ring which when compressed between the spigot and collar, seals the joint. Stiff mixture of cement mortar shall then be filled to withstand stress and prevent any water leakage, into the remaining annular space and rammed with a caulking tool.

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 pipe by means of uniformly applied pressure with the aid of a jack or similar appliance. The RCC pipes shall be of spigot and socket type and rubber rings shall be used, and the manufacturer's instructions shall be deemed to form a part of the tender requirements. 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.

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 the Employers Engineer, Contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75 mm 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 the Engineer to prevent entry of mud or silt etc.

If as a result of the removal of any obstructions the Employers Engineer 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 the Employers Engineer.

It shall also be ascertained by contractor that each stretch from manhole to manhole or the stretch as directed by Employers Engineer is absolutely clear and without any obstruction by means of visual examination of the interior of the pipe line suitably enlightened by projected sunlight or otherwise.

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 Employer's Requirement and as directed by the Employers Engineer. All equipment for testing at work site shall be supplied and erected by contractor. Water for testing of pipes shall be arranged by him. Damage during testing shall be contractor's responsibility and shall be rectified by him to full satisfaction of the Employers Engineer. Water used for the test shall be removed from pipes and not released to the excavated trenches.

After the joints have thoroughly set and have been checked by the Employers Engineer and before back filling the trenches, the entire section of the sewer or storm water drain shall be proved by the contractor to be water tight by filling in pipes with water to the level of 1.50m above the top of the highest pipe in the stretch and heading the water up for a period of one hour. The apparatus used for the purpose of testing shall be approved by the Employers Engineer. Contractor if required by the Employers Engineer shall dewater the excavated pit and keep it dry during the period of testing. The loss of water over a period of 30 minutes should be measured by adding water from a measuring vessel at regular 10 minutes intervals and noting the quantity required to maintain the original water level. For the approval of this test the average quantity added should not exceed 1 liter/ hour/100 linear metres / 10mm of nominal internal diameter. Any leakage including excessive sweating which causes a drop in the test water level will be visible and the defective part of the work shall be removed and made good.

In case of pressure pipeline, the completed stretch of pipeline shall be tested for site test pressure. The site test pressure should not be less than the maximum operating pressure plus the calculated surge pressure, but in no case should it exceed the hydrostatic test pressure as specified in IS: 458.

All of results of test and inspection data must be prepared by contractor at site so that the Engineer shall make decision of "fail or pass" at once. All cost for the inspection shall be borne by the Contractor.

1.10. Drop Manholes

When a branch connects a main line, and where the difference in level between water line (peak flow level) of main line and the invert level of branch line is more than 600 mm or a drop of more than 600 mm is required to be given in the same pipe line and it is uneconomical or impractical to arrange the connection within 600 mm, a drop connection shall be provided incorporating a vertical drop pipe from the higher sewer to the lower one.

The pipe shall be provided inside the shaft supported by brackets as per IS 4111. The diameter of the back drop should be at least as large as that of the incoming pipe. The drop pipe should terminate at its lower end with a plain or duck-foot bend turned so as to discharge its flow at 45 degrees or less to the direction of the flow in the main sewer. Adequate means for rodding should be provided for internal drops.

1.11. Rubble Stone Pitching

Rubble stone pitching shall be carried out for three channels to designed to cater flow to discharge as natural drainage.

- Stones for the works shall be of the specified varieties which are 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-1). The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS: 1124. The CONTRACTOR shall supply sample stones to the Employers Engineer for approval. Stones shall be laid with its grains horizontal so that the load transmitted is always perpendicular to the natural bed.
- For all works below ground level the masonry shall be random rubble uncoursed with ordinary quarry dressed stones for the hearting and selected quarry dressed stones for the facing.
- Chips and spalls shall be used wherever necessary to avoid to ensure that no hollow spaces are left in the pitching. Gravel quarry spalls should be laid underneath the ground to level undulations.
- All stones shall be sufficiently wetted before laying to prevent absorption of water from the mortar. However if any part of the pitching is required to be left behind, the wall shall be raked back (and not saw toothed) at an angle not exceeding 45 degree. Stone pitching shall be of 230mm thick of not less than 150mm x 150mm size. These shall be roughly dressed on sides and surface and the joints filled with small chips on the exposed surface unless otherwise specified.

1.12. Property Connections

Service pipes should be laid up to plot boundaries in the Project area. The service pipe details are as defined below:

Table A - Tentative Details of Property Connections

S. No.	Description	Value
1	Number of connections	Industrial: 20

1.13. List of Standards and Specifications

The design and Construction of storm water drainage network and the outfalls shall conform to design requirements and Construction specifications set out in the following Indian and International Standards.

- IS - 456 Code of practice for Plain & Reinforced concrete;
- IRC SP-50-1999 - Guidelines on Urban Drainage
- IS - 458 Pre-cast Concrete Pipes (with and without reinforcement);
- IS 783 -1985 Width and depth of trench for R.C.C. Pipes;
- IS 1726 Specification for Cast Iron Manhole Covers and Frames;
- IRC SP-42-1994 - Guidelines on Road Drainage
- IS 4985-2000 Unplasticized PVC pipes for potable water supplies - specification;
- IS 12235- (Parts 1 to 19) Thermoplastics pipes and fittings - methods of test; and
- IS 12592 Pre-cast Concrete Manhole Covers and Frames – Specifications.
- Schedule of specifications of Govt. Of Maharashtra and C.P.W.D. specifications (Govt. of India) 2009 with all latest amendments issued from time to time;
- CPHEEO Manual for Sewerage and Drainage -2014 - MoUD, GoI
- SP 35:1987 - Hand book of Water Supply and Drainage, Bureau of Indian Standards;
- Manual on artificial recharge of ground water by Central groundwater Board Ministry of Water-Resources Government of India;
- Rain water harvesting and conservation Manual by consultancy services organization CPWD, New Delhi, India;
- Code of Practice on Surface Water Drainage by Public Utilities Board, Singapore; and
- Managing Urban Runoff Drainage Handbook by Public Utilities Board, Singapore.

1.17 Power System

The electrical scope is to provide the complete electrical system including civil works as detailed below, complete in all respects and covers design, engineering, procurement / manufacturing of electrical equipment, testing at works, packing, transportation to site, storage, installation, testing, commissioning, handing-over in complete working order all the equipment's including all items as per contract, spares, manuals, etc. and to undertake subsequent DLP and O&M as detailed in the General Specifications section. Any works required to provide a complete and fully functional and safe system shall be deemed to be included whether mentioned here or not. The scope of electrical works shall broadly consist of the major following items:

- External Lighting:

11/0.415kV, outdoor type transformers / feeder pillars for street lighting pole including fixtures.

High Mast, Lighting poles, lighting panels, cabling etc. as required for street lighting

Luminaries, distribution boards etc. as required for each 33/11kV substation internal lighting

- Precast RCC Ducts of size 1.5mX1.5m for Power and Fiber optic cable with cable trays
- Earthing system
- Civil works complete in all respects

Request for Qualification cum Request for
Proposal (RFQ cum RFP)

for

**Design, Procurement, Construction, Testing and
Commissioning of 37M ROW Road with storm water
drains, Potable water, recycle water, Firefighting
network, electrical and effluent network with all allied
works, including Defect Liability Period (DLP) for 4 years
at AURIC Bidkin Industrial Area, Chhatrapati
Sambhajinagar, Maharashtra on EPC Basis**

VOLUME 2 – General Specification

PART -1 GENERAL CIVIL SPECIFICATIONS

August 2025

Managing Director

Maharashtra Industrial Township Limited

Udyog Sarathi, MIDC Office, Marol Industrial Area,
Andheri (East), Mumbai, Maharashtra State, India – 400093

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1. GENERAL AND PRELIMINARY

1.1 General

1.1.1 Standards

Materials and methods shall comply with the current issue of the standards indicated, generally the relevant Standards and Codes of Practice.

The Contractor shall make available to the Engineer-in-charge as required copies of each and any Codes of Practice, International Standards, test methods etc. relevant to the Works.

If the Contractor proposes the adoption of alternative Standards, he shall provide details and explanations for approval.

1.1.2 NOCs(No objection certificate)

The Contractor shall be responsible for obtaining all necessary permits, licences, and NOCs from the relevant authorities required for the proper execution of the Works. The permits, licences and no-objection certificates shall also cover all the materials, goods and instruments etc which are required to complete the Works. The Contractor shall ensure that all necessary permits, licences and NOCs are obtained prior to starting the work to which they related. All costs and fees associated with the necessary permits, licences and NOCs shall be borne by the Contractor. The Contractor is also responsible for any costs associated with charges made by the Department for examination, certification or connection.

1.1.3 Emergency Arrangements

The Contractor shall maintain arrangements whereby he can quickly call out labour outside normal working hours to carry out any work needed for an emergency associated with the Works. The Engineer-in-charge shall be provided at all times with a list of addresses and telephone numbers of the Contractor's staff who are currently responsible for organising emergency work.

The Contractor shall acquaint himself and his employees with any relevant local arrangements which are in existence for dealing with emergencies.

1.2 Environmental Conditions

1.2.1 Climatic Conditions

The following typical climatic conditions prevail in the area of the works;

Peak ambient temperature	-	45°C
Minimum ambient temperature	-	20°C
Average Relative humidity	-	65%

1.3 Documentation to be Supplied by the Contractor

1.3.1 Submission of Documentation and Drawings

Unless otherwise specified, all documentation and drawing submittals required by the Contract shall be in accordance with the following clauses.

1.3.2 Formats and Quantities

Documentation and drawings shall be submitted in English and in both paper and electronic versions. Three copies of paper versions shall be provided. For drawings this shall include one copy at the original sheet size (e.g. A1), unless agreed otherwise with the Engineer-in-charge. The format of the electronic copies shall be agreed with the Engineer-in-charge.

The Structural designs shall be submitted along with STAAD files (input and output) in soft as well as hard copies if applicable.

1.3.3 Delivery of Submittals

All submittals shall be made by delivery to the Engineer-in-charge's site office during the Engineer-in-charge's normal working hours.

1.3.4 Contractor's Approval

Documents and drawings submitted for approval shall be signed as approved by the Contractor. In the case of sub-contractor documents and drawings, these shall also be checked by the Contractor prior to issue for approval. The Contractor shall date stamp, and sign each of the sub-contractor's documents and drawings. Any documents or drawings submitted to the Engineer-in-charge for approval that have not been signed as checked and approved by the Contractor will be returned for re-submission.

1.3.5 Deviations

Submissions by the Contractor shall be accompanied by detail of any proposed deviations from the requirements of the Contract or failing which it shall be deemed that the Contractor's proposal are fully compliant vide the requirements of the Contract.

1.3.6 Approval by the Engineer-in-charge

A response will be given by the Engineer-in-charge within twenty-one days of receipt of the drawings or documents. The Engineer-in-charge will inform the Contractor by letter or by return of a copy of the document, marked with one of the following remarks:

Code A: Approved

Code B: Approved Subject to Comments

Code C: Returned with Comments

Code D: Examination Not Required

"Approved Subject to Comments" authorises the Contractor to proceed with the appropriate section of the Works subject to the corrections or comments noted on the document and/or accompanying letter or approval sheet. After correction, the document shall be resubmitted to the Engineer-in-charge for approval with all corrections made on the drawing.

"Returned with Comments" indicates that the document must be revised and resubmitted for approval before proceeding with the manufacture.

"Examination Not Required" indicates that the details on the document are not considered to require approval by the Engineer-in-charge due to such details being standard, typical etc., or not relevant to the acceptability of the proposed works/method.

The approval shall not be taken as constituting an expression of opinion on the part of the Engineer-in-charge as to the strength or efficiency of the plant and equipment or to its correctness or in any way relieving the Contractor from his responsibilities or obligations under the Contract.

1.3.7 Delayed Engineer-in-charge's Response

The Contractor shall not proceed with any Works that require approval until such approval is given by the Engineer-in-charge. In the event that the twenty-one-day review period elapses and no response is received from the Engineer-in-charge, the Contractor may proceed at his own risk with the affected element of the works subject to the fulfilment of his contractual obligations.

1.3.8 Late Submittals

Submissions for the Approval of the Engineer-in-charge shall be made at times to suit the Contractor's program and as detailed in the Contractor's program. Should the drawings and documents not be submitted in accordance with the Contractor's program the periods for review by the Engineer-in-charge shall be extended as necessary without the Contractor having any entitlement to any associated Extension of Time for Completion.

1.4 Programme and Progress

1.4.1 Management Plan

Within 15 days of the Date of Letter of Award, the Contractor shall submit a Management Plan. The Management Plan shall be in accordance with the Contractor's Quality Assurance Accreditation and the contents shall include but not be limited to:

- Site Management Structure;
- Contact Details for Key Staff;
- Programme;
- Document Numbering and Document Control Procedures;
- Pro-forma for Requests for Information, Requests for Inspection etc;

- Checking and Approval Procedures for Design elements under the Control of the Contractor;
- Change Control;
- Control Procedures for key activities, including survey, placement of concrete, pipe laying, testing, and preparation of as-built records;

The Management Plan shall be updated as appropriate throughout the duration of the Contract.

1.4.2 Programme and Progress

Within the period stipulated in the Contract the Contractor shall submit for approval, a programme or programmes for the execution of the Works. The programme(s) shall be presented in Gantt chart format, to the approval of the Engineer-in-charge, with the critical path and float periods clearly shown. The Schedule will be a Level 4 schedule. The Schedule should be prepared using P6

All construction activities including those by sub-contractors shall be shown, together with any temporary works construction, services diversions, traffic diversions and the like.

Critical interface dates for the issue of information for construction and for design and materials or equipment ordering by the Contractor shall be included.

If instructed by the Engineer-in-charge, the Contractor shall provide additional detailed tables, bar-charts and critical path(s) networks of the whole or parts of the Works.

The programme(s) shall be updated and/or expanded at such times as the Engineer-in-charge shall direct. Updated programming data in the form of Networks, Tables and Gantt charts showing actual progress in comparison with the Contract programme shall be submitted to the Engineer-in-charge at monthly intervals.

Any delay claims have to be supported by a time-impact analysis submitted at the along with the delay claim submission

1.4.3 Betterment of Existing Services

The Contractor shall, by his own representations to the relevant controlling authorities, determine the likelihood and extent of betterment works initiated by and executed concurrently with the new Works and shall make allowance for such work in programming his own work.

1.4.4 Photographs

When required, the Contractor shall provide a set of photographs comprising digital copies and four A4 size colour prints of each of five photographs, suitably inscribed in English as directed, of such portions of the Works in progress or completed as may be directed. The negatives of the photographs shall remain the copyright property of the Employer. The photographs will be submitted along with the monthly report.

Short videos of the work been done shall be submitted by Contractor on a monthly basis.

1.5 Health and Safety

1.5.1 Health and Safety Plan

Within 15 days of the Date of Letter of Award, the Contractor shall submit a Health and Safety Plan. The Health and Safety Plan shall contain, but not be limited to:

- Construction risk assessment and control measures;
- Organisation and management arrangements for implementation of the plan;
- Lifting schedule and lifting equipment certification;
- Scaffolding and temporary access controls;
- Provisions for First Aid, Welfare and Fire Fighting;
- Temporary Power Supplies;
- Access.

The Health and Safety Plan shall be updated as appropriate throughout the duration of the Contract.

1.5.2 Safety Officer

The Contractor shall appoint a competent safety officer and shall take all reasonable precautions to prevent accidents to the Contractor's workforce and to the public by providing, inter alia, proper ladders for access, adequate temporary covers to manholes, fencing around excavations, hard hats for use in designated areas and notices clearly indicating "hard-hat" areas, warning lights and general illumination of hazardous areas.

1.5.3 Cease Works

In the event that the Contractor's safety arrangements and precautions are not to the satisfaction of the Engineer-in-charge, he shall be instructed to cease work on the Works or particular section of the Works until such time as he improves such arrangements and precautions to satisfy the Engineer-in-charge.

1.5.4 Work near Live Sewers

Care must be exercised when working in or near live sewers, and tests must be made to verify that no low oxygen atmospheres, hydrogen sulphide or other poisonous gases are present, before anyone enters an existing manhole or confined space.

Particular attention is drawn to the dangers of poisoning, asphyxiation or explosion while working in or near, or inspecting, sewers, manholes, chambers, treatment units, pumping stations or any confined space. In this connection, the Contractor shall obtain appropriate safety equipment and acquaint all personnel of the dangers involved and precautions to be taken and shall regularly discuss with the Engineer-in-charge's Representative the sufficiency of safety precautions on Site.

1.5.5 Safety of the Public

The need for adequate protection to the general public in the vicinity of all excavations and other potentially dangerous areas of the Works is stressed.

1.5.6 First-Aid

The Contractor shall arrange for the treatment of casualties on the Site in first-aid units and for the removal by ambulance of injured or sick employees to hospitals or to their homes.

1.5.7 Fire Protection

The Contractor shall construct, equip and administer at his cost fire points in such positions and of such size as will provide an adequate service for the protection against fire on the Site. He shall install and maintain a proper warning system to ensure that firefighting equipment can be concentrated on a fire before it has had time to spread.

1.6 Plant and Methods

1.6.1 Contractor Design

Where the Contract requires the Contractor to undertake design, all drawings, calculations and any other information as may be required by the Engineer-in-charge to review and fully evaluate the Contractor's design shall be submitted for approval by the Contractor in accordance with his programme.

1.6.2 Plant and Methods

The Contractor shall submit a comprehensive plant schedule, which shall include the proposed dates of arrival on site of each major item of plant.

Before commencing any section of the Works, the Contractor shall obtain approval of the plant and methods proposed for use.

1.6.3 Contractor's Responsibility

The Contractor shall take upon himself the full and entire responsibility for the sufficiency of plant, centering, scaffolding, timbering, machinery, tools or implements and generally for all means used for the fulfilment of the Contract whether such means may or may not be approved or recommended by the Engineer-in-charge.

Notwithstanding any minimum requirements included in this Specification regarding quantity, output and adequacy of plant or outline of methods, the attaining of the specified standards of quality of work shall be the sole responsibility of the Contractor.

1.6.4 Abatement of Nuisance from Noise, Dust etc

The Contractor shall take precautions to minimise nuisance arising from noise, dust etc. Diesel and petrol engines shall be fitted with efficient silencers which are not necessarily those supplied by the plant manufacturers and if required plant shall be screened with

acoustic materials. The Contractor may be required to operate electrically driven plant if a suitable power supply is available.

Compressed air operated road breakers, tools, ventilation equipment, etc. shall be effectively muffled or shall be of a design with acceptably low noise frequency.

1.6.5 Coordination between Contractors

The Contractor shall ensure that he cooperates, coordinates and liaises with other Contractors working adjacent to the works and brings to the attention of the Engineer-in-charge any problems or difficulties faced.

1.6.6 Blasting

The Contractor shall obtain the prior written approval of the Engineer-in-charge, the Police and other relevant authorities for the use of explosives, magazine storage arrangements and blasting procedures, and shall provide trained and qualified safety men for the protection of persons and property during blasting operations.

1.6.7 Temporary Works

The Contractor shall submit to the Engineer-in-charge for approval details of Temporary Works not less than 21 days prior to commencement.

The Contractor is responsible for ensuring that Temporary works are not in any way detrimental to existing structures in any way.

The Contractor shall make safe and reinstate all areas affected by Temporary Works.

1.6.8 Topographical -Survey along pipe route alignment:

Contractor shall carry out Topographical survey along the route of rising main alignment. Topographical survey shall provide following minimum data

- i. Spot levels along the center line of road coming along the route of pipeline, spot levels of both side edges of road, spot levels along centerline and edges of a 2.0m wide corridor for pipe laying on both sides of road (total 4.0m wide corridor edge to edge).
- ii. Interval of spot levels shall be at 20m interval. At all road turnings spot levels to be measured at 1-2m intervals to capture turning radius.
- iii. Topo-survey shall also indicate any and all utility viz. a viz. building (residential/commercial/community etc.)/ trees and vegetation/light post/sheds etc. coming along the corridors on both sides of road
- iv. Any culvert/nallah/ all type of drains/pond/lake/any other water body coming along the corridor/pipe route shall be clearly indicated with all sizes/dimensions, top levels and invert levels of drains/nallahs etc.
- v. Where ever any such utility viz. a building (residential/commercial/community etc.)/ trees and vegetation/light post/sheds etc. / culvert/nallah/Major drains/pond/lake/any other water body /obstruction etc. coming along the 2.0m wide corridor on both sides of road, that shall occupy the whole or partial space of

corridor, survey and levels to be provided of adjacent space of those obstructions, along all four direction, for a minimum of 5m radius from the center of that obstruction.

- vi. Rail crossing/major road crossings (NH and SH)/small road crossing (Kaccha road and Pukka road etc.) shall be clearly indicated on the topo-survey drawing.
- vii. All spot levels shall be provided as points on the CAD/CSV/DXF file of topo-survey drawing having correct East/North and Elevation data.
- viii. For any critical locations along the route, photographs for actual site location shall also be provided.

1.7 The Site

1.7.1 Notice Boards

Notice boards shall be in both English and local language and shall be displayed in suitable positions on the sites to show the Employer's name together with the name of the Project and the names of the Engineer-in-charge and Contractor. The boards shall have a minimum overall size of 5.0m x 2.45m and shall be in a format to be provided by the Engineer-in-charge.

1.7.2 Interference in Land Interests

The Contractor shall confine his constructional operations to within the Site, or such other areas of land as may be negotiated and shall instruct his employees not to trespass.

Before exercising any right negotiated by him in connection with wayleaves or accommodation outside the Site, the Contractor shall notify the Engineer-in-charge in writing of such arrangements.

1.7.3 Access to Works

The necessary facilities will be given by the Employer for the access of the Contractor's employees to the Works and the Contractor shall be responsible for seeing that such employees obey all regulations made by the Employer in regard to the conditions of access to and over such property.

1.7.4 Temporary Fences

Temporary fencing erected around the Contractor's working area shall meet the requirements of Aurangabad Municipality and shall be to the satisfaction of the Engineer-in-charge.

1.7.5 Materials on and under the Site of Works

Materials arising from Site clearance, soil stripping and excavations shall belong to the Employer and shall not be removed from the Site without consent. The Contractor shall use

such materials obtained as the Engineer-in-charge may approve for use in construction of the Works or shall dispose of the materials as directed.

1.7.6 Billposting and Advertising

The Contractor shall not undertake or allow billposting or advertising of any kind upon the Works without the written consent of the Engineer-in-charge.

1.7.7 Clearance of Site

Final clearing shall be done before the final inspection.

The Contractor shall clean all interior and external surfaces exposed to view. The Contractor shall undertake the following to the satisfaction of the Engineer-in-charge:

1. Remove temporary labels, stains and foreign substances;
2. Polish transparent and glossy surfaces;
3. Clean roofs, gutters, downspouts and drainage systems;
4. Remove debris and surface dust from limited access surfaces;
5. Broom clean concrete floors and unoccupied spaces;
6. Clean light fixtures and lamps so they operate at maximum efficiency;
7. Other cleaning tasks as specified by the Engineer-in-charge.

The Contractor shall clean the Site and shall undertake the following to the satisfaction of the Engineer-in-charge:

1. Sweep paved areas and rake all other surfaces;
2. Remove litter and foreign substances;
3. Remove stains, chemical spills and other foreign deposits
4. Other cleaning tasks as specified by the Engineer-in-charge.

1.8 Setting Out of the Works

1.8.1 Datum

Levels on the drawings are to MSL (Mean Sea Level) Datum. Natural Ground level/ Altitude of the site is adopted at 577m above MSL. The Engineer-in-charge will indicate the position and value of a benchmark near the Works.

1.8.2 Temporary Bench Marks

The Contractor shall establish, construct and protect temporary bench marks during the period of construction and such bench marks shall be jointly checked periodically and the value agreed with the Engineer-in-charge.

The number and location of temporary bench marks shall be such that the maximum distance from a temporary bench mark to any construction activity shall not exceed 150

metres. Temporary bench marks shall be formed by concreting steel pins into the ground and shall be of sturdy construction and protected from displacement or damage.

1.8.3 Locations and Levels of Bench Marks

The Contractor shall plot all permanent and temporary bench marks on a suitably scaled plan drawing including details of their coordinates and reduced levels. A copy of the plan shall be issued to the Engineer-in-charge.

1.8.4 Site Reconnaissance

Prior to commencement, the Contractor shall carry out a full photographic and video reconnaissance of the Site with the Engineer-in-charge. Two colour prints of each negative, with descriptions of locations, shall be handed over to the Engineer-in-charge within two weeks and shall form a record of the Site before commencement of construction.

In addition to the still photographs, a video reconnaissance of the Site shall be made. Two copies of the video shall be made and handed over to the Engineer-in-charge.

1.8.5 Surface or Sea-bed Levels

Before commencing any section of the works, the Contractor shall check the levels shown as existing on the drawings by accurately surveying the whole of the Site. No work shall be commenced until the levels so measured have been checked and agreed by the Engineer-in-charge.

The Contractor shall provide the Engineer-in-charge with all co-ordinates and level data in an ASCII format.

1.8.6 Setting out of the Works

The Contractor shall clearly set out the works on the Site in advance of the permanent works to enable the trial holes and the positions of the existing services to be identified in actual relation to the permanent Works.

1.9 Temporary Facilities

1.9.1 Transport

The Contractor shall arrange for the transport, if necessary, of his staff and workmen to and from the Site of the Works.

1.9.2 Site Offices for the Engineer-in-charge

The Contractor shall provide, equipment, maintain and clean site offices for the exclusive use of the Engineer-in-charge for the whole of the Contract Period.

Where a septic tank has to be provided, the Contractor shall be responsible for arranging for its installation, regular emptying etc.

1.9.3 Assistance to the Engineer-in-charge

The Contractor shall provide for the exclusive use of the Engineer-in-charge all necessary instruments, which shall be new or in proven good condition, appliances, protective clothing, safety boots, and labour required for checking the setting out of the Works, testing, inspection and for any other attendance on the Engineer-in-charge. A schedule of basic equipment requirement is given in Appendix B.

1.9.4 Sanitary Conveniences

Sanitary conveniences for the use of persons employed on the Works shall be provided and maintained by the Contractor to the extent and in such manner and at such places as shall be approved by the Engineer-in-charge and the authority concerned. All persons connected with the Works shall be obliged to use them. The Contractor shall make temporary arrangements for the proper discharge of sewage and drainage from or in connection with the work and shall maintain the same to the satisfaction of the Engineer-in-charge and the authority concerned for as long as they may be required.

1.9.5 Accommodation for Contractor

No temporary sleeping quarters and/or camp accommodation shall be permitted on the Site. The Contractor shall house his workforce at a location and to a standard compliant with the current legislative requirements.

1.9.6 Services

The Contractor shall arrange the supply of fresh water, electricity, telephone, compressed air and other services to his Site establishment and shall provide, maintain for the duration of the Contract and remove on completion all pipes, cables and fittings to carry such services to his operations.

1.9.7 Electricity Distribution on site

All electrical installations forming part of the Temporary Works shall comply and be tested in accordance with Central Electrical Authority/IE Rules/Employer's specific Requirements for Electrical Installations.

1.9.8 Drinking Water

The Contractor shall provide an adequate supply of drinking water, with all necessary drainage, on the Site for the use of his staff and workpeople and shall make all the necessary arrangements with the relevant authorities. The number, capacity and location of the installations shall be to the satisfaction of the Engineer-in-charge.

1.9.9 Lighting

The Contractor shall install and maintain at his own cost a system of lighting to provide a reasonable degree of illumination over the area of the Works. He shall submit details of this scheme for the approval of the Engineer-in-charge before any work commences.

1.10 Traffic Management

1.10.1 Traffic Control

Traffic management is the responsibility of the Contractor. The Contractor shall provide, erect and maintain on the Site and at such positions on the approaches to the Site as may be required by the Engineer-in-charge or by the relevant authority all traffic signs and traffic control signals necessary for the direction and control of traffic. Control of traffic shall include vehicle speed and exclusion of vehicles as appropriate. Approval of the size of all such signs and the lettering and wording thereon shall be obtained before erection. The signs shall be reflectorized or adequately illuminated at night in an approved manner and kept clean and legible at all times. The Contractor shall reposition, cover or remove signs as required during the progress of the Works.

1.10.2 Flow of Traffic

The flow of traffic on the existing roads and access to properties shall be maintained at all times during the Contract. The flow of traffic shall take place at all times over a reasonable surface, which shall be segregated as far as possible from areas where work is in progress. Flagmen and signalling equipment shall be provided as necessary to control the traffic to the satisfaction of the Engineer-in-charge and the appropriate controlling authority. In the planning and execution of any temporary or permanent works which may affect the traffic flow and/or access to properties, the Contractor shall co-operate closely with the Engineer-in-charge and the appropriate controlling authority.

1.10.3 Temporary Diversion of Traffic

The diversion of traffic is the responsibility of the Contractor. The Contractor shall construct temporary diversion ways wherever the Works shall interfere with existing public or private roads or other ways over which there is a public or private right of way for any traffic.

The standard of construction shall be suitable in all respects for the class or classes of traffic using the existing way irrespective of the condition of the existing way. The details of such diversions shall be to the approval of the Engineer-in-charge and the appropriate controlling authority. The Contractor shall obtain the approval of such authority before constructing the diversion.

The Contractor shall prepare plans showing any proposed traffic diversions. The plans shall fully detail the diversion in all respects and shall include construction details if necessary. The plans shall show the position of ramps, traffic signs, cones, barriers, demarcation posts and tape, flashing lights and any other traffic control devices. The plans shall be submitted to the Engineer-in-charge for review and shall be approved by the controlling authority. Traffic diversion apparatus shall not be erected until prior approval have been given by the Engineer-in-charge and approving authority.

Diversion ways shall be constructed in advance of any interference with the existing ways and shall be maintained in a condition satisfactory to the Engineer-in-charge for as long as required.

The provisions of this Clause shall not apply to any temporary access or accommodation works which the Contractor may construct for his sole use in the execution of the Works.

1.11 Existing Services and Structures

1.11.1 Boundaries Cut Through

Fences, walls, etc. crossed by the Works and forming boundaries of plots outside the area occupied by the Works shall not be cut through or destroyed for more than the distance necessary to permit the erection of new fencing etc. and the Contractor shall make the ends of the cut fences reasonably secure. Where fences or walls are damaged or destroyed, the whole shall be restored and reinstated with like materials to the satisfaction of the owners or occupiers and the Engineer-in-charge.

1.11.2 Existing Services

The Contractor shall by his own representations to the relevant controlling authorities determine the extent and location of existing services. All such services information shall be recorded on the General Arrangement drawings and a copy made available to the Engineer-in-charge.

The Contractor shall execute the Works in such a manner that he does not damage or interfere with existing services on or near the Site, except as shown by the Contract drawings. If damage or interference is so caused the Contractor shall make repairs to the approval of the Engineer-in-charge and relevant authority or the authority may carry out the repairs at the cost of the Contractor. Additionally, the Contractor may be charged the Statutory Penalties enforced by the authorities.

Prior to backfilling, if any existing services shall have been exposed during the progress of the Works, the Contractor shall arrange for a representative of the relevant service authority to be present during backfilling operations, if such authority so requires.

When working adjacent to natural gas pipelines, the Contractor shall comply with the requirements of appropriate controlling authority as laid down in "Safe Working in the vicinity of natural gas pipeline", in addition to the requirements of the Maharashtra Electricity and Water Authority, Directorate of Natural Gas Distribution and any other appropriate controlling authority.

1.11.3 Modifications to Existing Manholes and Inspection Chambers etc.

When required, the Contractor shall raise or lower the cover levels of manholes, inspection chambers and the like for existing water, drainage, sewerage, electricity and telephone services. Details of the modifications required will be shown on the relevant drawings. Any damage, including ingress of sand, road construction materials and rubbish, shall be attended to as it occurs and in a manner approved by the Engineer-in-charge and the appropriate controlling authority.

1.11.4 Temporary Over Pumping

Where installation works involve the diversion or over pumping of sewage or drainage flows, detailed methods of working shall be drawn up and submitted to the Engineer-in-charge for approval and to Employer/PMC for agreement. Such method statements shall take note of known constraints.

1.11.5 Drains Streams etc.

Drains, pipes, channels, watercourses or streams affected by the Contractor's operations shall be reinstated to their original condition.

1.12 Records

1.12.1 Field Records

During the progress of the work, the Contractor shall maintain an up-to-date copy of all drawings, specifications, supplementary data and latest revisions.

The Contractor shall maintain a continuous record of all field deviations from the drawings, if any, as approved by the Engineer-in-charge and, within one month of the issue of the Certificate of Completion for the Works or parts of the Works, he shall submit to the Engineer-in-charge a set of the latest revisions of all drawings and specifications marked to show the Works or relevant sections of the Works as constructed.

1.12.2 'As Built' Drawings

On completion of the Works, the Contractor shall bring all the construction drawings up to 'As Built' status incorporating all modifications, additions, alterations etc., which may have been made during the construction. The 'As Built' drawings shall be to the same standard and format as the construction drawings, including the provision of 3-Dimensional co-ordinates and the representation of services as 3-Dimensional entities.

The Contractor's 'As Built' drawings shall be submitted as follows;

- 1 set of A1 size negatives on polyester film (gauge 110/115 gms);
- Bound sets of A2 size drawings. These must be stamped and signed by the Contractor's Representative;
- 1 digital disk in Autodesk Civil 3D format;
- 1 digital disk in Autodesk AutoCAD format;
- 1 digital disk in Microstation format.

The 'As Built' drawings shall:

- Display the Contractor's name and logo;
- Be bound using a suitable spiral binder;
- Have a front cover of approved quality and colour;
- Have a plastic transparent sheet above the cover;
- Have a backing sheet of required thickness;

- Be clearly legible.

2. MATERIALS AND EQUIPMENT

2.1 Quality of Materials

The term “materials” shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and equipment and plant of every kind to be supplied by the Contractor for incorporation in the Works.

Materials and equipment used in the Works shall be of the best quality of their respective kinds and shall comply with the current issue of the appropriate standard published by the Bureau of Indian Standards or other approved standard.

A copy of the relevant parts of the standards of the recognised national standards body shall be provided by the Contractor in English where required by the Contract, and be to the satisfaction of the Engineer-in-charge.

All materials shall be specifically designed for use in all climates. The Contractor shall provide full details of all materials proposed, including evidence that they have proved successful in use in conditions equal to those prevailing in India.

2.2 Alternative Materials

The Contractor may offer alternative materials (except Pipeline material which is Ductile iron DI K9 class) or equipment to those specified provided they are of at least equal quality. If alternatives are proposed, the Contractor shall submit for the Engineer-in-charge's approval details including technical descriptions, drawings and specifications to demonstrate that the alternatives are equal to the original.

2.3 Manufacturer's Instructions

Materials and equipment shall be used or installed in accordance with the instructions of the manufacturer unless otherwise required.

Materials and components shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination failing which such damaged materials will be rejected and shall not be used on any part of the Works under this contract

2.4 Supply of Materials

As soon as possible after the Contract has been awarded, the Contractor shall submit a list of suppliers from whom he proposes to purchase the materials and equipment required for the Works. This shall be at least 28 days prior to use. Samples shall also be submitted at the request of the Engineer-in-charge.

Samples shall be taken and tested in accordance with the relevant Indian Standards where applicable. Materials and equipment subsequently supplied shall not be changed without prior written approval.

2.5 Stock of Materials

The contractor shall inspect the Site and prepare a memorandum containing an inventory of the Site including the vacant and unencumbered land, buildings, structures, road works, trees and any other immovable property on or attached to the Site.

Contractor shall maintain a proper system of records to identify all inventories related to the, required materials, facilities and preparing and providing to the Employer a complete accounting of such inventory for every fiscal quarter and shall be accessible all the times by Engineer-in-charge for routine inspection.

2.6 Copies of Orders

The Contractor shall, if required, submit to the Engineer-in-charge copies of orders for materials and equipment to be incorporated in the Works.

2.7 Environmental Conditions

In supplying the materials for use in this Contract, the Contractor must consider the conditions to which these materials will be subjected at the various stages in the treatment process.

2.8 Shipping Documents

The Contractor shall submit complete shipping documents as soon as possible after shipping, in order to reach the Engineer-in-charge before the arrival of the shipment. Responsibility for delays, loss or damage to shipping documents shall rest with the Contractor.

The shipping documents shall be distributed as follows:

Documents	Employer	Engineer-in-charge's Site Office
Shipping Invoice for the Consignments		
Original	1	-
Copy	1	1
Packing List	1	1
Bill of Lading		
Original	1	-
Copy	1	1
Certification of Origin		
Original	1	-

Copy	1	1
Manufacturer's Certificate		
Original	1	-
Copy	1	1
Confirmation of Declaration of Insurance	1	1
Certificate of Inspection Authority	1	1

Should the Work or any part thereof, the manufacture and/or supply of any material, equipment or plant component as well as any equipment or tool required for the Work be delayed with respect to the relevant time schedules, the Contractor shall transport the part or component delayed by air at no extra cost to the Employer.

All imported freight consignments to be incorporated into the Works shall be imported directly.

2.9 Receiving Cum Damage Reports

The Contractor shall submit receiving reports to the Engineer-in-charge to cover each individual shipment received and checked at the job site. Each shipment on arrival at job site shall be unloaded, opened and carefully checked for any damage in transit and the Contractor shall immediately submit a damage report, countersigned by the Engineer-in-charge to the Insurance Company with copies to the Employer and to the Engineer. Where damage has occurred in Marine Transportation, a copy of the damage report shall also be sent to the registered/appointed surveyor.

In all cases of irreparable damages, the Contractor shall immediately notify the relevant manufacturer(s). He shall also immediately notify the Engineer-in-charge of the actions he will be initiating and undertaking in order to repair or replace the damaged part(s) and of the consequences this damage will have on the completion date of the Works. Any repairs proposed by the Contractor will be subject to the approval of the Engineer-in-charge.

2.10 Title to the Equipment

Title to the Equipment shall pass to the Employer upon delivery ex-factory, but the Contractor shall maintain total and exclusive care, custody and control including all risk or loss until issue of the last Initial Taking Over Certificate.

2.11 Local Agent

All materials and equipment shall be supplied by manufacturers or their agents who are to be approved by the Engineer-in-charge.

2.12 Spare Parts

Wherever possible there should be a local dealer or Agent within the India for imported equipment.

2.13 Unloading and Storage of Materials

The Contractor shall unload all imported equipment and material at the Site from trucks and trailers and delivery vehicles as the case may be. Items of permanent installation shall be properly and neatly stored in areas designated by the Engineer-in-charge and shall be protected to prevent damage or deterioration of any type. Storage methods shall be such as to cause minimum inconvenience to others and shall be arranged to facilitate inspection and withdrawing from stores. All equipment and material storage shall be subject to the approval of the Engineer-in-charge.

2.14 Ownership of Packing Materials

All packing boxes (excluding shipping containers belonging to shipping lines or other agencies but used by Contractors in bringing material to Site), planking, covering etc., shall become the property of the Employer as soon as the equipment and material which is contained therein arrives at Site. The Employer on application from the Contractor, may permit the Contractor to use some of the boxes, containers etc. for equipment and material storage purposes until the items are installed or erected by the Contractor.

2.15 Storage and handling of Materials

Materials and components shall be stored in such a manner as to preserve their quality and condition to the standards required by the Contract.

Unless otherwise described in the Contract, the installation, application or fixing of materials and components shall be in accordance with the recommendations of the manufacturer. Where appropriate, the Contractor shall make use of any technical advisory services offered by manufacturers.

2.16 Water

- a) Water shall be obtained from a public utility undertaking supply, and be of a potable quality.
- b) Water used in construction for all civil & structural works shall be clean and free from injurious amount of oil, acids, alkalis, organic matters or other harmful substances which may be deleterious to concrete, masonry or steel. The pH value of water sample shall be not less than 6. Potable water shall be considered satisfactory. Underground water can also be used with the prior approval of Engineer-in-Charge, if it meets all the requirements of IS:456.
- c) Tests on water samples shall be carried out in accordance with IS:3025 and they shall fulfil all the guidelines and requirements given in IS:456.

- d) The Engineer-in-Charge may require the Contractor to prove, that the concrete prepared with water, proposed to be used, shall have average 28 days compressive strength not lower than 90% of the strength of concrete prepared with distilled water.
- e) The Engineer-in-Charge may require the Contractor to get the water tested from an approved laboratory before starting the construction work and in case the water contains any oil/organic matter or an excess of acid, alkalis or any injurious amount of salts etc., beyond the permissible maximum limits given in IS:456, the Engineer-in-Charge may refuse to permit its use. In case the water is supplied by the owner, contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. In case there is any change in source of water, water samples shall be tested again to meet the specified requirements.
- f) Water shall be stored in tin barrels, steel tanks or water-tight reservoirs made with bricks / stone or reinforced concrete. Brick/stone masonry reservoirs shall have RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand and finished with neat cement punning. These reservoirs shall be of sufficient capacity to meet the water requirement, at any stage of construction.
- g) Water for curing shall be of the same quality as used for concreting and masonry works. Sea water shall not be used for preparation of cement mortar, concrete as well as for curing of plain/reinforced concrete and masonry works. Sea water shall not be used for hydro testing and checking the leakage of liquid retaining structures also.

3. EARTHWORKS

3.1 Definitions

- **Deadmen or Tell Tales:** Mounds of earth left undisturbed in pits dug out for borrowing earth
- **Burjis:** Short pillars of brick/ stone having top surface finished with cement plaster for marking etc.
- **Formation or Profile:** Final shape of the ground after excavation or filling up.
- **Foul condition:** Filthy and unhygienic conditions where physical movements are hampered such as soil mixed with sewage or night soil.
- **Lead:** All distances shall be measured over the shortest practical route and not necessarily the route actually taken. Route other than shortest practical route may be considered in cases of unavoidable circumstances and approved by Engineer-in-charge along with reasons in writing.
- Carriage by manual labour shall be reckoned in units of 50 metres or part thereof.
- Carriage by animal and mechanical transport shall be reckoned in one km. unit. Distances of 0.5 km. or more shall be taken as 1 km. and distance of less than 0.5 km. shall be ignored. However, when the total lead is less than 0.5 km., it will not be ignored but paid for separately in successive stages of 50 metres subject to the condition that

the rate worked on this basis does not exceed the rate for initial lead of 1 km. by mechanical/animal transport.

- **Lift:** The vertical distance for removal with reference to the ground level. The excavation up to 1.5 metres depth below the ground level and depositing the excavated materials upto 1.5 metres above the ground level are included in the rate of earth work. Lifts inherent in the lead due to ground slope shall not be paid for.
- **Safety rules:** Safety rules as laid down by the statutory authority and as provided in National Building Code (NBC) shall be followed.

3.2 Classification of Soils

The earthwork shall be classified under the following categories and measured separately for each category:

- a) **All kind of soils:** Generally, any strata, such as sand, gravel, loam, clay, mud, black cotton moorum, shingle, river or nallah bed boulders, siding of roads, paths etc. and hard core, macadam surface of any description (water bound, grouted tarmac etc.), lime concrete mud concrete and their mixtures which for excavation yields to application of picks, shovels, jumper, sacrifiers, ripper and other manual digging implements.
- a) **Ordinary rock:** Generally, any rock which can be excavated by splitting with crow bars or picks and does not require blasting, wedging or similar means for excavation such as lime stone, sand stone, hard laterite, hard conglomerate and un-reinforced cement concrete below ground level.
- b) If required light blasting may be resorted to for loosening the materials but this will not in any way entitle the material to be classified as 'Hard rock'.
- c) **Hard rock:** Generally, any rock or boulder for the excavation of which blasting is required such as quartzite, granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.
- d) **Hard rock (blasting prohibited):** Hard rock requiring blasting as described under (c) but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging, use of rock hammers and cutters or any other agreed method.

3.3 Antiquities and Useful Materials

Any finds of archaeological interest such as relics of antiquity, coins, fossils or other articles of value shall be delivered to the Engineer-in-Charge and shall be the property of the Government.

Any material obtained from the excavation which in the opinion of the Engineer-in-Charge is useful shall be stacked separately in regular stacks as directed by the Engineer-in-Charge and shall be the property of the Government.

3.4 Protections

Excavation where directed by the Engineer-in-Charge shall be securely barricaded and provided with proper caution signs, conspicuously displayed during the day and properly illuminated with red lights and/or written using fluorescent reflective paint as directed by engineer in charge during the night to avoid accident.

The Contractor shall take adequate protective measures to see that the excavation operations do not damage the adjoining structures or dislocate the services. Water supply pipes, sluice valve chambers, sewerage pipes, manholes, drainage pipes and chambers, communication cables, power supply cables etc. met within the course of excavation shall be properly supported and adequately protected, so that these services remain functional. However, if any service is damaged during excavation shall be restored in reasonable time.

Excavation shall not be carried out below the foundation level of the adjacent buildings until underpinning, shoring etc. is done as per the directions of the Engineer-in-Charge.

Any damages done by the contractor to any existing work shall be made good by him at his own cost. Existing drains pipes, culverts, overhead wires, water supply lines and similar services encountered during the course of execution shall be protected against damage by the contractor. The contractor shall not store material or otherwise occupy any part of the site in manner likely to hinder the operations of such services.

3.5 Site Clearance

Before the earth work is started, the area coming under cutting and filling shall be cleared of shrubs, rank vegetation, grass, brushwood, trees and saplings of girth up to 30cm measured at a height of one metre above ground level and rubbish removed up to a distance of 50 metres outside the periphery of the area under clearance. The roots of trees and saplings shall be removed to a depth of 60cm below ground level or 30 cm below formation level or 15 cm below sub grade level, whichever is lower, and the holes or hollows filled up with the earth, rammed and levelled.

The trees of girth above 30 cm measured at a height of one metre above ground shall be cut only after permission of the Engineer-in-Charge is obtained in writing. The roots of trees shall also be removed.

Existing structures and services such as old buildings, culverts, fencing, water supply pipe lines, sewers, power cables, communication cables, drainage pipes etc. within or adjacent to the area if required to be diverted/removed, shall be diverted/dismantled as per directions of the Engineer-in-Charge.

In case of archaeological monuments within or adjacent to the area, the contractor shall provide necessary fencing around such monuments as per the directions of the Engineer-in-Charge and protect the same properly during execution of works.

Disposal of Earth shall be disposed of at the specified location or as decided by the Engineer-in-Charge. The contractor has to take written permission about place of disposal of earth before the earth is disposed of, from Engineer-in-Charge.

3.6 Excavation General

The Contractor shall, before commencing any earthworks, survey and level the whole of the Site, and prepare plans and sections accordingly. The plans and sections shall, when finally, and mutually agreed, be signed by the Engineer and Contractor as representing the levels at the commencement of the earthworks.

The Contractor shall inform himself about the nature of the strata, materials, and the likely volume of water, in excavations, open cuttings, and trenches.

The Contractor shall remove the whole of the turf, topsoil, concrete, flagging, paving, kerbing, road-metalling and other materials from the site of any excavation and shall keep separately and preserve the same for re-use afterwards. The ground shall be excavated for the permanent and temporary works to the required depths, widths and levels so that the dimensions of the permanent work shall not be less than is shown on the drawings, or as may be directed. All rubbish, and matter of an offensive nature taken out of any excavation shall be disposed of at once and not left on the surface.

No authorisation, approval or direction of the Engineer with regard to excavation, or any matter or thing connected therewith, shall in any way relieve the Contractor of his responsibility and liability therefore, and for the effects thereof, as provided in the Contract and in this Specification. The Contractor shall carry out all excavations required for the Permanent Works in whatever materials may be met with. All excavations shall be carried out to suitable lengths, widths, depths and profiles required for the safe construction of the Works shown on the drawings, or to such other dimensions as may be ordered by the Engineer in writing.

When instructed by the Engineer, the Contractor shall produce the calculations for the structural stability of any temporary works, but approval shall not relieve the Contractor of his responsibility for adequately supporting any excavation.

Excavation shall be carried out so as to avoid disturbance to the surrounding ground, particularly when working close to existing installations, and where necessary or instructed by the Engineer the Contractor shall maintain vertical sides to the excavations and provide all necessary side supports to achieve this.

Soft or unsound areas uncovered during excavation shall be notified immediately to the Engineer.

Excavations shall be kept dry by the use of approved dewatering equipment, pumps, sumps and sub-drains as necessary.

3.7 Setting Out and Making Profiles

A masonry pillar to serve as a bench mark will be erected at a suitable point in the area, which is visible from the largest area. This bench mark shall be constructed and connected with the standard bench mark as approved by the Engineer-in-Charge. Necessary profiles with strings stretched on pegs, bamboos or 'Burjis' shall be made to indicate the correct formation levels before the work is started. The contractor shall supply labour and material for constructing bench mark, setting out and making profiles and connecting bench mark

with the standard bench mark at his own cost. The pegs, bamboos or 'Burjis' and the bench mark shall be maintained by the contractor at his own cost during the excavation to check the profiles.

The ground levels shall be taken at 5 to 15 metres intervals (as directed by the Engineer-in-Charge) in uniformly sloping ground and at closer intervals where local mounds, pits or undulations are met with. The ground levels shall be recorded in field books and plotted on plans. The plans shall be drawn to a scale of 5 metres to one cm or any other suitable scale decided by the Engineer-in-Charge. North direction line and position of bench mark shall invariable be shown on the plans. These plans shall be signed by the contractor and the Engineer-in-Charge or their authorized representatives before the earth work is started. The labour required for taking levels shall be supplied by the contractor at his own cost.

3.8 Excavation in All Kinds of Soils

All excavation operations manually or by mechanical means shall include excavation and 'getting out' the excavated materials. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the items of excavation stating lead.

During the excavation the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or undercutting shall not be done.

In firm soils, the sides of the trenches shall be kept vertical upto a depth of 2 metres from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal: 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be suitably increased or sides sloped or the soil shored up as directed by the Engineer-in-Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-in-Charge regarding the stepping, sloping or shoring to be done for excavation deeper than 2 metres.

The excavation shall be done true to levels, slope, shape and pattern indicated by the Engineer-in-Charge.

In case of excavation for foundation in trenches or over areas, the bed of excavation shall be to the correct level or slope and consolidated by watering and ramming. If the excavation for foundation is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for levelling/ bed concrete for foundations. Soft/defective spots at the bed of the foundations shall be dug out and filled with concrete (to be paid separately) as directed by the Engineer-in-Charge.

While carrying out the excavation for drain work care shall be taken to cut the side and bottom to the required shape, slope and gradient. The surface shall then be properly dressed. If the excavation is done to a depth greater than that shown on the drawing or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor

at his own cost with stiff clay puddle at places where the drains are required to be pitched and with ordinary earth, properly watered and rammed, where the drains are not required to be pitched. In case the drain is required to be pitched, the back filling with clay puddle, if required, shall be done simultaneously as the pitching work proceeds. The brick pitched storm water drains should be avoided as far as possible in filled-up areas and loose soils.

In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling in with earth duly watered, consolidated and rammed.

In case the excavation is done wider than that shown on the drawings or as required by the Engineer-in-Charge, additional filling wherever required on the account shall be done by the contractor at his own cost.

The excavation shall be done manually or by mechanical means as directed by Engineer-in-charge considering feasibility, urgency of work, availability of labour /mechanical equipment and other factors involved. Contractor shall ensure every safety measures for the workers. Neither any deduction will be made nor any extra payment will be made on this account.

3.9 Excavation in Ordinary/Hard Rock

All excavation operations shall include excavation and 'getting out' the excavated matter. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the item of excavation stating lead.

During the excavation, the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or under cutting shall not be done.

Where hard rock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in-Charge in writing for resorting to the blasting operations. Blasting operations shall be done as specified in clause 0 and chiselling shall be done to obtain correct levels, slopes, shape and pattern of excavation as per the drawings or as required by the Engineer-in-Charge and nothing extra shall be payable for chiselling.

Where blasting operations are prohibited or are not practicable, excavation in hard rock shall be done by chiselling.

In ordinary rock excavation shall be carried out by crowbars, pick axes or pneumatic drills and blasting operation shall not be generally adopted. Where blasting operations are not prohibited and it is practicable to resort to blasting for excavation in ordinary rock, contractor may do so with the permission of the Engineer-in-Charge in writing but nothing extra shall be paid for this blasting.

If the excavation for foundations or drains is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge. The excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for levelling/ bed concrete

for foundations. Soft/ defective spots at the bed of foundations shall be dug out and filled with concrete as directed by the Engineer-in-Charge and nothing extra shall be payable.

3.10 Existing Roads and Services

The Contractor shall take all precautions which, in the opinion of the Engineer-in-charge, are necessary to protect from damage, and ensure the uninterrupted operation of, all existing roads and services which are on the line of or adjacent to the work, and shall maintain these until, in the opinion of the Engineer-in-charge, the general progress of the work renders further protection unnecessary. All damage occasioned by the Contractor to these roads and services shall be repaired without delay at the Contractor's cost, to the specification and instruction of the controlling authority and to the satisfaction of the Engineer-in-charge.

3.11 Borrow Pits

The Contractor shall obtain permission of the persons or authorities concerned for the siting of approved borrow pits. The Contractor shall leave borrow pits in a tidy state and ensure that they are self-draining and do not constitute a danger to health.

3.12 Excavation

3.12.1 Excavation for Structures

The bottom of all excavations for the foundations of structures shall be carefully levelled and compacted and, if necessary, stepped or benched horizontally. Any pockets of soft or unsuitable material or loose rock in the bottom of excavations shall be removed and refilled with concrete or other suitable material, as directed.

If, due to excessive exposure after excavation, or for any other reason, the surfaces of excavations deteriorate, the unsuitable material shall be removed or recompacted as directed by the Engineer at the Contractor's expense.

No excavation shall be filled or covered with concrete until it has been inspected and approval given by the Engineer to proceed. Immediately after approval, foundations shall be blinded with concrete as detailed.

3.12.2 Breaking Out of Existing Road Pavement

If pavement layers have to be broken out from existing roads, underlying layers of material shall not be disturbed. Damage shall be made good by the Contractor.

3.12.3 Blasting

All blasting shall be carried out by an approved specialist. Prior to the commencement of blasting on site, the Contractor shall submit for approval the proposed blasting patterns, charges and safety procedures.

3.12.4 Excavations beyond True Line and Level

If excavations other than for concrete work are carried out beyond true line and level the Contractor shall fill to the required line and level with approved material using approved methods.

If excavations for concrete works are carried out beyond true line and level the Contractor shall fill to the required line and level with concrete similar in grade to that intended to be used in the concrete works.

3.12.5 Spoil Disposal

Excavated material from the Works which is approved for re-use shall be placed directly in its final position or stockpiled on Site. Surplus materials shall be removed.

The Contractor shall ensure that the angle at which any fill is stockpiled is less than the natural angle of repose of the fill and shall take such measures as are necessary to prevent slip or collapse of stockpiles. Fences or walls shall be provided around the perimeters of stockpiles to prevent danger to the public.

The Contractor shall trim and regulate stockpiles and tips to profiles and levels as directed and maintain the flow of water-courses affected by them, and shall observe the requirements of the owner or relevant authority.

3.12.6 Removal of Water

At locations where the excavation extends below the groundwater table, a dewatering system is to be provided which will lower ambient groundwater levels. The resulting groundwater level shall be at a depth which is sufficiently below the excavation level so as to allow the safe and proper execution of the work. The resulting foundation level shall be a stable, dry sub-grade which is suitable for the execution of subsequent operations.

The Contractor is to design the dewatering methods and settling basins so that no critical amounts of soil, sand or silt are removed during either the dewatering operations.

Complete working drawings showing the type of dewatering and groundwater control system proposed shall be submitted to the Engineer-in-Charge for his review. The Contractor's submittal shall include drawings that show the arrangement, location and depths of the proposed dewatering system. A complete description of the equipment and materials to be used and the procedures to be followed to be given, together with details of required standby equipment and standby power supply. The Contractor shall also indicate his proposed location(s) for the discharge of extracted groundwater.

The dewatering system design should also include the details of measures required to prevent damage due to settlement of roads, pavements, utilities, sewers, buildings and other structures outside the excavation but within the area affected by the dewatering.

3.12.7 Removal of Unsuitable Material

3.12.8 The Engineer may order the excavation and removal of any material deemed unsuitable for supporting the fill, pipelines or structures to be placed thereon, and its replacement by suitable approved material. Unsuitable material shall be removed from site as soon as practicable after excavation. Storage of unsuitable material will not be permitted.

3.12.9 Formation Tolerance

The finished surface at formation level resulting from excavation or breaking out of road pavement shall be trimmed and compacted to the levels shown on the Drawings within a tolerance of $\pm 25\text{mm}$.

3.12.10 Testing at Formation Level

Tests shall be carried out at formation level to establish that the top 150mm of subgrade has achieved a relative compaction of at least 95% of the laboratory maximum dry density, determined in accordance with IS: 2720 (Part 8) . Where the formation is at or below original ground level, laboratory CBR tests (IS: 2720 (Part 16)) shall be carried out, as directed, and the minimum acceptable CBR value shall be 15%. Testing shall be at the rate of one density test for each 500m² and one CBR test for each 2500m². CBR tests shall not be required to the formation level for structures. CBR tests shall be undertaken to the formation for road works only.

If this compaction cannot be achieved or if the material below formation level is unsuitable, then the material shall be removed to the extent directed and disposed of by the Contractor. The resulting void shall be backfilled with suitable material compacted in layers not exceeding 150mm thick to achieve the above requirement, or other higher CBR value required by succeeding construction layers. CBR tests shall not be required to the formation level for structures. CBR tests shall be undertaken to the formation for road works only.

Special methods of compaction shall be used over areas which are inaccessible to rollers or other heavy plant. The Contractor shall avoid damage to pipes, cables, structures and the like, when compacting fill around and over them.

3.12.11 Inspection of Excavations

The Contractor shall obtain approval of excavations prior to placing pavement layers, fill, pipes or pipe bedding material, concrete or any other covering. The Contractor shall maintain open excavations in an approved condition, and shall rectify the effects of deterioration due to weather.

3.12.12 Preparation of Surfaces to Receive Concrete

A blinding layer of concrete or the first pour of concrete, according to the detail on the Drawings, shall be placed immediately after the required level has been achieved and the excavated surface approved.

3.13 Filling

3.13.1 Test Standards

Unless stated otherwise, testing of fill materials and workmanship shall be carried out in accordance with BS812 and IS: 2720 (Part 8) . Laboratory Maximum Dry Density tests shall be in accordance with IS: 2720 (Part 8) ; Liquid Limit shall be determined in accordance with

Test 2A or 2B of BS 1377. In situ CBR testing shall be carried out in accordance with ASTM D4429. CBR tests shall be undertaken to fill for road works only.

3.13.2 Backfill – General

Except around structures, excavations shall be backfilled with approved material compacted in layers of 200mm maximum thickness to achieve a density of at least 95% of the laboratory maximum dry density. On site dry density testing shall be in accordance with Test 15 of BS 1377/relevant IS Code.

3.13.3 Backfilling to Structures

The Contractor shall not backfill around structures until the structural elements have attained adequate strength and the approval of the Engineer to proceed has been obtained. Unless otherwise directed, the backfill material shall be selected excavated material, thoroughly compacted in layers not exceeding 200mm thick to achieve a density of at least 95% of the laboratory maximum dry density.

The Contractor shall restrict compaction plant used on fill to structures, within 1m of a structure, to the following items:

1. Vibratory roller having a mass per metre width of roll, not exceeding 1,300kg with a total mass not exceeding 1,000kg;
2. Vibrating plate compactor having a mass not exceeding 1,000kg;
3. Vibro-tamper having a mass not exceeding 75kg.

The masses of plant listed above shall be determined in accordance with Series 600 of the UK department of Transport Specification for Highway Works.

The compacted level of the fill within this zone shall not differ during construction from the compacted level of the remainder of the adjoining fill to structures by more than 250mm.

3.13.4 General Filling

Filling to areas which have no specific load-bearing or structural role shall be as follows. Embankments and other areas of fill shall be formed of suitable materials capable of normal compaction to form a stable fill, deposited and compacted as soon as practicable after excavation in layers of thickness appropriate to the compaction plant used.

The filling shall, where practicable, be built up and compacted evenly, and shall be maintained at all times with a sufficient camber and cross fall and a surface sufficiently even to enable surface water to drain readily from it.

3.13.5 Compaction of Subgrade

Prior to placing fill, the top 150mm of subgrade under structures and road pavement layers shall be compacted to a density of not less than 95% of the laboratory maximum dry density.

3.13.6 Fill Material

Fill material shall be approved evenly-graded granular material obtained from excavations or borrow pits. The material shall be free from organic matter, and shall have the following properties:

Particle size : 100mm maximum

Percentage retained on 75mm sieve : 10% maximum

Percentage passing 75 microns sieve : 20% maximum

Liquid Limit : 35% maximum

Plasticity Index : 6% maximum

CBR values after 96 hours soaking:

- a) at 90% of laboratory MDD : 10% minimum
- b) at 95% of laboratory MDD : 15% minimum

Chloride content : 3.3% maximum
(BS EN 1744-1) (top 150mm only)

Sulphate content : 2.0% maximum
(BS EN 1744-1) (top 150mm only)

CBR tests shall be undertaken to the fill material for road works only.

Fill for use behind earth-retaining structures shall additionally be tested by means of shear box tests (AASHO T234 or T236, as appropriate) to prove that it will achieve, in its placed condition, a minimum internal angle of friction of 33 degrees when compacted to 95% of the laboratory maximum dry density.

The Contractor shall carry out the following initial tests on material proposed for use as fill:

- Grading;
- Dry density/moisture content relationship;
- Shear tests;
- Plasticity Index;
- Tests for chloride and sulphate contents.

CBR tests at optimum moisture content and after 96 hours soaking, at both 90% and 95% of laboratory MDD CBR tests shall be undertaken to the fill material for roadworks only.

Thereafter, one set of tests shall be carried out for each 200m³ of fill delivered to Site, or daily, whichever is the less frequent.

3.13.7 Placing of Fill

Granular material shall be placed and compacted in layers not exceeding 200mm thick to achieve a density of 95% of the laboratory maximum dry density.

Special methods of compaction shall be used over areas which are inaccessible to rollers or other heavy plant. The Contractor shall avoid damage to pipes, cables, structures and the like, when compacting fill around and over them.

3.13.8 Formation Tolerance for Fill

The finished surface at formation level resulting from filling operations shall be within 25mm of the levels shown on the Drawings.

3.13.9 Testing of Fill - General

Tests shall be carried out on fill to determine the degree of compaction achieved, at the rate of one test for each 500m² of each layer. Compacted layers shall not be covered without approval.

The density of individual compacted layers shall be determined by an appropriate method detailed in Test 15 of BS 1377/ IS 2720 (Part 16), or AASHTO T 191 together with ASTM D1556, as directed.

3.13.10 Testing of Top Layer of Fill

Tests shall be carried out on the top layer of fill as follows:

1. Laboratory tests to monitor the consistency of the approved material during construction:

Test	Frequency of Test (not less than one test per.....)
Maximum dry density	1500m ²
Optimum moisture Content	
Grading	
Plasticity Index	
Linear Shrinkage	
CBR	
Sulphate content	3500m ²
Chloride content	

2. In-situ tests to confirm that the required degree of compaction is being achieved during construction:

Test	Frequency of Test(not less than one test per.....)
------	--

Dry Density	500m ²
CBR	2500m ²

In situ CBR shall be applicable to road works only.

3.14 Controlled Low Strength Fill

Areas of over-excavation on which structures are to be founded shall be filled with controlled low flow able strength fill. The purpose of this material is to ensure that movement in the structure is not induced by settlement of the fill.

Such fill shall be Dara Fill (as manufactured by GRACE Construction Products/Emirates Chemicals LLC), or similar approved stabilised fill mix. A typical mix design is:

100 kg/m³ OPC; 1400kg/m³ sand; 135 kg/m³ water; 90 ml Dara Fill admixture.

The fill shall: be cement bound; have air content of nom 20 – 35%; achieve nom crushing strength of 7.5N/mm²; be flow able; be impermeable once set to limit the potential for migration of fines into the fill; have a wet density of nom 1600 – 2000 kg/m³.

4. MATERIAL

4.1 Cement

4.1.1 Cement General

The cement to be used throughout the Works shall be obtained from manufacturers approved in writing. Specific requirement for the type of cement to be used shall be as shown in the drawings or as specified in the contract or as directed by the Engineer-in-Charge and shall be meeting specifications as under:

Specification for 33 grade ordinary portland cement	IS:269
Specification for portland slag cement	IS:455
Specification for Portland pozzolana cement (fly ash based)	IS: 1489 Pt. 1
Specification for Portland pozzolana cement (calcined clay based)	IS: 1489 Pt.2
Specification for Masonry Cement	IS:3466
Specification for high alumina cement for structural use	IS:6452
Specification for rapid hardening portland cement	IS:8041
Specification for 43 grade ordinary portland cement	IS:8112
Specification for 53 grade ordinary portland cement	IS: 12269
Specification for Sulphate Resisting Portland cement	IS: 12330

The temperature of the cement shall not exceed 65°C at the time of incorporation into a concrete mix.

4.1.2 Storage at Site

- a) The storage of cement (lifted from the Owner's godown or procured by the Contractor himself) at the site of work shall be at contractor's expense and risk and shall meet the requirements of IS:4082. The cement shall be stored above ground in a suitable weather tight building or godown and in such a manner as to permit easy access for proper inspection and also to prevent deterioration due to moisture. In the event of any damage occurring to the quality of cement due to faulty storage or on account of negligence on the part of the contractor, such damages shall be borne by the contractor himself.
- b) All approved cement shall be arranged in batches with type, brand and date of receipt flagged on them. A maximum of eight bags shall be stacked one over the other. Cement bags shall be used in the same order as received from the manufactured owner. The contractor shall maintain a register, on day to day basis, giving the details of the receipt/consumption, source of supply and type of cement etc. The register shall always be accessible to the Engineer-in-Charge for verification.

4.1.3 Cement Testing

Cement shall be certified by the manufacturer as complying with the requirements of the appropriate specification. Before ordering cement, the Contractor shall submit details of the proposed supplier and information on the proposed methods of transport, storage and certification for approval and show that the quantity and quality required can be attained and maintained throughout the construction period. Representative samples of the proposed cement are to be taken and forwarded to an independent laboratory approved by the Engineer-in-charge for analysis before the source is approved.

Having obtained approval, the Contractor shall not change the agreed arrangements without permission. Each consignment of cement shall be accompanied by a certificate showing the place of manufacture and the results of standard tests carried out on each day's bulk production included in the consignment. Additionally, tests shall be carried out on each consignment of cement on arrival, and also at monthly intervals during storage. The Contractor shall store the cement so that separate consignments can be identified until the results of the testing are available. Tests should be carried out for the properties listed in the following table with test methods and limits to the relevant parts of relevant Indian standard codes as appropriate:

Properties to be tested

- Strength;
- Fineness;
- Setting Time;
- Soundness;

- Reactive Alkali Level as Na₂O Equivalent;
- Chloride Content;
- Loss on Ignition;
- Insoluble Residue;
- Tricalcium Aluminate Content;
- SiO₂, MgO, Al₂O₃, Fe₂O₃, CaO contents;
- SO₃

4.1.4 Silica Fume

Silica fume shall not contain more than 0.2% silica metal by mass or any deleterious materials, such as carbon, quartz, rust and cellulose fibres. The materials must originate from silicon plants producing silicon or ferrosilicon with silicon contents higher than 85%. The suitability of the silica fume shall be ascertained by testing to confirm that its properties are within the following limits.

Parameter	Requirement
Silica Fume Powder	
SiO ₂	Min 85%
Loss on Ignition	Max 5%
Fineness	Min 15000m ² /kg
Activity index	>95% after 28 days
Carbon content	Max 2%
Alkali level as Na ₂ O equivalent	Max 2%
Relative density	2.2
Silica Fume Slurry	
pH	5.5±1
Water content	50% ±2%
Relative density	1.3-1.4

4.1.5 Rejection

The Engineer-in-Charge may reject at his discretion any cement, notwithstanding the manufacturer's certificate or failing to meet the requirements of relevant Indian standard codes for testing of cement. He may similarly reject any cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or any other cause. Any cement which is considered defective, shall not be used and shall be promptly removed from the site by the contractor.

4.2 Aggregate

- a) Coarse and fine aggregates for Civil and Structural Works shall conform in all respects to IS:383 (Specification for coarse and fine aggregates from natural sources for concrete). Aggregates shall be obtained from an approved source known to produce the same satisfactorily. Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or a combination thereof. These shall be chemically inert, hard, strong, dense durable, clean and free from veins, adherent coatings, injurious amount of alkalis, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells etc.
- b) Source and type of aggregates shall be got approved by the Engineer-in-Charge prior to procurement. Change in source and type of aggregates, at later stage, shall not be generally permitted; but under specific circumstances, Engineer-in-Charge can allow a change in source and type of aggregate. Contractor shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit fresh mix design for approval of the Engineer-in-Charge. Any such change, if permitted by the Engineer-in-Charge, shall be without any time and cost implication to the owner.
- c) Aggregates which may chemically react with alkalis of cement or might cause corrosion of the reinforcement, shall not be used. If so desired by the Engineer-in-Charge, the Contractor shall carry out alkali reactivity tests and submit the results to him for approval.
- d) The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS:2386 - Part -II (Methods of Test for aggregates for concrete), shall not exceed the limits defined in IS:383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, the contractor shall submit necessary test results as per IS:383 and IS:2386 to the Engineer-in-Charge prior to his acceptance and approval. The method of Sampling shall be in accordance with the requirements given in IS:2430.
- e) Coarse and fine aggregates shall be batched separately. All-in-aggregate shall be used only where specifically permitted by the Engineer-in-Charge.
- f) Separate sieve analysis and grading curves shall be prepared by the Contractor for Any/all batches of coarse and fine aggregates, and submitted to the Engineer-in-Charge, whenever asked for, to ensure conformity with those submitted along with the mix design.
- g) Whenever required by Engineer-in-Charge, the aggregates (coarse/fine) shall be washed and/or sieved by the contractor before use in the works to obtain clean and graded aggregate at no extra cost to the owner.
- h) Aggregates not in conformity with the specifications shall be rejected and the Contractor shall immediately remove them from the site of work.

4.2.1 Coarse Aggregates

- a) Coarse aggregates are the aggregates, which are retained on 4.75mm BIS Sieve. It shall have a specific gravity not less than 2.6 (saturated surface dry basis).
- b) These may be obtained from crushed or uncrushed gravel or stone as per clause 3.1 and may be supplied as single sized or graded. The grading of the aggregates shall be as per IS1383 or as required by the mix design, to obtain densest possible concrete. For this purpose, the contractor shall submit to the Engineer-in-Charge at least three sets of mix design and test results, each with different grading of coarse aggregates, proposed to be used. The Engineer-in-Charge may allow "All-in-aggregates" to be used provided they satisfy the requirements of IS:383.

4.2.2 Fine Aggregates

- a) Fine aggregates are the aggregates which pass through 4.75mm BIS sieve but not more than ten percent (10%) pass through 150 micron BIS sieve. These shall comply with the requirements of grading zones I, II and III of IS:383. Fine aggregates conforming to grade zone IV shall not be used for reinforced concrete works.
- b) Fine aggregates shall consist of material resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies, or crushed stone sand or gravel sand. Sand from sea shores, creeks or river banks affected by tides, shall not be used for filling or concrete works.

4.2.3 Sampling and Testing

The Contractor shall carry out all tests including mix designs of concrete, at his own expense, at the start of work as well as during any stage of construction as required by the Engineer-in-Charge. Test shall be carried out in accordance with IS:516- Methods of test for strength of concrete and IS:2386-Methods of test for aggregates for concrete. Testing shall be carried out from laboratories approved by the Engineer-in-Charge. The method of sampling shall be in accordance with the requirements given in IS:2430.

4.2.4 Alkali – Reactivity Potential

Aggregate shall not contain any matter which is likely to undergo disruptive expansive reactions with alkalis in the mix or otherwise affect the long-term durability of the concrete.

The Contractor shall initially assess an aggregate source by petrographic examination in accordance with relevant Indian standards if potential reactivity is indicated, then accelerated mortar bar tests in shall be carried out.

4.2.5 Storage of Aggregates

- a) Storage of all types of aggregates at site of work shall be at contractor's expense and risk and shall be stored as specified in IS:4082. Aggregates shall in no case be stored near to the excavated earth or directly over ground surface.
- b) The Contractor shall maintain sufficient quantities of aggregates, near to the place of work, required for the continuity of the work. Each type and grade of aggregate shall be stored separately on hard, firm surface having adequate slope for drainage of water.

- c) Aggregates delivered at site in wet condition or becoming wet due to rain or any other means, shall not be used for atleast 24 hours. The Contractor shall obtain prior approval of the Engineer-in-charge for the use of such aggregates and shall adjust the water content in accordance with IS:2386 to achieve the desired mix. In the absence of test results, and to allow variation in mass of aggregates and water content on account of moisture content, the Contractor can make suitable adjustment in the masses as per IS:456, for preparation of nominal mix concrete only.

4.3 Sand

4.3.1 Sand for Masonry Mortars

- a) The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS:2116.
- b) The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.
- c) Unless found satisfactory as a result of further tests as may be specified by the Engineer-in-Charge, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine silt, fine dust and organic impurities in the sand, when tested in accordance with IS:2386, shall not be more than 5% by mass in natural sand, or crushed gravel sand or crushed stone sand. For organic impurities, when determined in accordance with IS:2386, colour of the liquid shall be lighter than that indicated by the standard solution specified in IS:2386.

4.3.2 Grading of Sand

- a) The particle size grading of sand for use in mortars shall be within the limits as specified below:

IS Sieve Designation IS: 460 (PART I)	Percentage passing by mass	Ref. To method of
4.75 mm	100	IS 2385 (Part I)
2.36 mm	90 to 100	
1.18 mm	70 to 100	
600 micron	40 to 100	
300 micron	5 to 70	
150 micron	0 to 15	

- e) In case of a sand whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles, this shall be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable sizes of natural sand particles or crushed stone screenings which are by themselves unsuitable. Based on test results and in the light of practical experience with the use of local materials, deviation in grading of sand may be considered by the Engineer-in-Charge. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

4.3.3 Sampling and Testing

- a) The method of sampling shall be in accordance with IS:2430. The amount of material required for each test shall be as specified in relevant parts of IS:2386. Any test which the engineer-in-charge may require in connection with this, shall be carried out in accordance with the relevant parts of IS:2386.
- b) If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) may be made in accordance with IS:2250 using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality

4.3.4 Sand for Filling

Sand for filling shall meet the requirements of IS:383 and shall be natural sand, hard, strong, free from any organic and deleterious materials. Any sand proposed for filling, shall be used only after it is approved by the Engineer-in-Charge. Sand obtained from seashores, creeks or riverbanks affected by tides, shall not be used for filling. Fine aggregates suitable for concreting works shall be suitable for filling also. No sand below grading zone-111 as per IS:383 shall be allowed for filling.

4.4 Reinforcement

4.4.1 General

All steel bars, sections, plates, and other miscellaneous steel materials, etc shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing etc, for all materials covered under this section, shall conform to respective Indian standard codes.

All reinforcement will be TMT Fe 500D Corrosion Resistant steel (CRS) conforming to IS 1786:2008 or relevant codes with latest revisions.

4.4.2 Structural Steel

- a) Structural steel to be used for general structural purposes shall be one of the following or in combination thereof. Structural steel sections shall conform to following BIS Codes.

Steel tubes for structural purposes.

IS:1161

Mild Steel Tubes, tubulars and other wrought steel fittings.	IS: 1239
Steel for general structural purposes (Grade A).	IS:2062
Hollow steel sections for structural use.	IS:4923

f) Miscellaneous Steel Materials

Miscellaneous steel materials shall be conforming to the following B IS Codes.

Steel wire ropes for general engineering purposes	IS:2266
Thimbles for wire ropes.	IS: 2315
Bulldog grips.	IS:2361
Mild Steel Tubes, tubulars and other wrought steel fillings. (For Hand rail tubular sections).	IS: 1239

4.4.3 Anchor Bolts

Material for Anchor Bolts such as MS bars, washers, nuts, pipe sleeves and plates etc. shall be as per relevant BIS Codes mentioned above.

4.4.4 Insert Plates& Anchor Fasteners

Material for Insert plates shall be as per relevant BIS Codes mentioned above
Anchor Fasteners shall be Hilti type or equivalent as per standards

4.4.5 Storage of Reinforcement

Reinforcement shall be stored on racks with sufficient supports to avoid permanent deformation of the bars with a waterproof overhead cover to screen stocks from contamination from windblown dust. Delivery and storage shall be organised in such a manner as to make identification easy. Supports shall be such that distortion of bars is avoided and contamination and corrosion prevented.

Individual bundles of reinforcing bars shall be durably marked to identify source, batch number, type and diameter.

Reinforcement must not be roughly handled, dropped from a height, or subjected to shock loading or mechanical damage.

Any reinforcement which becomes contaminated shall be abrasive blasted with an approved blasting media, and washed if necessary, not earlier than 3 days before its incorporation in the Works.

Reinforcement shall be stored clear of the ground and protected from contamination by other materials. At time of placing concrete, reinforcement to be clean and free of corrosive

pitting, loose mill scale, loose rust, ice, oil and other substances which may adversely affect the reinforcement, concrete, or bond between the two.

4.5 Bricks

4.5.1 General

Bricks for masonry works shall conform to IS: 1077 - Specification for common burnt clay building bricks and shall be of class 5.0. Specific requirement for any other class of bricks shall be as shown in drawings or as described in the contract for a particular site or type of work. Physical requirements, quality, dimensions, tolerances etc. of common burnt clay building bricks shall conform to the requirements of IS:1077. Bricks shall be hand - moulded or machine moulded and shall be made from suitable soils. The bricks shall have smooth rectangular faces with sharp comers and shall be well burnt, sound, hard, tough and uniform in colour. These shall be free from cracks, chips, flaws, stone or humps of any kind.

4.5.2 Tests after Delivery

The Contractor shall take samples of each type of brick as directed by the Engineer-in-Charge as per the requirements of IS:5454 and tests shall be carried out as per IS:3495. The cost for carrying out any or all the tests, shall be borne by the Contractor. The bricks, when tested, as per IS:3495 shall have a minimum average compressive strength, as given in the Code, for a particular class of brick. Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24 hours.

Brick samples so approved, shall be deposited with the Engineer-in-Charge. All subsequent deliveries shall be upto the standards of the approved samples.

Stacking of Bricks

Bricks shall be stored at site as per the requirements given in IS:4082 and shall not be dumped at site. They shall be unloaded from trucks to a place on a levelled surface near to the work site. They shall be stacked in regular tiers even as they are unloaded, to minimise breakages and defacement of bricks. The supply of bricks shall be so arranged that as far as possible, at least two days requirements of bricks are available at site at any time. Bricks, of different class, shall be stacked separately

4.5.3 Local Bricks / Class 3.5 Bricks

Where shown on drawings, locally available bricks of non-modular size (230mm x 115mm x 75mm) in place of bricks of modular size (190mm x 90mm x 90mm) can be used in case the bricks satisfy the other requirements of IS: 1077. Minimum compressive strength of these bricks shall not be less than 3.5N/mm²

4.6 Stone

4.6.1 General

All Stones used for masonry works shall conform to the requirements of following BIS Codes.

Method of identification of natural building stones. IS : 1123

Recommendations for dimensions and workmanship of natural building stones for masonry work. IS: 1127

Recommendations for dressing of natural building stones. IS: 1129

4.6.2 Quality of Stones

Stones shall be of approved quality, hard, dense, strong, sound, durable, clean and uniform in colour. They shall also be free from veins, adherent coatings, injurious amount of alkalies, vegetable matters and other deleterious substances such as iron pyrites, coal, lignite, mica, sea shells etc. Unless otherwise approved, stones from one single quarry shall be used for any one work. The strength of stones should be adequate to carry the imposed load and shall meet all the requirements of IS:1905, taking into account the appropriate crushing strength of stone and type of the mortar used. The percentage of water absorption, when tested in accordance with IS: 1124, shall not exceed 5 percent.

Stones normally used, shall be small enough to be lifted and placed by hand. The length of the stone shall not exceed 3 times the height. Width of stone on base shall not be less than 150mm and in no case exceed 1/4th thickness of the wall. Height of the stone shall not be more than 300mm.

4.6.3 Unloading/Stacking

The stones shall be unloaded from the trucks to a site near to the place of work as defined in IS:4082 and shall be stacked on a firm ground having adequate slope for drainage. The supply of stones shall be so arranged that as far as possible, at least two days' requirements of stone are available at site at any time.

4.7 Admixtures

All concrete admixtures shall in general comply with the following BIS Codes unless otherwise stipulated in this specification.

- Specification for integral cement water proofing compounds. IS:2645
- Specification for other admixtures for concrete: IS:9103

Generally, admixtures shall have IS1 certification marks. However, even in case of BIS certified admixtures, Engineer-in-Charge may require the Contractor to carry out and submit any or all the tests (as specified in relevant BIS Codes), from approved laboratories, over and above the manufacturer's test certificate, before giving his final approval.

In case, admixtures certified by BIS are not available, the contractor shall submit to the Engineer-in-Charge the type and/or proprietary brand of the admixture from only reputed manufacturers along with necessary test certificates from recognised and approved laboratories or any other document directed by Engineer-in-Charge for the latter's final

approval. In such cases, names of at least two manufacturers shall be submitted to the Engineer-in-Charge for his selection. In case, both the names are rejected, the contractor shall submit a fresh list of two manufacturers for approval by the Engineer-in-Charge.

The Engineer-in-Charge may direct the contractor to submit test results as required by IS: 2645 or IS: 9103 for any admixture proposed to be used in the concrete in any approved laboratory at his discretion at any stage of the work. The cost of any/all tests required to satisfy compliance with this specification shall be borne by the Contractor.

In case of non-availability of any BIS code for testing and acceptability criteria, relevant American, British or German Code shall be applicable.

Prior approval of the Engineer-in-Charge shall be obtained while using water reducing admixtures in the concrete (PCC/RCC) or mortar. Other type of admixtures such as accelerating admixtures, retarding admixtures or air entraining admixtures, shall not be used unless specified on the design drawings or prior approval taken from the design approving authority. Once approved, utmost care shall be exercised at site by the Contractor to maintain the consistency in the quality of admixture and the concrete/ mortar so produced.

The suitability and effectiveness of any admixture shall be verified by trial with the designed concrete mixes using cement, aggregates together with any other materials to be actually used in the works as per the direction of Engineer-in-Charge. If two or more admixtures are to be used simultaneously in the same concrete mix, the Contractor must submit necessary test results from an approved laboratory to show their interaction and compatibility. Any/all tests specified in BIS Codes shall be carried out only with the type of material and mix design, to be actually used in the work site.

No admixture shall impair the durability of the concrete nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of reinforcement. Use of admixtures shall not reduce the dry density of concrete. Once the proportion of admixture has been established, strict check shall be maintained not to alter the proportions of ingredients and water-cement ratio of the Design Mix during execution.

The chloride contents in admixtures shall not exceed 2% by mass of the admixture or 0.03% by mass of the cement.

Admixtures which do not meet the requirements stipulated in this specification shall be rejected and shall not be used.

4.7.1 Corrosion inhibitors

Corrosion inhibitors shall be calcium nitrite based and be in a liquid form suitable for addition to concrete during batching. The corrosion inhibitor shall contain $30 \pm 2\%$ calcium nitrite by mass and have a minimum 10 year of field history in similar products. The suitability of the inhibitor, compatibility with other products in the concrete and dosage shall be confirmed in writing by the manufacturer. This shall include detailed long-term independent test data that conclusively substantiates the products ability. This should include as a minimum test data to relevant Indian standards.

Upon request the Contractor shall submit test method(s) which determine the plastic and hardened concentration of the active component in the corrosion inhibitor.

4.7.2 Polypropylene Fibres

Polypropylene fibre reinforcement shall be 100% virgin polypropylene fibres specifically manufactured for use as a concrete reinforcement and so certified by the manufacturer. It shall contain no reprocessed olefin materials. The fibre dosage shall provide a minimum surface area of 200m² of fibres per cubic metre of concrete. The length of each fibre shall be between 10mm and 50mm. Fibres may be monofilament or fibrillated.

4.8 Water Proofing Compounds

Water proofing compounds shall be mixed with only ordinary portland cement of grade 33, conforming to IS:269.

The permeability of the specimen with the admixture shall be less than half of the permeability with similar specimen without the use of these compounds. These compounds shall be used in such proportion as recommended by manufacturer but in no case it shall exceed 3% by weight of cement.

The initial setting time of the cement with the use of these compounds shall not be less than 30 minutes and final setting time shall not be more than 10 hours. Test shall be carried out in accordance with IS:4031. Compressive strength of specimen at 3 days shall not be less than 160kg/sq.cm nor 80% of the 3 days compressive strength of mortar cubes prepared with same cement and sand only, whichever is higher. Similarly compressive strength at 7 days shall not be less than 220 kg/sq.cm nor less than 80% of the 7 days compressive strength prepared with the same cement and sand only, whichever is higher. The test to determine the compressive strength shall conform to IS: 4031.

4.9 Water Bars

PVC water bars shall be used in reinforced concrete construction of liquid retaining structures or any other structure to safeguard them from hydrostatic pressure and water leakage and any relative movement between two parts of the structure due to thermal loading shrinkage or differential movement of foundations. Wherever desired or shown in the drawings, they shall be used at expansion/contraction/construction joints. These shall be pre-formed and shall provide a permanent water tight seal along the entire joint in the poured concrete structures. These shall also be flexible enough to withstand deflection/displacements at joints arising due to variation of temperatures or settlement of foundations. The minimum thickness of water bar shall be as shown on drawings or described in the schedule of rates and unless otherwise mentioned, these shall be able to withstand a water head of at least 12 meters.

Performance requirements of PVC water bars shall meet the requirements of IS: 12200. These shall be of approved make and of ribbed/serrated/plane type with a bulb at the centre. The thickness and width of water bars shall be as per schedule of rates/ drawings but in no case the thickness shall be less than 5mm and width less than 150mm. The joining of the water bars shall be carried out by vulcanizing strictly as per the manufacturer's specifications. Lapped joints shall not be allowed under any circumstances.

4.10 Bitumen/Bituminous Materials

Bitumen to be used for various types of work shall meet all the requirements of relevant BIS Codes as given below:

Specification of Paving Bitumen.	IS: 73
Specification for bitumen mastic for flooring.	IS: 1195
Specification for Bitumen felts for water proofing and damp proofing.	IS: 1322
Specification for Bituminous compounds for water proofing and caulking purposes.	IS: 1834
Specification for preformed fillers for expansion joint in concrete pavements and structures.	IS: 1838
Specification for bitumen mastic for use in water proofing of roofs.	IS:3037
Specification for bitumen primer for use in water proofing and damp proofing.	IS:3384
Specification for Bitumen Mastic for Tanking and Damp proofing.	IS:5871

5. CONCRETE

5.1 Plain and Reinforced Cement Concrete

5.1.1 Scope

This specification establishes the requirements of materials, mix proportioning, placing, curing, etc. of all types of cast-in-situ and precast concrete used in foundations, underground and over ground structures, floors, pavements etc. Any special requirements as shown or noted on the drawings shall supersede over the provisions of this specifications.

5.1.2 Reference Codes and Specifications

Apart from this specification, construction of plain and reinforced concrete works shall be in accordance with the Indian Standard Code of Practice for "Plain and Reinforced Concrete" IS:456 and other relevant codes mentioned therein.

In case of conflict between the clauses mentioned in this specification and those in the Bureau of Indian Standards (BIS), this specification shall govern.

5.1.3 Grades of Concrete

Unless otherwise noted on the drawings, or called for in the schedule of rates, the grades of concrete shall generally be as per details below:

Grades of Concrete	
Grade designation	Specified Characteristic Comprehensive Strength of 150 mm cube at 28 days (N/mm ²)
M 15	15
M 20	20
M 25	25
M 30	30
M 35	35
M 40	40
M 45	45
M 50	50
M 55	55

Notes: The characteristic strength is defined as the strength of material below which not more than five (5) percent of the test results are expected to fall.

Plain and reinforced cement concrete work shall confirm to Indian Standard for plain and concrete- Code of practice fourth revision IS 456:2000.

5.1.4 Type of Concrete Mix

Unless otherwise noted on drawings, all lean/plain and reinforced concrete shall be of M20 grade suitable for sever exposure condition and Reinforcement Cement Concrete shall be of grade M25 suitable for very severe exposure condition confirming to IS 456:2000.

5.1.5 Nominal Mix Concrete

This concrete shall be made (without preliminary tests) by adopting nominal concrete mix with proportions of materials as specified in table below:

Nominal mix of concrete (by mass)	Quantity of water per 50 kg of cement (Max) litres
1:5:10	60
1:3:6	34
M 15 (1:2:4)	32
M 20 (1:1.5:3)	34

Note:

1. The proportions of the fine to coarse aggregates should be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregates becomes larger graded coarse aggregates shall be used.

5.1.6 Design Mix Concrete

The mix shall be designed to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values. The target mean strength of concrete mix shall be equal to the characteristic strength plus 1.65 times the standard deviation. As long as the quality of materials does not change, a mix design done earlier; may be considered adequate for later work. However, in case the quality of materials changes or there is a break in the continuity of construction and the same work is allocated to a new contractor, the Engineer-in-Charge shall ask for a new design mix.

Irrespective of the grade of concrete required to be produced as per characteristic strength criteria, the minimum cement content and maximum free water cement ratio in the design concrete shall be strictly maintained for the corresponding grade of concrete.

5.2 Concrete Mix Proportioning

Proportioning, as used in this specification, shall mean the process of determining the proportions of the various ingredients to be used to produce concrete of the required workability when fresh green and strength, durability and surface finish, when hardened. The following information shall be collected prior to design of the concrete mix :

- Grade designation.
- Type of cement.
- Maximum nominal size of aggregate.
- Minimum cement content.
- Maximum free water cement ratio
- Workability requirements.

The Engineer-in-Charge shall verify the strength of the concrete mix, before giving his sanction of its use. However, this does not absolve the Contractor of his responsibility as regards achieving the prescribed strength of the mix. If during the execution of the work, cube tests show lower strengths than required, the Engineer-in-Charge shall order fresh trial mixes to be made by the Contractor.

No claim to alter the rates of concrete work shall be entertained due to such changes in mix variations. Any variation in cement consumption shall be taken into consideration for material reconciliation. Preliminary mix designs shall be established well ahead of start of work.

5.2.1 Maximum Density

Suitable proportions of sand and the different sizes of coarse aggregates for each grade of concrete shall be selected to give as nearly as practicable the maximum density. This shall be determined by mathematical means, laboratory tests, field trials and suitable changes in

aggregate gradation. The contractor shall submit to the Engineer-in-Charge at least three sets of mix design and corresponding test results after varying the mix proportions and / or grading of aggregate so as to establish the maximum density of any particular grade of concrete.

5.2.2 Free Water Cement Ratio

Once a mix, including its free water cement ratio, has been determined and approved for use by the Engineer-in-Charge, that free water cement ratio shall be maintained. The Contractor shall determine the water content of the aggregates frequently as the work progresses, and the amount of mixing water shall be adjusted so as to maintain the approved free water cement ratio.

5.2.3 Consistency

The concrete shall have a consistency such that it shall be workable in the required position and when properly vibrated it flows around reinforcing steel, all embedded fixtures, etc.

5.2.4 Workability

The concrete mix proportion shall be such that the concrete is of adequate workability for the placing condition and can be properly compacted with the means available. Use of additives of approved make shall be taken recourse to where required for attaining proper workability as specified under clause 4.7.

The ranges of values of workability of concrete shall be in accordance with IS: 1199. However, the actual values to be followed shall be established depending on aggregate sizing, mix proportions, placing conditions, etc and shall be got approved by the Engineer-in-Charge.

5.2.5 Durability

For achieving sufficiently durable concrete, strong, dense aggregates, low water-cement ratio and adequate cement content shall always be used. Workability of concrete shall be such that concrete can be completely compacted with the means available. Leak-proof formwork shall be used so as to ensure no loss of cement-slurry during pouring and compaction. Cover to reinforcement shall be uniform and as shown on drawings. Concrete mix design shall always take into account the type of cement, minimum cement content irrespective of the type of cement and maximum free water cement ratio and minimum grade of concrete conforming to the exposure conditions as given in Table below.

Exposure	Plain Concrete			Reinforced Concrete		
	Minimum cement concrete ratio (kg/m ³)	Maximum free water content ratio	Minimum grade of concrete	Minimum cement concrete ratio (kg/m ³)	Maximum free water content ratio	Minimum grade of concrete

Mild	240	0.60	M 15	330	0.55	M 20
Moderate	265	0.60	M 15	330	0.50	M 25
Severe	275	0.50	M 20	350	0.45	M 30
Very Severe	280	0.45	M 20	400	0.45	M 35
Extreme	310	0.40	M 20	400	0.40	M 40

Generally, the following types of cement shall be used for Plain and Reinforced concrete works:

- 33 Grade Ordinary Portland Cement conforming to IS: 269.
- 43 Grade Ordinary Portland Cement conforming to IS: 8112.
- Portland Slag Cement conforming to IS: 455.
- Portland Pozzolana Cement conforming to IS: 1489.
- Sulphate Resisting Portland Cement conforming to IS: 12330

Sulphate Resisting Portland Cement shall be used only for specific requirements depending on environmental and process exposure conditions to which the structures may be subjected to like high sulphate concentrations, processes involving sulphur handling etc.

The minimum cement content as mentioned in table above shall be adjusted for aggregates other than 20mm nominal maximum size. The minimum cement content in the concrete mix shall be increased by 40kg/m³ and decreased by 30 kg/m³ for 10 mm and 40 mm nominal maximum size aggregates respectively.

Structures in contact with sewage or effluent shall be under 'extreme'. Structures not in direct contact with sewage or effluent will be "very severe". The Structural Components shall be designed as per IS: 3370 & IS: 456-2000 and other relevant Codes with latest revisions.

5.2.6 Limits to Deleterious Constituents

Careful selection of the mix and the constituent materials shall be made to limit the presence of deleterious constituents in concrete. The total acid soluble chloride content calculated from the mix proportion and the measured chloride content of each of the constituents shall not exceed 0.6 kg/m³ at the time of placing of concrete. The total water soluble sulphate content of the concrete mix shall not exceed 4 percent by mass of the cement in the mix

5.3 Batching

In proportioning concrete, the quantity of both cement and aggregate shall be determined by mass. Where the mass of cement is determined on the basis of mass of cement per bag, a reasonable number of bags shall be weighed periodically to check the net mass. Where the cement is weighed at site and not in bags, it shall be weighed separately from the aggregates. Water shall be either measured by volume in calibrated tanks or weighed. Any

solid admixtures that are to be added, shall be measured by mass; liquid and paste admixtures shall be measured by volume or mass. Batching plant, shall conform to IS:4925. All measuring equipment shall be maintained in a clean serviceable condition, and their accuracy shall be within +2% and +3% for measurement of cement and aggregates/water/admixtures, respectively.

Except where it can be shown to the satisfaction of the Engineer-in-Charge that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions when required, different sizes being stacked in separate stock piles. The grading of coarse and fine aggregates shall be checked frequently, the frequency for a given job being determined by the Engineer-in-Charge to ensure that the approved grading is maintained.

Under very special circumstances change from weigh batching to appropriate volume batching may be permitted by Engineer-in-Charge. However, in such cases all conversions from mass of ingredients to volume shall be based on actual and appropriate bulk densities physically measured at site and approved by the Engineer-in-Charge.

The amount of added water shall be adjusted to compensate for any observed variations in the moisture contents in both fine and coarse aggregates. For the determination of moisture content in the aggregates, IS:2386 (Part-3) may be referred to. To allow for the variation in mass of aggregates due to variation in their moisture content, suitable adjustments in the mass of aggregate shall also be made. In the absence of exact data, only in the case of nominal mixes, the amount of surface water may be estimated from the values given in Table below:

Aggregate	Approx Quantity of surface water	
	Surface by mass	Litres/m ³
Very wet sand	7.5	120
Moderate wet sand	5.0	80
Moist sand	2.5	40
Moist gravel or crushed rock	1.25-2.5	20-40

No substitutions in materials used on the work or alterations in the established proportions, except as permitted in specifications shall be made without additional tests to show that the quality and strength of concrete are satisfactory. In case the Contractor proposes any change in the already approved mix design, fresh mix design with supportive laboratory tests shall be submitted to the Engineer-in-Charge and his approval has to be obtained prior to using the revised mix proportion in the works. However, such proposals for revision shall only be entertained in case of successive failure of test cubes to achieve the required strength

5.4 Concrete Mixing

The mixing of concrete shall be strictly carried out in an approved type of mechanical concrete mixer. The mixer shall be fitted with water measuring devices. The mixing shall be continued until there is a uniform distribution of the material and the mass is uniform in colour and consistency.

If there is segregation after unloading from the mixer, the concrete shall be remixed. Percent by mass Use of Ready Mixed Concrete supplied by Ready Mixed Concrete Plants or from on/off-site batching plants (IS:4926) shall be preferred for structural concrete. All records and charts for the batching and mixing operations shall be prepared and maintained by the contractor as per the instructions of Engineer-in-Charge.

5.4.1 Mixer

Mechanical Mixers shall comply with IS:1791 and 12119 and shall be maintained in satisfactory operating condition. These shall be used only for producing lean/ plain concrete and/ or nominal mix concrete wherever permitted.

5.4.2 Mixing Time

Mixing time shall be as indicated in the following table. Excessive mixing requiring additions of water shall not be permitted. Time shall start when all solid materials are poured in the revolving mixer drum, provided that all of the mixing water shall be introduced before one-fourth of the mixing time has elapsed. The Engineer-in-Charge may, however, direct a change in the mixing time, if he considers such a change necessary.

Capacity of mixer	Minimum Mixing time
2 m³ or less	2 minutes
Above 2 m³	3 minutes or as recommended by the mixer manufacturer

5.4.3 Hand Mixing

Hand mixing of concrete shall not be permitted. However, for non-critical applications namely foundations for crossovers, isolated operating platforms etc. using concrete of maximum grade M20 and located at far away isolated places, this may be permitted by the Engineer-in-charge as a special case. Ten percent (10%) extra cement shall be added to the design proportion. Mixing shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. No extra payment shall be made to the Contractor for mixing by hand or for using extra cement due to hand mixing.

5.4.4 Additives

Additive in concrete shall be used only with the prior approval of the Engineer-in-Charge and shall comply with IS:456. Any additive used for obtaining proper workability or leak-proofness of concrete or repairing works of concrete due to non-conformance to the

specifications, shall not be measured and paid for. All costs relating to such usage shall be borne by the Contractor.

5.5 Trial Mixes

5.5.1 Laboratory Trial Mixes

Preliminary laboratory tests shall be carried out in dedicated laboratory established at site with all-time access of Engineer-in-charge to determine the mixes to satisfy the specification with the available materials.

Trial mixes shall be tested with relevant Indian standards to determine the following properties of mixes proposed for initial field tests:

1. Bleeding (non- vibrating) Nil/negligible;
2. Air content if applicable;
3. Free water/cement ratio;
4. Consistence (workability);
5. Fresh and hardened concrete densities.

The following tests should commence when the concrete specimens are 28 days old:

1. Absorption. The upper target limit for absorption after 30 mins shall be 2% for reinforced concrete and 2.3% for unreinforced concrete;
2. Initial surface absorption tests (ISAT).

The target limits shall be:

Time after starting test	10 min	30 min	1 hour
ISAT results ml/m ² /s	0.25	0.17	0.10

For Reinforced Concrete only:

1. Penetration of water. The target limit for penetration at 4 days shall be 30mm;
2. Chloride permeability. The target limit shall be 1000 Coulombs.

If any of the values obtained for properties mentioned above for unreinforced concrete or for reinforced concrete are unacceptable, the mixes shall be re-designed.

5.5.2 Initial Field Tests

Full scale trial mixes shall be prepared for each proposed mix using the batching plant proposed for use in the works and shall be undertaken at least 35 days before the commencement of concreting. Six cylinders/cubes shall be taken from each mix, three for compressive testing at 7 days and three for testing at 28 days.

The remainder of the mix shall be cast in a wooden mould and compacted. After 24 hours the sides of the mould shall be struck and the surface examined in order to satisfy the Engineer-in-charge that an acceptable surface can be obtained with the mix.

The strength requirements shall be considered to be satisfied if the strength of the cubes tested after 28 days meet the limits given in IS code. In addition, the consistency of the trial mix shall be to the satisfaction of the Engineer-in-charge and within tolerance limits given in relevant IS code to the approval of the Engineer-in-charge.

When a proposed mix has been approved, no variations shall be made in the mix proportions, or in the type size, grading zone or source of any of the constituents except with the approval of the Engineer-in-charge, who may require further trial mixes to be made before any such variations are approved.

Until the results of trial mixes for a particular class have been approved by the Engineer-in-charge, no concrete of the relevant class shall be placed in the Works.

When the Contractor intends to purchase factory-made precast concrete units, trial mixes may be dispensed with provided that evidence is given to satisfy the Engineer-in-charge that the factory regularly produces concrete which complies with this Specification. The evidence shall include details of mix proportions, water-cement ratios, slumps and strengths obtained at 28 days.

5.6 Quality Control

5.6.1 Quality and Testing

Concrete, mixing, sampling, curing all shall comply with relevant Indian standards where specifications specified herein differs.

Concrete for water-retaining structures shall be watertight and shall comply with the recommendations of relevant Indian standard code.

Mass concrete for paving shall be tested and shall have a characteristic flexural strength of 4.5N/mm^2 at 28 days. Characteristic flexural strengths are for concrete which has been cured at a temperature of $20\text{ }^\circ\text{C} \pm 2\text{ }^\circ\text{C}$ and are values below which no more than 5% of the test results fall.

Before placing concrete, the Contractor shall obtain approval of the mixes proposed for each class of concrete and the average target strengths. The mixes shall be designed to achieve the minimum workability for the Contractor to place and compact the concrete with the equipment proposed for use.

The mean strength shall exceed the Characteristic Strength by a margin of at least 1.65 times the standard deviation expected from the concreting plant, except that no standard deviation less than 3.5 N/mm^2 shall be used as a basis for designing a mix.

5.6.2 Test Specimens

Complete, correlated records for sampling and testing shall be maintained to include as a minimum:

- Sampling, site tests, and identification numbers of specimens tested in the laboratory;
- Location of the parts of the structure represented by each sample;
- Location in the structure of the batch from which each sample is taken.

A visual examination of each batch of concrete delivered to site shall be undertaken by suitably experienced and qualified personnel. Water-cement ratio for each batch delivered shall be checked from complete and accurate autographic records, showing aggregate moisture corrections.

Slump, flow table, or slump flow consistence tests shall be carried out at the site of the pour on each truck load of concrete delivered. The consistence shall be as per the mix design with the permitted tolerances given in relevant standard.

Temperature measurements of the concrete shall be carried out on each batch of concrete if the ambient temperature at the time of placing lies outside the range 10-25°C.

One sample shall be taken from concrete delivered to site, at the frequency given in the Table of Mixes and whenever doubts are raised regarding the quality of the concrete. The sampling shall be in accordance with relevant IS code and tested for placement temperature, consistence (workability), plastic density, water-cement ratio and compressive strength.

From each sample three cubes/cylinders shall be made for testing at 28 days and one for testing at 7 days for control purposes. The 28 day results shall be the mean of three cubes.

Procedures for testing conformity shall be carried out in accordance with relevant Indian standards to the approval of the Engineer-in-charge.

Water shall not be added on site to retemper concrete prior to concrete placement.

Superplasticiser may be added to the concrete, but the addition of admixtures shall only be carried out by authorised personnel, and shall be recorded and signed on site placement records to show amount incorporated.

Tests for consistence shall be repeated after addition of super plasticising admixtures, and after the concrete has been remixed in the truck for at least 2 minutes at maximum revolutions. If the concrete subsequently fails the consistence testing, the concrete shall be rejected from the Works.

5.6.3 Test Certification

All testing equipment and procedures shall have a valid testing certificate or equivalent international standard. Personnel undertaking sampling and testing of concrete shall be suitably qualified and experienced.

The name and Certifying Body reference number of the laboratories shall be submitted for the approval of the Engineer-in-charge well in advance of making trial mixes or concrete for use in the works.

5.6.4 Test Results

Reports of the identity testing results shall be submitted for the approval of the Engineer-in-charge within one day of the completion of each test.

A complete set of test results will be retained on site for inspection any time or as appropriate.

5.6.5 Broken Samples from Failed Tests

The pieces of each cube/cylinder which fail to meet the conformity requirements for individual results shall be kept separately for a period of three months

5.6.6 Early Age Strength Testing

A regime of accelerated or normal curing and early testing which is capable of predicting the 28 day strength of Designed mixes may be used for determining compliance, subject to prior approval. If such a regime is adopted, two additional cubes must be made from each sample and cured normally so that, in the event of non-compliance, they can be tested at 28 days to provide information which will help in deciding the action to be taken

5.6.7 Failures

In the event of non-conformity, the concrete supplier shall be informed and the supplier's compliance to conformity criteria requirements of relevant standards examined. Following this investigation, one or more of the following actions will be instructed:

1. Changing the mix;
2. Improving quality control;
3. Cutting and testing specimens from placed concrete;
4. Durability testing of placed concrete;
5. Load-testing relevant structural units;
6. Non-destructive testing of placed concrete;
7. Cutting-out and replacing defective concrete.

In the event of (iii) the Contractor shall cut specimens from approved locations. Cores shall be tested and the method of interpretation of the results shall be subject to the approval of the Engineer-in-charge.

The Engineer-in-charge may issue instructions for the work to be stopped or delayed until reasons for the failure have been established; possible consequences assessed and appropriate preventative and remedial measures taken.

Wherever the specified sampling, testing and compliance procedures show that a concrete mix is not in accordance with the specification (even if the work is eventually accepted), and measures are taken to help in establishing whether or not the work is acceptable, such measures:

- will be at the expense of the Contractor, and
- will not be considered as grounds for extension of time.

5.6.8 Other Tests

The air content of air-entrained concrete shall be determined for each batch produced until consistency has been achieved, when fewer batches may be tested.

Random monitoring of the plastic density of the concrete shall be carried out weekly, using a calibrated container.

5.7 Batching

5.7.1 Machinery

Batching shall be by weigh-batching machines equipped with accuracy checks for the weighing mechanism. The machines shall be cleaned, checked and adjusted regularly as approved.

The water supply to the concrete mixers shall have a metering system to control and record the amount

5.7.2 Accuracy of Batching

Batched materials shall be measured out within the following tolerances and discharged into the mixer without loss:

Cement $\pm 2\%$ of the weight of the cement in the batch.

Aggregate $\pm 2\%$ of the weight of each aggregate in the batch.

Water $\pm 3\%$ of the weight of water added to the batch.

Admixture $\pm 5\%$ of the amount to be added to the batch.

The batched quantities shall be adjusted to compensate for variation in the moisture content of the aggregates with the approval of the Engineer-in-charge.

5.7.3 Batching and Mixing

The batching and mixing of concrete shall comply with relevant sections of Indian standards. The concrete batching plant shall be capable of providing concrete at the rate necessary to comply with the approved construction schedule.

All mixers shall be properly maintained in good working order in every respect. For each mixer proposed, the Contractor shall provide a copy of the manufacturer's specification and statement of performance capability. The amount of concrete mixed in any one batch shall not exceed the rated capacity of the mixer.

No concreting shall commence in any portion of the Works until the preparations have been accepted and permission given by the Engineer-in-charge. Adequate notice must be given to the Engineer-in-charge that areas are ready for concreting to enable the Engineer-in-charge to attend and make necessary tests, inspections and checks.

If concreting is not started within 24 hours of consent being given, consent shall again be obtained from the Engineer-in-charge. Concreting shall then proceed continuously over the area to be completed.

5.7.4 Pre-production Site Check

Before concreting is commenced the reinforcement and other embedded items shall be thoroughly cleaned of all deleterious matter including concrete splash from previous concreting operations.

The Contractor shall take every precaution to ensure that contamination due to windborne dust, organic or chemical products from ongoing operations surrounding the works does not occur.

All forms and falsework shall be carefully examined for access and safety and the space to be occupied by the concrete thoroughly cleaned out. Where considered necessary by the Engineer-in-charge, joints between panels of formwork shall be filled with an acceptable material.

5.7.5 Other Production Site Checks

No concrete shall be placed in the works until the batching plant, transit vehicles, concrete ingredients, mix batch quantities, quality procedures and results of laboratory and works trial mixes have been approved by the Engineer-in-charge.

Volume batching of constituent proportions shall not be permitted.

Accuracy of weighing and water dispensing mechanisms in batching plants shall be maintained within the tolerances. Accuracy shall be checked against accurate masses and volumes every four weeks or more frequently if required by the Engineer-in-charge. The masses of cement and each size of aggregate in each batch of concrete shall be recorded at the batching plant. The masses shall be within $\pm 3\%$ of the masses per batch derived from trial mixes and agreed by the Engineer-in-charge.

Dispensing equipment for admixtures shall be to the approval of the Engineer-in-charge and shall be accurate to within $\pm 5\%$ of the quantity of admixture being used. Admixture dispensers shall be checked for accuracy at the same frequency as the weighing and water dispensing mechanisms.

The batch masses of fine and coarse aggregate shall be adjusted to allow for the free water contained in them. The quantity of water added to each batch shall be adjusted by the quantity of free water contained in the fine and coarse aggregate and the liquid content of any admixture.

The times at which cement and water are introduced to each batch shall be recorded. Concrete shall be transported in mixer trucks, which shall be operated in accordance with the manufacturer's recommendations.

Each load of concrete shall be accompanied by a delivery note that states:

- Contract name;
- Concrete Strength Class;
- Nominal workability (consistency);
- Masses of constituents;

- Time at which water was added

5.7.6 Production Checks

Concrete shall be completely discharged within 60 minutes of water being added to the mix.

Workability of each truckload of concrete shall be determined at Site using relevant Indian Standards appropriate to the consistency of the concrete (i.e., slump or flow tests). Workability shall be within the tolerances permitted.

Temperature of concrete at time of discharge shall not exceed 30°C. Temperature measurements of the concrete at placing shall be carried out on each batch of concrete if the ambient temperature lies outside the range 10-25°C.

Concrete mixed as above shall not be modified by the addition of water or otherwise in order to facilitate handling or for any other purpose.

Autographic records and a record book shall be kept at Site by the Contractor and be available for inspection by the Engineer-in-charge at all times. The records shall contain the following information relating to each delivery of concrete to the Site:

- Registration number of truck, name of concrete supplier and location of batching plant;
- Time of introduction of cement and water to the mix;
- Time of arrival of truck at the concrete pour location and times when concrete discharge and compaction were completed;
- Strength Class of concrete and actual mix proportions including admixtures;
- Position in which concrete batch is to be placed;
- Whether test cylinders/cubes were taken from the load and sample reference numbers;
- Workability test results;
- Concrete temperature at time of start and completion of discharge.

A daily concrete batching report shall be prepared and submitted to Employer detailing the type and source of cement used, the quantities of any admixture used, the required aggregate and water weights per cubic metre, the amount of free moisture in each size of aggregate, the batched aggregate and water weights per cubic metre.

On cessation of work, including all stoppages exceeding 20 minutes, the mixers and all handling plant shall be washed out with clean water.

5.7.7 Hot Weather Concreting

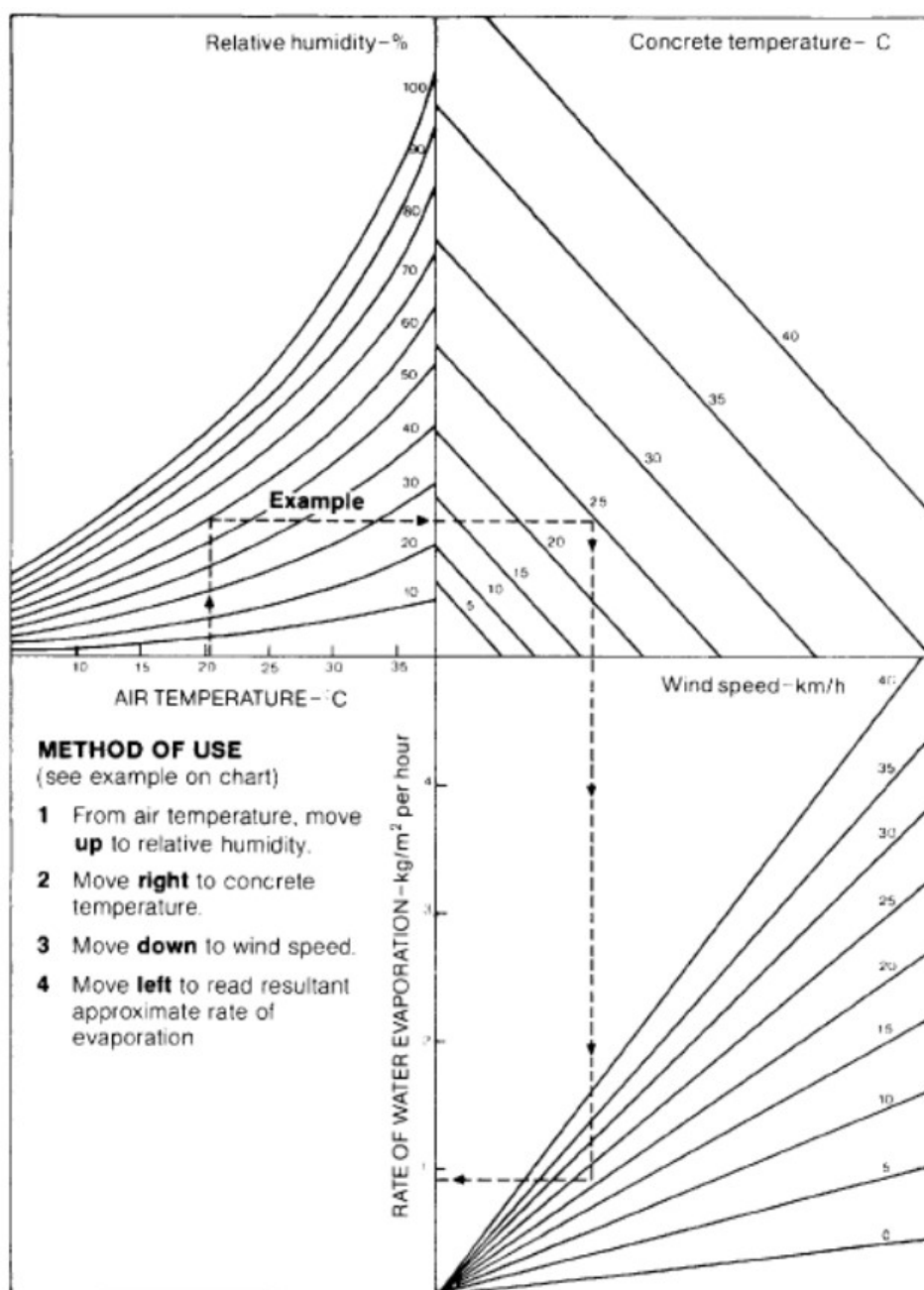
When the temperature of fresh design mix concrete exceeds 30°C with the consequence that workability is adversely affected, mixing and placing of the concrete in question shall be terminated.

Special precautions shall be taken to ensure the concrete temperature at placing is maintained below 30°C. These precautions may include:

- Protecting all aggregate stockpiles, water lines and tanks as well as the mixer from the direct rays of the sun;
- Mixing water cooled by the addition of ice to the storage tanks;
- Concreting carried out during the cooler parts of the day or during the night;
- Cooling all chutes, formwork and reinforcement by watering when possible, or otherwise protecting the site of placing from the direct rays of the sun. Any water so used shall be removed before placing the concrete in the formwork
- Providing wind shields during periods of drying winds.

To minimise the possibility of plastic shrinkage of the fresh concrete the rate of evaporation of water from the surface of the concrete shall be measured according to relevant Indian standard and if this exceeds 1.0 kilogram per square metre per hour, the concrete shall be protected immediately after placing, which may be required directly after placement but before surface finishing for a large pour.

Evaporation shall be determined using the following nomogram (Concrete Society Report 22).



5.8 Placing

5.8.1 Construction Sequence/ Timing Requirements

The Contractor's attention is drawn to the need to address the risk of Delayed Ettringite Formation.

The Contractor shall submit a detailed method statement to the Engineer-in-charge for approval defining his proposed arrangement to avoid the effects of thermal cracking and temperature differentials. The method statement shall include but not be limited to, the size and sequence of pours, concrete temperature-monitoring system of pours, formwork type and removal time, and calculations for temperature and strain development at internal and

surface locations, taking into account heat of hydration, ambient radiation and temperature, and physical restraints.

The Contractor shall assess the weather conditions immediately prior to pouring concrete in watertight concrete structures and shall if necessary, either suspend placing of watertight concrete, or carry out placing during the late afternoon or evening if the weather is considered to be too hot and/or sunny. Other methods of keeping the concrete within an acceptable maximum temperature may be used with the agreement of the Engineer-in-charge. All concrete showing signs of excessive cracking due to early thermal and drying shrinkage effects shall be removed at the Contractor's expense.

The maximum temperature of the concrete during hydration shall not exceed 70°C.

5.8.2 Thick sections

The temperature differentials in elements greater than 0.5-metre-thick shall be limited to a maximum permissible between the core and the surface of 20°C (or 30°C for aggregate having a coefficient of thermal expansion not exceeding $10 \times 10^{-6}/^{\circ}\text{C}$). The Contractor shall undertake a trial pour under conditions representative of those anticipated during the works. Thermocouples shall be used to monitor the ambient, core and surface temperature values in the trial pour and in the works.

Details of the trial shall be submitted to the Engineer-in-charge for approval prior to the production of concrete.

5.8.3 Surfaces to Receive Concrete

Surfaces to receive concrete shall be cleaned immediately before placing concrete. Surfaces shall be clean with no debris, tying wire clippings, fastenings or free water. Absorbent surfaces where concrete is to be laid shall be wetted to a saturate surface dry condition immediately prior to concrete placement.

5.8.4 Inspection of Surfaces

Notice shall be given to the Engineer-in-charge to allow inspections of reinforcement and surfaces before each pour of concrete. The period of notice shall be at least 24 hours. Process control sheets shall be developed to administer the procedures for inspection and approval.

5.8.5 Chutes and Drop Pipes

Concrete may be placed directly from a truck mixer or other transporting equipment. The chutes attached to this equipment may be used provided that the clear free fall from the end of the chute is no greater than 2 metre and that the slope of the chute does not exceed 1 vertical to 1 horizontal. When transferring concrete vertically from higher to lower elevations, drop pipes (trunking) shall be used.

5.8.6 Buckets and Skips

Concrete buckets and skips may be used provided that the equipment is designed to discharge concrete of the slump required, the discharge gates are tight against escaping grout when closed and that any free fall of concrete does not exceed 1 metre.

5.8.7 Pumps

The delivery pipe shall be steel or heavy duty flexible hose and the concrete shall be supplied continuously to the pump. The pump shall be of adequate capacity and power to ensure delivery of a continuous supply of concrete.

Whenever the supply of concrete to the pump is interrupted for more than 1 hour the chutes, pumps, pipes and any other means of distribution shall be thoroughly flushed out with water and cleaned, and shall be flushed with water immediately prior to the resumption of concreting.

All wash water used shall be discharged outside the formwork and clear of any freshly placed concrete. When pumping is complete, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place. At all times when pumping concrete Contractor shall provide adequate alternative arrangements for placing the concrete in case of a breakdown of the pumping equipment.

5.8.8 Placing

Concrete shall be placed and compacted without delay and in accordance with the recommendations of ACI 304R and ACI 309 such that dense homogenous concrete is obtained within the Works.

Concrete shall be placed directly in its final position without segregation or displacement of the reinforcement, embedded items and formwork.

The Contractor shall take suitable precautions when placing concrete in the tidal zone or in the open during heavy rain to protect the concrete from the adverse effects of tidal variation and the weather.

Concrete placement temperature shall be limited to a maximum of 30°C and to a minimum of 5°C.

Concrete shall generally be placed without segregation.

The size of each lift of concrete shall be limited to 600mm to ensure full compacting of concrete between layers. Greater or lesser lift heights shall be proposed by the Contractor for the approval of the Engineer-in-charge to suit concrete type and shall achieve efficient amalgamation during compaction. Where spreading of concrete in the forms is necessary it shall be carried out by approved means and not by the use of vibrators. Concrete shall not be allowed to fall freely more than 2 metres.

Placing in each section of work shall be continuous between construction joints. The Contractor shall make provision for standby equipment. If the placing of concrete is delayed due to breakdown of equipment or other cause then the Contractor shall erect vertical stop-ends and form a construction joint, or remove the concrete already placed and restart after repair of the equipment, as agreed with the Engineer-in-charge.

Placing shall not take place in the open during high winds, storms or heavy rains. If such conditions are likely to occur the Contractor may provide protection for the materials, plant and formwork so that work may proceed.

Contractor shall submit daily returns in respect of all concrete placed during the previous day.

The returns shall give for each location in the work:

- The position of the pour (e.g. bay or lift reference number);
- The Strength Class of the concrete placed;
- The total volume of concrete placed and the number of batches used.

In addition, Contractor shall maintain an accurate and up to date record showing dates, times, weather and temperature conditions when each part of the work was concreted.

Results of all tests on concrete shall be recorded and identified with the parts of the work to which they relate.

5.8.9 Compaction

Concrete shall be thoroughly compacted in its final position, whichever is lesser: within two hour of water being added to the cement at the batcher or loss of workability of concrete does not allow satisfactory placement of concrete. Partially-set concrete shall not be used in the works.

Poker vibrators shall be operated such that each layer of concrete is well compacted and is thoroughly intermixed with the previously placed layer at the joint line and shall be withdrawn from the concrete in a manner that does not form voids. Vibration shall be applied continuously during the placing of each batch of concrete until the expulsion of air has practically ceased and in a manner that does not promote segregation of the ingredients.

Vibration shall not to be applied directly or indirectly to concrete after the initial set has taken place, where a construction joint shall be created.

Poker vibrators shall not be used to make concrete flow horizontally into position, except where necessary to achieve full compaction under void formers and cast-in accessories and at vertical joints. Compaction shall continue until the expulsion of air has virtually ceased, and in a manner which does not promote segregation of the ingredients.

Slabs 100 millimetres thick or less shall be compacted by vibrating beams or other approved techniques and not by internal vibrators.

The formation of cold joints shall not be permitted.

No-fines concrete shall be lightly tamped only.

5.8.10 Vibrators

Sufficient numbers and types of vibrators, including back-up, shall be maintained on site to suit the rate of pouring, consistency and location of concrete. Concrete placing shall cease in the event of a total breakdown of the vibration equipment and shall be reduced with

partial failure of the equipment. Concrete that has not been properly compacted shall be rejected.

External vibrators shall be used only on approval from the Engineer-in-charge.

5.8.11 Continuity of Placing

Placing in each section of work shall be continuous between construction joints. The Contractor shall make provision for standby equipment. If the placing of concrete is delayed due to breakdown then the Contractor shall erect vertical stop-ends and form a construction joint or remove the concrete already placed and restart after repair of the breakdown, as directed.

5.8.12 Placing in Inclement Weather

Placing shall not take place in the open during storms or heavy rains. If such conditions are likely to occur the Contractor shall provide protection for the materials, plant and formwork so that work may proceed. If strong winds are prevalent protection from driving rain and dust shall be provided.

5.8.13 Placing at Night

If approval has been given for placing at night or in dark interiors, adequate lighting shall be provided where mixing, transportation and placing are in progress.

5.8.14 Placing under Water

5.8.15 Underwater concrete shall be placed with minimum disturbance of the water. Running water and wave wash shall be controlled. The specified concrete grade shall be used and the mix design shall provide for good flowing ability.

Tremie pipes, bottom-dump skips or other approved placing equipment shall be used. Segregation shall be avoided.

Placing shall be commenced in approved sections and continued to completion.

The tremie pipe shall be buried in the concrete and the pipe must not be emptied until the pour is complete. If a bottom-dump skip is used, the contents shall be covered by canvas or similar before lowering into the water. The doors shall be opened when the skip is resting on the bottom with no tension in the support cable, and the skip shall be lifted gradually so that the concrete flows out steadily.

5.9 Formwork

5.9.1 General

Formwork shall be designed and constructed in accordance with the recommendations of relevant Indian standard or similar approved standard and shall ensure that the finished concrete members conform accurately to the dimensions, lines and elevations shown on the drawings and to the specified tolerances.

The Contractor shall submit details of formwork to Engineer-in-charge for review and approval in advance of concreting.

Details of formwork for special finishes shall be approved before materials are ordered.

Formwork shall be designed and constructed to withstand the worst combination of the following without producing deformation of the finished concrete in excess of the specified tolerances:

Total weight of formwork, reinforcement and concrete.

- Construction loads including dynamic effects of placing, compacting and construction traffic;
- Wind loads.

The faces of formwork shall be clean, free from protrusions, adhering grout and other imperfections or defects and shall be removable without disturbing the concrete.

Top formwork shall be provided to slopes of 30 degrees or more from horizontal.

Formwork panels shall have true edges for accurate alignment and shall be fixed with either vertical or horizontal joints. Joints shall be close fitting and shall not permit leakage of grout, nor steps and ridges in exposed surfaces.

Rough formwork shall be butt-jointed, seasoned, sawn timber

Fine finish formwork shall be used for all concrete surfaces unless detailed otherwise on the Drawings. This finish shall be obtained from forms designed to produce a hard smooth surface with true, clean arises.

Concrete shall not be placed prior to inspection and approval of the formwork for each individual pour. Not less than four working hours' notice shall be given for the inspection and approval of the formwork and reinforcement.

5.9.2 Form Ties

Form ties shall be factory fabricated, removable or snap-off metal ties which will neither allow formwork deflection nor spall the concrete when removed. The ties shall be provided with backing plates to distribute loads evenly to the formwork.

Bolt or tie systems which, when removed, leave a hole through the member, shall not be permitted in liquid retaining structures. Ties shall be fitted with devices that will leave holes in the concrete surface not less than 6 millimetres nor more than 25 millimetres in diameter. Bolts and rods that are to be completely withdrawn from the finished concrete shall be coated with an approved non-staining bond breaker prior to concreting.

Tie cavities shall be roughened and filled with approved non-shrink concrete or epoxy mortar.

Removable ties shall be located so that the specified cover to reinforcement is maintained to all surfaces including that of the tie-holes. If ties are left in, the cover to the part of the tie which remains in the concrete shall be as specified for the reinforcement or as approved by the Engineer-in-charge.

5.9.3 Boxouts

Boxes for forming holes shall be constructed to be easily removable without damaging the concrete during removal. They shall be properly vented to permit the escape of entrapped air and shall be capable of being sealed subsequently to prevent the loss of grout. The use of polystyrene blocks for forming holes shall not be allowed unless used purely as void filler within otherwise rigidly constructed boxes.

5.9.4 Inspection Holes

Openings in formwork for inspection and cleaning-out shall be formed so that they can be completely sealed before the placing of concrete.

5.9.5 Formwork Props

The Contractor shall submit a method statement for proposals for prop bearings and sequence of propping / repropping and backpropping at least 14 days before commencement of concreting.

Formwork props shall prevent deflection and damage to the structure. Carry down props to bearings strong enough to provide adequate support throughout concreting operations.

All props shall be supported on adequate sole plates and shall not bear directly on or against previous concrete. They shall be capable of being released gently without shock to the supported formwork. No appliance for supporting the formwork shall be built into the permanent structure.

5.9.6 Chamfers

Where chamfers are required the fillets shall be cut to provide an even line.

All outward projecting 90 degree corners shall have a 25 millimetre x 25 millimetre chamfer unless shown otherwise on the drawings.

5.9.7 Treatment of Formwork

Forms, other than retained-in-place metal forms, shall be coated with form oil (mould oil) or form release agent before the concrete is placed. The coatings shall be approved commercial formulations of satisfactory and proven performance.

Release agents which are suitable for use with the type(s) of formwork, formed finishes and specified applied finishes shall be used. The same type and make of release agent shall be used throughout the entire area of any one finish and shall be applied evenly to form faces, from top downwards, and to horizontal surfaces last. The minimum amount necessary shall be used to obtain a clean release and prevent excessive local collection.

Release agents shall not bond with, stain or adversely affect the concrete surfaces and shall not impair subsequent treatment of concrete surfaces depending upon the bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing agent. Forms for unexposed surfaces that are to be treated with a waterproof membrane shall be

moistened with water immediately before placing concrete. Surplus oil on form surfaces, reinforcing steel and construction joints shall be removed before placing the concrete.

Release agent shall be prevented from touching the reinforcement, hardened concrete, other materials not part of the form face, and permanent forms.

Surface retarders shall not be used for formed faces unless as part of any construction joint details, or otherwise for the approval of the Engineer.

5.9.8 Removal of Formwork

The consent of the Engineer-in-charge shall be obtained in all cases before any formwork is removed, but any permission given or indicated in these documents shall in no case relieve the Contractor of his responsibility in respect of any injury or of any damage to the concrete work arising from the removal of the forms.

Formwork shall be removed in a manner not to damage the concrete, and at times to suit the requirements for its curing and to prevent restraint that may arise from elastic shortening, shrinkage or creep. Formwork shall not be removed until the concrete has sufficient strength to support itself.

Side forms shall not be removed until the concrete has sufficient strength to support itself. Soffit forms, centres and props may be removed when the member has sufficient strength and stiffness to carry itself and any loading without unacceptable stresses or deflections. Load shall not be applied to a member until it can be demonstrated that it has sufficient strength and stiffness.

Where water proofing membrane is applied to remove formwork, it shall be ensured that a minimum concrete compressive strength of 10N/mm^2 is reached before the formwork is stripped.

Where it is intended to re-use formwork, it shall be thoroughly cleaned and made good by the Contractor to the satisfaction of the Engineer-in-charge.

No remedial work, or covering up, shall be undertaken until the struck concrete face has been inspected and approved by the Engineer.

External loading shall not be applied until the concrete has reached the 28-day characteristic strength.

Formwork striking times shall be determined in accordance with relevant Indian standards.

Proposals by the Contractor for the striking of formwork shall be submitted to the Engineer-in-charge for approval prior to the commencement of concrete production for the main works.

5.9.9 Permanent Formwork

Permanent formers of GRP pipe are to be used where indicated on the drawings. The min. wall thickness of the GRP shall be 5mm.

5.9.10 Controlled Permeability Formwork

Controlled permeability formwork may be used to reduce the incidence of blow holes on surfaces to receive coatings. It shall be a proprietary system designed for (and with a track-record in) concrete construction, shall be generally robust and fit for purpose, and shall be the subject of a submission for approval, in accordance with Concrete Society Technical Report 52.

5.10 Reinforcement Works

5.10.1 Reinforcement General

All reinforcing steel shall be supplied by an approved reinforcement manufacturer. Site records shall be kept of delivery documents and labels.

The Contractor shall check the schedules against the drawings and be responsible for their accuracy and fit.

The Contractor shall maintain a record of test results for Qualification, Performance and Results to include the following:

- Yield load;
- Yield/Proof stress;
- Ultimate load;
- Mode of failure and where occurring;
- Other pertinent data

5.10.2 Fixing

Reinforcement shall be fabricated to the shapes and dimensions shown and shall be fixed in strict accordance with the owner approved Drawings as prepared by the Contractor. However, minor adjustments may be made to keep reinforcement clear of pipes, openings, water bars, built in items etc.

Reinforcement shall be fixed into cages or mats by binding the intersections and laps with tying wire or approved fixing clips. The fixings shall be of sufficient quantity to ensure that the reinforcement is held securely in place during construction and concreting. Use of additional steel for support of temporary works shall be permitted subject to the approval of the Engineer-in-charge.

Tack welding shall not be carried out unless authorised by the Engineer-in-charge and recommended by the reinforcement manufacturer, and then only to the manufacturer's recommendations.

In addition to supports shown on drawings or schedules, the Contractor shall provide chairs and spacers as necessary to support reinforcement in position and maintain the specified cover. Bar reinforcement must be fixed in position before the concrete is placed.

Suitable precautions shall be taken by Contractor to prevent displacement of the reinforcement during the placing and compaction of the concrete and maintain the specified cover. The placement of reinforcement with kinks or bends shall not be permitted.

Contact between ordinary carbon steel and stainless or galvanized reinforcement shall be prevented.

5.10.3 Bending Schedules

Cutting and bending of reinforcement shall be carried out in accordance with approved schedules and relevant Indian standards.

Restrictions on bending steel shall be as follows:

- Rebending including minor adjustments: Obtain instructions;
- Temperatures below 5°C: Obtain instructions;
- Temperatures greater than 100°C: Prohibited.

Cutting shall be carried out with an approved cropping machine.

On site facilities shall be provided for bending reinforcement to deal with approved minor adjustments.

Grade 250 bars shall be bent to radii not less than BS 8666: Table 1. Grade 460/425 bars must not be re-bent or straightened without approval from the Engineer-in-charge.

Any bars showing signs of cracking or brittleness, after bending or re-bending, shall be rejected.

5.10.4 Welding

Electric arc welding may be used, if approved, for joining bars. Covered-alloy or shielded-arc electrodes and workmanship shall conform to relevant standards. Joints shall be butt-welded with standard double-V or double-U welds.

Electric arc welding of any reinforcement is prohibited on all bridgeworks.

5.10.5 Cover to Reinforcement

Where required to support and retain the reinforcement in its correct position, Contractor shall provide templates, stools or other supports. Target or nominal cover to reinforcement shall be in accordance with the Drawings and this Specification. Cover shall be maintained over ties, stirrups and lap splices.

Approved type(s) of cover spacers shall be used which will adequately support the reinforcement, adequately resist displacement, not cause indentation of the formwork and made from: Plastics (perforated to at least 25% of their area), or Concrete (strength and durability to match surrounding concrete). Spacers and chairs shall be in accordance with Indian Standards Cover spacers shall not be closer than 300 mm centre to centre and staggered on adjacent parallel bars.

Where precast concrete support blocks are used, they shall be wedge-shaped, not larger than 90 millimetres by 90 millimetres, of a thickness necessary to provide the required cover and with an embedded hooked stainless steel tie wire for anchorage.

If the formed surface is exposed to view, the precast concrete support block shall be the same quality, texture and colour as the finished surface.

Following concreting checks shall be carried out using a cover meter in accordance with Indian standards over at least 10% of accessible surfaces at a 1m spacing prior to covering up. The measured cover values to all steel shall not be less than the minimum cover value given in the Table of Mixes. The results of the survey shall be submitted to the Engineer-in-charge for approval prior to any covering up.

5.11 Joints

5.11.1 Construction Joints

Construction joints shall be located and the sequence of placing arranged as approved, or as shown on the Drawings, to minimise shrinkage and thermal strains in the concrete.

Concrete placing shall not be interrupted except where joints occur, and shall continue after normal hours if necessary to achieve this.

Joints shall be formed square to the work with keyways included.

Horizontal joints shall be generally at least 500mm above ground level (relevant Indian standard shall apply), and 500mm above high water level in marine locations, or as shown on the Drawings.

Upon removal of the formwork the joint face shall be inspected, and if the soundness of the concrete is not approved the Contractor shall investigate and remedy defects.

Before placing is resumed at a joint the set surface shall be roughened to remove laitance and expose the aggregate; the concrete shall have gained sufficient strength to ensure that aggregate is not in any way damaged or loosened within the matrix. If damaging materials have come into contact with the surface of the joint the concrete shall be cut back and the roughened surface cleaned by compressed air or water jets and brushed and watered immediately before placing.

Chemical surface-retarders shall not be used.

Construction joints shall be sealed with an approved sealant on debonding tape at external and liquid-contact faces.

Construction joints in water-retaining structures shall incorporate an approved water bar and construction joint details shall be submitted to the Engineer-in-charge for approval.

5.11.2 Design Joints

Expansion and contraction joints shall be as shown on the Drawings.

A contraction joints in a non-water-retaining structure shall form a plane of discontinuity in the member. The concrete face first cast shall be painted with two coats of approved rubberised bitumen paint before the adjacent concrete is placed. The adjacent concrete shall include a groove against the joint for sealant. The exposed edges shall be sealed with an approved sealant on debonding tape.

If a contraction joint is likely to be contaminated, the joint shall be sealed immediately with an approved free-flowing sealing fluid as soon as the formwork has been removed.

An expansion joints in a non-water-retaining structure shall be formed as for a contraction joint, but non-absorbent closed-cell polyethylene joint filler shall be included so that the adjacent concrete members can expand.

A design joint in a water-retaining structure shall include a continuous water stop strip of copper, rubber, rubber and steel or PVC fixed across the joint as shown on the Drawings. The concrete shall be free from honeycombing and worked against the embedded part of the strip. Projecting portions of the strip shall be protected from damage during operations and, in the case of rubber and plastic, from light and heat.

Bituminous paint shall be applied to the lips of the loop of copper water stop and the loop filled with bituminous compound before embedding in the concrete.

The method of joining water stops shall be in accordance with the manufacturer's instructions.

5.12 Curing and Protection

5.12.1 Curing

Concrete shall be cured by keeping it continuously moist wet for the specified period of time to ensure complete hydration of cement and its hardening. Curing shall be started after 8 hours of placement of concrete in normal weather, and in hot weather after 4 hours. The water used for curing shall be of the same quality as that used for making of concrete.

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances such as hose, sprinklers etc. A layer of sacking, canvas, hessian, or other approved material, which will hold moisture for long periods and prevent loss of moisture from the concrete, shall be used as covering. Type of covering which would stain, disfigure or damage the concrete, during and after the curing period, shall not be used. Only approved covering shall be used for curing. Exposed surfaces of concrete shall be maintained continuously in a damp or wet condition for at least the first 7 days after placing of concrete.

The Contractor shall have all equipment and materials required for curing on hand and ready to use before concrete is placed.

For curing the concrete in pavements, floors, flat roofs or other level surfaces, the ponding method of curing shall be used. For the first 24 hours after concreting, the concrete shall be cured by use of wet sacking, canvas, hessian etc. The minimum water depth of 25mm for ponding shall be maintained. The method of containing the ponded water shall be approved by the Engineer-in-Charge. The ponded areas shall be kept continuously filled with water, and leaks, if any, shall be promptly repaired. Areas cured by ponding method shall be cleared of all debris and foreign materials after curing period is over.

Alternatively, membrane curing may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compounds shall be applied to all exposed surfaces of the concrete by spraying or brushing as soon as possible after the concrete has set

Minimum film thickness of such curing compounds shall be as per the recommendation of the manufacturer so as to obtain an efficiency of 90% as specified by BS-8110. This film of curing compound shall be fully removed from the concrete surface after the curing period specified earlier. Engineer-in-Charge may not allow curing by curing compounds for those surfaces where use of curing compound may be detrimental to application of future finishes over the concrete. Impermeable membranes such as polyethylene sheeting closely covering the concrete surface may also be used.

For concretes containing Portland pozzolana cement or Portland slag cement, the curing period as given above shall be doubled. Curing by ponding shall, however, commence after the first 24 hours of concreting.

5.12.2 Curing and Protection

Concrete shall be protected from sunshine and drying winds by approved shading and wind-breaks, and from cold, rain or running water, for a period of 14 days after placing. During this period the following measures shall be taken to prevent the loss of moisture and to minimise thermal stresses caused by the difference in temperature between the surface of the concrete and the core of the concrete mass:

1. Horizontal surfaces.

- Polythene sheeting shall be placed immediately after finishing.
- After final set has taken place, the polythene shall be replaced by wet hessian covered with polythene; the hessian shall be kept permanently damp.
- After 14 days, the hessian and polythene shall be removed and an approved aluminised or white resin-based curing compound applied. The rate of application shall be as recommended by the manufacturer.
- Alternative methods of curing must be approved before use where special finishes are required.

2. Vertical surfaces.

- Polythene over wet hessian shall be secured to the surfaces immediately after removal of the formwork. The hessian shall be kept permanently damp.
- After 14 days the hessian and polythene shall be removed and an approved aluminised or white resin-based curing compound applied.
- Water used during curing operations shall be potable water. Curing membranes shall be compatible with waterproofing or other materials that may subsequently be applied to the surface of the concrete.

5.12.3 Contamination

Concrete shall be protected from contamination by sea or brackish water, oil, fuel and other deleterious materials for a minimum period of 30 days after placing.

5.12.4 Insulating Formwork

Insulating formwork shall be left in place for 72 hours after placing or until the temperature peak of the concrete is reached. The initial curing period in as mentioned above may then be reduced in proportion.

5.12.5 Protection of Joints

Rebates formed to receive sealant and the surfaces of construction joints shall be protected from curing compound by wet hessian to ensure proper curing of the joint surface and adjacent concrete. The protection shall remain in place until the joint surface is sealed.

5.13 Finishes

5.13.1 Finishes General

The finished faces of concrete shall be sound, even coloured, even-textured and free from defects. Arises shall have a 20 x 20mm chamfer unless detailed otherwise on the Drawings. A fine finish shall be provided unless detailed otherwise on the Drawings.

5.13.2 Concrete Surfaces without Formwork

On upward-facing surfaces which do not require formwork or special finish the finish shall be produced by proper placing and compacting operations alone.

For a fair finish, screeding shall be used, carried out by sliding and tamping a screed board running on the top edges of the formwork, or on screeding guides, to give a dense concrete skin.

For a fine finish screeding shall be used as described, then left until the concrete has stiffened and the film of moisture has disappeared. A steel or wooden float shall then be used for a glossy or sandpaper surface as required. Working shall be the minimum compatible with a good finish. The surface shall be protected from water drops.

5.13.3 Wire-Brushed Finish

After removal of the formwork the surface of the concrete shall be abraded by stiff wire brushes and water to remove the cement laitance and expose the aggregate.

5.13.4 Bush-Hammered Finish (Roughened surface)

The surface shall be abraded by carborundum stones to remove irregularities. Within 3 weeks, the surface shall be bush hammered to remove the cement laitance and expose the aggregate. Approved bush hammers shall be worked to within 12mm of corners and arrases; the remaining 12mm shall be hand-chiselled to match. Bush hammers shall be operated perpendicularly to the surface, and the remaining exposed aggregates shall not be loose or fractured. The treated surface shall be washed with water and stiffly brushed. The exposed aggregate shall be clean and free from film.

5.13.5 Chemical Retarders

Chemical surface retarders, if approved, may be used to produce an exposed aggregate finish, and the Contractor shall demonstrate that the durability of the concrete surface is not reduced.

5.13.6 Carborundum Finish

Carborundum finish shall be achieved by sprinkling carborundum grit on the unset surface and working-in by wooden float. The grit shall vary in size between BS 1.18mm mesh and BS 0.60mm mesh and shall be distributed from a BS 1.18mm hand-screen at the rate of 2.15 kg per m².

5.13.7 Specimen Panels of Concrete

The Contractor shall produce specimen panels of finished concrete for approval. The approved panels shall be retained by the Engineer-in-charge and used to determine the acceptability of concrete finishes in the Works.

5.14 Special Concrete

- 5.14.1 Special concrete may be used only with prior permission of AITL. Contractor shall submit material specifications, sourcing details and mix design complying to relevant standards for review and approval by PMNC.

5.15 Tolerances

5.15.1 Tolerances of Concrete Surfaces

The tolerances of concrete surfaces shall be in accordance with the relevant Indian standards.

The Contractor shall manage the tolerances between his purchased metalwork and cast in-situ concrete.

5.16 Action in the event of Non-compliance

In the event of a failure to comply with the specification, then any of the following actions may be instructed:

- Work should stop;
- Investigation of the non-compliance;
- Redesign of the concrete mix;
- Improving quality control;
- Cutting and testing specimens from placed concrete;
- Durability testing of placed concrete;
- Load-testing relevant structural units;
- Non-destructive testing of placed concrete;

- Breaking-out and replacing concrete.

In the event of the Contractor shall cut specimens from approved locations. Cores shall be tested in accordance with relevant Indian standard. If the estimated in situ cube strength is less than 80% of the characteristic strength of concrete mix then the concrete represented by the cores shall be treated as non-compliant.

The Company may issue instructions for the work to be stopped until reasons for the failure have been established; possible consequences assessed and appropriate preventative and remedial measures taken. Wherever a non-compliance has been identified (even if the work is eventually accepted) the corrective actions arising will be at the expense of the Contractor, and will not be considered as grounds for extension of time.

5.17 Repairs and Remedial Works

Methods and details for carrying out remedial work to damage and defects shall be submitted in the form of a detailed method statement for approval.

In general, repairs and remedial methods shall be based on the use of proprietary polymer modified cementitious materials.

No remedial work, or covering up, shall be undertaken until the struck concrete face has been inspected and approved.

The location and nature of all repairs and remedial works shall be recorded and a copy of the records handed over at completion.

5.18 Surface Protection Materials

5.18.1 External Sheet Tanking Membrane

External sheet tanking membrane to concrete substructures shall be an impervious, cold applied flexible laminated sheet, consisting of multi-layer high density cross laminated polyethylene film with a backing of self-adhesive rubber bitumen compound to give a combined thickness of 1.5 mm and protected with silicone coated release paper. The mass of the membrane shall be not less than 1.6 kg/m² gross. A special grade of compound formulated for hot climates shall be used, which has in excess of 10 years of successful usage in the India. The laminate shall withstand cracking of the substrate up to a crack width of 0.6 mm. Minimum test performance data shall be as follows:

Property	Test Method	Results
Tape Strength	ASTM D638/Equivalent	Long. 4.2 N/mm Trans. 4.8N/mm
Tensile Strength	ASTM D638/Equivalent	Long. 42 N/mm ² Trans. 48 N/mm ²

Elongation Film	ASTM D638/Equivalent	Long. 210% Trans. 160%
Tear Resistance	ASTM D1004/Equivalent	Long. 270 N/mm Trans. 270 N/mm
Adhesion to Primed Concrete	ASTM D1000/Equivalent	1.8 N/mm
Adhesion to Self	ASTM D1000/Equivalent	1.8 N/mm
Puncture Resistance		290 N 65 mm
Water Resistance	ASTM E154/Equivalent	After 24 hours 0.14%
	ASTM D570/Equivalent	After 35 days 0.95%
Environmental Resistance	ASTM D543/Equivalent	Conforms
Moisture Vapour Transmission Rate	ASTM E96/Equivalent	0.3 g/m ² /24 hrs
Adhesive Softening Point	ASTM D36/Equivalent	Not lower than 103°C

5.18.2 External Brush-Applied Tanking Membrane

Coatings shall be solvent based bituminous compounds complying with relevant Indian standards. They shall be applied in two coats and the second coat shall incorporate non-asbestos fibre reinforcement and shall be applied to a minimum thickness of 1.5 mm.

5.19 Application of Concrete Surface Treatment

5.19.1 Above Ground Concrete Coatings General

All exposed surfaces of reinforced concrete elements shall be protected by a water repellent, chloride resistant coating. Coatings for specific applications are to be as shown on the Drawings. All other surfaces shall receive the protective and decorative coating specified for bridges.

The complete coating system, including primers, shall be applied in accordance with the manufacturer's instructions.

Coatings shall be applied by a specialist applicator approved by the manufacturer and the Engineer-in-charge, and shall have at least five years' proven successful experience.

A method statement for application shall be submitted giving full details of all equipment and application methods proposed, and safe access provisions. The method statement shall include wet and dry film thickness tests, pull off tests and any other quality control tests appropriate to the coating performance.

Sample panels of each coating type shall be prepared, before approval of material and applicator, on L shaped panels comprising vertical and horizontal surfaces of at least 1 m² each.

Full records of areas coated, quantity of material applied, ambient and substrate temperature, and humidity shall be kept on a daily basis and submitted to the Engineer.

5.19.2 Surface Preparation

Surfaces shall be lightly grit blasted to remove all contamination such as oil, grease, loose particles, decayed matter, laitance, mould release oils and curing compounds.

Any surface defects and blow holes shall be filled to produce a fine finish using a proprietary product such as an acrylic modified cementitious repair fairing coat (or mortar for larger defects). The repair shall be completed at least 48 hours before application of coatings.

5.19.3 Coating of Exposed Concrete Surfaces

Exposed concrete surfaces shall be coated in accordance with the relevant Section of this Specification. The general and surface preparation requirements of this Section shall be followed.

5.20 Vacuum Dewatering

5.20.1 Vacuum Dewatering General

Vacuum dewatering, where specified shall be in accordance with the requirements of this Specification and shall be carried out by a specialist contractor with at least five years' experience of application of the process in the Middle East.

Vacuum dewatering shall be achieved by the use of specialist system incorporating a filter mat and vacuum extraction of water at a suction pressure of between 0.6 and 0.8 atmospheres.

Concrete with micro silica shall not be used in areas subject to vacuum dewatering. Where blast furnace slag or pulverised fuel ash are used, the test results of fineness of the cement and cement substitute material shall be submitted to the specialist contractor, and written acceptance of suitability obtained.

For all mixes, the details of mix design shall be submitted to the specialist contractor and written acceptance of suitability obtained.

Following submittal of the contractor's method statement and initial approval, a trial area of vacuum dewatering shall be carried out. The trial area of slab shall be at least 100 m² and shall not be part of the permanent Works, and shall be laid using the mix, equipment and personnel proposed. Finishes and joints within the trial area shall match the requirements of the final slab.

Vacuum dewatering shall be carried out on each part of the slab for a period of one minute for each centimetre of slab thickness, or as otherwise established by trial or during the progress of the Works and agreed by the Engineer.

5.21 Deleted

5.22 Concrete (Piling work) N/A

6. DESIGN REQUIREMENTS

6.1 General

The following design requirements shall be as per the provisions of IS: 456- 2000 for all reinforced or plain concrete structures:

- i. All blinding concrete shall be a minimum 100 mm thick in concrete M20 grade and all levelling concrete shall be a minimum 100 mm thick in concrete M10 grade.
- ii. All structural reinforced concrete for liquid water retaining structures shall at least be of M35 and for building structures shall be at least M25
- iii. The minimum Cement Content in Concrete shall be as per Cl 5.2.5/latest relevant IS code (whichever higher) for all concrete work as per the specified concrete grade.
- iv. The minimum grade of concrete for sewage retaining structures shall be a M35 design mix having minimum cement content shall be as per Cl 5.2.5/latest relevant IS code (whichever higher). The quantity of the admixture shall be as per mix design.
- v. Ready Mix Concrete is preferable for all RCC works. The mix design for the same shall be approved by PMNC/Engineer-in-charge. The contractor should preferably have own RMC batching plant or else he should get approval from PMC/Engineer-in-charge for the agency from whom RMC is procured.
- vi. The minimum cover to all reinforcement including stirrups and links shall be as specified in Standard Specifications and IS: 456-2000. However, the minimum clear cover shall not be less than the following:

Location	Minimum Clear Cover (in mm)
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Slabs (floor & roof), Canopy Cantilevers, Waist Slabs, Chhajjas	25mm
Beams (floor, roof and tie), Lintel and Plinth	30mm
Columns	50 mm
Column Pedestals	75 mm
Foundation Slabs	75 mm
<i>Retaining Walls, Basements and Pit Walls</i>	
• Face in contact with earth	-50 mm
• Free Face	50 mm
Liquid Retaining Structures	
• Face in contact with liquid	-50 mm
• Face away from liquid but in contact with earth	50 mm
• Free Face	
Raft slab, Bottom, Sides & Top	75 mm
Piles	75 mm
Pile Caps	75 mm

- vii. All buildings shall have minimum 1.0 m wide, 100 mm thick plinth protection paving in M20 grade concrete. All plinth protection shall be supported on well-compacted stratum and hand packed rubble soling 230 mm thick minimum.
- viii. Any structure or pipeline crossing below roads shall be designed for Class A of IRC loading.
- ix. The bridges and supporting structure shall be designed to safely withstand the loadings such as loads and torque transmitted through scrapper blades, motor etc. Depending on the arrangement offered besides other loads. Necessary camber shall be provided in the bridges/pipe supports to account for deflection.
- x. All pipes and conduits laid below the structural plinth and road works shall be embedded in concrete of grade M-20 having minimum 150 mm thick concrete cover all around.
- xi. Approved quality waterproofing compound (chloride free) shall be added during concreting of all liquid retaining structures, in the proportion specified by the Manufacturer or 2 % by weight of cement, whichever is higher.
- xii. For walls and base slabs of liquid retaining structures, the following shall be considered.

- xiii. Minimum reinforcement shall be as per latest IS 3370, part II. This reinforcement shall be placed closer to the concrete faces and the minimum specified clear cover as per IS: 3370 and Clause (f) above.
- xiv. The maximum length of Panel to be concreted, sequential of pouring and height of pour shall be as per Standard Specifications, IS 456-2000 and IS 3370-part I, latest revision as applicable.
- xv. The minimum thickness of all RCC works for various structural members/elements shall be as follows:

i) Walls for liquid retaining structures	200 mm
ii) Roof slabs for liquid retaining structures	200 mm
iii) Bottom slabs for liquid retaining	200 mm
iv) Floor slabs including roof slabs, walkways, canopy slabs	150mm
v) Walls of cables/pipe trenches, underground pits etc	175mm
vi) Column footings	300 mm
vii) Parapets, chajjas	100 mm
Viii) Precast trench covers	100 mm
ix) Pile caps	500 mm

Ordinary Portland cement shall be used in the design and construction.

6.2 Standards of Construction Safety

- i. IS: 3696 - Safety code for scaffolds and ladder (Part 1 & 2)
- ii. IS: 3764 - Safety code for Excavation Work
- iii. IS: 7205 - Safety code for erection of structural steel Work

6.3 General Arrangement of Plant

- i. The following general guidelines shall be considered while preparing the general arrangement of the proposed plant besides the process requirements, as specified in these documents.
- ii. The general arrangements and planned layouts of all the treatment units of Water Conveyance System, depended buildings and other structures shall be got approved from the EMPLOYER/ PMC. Changes if any suggested will be incorporated in the final layout at no extra cost to EMPLOYER/ PMC.
- iii. Suitable passages, lifting eyes or other means shall be provided to permit the removal of equipment that may be required during the course of its normal operational life for maintenance or any other purpose.

- iv. Areas where leakage is likely to occur whether under normal use or during maintenance shall be provided with covered drainage channels, which shall direct spilled liquid either to a suitable plant drain or to a sump from where it can be pumped out to external drain in the plant area.

6.4 Orientation

- i. The Layout of the proposed plant shall be suitably prepared and to fit it within the space allotted in order to interface conveniently with the existing infrastructure of roadways as well as inlet and outlet Pipe-Work.
- ii. Underground services, requiring to be relocated in order to accommodate the proposed site layout, shall be relocated by the Contractor with the approval of the Employer/ PMC's representative.

6.5 Buildings and Structures

Unless otherwise specified, all the buildings and structural works shall generally comply with the following EMPLOYER/ PMC's requirements:

The buildings shall have an aesthetically good elevation.

- i. All building works shall be in reinforced concrete framework.
- ii. All external walls shall be in 230 mm thick brick masonry built in cement mortar in (1:5).
- iii. All internal partition walls shall be in 115 mm thick brick masonry built in cement mortar (1:4) with two 8 mm dia. MS bar in every fourth course laid horizontally. Transoms and mullions shall be of size 115 mm x 230 mm and shall form Panels not exceeding 3500 mm x 3500 mm in size.
- iv. All internal masonry surfaces shall be finished with 12 mm thick cement plaster in cement mortar (1:4) with plaster of Paris (POP). The walls shall be finished with painting and the type of painting shall be in accordance with the specifications as specified.
- v. All external masonry surfaces shall be plastered in two coats with sand faced cement plaster in cement mortar (1:4) & shall have total thickness of 23 mm. Waterproofing compound of approved make and quality shall be added to the cement mortar in proportions specified by the Manufacturer only with use of PVC chicken mesh wherever applicable.
- vi. All external surfaces above ground level shall be painted.
- vii. Type of flooring of various units shall be as specified.
- viii. All steps shall have 20 mm nosing.
- ix. RCC stairways shall be provided to permit access between different levels within buildings. All roof tops and tops of overhead tanks shall be made accessible with the staircases. Vertical ladders in stainless steel fitted with landing point

extensions will be permitted where considered appropriate by the EMPLOYER/PMC's representative to access areas not frequently visited.

- x. All floor cutouts and cable ducts, etc. shall be covered with pre-cast concrete covers in outdoor areas and Stainless Steel 304 chequered plates of adequate thickness in indoor areas.

The cables shall be supported on Aluminum / stainless steel cable bays and firmly secured.

- xi. The reinforced concrete roofs shall be made waterproof by application of approved cement water proofing treatment by India Waterproofing, guaranteed for 10 years. Cement concrete vatta shall be provided for upstand surface. The finished roof surface shall have adequate slope to drain rainwater to RW down take points.
- xii. For roofing drainage, UPVC pipes confirming to IS: 13592 shall be provided. For roof' areas up to 40 sq.m minimum two numbers 110 mm diameter pipes shall be provided. For every additional area of 40 m2 or part thereof, at least one no. 110 mm diameter pipe shall be provided.
- xiii. Top surfaces of chajjas and canopies shall be made waterproof by providing a brick-bat waterproofing treatment and sloped to drain the rainwater or as above.
- xiv. Plinth shall be minimum 600 mm above finished ground level around building.
- xv. All concrete channels and ducts used for conveying liquid shall have smooth finish from inside. The width of concrete channels shall not be less than 500 mm.
- xvi. Kerbs to be provided below the hand railing on the catwalks / pathways should be as per relevant sections of the Factory Act.
- xvii. All rooms in the treatment plant buildings shall be provided with appropriate signboards indicating the function of the rooms involved.
- xviii. Wherever equipment & machinery is required to be moved for inspection, servicing, replacement etc. suitable moveable gantry/monorail of required capacity shall be provided.
- xix. Emergency exit doorways shall be provided in buildings to comply with local and international regulations. Stairways and paved areas shall be provided at exit points.
- xx. Water purifier shall be fixed for drinking water purpose.
- xxi. All chequered plates shall be Stainless Steel 304 with proper fitting in place and arrangement for lifting.
- xxii. All doors and windows shall be as specified in Table A of this sub section.
- xxiii. Opening of the windows shall be minimum 25% of the wall area.
- xxiv. Minimum sizes of various structures shall be as given in layout drawing or as obtained from the Parameters for sizing or as specified for carpet areas of utility buildings elsewhere in the document.

- xxv. Fire safety board and 'No Smoking' sign board shall be installed in the area prone to flame to prevent any accident and/or as per the D.C. rules.
- xxvi. Furniture shall be supplied as per details mentioned in the document elsewhere.

6.6 Site Drainage

- a) Storm water drains running along the roads (to be provided under this Contract) shall be sized suitably allowing for 100% run-off.
- b) All storm water drains shall be in RCC/PCC.
- c) The design norms for storm water drain shall be followed as per CPHEEO Manual.

6.7 Cable and Pipe Trenches

- a) All cables to be laid in HDPE pipes.
- b) All the instruments such as measuring Meter, Panels etc. shall be well protected from heavy rainfall and corrosion with stainless steel sheeting covers and/or plastic, fibrous material having minimum life of 15 years.

6.8 Pipes and Ducts

- a) RCC ducts for drainage shall have minimum 1m thick of soil overburden while running across a road. Access shafts of size not less than 600 mm x 1000 mm shall be provided.
- b) All drains (except storm water drains running along the periphery of compound wall) shall be covered and designed structurally for appropriate loads.

6.9 Valve Chambers

Valve Chambers shall be of adequate size to facilitate ease in maintenance and operation. Valve chamber 1.5m deep below ground shall be brick masonry and valve chamber having depth greater than 1.5m shall be in RCC construction. Valve chambers sizes shall be as per CPHEEO manual.

6.10 Inlet and Interconnection Chambers

These chambers shall be constructed in RCC. Each chamber shall be provided with platform at top as necessary. Suitable provision shall be made to access the bottom of the Chambers.

6.11 Finishes

- a) Interior Wall (other than water retaining structure):
- b) All interior walls should be painted with two coats of approved quality and color of Oil based distemper over one coat of primer as directed by Engineer.
- c) Exterior Wall (other than water retaining structure):

- i. The colour scheme of the external surfaces of the building will have to be decided according to the designed elevation after approval of the Engineer.
 - ii. In case the structure is plastered then the plastering will be sand faced cement plaster in CM (1:4) 23 mm thick followed by exterior type two coats of approved quality and colour of acrylic exterior emulsion wall finishing paint over one coat of primer.
 - iii. This shall be of approved shade and brand to give an even shade on the Work in 2 or more coats.
- d) All the structures above ground shall be painted with 2 coats of acrylic emulsion paint over a coat of primer.

7. PIPEWORK

7.1 General

7.1.1 Design Considerations for Pipelines

- a) Design of header should allow longitudinal movement of the header section to prevent stress build-up in header due to thermal expansion/contraction forces. This Consists of self-limiting hold down and sliding mechanism. The sliding mechanism shall provide minimum resistance to movement of header under full buoyant uplift load.
- b) If piping is located at ground level, runs of lines should not obstruct any maintenance, operational access ways, or emergency egress/access. If crossing of walkways is unavoidable, the lines should be provided with stiles.
- c) Flexible joint/Mechanical Coupling shall be provided where necessary to facilitate removal of piping or allow differential settlement of building structure.
- d) Where pipes are running together in parallel, their supports shall be grouped and can be common support.
- e) Dead ends and pockets in line are to be avoided.
- f) Piping located in paved areas to be elevated 600 mm to bottom of pipe e.g. Control valve sets and manifold sets.
- g) Where pipes are running at grade in graded areas the minimum bottom of the pipe is to be 500 mm.
- h) Piping shall be designed with sufficient flexibility to absorb any excessive stresses.
- i) Minimum spacing between pipes shall be based on staggered flanges with at least 25 mm clearance between the outside of the bare pipe or outside of the insulation, to outside of bare flange or outside of flange insulation on the adjacent line. Piping without flanges to have 100 mm clearance between bare pipes or between insulation. Adequate

spacing to be allowed for expansion/contraction between lines at loops and any change of direction

- j) All piping shall be adequately supported and restrained so-as to prevent undue vibration, deflection, stresses or loads on equipment. Vertical Piping shall be supported from below in preference to hanging from above.
- k) Branch connections shall be made from the top of the headers.
- l) Block valves shall be installed in a horizontal run of each branch line to a group of common users.

7.1.2 Design Considerations for Pipe Supports

- a) Vertical piping section shall have a minimum of vertical supports and additional supports as necessary to maintain the level. Each Pipe support shall provide a bearing surface contoured to fit 360 degrees of piping.
- b) Piping Supports to resist thrust generated by expansion or contraction of headers.
- c) Maximum spacing to be maintained between supports as per Standard Practice.
- d) Sliding Mechanism shall provide 3 mm clearances around the header and be self-limiting if the mechanism is overtightened.
- e) Design of Pipe support shall consider the maximum horizontal thrust that will initiate movement of header relative to mechanism under full buoyant uplift load.
- f) Design of Thrust Blocks shall be as per Clause No. 7.5 Concrete Stools, Anchor and Thrust Blocks
- g) All supports shall be designed and endorsed by the contractor and submitted for review and approval by PMNC
- h) Pipe supports shall be close enough to prevent sagging.
- i) Tees and crosses shall be used in place of elbows where mechanical cleaning may be required.
- j) Rodding points shall be provided at suitable locations.
- k) Reducers shall have level invert and branches shall be taken from the top of a pipe. Long vertical rises shall be avoided especially above the discharge valve of a dosing pump.
- l) Pipework design shall minimize any tendency for settlement of particles. Provision shall be made for flushing all sections with clean water. Wherever possible, the velocity of the effluent in any part of the pipework system shall be maintained as per CPHEEO manual for the entire range of operating conditions.
- m) All the piping shall be supported and restrained so-as to prevent undue vibration, deflection, stresses or loads on equipment. Piping shall be supported from below in preference to hanging from above.

- n) Support span for non-metallic pipes shall be in line with pipe manufacturer's recommendations.
- o) Where pipes are running together in parallel, they shall be grouped and supported on a common support.
- p) Piping supports shall permit appropriate movement for expansion and contraction in desired direction and prevent transmission of vibration.

7.1.3 Design Considerations for Sliding Supports

Bidder to locate sliding supports directly adjacent to expansion joints and maintain

- a) Standard spacing between sliding supports in vertical and horizontal runs of piping.
- b) Sliding support shall allow for longitudinal movement of the pipe due to thermal expansion.
- c) Supports shall allow standard clearance around the pipe to permit pipe movement.
- d) Design sliding supports to resist uplift due to buoyant forces with a minimum required safety factor.
- e) Bidder to attach sliding supports to walls and floors with appropriately sized anchor bolts consistent with the specification.

7.1.4 Design Considerations for Anchor Supports

- a) Anchor support shall be adequate to resist longitudinal and lateral pipe movement due to thermal expansion at the stated differential temperature.

7.1.5 Existing Underground Services

When working in the vicinity of existing underground services, all trial holes/trenches and subsequent excavation shall be carried out by hand. Before digging, the Contractor shall notify the relevant Authorities and shall comply with all the requirements, specifications and restrictions imposed by them.

The Contractor shall take all practical steps to avoid damage to existing underground services. These steps shall include:

The Contractor shall take all practical steps to avoid damage to existing underground services. These steps shall include:

- Making contact with all relevant authorities to establish location records of existing services;
- All services indicated as being within 5m of the works (including from the extents of the temporary works) shall be located by tracing or other means.

All traced services which are within 1m of the edge of an excavation shall be identified by hand excavation of trial holes/trenches.

Extreme care and caution shall be exercised when working in the proximity of HV electric cables or coaxial telephone cables carrying national or international circuits.

All exposed existing cables, pipes, ducts etc, shall be adequately supported and protected to the satisfaction of the Engineer and the relevant Authority.

7.1.6 Water Supply Hygiene

Before any person is engaged on work involving contact by direct or indirect means with potable water, he shall be notified of the need for personal hygiene and the dangers of contamination. He shall complete a medical questionnaire. The Contractor shall notify the Engineer-in-charge of any person who has been certified by a doctor as suffering from an illness associated with looseness of bowels or other stomach illnesses. Such persons shall not be permitted to work in the vicinity of potable water until an approved doctor has certified that it is safe for him to be so employed. Where necessary, he shall be tested for waterborne diseases.

7.1.7 Compliance with Existing Statutory Authority Requirements

The Contractor shall take due account of any specifications issued by and/or specific requirements pertaining to the respective adopting Statutory Authority. Should an instance arise where the Authority's specified requirements conflict with this project specification, and unless instructed to the contrary by the Engineer, the Authority's specified requirements shall prevail.

7.1.8 Definitions

“RTR” - Reinforced Thermosetting Resin to include Fibre Reinforced Plastic (FRP), Glass Reinforced Plastic (GRP) and Reinforced Plastic Mortar or matrix (RPM).

Structured-Wall Pipes and Fittings - Products which have an optimized design with regard to material usage to achieve the relevant performance requirements.

Profile wall - a pipe wall construction that presents a smooth surface in the waterway but includes ribs or other shapes, which can be either solid or hollow that help brace the pipe against deformation.

7.1.8.1 Pressure Pipes and Pressure Ratings

Pressure pipelines shall be those pipelines through which fluid is pumped or which at any point operate under an internal pressure in excess of 3.0 metres head of water.

The pressure ratings for all pipes and fittings shall be those calculated to give a minimum service life of 50 years at an ambient temperature of higher than 40° centigrade.

Pressure ratings for valves shall be those calculated for maximum working pressure at an ambient temperature of 20° centigrade.

The system test pressure shall be calculated from the design pressure by:

If the surge is calculated:

System Test Pressure = (Design Pressure + Surge) + 1 bar

If surge is not calculated:

System Test Pressure = Design Pressure x 1.5

Or System Test Pressure = Design Pressure + 5 bar whichever is the least

7.1.8.2 Dimensional

Apart from specials, rocker pipes and cut to suit lengths, pipes shall be supplied in any standard lengths allowed under the specification. Unless otherwise specified the tolerance on all pipe dimensions shall be $\pm 5\text{mm}$.

7.1.8.3 Marking of pipes and fittings

Each pipe, special and fitting shall be clearly and indelibly marked at the place of manufacture with:

- The name or distinctive mark of the manufacturer;
- The country of manufacture;
- The date of manufacture;
- The class or pressure rating;
- The nominal diameter;
- The manufacturing standard to which it has been produced;
- For rigid pipes, crushing strength (in kN/m) or class;
- For flexible pipes, stiffness (in N/sq.m).

7.1.9 Quality Assurance

Unless otherwise indicated on the drawings, or specifically permitted by the Engineer, all pipes and RTR fittings shall be furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished in conjunction with specified valves and fittings. However, it shall not be a requirement that the same manufacturer manufacture the pipe and fittings, provided the pipe, valve and fittings are compatible in both compounding and size. The pipes, valves and fittings shall be designed, manufactured and constructed in accordance with the best practice-applying manufacturer's standard installation guidance deemed suitable for the intended service.

Any manufacturers design and engineering shall be performed by personnel regularly employed by the manufacturers who are experienced in the design of pipes similar to those specified.

All pipes, valves and fittings shall be inspected and tested at the foundry and/or factory as required by the standard specifications to which the material is manufactured. The sworn certificates of such tests and their results shall be issued in duplicate to the Engineer-in-charge prior to the shipment.

Prior to dispatch from the factory, the Contractor shall notify the Engineer-in-charge in sufficient time to allow the Engineer, or his representative, to carry out a visual inspection and dimensional checks of the pipes, valves and fittings, if so desired.

7.1.10 Inspections at Site

Inspection of the pipe, valve or fitting will be made by the Engineer-in-charge or other representatives of the Employer after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job or where permitted by the Engineer-in-charge repaired to his satisfaction.

All pipes, valves and fittings shall be subject to visual inspection at any time and shall meet with the specified requirements. Any damage shall be notified to the Engineer-in-charge for a decision as to the acceptability, with or without repairs or remedial work. The criteria set out below will be used for guidance, but are not to be regarded as representing necessarily all grounds for rejection. The final decision will be taken by the Engineer-in-charge based on his judgment of the suitability of the items for the purpose intended.

All notification shall be made by written Inspection Request. An advance copy may be sent electronically to the Engineer's office, but the original must arrive or be submitted before the scheduled day of inspection.

Minimum notification times must be as follows:

1. 24 hours on site;
2. 72 hours for areas within AITL area;
3. 3 weeks outside of AITL area.

The Contractor shall store pipes under shade in a properly prepared and maintained storage area demarcated in respect of pipe sizes, pressure ratings, stiffnesses/strengths and manufacturers.

7.1.10.1 Flexible pipes – Visual Inspections at Site

Condition	Requirements	
	Unplasticised Polyvinyl Chloride/Polyethylene	Reinforced Thermosetting Resin
Ellipticity	± 1% on mean diameter	As per specifications
Length	± 25mm	As per specifications
Wall thickness	Pipe wall thickness measured at any point must be such that the Standard Dimension Ratio calculated on that thickness is within the stipulated range.	As per specifications
End Squareness /	N/A	As per specifications

End Planeness		
Surface finish	There shall be no flaking or indication of disintegration. There shall be no evidence of extrusion dye-marks or 'spider-lines'.	There shall be no crazing of internal or external gel-coats or resin rich layers. Resin dry areas not exceeding 6mm dia. Internally or 60mm dia. Externally may be accepted if made good.
Scratches	No internal scratches. External surfaces shall be free from longitudinal scratches and circumferential scratches longer than 100mm or deeper than 5% of the pipe wall thickness.	Scratches not exceeding 0.3 mm deep may be accepted without repair. Scratches exceeding 0.3 mm deep may be accepted if satisfactorily made good.
Cracks	All pipes shall be free from cracks.	<u>Longitudinal cracks:</u> There shall be none on internal surfaces. External cracks may be accepted after repair if less than 200mm long. <u>Circumferential cracks:</u> No cracks shall be of sufficient depth to expose glass fibres. Cracks not exceeding 200mm length may be accepted after repair. <u>"Star Cracks"</u> may be accepted after repair if all cracks are contained within a circle of 100mm diameter.
Voids	No visible voids will be accepted	Voids (or blisters) may be accepted after repair if not greater than 2mm diameter and 1mm depth provided that not more than 0.5% of surface area is affected.
Protuberances	There shall be no protruding aggregates.	There shall be no protruding fibres from the internal surface of the pipe. Wrinkles and undulations shall not exceed 3mm in height.

	There shall be no protuberances of any sort extending more than 2mm from the normal surface.	
Inclusions	There shall be no visible inclusions or extraneous matter	There shall be no visible inclusions or extraneous matter, other than permitted fillers of aggregates.
Delamination	Not applicable	There shall be no visible delamination.

7.1.10.2 Fabricated items (other than pipes)

Condition	Requirements
	Reinforced Thermosetting Resin
Surface finish	<p>There shall be no crazing of gel coats or resin rich layers.</p> <p>Resin dry areas not exceeding 6mm dia. on moulded and corrosion resistant surfaces may be accepted if made good. Not more than 0.5% of the surface area shall be so affected.</p> <p>There shall be no resin dry areas on other surface after repair.</p>
Scratches	<p>Scratches not exceeding 0.2 mm deep to moulded and corrosion resistant surfaces may be accepted without repair provided that no glass fibres are exposed. Scratches exceeding 0.2mm deep but not exceeding 0.5mm deep may be accepted if satisfactorily made good. The total extent of scratching shall not exceed 200mm length per 1 sq. meter surface area. Alternatively, where small scratches are grouped together, the affected area shall not exceed 1% of the surface area.</p> <p>Scratches to other surfaces may be repaired provided that the structural integrity of the laminate is not impaired.</p>
Cracks	<p>For moulded and corrosion resistant surfaces there shall be no cracks of depth greater than 0.5mm or of sufficient depth to expose glass fibres. Cracks up to 0.5mm depth not exposing glass fibres and not exceeding 200mm in length may be accepted after repair but such cracks shall not present to an extent greater than 1 crack per 5 sq. metres of surface area.</p> <p>Cracks not exceeding 200mm in length to other surfaces may be repaired provided that the structural integrity of the laminate is not impaired.</p> <p>“Star Cracks” may be accepted after repair if all cracks are contained within a circle of 100mm diameter and a maximum of 0.2% of the area of any one moulding is affected.</p>
Voids	<p>Voids (or blisters) at moulded and corrosion resistant surfaces may be repaired if not greater than 2mm diameter and 1mm depth provided that the voids occur in discrete areas of discrete clusters and the sum</p>

	of the areas does not exceed 0.5% of the total moulded area. Voids to other surfaces may be repaired if they do not extend to more than 20% of the laminate thickness and not more than 3% of the surface area is affected.
Protuberances	There shall be no protruding fibres from the internal surface of laminates. Wrinkles and undulations shall be gradual and the internal surface shall be continuous at such locations. Such defects shall not appear extensively on single mouldings and shall not be repeated through a production run.
Inclusions	There shall be no visible inclusions or extraneous matter, other than permitted fillers of aggregates.
Delamination	There shall be no visible delamination.

7.2 Submittals

Prior to the placement of purchase orders for pipes, valves and fittings, the Contractor shall submit documentation to the Engineer to establish compliance, and shall obtain the Engineer-in-charge's approval. The documentation to be submitted shall include at least the following:

1. Documentation of manufacturer's qualifications and experience, with systems similar to those specified;
2. Manufacturer's installation instructions, recommended field quality control procedures and specific field handling and storage requirements;
3. Shop drawings including piping layouts and schedules shall be submitted to the Engineer and shall include dimensioning, fittings, locations of valves and appurtenances, joint details, methods and locations of supports and all other pertinent technical specifications to be furnished;
4. Shop drawing submittals for piping under this section shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished. Types and locations of pipe hangers and/or supports shall be shown on the piping layout for each piping submittal.
5. Test certificates confirming compliance with the relevant specification;
6. Confirmation of compliance with the specifications, with details of any deviations.

In addition, for RTR pipe and fittings, submit the following:

1. The work size of each diameter of pipe, defined as the internal diameter, declared by the manufacturer;
2. Design calculations (including checks against positive and negative internal pressure, external soil and traffic loads, handling, and the effects of the environmental conditions);

3. For filament wound pipes, a method statement describing how structural reinforcement shall be prevented from penetrating the barrier layers;
4. Resin manufacturer's corrosion service data for the proposed resin systems. Corrosion service data shall show satisfaction long term service in similar physical and chemical environments to those specified herein;
5. Sample coupons of each different laminate not less than 300 x 300 mm square. Provide sample laminate coupons for each method of manufacture;
6. Details of the proposed laminate construction for RTR fittings.
7. Samples of liquid and cast resin together with reinforcements and surfacing veils (or fabrics) required to manufacture the samples indicated above.

In addition, for valves submit the following:

1. The total weight of each item;
2. Materials of construction and coating details;
3. Certified hydrostatic test data, per manufacturer's standard procedure;
4. For each valve specified to be manufactured, tested and/or installed, submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation;
5. Draft Operation and Maintenance Manual.

In addition, for HDPE pipes, submit the following:

1. Calculations covering the soil pressure on the buried pipe and restraint of expansion or contraction. Restraint anchors shall be provided if required. Manholes may be regarded as such restraint blocks, provided that they can be shown to provide the necessary resistance;
2. The manufacturer shall provide proof of successful past use of the HDPE pipes and fittings on work of a similar environment and scope to that for this project;
3. Method Statement: shall include details on connection of pipe to manhole lining materials to ensure protection of connection on lined concrete manhole;
4. Detailed shop drawings shall be submitted to the Engineer-in-charge for approval. These shall show all relevant details including:
 - Connections to manholes;
 - Jointing to existing mains;
 - Joints detail;
 - The contractor shall furnish the Engineer with samples of the proposed connections between the pipe and manhole lining when used with lined concrete manholes and provide testing as required by the Engineer.
5. Representative samples of each type shall be submitted to the Engineer-in-charge for approval;

6. Different sizes and types of pipes and fittings, even if from the same manufacturer, shall be placed in separate submittals

7.3 Materials for Pipework and Ancillaries

7.3.1 PVC-U Pipes

All PVC-U pipes shall comply with ISO 161/1 as applicable or other approved standard. Unless a higher class is noted elsewhere in the Contract Documents, PVC-U pipes for pressure applications shall be PN 10 at 20°C. The permitted pressure will be de rated by a third for 40°C. If the working pressure of the system is greater than 4.5 bar, the pressure class of the pipe shall be at least 2.2 times greater than the working pressure.

The material shall have a minimum extrapolated hoop tensile strength of 17.5MN/m² at 50 years and at a temperature of 35°C.

Where PVC-U pipes are used for drainage purposes a standard dimension ratio (SDR) of 41 is required or Type SN4 in accordance with Indian standards.

Joints for gravity pipe shall be made by means of rubber ring seal connections.

Slotted PVC-U pipes for land and storm water/land drains shall be of an approved design giving infiltration rates at least equal to those specified in Indian standards for porous concrete pipes and they shall comply with them.

Any pipe or part pipe with discoloration, scratching, abrasion, pit marks or otherwise considered unsuitable by the Engineer-in-charge shall be rejected.

7.3.2 Precast Concrete Pipes and Fittings

Precast concrete pipes and fittings of circular cross-section used for the conveyance of sewage or surface water, Concrete Manholes and inspection chambers shall comply with the appropriate Indian standards. All precast concrete products shall be made using sulphate resisting cement.

Concrete jacking pipes shall comply with the relevant provisions of Indian standards. The Contractor shall ensure that the pipes can withstand the jacking loads without damage.

All pipes and fittings shall have gasket spigot and socket type joints unless noted otherwise. Strength class is to be Class 120 unless noted elsewhere in the Contract. Strength class is minimum crushing load in KN/m divided by one thousandth of nominal diameter in mm.

7.3.3 Pipe Joints General

Unless specified elsewhere, rubber joint rings for water mains and drainage purposes shall be types W and D respectively complying with the relevant standards and shall generally be obtained from the pipe manufacturers. The elastomer used for the manufacturer of the rings shall be first grade plantation rubber, styrene butadiene or ethylene propylene rubber complying with Indian standards.

7.3.4 Step Irons

Step irons for manholes shall be in accordance with Indian standards.

7.3.5 CI Covers and Frames

Cast ductile iron covers and frames shall be of the size, type and grade shown on the Drawings and shall comply with Indian standards. They shall be lockable unless noted otherwise. If specified elsewhere to be airtight, they shall be capable of resisting an internal pressure of 100kN/m². All covers shall be obtained from approved manufacturers to the sizes, grades and pattern numbers as detailed. Where no grade is detailed, Class D400 shall be used in paved areas and Class C250 in areas where there is no vehicular access.

Covers shall be supplied complete with 5 sets of lifting keys obtained from the cover manufacturer. Frames and covers for sewers shall have a removable self-sealing GRP or similar corrosion-resistant plate that fits securely between cover and frame such that the minimum surface area of the frame is exposed to the atmosphere within the manhole. The design of the frame, cover and plate shall be to the approval of the Engineer. Covers and frames to air valve chambers shall be of ventilated type unless the chamber is separately ventilated.

All manhole covers shall be coated with 400 micron spray epoxy.

7.3.6 CI Surface Boxes, Gully Gratings and Frames

Cast ductile iron surface boxes, gully gratings and frames shall be heavy duty complying with Indian standards for Class D400 loading except for kerb gullies which shall be Class C250 loading. Kerb gullies shall have reversible covers capable of preventing the ingress of sand and shall suit the kerb profile. Kerb gully frames shall include an internal GRP grating and road retaining bar. The weir entrance to the road gully shall be barred vertically to prevent the ingress of objects larger than 75mm.

7.3.7 Gullies

Road gullies shall be polypropylene or GRP in accordance with Indian standards, 450mm internal diameter by 900 or 1,050mm deep with 150mm outlet and without trap for soakaways but with trap for a positive drainage system. They shall be complete with GRP perforated basket and incorporate a 100mm diameter opening in the base, unless otherwise directed by the Engineer-in-charge.

7.3.8 Protection to CI Manhole Covers etc

Gratings, covers and frames shall be prepared in accordance with the relevant clause for preparation of steelwork prior to protective treatment and shall be coated with heavy duty abrasion resistant epoxy paint to a minimum DFT of 375 microns prior to installation.

Contact surfaces of covers and frames (other than machined covers) shall be coated with approved heavy duty grease immediately prior to final fitting of covers. Surfaces of machined covers and frames shall be coated with approved graphite grease immediately prior to final fitting of covers.

7.3.9 Manhole Linings

Manhole linings shall effectively resist the corrosive effects of septic sewage or effluent with a normal maximum temperature of up to 40 degree Centigrade.

The lining shall be subjected to the following test. The lining shall be fully resistant to 10% W/V sulphuric acid at 50 degrees C when subjected to an immersion test which shall last a minimum of 100 days. The laboratory and method of testing shall be to the approval of the Engineer.

Manhole linings shall have a resin rich lining having a nominal thickness of 1.5mm consisting of an inner most 0.3mm layer reinforced with 'C' glass. The remainder of the lining shall consist of acid resistant chopped 'ECR' glass strand or mat and having a glass content between 25 and 30% by weight. Manhole linings shall be provided with a resin rich outer layer reinforced with 'C' glass veil.

The resin to be used for the resin rich lining of the manhole lining shall be an epoxy based Vinylester resin. For the structural wall of the manhole lining high grade Isophthalic polyester resin shall be used. No dark pigments shall be used. Fine silica sand containing no impurities and complying with requirements of Indian standards – may be added to the structural layer to achieve adequate stiffness.

All glass reinforcement except for the inner and outer surfaces of the manhole lining shall be of the acid resistant 'ECR' type.

The internal surface of the liner material shall be smooth and both the internal and external surfaces shall be clean and free from defects such as protruding fibre, voids, pits, bubbles, cracks, blisters or foreign matter which would impair their performance in service.

The external surface of the lining shall have suitable GRP lugs moulded on the surface at appropriate spacings to allow adequate bonding to the concrete.

The manufacturing tolerances shall be $\pm 0.5\%$. All deviations from roundness, with the exception of deformation due to self-weight, shall be contained within this tolerance.

At no position shall the thickness of the manhole liner material be less than 7mm.

Circular lining material shall be able to withstand an external hydrostatic head of concrete of 7 metres without deforming.

The lining material shall have adequate strength to withstand loading, off-loading and site handling. It shall not buckle or distort so as to affect circularity, water-tightness or continuity of laminate when a concrete surround is being placed. Internal bracing whilst pouring concrete shall be adopted if required.

Joints, where permitted, shall be as detailed and shall be made using an external purpose-made sleeve or plate bonded by an approved solvent to the liner and shall be equal or superior in performance to the lining, in both the circumferential and longitudinal directions. Over bonding shall extend for a minimum of 150mm on each side of the joint.

A representative sample of the liner material shall be submitted to the Engineer for testing and for comparison with the product as delivered to Site, together with full details of the chemical properties of the resins.

7.3.10 Ladders

Aluminium alloy ladders shall be of approved design and obtained from an approved manufacturer. The dimension of ladder widths, rung spacing etc. shall comply with Indian standards.

GRP ladders shall be of approved design and obtained from an approved manufacturer. They shall comply with Indian standards.

7.3.11 Safety Chains

Mild steel safety chains shall be 8 mm nominal size Grade M(4) non-calibrated chain, Type 1, complying with relevant Indian standards. After manufacture, mild steel safety chains shall be hot dip galvanized as per standards.

Chain links shall be welded and have an internal length not exceeding 45mm and an internal width of between 12mm and 18mm. The fins caused by welding shall be removed and the weld shall be smoothly finished all round. When tested in accordance with standards, each chain shall withstand a breaking force of 30kN and a proof force of 15kN.

7.3.12 Water stops

Plasticized PVC water stops shall comply with the relevant provisions of WIS 4-31-02.

7.3.13 Filter Fabric

Filter fabric surround to soakaways and land drains shall be suitable for subsurface filtration. Geotextile is to have a minimum tear resistance of 225N. A minimum permeability of 90 l/m².s and a mean O₉₀ size of 0.18mm is required. The Contractor is to demonstrate the suitability of the geotextile for the particular application including submission of calculations together with soil grading curves to the approval of the Engineer. Geotextile shall be laid with 500mm overlaps at joints unless indicated elsewhere in the Contract.

7.3.14 Marker Tape

Marker tape shall be provided where directed and shall be approved high quality, acid and alkali-resistant polyethylene film 250mm wide, with a minimum thickness of 150 microns. Tape shall have minimum tensile strength of 125kg/cm² longitudinally and 105kg/cm² laterally with an elongation factor of 350%. Where the service is of a non-magnetically detectable nature, approved metal-backed tape shall be used.

Tape shall be printed with 50mm high black lettering, alternately in Arabic and English. The complete wordings shall be repeated every 2m along the tape. The colours shall be vivid, glossy and permanent with a life expectancy of 40 years.

Warning tapes shall be coloured and inscribed for identification as follows:

Service	Colour	Inscription
Electricity Ducts/ Cables	Red	'CAUTION-BURIED ELECTRIC CABLE'
Telephone Ducts/ Cables	Green	'CAUTION-BURIED TELEPHONE CABLE'

Potable Water	Blue	'CAUTION-BURIED WATERMAIN'
Foul/Surface Water Rising Main	Yellow	'CAUTION-BURIED RISING MAIN SEWER'
Foul/Surface Water Sewer	Yellow	'CAUTION-BURIED GRAVITY SEWER'

7.3.15 Oil Separators

The design of oil separators is to conform to the pollution prevention guidelines of UK Environmental Agency "Use and Design of Oil Separators in Surface Water Drainage Systems: PPG3" or to similar requirements by other regulatory agencies where approved by the Engineer-in-charge.

Unless shown otherwise in the drawings, oil separators shall be of the Class I as per Indian standards.

An oil level alarm shall be provided to indicate both a visual and audible warning when the level reaches 80% of its maximum capacity. The sensor shall be rated to IP68 or higher.

7.4 Trenches

7.4.1 Trench Excavation

Prior to commencing any excavation, the Contractor shall submit to the Engineer-in-charge for approval of his proposals for the provision of any necessary traffic control measures and the erection of safety barriers and night-time lighting. This shall not relieve the Contractor of any responsibility for complying with the requirements of the Police Department, local Municipality or any other Authority, and the Contractor shall make himself fully aware of these requirements prior to his submission to the Engineer-in-charge.

Before opening a section of trench the Contractor shall satisfy himself that the line of the trench is clear of underground obstructions, by taking out trial holes on the line of the trench.

Trenches shall be excavated to the lines shown on the Drawings and to levels that will allow for the pipe wall thickness and bedding thickness, if any. civil

Sight rails shall be set up and fixed securely into the ground and maintained at intervals not exceeding 25 metres. A minimum of three sight rails shall be maintained for every length of trench being excavated to one grade.

The widths of trenches shall be such as to provide at least 150mm clearance between the barrel of the pipe and the side of the excavation or timber or other sheeting, but the width measured between undisturbed faces of the trench sides at a level of 300mm above the crown of the pipe shall not, unless approved or required by the Engineer-in-charge, exceed the outside diameter of the pipe being laid plus 550mm for pipes up to and including 800mm diameter, and plus 750mm for pipes over 800mm in diameter. If the width of the trench exceeds the specified dimension or the trench supports move so as to disturb the ground in the trench side at or below crown level, the Contractor shall, at his own expense, extend the

bedding to the full width of the trench. The Contractor shall be responsible for the disposal of surplus excavated material off site to an approved area.

If any loose, soft or bad ground is encountered, the Contractor shall report this to the Engineer and, where directed, shall excavate the same to a solid foundation and replace this with concrete or Class I fill material or other approved fill, as directed.

The Contractor shall ensure that all excavation and trench side support is carried out in a careful manner, that it is rendered secure and safe, and that all necessary measures are taken to prevent the removal or falling-in of material beyond the trench dimensions detailed. The Contractor shall maintain all trench side support until the completion of the work to the satisfaction of the Engineer and shall promptly remove any material which has collapsed into the excavation. Except where described in the Contract or approved by the Engineer-in-charge, excavations shall not be battered.

The Contractor shall protect his excavation with suitable supports viz. Sheet piling, frame supports, effective use of formwork etc. where such support is necessary to ensure the safety of the workmen, the integrity of adjoining structures and work generally. Where ordered, the Contractor shall leave steel sheet piling, plain or interlocking steel sheeting or timbering in excavations, trenches or headings.

A clear space of a minimum of 2m or greater if instructed by the engineer shall be left between the edges of excavations and the inner toes of spoil banks. No vehicles or other heavy machinery is permitted may operate within this clear space.

When a void occurs between the sides of the excavation and the trench supports, this shall be filled with Class III fill material well-compacted in 200mm layers up to ground level immediately after the final positioning of the trench supports. A clear space shall be left between the edges of excavations and the inner toes of spoil banks, to the approval of the Engineer-in-charge. Back-throwing shall not be allowed and all materials shall be brought to the surface and formed in heaps clear of the excavation.

Where two pipes are to be laid side by side in the same trench, but at different levels, the excavation shall first be taken down to a level 200mm above formation level for the upper pipe; the excavation for the lower pipe shall then be carried out and the lower pipe laid, jointed and completed; backfilling shall then be carried out up to formation level of the upper pipe, the remainder of the excavation for the upper pipe completed, and the laying of the pipe completed. Unless otherwise approved by the Engineer-in-charge, sewers shall be laid from the downstream end.

Except where indicated elsewhere in the Contract, the minimum depth to the top of pipes shall be 1200mm under roads and other trafficked and hard standing areas and 900mm elsewhere.

All flexible pipelines will be subjected to in-situ deflection measurements, firstly after placing and compaction of the surrounds and secondly not less than four weeks following completion of backfill. Any section of pipe failing to meet the deflection criteria shall have its surround material re-compacted, such procedure being repeated until the in-situ pipe is found to satisfactory. Pipes will be regarded as damaged and shall be removed from the trench and condemned if their in-situ deflection at any time exceeds the values stated in

the table below. Such pipe shall be removed from site and shall not be used in any part of the Works.

Deflections in pipes smaller than 600mm diameter shall be measured by pulling through approved cylindrical plug dimensioned to suit the minimum deflected diameter of the pipe. For pipes 600mm and larger internal measurements are to be made in the vertical plane, with readings at both ends and one in the midpoint of each pipe. All measurements to be taken no sooner than 4 weeks after backfilling, except in pipelines where access points are more than 100 metres apart, in which case they may be taken progressively with the backfilling.

7.4.2 Road Crossings

The Contractor shall close sheet and adequately support all trenches across existing roads. Care shall be taken by the Contractor to ensure that existing roads and services are not damaged by road crossing operations and that the safety of the workforce and general public is maintained.

7.4.3 Pumping and Dewatering

Excavations shall be kept free from water at all times and adequate pumping plant, including special dewatering equipment, shall be provided together with means of conveying away the pumped water and all water from excavations. Sumps, when used, shall be formed clear of excavations for permanent works. Silt traps shall be provided unless directed otherwise by the Engineer.

The Contractor shall submit details of his proposed dewatering methods to the Engineer for approval. All dewatering will be subject to relevant discharge approvals

7.4.4 Sub-Drains

If necessary for the construction of the Works, the Contractor shall lay sub-drains, where directed, to convey the water to pumping sumps or soakaways. Sub-drains shall be laid unjointed with the invert not less than 300mm below the formation level of the permanent works, and shall be covered with gravel to formation level. The Contractor shall ensure that these drains are kept free from silt. The pipe materials for sub drains shall be to the approval of the Engineer.

7.4.5 Trenches under Roads

All trenches for services, drains and the like cut in to or adjacent to the roads or surfaced area formation shall, where possible, be compacted, backfilled and consolidated before the sub-base and pavement are laid. The Contractor shall satisfy the Engineer-in-charge as to the proper consolidation of all backfilling in trenches. Any subsidence shall be made good and the trench thoroughly tested by rolling to the Engineer's satisfaction. Damage to the road or surfaced area foundation or surface due to subsidence of trench filling shall be made good at the Contractor's expense.

Backfill materials more than 300mm above the tops of ducts and pipes and all materials around and over manholes, soakaways, etc. shall be well compacted in approved layers by mechanical compactors so that a minimum 95% relative compaction is achieved throughout.

Where trenches have been cut through existing paved roads the trench backfill shall be brought up to formation level whereupon the pavement layers shall be reinstated and rolled to the Engineer-in-charge's satisfaction using similar approved materials.

7.4.6 Material for Pipe Bedding and Trench Filling

Material to be used for pipe bedding shall be murrum of approved quality and trench backfill (divided into Classes I, II and III) shall be free from vegetable and perishable matter and shall be obtained from sources approved by the Engineer-in-charge. They shall comply with the following particular requirements:

Class I Trench Fill shall be free-draining, rounded, granular material consisting of natural gravel or similar material.

For pipes up to and including 300mm, the nominal size shall be 10mm; for pipes exceeding 300mm but not exceeding 900mm diameter, the nominal size shall be 14mm; above 900mm diameter, the nominal size shall be 20mm. The overall grading shall be such that the material shall have a Compaction Fraction of 0.10 or less.

Class II Trench Fill shall consist of approved granular material obtained from excavations or borrow pits and shall exclude stones larger than 25mm in size. The material shall be capable of being compacted to a stable mass and shall achieve a laboratory CBR of 20% after 96 hours soaking, when compacted to 95% of the laboratory maximum dry density tested in accordance with relevant Indian standards.

Class III Trench Fill shall consist of approved granular material obtained from excavations or borrow pits, shall be capable of being compacted to a stable mass and shall achieve a laboratory CBR of 20% after 96 hours soaking when compacted to 95% of the laboratory maximum dry density.

Where separate bedding material is required for pressure pipes up to and including 300mm diameter, it shall consist of Class I Trench Fill.

7.4.7 Bedding for Pipes

Unless directed otherwise by the Engineer-in-charge, should any trench invert be over-dug, it shall be made good with the class of material specified for the layer immediately overlaying it.

If any bedding material is damaged by water, sewage, collapse of trench sides or in another way, it shall be removed from the trench and replaced with new material before any pipes are laid or re-laid.

The required bedding and surround for rigid pipes shall conform to one of the following three categories:

Class B bedding shall comprise a Class I Trench Fill bed at the base of the pipe with a Class II Trench Fill surround to the sides and the crown.

Class G bedding shall comprise a full Class I Trench Fill surround to the pipe. The minimum thickness of fill material shall be 200mm.

Class Z bedding shall comprise a full mass concrete bed and surround.

The category of bedding used in the Works shall be as noted on the Drawings or instructed by the Engineer-in-charge.

Where Class Z bedding is required, the backfill shall not be commenced until at least twenty-four hours after the placing of the concrete has been completed. Heavy rammers shall not be used nor shall traffic loads be imposed until at least seventy-two hours after concreting, or as directed by the Engineer-in-charge.

Where Class B or Class G bedding is required, the bedding material shall be hollowed out to receive the sockets and allow proper jointing and wrapping. The bedding shall be completed to the required level and compacted such that the pipes are evenly supported over their entire lengths.

Bedding for pipes shall be constructed by spreading and compacting material over the full width of the trench.

7.4.8 Backfilling to Pipes

During placing or compaction of backfill, the Contractor shall take all precautions necessary to prevent movement or flotation of pipes.

The side fill shall be placed and compacted as soon as possible after pipe-laying and testing, or as soon as it is safe to do so without damaging concrete beddings or surrounds.

Timbering or sheeting shall be withdrawn progressively as filling proceeds where practicable to ensure that no voids are left in the filling.

Initial backfill shall be placed over the pipe as soon as possible to provide a protective layer of material, hand-compacted to a level 300mm above the crown of the pipe. Remaining backfill shall then be placed and thoroughly compacted in layers not exceeding 200mm thick.

Material shall not be dropped from an excessive height. Where required water may be added to assist compaction.

Power operated rammers or other mechanical compaction equipment shall not be used within 300mm of the top of the pipe.

Heavy mechanical equipment shall not be allowed to cross any pipeline until the trench has been completely backfilled and compacted.

7.4.9 Standards of Compaction

The standards of compaction of trench fill materials shall be as follows:

- **Well-compacted:** The material shall be compacted by mechanical means in layers not exceeding 200mm compacted thickness. The density obtained in each layer shall not be less than 95% of the maximum dry density determined as per Indian standards or as directed by the Engineer-in-charge. Tests shall be carried out as instructed by the Engineer-in-charge, up to a maximum of two tests per layer per 100 metres of trench.

- **Hand-compacted:** The material shall be thoroughly compacted by hand in layers not exceeding 100mm compacted thickness, using an iron rammer weighing not less than 4.5kg. The density obtained in each layer shall not be less than 95% of the maximum dry density determined using relevant Indian standards or as directed by the Engineer-in-charge. Tests shall be carried out as instructed by the Engineer-in-charge, up to a maximum of two tests per layer per 100 metres of trench.

7.4.10 Concrete Surround

Concrete provided as a protective surround to pipes shall comply with the requirements for mass concrete as detailed elsewhere in the Specification. Where pipes with flexible joints are used, concrete protection shall be interrupted over its full cross section at each joint by a shaped compressible filler consisting of 20mm thick bitumen impregnated filler unless specified otherwise in the Contract. Such joint filler shall be provided at each pipe joint as indicated on the drawings unless directed otherwise by the Engineer-in-charge.

Concrete surround will normally be required under roads where the cover to the pipe crown is less than 900mm and in gardens and areas not subject to traffic loading where the cover is less than 600mm. Additionally, the Engineer may direct the Contractor to lay pipes in concrete surround where in his opinion the pipes are vulnerable to corrosion by adverse ground conditions or exposed to damage by other Contractors.

RTR pipe shall be protected from direct contact with the concrete in accordance with the pipe manufacturer's recommendations.

Concrete shall be as per shown on the drawings. The minimum thickness of concrete between the bottom of the pipe and the trench shall be 0.25x nominal pipe diameter, subject to 150mm minimum, with a minimum 100mm beneath sockets. Additional concrete cover maybe needed to prevent floatation during the placing or the pipe may need anchoring at the Engineers discretion to secure during concrete placement.

Flexible pipes with concrete surround shall have a maximum pipe length of 3 metres. The pipes shall be set to correct alignment allowing for deflection with appropriate isolation joints where detailed in the standard drawings.

The Contractor may use wooden folding wedges on precast concrete blocks cast at least 7 days in advance to support the pipe before concreting. The wedges should be the same length as the blocks and the blocks shall be founded on the trench bottom to support the pipe adequately without settlement. The wedges shall be removed during placing concrete. Blocks may have thin tie wires cast in to assist in holding down the pipe during concrete pouring. Gaps of 450mm long shall be left at the ends of each pipe for expansion/movement joint as shown on the drawings.

No traffic load shall be placed on the concrete surround within 72 hours of the concrete surround.

7.4.11 Marker Tapes

The Contractor shall install approved marker tape during backfilling work over buried pipes, cables, conduits and ducts, as required. The tape shall be compliant with Indian standards.

Where required by the relevant utility or authority, tiles shall be provided to their approval.

7.5 Construction of Pipework and Manholes

7.5.1 Pipework and Manholes–General

The Contractor shall construct pipelines, manholes and chambers to the lines and levels shown on the drawings and provide the materials in accordance with the Specification.

All pipes, half-pipes, junctions, bends, fittings, etc. shall be of first class quality and obtained from an approved manufacturer

Lowering of pipes during installation to be done with crane and trained staff only.

7.5.2 Concrete Stools, Anchor and Thrust Blocks

Except where welded, laminated or self-anchoring joints are used, thrusts from bends and branches in pressure pipes shall be resisted by concrete thrust blocks cast in contact with undisturbed ground. Concrete stools, anchor and thrust blocks, and other supports for pipes shall be cast in situ or fixed after the installation has been finally positioned to the lines and levels shown on the drawings but before loading or charging the installation.

Unless otherwise directed by the Engineer-in-charge, concrete shall be cast directly against the undisturbed face of the trench excavation. The Contractor shall maintain correct clearances in order that bolts, nuts and joints may be tightened or removed after supports have been installed. The Contractor shall provide temporary supports pending the casting of fixing of permanent supports, fixings, fittings, anchors and stools. Any additional excavation required to accommodate thrust blocks shall be carried out after the bend or branch is in position and the thrust face shall be trimmed back immediately prior to concreting.

Where thrust blocks are cast against flexible pipes the pipe shall, prior to concreting, be wrapped with 2 layers of an approved tape of minimum thickness 1.15mm applied with 50% overlap.

All bends and stop-ends on pressure mains shall be securely anchored by concrete placed between the bend or stop-end and the solid undisturbed vertical face of the trench. The concrete shall be as detailed on the drawings.

If directed by the Engineer-in-charge, the Contractor shall provide detailed drawings and calculations of his proposed supports and thrust blocks for approval.

Unless otherwise directed, thrust blocks shall be allowed to develop adequate strength with a minimum setting time after casting of 24 hours before any pressure is applied to the pipeline.

7.5.3 Unloading and Laying out Pipes

Pipes and specials shall be unloaded with great care to avoid breakages and allow inspection of their state on arrival. If they are shipped in packs or pallets, each pack or pallet shall be lifted individually with suitable lifting equipment. If the pipes have to be unloaded singly and by hand, this shall be done by means of skids and check ropes and no pipes shall be dropped

or allowed to roll unchecked. Pipes shall not be allowed to roll together and shall be wedged to prevent further movement. The Contractor shall submit the manufacturer's proposals for unloading, stacking and laying out pipes.

PVC-U pipes shall be uniformly stacked along the pipe length and shall be given side support. Stacks shall be limited to 1 metre in height or 4 layers; whichever is the lesser. PVC-U, PE and RTR pipes and fittings shall be stored completely under shade at all times.

Pipes or specials shall not be laid out in such a manner as to impede traffic, or obstruct paths or accesses to properties. Pipes or specials shall not be laid out in beds of ditches; every precaution shall be taken to preserve their cleanliness before laying.

All pipes and specials shall be carefully examined before laying and any damage to the pipe coating or lining shall be made good to the approval of the Engineer-in-charge.

Before the trench is backfilled, the pipes shall again be examined and any further damage caused to the coating during laying shall be made good.

7.5.4 Laying and Jointing Pipes

All pipe systems shall be laid to true and even falls and to the lines and levels shown on the drawings. The Contractor shall supply and fix all necessary bends, tees, tapers, valves and other specials, and shall carry out all necessary cutting, coring, drilling holes, jointing and connecting to new and existing work.

Pipes shall be kept free from mud, debris and other obstruction during laying and until handed over, and suitably sized stoppers shall be used to block up the ends of all pipes, junctions, etc., while preparing the trench for the next pipe or after working hours. The excavation shall in all cases be carefully completed at least 6 metres but not more than 50 metres in advance of the laying of the pipes, unless agreed otherwise by the Engineer-in-charge.

Where ground water is encountered, it shall be kept below the formation level of the trench.

Before laying, each pipe shall be brushed out and examined and each spun iron pipe shall be tested for soundness by being tapped with a hammer while the pipe is suspended clear of the ground.

Each pipe shall be carefully lowered onto the prepared bed by means of the necessary slings and tackle. If the prepared bed is damaged and if stones are dislodged into the trench, the pipe shall be raised and the bed made good and stones removed before pipe laying is continued.

Pipes shall not be jointed before being lowered into the trench without the permission of the Engineer-in-charge.

Joint lubricants for sliding joints shall have no deleterious effect on either the joint rings or pipes, and be unaffected by the liquid to be conveyed. Joint lubricant for potable water pipes must be approved for use with potable water.

No pipe or pipeline may be used for trench drainage purposes without the permission of the Engineer-in-charge.

Where pipes with flexible joints are required to be laid to curves, the deflection at any laid joint shall not exceed two thirds of the maximum deflection recommended by the manufacturer.

Between adjacent manholes, the total length of pipeline shall remain uncovered until it has been inspected and satisfactorily tested. Such inspection shall not relieve the Contractor of his responsibility for delivering the whole of the Works in a watertight, correct and perfect condition.

No pipe shall be covered up until it has been inspected and satisfactorily tested as specified.

Unless otherwise approved by the Engineer-in-charge, sewers shall be laid from the downstream end with the pipe sockets facing upstream.

Where pipes are built into manholes, pits, chambers, thrust blocks and other firmly-founded structures, at changes in class of pipe bedding and at other locations where differential settlement can be expected, a flexible joint shall be provided as close as is feasible to the outside face of the structure and a second pipe (rocker pipe) provided as set out below:

Diameter, D mm	First (maximum length projecting) mm	Second (rocker mm)	Pipe Pipe pipe)
150 to 400	400	600	
Larger than 400	D/2	1.5D	

7.5.5 Cutting Pipes

Pipes shall be cut by a method which provides a clean square profile, without splitting or fracturing the pipe wall, and which minimises damage to any protective coating. Where necessary, the cut ends of pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used and any protective coatings shall be made good. Spigot ends shall be prepared for reuse in accordance with the manufacturer's instructions.

Where GRP or ductile iron pipes are to be cut to form non-standard lengths, the Contractor shall comply with the manufacturer's recommendations in respect of ovality correction and tolerances to the cut spigot end. Where concrete pipes are cut, any exposed reinforcement shall be sealed with an epoxy resin mortar.

7.5.6 Junctions

The Contractor shall install junctions where directed. Before the trench is refilled, he shall make accurate measurements of the distance from each junction to the centres of the nearest manholes upstream and downstream, and record the invert level of the branch and shall furnish this information to the Engineer-in-charge, with details of the size and direction of the branch.

7.5.7 Puddle/Anchor Flanges

Where pipes are built through concrete walls, puddle/ anchor flanges shall be provided. Cast-on or welded flanges shall be provided. This requirement shall apply to all concrete structures and chambers except manholes.

7.6 Testing

7.6.1 Testing General

The Contractor shall ensure that all pipes, fittings, specials etc. are watertight to the satisfaction of the Engineer-in-charge.

The Contractor shall supply all the necessary labour, blank flanges, anchors, air-valves, test pumps, gauges, clips, stoppers etc. for testing. Prior to use, the pressure gauge shall be tested at an approved independent testing laboratory and test certificates provided to the Engineer-in-charge.

Water required for testing shall be obtained from an approved source. The pipeline shall be filled in such a way that the pipework is not damaged in any way. The Contractor shall supply and dispose of the water for testing.

The Contractor shall give the Engineer-in-charge adequate notice in writing of his intention to test any pipeline (at least 24 hours for pressure pipelines). Testing shall not proceed until permission to do so has been received from the Engineer-in-charge. Permission to test shall not imply approval of the method nor relieve the Contractor in any way of his responsibilities in connection with the Works.

All pipes shall be cleaned and tested as the work proceeds. If 3 (three) months or more shall elapse between the final test and the pipeline being taken over, the Engineer-in-charge may require the pipeline to be retested as specified for the final test.

Pipes, fixtures and fittings which fail under test, or are broken by or found to be broken under test, or considered by the Engineer-in-charge as a result of the test to be unserviceable shall be rejected and removed from the site forthwith and shall be replaced. Replacement shall be at the Contractor's expense if, in the opinion of the Engineer-in-charge, failure is due to the Contractor's treatment, faulty installation of the component or inadequate inspection. After replacement the testing shall be repeated.

In the event of failure of a section of pipeline causing damage to any adjacent road, pavement, structure or existing service, the Contractor shall be liable for all remedial work necessary to restore the damaged item to its original condition.

On completion and prior to disinfection, if so required, pipes and specials shall be cleaned out and flushed with water, all silt, mortar, concrete debris and other obstructions being removed.

Such testing or inspection of any of the Works shall not be held to relieve the Contractor from his responsibility to deliver the whole of the Works in a sound and clean state, free from leakage and other defects under the maximum test or operating pressure, whichever is the greatest.

Upon satisfactory testing of a pipeline or section of a pipeline the Contractor shall submit a test acceptance form in a format to be mutually agreed, for signature by the Engineer-in-charge. This form shall be the true record of all acceptable tests. The Contractor shall retain one copy on site at all times.

7.6.2 Testing of PVC-U Pipelines

In addition to the other tests as described in the Contract, immediately after backfilling, a wooden ball 3% smaller than the pipe bore shall be passed through PVC-U pipelines. A further test using a wooden ball 5% smaller than pipe bore shall be carried out prior to the pipeline being put into service.

7.6.3 Testing of Gravity Surface Water Systems

Pipes up to and including 600mm diameter shall be air-tested in lengths from manhole to manhole before, during and after backfilling. Pipes greater than 600mm in diameter shall be visually inspected internally.

In addition to the above, all pipelines shall be inspected on completion to ensure that there is no infiltration of ground water, where the pipeline is below the water table. Manholes shall be visually inspected to ensure that there is no discernible infiltration.

Manholes and chambers shall be water-tight. Water testing of surface and land drains will not generally be required unless specifically ordered by the Engineer-in-charge.

Remedial work shall be carried out as necessary to obtain satisfactory air-tests and acceptable exclusion of ground water.

7.6.4 Testing of Pressure Pipelines

Before backfilling, pressure pipework shall be hydrostatically tested in accordance with relevant Indian standards for a continuous period of 4 hours. Cement lined pipes shall be kept at working pressure for a continuous period of 24 hours prior to carrying out of the test.

Sections for testing shall be in lengths approved by the Engineer-in-charge. The Contractor shall submit his proposals for pressure testing prior to commencement of pipe laying. Road crossings and other short sections of pipe installed independently of main runs shall be tested separately. Testing shall follow immediately upon pipe laying and, upon satisfactory completion of the test, shall be backfilled so that tested lines are not left exposed.

Test pressure measurements shall be made at the lowest point of the pipeline section under test.

The system test pressure shall be calculated from the design pressure by:

If the surge is calculated:

System Test Pressure = (Design Pressure + Surge) + 1 bar

If surge is not calculated:

System Test Pressure = Design Pressure x 1.5

Or System Test Pressure = Design Pressure + 5 bar whichever is the least

The Contractor shall completely fill the section of pipeline under test with potable water or where approved final effluent or raw water, expelling air from the pipe. Before applying the test pressure, air valves shall be isolated from the main to avoid damage to the floats. Testing against valves is not permitted unless directed by the Engineer-in-charge.

During the test, water shall be added if the pressure drops, the test pressure restored, and the amount added shall be recorded. On each test length the acceptance criteria shall be that the amount of water added does not exceed 0.1 litre/mm of diameter/km of length/24 hours/30 metres of head. Where pumping is required to maintain the pressure it shall be done at 30 minute intervals.

Following successful testing of all sections, the pipeline in its entirety shall be re-tested to the same test pressure as for the individual sections.

Before the pressure testing of the pipeline is carried out, the trench shall be sufficiently refilled to ensure that the requisite anchorage is provided for each pipe as this will prevent movement during the testing period.

7.6.5 Test Pressure for Valves

Gate and check valves shall be tested to the test pressure of the main in which they are situated or to the maximum pressure rating of the valve, whichever is the greater. The test shall be sustained for 30 minutes. Valves shall be works tested and independently certified. Air release valves shall withstand a test pressure of 16 bar. They shall be works tested and independently certified. Test pressures may be lower where specified by the Engineer-in-charge.

7.6.6 Flushing of Pipelines

Before the pipeline is put into service it shall be flushed at washouts and valves etc., to ensure complete freedom from obstructions and debris. Unless directed otherwise by the Engineer-in-charge, the Contractor shall provide the water for flushing which shall be of potable quality.

7.6.7 Disinfection of Potable Water Pipelines

Mains and services for potable water shall be disinfected prior to commissioning. The Contractor shall submit a method statement indicating means of testing and obtaining test results. The Engineer-in-charge may direct the Contractor to use particular testing laboratories.

7.6.8 Testing RTR Fittings

Tests on RTR fitting fabrication will be in accordance with relevant Indian standard and in particular;

1. The laminate shall be fully cured and shall show full resistance to a commercial acetone sensitivity test.

2. The laminate shall give Barcol Hardness of at least 90% of the resin manufacturer's recommendations. The measurement of hardness by means of a Barcol Impressor shall be carried out in accordance with relevant standards.
3. Resin burn off tests shall be performed on cut-outs for man-ways or other apertures. Where no such cut-out exists the Engineer-in-charge reserves the right to have 50mm diameter cut-outs for checks to be made local glass reinforcement content; the laminate shall then be repaired by the manufacturer. The tests shall be conducted in accordance with the relevant Indian standards, except that the result shall define glass content.
4. Where directed by the Engineer-in-charge the following strengths of the laminate shall be determined as per relevant Indian standards as follows:
 - Ultimate tensile unit strength, lap shear strength and extensibility
 - Flexural strength.
 - Where a laminate has been designed to take bolts in the make up of the structure, tests for bolt bearing strength shall be performed.
 - Where a laminate is to be used in conjunction with electrical control equipment, electrical strength and insulation resistance tests in accordance with Indian standards may be called for.
5. Additional tests may be called for at the discretion of the Engineer-in-charge.

All the tests reference above shall be witnessed unless waived in writing by the Engineer.

Test Certificates shall be obtained as follows:

From the resin supplier for the following properties of the resin when cured as proposed for the laminate manufacturing procedure:

1. Heat distortion temperature.
2. Barcol hardness.
3. Extension to failure of fully cured unreinforced resin.

From the glass reinforcement manufacturer for all the different grades and types of glass employed in the fabrication of the laminate

8. BLOCKWORK

8.1 Cement

Cement shall be Ordinary Portland Cement or any other cement as specified complying Indian standards.

8.2 Aggregate

Aggregate shall be natural aggregate complying with Indian standards.

8.3 Sand

Sand for mortar shall comply with specifications as specified.

8.4 Lime

Lime for mortar shall be hydrated semi-hydraulic lime complying with Indian standards.

8.5 Water

Water for mortar shall be as specified for Concrete.

8.6 Mortar Plasticiser

Mortar plasticiser shall be of an approved proprietary air-entraining type complying with Indian standards.

8.7 Precast Concrete Blocks

Precast concrete blocks shall be manufactured and tested in accordance with relevant standards and shall comply with Local Orders. Unless detailed otherwise, blocks shall be of the following types:

1. Minimum compressive strength of 7.5 N/mm² for non-load-bearing blockwork and 12.5 N/mm² for load-bearing blockwork, using Sulphate Resisting Cement and suitably graded fine and coarse aggregate, for use below damp-proof course level.
2. Minimum compressive strength of 7.5 N/mm² for non-load-bearing blockwork and 12.5 N/mm² for load-bearing blockwork, using Ordinary Portland Cement and suitably graded fine and coarse aggregate, for use above damp-proof course level.

The constituents of the concrete mix shall comply with the criteria laid down for constituents in the Concrete Specification. Blocks shall have a density (calculated by dividing the mass of the block by the overall volume) in the range 1500 kg/m³ to 2160 kg/m³.

Each block shall be clearly and permanently marked indicating the date of casting and its use whether for below or above damp-proof course level.

Blocks shall be of work size 200mm high, 400mm long and 200mm or 100mm thick, and shall be solid unless detailed otherwise.

Where hollow blockwork is specified for work above damp-proof course level, the blocks shall have two voids running vertically; the minimum thickness of outside skin shall be 30mm and of diaphragms 25mm; the maximum longitudinal dimension of any one void shall be 150mm.

Blocks shall be protected from the sun and cured for not less than 10 days.

8.8 Testing of Blocks

The Contractor shall supply certificates of tests carried out on representative samples of each batch of blocks.

The general procedure for sampling and testing shall be as per Indian standards

8.9 Special Blocks

Special shaped blocks, required to form proper bonding, which cannot be made in a standard block-making machine may be made in approved wooden moulds.

8.10 Concrete Screen Walling Blocks

Ornamental precast concrete screen walling blocks shall be to the sizes and shapes shown on the Drawings or as directed.

Blocks shall be obtained from an approved supplier.

8.11 Damp-proof Courses

Felt for damp-proof courses shall be bituminous 3-ply felt to relevant Indian standards.

8.12 Reinforcement

Reinforcement for walls shall be stainless steel (grade 316) expanded metal mesh strip supplied by an approved manufacturer. Unless detailed otherwise on the Drawings, galvanised mesh shall be used.

Rod reinforcement for concrete infill and lintels shall be as specified for Concrete.

8.13 Anchor Ties

Slots and anchors for bonding to concrete shall be of 18-gauge galvanised steel supplied by an approved manufacturer, and fixed on an alternate course.

8.14 Movement Joints

Sealant for movement joints shall be gun grade quality and shall conform to Indian standards.

Movement joints shall be primed with an appropriate primer and backed with debonding tape or foam prior to sealing.

Sealant, debonding tape or foam, and primer for sealant shall be obtained from the same manufacturer unless otherwise approved.

8.15 Sliding Joints

Sliding joint materials shall be supplied by an approved manufacturer and shall comprise a layer of self-adhesive

PTFE strip followed by a layer of uncoated PTFE strip applied strictly in accordance with the manufacturer's instructions.

8.16 Mortar Mixes

Mortar for blockwork below ground floor slab level and in contact with the ground shall be a mix measured by volume of one part of Sulphate Resisting Cement, one quarter of a part of lime and three parts of sand. The minimum compressive strength at 28 days shall be 11 N/mm².

Mortar for blockwork above ground floor slab level shall be a mix measured by volume of one part of Ordinary Portland Cement, one half of a part of lime, and four and a half parts of sand. The minimum compressive strength at 28 days shall be 5.5 N/mm².

Plasticiser may be used in lieu of lime; the quantity of plasticiser used shall be strictly in accordance with the manufacturer's recommendations.

Mortar shall be tested in accordance with Indian standards at the rate of one sample per 25m² of blockwork.

8.17 Mortar – General

Mortar shall be mixed dry and then with the minimum practicable quantity of water added until the correct consistency is obtained. Mortar shall be thoroughly mixed on a clean platform and shall be used as mixed. Mortar shall be used within one hour of the addition of water. No mortar which has been allowed to set prior to use shall be used in the work.

8.18 Laying of Damp-proof Courses

Bituminous felt damp-proof courses shall be laid on an even bed of mortar in accordance with relevant standards and shall be lapped 150mm at joints.

8.19 Laying of Blockwork

Blockwork shall be laid in accordance with the recommendations of Indian standards.

Blocks shall not be set in place within 28 days of casting.

Blocks shall be wetted by sprinkling with fresh water before being laid.

Blocks shall be laid in stretcher bond, solidly bedded, jointed and flushed up in mortar. Joints shall have a nominal thickness of 10mm and extreme thicknesses of 5mm and 15mm.

Blockwork shall be set out and built to the respective dimensions, thicknesses and heights required and the Contractor shall set out courses, openings and the like with approved setting out rods.

Blocks shall be well buttered with mortar before being laid and joints shall be thoroughly filled and flushed up from the top as the work proceeds. Blockwork shall be carried up in a uniform manner, no portion being raised more than one metre above another. Perpend, quoins and the like shall be kept strictly true and square and the whole properly bonded together and levelled.

Where a horizontal or vertical joint is not solidly filled or where it is found that the Contractor has used blocks other than the blocks specified the whole panel of wall shall be considered suspect and shall be removed and rebuilt.

Wall faces which are to receive an applied finish shall be hacked and the joints shall be raked out to form a key.

8.20 Fair Faced Blockwork

Wall faces required to be finished fair face shall be built with blocks having unblemished surfaces, with good clean arises to all exposed edges and shall be pointed with a neat flush joint as the work proceeds.

Before any fair faced block walls are commenced the Contractor shall provide for approval a specimen panel of minimum size 2 metres square. Thereafter all fair faced blockwork shall conform to this approved standard.

Holes through fair faced blockwork shall be saw-cut, drilled or formed with original faces of saw-cut blocks to give a neat fair faced appearance without mortar rendering.

8.21 Load bearing Walls

Load bearing walls required to support a concrete floor or roof shall have a separating joint consisting of two layers of PTFE slip material at the top of the wall to provide a slip surface.

The corners and intersections of loadbearing walls shall be constructed with hollow blocks and shall have the voids filled with concrete reinforced with one 16mm high yield steel bar for the full height of each void. Bars shall be lapped with starter bars from footings. At L-shaped corners three voids shall be filled and at T-shaped intersections four voids shall be filled. To allow the removal of excess mortar prior to concreting, clean-out openings shall be formed at the base of reinforced sections of wall by the use of 190 x 190 x 90mm solid block supports laid with the 90mm dimension at centres to coincide with second course perpend.

The top course of walls shall be constructed of U-shaped blocks filled with concrete reinforced with two 16mm high yield steel bars to provide a continuous tie at the top of the wall and trowelled smooth to receive the slip materials.

The concrete mix for filling to hollow blocks, U-shaped blocks and lintels shall be grade 30/10/M as specified for Concrete.

8.22 Non-load Bearing Walls

Non load-bearing walls shall not be constructed at the same time as load-bearing walls but shall be built at least two weeks after the concrete slab formwork has been struck.

Non load bearing walls shall be tied to load bearing walls by 400mm long expanded metal strips, 50mm narrower than the former, built into alternate courses. Strips shall be built into load bearing walls and later embedded in the mortar joints of the non load bearing walls. Toothing into load bearing walls shall not be permitted.

Non load bearing walls shall be tied to concrete members by anchor ties at alternate courses. The slots of such ties shall be cast in at the time of concreting.

Joints between non load-bearing walls and load-bearing walls or concrete members shall be sealed both sides with 10mm wide sealant. For fair faced walls the joint shall be raked out each side to the required depth and for rendered or tiled walls the render or tiling shall be stopped 10mm short of the load-bearing element. Sealant shall be 10mm deep.

Where the top of a non-load-bearing wall abuts a load bearing structure a separating layer of an approved compressible filler material, of not less than 10mm thickness shall be inserted, and sealed both sides to a depth of 10mm.

8.23 Bearings for Lintels

Bearings for lintels shall be 150mm or the depth of the lintel, whichever is greater. Voids in hollow blockwork immediately below bearings shall be filled solid with concrete grade 30/10/M.

8.24 Cavity Ties and Anchors

Where both skins of cavity walls are built in blockwork, the skins shall be tied together with galvanised mild steel butterfly pattern wall ties to relevant Indian standard, spaced at the rate of one every 800mm horizontally and 400mm vertically, staggered, and every 400mm vertically at ends, jambs and quoins.

Where cavities of cavity walls are formed between blockwork and concrete, the blockwork skin shall be tied to the concrete by means of approved anchor ties.

8.25 Protection of Cavities

The Contractor shall ensure that cavities are suitably protected from any mortar, concrete or other material falling into them. He shall submit for approval details of the methods that he proposes to use.

8.26 Cavity Insulation

Cavity walls shall be insulated with 50mm rock wool batts supplied by an approved manufacturer.

8.27 Protection of Finished Walls

The Contractor shall ensure that finished walling is not damaged by subsequent operations. Newly or partially built walling shall be cured by covering with hessian or other approved material kept wet for three days

8.28 External Pointing

External joinery or metalwork bedded against blockwork or concrete shall be pointed with an approved silicone sealant.

9. BUILDING FINISHES

9.1 Screed and Render

9.1.1 Cement and Water

Cement and water shall be as specified for Concrete.

9.1.2 Lime and Sand

Lime for rendering shall comply with relevant Indian standard.

Sand for rendering shall comply with relevant Indian standard. Sand for screeding shall comply with Indian standards.

9.1.3 Floor Screed

Floor screed shall consist of a mix of four parts sand to one part of cement mixed with the minimum practicable amount of water. The water/cement ratio shall not exceed 0.42.

9.1.4 Laying of Floor Screed

Screed shall be laid in bays of area not exceeding 16m² and length not exceeding 5m. Screed in wet areas shall be laid to minimum 1% falls to floor drains.

Concrete floor slabs shall be sweep-blasted to remove laitance and shall have all loose material removed by brushing. Where electrical conduits and the like are to be buried in screeds they shall be rigidly fixed to the concrete floor and the screed continuously reinforced along the length of the conduit with a 150mm wide strip of galvanised expanded metal mesh. The mesh shall be positioned midway between the crown of the conduit and finished screed level and shall be fixed to the concrete floor at 300mm centres on both sides of the conduit by shot-fired masonry nails or other approved means.

Floor slabs shall be soaked for 12 hours with fresh water. Standing water shall then be removed by brushing or compressed air, neat cement grout scrubbed into the damp concrete surface and screed material laid immediately. Screed material shall be compacted and finished by wooden floats to the required levels and falls. The maximum permissible surface deviation shall be a 3mm gap under a 3m straight edge.

A minimum of 24 hours shall elapse between the placing of adjacent bays.

Finished bays shall be continuously wet cured for 7 days.

9.1.5 Dividing Strips

Dividing strips between different floor finishes, other than at entrance doors to toilets, kitchens and wet areas, shall be of approved heavy duty polished aluminium section, fixed to the substrate by stainless steel or aluminium alloy screws at 200mm centres on both sides of the strip. Dividers shall have a nominal exposed width of 6mm.

At entrance doors to toilets, kitchens and wet areas, the dividing strip shall comprise a 150mm wide x 50mm thick threshold of best quality Carrara polished marble fixed rigidly between jambs, 10mm proud of adjacent finishes. Marble shall be fixed down using 8mm diameter stainless steel pins at 250mm centres, epoxy grouted into both the concrete substrate and the underside of the marble. The gap below the marble threshold shall also be filled with epoxy grout. Through-drilling of marble will not be permitted. Samples of marble shall be submitted to the Engineer-in-charge/Employer for selection of a colour.

9.1.6 Self-levelling Floor Compound

Self-levelling floor compound shall be an approved proprietary cementitious free-flowing compound capable of being laid to any thickness in the range 1mm to 20mm, Nitoflor Leveltop GP, or equal and approved. For thicknesses greater than 10mm a clean sharp sand filler complying with relevant Indian standard, may be incorporated into the mix. The material shall have a minimum 28-day compressive strength of 30 N/mm² when tested as 50mm cubes cured at 35°C.

Prior to laying floor compound, the concrete substrate, which shall be at least 14 days old, shall be sweep-blasted to remove laitance. The blast-cleaned surface shall then be prepared and primed in accordance with the floor compound manufacturer's requirements. Floor compound shall be laid and finished in one layer, strictly in accordance with the manufacturer's printed instructions.

9.1.7 Concrete Surface Hardener

Where detailed, concrete floors shall be treated with an approved concrete surface hardening and dust proofing compound, applied strictly in accordance with the manufacturer's instructions. The hardener shall be of the penetrating type that reacts chemically with lime and other soluble particles in the concrete to form hard crystals permanently bound into the concrete matrix, as Nitoflor Lithurin, or equal and approved.

9.1.8 Protection of Finished Flooring

Floor finishes shall be covered up and protected during the course of the works, and cleaned off and left sound, true and level upon completion.

9.1.9 Render

Render shall be a mix measured by volume of one part of cement, one quarter of a part of lime and four parts of sand.

Render shall be mixed dry in a clean container or on a clean board and then with the minimum practicable quantity of water added. The water/cement ratio shall not exceed 0.42.

9.1.10 Application of Render

Blockwork walls shall be left for at least 14 days before the application of render.

As far as is practicable, rendering shall not be commenced until all mechanical and electrical services, conduits, pipes, and fixtures have been installed.

Irregularities in surfaces to be rendered shall be filled with mortar, without lime, 24 hours before rendering is commenced. Joints in blockwork shall be raked out before rendering to form a good key. Concrete surfaces to be rendered shall be sweep-blasted to expose aggregate and provide an adequate mechanical key for the render.

Surface to be rendered shall be clean and free from dust, loose mortar and all traces of salts.

Surfaces shall be thoroughly sprayed and soaked with fresh water, and surface water allowed to disappear before render is applied.

After preparation of surfaces, a coat of cement slurry shall be applied to the damp surface to be rendered by means of a tyrolean machine, and wet cured for 24 hours. The render coat shall then be applied to the damp slurry coat by means of trowels, between screeds laid, ruled and plumbed as necessary. This coat, which shall be to the required thickness, shall be allowed to set hard and then wet cured. Surfaces shall be finished with a sponge or with a wood or steel float to smooth flat surfaces free from all marks.

Wet curing of finished render shall be undertaken for a minimum of 4 days, but as long as is necessary to prevent cracking.

The Contractor shall ensure that the work is protected from direct sunlight during execution and curing, and that the surrounding building work and paving is protected from cement or tyrolean splashes.

9.1.11 Edges of Render

Bevelled or struck edges shall be worked where the render finishes against joinery work, fair faced concrete etc., as indicated on the Drawings, or as directed. Expanded metal render stops and angle beads, rigidly fixed to the substrate, shall be provided at all other edges and corners. Render stops shall be galvanised steel in dry air-conditioned areas internally, and stainless steel grade 316 externally and in internal wet and/or un-air conditioned areas.

9.1.12 Textured Protective Paint Finish

Textured protective paint finish to render and concrete shall be Arpax M50, as manufactured by W&J Leigh & Co, or equal and approved. The paint finish shall be applied as one coat of Arpax E318 sealer coat followed by one coat of Arpax M50 and one coat of Arpax M20, all strictly in accordance with the manufacturer's recommendations.

Alternative protective systems will only be considered if they provide equivalent protection to the specified system in terms of carbon dioxide diffusion, water vapour permeability, and salt spray/chloride permeability.

Up to four sample panels, each 1m², shall be prepared and submitted to the Engineer/Employer for selection of a preferred colour.

9.1.13 Smooth Protective Paint Finish

Smooth protective paint finish to render and concrete shall be Arpax M20, as manufactured by W&J Leigh & Co, or equal and approved. The paint finish shall be applied as one coat of Arpax M20, thinned 15%, followed by two coats of Arpax M20, unthinned, all strictly in accordance with the manufacturer's recommendations.

Alternative protective systems will only be considered if they provide equivalent protection to the specified system in terms of carbon dioxide diffusion, water vapour permeability, and salt spray/chloride permeability.

Up to four sample panels, each 1m², shall be prepared and submitted to the Engineer-in-Charge/Employer for selection of a preferred colour.

9.1.14 Tyrolean Finish

Tyrolean render shall be Cullamix ready mixed decorative wall finish, as manufactured by the Cement Marketing Company Ltd., or equal and approved, applied in accordance with the manufacturer's instructions.

All external rendering shown on the Drawings shall have a tyrolean finish unless detailed otherwise. The rendering shall consist of three coat work as CX4 Cullamix tyrolean finish specification D.

The finish shall be built up in layers to give the required honeycombed texture.

The interval between the application of successive layers shall depend on the suction of the surface. If the surface is sufficiently absorbent, the process shall be practically continuous. Where possible, an area shall be completed to an architectural feature at the end of a day's work but, where this is not possible, the operator shall feather out the tyrolean application in order that the next day's work will marry. The mixture shall be flicked on using an approved tyrolean machine.

Curing of tyrolean finish shall commence as soon as a water spray can be applied to the surface without causing damage and shall be continued for as long as is necessary to prevent cracks appearing.

9.2 Painting

9.2.1 Stopping

Stopping of surfaces prior to painting shall be carried out using the following materials:

1. For render it shall be cement-based filler.
2. For concrete or blockwork, it shall be of similar materials to the background and shall be finished with a similar texture.
3. For internal woodwork, hardboard, fibreboard and plywood to be painted it shall be putty complying with relevant Indian standard which shall be tinted to match the colour of the undercoat.

4. For clear finished woodwork it shall be a putty complying with Indian standards tinted to match the surrounding woodwork. This shall only be applied to small holes and minor blemishes. Large holes shall be repaired with graving pieces or grain pins.

9.2.2 Surface Preparation

Painting shall not be carried out on render which has not thoroughly dried out. The rendered surface shall be lightly rubbed down with fine sandpaper and all loose particles removed.

2 coats of approved brand of wall putty to be applied to exterior walls prior to application of epoxy primer and painting on chambers/tanks/buildings as per Manufacturer's instruction.

Concrete surfaces shall be clean, dry and free from loose material before painting.

Woodwork shall be brought to an even silky finish by the use of fine sandpaper. All woodwork for painting shall be knotted, stopped and primed.

Surfaces shall be cleaned and rubbed down between each coat.

9.2.3 Painting and Decorating – General

Prior to start of works, contractor to submit proposed colour schemes of paint shades and get it approved from AITL/Engineer incharge.

Painting and decorating shall be executed in accordance with the recommendations of relevant Indian standards.

Every possible precaution shall be taken to keep down dust before and during painting processes. No paint shall be applied to surfaces structurally or superficially damp and all surfaces shall be ascertained to be free from condensation, efflorescence etc before the application of each coat.

Primed or undercoated woodwork and metalwork shall not be left in an exposed or unsuitable situation for an undue period before completing the painting process. No exterior or exposed painting shall be carried out under adverse weather conditions, such as rain, extreme humidity (greater than 80%), dust storms etc.

Metal fittings such as ironmongery etc, not required to be painted, shall first be fitted and then removed before the preparatory processes are commenced. When all painting is completed, the fittings shall be cleaned and refixed in position. Electrical switches and other wall fittings shall be removed during painting.

The Contractor shall be responsible for protecting from damage paintwork and all other work during and after painting operations including the provision of all necessary dust sheets, covers etc.

Brushes, pails, kettles etc used in carrying out the work shall be clean and free from foreign matter. They shall be thoroughly cleaned before being used for different types or classes of material.

The Contractor shall provide suitable movable receptacles into which shall be placed all waste liquids, slop washings etc which shall on no account be thrown down any gullies,

manholes, sinks, WCs or any other sanitary fittings. Solid refuse or inflammable residues shall be removed from the site and disposed of in accordance with Municipality regulations.

Dilution of painting materials shall not be allowed except as recommended by the manufacturer and as approved.

9.2.4 Care of Materials

Paint and the like shall be brought to the Works in unopened and sealed tins; paint shall be not taken from one site to another.

Decorating materials shall be used within six months of delivery.

Paint and the like shall be kept well stirred and shall not be used when a thick sediment has settled. Any paint or the like which develops a skin on the contents within the tin shall be removed from the Works. Any residue left in one tin shall not under any circumstances be added to the contents of another tin.

The Contractor shall provide a suitable store in an approved position where paint and the like shall be stored without risk of deterioration from sunlight or weather.

9.2.5 Colour Scheme

Colours of building finishes shall be as detailed in specifications.

Colours shall not be mixed on site.

9.2.6 Workmanship

All grit and shot blasting, scraping, cleaning, stopping and painting shall be done by skilled operatives. Paint shall be applied by brushing or spraying in accordance with the manufacturer's instructions. Thinners shall only be added to paints in strict accordance with the manufacturer's permitted percentages and viscosity tests shall be carried out on random samples of mixed paints as directed. Brushes stored in thinners shall be thoroughly worked out to remove all thinner before re-use. Except as herein specified, no paint shall be applied to any surface when it is in the slightest degree damp; any paint applied to such damp surfaces shall be removed, re-prepared and the surface re-painted. The Contractor shall take all precautions necessary to prevent dust and dirt coming into contact with freshly painted surfaces or with surfaces being coated. Full coatings shall be applied in accordance with the rates of coverage recommended by the manufacturers, having regard to the surface texture and the conditions of application. Sample plates shall be prepared for approval and, when approved, shall be adopted as the standard to be achieved in the finished work.

The Contractor shall take particular care to instruct his workmen to use brushes of appropriate size in the application of paint. All cutting-in shall be executed with brushes not wider than 20mm. The use of masking tape shall be obligatory where directed.

The tint of each coat shall vary from the previous one and each coat shall be approved before the next is applied.

All the finishing tints shall be approved.

Each coat of paint and the like shall be thoroughly dry before the application of a further coat.

Not less than 24 hours shall be allowed between each coat, but the maximum intervals shall not exceed 21 days.

Before buildings are handed over the paintwork shall be free of all imperfections, chips etc. Floors, windows, fittings etc shall be thoroughly cleaned of splashes, drips etc upon completion.

9.2.7 Emulsion Paint

Emulsion paint shall be acrylic copolymer based paint applied in three coats in accordance with the manufacturer's instructions. The finished surface shall present a satin finish. Where used externally, emulsion paint shall be of external quality.

9.2.8 Gloss Paint

Gloss paint shall be alkyd based paint applied to primed surfaces in two undercoats and one or more top coats as required to produce a surface which is consistent and unstreaked in finish and colour.

9.2.9 Painting – General

Painting of buildings shall comply with the recommendations of Indian standard.

9.2.10 Painting of Woodwork

The moisture content of joinery timber at the time of painting shall not be more than 14%. All wrought woodwork to receive a clear varnish finish shall be rubbed down to a smooth surface. Wrought woodwork for painting shall be prepared and primed in the joiner's shop. Large or loose knots shall be cut out and plugged and filled. Nail holes, cracks or other defects shall be filled and levelled up with hard stopping. Small knots and pitch streaks shall then be given two coats of knotting. Joints shall be thoroughly primed before assembly.

As soon as knotting is thoroughly dry the whole of the joinery shall be given a coat of priming paint, care being taken to work the primer into all corners and crevices. End grain and surfaces which will be concealed upon erection shall be given two coats of primer. Spraying will not be permitted.

After erection on site a further coat of primer shall be applied to all accessible faces.

When the primer is dry, and before applying the undercoats, all cracks, nail holes etc shall be stopped. Woodwork which has been primed for some time shall be wiped down and rubbed with damp abrasive, leathered off and allowed to dry before applying undercoat.

Joinery shall then be given two coats of undercoating paint followed by one or more coats of alkyd resin enamel paint.

9.2.11 Clear Varnish

Clear varnish shall be polyurethane varnish obtained from an approved manufacturer.

Hardwood described as being polyurethane 'clear' or 'bright' varnished shall be filled, rubbed down and painted with one priming coat and three finishing coats of polyurethane clear high gloss wood finish, all in accordance with the manufacturer's instructions. Woodwork shall be lightly rubbed down between coats and care shall be taken to avoid the presence of dust by wiping the work with a 'tack' rag immediately before application of the varnish.

9.2.12 Stained Woodwork

Woodwork to have a stained natural finish shall be rubbed down and prepared to a smooth finish. It shall then be treated with two coats of an approved proprietary brand of stain/wood preservative which will impart a natural timber finish or approved shade to the woodwork. The stain shall be applied in accordance with the manufacturer's instructions to give an even-toned finish.

9.2.13 Polishing

Where woodwork is described as polished it shall first be stained with an approved wood stain. First quality button polish shall then be applied; the first two applications may be by brush but subsequent applications shall be by means of a polisher's rubber and shall be continued until the wood grain is completely filled.

9.2.14 Cement Paint

Cement paint shall be an approved cement-based textured decorative surface coating applied strictly in accordance with the manufacturer's instructions.

Sample panels of different colours shall be prepared, up to a maximum of four. Panels shall be 1.0m² and shall be removed prior to application of the approved paint.

9.2.15 Painting of Exposed uPVC Pipework

Exposed uPVC pipework, fittings and brackets shall be abraded and painted with three coats of exterior quality emulsion paint.

9.2.16 External protective coating for visible structures

Protective coating shall be applied to the external visible faces of the concrete structures which are normally exposed to sunlight. The coating shall be an elastomeric coating based on acrylic co-polymers. It shall be waterproof and UV stable. The surface preparation shall comply with the manufacturer's recommendations including the priming. Two coats of the coating shall be applied in accordance with the manufacturer's recommendations. Colour to be grey and a sample panel will be completed by the Contractor to the satisfaction of the Engineer-in-charge, in advance of the permanent coating works.

2 coats of epoxy paint or acrylic paint over epoxy primer over 2 coats of approved brand of wall putty shall be applied from outside the technology buildings/chambers/tanks for a

pleasant aesthetic appearance as per Manufacturer's specification and approved by Engineer in charge.

9.3 Miscellaneous

9.3.1 Building Finishes

All building finishes shall be in accordance with specifications specified and as approved by AITL/Engineer incharge.

Schedule of Finishes

UnitName	Floor Finish	Doors	Windows	Painting	Roof finish
LV Room	Flooring of antistatic material over 40 mm thk IPS (with abrasion resistant additive)	GI Rolling Shutter 16 gauge (see through)	Sliding Anodized Aluminium (heavy section) Glazed	Internal: Plastic paint External: waterproof weather coat paint As approved by AITL/Engineer incharge	Grading and water proofing
Control Room Battery room	Vitrified / Marbonite flooring with same skirting. The size of Marbonite tiles shall be min 600 mm x 600 mm & thickness min 10 –12 mm Top:-False/Raised (Computer)flooring for Control room Acid resistant tiles over Concrete flooring	35 mm thk. Solid Core Flush Door with heavy duty brass Hinges, Aldrop, Tower Bolt, Handles, etc. with plastic lamination	Sliding Anodized Aluminium (heavy section) Glazed	Internal: Plastic paint External: waterproof weathercoat paint As approved by AITL/Engineer incharge	False Ceiling Air Conditioned Grading and water proofing
DG House	40 mm thk IPS (with abrasion resistant additive)	As approved by AITL/Engineer incharge	As approved by AITL/Engineer incharge	As approved by AITL/Engineer incharge	As approved by AITL/Engineer incharge

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Note:

- e) The area of units shall be as planned by Bidder and the details of
- f) same shall be submitted with Bid.

9.3.2 Computer Flooring

Modular Computer type flooring shall consist of easily removed flooring panels supported on galvanised mild steel pedestals and be capable supporting distributed load of 2500 kg/m² and a concentrated load of 400 kg. Flooring panels shall be easily cleaned with a non-slip, grey coloured, anti-static surface. Pedestals and stringers shall be galvanised as per standard. The flooring shall incorporate ventilation outlets to assist with heat dissipation from the underside of the floor and be fire retardant in accordance with class F30 of relevant standard. Spare tiles and any specialist tools required for access and maintenance shall be supplied to the Employer.

9.3.3 Roller Shutter Doors

Roller shutter access doors shall be face mounted, hand-chain operated units. Doors shall be lockable when in the closed position. The curtain shall consist of interlocking galvanised mild steel contour slats, primed and painted brown in accordance with relevant Indian standard. The curtain shall be fitted with a sprung counter balance to ease operation and prevent the door free-falling during closing. Door guides shall be galvanised mild steel. A hood shall be provided to cover the operating mechanism, this shall be galvanised mild steel, primed and painted to match the curtain.

10. ROOF COVERINGS

10.1 Guarantee

The Contractor still provide a ten year guarantee for the roof waterproofing, and shall affect any necessary remedial work within 30 days of formal notification.

10.2 Cement

Cement shall be Ordinary Portland Cement or as specified in tender document.

10.3 Sand

Sand shall be wadi sand and shall comply with relevant Indian standard.

10.4 Water

Water shall be as specified.

10.5 Roof Screed

Roof screed shall consist of a mix of four parts of sand to one part of cement mixed with the minimum practicable amount of screed water. The water/cement ratio shall not exceed 0.45.

10.6 Waterproofing Materials

Water-proofing materials shall be Bituthene Primer HC, Bituthene Mastic HC, Bituthene 1000 HC, Bitushield HC and ServiJoint HC as manufactured by Serviced Ltd. or equal and approved by Engineer-in charge.

10.7 Insulation

Roof insulation shall be 50mm thick extruded "Roofmate" or similar approved polystyrene foam board with rebated edges.

10.8 Solar Slabs

Roof solar slabs shall be 600 x 600 x 50mm natural coloured precast concrete complying generally with BS 368.

10.9 Solar Slabs Support Pads

Solar slab support and spacer pads shall be 5mm thick x 120mm diameter PVC pads.

10.10 Gravel Borders

Gravel borders shall be 20mm single size crushed limestone from an approved source.

10.11 Laying of Roof Screed

Screed shall be laid in bays of area not exceeding 16m² and length not exceeding 5m.

Concrete roof slabs shall be sweep-blasted to remove laitance, shall have all loose material removed by brushing and shall be soaked for 12 hours with fresh water. Standing water shall then be removed by brushing or compressed air, neat cement grout scrubbed into the damp concrete surface and screed material laid immediately. Screed material shall be compacted and finished by wooden floats to the required falls. The maximum permissible surface deviation shall be a 5mm gap under a 3m straight edge.

A minimum of 24 hours shall elapse between the placing of adjacent bays.

Finished bays shall be continuously wet cured for 7 days.

10.12 Laying of Waterproofing Materials

Waterproofing materials shall be laid or applied in accordance with manufacturer's instructions. The waterproofing membrane shall be debonded for 75mm each side of screed bay joints by a layer of Visqueen or equal and approved.

On completion of waterproofing operations and prior to the laying of roof insulation, roofs shall be tested for water-tightness by ponding with freshwater of minimum depth 25mm for a period of 24 hours. Any leaks shall be repaired and the roof re-tested for water-tightness before subsequent operations are commenced.

10.13 Fixing of Aluminium Flashings

Aluminium flashings and the like for insitu work shall be cut from coils and kept free from contact with lime and all other corrosive agents before fixing. Aluminium surfaces in contact with concrete or mortar shall be painted with two coats of bituminous paint, prior to installation. Fixing shall be round head aluminium alloy screws to Indian standard, into Raw plugs or equal and approved.

10.14 Laying of Roof Insulation

Insulation boards shall be laid loose with staggered joints and shall be cut as necessary to fit tightly around protruding elements and against parapets.

10.15 Laying of Roof Solar Slabs

Solar slabs shall be laid loose to a square pattern on 5mm PVC support and spacer pads and shall be cut as necessary to allow a 150mm wide gravel border around protruding elements and Slabs shall be laid so that cutting is kept to a minimum and cut tiles are next to parapets; cut edges shall be rubbed smooth.

10.16 Laying of Gravel Borders

Gravel borders shall be 50mm thick and 150mm wide, laid loose over roof insulation between the edge of precast concrete solar slabs and protruding elements and parapets. Gravel borders shall incorporate stainless steel mesh cages to prevent the gravel border from falling through gargoyles.

10.17 Joints in Roof Screed

Joints in the roof screed shall be provided to correspond with any joints in the structural concrete.

10.18 Joints Sealing

Joint sealing compounds shall be impermeable ductile material of a type suitable for the conditions of exposure in which they are to be placed, and capable of providing a durable,

flexible and watertight seal by adhesion to the concrete throughout the range of joint movement.

11. CARPENTRY, JOINERY AND IRONMONGERY

11.1 Timber

The following timbers shall be used for carpentry and joinery work:

Timber for concealed work: Softwood used in the Works shall be approved European white wood and shall be treated before fixing with two coats of clear wood preservative.

Concealed surfaces of softwood joinery shall be primed.

Timber for exposed joinery: Timber for exposed joinery, and where referred to as hardwood, shall be approved selected Red Meranti or other approved species, unless specifically described otherwise, and shall conform to the relevant requirements of Indian standards.

11.2 Physical Condition of Timber

Timber shall be thoroughly seasoned and matured, sound, straight, free from warp, sapwood, signs of rot, shakes, large and loose knots, worm holes, wanes, cracks and other defects, and shall be sawn wrought die square and true on all four sides, or circular, to the scantlings and shapes on the Drawings.

Such timber may contain sound or tight knots on any surface provided that the mean diameter of any one knot does not exceed 20mm and the knot nowhere occupies more than one sixth of the width of the surface.

Samples of each of the approved hardwoods shall be kept on Site, stored in such a manner that the colour shall not be affected by sunlight. All hardwood subsequently used in the Works shall be of the same quality and colour as the approved samples.

Joinery shall be of sufficient size and strength for its specific function. All work whether hardwood or softwood shall comply with the requirements of relevant standard and no imperfection in the timber shall exceed that permitted of that standard for work to receive a clear finish and Class I for work to be painted with an opaque finish.

11.3 Moisture Content of Timber

Moisture content of timber shall comply with the requirements of relevant Indian standards

Softwood shall have a maximum moisture content of 15%.

Hardwood shall have a maximum moisture content of 12% and shall have been kiln dried or properly seasoned by other approved means.

The Contractor shall supply a copy of the timber supplier's certificate specifying the moisture content of the timber on delivery.

Timber for joinery work shall be properly stacked and protected from the weather and ground moisture and stored in such a way that the moisture content is not affected.

11.4 Plywood and Melamine

Plywood for external applications or in contact with external surfaces, shall comply with BS 1455, and be equal in quality to Grade 2, Type WRP.

Plywood for internal applications shall comply with relevant standards and be equal in quality to Grade 2, Type MR.

Face veneer shall be hard and durable and capable of being finished to smooth surface and be equal to an approved sample.

Melamine shall be not less than 1.5mm thick and shall comply with relevant standard, and of an approved colour and pattern.

Joinery finished with a decorative laminated sheet shall have a suitable balancing laminated sheet on the reverse side. The laminates shall be bevelled off with a plane along all arises.

Where laminate is fixed to doors or shelves etc., without a laminate to the outer edge, a raised hardwood lipping shall be provided and the laminate finished flush against the lipping.

11.5 Blockboard

Blockboard shall comply with relevant standard.

11.6 Adhesives

Adhesives for woodwork shall have proportions at least equal to values as specified in relevant standard.

Adhesives for fixing laminated plastic sheets to wood surfaces shall be petroleum based contact adhesives of approved type.

PVA types of adhesives will not be accepted.

11.7 Flush Doors

Flush doors shall comply with the requirements of Indian standards.

The core of solid core flush doors shall be constructed of longitudinal laminations of precision planed timber, butt-jointed and glued with resin based adhesive under hydraulic pressure, the whole forming a rigid fire-resistant raft. Both sides shall be covered with an external grade plywood not less than 6 mm thick and in accordance with the general requirements of Indian standards.

Flush doors shall have 10 mm hardwood lipping tongues into all edges. In the case of hardwood faced flush doors to receive a clear finish, the lipping shall match the facing veneer.

Hardwood face veneers shall be Group 1 Burma Teak, striped Sapele or other approved and shall be sliced out and matched as directed. For doors to receive a painted finish, rotary cut veneers may be used.

Metal air-transfer grilles shall be of approved aluminium design.

The Contractor shall store flush doors in a weatherproof shed and they shall be stacked in a flat position so that their true shape is preserved until required for use.

11.8 Framed, Ledged and Braced Board

Ends of match boarding shall be tongues and grooved into rails and stiles except at the bottom rail where a bevelled rebate shall receive the ends of the boards on the outside. Stiles and rails shall be morticed and tenoned together. Construction shall comply with relevant standard.

11.9 Fire-check Doors

Fire-resisting flush doors shall be constructed in accordance with the requirements of relevant Indian standard and shall have a half-hour fire-check rating in accordance with standard. Frames to fire-resisting doors shall have a 25mm deep continuous rebate or applied stop, the latter fixed in accordance with the standard.

Where air-transfer grilles occur in half-hour fire doors, approved intumescent honeycomb fire dampers shall be fitted.

11.10 Workmanship

The Contractor shall provide temporary doors where necessary during the progress of the work. Structural timbers shall extend in one piece between their supports or fixings or be jointed in an approved manner.

Where structural timbers are notched over supports, the depth of the notch shall not be more than two-fifths of the depth of the timber.

Where structural timbers are to be cut for the passage of pipes and the like, cuts shall be made as near to the neutral axis as possible and shall not exceed one third of the depth of the timber. Alternatively, they shall be made in the top edge of the timber as far from the centre of the span as possible.

Carpentry work which does not form an essential part of the structural fabric shall not be executed nor brought onto site until required, unless the Contractor can show that such materials will be adequately stored and protected.

Timber for joinery work shall be cut to size and shape, properly jointed and put together, including framing, gluing, dowelling, screwing and mortising etc.

Joinery shall be prepared and framed up and put together at least four weeks before being installed, but shall not be glued or wedged up until immediately before installation. Should any shrinkage or other defects appear in the work, the defective parts or units shall be replaced.

Joints and quality of workmanship shall be in accordance with relevant standard.

Timber required to be wrought shall have the faces brought to a smooth finish (not machine planed only) with all arises pencil-rounded.

Dimensions of joinery items to be fitted into structural openings shall be obtained in-situ and not from the Drawings.

Faces of timber in contact with the structure or other non-wood surfaces shall be treated with preservative and primed before fixing.

Cover beads, architraves etc. abutting any irregular surface shall be accurately scribed to fit.

11.11 Built-in Joinery

Where joinery works are to be built-in before the surrounding building carcass is completed, the Contractor shall ensure that the joinery works are set plumb and true and shall not be damaged or displaced by subsequent building operations.

11.12 Fixed-in Joinery

Where joinery works are to be fixed-in after the surrounding building carcass is completed, the Contractor shall ensure that the necessary fixings are incorporated in the carcass. The work shall be fixed in plumb and true and in accordance with the Drawings with all necessary wedges and shims as detailed or as may be directed. Overhead clearances and levels shall be maintained where applicable.

11.13 Frames and Linings

Frame and linings shall be secured at jambs by screwing to sawn softwood grounds, blockings or packing pieces. The latter shall be secured to the structure at jambs by screws and plugs at maximum 600mm centres.

11.14 Architraves, Door Stops, Skirtings etc.

Architraves, door stops, cover beads etc. shall be mitred at external angles and scribed at internal angles.

11.15 Access Panels

Access panels shall be easily removable, held in position with domed cups and screws, and be formed with 25mm block board, painted and with edges lipped with 15mm hard wood.

11.16 Fixings and Jointing

Softwood in carpentry work shall be put together with steel nails except where described as framed when it shall be properly jointed and held together with glue and steel screws. Fixings shall be steel screws.

Fixing of hardwood joinery shall be by means of brass wood screws to relevant standard.

Screws heads in work to be painted shall be properly countersunk and stopped. Screw heads in polished work shall be counter-bored and fitted with glued pellets (grain pins) produced with an appropriate tool and matching drill bit. The grain of the pellet shall be in the same direction as the grain of the member.

11.17 Screw Fixing of Aluminium

Where aluminium components are fixed to joinery work, aluminium or cadmium plated screws and washers shall be used.

Brass screws shall not be used in conjunction with aluminium.

11.18 Protection of Joinery from Damage

Joinery shall be protected from damage during the course of the Works. The Contractor shall ensure that doors, drawers etc., work easily and shall make all necessary adjustments before from damage handing over and during the maintenance period.

11.19 Ironmongery

Ironmongery, including latches, knobs, handles, closures, kick plates, indicator bolts, barrel bolts and cupboard door pulls and latches etc. shall be supplied by approved supplier. Names and reference numbers in the schedule shall be taken from the manufacturer's catalogue. The door locks should match the existing locks at the Sewage Treatment Works in order that the existing master key system can be retained. The locks are 'Union' Locks and the master key is ref. CHYC.

The fitting and fixing of ironmongery shall be in accordance with the manufacturer's instructions. Ironmongery shall be fitted prior to any finishing, removed for finishing and fixed on completion of all applied surfacing. Hinges shall be stainless steel or brass butt hinges countersunk-screwed to door and frame; generally, three 150mm hinges for framed doors (including panelled units of this type) and solid core doors and two 150mm hinges for flush plywood hollow core doors. Cupboards shall have 25mm wide brass continuous strip hinges for the full length of doors. Doors shall be properly and accurately hung to fit neatly into mortices in frames.

Locks shall be provided with two sets of keys and door closures shall be provided with adjusters.

All ironmongery shall be fixed with matching screws.

Ironmongery shall be kept carefully wrapped and protected until required and when fixed shall be carefully protected against defacement by mortar and plaster droppings, paint splashes, smudges etc.

13. GLAZING

13.1 Glazing Materials

Clear glass for internal partitions shall be float plate glass complying with Indian standard.

Solar glass for external windows shall comply with Indian standards.

Non-reflective, toughened glass shall be at least 5mm thick complying with Indian Standards. The Contractor shall be required to obtain samples for the Engineer-in-charge's approval.

13.2 Glazing – General

Glass shall be to the thicknesses recommended by the manufacturer calculated according to wind loading, pane size, etc. and as per relevant Indian standard.

Types of glazing (single or double, etc.) shall be as indicated on the Drawings.

Glass shall be cut to allow a minimum gap of 2mm all around. Glass in aluminium windows shall be set in neoprene or PVC gaskets and shall be secured with aluminium beads, all as appropriate to the aluminium profiles employed.

Glass in timber doors, partitions etc. shall rest on glazing blocks supporting the bottom edge and shall be completely bedded on front, back and edges with approved glazing compound. Surplus compound shall be neatly trimmed off.

13.3 Workmanship

Glazing shall generally comply with relevant standard. Glass shall be inserted into window frames by competent and experienced tradesmen. Neoprene or PVC insert glazing beads, where used, shall be accurately cut to length and matted at corners. Setting blocks shall be used to locate glass in the correct position. Tolerances required by the manufacturer of the windows shall be maintained.

Rebates to receive glass shall be cleaned and primed before glazing.

Surface preparation and painting adjacent to window frames shall be completed before window frame installation.

13.4 Cleaning

On completion, glass shall be cleaned and polished on both sides before handing over of the works.

14. PLUMBING AND SANITATION

14.1 General

14.1.1 Regulations

The water services and sanitation services installations shall be carried out in accordance with the regulations of the local water and health authorities and to their complete satisfaction.

14.1.2 Basis of Design

The Contractor shall design and execute the Works for the plumbing and sanitation system. The works shall comply with the requirements of all competent bodies including the following or local equivalents:

1. Local water and health authorities;
2. Insurance companies;
3. British Standards;
4. IHVE/CIBS Guide Books;
5. Fire Regulations;
6. Institute of Plumbing Data Book.

14.1.3 Working drawings

Large scale detailed isometric layout drawings shall be prepared by the Contractor and submitted for approval. The drawings shall show the size, positions, levels and falls of all pipes and ducts and the type and position of all fittings. In addition, the details of any builder's work required shall be shown together with pipe fixing positions and details of fixings. No materials shall be ordered until working drawings are approved in writing.

14.2 Buildings Drainage

14.2.1 General

Building's drainage shall comply with relevant standards.

14.2.2 Materials

Soil and ventilation pipes shall be of the captive ring seal type to relevant standard manufactured in uPVC by Bartol Plastics Ltd., or equal and approved.

Underground drainage pipes of 110mm size and above shall be uPVC to BS 3505 as water main manufactured by Hepworths Plastics or equal and approved with rubber ring seal joints. Underground drainage pipes below 110mm size shall be as specified for soil and ventilation pipes, unless detailed otherwise on the Drawings.

- Trapped floor gullies shall be uPVC as manufactured by Hepworth Plastics, or equal and approved complying with relevant standard. Gully tiles and grids shall be stainless steel. uPVC extension pieces shall be fitted to suit the levels detailed on the Drawings.
- 14.2.3 Roof terminals to vent pipes
- Ventilation pipes shall be provided with a uPVC balloon grating at the roof termination. Gratings shall be fixed 600mm above roof solar slab level.
- 14.2.4 Access pipes
- Access pipes shall be provided at the foot of soil vent stacks 300mm above floor level, and at bends above this level.
- 14.2.5 Long radius bends
- A long radius bend shall be fitted at the base of all soil, waste and rainwater stacks. Horizontal bends in pipes below floor slabs shall have a 1000mm radius.
- 14.2.6 Rainwater Stacks
- Rainwater stacks shall terminate at roof level with Rainwater purpose made inlets to allow an efficient water entry but with inlets some provision to discourage the ingress of sand. Proprietary ferrous inlets shall be plastic powder coated and fitted with appropriate adaptors to uPVC rainwater stacks.
- 14.2.7 Fixing of above-slab pipework
- Pipes shall be fixed to the structure at 2m centres for vertical runs and 1m centres for horizontal runs. Brackets shall be painted galvanized mild steel and fixings shall be stainless steel screws into raw plugs.
- 14.2.8 Expansion
- Provision shall be made for expansion by ensuring that spigot and socket joints are put together with the recommended 10mm gaps.
- 14.2.9 Testing of drains
- Drains shall be tested in accordance with the IS codes.
- 14.2.10 Cleaning drains on completion
- The Contractor shall, on completion of the work and immediately before handover, cleanse the whole of the drains with rods and accessories, cleanse all traps and gullies, bolt down all access covers etc., and shall leave the whole of the drainage system complete, in sound condition and efficient working order.

14.3 Sanitary Plumbing

14.3.1 Materials

- Waste and overflow pipework shall be of the push-fit ring seal type to IS code manufactured in polypropylene. Connections of overflow pipework to tanks and cisterns shall be by compression nut joints.
- 14.3.2 Waste traps**
- Sanitary fittings shall be fitted with white polypropylene traps on waste outlets in accordance with the following:
- | | | |
|------------|---|---------------------------------------|
| Washbasins | : | 32mm anti-syphon traps with 76mm seal |
| Sinks | : | 38mm anti-syphon traps with 76mm seal |
| Showers | : | 38mm tubular 'S' traps with 76mm seal |
- Traps shall comply with BS 3943.
- 14.3.3 Waste pipe gradients**
- Horizontal waste pipes below basins, sinks, urinals and the like shall fall at a uniform gradient of 1 in 45.
- 14.3.4 Access to waste pipes**
- Ends of horizontal runs of waste pipes shall be provided with access plugs. Blank ends shall have plugs to allow horizontal rodding; 40° bends, where wastes drop vertically, shall have swept tees or crosses with plugs on the top leg to allow vertical rodding.
- 14.3.5 Fixing of waste pipes**
- Waste pipes shall be fixed to the structure at 1m centres with polypropylene pipe clips, stainless steel screws and raw plugs.
- 14.3.6 Testing of waste and vent pipes**
- An air test shall be applied to all waste and vent pipes as follows:
- A gauge in the form of a glass U tube shall be connected to the drain plug in the section of pipe under test. Air shall be blown into the section of the pipe until a pressure equivalent to 100mm of water is indicated on the gauge. Without further blowing or pumping, the pressure shall not have fallen below 75mm after a period 5 minutes.
- The Contractor shall locate and remedy any defects found whilst carrying out the test, and the test repeated until found to be satisfactory.
- 14.3.7 Cleaning of sanitary Plumbing installation on completion**
- The Contractor shall, on completion of the installation and immediately prior to handover, thoroughly cleanse and leave the system in sound condition and efficient working order.

14.4 Sanitary Fittings

14.4.1 General

Sanitary fittings shall be obtained from approved vendor or shall be of a quality equal to that provided by the following manufacturers:

1. Armitage Shanks Ltd.
2. Ideal Standard Ltd.
3. Royal Doulton.

All fittings shall be obtained from one manufacturer, and shall be complete with all necessary plugs, chains, screws, washers, grommets etc.

14.4.2 Installation of fittings

The Contractor shall fix all sanitary fittings, including connections to waste pipes and water services, strictly in accordance with the manufacturer's recommendations. Concealed fixing screws shall be stainless steel and exposed screws chrome plated steel.

14.5 Water Meter

A. Overview of Meter

1. The meters shall transmit the real-time water flow data using cellular 4G communication to a secure cloud. The cloud service provider shall be empanelled with the Ministry of Electronics & Information Technology (MeitY).
2. The meter shall have provision for dual-SIM to overcome connectivity challenges from single network operator.
3. The SIM cards shall be supplied by the bidder based on the available network at the respective site.
4. The data shall be transmitted every 8 hours / 24 hours as required by the purchaser / buyer. Each transmitted data should have hourly log.
5. The detailed product and software requirements are mentioned below.

B. Technical specifications of Tamper Proof Digital Water Flow Meters with Telemetry

Metering Technology	Ultrasonic
Meter size	As required – to be updated by the buyer
Communication	Inbuilt dual SIM based 4G with fallback on 2G.

Power Source	<p>The meter and telemetry shall be operated using non-rechargeable batteries with minimum 5 years life (with 1 transmission per day).</p> <p>(The bidder may have to justify the life of the battery by disclosing/demonstrating the power consumption during different modes compared to the battery full capacity during technical evaluation)</p>
Sealing	The meter and telemetry system shall have proper mechanical sealing arrangement (Tamperproof).
Certification	ISO 4064: 2014
Ingress Protection	Meter along with the telemetry system should be housed and sealed in a single box and shall be IP68 compliant.
Accuracy	Class 2, T50, as per ISO 4064:2014
Performance Certificate	The meter manufacturer shall submit the performance test certificate as per ISO4064 from FCRI along with the bid.
Calibration Lab	<p>The meter manufacturer must possess a NABL-accredited permanent facility dedicated to the calibration and testing of Ultrasonic Flowmeters, with a flow range spanning from 1 m³/hr to 720 m³/hr. A valid certification must be attached with the bid.</p> <p>The meter manufacturer must provide a factory calibration certificate, issued in compliance with the NABL standard ISO 17025.</p>
Parameters to monitor	<p>The meter should transmit the following parameters to a secure cloud once / thrice in a day</p> <ol style="list-style-type: none"> 1. Timestamp 2. Cumulative flow volume 3. Cumulative pump working hours 4. Instantaneous flow rate at the time of transmission 5. Pump ON/OFF timestamp 6. Cumulative flow volume at every ON & OFF event

Cloud	The Communication / telemetry data should be directly captured in a secure cloud. The cloud service provider should be empanelled with the Ministry of Electronics and Information Technology (MeitY).
Data logging & transmission frequency	Every 24 hours / 8 hours by default. It should be configurable over the air.
Data Storage	The meter shall store the data internally in the meter for minimum 1 year
Battery Life	The battery shall run for a minimum of 5 years with 1 transmission per day. The battery shall be replaceable on field without any data loss.
Data Management Software	The bidder shall acquire the data in the secured cloud and shall provide a web dashboard and mobile application to view and download data from the meters. The cloud service provider shall be empanelled by the Ministry of Electronics & Information Technology (MeitY). Detailed software requirements are mentioned below.
Communication protocol	The device shall use any light weight Message Queuing Telemetry Transport (MQTT) protocol to establish connection with the server so that data can be transferred securely
Communication security	The communication from the device and the cloud shall be secured with a minimum TLS1.2 (Transport Layer Security) standard to ensure data integrity and privacy.
Integration with other dashboards	The bidder shall provide web APIs (Application Programming interfaces) to integrate the flow meter data with any other dashboard as desired by the purchaser.
Installation of Meter	
Location	The meter shall be installed at all the required locations as specified by the buyer.
Other requirements	

Material of construction	The body of the meter shall be brass/bronze/Powder-coated cast iron/engineering plastic
Meter indicator	The meter shall display the following parameters on LCD <ol style="list-style-type: none"> 1) Instantaneous flow rate 2) Cumulative flow volume 3) Flow direction

C. Software Requirements & Key Dashboard Features

Cloud environment	The Communication/telemetry data should be directly captured in a secure cloud. <u>The cloud service provider should be empanelled with MeitY.</u>
User logins	Logins shall be provided from the ground user level to a higher management level, grouping the devices as per the purchaser's requirement. The software shall have the provision for device grouping and hierarchy mapping as given.
Reporting	The software shall provide detailed reports downloadable from the application and also sent through automated email. The following minimum reports shall be available on the software. <ol style="list-style-type: none"> 1. Daily water usage report 2. Monthly water usage report 3. Division/cluster-wise usage report (eg - pump houses, individual zones, STP, etc.)
Data visualisation	The software shall have inbuilt data analytics with visualization for the minimum of the following features <ol style="list-style-type: none"> 1. Graph on daily water usage as per device/cluster 2. Graph on monthly water usage as per device/cluster/zone 3. Device-related static information including calibration certificate, installation date, calibration due date, etc.

Alerts and Notifications	<p>The system shall be able to generate the following minimum alerts via email/SMS/WhatsApp at the device and cluster level as per the requirement</p> <ol style="list-style-type: none"> 1. Daily water usage 2. Monthly water usage 3. Deviation from assigned limits/thresholds 4. Deviation from the operational hours
Device management	<p>The software shall display device details along with device performance such as</p> <ol style="list-style-type: none"> 1. Model details & Use case 2. Battery status 3. Network status 4. Calibration details
Advanced analytics	<p>The software shall be capable of generating on-demand advanced analytics and customized reports on the flow meter time series data.</p> <p>The advanced reports include but are not limited to</p> <ol style="list-style-type: none"> 1. Digital water balance 2. Comparative assessment 3. Water-related KPIs 4. Alarm summary

15 METALWORK

15.1 Minor Steelwork

- 15.1.1 Minor steelwork items shall comply with the section of the Specification covering Structural Steelwork.

15.2 Bolts

Expanding steel fixing bolts shall be stainless steel. When expanding bolts are used externally, fixing holes shall be sealed with approved resin grout.

15.3 Aluminium

Extruded aluminium shall be of BS alloy 6082 or equivalent; sheet aluminium shall be BS alloy 3103 or 5251 or equivalent, and all other of aluminium shall be of alloys which possess such properties that they will be durable in the climate that exists on Site.

Where practicable, all screws and bolt heads shall be concealed. Where this is impracticable on exterior faces, they shall be countersunk. Jointed work shall be closely fitted and finished smoothly and evenly.

Aluminium for angles and channels shall be BS alloy 6082 or equivalent together with bolts, screws etc, shall comply with the relevant requirements of BS 1161, BS 1473, and BS 1494, Part 1 and/or Code of practice for use of Aluminium alloys in Structures IS 8147-1976(R2005) Materials for windows, screens and doors, form of construction, finishes and performance shall generally be in accordance with the relevant Indian standard.

Where aluminium is in contact with any dissimilar metal or galvanised metal, the Contractor shall preclude the possibility of electrolytic action by applying a petroleum impregnated tape or similar protection, or by painting the contracting aluminium with bitumen, or by use of nylon washers and grommets to ensure a minimum separation of 2mm.

Fixings to timber shall be made with aluminium alloy screws.

The Contractor shall ensure that no aluminium is allowed to have contact with unset cement.

15.4 Aluminium Flashings and Trims

Aluminium sheet or strip shall not be less than 0.9mm in thickness with a degree of hardness corresponding to the recommendations in relevant Indian standard, appropriate to its thickness and composition. Fixing shall be with aluminium clips secured with aluminium alloy screws.

Aluminium sheet turned up against walls and upstands shall be welted to an aluminium flashing or apron strip. Flashings and apron strips shall be folded and tucked into blockwork joints to a minimum depth of 25mm, secured by folded aluminium sheet wedges, and pointed with sealant. Vertical joints in aprons and flashings shall be welted.

Care shall be taken to avoid contact of aluminium with dissimilar metals, and materials containing alkalis, etc.

15.5 Expanded Metal Mesh

For general purposes, expanded metal mesh shall comply with BS 405 and shall be galvanised and of approved shape and size.

15.6 Aluminium Louvres and Flyscreens

All aluminium parts shall be finished in stoved polyester powder paint or as recommended in Indian standards.

Louvres shall be continuous horizontal static single banks comprising cold roll formed louvres mounted at 50mm or 100mm pitch on concealed mullions and incorporating head, jamb and Sill sections with mullion shoes. Fixing shall be by means of stainless steel bolts through mullion shoes with isolating grommets and washers. Gaps between louvre frames

and structural openings shall be sealed both sides with the manufacturer's recommended mastic sealant.

The Contractor shall store, assemble and fix aluminium louvres and flyscreens in accordance with the manufacturer's instructions and shall leave them clean and in perfect working order on completion.

Sand trap louvers shall be installed whenever shown on the drawings as per the following specifications:

- The frame and blades are of high quality extruded aluminium profiled construction with the advantages of corrosion resistance and rigidity.
- Composed two sets of inverted U - channels mounted vertically on two opposite rows.
- Drain holes of diameter 20 mm are provided in two rows at the bottom of the louver for emptying filtered sand and dust.

Designed to separate and dust from the air stream.

15.7 Aluminium Doors and Windows

The Contractor shall arrange for the manufacture of bronze anodised aluminium windows and doors by an approved manufacturer. The manufacturer shall be required to submit for approval, prior to the commencement of fabrication, detailed drawings of windows and doors. The Contractor shall be responsible for the co-ordination of dimensions and details, in accordance with the door schedule.

The Contractor shall describe and indicate on the detailed drawings the relation and method of fixing to, and sealing between, adjacent parts of the structure. Fixings of doors and windows to sub-frames shall be of non-ferrous metal. Sealants shall be approved silicone sealants complying with relevant Indian standards.

There shall be no variation in shape, texture, colour, hue or chroma of the aluminium sections or components. The manufacturer shall submit for approval a range of anodised finishes which shall be in accordance with relevant Indian standards.

When closed, windows and doors shall be sealed so that no air movement in excess of 0.25 m/s shall be perceived at 1 metre from inner faces. The weather performance of windows and doors shall be in accordance with relevant standards.

The Contractor shall demonstrate that the prevailing climatic conditions will not adversely affect the expected or implied performance of windows and doors and that they will, when closed, exclude rain.

Aluminium windows shall be complete with glazing gaskets, gear for operation of moving parts, cylinder locks, catches and fly screens. Locking devices shall be provided to all opening parts, details of which shall be submitted for approval.

Fixed glazing units shall be fabricated from extruded section, and glazing shall be set in neoprene gaskets and secured with aluminium beads.

The Contractor shall store and fix, including assembling component parts, aluminium doors and windows in accordance with the manufacturer's printed instructions.

The backs of all aluminium frames shall be painted with two coats of bituminous paint or protected by other approved means before fixing. Aluminium framings shall be protected against damage from rendering, plaster etc. during building works, by covering with masking tape or by other approved means.

Exposed frames shall be protected against alkali or acid washes, abrasion or impact damage which may be caused by negligence or following trades.

The Contractor shall ease and adjust all aluminium doors and windows and leave in perfect working condition on completion.

15.8 Window Frame Tolerances

Window frame tolerances shall be as required by the window manufacturer and as set out in IS 4021,

15.9 Roller Shutter Doors

Roller shutter access doors shall be face mounted, handed-chain operated units. Doors shall be lockable when in the closed position. The curtain shall consist of interlocking galvanised mild steel contour slats, primed and painted brown in accordance with relevant standard and colour 06 C 39. The curtain shall be fitted with a sprung counter balance to ease operation and prevent the door free-falling during closing. Door guides shall be galvanised mild steel. A hood shall be provided to cover the operating mechanism, this shall be galvanised mild steel, primed and painted to match the curtain.

15.10 Bird Screens

Bird screens to be installed on the outside of the claustra blocks. The bird screens shall comprise 2.5mm electro galvanized welded wire mesh and frame (25mm x 2.5mm), all coated with primer and polyurethane topcoat, fixings shall be stainless steel. All to the satisfaction of the Engineer-in-charge.