Ref: KIIDC/Projects/EPC / 1 / 2020

EPC Tender Document
for
"KIIFB- KIIDC - Extension of Moolathara Right Bank Canal from Korayar to Varattayar"

Issued by:

The Managing Director,
Kerala Irrigation Infrastructure Development Corporation Limited,
PARVATHY, TC 36 /1, NH 66 Service Road,
Eanchakkal Jn, Chakkai P O,
Thiruvananthapuram -696024, Kerala
Email: iiidctvm@gmail.com

Project Funding by:
Kerala Infrastructure Investment Fund Board (KIIFB)
Felicity Square,
Palayam, Thiruvananthapuram.

KERALA IRRIGATION INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED (KIIDC)

Ref: KIIDC/Projects/EPC/1/2020

EPC TENDER DOCUMENT FOR

KIIDC desires to invite Tender for

"KIIFB-KIIDC - Extension of Moolathara Right Bank Canal from Korayar to Varattayar"

The detailed Tender including Bid Security, TOR, Eligibility criteria etc., can be downloaded from website of http://kiidc.kerala.gov.in from 14 - 08 – 2020onwards.

The last date for online submission of bids is ***14- 10 -2020*** up to 16.00 hrs.

For more details contact:
Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram
Website: http://kiidc.kerala.gov.in
E-mail: **iidctvm@gmail.com**

Managing Director
Kerala Irrigation Infrastructure Development Corporation Limited
Thiruvananthapuram

DISCLAIMER

The information contained in this Tender document (the "Tender") 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 their employees or advisors, is provided to Bidder(s) on the terms and conditions set out in this Tender and such other terms and conditions subject to which such information is provided.

This Tender is not an agreement and is neither an offer nor invitation by the Employer to the prospective Bidders or any other person. The purpose of this Tender is to provide interested entities with information that may be useful to them in preparing their bids (the "Bid") including all the necessary submissions and the financial offers pursuant to this Tender. This Tender 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 Tender may not be appropriate for all persons, and it is not possible for the Employer, its employeesoradvisors to consider the investment objectives, financial situation and particular needs of each party who reads or uses this Tender. The assumptions, assessments, statements andinformation contained in this Tender may not be complete, accurate, adequateorcorrect. Each Bidder should, therefore, conduct its own investigations and analysis and should check the accuracy, adequacy, correctness, reliability and completeness of the assumptions, assessments; statementsand information contained in this Tender and obtains independent advice from appropriate sources.

Information provided in this Tender to the Bidder(s) is on a wide range of matters, some of which depends upon interpretation of law. The information given is not 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 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 Tender or otherwise, including the accuracy, adequacy, correctness, completeness or reliability of the Tender and any assessment, assumption, statement or information contained therein or deemed to form part of this Tender or arising in any way during the 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 Tender. 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 Tender. The issue of this Tender does not imply that the Employer is bound to select a Bidder or to appoint the Selected Bidder 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 will 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 for submission of the Bid, regardless of the conduct or outcome of the Bidding Process.

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Volume 1: Tender Procedures

Section I: Instruction to Tenderers

KERALA IRRIGATION INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED (KIIDC)

NOTICE INVITINGTENDERS

OFFICE OF THE MANAGING DIRECTOR,
KERALA IRRIGATION INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED
'e' Procurement Notice
Ref. No.: KIIDC / Projects / EPC / 1 / 2020, Dated: 14 / 08 / 2020

Managing Director, **Kerala Irrigation Infrastructure Development Corporation Limited** invites bids from eligible bidders for the above work under Engineering, Procurement, and Construction (EPC) system.

a) Scope of Work: *The scope of work includes Investigation, Survey, Design, Construction, Testing, Commissioning of Construction of ChittoorMoolathara Right Bank Canal Extension from Korayar to Varattayar, through the acquired land and providing Micro Irrigation to the envisaged ayacut and Performance based Operation and Maintenance for 5 years from the date of issue of completion certificate within the Defect Liability Period [DLP] of 5 years in Kozhinjampara Firka in Palakkad District, Kerala. The EPC contactor is bound to design and Implement the project adopting the latest technologies in Engineering Sector, within the constraint of limited width of acquiredland, approved hydraulic particulars of the canal, operation and maintenance of canal etc.*

b) Salient components of the Scheme:

By keeping the approved hydraulic particulars, convey the water through pipe conduit or by other means, within the restricted land width of 10m, providing micro irrigation to the entire ayacut area, renovation of 14 numbers of pond with strengthening of the bank, providing necessary man hole, inspection chamber, strengthening/ protection of river banks, wherever necessary to the extent required, providing lift irrigation scheme from the proposed pipe line to the highest elevated area as well as ayacut in the lower portions of the canal bed of the ayacut and providing micro Irrigation to the above ayacut. The approximate canal length - 6430M consists of open conduit of 2710m, Syphon 210m, aqueduct 3510m, and tunnel of 660m. The EPC agency should conduct detailed investigation, including Soil Investigation, Design and construction, using appropriate technology in an economical manner with the site constraints.

Schedule -A Part A

Sl.No	Description of the Component	Indicative Quantity	Unit
1	Conducting topographical survey, conducting soil investigation, design and preparation of drawings and construction/**laying pipe line** through the acquired land and keeping the approved hydraulic particulars **(+175.221m at Ch.0.000m to +170.05m at Ch. 6430m)**, adopting the latest technologies in an economical as well as practically viable way to suit the topography of the area and to provide micro irrigation to the envisaged ayacut, approval of design from the competent Authority, and implementing the project within a period of 36 months, testing and commissioning of the project, etc. complete from Korayar to Varattayar. (**Extension of Moolathara Right Bank canal for a length of 6430km**). The project should be completed in all aspects, within a period of 30 months, including the construction of different hydraulic structures such as **conduit, aqueduct, siphon, tunnel**etc. to suit the topography of the area and to feed the entire ayacut area of the scheme, including the protective measures to river banks, abutment of piers of aqueducts,hydraulic structures such as inspection chamber, manhole, surplus escape, controlling regulators as well as sluices to feed ayacut area etc.	**6430m**	
2	Design, Preparing drawings and Providing **Lift Irrigation Scheme**to the highest elevated area as well as ayacut in the lower portions of the canal bed level of field, where gravitational flow is not possible, including constructing sump at the suitable place, near the entrance area of Tunnel, Pump House, Cistern/Overhead tank at the Highest elevated area, design and installing motor and pump set, including taking into the consideration of the feasibility of conventional/ natural source of Energy, delivery line from pump set to overhead tank (approximate length of 1500m), suction pipe line, installation of transformer, if found necessary, electrical works, sanction from competent authorities such as Electrical Inspectorate etc.complete. The project should be inclusive of all aspects of works related to testing and commissioning of lift irrigation scheme, including provision for taking delivery of water at intermediate points to feed the ayacut through	**1 unit**	

	gravity flow, if found viable etc. complete. The entire project should be completed within the project period of 30 months.		
3	Repairing and **Renovating the existing MRBC** from beginning to the end (approximate length of 7000m in total length of 12645m, wherever necessary) so as prevent the seepage of water from the canal, including re-construction of 91 Sluices, providing M S shutters and screw gear arrangement etc. complete including cost and conveyance of materials, labour charges etc. complete. The work should be completed in such a way that the water distribution through the existing canal should not be disturbed, during the water distribution period.	**1 unit**	
4	Design and installation of **Micro Irrigation System** with electronically controlled valve in the project area (approximately3575Ha), including conducting ContourSurvey, Individual Farm Boundary Survey, Preparation of Design and Drawings, Preparation of Operation Manual, formation of Water Users Association, Training to the farmers, Cost of related all accessories such as Primary Filtration, Feeder Main, In field Valve, Safety Accessories and Drip System, Fertigation Equipment, Main and Sub main PVC, Pressure Regulator, Drip Manifold Accessories, Construction of store rooms, Installation of Pump set and Motor, electrical accessories including installation of transformer, if necessary, or using other mode of energy such as solar etc., contruction of control rooms wherever requiredand Operation and Maintenance for a period of 5 years, from the date of issue of completion certificate.	**3575 Ha**	
5	**Improving 14 Nos of Public ponds**, within the project area, by removing silt and deepening the pond and protecting the banks so as to enhance the capacity of tanks, providing feeder channel, pipe line with control valves etc to the tanks from main canal, if possible etc. complete	**14 nos**	
Schedule – A Part – B			
	Price Contingencies		
	PS charges		
	User charges		
	GST		
	Seignorage Charges		
	Unforeseen items		

Note:1. Quantities indicated in the Table above are indicative and need to be

confirmed by Contractorthrough a Systematic Investment Plan [SIP].All components of implementation of SIP are to be understood including commissioning and duly approved by Engineer-In-Charge.

These are minimum quantities which need to be provided by the contractor.

The interested bidders may download the bid documents from the official website of Kerala Irrigation Infrastructure Development Corporation **i.e, www.kiidc.kerala.gov.in** from **14/08/2020**. The field data can be had from the office of the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram, on any working day before bid submission closing date i.e., 16:00 hrsof **14/10/2020**.

KERALA IRRIGATION INFRASTRUCTURE DEVELOPMENT CORPORATION LIMITED (KIIDC)

II) NIT DETAILS:

INDENT	
Indent Type	PRICE BID EPC
Indent Notice No	KIIDC/Projects/EPC / 1 / 2020, Dated : 14-08-2020
Name of the Employer	Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC)
The Name of the Project	**KIIFB– KIIDC- Extension of Moolathara Right Bank Canal from Korayar to Varattayar**
Type of the Work	**Piped Irrigation Canal with Micro Irrigation net work including lift Irrigation Scheme, Renovation of Pond, Renovation of damaged canal**
Source of Funding	The KIIDC is empowered as an SPV of KIIFB with funds to be utilized for execution of this Project. All eligible payments under the contract(s) for the package for which this Invitation for Tender is issued shall be made by the Kerala Infrastructure Investment Fund Board (KIIFB). All the Government Orders, Circulars available in the KIIFB web site **https://kiifb.org/resources.jsp** on 14-08-2020 and those that may be published till the end of the diffect liability project will be applicable for the payments, quality control etc.
ADMINISTRATIVE SANCTION	
Particulars Ref. No	GO (Rt) No 610/2019/ WRD of WATER RESOURCES (INTER STATE WATER CELL) DEPARTMENT Dated 27-08-2019
Sanction Authority	Government of Kerala
Date	27-08-2019
Estimated Contract Value(INR)	**Rs. 227.84 crores**

NOTICE INVITING TENDER	
TENDER DETAILS	
Departme nt Name	Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC)
Circle / Division	Thiruvananthapuram
Name of Project	**KIIFB-KIIDC-Extension of Moolathara Right Bank Canal from Korayar to Varattayar**
Name of Work	**KIIFB-KIIDC -Extension of Moolathara Right Bank Canal from Korayar to Varattayar**
Estimated Contract Value (INR), including GST	**Rs.255.18Crore (Rupees Two Hundred and FiftyFiveCrore and Eighteen Lakhs only)**
InternalBench mark ValueBenchMar kValue, excluding GST	**Rs.227.84Crore (Rupees Two Hundred and Twenty Seven Crore and EightyFourLakhsonly)**
Period of Completion [in Months]	Design and Construction - 30 Months
Form of Contract	EPC
Tender Evaluation Type	Price Bid EPC
Evaluation Criteria	Based on Price
Tender/Bidding Type	Open
Type of Work	Irrigation
Bid Call (Nos)	1st Call (60 Days)
Tender Category	Works
TRANSCATION FEE DETAILS	
Transaction Fee Payable to KIIDC, Thiruvananthapuram	
AMOUNT DETAILS	
Bid Processing Fee (INR)	Rs.10,000/- +GST
BidProcessing FeePayable To	Demand Draft drawn in favour of the Managing Director, KIIDC, Payable at Thiruvananthapuram
Sales Tax(%)	Not Applicable
Sale Tax	Not Applicable

Payable To	
Bid Security (INR)	**Rs 2,28,00,000/-** [1% of the IBM Value]
Bid Security BG Drawn in favor of	**[Rs. 2,28,00,000/-]** 1% of the IBM Value at the time of submission of Bids and in the form of Online payment Gateway only / Unconditional and irrecoverable Bank Guarantee issued by Nationalized Bank in the standard format as shown in the Tender schedule and it shall be drawn in favour of **Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited**, payable at Thiruvananthapuram
TENDER DATES	
Document Downloading Start Date	**14 / 08 / 2020**
Last date of receipt of queries on Tender by e-mail	**21 / 08 /2020, 04: 00 PM**
Pre-Bid Meeting	**26 / 08 /2020, 03: 00 PM / Offline**
Bid Document Downloading End Date	**14 / 10 /2020, 03: 00 PM**
Last Date & Time for Receipt of Bids	**14/ 10 /2020, 04: 00 PM**
Date of opening of Bids	**16 / 10 /2020, 03: 00 PM**
Bid Validity Period	**180 (One Hundred and Eighty)** Days from the date of tender opening
Price Bid Opening Date (Financial Bid Stage)	**Will be notified later**
OTHER DETAILS	
Officer Inviting Bids	**The Managing Director,** **Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC), Thiruvananthapuram.**
Bid Opening Authority	**The Managing Director,** **Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC), Thiruvananthapuram.**
Departmental Address for Submission of Documents	**Attention: The Managing Director** Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC), Thiruvananthapuram,
Contact Details	Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC), Thiruvananthapuram

E-mail	**iidctvm@gmail.com**
Package No	N/A
Bidder Nationality	National Competent Bidding (NCB)
Language of the Tender	The language of the bid is: **English** All correspondence exchange shall be in **English language**. Language for translation of supporting documents and printed literature is **English**
Currency Type	INR-Indian Rupee
Default Currency	INR-Indian Rupee
Bid Capacity	(2AN- B)> Estimate Contract Value (ECV)
Consortium/Joint Venture	Admissible
Withdraw Bid	Not Applicable
Regret Bid	Not Applicable
Eligibility and Qualification Criteria for considering of award of work	
Registration	Registered Bidders of Kerala PWD / Central PWD / Other Central or State Government Departments / State or Central Public Sector Undertakings etc. who have successfully completed similar works. JV/ Consortiums can bid the project. In such cases, at least any one of the member should satisfy the requirements. Work Execution Period - 30 months (including Monsoon period) O&M (on performance based) -5 years with including Defect liability period of 5 years.
Specific Experience	1. The bidder should have successfully and substantially completed at least one work of similar nature costing more than 50% (Fifty Percentage) of the estimated cost of the work within the last **five** years. Similar work means large Irrigation Infrastructure projects like Penstock, Tunnel, Canals, Dams, Regulators etc. The value will be updated by giving 10% simple weightage per year to bring them to 2019-20 price level.
	2. The bidder's average net worth for the last **three**financial years shall not be less than **70% of PAC**. In this regard certificate issued by Chartered Accountant in the current financial year shall be uploaded by the bidder. 3. The bidder as a contractor should have Satisfactorily Completed a work which involves laying of pipeline works with project cost not less than **Rs. 50,00,00,000/- (Rupees Fifty Crore only)** during the last **five** financial years ending with 2019-20. The value will be updated by giving 10% simple weightage per year to bring them to 2019-20 price level. 4. The bidder who has applied for/ availed "Corporate Debt

	Restructuring" (CDR) or "Strategic Debt Restructuring" (SDR) in the last **Five (5)** financial years ***is not eligible to participate in the bid.***In regards to this clause, a certificate issued by the Chartered Accountant in the current financial year shall be uploaded by the bidder. 5. If the design proposed is with MS pipes, DI pipes, HDPE pipes and CPVC pipes, the bidder has to submit copies of Memorandum of Understanding (MoU) with manufacturers having satisfactory manufacturing experience along with BIS license for a period of not less than **five** years. The Memorandum of Understanding (MoU) should clearly indicate that the manufacturer shall supply the agreement quantity for this work. 6. The firm should have been involved in atleastone unique state of the art Irrigation system project with weather and sensor based controls. 7. The firm should have an agriculturist with minimum **fifteen**year's experienceand adequate staff to carry out the works.
	8. The bidder should have experience in the execution of micro Irrigation works within the last **five** years. If the bidder does not have the corresponding experiencehe can associate with a contractor/ company qualifying the above criteria.In such case an MOU duly signed between the bidder and the associate contractor is to be submitted along with the tender to the effect that if the work is awarded to bidder, the contractor with his men and machinery shall complete the micro irrigation works as per the schedules and specifications of the tender, under the control and direction of bidder. However bidder alone shall be responsible to the accepting authority as regards execution of the work and further defects liability, if any. The credentials to substantiate the qualification and experience of associate contractor should also be submitted along with the bid.
Technical Requirement	9. The bidder should have successfully and substantially completed atleast one structural steel work of minimum **450 Ton** in the above contract or in any other contract during the past **five** years.
	Note: Proportionate Quantities will also be considered at the time of evaluation for the completed works of similar nature. 10. The bidder should enclose experience certificates in support of technical criteria / requirement issued by the Engineer-In-Chief of the State / Central Government Departments / Undertakings, not below the rank of Executive Engineer or Equivalent and countersigned by the next higher authority not below the rank of Superintending Engineer. 11. The bidders should furnish the particulars of Quality Control Testing Lab owned or tie up with established quality control laboratories.

Criteria	Single entity	In case of JV/Consortium	
		Lead member	Joint member
<u>Technical criteria</u> The bidder should have experience in surveying, Design, fixing alignment, develop detailed drawing, diversion plans of existing services etc. for water conducting systems for projects costing minimum 100% of the estimated cost of the works in the role of prime contractor, JV member, subcontractor, management contractor, design consultant, or PMC for at least the last ten (10) years prior to the bid submission dead line. If the bidder does not have the corresponding experience, he can associate with a consultancy firm qualifying the above criteria. In such case, an Undertaking from the consultancy to the effect that if the work is awarded to the bidder, they will associate, prepare and provide the required design. The credentials of the consultancy should also be submitted along with the bid.	Must satisfy	Anyone member should satisfy.	Anyone member should satisfy.
The bidder should have successfully and substantially completed at least one work of similar nature costing more than 50% (Fifty Percentage) of the estimated cost of the work within the last **five** years. Similar work means large Irrigation Infrastructure projects like Penstock, Tunnel, Canals, Dams, Regulators etc.	Must satisfy	Any one member should satisfy.	Anyone member should satisfy.
The bidder should have experience in the execution of micro Irrigation works within the last **five** years. If the bidder does not have the corresponding experience, he can associate with a contractor/company qualifying the above criteria. In such case an MOU duly signed between the bidder and the associate contractor is to be submitted along with the tender to the effect that if	Must satisfy	NA	NA

the work is awarded to bidder, the contractor with his men and machinery shall complete the micro irrigation works as per the schedules and specifications of the tender, under the control and direction of bidder. However bidder alone shall be responsible to the accepting authority as regards execution of the work and further defects liability, if any. The credentials to substantiate the qualification and experience of associate contractor should also be submitted along with the bid.			
The bidder should have successfully and substantially completed atleast one structural steel work of minimum 450 Ton in the above contract or in any other contract during the past five years.	Must satisfy	Must satisfy	Must satisfy 60% of the requirement
Financial criteria: Must have an average annual Financial turnover of 70 % of PACfor the past **three** financial years.	Must satisfy	Must satisfy	NA
Should not have incurred any loss (profit after tax should be positive) in more than two years during last five consecutive years ending 31st March 2020.	Must satisfy	Must satisfy	NA
Should have a solvency of **Rs. 40 Crores**.	Must satisfy	Must satisfy	NA
The bidder should enclose experience certificate issued by the Engineer-in-charge of the State/Central Government Departments not below the rank of Executive Engineer or equivalent authority and should have countersigned by the next higher authority. **Assessed available Bid Capacity as per formula (2AN-B) must be greater than the Estimate Contract Value.** A= Maximum value of Civil Engineering works executed in any one financial year during the last (5) Five financial years (updated to current price level) taking into account the work executed for the mentioned period. N= Number of years prescribed for completion of the work for which tenders are invited. B= Updated value (at current price level) of all existing Commitments i.e., ongoing orders, orders likely to be awarded to be executed during the Period of completion of the similar nature of work completed for which Tenders are invited. Annual turnover cost of completed works and balance works on hand etc., shall be updated by giving weightage of 10% per year to bring them to current price level.			

Liquid Assets/Credit Facilities Posses	**Rs. 40crores (Rupees Forty Crore only)**

Critical Equipment Required

Equipment Required	**Quantity Required**
Mini Excavator for Trenching	02 Nos
JCB / Hitachi	03 Nos
Concrete Hopper Miller	03 Nos
Pin Vibrator	03 Nos
Pan Vibrator	03 Nos
Water Tanker	02 Nos
Trucks / Tractors / Tippers	10 Nos
Cranes	02 Nos
Tunnel Boring Machine	02 Nos
DG set 125KVA – 200KVA	02 Nos

Availability of Key Personal

Position	**Qualification**	**No. of Persons**	**Total Experience in years**	**Experience in Similar Work [years]**
Project Manager	B.Tech Civil Experience in Civil EngineeringProject (5years as Project Manager should have O&M experience)	1 Nos	20	12
A. Design Phase				
Civil Engineering Expert	B.Tech Civil Engg, &M.Tech in Structural Engg. (8 years' experience inDesign of Civil Engineering Project)	1 Nos	15	10
Draftsman	ITIDraftsman/ Diploma CivilEngineering	1 Nos	5	5
B. Construction Phase				
Construction Manager	B.Tech. Civil with minimum 10 years' experience in Irrigation Projects / Water Resource Projects	1 Nos	15	5
Project Engineer	B.E/ B.Tech in Civil Engg(3 year's experience in Irrigation Projects)	4 Nos	10	5
Agricultarist	With minimum 15 years experiance			
C. Operation and Maintenance Phase				

Project Engineer –Civil	B.Tech. Civil	1 Nos	5	3
Mech. / Equip. Maintenance Engineer	B.Tech. Mechanical with O & M of watersupply project experience	1 Nos	5	3
Agriculturist	With minimum 15 years experiance			
Electrical / Instrumentation Engineer	B.Tech. Electrical / Instrumentation with O& M of Civil Engineering Project	1 Nos	5	3
Bid Submission	The bidder shall submit the bids as follow: Online submission : Scanned copy of the original			
Power of Attorney (PoA)	The written confirmation of authorization to sign on behalf of the Bidder shall consist of Power of Attorney (PoA) on a Notarized Non-Judicial paper of minimum value of Indian Rupees **200/-** (Rupees Two Hundred only).			
General Terms & Conditions / Eligibility	As per Tender Document			
General Technical Terms and Conditions (Procedure)	As per Tender Document			
Eligible Class of Contractors as per G.O. M's No.	As per Tender Document			

General Terms and Conditions:

Bids are invited for the above mentioned work from the eligible registered contractors in any respective Departments of Government of Kerala. The details of Tender conditions and terms can be down loaded from the the official website of Kerala Irrigation Infrastructure Development Corporation, Thiruvananthapuram i.e, **www.kiidc.kerala.gov.in**

Internal Benchmark Value is Rs 227.84 Crore (Rupees Two Hundred and Twenty SevenCrore and Eighty Four lakhs only), excluding GST.

The bidder has required to submit the hard copy of the bid along with a non refundable fee in the form of Demand Draft of **Rs. 10,000/- + GST**, drawn in any Nationalized Bank and in favour of the Managing Director, Kerala Irrigation Infrastructure Development Corporation, Thiruvananthapuram.

Bid Security to be paid by way of unconditional and irrevocable Bank Guarantee or online payment issued by any Nationalized Bank in the standard format as shown in the Bid document, drawn in favour of Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited for **Rs. 2, 28, 00,000/-** (i.e. 1.00% of IBM Value) along with bids. The successful bidder should furnish Performance Guarantee 2.5% of Tender Contract Value at the time of agreement. The proportionate value of Performance Guarantee for CAPEX value will be returned after defect liability period of 5 years and the proportionate value of Performance Guarantee for OPEX value will be returned after completion of 5 years O&M period.

The bidders can view/down load the bid documents from the official web site of Kerala Irrigation Infrastructure Development Corporation, Thiruvananthapuram i.e, **www.kiidc.kerala.gov.in**

Note: - (i) The date stipulated above is firm and under no circumstances they will be relaxed unless otherwise extended by an official notification or happen to be Public Holiday.

(ii)The Bank Guarantee submitted by the success full bidder at the time of tender with conditional obligations shall not accept and retained against Bid Security for performance at the time of conclusion of contract.

(iii) Unconditional and irrevocable Bank Guarantee shall be obtained towards Bid security for the entire specified amount at the time of concluding agreement)

The EPC Coctracor should follow the following clauses.

The Department will carry out the technical bid evaluation solely based on the uploaded certificates / documents, in the e-procurement system and open the price bids of the responsive bidders.

The Department will notify the successful bidder for submission of original hard copies of all uploaded documents, prior to entering into agreement.

After submission of the online bids, the all bidders may furnish hard copies of all documents submitted, and to be reached in the tendered office within another 4 working days' time either personally or through courier or post and the receipt of the same within the stipulated date shall be the responsibility of the successful bidder. In this time of pandemic caused by COVID 19 it is not mandatory that the contractors shall produce the document in the sstipulated time. On receipt of the documents (if any submitted), the KIIDC will ensure the genuineness of the BG and all other certificates/documents uploaded by the bidder in e-procurement system in support of the qualification criteria before concluding the agreement.

If any successful bidder fails to submit the original hard copies of the uploaded certificates / Documents, BG within the stipulated time or if any variation is noticed between the uploaded documents and the hard copies submitted by the bidder, the successful bidder will be suspended from participating in the tender on e-procurement platform for a period of 3 (three) years. The e-procurement system would de-active the user ID of such defaulting successful bidder based on the trigger/recommendation by the Tender Inviting Authority in the system. Besides this, the department shall invoke all processes of law including criminal prosecution of such defaulting bidder as an act of extreme deterrence to avoid delay in the tender process for execution of all development schemes taken up by the Government. The information to this extent will be displayed in the e-procurement platform website.

The Tenderers shall be required to furnish a declaration and as per the pro-forma available in the tender schedules are to be in online stating that the soft copies uploaded by them are genuine. Any incorrectness/deviation noticed will be viewed seriously and apart from canceling the work duly forfeiting the Bid security, Criminal Action will be initiated including suspension of business.

The bidders who are desirous of participating in 'e' procurement shall submit their Technical bids, price bids etc., in the standard formats prescribed in the Tender documents displayed at 'e' market place. The bidders should upload the scanned copies of all the relevant certificates, documents etc., in the 'e' market place in support of their Technical Bids. The bidders shall sign on all the statements, documents, certificates uploaded by him owning responsibility for their correctness/authenticity

The technical bid evaluation of the tenderers will be done on the certificates /

documents uploaded through on-line only, towards qualification criteria furnished by them.
Copy of Latest valid Income Tax Return along with proof of receipt and copy of PAN Card must be uploaded.
Copy of GST Registration Certificate along with GSTIN No. obtained from respective Department and latest Clearance Certificate must be uploaded.
GST and other statutory taxes and duties will be adopted time to time as per instructions of Government of Kerala
Period of completion: 30 months + warranty as applicable.
The date stipulated in the NIT is fixed and under no circumstances they will be relaxed under unless otherwise extended by an official notification or happen to be Public Holiday. Any other condition regarding receipt of tenders in conventional method appearing in the tender documents may please be treated as not applicable.
Each bidder should demonstrate the availability of key and critical equipment either owned or leased as shown in the NIT. The bidders should furnish the particulars of Quality Control Testing Lab owned or tie up with established quality control laboratories.
The bidder is subjected to be disqualified and liable for black listing and forfeiture of Bid Security, if he is found to have misled or furnished false information in the formsstatements / certificates submitted in proof of qualification requirements.
Even while execution of the work, if found that the contractor had produced false / fake certificates of experience he will be liable for black listing and the contract will be liable for termination and liable for forfeiture of Bid Security and all the amounts due to him.
Bidders shall submit a declaration without any reservation what so everthat the submitted eligibility and qualification details, technical and financial bid are without any deviations and are strictly in conformity with the documents issued by the employer.
Declaration should be given for the credentials submitted by the bidder.
The employer reserves the right to relax the conditions and required foreligibilityofthe bidders in the public interest. The Bidder(s) shall not have any right to question the decision taken by the employer in this regard.

Special Conditions:

The work should be got tested as per relevant IS Codes and Standards approved by the Department, Third Party Quality Control before the total supplies are affected.
The Bidder has to furnish self-declaration of Latest Present and Permanent Postal Address along with Telephone Number, Mobile Number for Communication; Any Changes must be communicated to the Tender Inviting Authority failure to notify the changes prior one month the date of change of Address, the Available Address at Tender Inviting Authority will be deemed to fit for communication. It is the responsibility of the bidder; the Department will not take any responsibility for any delay, loss in communication of any Correspondence.
The Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited reserved the right to reject any tender or drop the proposals for receiving the tenders without assigning any reason. The details of rules and regulations and other required information can be had at the above address during the office hours on all working days
The successful bidder should furnish Performance Guarantee at 2.5% of Tender Contract Value at the time of agreement. The proportionate value of Performance Guarantee for CAPEX value will be returned after defect liability period of 5 years and the proportionate value of Performance GuaranteeforOPEX value will be returned after completion of

5years O&M period.

Bid Security noted against the work i.e., at 1% of estimate contract value should be paid in the shape of BG / online payment in favor of Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited. The balance Bid Security i.e., @ 1.5% of estimate contract value should be paid by B.G for the amounts till the defect liability period is completed i.e., 5 years from the date of completion of work to be paid at the time of entering into agreement. The BG's taken earlier than theTender Notice will not be valid.

Tenders with an excess of 5% of the Internal BenchMarkValue, arrived by the department shall be summarily rejected.

Tenders up to 25% less than the estimate may be accepted but for tenders less than 25% of the estimate / internal benchmark value mark arrived by the department, a Bank Guarantee for the difference between the tender amount and 75% of the estimate value /Internal Bench Mark value mark arrived by the department should be furnished at time of agreement as additional Security deposit, so if the tenderer leaves the work in mid-way and the department is forced to call for the tender for the work

The bidder who has applied for/ availed "Corporate Debt Restructuring" (CDR) or “Strategic Debt Restructuring" (SDR) in the last Five (5) financial years is not eligible to participate in the bid. In regards to this clause, a certificate issued by the Chartered Accountant in the current financial year shall be uploaded by the bidder.

Employer reserves the right to cancel / alter the bid conditions at any time.

Any Tender or all the tenders can be cancelled without assigning any reasons. Conditional tenders will not be considered.

For particulars please apply to the General Manager, KIIDC, Thiruvananthapuram and clarification can be had till a day earlier to the opening date of tenders.

If the tender is made by an individual, it shall be signed with full name and his address shall be given if it is made by a firm. It shall be signed with the co-partnership name by a member of the firm who shall also sign his own name and address of each member of the firm shall be given. If the tender is made by corporation it shall be signed by the duly authorized officer who shall produce with his tender satisfactory evidence of his authorization. Such tendering corporation may be required before the contract executed to furnish evidence of the corporate existence. In the case of Proprietary or partnership firm it will be necessary to produce the certificate before mentioned for the proprietor or proprietors and for each of the partners as the case may be.

All documents of the Bid as required shall be typed or written in indelible ink and shall be signed by the Bidder or person duly authorized to sign on behalf of the Bidder.

In the event of the tender being submitted by a partnership firm or joint venture/consortium, it must be signed by the lead partner holding a valid power-of attorney authorizing him to do so, such power of attorney to be produced with the tender, and it must disclose that the firm is duly registered under the Indian Partnership Act,1952

Note: - The tenderers particular attention is drawn to the sections and clauses in the standard preliminary specification dealing with the following:

a) Test inspection and rejection of defective materials of Supplies.

Carriage

Construction works.

Water and Lighting.

Cleaning during progress and for delivery

Accidents

Delays
Particulars ofpayment.
The tenderer should closely pursue all the specifications Clause which govern the rates for which is tendering. The Supplier has to fulfill all requirements in tender document.

Procedure for Submission of Bids:

Bidders may contact, Office of the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, for any clarifications, or information on any working day during office hours.

The bidder has to submit the hard copy of the bid along with a non refundable fee in the form of Demand Draft of Rs. 10,000/- + GST, drawn in any national Bank and in favour of the Managing Director, Kerala Irrigation Infrastructure Development Corporation, Thiruvananthapuram.

Bidders are requested to submit the bid in two stages
Stage – I: Eligibility and Technical Bid Stage
Stage – II: Financial Bid Stage

The first stage will cover the qualifications eligibility details and the technical bid. The bidder shall upload documents in support of the above. The bidder shall submit price bid online under second stage which may include proposals for financing to cover part of the scope of the work as per bid documents before the bid submission closing date.

Bidders shall submit a declaration without any reservation whatsoever that the submitted eligibility and qualification details, Techno-Commercial bid and financial bid are without any deviations and are strictly in conformity with the documents issued by the Employer. Declaration should begiven by the bidder for the correctness of the credentials submitted by him.

The Bidders shall sign on all documents, including and has to submit all documents including Bid Security and Transaction fee payable through bank draft drawn on Nationalized Bank, in favour of the Managing Director, Kerala Irrigation Infrastructure Development Corporation, Thiruvananthapuram etc. It is bidder's responsility, for their correctness/authenticity of documents submitted by them. The documents without signature of the bidder will be considered as invalid documents and the same will not be considered in evaluation of the bid.

Submission of original hard copies of the uploaded scan copies of BG towards Bid Security by participating bidders to the tender inviting authority before opening of the price bid is dispensed forthwith.

The department / authority will carry out the technical bid evaluation solely based on certificates / documents, BG towards Bid Security and open the price bids of the responsive bidders after approval from the competent authority as per rules in force.

The department will not take any responsibility for any delay in receipt/non-receipt of original BG towards Bid Security, certificates / Documents, from the successful bidder before the stipulated time. On receipt of the documents, the Department will ensure the genuinely of the BG towards Bid Security and all other certificates/documents submitted by the bidder, in support of the qualification criteria before concluding the agreement.

If any successful bidder fails to execute the agreement, stipulating the conditions in the bid document, the successful bidder will be suspended from participating in the tender on e-procurement platform for a period of 3 (three) yearsand, the work shall either be entrusted to the second successful bidder, or rearranged , at the Risk &Cost of the original successful bidder, at the discretion of the tendering authority. Besides this, the department shall invoke all processes of law including criminal prosecution of such defaulting bidder as an act of extreme deterrence to avoid delay in the tender process for execution of all development schemes taken up by the Government. The information to

this extent will be displayed in the e-procurement platform website also.
As per G.O.Ms.No.8 of IT, Electronics & Communication Dept., Dt.08-05-2016 Bid Security should be paid through online / BG in favour of Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited only.
The successful (L1) bidder shall furnish the original hard copies of all the documents / certificates / statements before concluding Agreement.

Deactivation of Bidders:

The bidder (L_1) found defaulting in submission of hard copies of original BG for Bid Security to the Tender Inviting Authority on or before the tender stipulated time, the bidder will be suspended / disqualified from participating in tenders on e-Procurement platform for a period of 36 months from date of bid submission besides forfeiture of Bid Security. Other conditions as per tender document are applicable.

Payment of Transaction Fee and Bid Security:

It is mandatory for all the participating bidders to pay the Transaction fee of a non refundable fee in the form of Demand Draft of Rs. 10,000/- + GST, drawn in any national Bank and in favour of the Managing Director, Kerala Irrigation Infrastructure Development Corporation, Thiruvananthapuram.
The technical bid evaluation of the tenderers will be done on the certificates / documents, towards qualification criteria furnished by them.

Required Tender Document Details:		
Sl. No.	**Document Name**	**Document Type**
1	Registration Certification	Mandatory
2	Bid Security	Mandatory
3	Transaction Fee Payable	Mandatory
4	PAN CARD and Submission of latest Income Tax Return along with Proof of Receipt	Mandatory
5	GST Registration Copy	Mandatory
6	Declaration as per proforma attached in Tender Documents	Mandatory
7	Annual Turnover Certificate certified by Chartered Accountant	Mandatory
8	Similar Work Experience Certificate for the work completed within the Specified period	Mandatory
9	Certificate in support of Existing Commitments	Mandatory
10	Experience Certificate in support of quantities executed – within block period	Mandatory
11	Liquidated Assets /Solvency Certificate from authorized Bank	Mandatory
12	Scanned copy of declaration on Key Critical Equipment owned on Non-Judicial stamp paper of Rs. 200	Mandatory
13	Qualification Certificate of Key Personnel	Mandatory

14	MoU with manufactures / Suppliers of MS pipes, DI pipes and CPVC pipes.	Mandatory
15	If any other documents as per Tender Document	Optional

Tender Document:

The bidder is requested to download the tender document and read all the terms and conditions mentioned in the tender Document and seek clarification if in doubt from the Tender Inviting Authority. The bidder has to keep track of any changes by viewing the addendum / Corrigendum's issued by the Tender Inviting Authority on time-to-time basis in the website. The KIIDC shall not be responsible for any claims/problems arising out of this.

Bid Submission Acknowledgement:

The user should complete all the processes and steps required for bid submission. KIIDC is not responsible for incomplete bid submission by users. Users may also note that the incomplete bids will not be processed by the Tender Inviting Authority.

Scope of the Project:

The scope of work includes "Investigation, Survey, Design, Construction, Testing, Commissioning of Construction of Moolathara Right Bank Canal Extension from Korayar to Varattayar, through the acquired land and providing Micro Irrigation to the envisaged ayacut and Performance based Operation and Maintenance for 5 years from the date of issue of completion certificatewithin the Defect Liability Period [DLP] of 5 years in KozhinjamparaFirka in Palakkad District, Kerala". The EPC contactor is bound to design and Implement the project adopting the latest technologies in Engineering Sector, within the constraint of limited width of acquiredland, approved hydraulic particulars of the canal, operation and maintenance of canal etc.

Appropriate state of the art construction procedure & technologies shall be adopted for providing Irrigation system and various alternatives shall be explored for providing best possible solutions at every stage of construction of, pipe laying, wherever necessary, approaches, crossing etc.

Design Features of the Proposed Irrigation System

Flow control valves/Regulators shall be provided in the network to restrict excess flows in the network.

The Bidder shall conduct Topographic survey and establish Permanent Bench Marksat regular intervals with reference to GTS/DGPS in order to execute the work. The EPC Agency shall submit the Designs and Drawings duly taking into account& compatible with the existing Irrigation system. Contractor shall also undertake Fieldsurvey, GPRS survey etc. for providing Micro Irrigation to the field.

Contractor shall undertake design of water distribution work using latest versions of Water Gemssoftware/EPA Net Software Contractor shall submit all designs and drawing with BOQ and estimates for approval by competentauthority.

After approval of the Drawings and Designs by the competent authority, the EPC Agency shall submit detailed estimate along with BOQ's based on the approved drawings which will be approved by the Departmental/KIIDC authorities based on which the execution shall be done. As per the provisions of EPC system, this shall form the basis of payment within the overall percentage break up mentioned in the document.

The project shall be executed, completed and commissioned within the period of completion, and the O&M of the project shall be carried out for a period of 5 years including 5 years Defects Liability period (DLP) after completion of construction and commissioning of the project, in compliance with the key Performance Indicators

specified.

It shall be expressly understood by the EPC Agency that the Drawings and details appended at the time of bidding are only indicative but not exhaustive.

It shall be expressly understood the scope of the project, by the EPC Agency. i.e. by keeping the approved hydraulic particulars, convey the water through pipe conduit or by other means, within the acquired land width of 10m, providing micro irrigation to the entire ayacut area, renovation of 14 numbers of pond with strengthening of the bank, providing necessary man hole, inspection chamber, strengthening/ protection of river banks, Renovation of damaged portion of existing canal including construction of new sluices etc., providing lift irrigation scheme from the proposed pipe line to the highest elevated area as well as ayacut in the lower portions of the canal bed of the ayacut and providing micro Irrigation to the above ayacut. The approximate canal length - 6430M consists of open conduit of 2710m, Syphon 210m, aqueduct 3510m, and tunnel of 660m. The EPC agency should conduct detailed investigation, including Soil Investigation, Design and construction, using appropriate technology in an economical manner with the site constraints.

The EPC agency is at liberty to prepare alternative better solutions at lesser Project cost, without sacrificing the goal of the project and its life span. The agency, in that case shall propose the variation in detail with supporting scientific reports in proof of it, dully authenticated by design experts in the relevant fields.

Proof Check Consultant is appointed by the Contractor for proof checking the detailed calculations, drawing and designs, which are proposed by the Contractor. The Proof Check Consultant shall be appointed from the panel of consultants proposed by the Contractor and approved by the SPV

Deliverables of the Scheme:

Sl. No.	**Description of work**	**Remarks**
4.1	**4.1.1:** The bidder has to do ETS Survey, Investigation, Design, Build, Commissioning, Operation and Maintenance of the entire system for a period of **5**yearsincluding Defect Liability Period of **5**years. **4.1.2:** The bidder should get the entire area surveyed using total station and prepare the L.S, C.S and block levels of each component, land plan schedule, TBMs and design the entire project and shall be got approved by the department. **4.1.3:** Before the commencement of the execution, Soilinvestigation should be carried out for all the components for designanalysis **4.1.4:** The economic size of Pumping mains should be designed duly considering the static head, frictional losses and surge head as per IS codes and manual. The transmission main shall be designed for surge protection as per latest proven methods and standards and protected against surge pressure by providing suitable protection system like Air vessels/ Bladder Vessels, Air Valves, Air cushion valves, Scour valves as per design and sluice	The EPC Agency shall conduct detailed investigation and come upwithdetailed designs and Drawings which shallbeapprovedby the Engineer-In-charge withintheoverall objectivesof the scheme. The designs and drawings shall be done using state of the art software for Civil, Structuraland Hydraulic Engineering and the best practices shall be followed in compatible with BIS/ GoIDirectives/ ISO etc.

	valves including all allied works shall be located for fixing at appropriate places as per deigns and longitudinal sections and got approved from the Department. **4.1.5:** The designs and plans (LS as well as alignment plan) of all the components under the above scheme, shall indicate all the salient features such as details of ground levels, HGL, invert levels of the pipes, size and material of the pipes and required MWL, LWL and HGL also indicating the location of valves and all other allied parts. These shall be prepared and got approved by the Engineer-In-Charge. **4.1.6:** All the pumping mains and gravity mains shall be designed for ultimate demand taking into account static head, friction losses other losses and surge asper IS codes and manual. Surge control devices such as air cushion valves as per design are to be placed at appropriate places as per necessity. Designs shall be got approved by the department and got executed by the agency as per the approveddesigns. **4.1.7:** Pumps of ISI make Kirloskar/Mather & Platt/ Jyothi/WPIL/Best & Crompton/ Grundfos or any other reputed make specifically approved by the department with relevant ISO Certification to draw raw /clear water with suitable motors of make Crompton Greaves/ GEC/ N.G.E.F/ Kirloskar/ Jyothi/ Seimens/ ABB or any other reputed make specifically approved by the Department with shall be provided for prospective demand as per design and to have minimum operation and maintenance cost as approved by Department. The combined efficiency must be not less than 75% and the pumps should also comply with Hydraulic Institute Standards. Motors shall be of high efficiency (Energy) efficient motors complying with relevant IS codes. **4.1.8:** Thefloorlevelsof the pumping station and water level in the sumps are to be fixed for the positive suction whereverpossible. All the components should be provided with name boards as directed by the departmental officers. All the surplus excavated earthof each item is to be conveyed and leveled as directed by the departmental officers. All the Excavated trenches shall be restored to original condition as per the existing road pavement structure. The entire scheme should be completed and commissioned in 30months. **4.1.9.1**All valves on the pipeline network shall be of DI D/F electrically actuated, Resilient seated soft sealing with EPDM of reputed make only with ISO 9001- 2008 and to be approved by the Department and valves on the pipeline network shall be Manually operated DI D/F	If there is any conflict of specifications, the competent authorities' decision shall be final and binding on the EPC Agency.

	resilient seated soft sealing type. Bidder shall provide Kinetic air valve, PRVs and scour valve as specified in the IS code shall be followed while designing thedistribution system with all necessary valves in place as per standards. **Auxiliary items:** Road Restoration ***For Road Restoration in B/T Surface*** Restoration with GSB layer of 300mm thick for trench width upto75 mm below top of road surface. Laying of75mm thick WBM layer above GSB layer of 300mm thick and primer coat, tack coat, Premix carpet followed by Seal coat for a trench width of 1.2m. ***For Road Restoration in CC Road*** Restoration with GSB layer of 300mm thickfor trench width up to 300mm below top of the road surface. Laying of 100mm thick PCC (1:4:8) layer above GSB layer of 300mm thick and 200 mm thick CC M30 layer above 100mm thick PCC (1:4:8) layer. In Bituminous road restoration, Use of Paver is mandatory for carriage way width above 3.75 m of road restoration. **4.1.10.1** The bidder should provide as-built drawings after successful completion of the scheme (CAPEX component) and should submit updated as-built drawings after completion of O&M period (OPEX component) in consultation with Engineer – in – Charge and as per directions of the department. The bidder should handover the scheme after successful completion of work. **4.1.10.2**All Statutory charges payable to line Departments like Irrigation, R&B etc. will be borne by the departmentexcept electrical inspectorate Charges. **4.1.10.3** All approvals required for execution of work shall be taken up by contractor. **4.1.10.4** The bidder has to make arrangements for traffic Management & Safety Management during the execution as required.	
4.2.1	Conducting topographical survey, conducting soil investigation, design and preparation of drawings and construction/**laying pipe line** through the acquired land and keeping the approved hydraulic particulars **(+175.221m at Ch.0.000m to +170.05m at Ch. 6430m)**, adopting the latest technologies in an economical as well as practically viable way to suit the topography of the area and to provide micro irrigation to the envisaged ayacut, approval of design from the competent Authority, and implementing the project within a period of 36 months, testing and commissioning of the project, etc. complete from Korayar to Varattayar. (**Extension of Moolathara Right Bank canal for a length of 6430km**). The project should be completed in all aspects, within a period of 30	

	months, including the construction of different hydraulic structures such as **conduit, aqueduct, siphon, tunnel**etc. to suit the topography of the area and to feed the entire ayacut area of the scheme, including the protective measures to river banks, abutment of piers of aqueducts, hydraulic structures such as inspection chamber, manhole, surplus escape, controlling regulators as well as sluices to feed ayacut area etc.	**6430m**
4.2.2	Design, Preparing drawings and Providing **Lift Irrigation Scheme** to the highest elevated area as well as ayacut in the lower portions of the canal bed of field, where gravitational flow is not possible, including constructing sump at the suitable place, near the entrance area of Tunnel, Pump House, Cistern/Overhead tank at the Highest elevated area, design and installing motor and pump set, including taking into the consideration of the feasibility of conventional/ natural source of Energy, delivery line from pump set to overhead tank (approximate length of 1500m), suction pipe line, installation of transformer, if found necessary, electrical works, sanction from competent authorities such as Electrical Inspectorate etc. complete. The project should be inclusive of all aspects of works related to testing and commissioning of lift irrigation scheme, including provision for taking delivery of water at intermediate points to feed the ayacut through gravity flow, if found viable etc. complete. The entire project should be completed within the project period of 30 months.	**1 unit**
4.2.3	Repairing and **Renovating the existing MRBC** from beginning to the end (approximate length of 7000m in total length of 12645m, wherever necessary) so as prevent the seepage of water from the canal, including re-construction of 91 Sluices, providing M S shutters and screw gear arrangement etc. complete including cost and conveyance of materials, labour charges etc. complete. The work should be completed in such a way that the water distribution through the existing canal should not be disturbed, during the water distribution period.	**1 unit**

4.2.4	Design and installation of **Micro Irrigation System** with electronically controlled valve in the project area (approximately 3575Ha), including conducting Contour Survey, Individual Farm Boundary Survey, Preparation of Design and Drawings, Preparation of Operation Manual, formation of Water Users Association, Training to the farmers, Cost of related all accessories such as Primary Filtration, Feeder Main, In field Valve, Safety Accessories and Drip System, Fertigation Equipment, Main and Sub main PVC, Pressure Regulator, Drip Manifold Accessories, Construction of store rooms, Installation of Pump set and Motor, electrical accessories including installation of transformer, if necessary, or using other mode of energy such as solar etc., contruction of control rooms wherever required and Operation and Maintenance for a period of 5 years, from the date of issue of completion certificate.	**3575 Ha**
4.2.5	**Improving 14 Nos of Public ponds**, within the project area, by removing silt and deepening the pond and protecting the banks so as to enhance the capacity of tanks, providing feeder channel, pipe line with control valves etc to the tanks from main canal, if possible etc. complete	**14 Nos**

Note – The quantities are approximate ones arrived. The bidder has to verify it and satisfy himself regarding its adequacy. No Variation in Costs shall be paid later due to any variations in this." It shall be expressly understood that the EPC agency shall furnish the detailed Bill of Quantities (BoQ) &Estimate based on approved designs and drawings as per provisions of the bid document/BIS standards which shall form the basis of detailed percentage breakup of payment schedule within the overall component limits approved by EPC Committee-I and variationsifanywill be dealt with as per EPC guidelines.

The Internal Bench Mark of the above scope of work and deliverables shall be Rs. 227.84 Crore, excluding GST

The EPC Contractoris to abide the following conditions:

The "Employer" is the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited i.e., the Agreement Concluding authority. "Engineer in Charge" is the "Executive Engineer / Deputy General Manager" in charge of execution.

Entrustment of the additional items contingent to the main work and within the scope of contract will be authorized by the "Employer" and the EPC agency shall be bound to execute such additional items at no extra cost to the employer and the cost of such items shall be deemed to have been included in the contract price quoted.

Entrustment of additional items of work contingent to main work and outside the scope of contract will be authorized by the employer with the prior approval of EPC- Committee.

In such cases where the approved designs result in "Substantial Reduction" in quantities of that component from the estimated quantities, the payment schedule will be adjusted to the actual quantities. Payment schedule will remain unchanged in case of increase in the quantities in a component.

The EPC Agency shall carry out investigation, detailed layout, designs and drawings of all components of the work to be approved by competent departmental authority. The EPC Agency shall follow all the relevant follow all the relevant CPHEEO manuals/ BIS/GoImanuals/advisories etc. issued from time to time for various components of works.

The EPC Agency shall furnish "detailed estimate" with BOQ's prepared based on approved

designs and drawings by competent authority. IBM is arrived (Excluding reimbursable items) based on DSR 2016 rates effective from 1stApril 2016.

PAYMENTSCHEDULE

Payment Schedule to be approved by EPC Committee:

Sl. No.	Description	% of weightage inthe contract price
1	Design, manufacturing and laying pipeline including construction of all hydraulic structures, protective measures, reformation of banks, sluice control valves etc.	58.52%
2	Lift irrigation scheme, including supply and erecting of pump set and motor, construction of sump, pump house, tank, laying suction and delivery line, Electrification works etc.	0.97%
3	Micro irrigation system, including all accessories with electronically controlled valves, forming WUA, training to farmers, operation and maintenance of the system for 5years etc.	30.56%
4	Revival of ponds, including deepening and protecting the banks	5.84%
5	Repairing, renovating the existing canal, including re construction of sluices, MS shutters etc.	4.11%

SECTION I: INSTRUCTIONS TO TENDERERS

GENERAL

Description of the works: "As per Notice Inviting Tenders"

Source of Funds:

The Kerala Irrigation Infrastructure Development Corporation Limited [KIIDC] is empowered with grant of funds from Kerala Infrastructure Investment Fund Board (KIIFB) to be utilized for execution of this Project. All eligible payments under the contract(s) for the package for which this Invitation for Bids is issued shall be made by the KIIFB

The Eligibility criteria and Qualification requirements:

Eligibility Criteria: The proposals of only those bidders who possess the following technical and financial capability would be technically evaluated and financial bids of bidders who qualify in technical evaluation shall only be opened and lowest bidder shall be awarded the work.

Technical Evaluation will be done only based on the documents uploaded on the e-procurement platform and any subsequent G.O.s issued from time to time by the Government.

General Requirement:

Registered Bidders of Kerala PWD / Central PWD / Other Central or State Government

Departments / State or Central Public Sector Undertakings etc. who have successfully completed similar works.

The bids are limited to those individuals, firms, companies, who meet the following qualification and the eligibility requirements.

Work Execution Period–**30 months(including Monsoon period)**

O&M (excluding power charges) period –**5years with including Defect liability period of 5 years.**

The bidder should furnish Bid Security of Rs**. 2, 28, 00,000**/-intheshape of online payment or irrevocable bank guarantee in favourof**theManaging Director**, **Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC)** by using the option of Net Banking / RTGS / NEFT from their registered bank accounts.

The successful bidder should furnish Performance Guarantee at2.5%of Tender Contract Value at the time of agreement. The proportionate value of Performance Guarantee for CAPEX value will be returned after defect liability period of 5 years and the proportionate value of Performance Guarantee for OPEX value will be returned after completion of **5years** O&M period

Technical Requirements:

The Bidder should have executed the following minimum Quantities in any one financial year during the last Five Financial Years ending with 31-03-2020 (i.e. 1-04-2015 to 31-03- 2020).

Should have completed supply, delivery, laying, jointing and testing of DI / MS Pipe diameter 150/2800 cm and above for a length of not less than 1500/5770Rmt.

Should have experience in design, construction and commissioning of tunnels of minimum diameter 300 cm and above for a length of not less than 660 Rmt.

Should have successfully and substantially completed atleast one structural steel work of minimum 900 Ton.

Note: Proportionate Quantities will also be considered at thetimeofevaluationforthecompleted works of similar nature.

The bidder should enclose experience certificates in support of technical criteria / requirement issued by the Engineer-In-Chief of the State / Central Government departments / Undertakings, not below the rank of Executive Engineer or Equivalent and countersigned by the next higher authority not below the rank of Superintending Engineer or equivalent.

The bidders should furnish the particulars of Quality Control Testing Lab owned or tie up with established quality control laboratories.

Financial Requirements:

a) The bidder should have successfully and substantially completed at least one work of similar nature costing more than 50% (Fifty Percentage) of the estimated cost of the work within the last **five** years. Similar work means large Irrigation Infrastructure projects like Penstock, Tunnel, Canals, Dams, Regulators etc.The value will be updated by giving 10% simple weightage per year to bring them to 2019-20 price level.

b) The bidder should produce Liquid asset / Credit facilities / Solvency certificate from any Indian Nationalized / Scheduled banks of value shall not be less than **Rs. 40,00,00,000 (Rupees FortyCrore only)**.

The bidder's average net worthforthelast 3 financial years shall not be less than **70% of this probable amount of contract**

In this regard certificate issued by Chartered Accountant in the current financial year shall be uploaded by the bidder.

The bidder as a prime contractor should have Satisfactorily Completed at leastlaying

pipeline works of one water supply project with minimum 3 years of O&M with project cost not less than Rs 50,00,00,000/- (Rupees fifty Crore Lakh only). The value will be updated by giving 10% simple weightage per year to bring them to 2019-2020 price level.

The bidder should have experience in surveying, Design, fixing alignment, develop detailed drawing, diversion plans of existing services etc. for water conducting systems for projects costing minimum 100% of the estimated cost of the works in the role of prime contractor, JV member, subcontractor, management contractor, design consultant, or PMC for at least the last Five (5) years prior to the bid submission dead line. If the bidder does not have the corresponding experience, he can associate with a consultancy firm qualifying the above criteria. In such case, an Undertaking from the consultancy to the effect that if the work is awarded to the bidder, they will associate, prepare and provide the required design. The credentials of the consultancy should also be submitted along with the bid.

The bidder should have experience in the execution of micro Irrigation works within the last 5 years. If the bidder does not have the corresponding experience, he can associate with a contractor/company qualifying the above criteria. In such case an MOU duly signed between the bidder and the associate contractor is to be submitted along with the tender to the effect that if the work is awarded to bidder, the contractor with his men and machinery shall complete the micro irrigation works as per the schedules and specifications of the tender, under the control and direction of bidder. However, bidder alone shall be responsible to the accepting authority as regards execution of the work and further defects liability, if any. The credentials to substantiate the qualification and experience of associate contractor should also be submitted along with the bid.

The bidder who has applied for/ availed "Corporate Debt Restructuring" (CDR) or "Strategic Debt Restructuring" (SDR) in the last Five (5) financial years ***is not eligible to participate in the bid***. In regards to this clause, a certificate issued by the CharteredAccountantinthecurrentfinancialyearshallbeuploadedbythebidder.

For MS pipes, DI pipes and HDPE pipes and CPVC pipes, the bidder has tosubmitcopies of Memorandum of Understanding (MoU) with manufacturers having satisfactory manufacturing experience along with BIS license for a period of not less than 5 years. The Memorandum of Understanding (MoU) should clearly indicate that the manufacturer shall supply the agreement quantity for this work.

Assessed available Bid Capacity as per formula (2AN-B) must begreaterthantheEstimateContract Value

A= Maximum value of Civil Engineering works executed in any one financial year during the last (5) Five financial years (updated to current price level) taking into account the work executed for the mentioned period.

N= Number of years prescribed for completion of the work for which tenders are invited.

B= Updated value (at current price level) of all existing Commitments i.e., ongoing orders, orders likely to be awarded to be executed during the Period of completion of the similar nature of work completed for which Tenders are invited.

Annual turnover cost of completed works and balance works on hand etc., shall be updated by giving weightage of 10% per year to bring them to current price level.

The bidder should furnish the availability (either owned or leased) of following key and critical equipment required for the work.

JCB / Hitachi - 3Nos.

MiniExcavatorfortrenching–2Nos.

PinVibrators–3Nos.

Pan Vibrators – 3Nos.

Water Tanker – 2Nos.
Trucks/Tractor/Tippers–10Nos.
ConcreteHopperMiller–3Nos.
Cranes -2Nos.
Tunnel boring machine – 2 Nos
DG set 125KV -200KV – 2 Nos

The bidder should furnish the availability of following key personnel.

Position	**Qualification**	**No. of Persons**	**Total Work Experience (Min) [years]**	**Experience In Similar Work [years]**
Project Manager	B.Tech Civil Experience in Civil Engineering Scheme. (5 years as Project Manager should have O&M experience)	1 Nos	20	12
D. Design Phase				
Civil Engineering Expert	B.Tech Civil Engineering, &M.Tech in Structural Engineering. (8 years' experience in Design of Civil Engineering Project)	1 Nos	15	10
Draftsman	ITIDraftsman/Diploma in Civil Engineering	1 Nos	5	5
E. Construction Phase				
Constructi on Manager	B.Tech. Civil, with minimum 10 years' experience in Irrigation Projects / water resource Projects	1 Nos	15	5
Project Engineer	B.E/ B.Tech in Civil Engineering (3 years' experienceinIrrigation Projects)	4 Nos	10	5
Agricultarist	With minimum 15 years experiance			
F. Operation and Maintenance Phase				
Project Engineer Civil	B.Tech. Civil	1 Nos	5	3
Mech. / Equip. Maintenance Engineer	B.Tech. Mechanical with O & M of Civil Engineering project experience	1 Nos	5	3
Electrical / Instrument ation Engineer	B.Tech. Electrical / Instrumentation with O & M of Civil Engineering project	1 Nos	5	3

The bidders should furnish the particulars of Quality Control Testing Lab owned or tie up with established quality control laboratories.
The bidder should furnish the Income Tax PAN and submission of Latest Income Tax Return along with proof of receipt.
GST and other statutory taxes and duties will be adopted time to time as per the instructions of Government of Kerala.
The Bidder should furnish the GST Registration Certificate, if not uploaded at the time of tendering should be furnished at the time of agreement.
NOTE: **The Internal Bench Mark [IBM] is arrived based on the probable quantities indicated in the deliverables**.

Cost ofTendering:

The bidder shall bear all cost associated with the preparation and submission of his tender and the Employer will in no case be responsible or liable for these costs, regardless of the conduct or outcome of the tendering procedure.

SiteVisit

The bidder is strongly advised to visit and examine the site of work and its surroundings. He shall acquaint and obtain himself at his own responsibility all relevant information such as existing utilities including underground services, availability of labour, basic material, water, electricity etc., that may be necessary for preparation of the tender. A declaration to this effect will have to be signed by the bidder in his tender.

Content of tenderingdocuments

The tender document issued for the purpose of this tender is in two parts Technical Bid and Financial Bid. Technical Bid contains Volume-I & Volume-II and Financial Bid is in Volume-III.
Bidder is expected to examine carefully all instructions, conditions, terms, specifications and drawings in the standard tender document viz. Technical Bid and Financial Bid, Technical Bid contains Volume-I & Volume-II and Financial Bid is in Volume-III. Failure to comply with the requirements of tender stipulations will be at the bidder's risk. Pursuant to **clause 23**the tenders which are not substantially responsive to the requirements of this tender will berejected.

Clarification of tender documents (Not used)

In case any clarification is required by the bidder, he may obtain it personally or in writing well in advance from the Employer. Clarification for which written request has been received at least 3 days prior to Pre-Bid meeting only will be answered.

Amendments to tenderdocument

At any time prior to the dead line for submission of tender, the employer may for any reason whether at his own initiative or in response to a clarification requested by a prospective bidder modify the tender document by issuance of an addendum. The addendum will be kept in website **www.kiidc.kerala.gov.in**one week prior to date of submission of bid.

Languageofthedocuments

The language of tender shall be English.

Documents comprising thetender

The tender to be prepared by the bidder shall comprise of the form of tender and appendices thereto, the Bid Security, the information on technical man power to be available on this work, the contractors alternative technical proposals based on scope of work as defined in Volume II, design criteria, soil data and other such relevant information and any other material required to be completed and submitted in accordance with the instructions to bidders embodied in tender document. The forms and the data

provided in this document shall be used without exception.

The Technical Bid shall comprise of the following:

Scanned copy ofBid Security
Scanned copy of Registration
Scanned copy of Proof ofExperience
DataSheet-1– Bidder's Appreciation of theProject
DataSheet-2– Bidder's Organizational setup for theProject
DataSheet-3– Project Components along withDrawings
DataSheet-4– Management of Design and EngineeringServices
DataSheet-5– Construction Methodology of different componentsproposed
DataSheet-6– Proposed Deployment of Key Personnel
DataSheet-7– Proposed Deployment of ConstructionEquipment
DataSheet-8– Proposed Sub-Contractors
DataSheet-9– Proposed Source of KeyMaterials
Data Sheet-10 – Proposed Construction Schedule of theProject
Data Sheet-11– Quality Control and AssuranceSystem

Tender prices

11.1 The bidder shall quote his offer on form of tender Volume III as Lump sum at appropriate place of the tender document to be submitted as per procedure set in **clause 17**. The Bidder shall quote further breakdown of Lump sum costs in **Annexure– I**, **Volume III**. The bidder shall also quote unit prices in **Annexure II, Volume – III**. Negotiations are not permitted at any stage in respect of price bid. The additions & deductions will be worked out based on the **Annexure – II**.

11.2 The lump sum price quoted by the bidder shall include all the costs towards survey, investigations, designing, execution, O&M and completing the works as predefined scope of work and based on design criteria and Employers Requirement. The lumpsum offer shall provide for all superintendence, labour, material, plant, equipment and all other things required for work including all taxes, GST, duties, royalties and such other charges except for the exceptions provided for in the contract.

In addition to L.S. Price the bidder are also to quote unit prices as an **Annexure – I, II and III** which shall be reviewed and approved by the employer.

Tender validity

Validity of the tender will be **180 Days** from the date fixed for opening of the tenders and thereafter until it is withdrawn by notice in writing duly addressed to the authority opening the tender.

13.1 The bidder shall furnish as a part of his tender Bid Security for **Rs. 2, 28, 00,000/- (Rupees Two Croresand Twenty Eight lakhs only)**.

13.2. The Bid Security to be furnished shall be pay online / Bank Guarantee in favourof**TheManaging Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram**.

13.3. Any tender not accompanied by the Bid Security will stand rejected.

13.4. In the event of the tender being accepted subject to provisions of the **subclause 13.5** below, the said amount of bid Security, if so requested by the bidder be appropriated towards the amount of performance Security deposit payable by him under the conditions of contract.

13.5. "**Forfeiture of Bid Security**": If after submitting the tender, the bidder withdraws his offer or modifies the same or if after acceptance of his tender fails or neglects to furnish the Performance Security, without prejudice to any rights and powers of the Employer

here under or in law, the employer shall be entitled to forfeit the full amount of Bid Security deposited by the bidder. The employer shall also have right to forfeit the full amount of Bid Security if the contractor fails to submit the performance guarantee (as per clause 28.1) within 21 days from the receipt of LOA issued pursuant to clauseNo.27.

13.6. In the event of tender being not accepted the amount of Bid Security deposited by the bidder, shall unless it is prior thereto to forfeit under provisions this contract, be refunded to him on passing of receipt thereto without any interest.

13.7**. Charges payable to:**

Transaction Fee: It is mandatory for all the participating bidders to pay the transaction fee at the time of bid submission. The amount is not reimbursable. Transaction fee should be in the the form of Demand Draft of Rs. 10,000/- + GST, drawn in any Nationalized Bank and in favour of the Managing Director, Kerala Irrigation Infrastructure Development Corporation, Thiruvananthapuram.

13.8. Any bid not accompanied by both the Bid Security and Transaction fee will be rejected by the employer as "non-responsive".

13.9.The EPC contractor should abide to recover 10%of the each running account Bill. Howeverthe max retention amount withheld is limited to 2.5% of the accepted amount of contract.

No Variations in tendering conditions

The bidders are hereby instructed to not to alternate any changes in the bidding documents. If any changes are made by bidder it shall be treated as tampering of documents and the bid shall be summarily be rejected.

Pre-tender meeting

15.1. A pre-tender conference open to all prospective bidders will be held in the **Office of the Managing Director,** Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram wherein the prospective bidders will have an opportunity to obtain clarifications regarding the tender conditions and the work. For this, only questions received in writing 3 days prior to the pre-tender meeting shall be clarified in writing.

15.2. The prospective bidders are free to ask any additional information or clarification in writing and reply to the same will be given in writing. Minutes of the meeting including copies of the questions raised and the replies given will be furnished to all those attending the meeting (subsequently to all the bidders). Any modifications of tender document which may become necessary as a result of pre tender conference shall be through issuance of an addendum pursuant to **clause 8&9**of these instructions.

Format and signing oftenders

16.1. The bidder shall prepare only one copy of the documents comprising the bid as described in this document of these Instructions toBidders.

16.2. The bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the bidder.

16.3 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 all such corrections shall be initialed by the person or persons signing the bid.

16.4. All witnesses and sureties shall be persons of status and probity and their full names,occupations and addresses shall be printed below their signatures.

Submission oftenders

17.1 Bidders need to contact the General Manager, Kerala Irrigation Infrastructure

Development Corporation Limitedforinformation one-procurement.

17.2. The bidders may note the following

Furnishing of hard copies by the bidders before opening the technical bid is dispensed with.

The technical bid evaluation of the bidders will be done on the certificates / documents submitted towards qualification criteria furnished by the bidders.

The bidder shall invariably furnish the original BG for BID SECURITY, hard copies of all documents to **the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited**, before opening the price bids either personally or through courier or by post and the receipt of the same within the stipulated time shall be the responsibility of the bidder. Department will not take any responsibility for any delay or non-receipt.

The bidders shall be required to furnish a declaration that the documents submitted by them are genuine. Any incorrectness/ deviation noticed will be viewed seriously apart from canceling the work duly forfeiting the BID SECURITY, criminal action will be initiated including suspension of business.

vi) If any bidder fails to submit the original BG for BID SECURITY, transaction fee in the prescribed form, hard copies of all documents within the stipulated time, the bidders will be suspended / disqualified from participating in the tenders on "e-procurement" platform for a period of 36months from the date of bid submission. The suspension of bidder shall be automatically enforced.

Tenderopening

Tender opening will be as per the e-procurement procedures.

Process to be confidential

After opening of the tenders publicly information relating to the examination, clarification, evaluation and comparison of tenders and recommendations concerning the award of contract shall not be disclosed to the bidders or other persons not officially concerned with such process until the award of the contract to successful bidder has been announced.

Any effort by a bidder to influence the employer in process of examination clarification evaluation comparison of bids and in decision concerning the award of contract may result in rejection of tender.

Clarification of tenders

To assist in examination, evaluation of tenders the employer may ask bidders individually, for clarification of their offer including break down of costs, reasons in case of very high/very low offer. Such request shall be in writing and the response shall also be in writing.

Tender liable for rejection

The tender is likely to be rejected if on opening it is found that –

The bidder has not strictly followed the procedure laid down for submission of tender.

The bidder has proposed conditions which are inconsistent with or contrary to the terms and conditionsspecified.

Additions, correctionsoralteration are made by the bidder on any page of the tender document.

Any page or pasted slips are missing.

The bidder has not signed the tender.

The bidder has specified any additional condition.

The bidder has not attached the addendum to the main tender form as stated in Para 7.

In case the technical proposal of bidder who has quoted lowest price and who has satisfied other criteria is not conforming to the stipulations made, the bidder without

revising the cost shall modify the same to conform to the stipulations. If the bidder refuses to modify thisthen the tender shall be treated as non-responsive and rejected.
ThebidderhasquotedfinancialofferanywhereotherthanspecifiedinFinancialBid.

Correction of errors

If there is any discrepancy between the offer quoted in figures and in words, the rate quoted in words will be treated as the offer.

Evaluation and comparison of tenders

Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited will evaluate whether each tenderer is satisfying the eligibility criteria prescribed in the tender document and declares them as a qualified tenderer.

If the technical bid of a tenderer is not satisfying any of the eligibility criteria it will be rejected by the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited. However, the tender accepting authority detects any error in the evaluation of tenders by Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, the tender accepting authority while returning the tenders may direct the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited or Chief Engineer as the case may be, to re-evaluate the tenders.

If any alteration is made by the tenderer in the tender documents, the conditions of the contract, the drawings, specifications or statements / formats or quantities the tenderwill be rejected.

Award criteria

Subject to clause 23, the employer will award the contract to a bidder whose tender has been found to satisfy all requirements of tender document and who has offered the lowest price.

Department's right to accept any tender and to reject any or all tenders Not withstanding the clause 24, the employer reserves the right to accept or reject any tender and to cancel the tender process and reject all the tenders at any time prior to award of contract without there by incurring any liability to the affected bidders or any obligation to inform affected bidder/s of the grounds for employer's action.

Notification of award.

Prior to the expiration of tender validity period or any such extended period, the employer will notify the successful bidder in writing by a registered letter that his tender has been accepted. This letter (herein after and in conditions of contract called letter of acceptance) shall name the sum which the employer will pay to the Contractor in consideration of the execution, completion and maintenance of the work by the Contractor as prescribed in the Contract. This notification of award will constitute formation of contract.

Upon furnishing the performance Security by the successful bidder in accordance with the **clause 27** the order to start work will be given. The work order shall be accompanied by a true copy of the agreement bearing the number under which it is registered in the office of the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited.

Performance guarantee

2.5%with a total of accepted tender amount / contract value as performance Security. Fifty percentage (50%) of this amount should be in the form of Treasury Fixed deposit in the name of Agreement Authority for a period not less than 28 (twenty-eight) days after the completion of defect liability period and the remaining fifty percentage in the form of bank guarantee or in any other forms prescribed in the revised PWD manual and shall be valid till 28(twenty-eight) days after the completion of defect liability period of the Work, in any of the following forms. The balance fifty percentage (50%) of the performance guarantee shall be either in the form of demand draft drawn in favour of the Managing

Director, Kerala Irrigation Infrastructure Development Corporation Limited or in the form of bank guarantee issued by a Nationalized Banks of India or any scheduled Bank in favour of the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited. The Performance Security shall be valid until the Contractor has fully and satisfactorily completed all of its obligations of the Contract.

Signing of agreement

Upon furnishing the Performance guarantee the contractor will be invited to conclude the agreement.

Section 2: Conditions of Contract

SECTION - 2: CONDITIONS OF CONTRACT

A.GENERAL

Definitions:

The Employer is the Kerala Irrigation Infrastructure Development Corporation Limited represented by the Managing Director.

Address

: Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC],
PARVATHY, TC 36 /1, NH 66 Service Road,
Near EanchakkalJn, Chakkai P O,
Thiruvananthapuram -696024, Kerala
Email: iiidctvm@gmail.com

The "Engineer" is Deputy General Manager orany authorized representative appointed by the KIIDC

The following additional words and expressions shall have the meanings assigned to them, except where the context otherwise required:

Authority or Department shall mean the successors in office and assigns.

The "Engineer-in-Chief" shall mean the Chief Engineer, KIIDC.

The "Superintending Engineer" shall mean the General Manager, Kerala Irrigation Infrastructure Development Corporation Limited who is designated as such for the time being, in whose jurisdiction the works lies.

The "Executive Engineer" shall mean the Deputy General Manager, Kerala Irrigation Infrastructure Development Corporation Limitedwhois designated as such for the time being, in whose jurisdiction the works lies.

The "Engineer" shall mean any authorized representative who appointed by the employer to perform the duties and responsibilities of supervising the contract.

The "Engineer's representative "means the project manager appointed / nominated by the Engineer, who is consultant to the department to perform the duties and the responsibilities of the engineer in supervising the contract.

A "Day" shall mean a day of 24 hours from midnight to midnight irrespective of the number of hours worked in that day.

A "Week" shall mean 7 consecutive days without regard to the number of hours worked in any day in that week.

The "Site" shall mean the lands and /or other places, on under, in or through which the work is to be executed under the Contract including any other lands or places which may be allotted by the Department or used for the purpose of Contract.

"Urgent Works" shall mean any measures which, in the opinion of Engineer becomes necessary during the progress of the work to obviate any risk or accident or failure or which becomes necessary for Securityoftheworkor the persons working thereon.

Engineer's Duties

The Engineer shall obtain the specific approval of the Employer in respect of the following:

Approving sublettingof theWork
Granting claims totheContractor
Ordering suspension of thework
Determining an extension oftime
Waiving off the penalty and arranging the repayment of compensationfordelay
Issuing of VariationOrder
Ordering any work/test beyond the scope of theContract
Determining rates for the extra items /extrawork

Any variations in the contractcondition
Approval to designs and working drawings

Duties of the Engineer's Representative

The duties of the Engineer's Representative are to watch and supervise the work and to test and examine any materials to be used or workmanship employed in connection with theWorks

Interpretation:

In interpreting these Conditions of Contract, singular also means plural, male alsomeansfemale, and vice-versa. Headings have no significance. Works have their normal meaning under the language of the contract unless specifically defined. The Engineers- in-charge will provide instructions clarifying queries about the conditions of Contract.

The documents forming the Contract shall be interpreted in the following order of priority:

ContractAgreement
Letter of Acceptance, notice to proceed with theworks
Contractor's Tender (Technicalbid)
Conditions of contract (IncludingSpecialConditions)
Specifications
Drawings
Bill of quantities(Price-bid)
Any other document listed as forming part of theContract.

Engineer-in-Charge'sDecisions:

Except where otherwise specifically stated, the Engineer-in-charge will decide the contractual matters between the KIIDCandthe Contractor in the role representing the Department / KIIDC.

Delegation:

3.1. The Engineer-in-charge may delegate any of his duties and responsibilities to other officers and may cancel any delegation by an official orderissued.

Communications:

4.1. Communications between parties, which are referred to in the conditions, are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act)

Sub-contracting:

5.1. If the prime contractor desires to sub-let a part of the work, he should submit the same at the time of filing tenders itself or during execution, giving the name of the proposed Sub-contractor, along with details of his qualification and experience. The Tender Accepting Authority should verify the experience of the Sub-contractor and if the Sub- contractor satisfies the qualification criteria in proportion to the value of work proposed to be sub-let, he may permit the same. The total value of works to be awarded on sub-letting shall not exceed 50% of contract value. The extent of subletting shall be added to the experience of the sub-contractor and to that extent deducted from that of the main contractor. The Agency shall submit the names of their representatives who will be supervising the work along with their photo ID card to the department within a month from the date of entering into agreement. Further, in case of change in the personnel the same shall be intimated tothedepartment, a week in advance. If other is found to be executing / supervising the work, such work will be treated as a work let out unauthorized.

5.2. If itisfoundthattheagencyhassub-lettheworkunauthorized,theagencyshall be

blacklisted and barred from participating in bidding for Government works for a period of six years.

5.3. Recognitionofunauthorized subletting may be based on reports of V&E Department or any officer above the rank of ExecutiveEngineer.

5.4. On receipt of such a report, the agreement concluding authority shall call for an explanation from the agency fixing a time limit not exceeding 30 days. If no reply is received within the time limit, it will be deemed that the agency has no explanation to offer and orders shall be passed black-listingtheagency by the Government as perG.O.

5.5. If a reply is received, the reply shall be examined and an order after giving due to consideration to the reply shall be passed by theGovernment.

5.6. A contracting firm shall also be black listed it is found that the firm has a person as partner / director who is also a partner / director in a black –listedfirm.

Other Contractors:

6.1. The Contractor shall cooperate and share the Site with other contractors, Public authorities, utilities, and the KIIDCAuthority. The Contractor shall also providefacilitiesandservicesforthemasdirectedbytheEngineer-in-charge.

Personnel:

7.1. The Contractor shall employ the required Key Personnel named in the Schedule of Key Personnel to carry out the functions stated in the Schedule or other personnel approved by the Engineer-in-charge. The Engineer-in-charge will approve any proposed replacement of Key Personnel only if their qualifications, abilities, and relevant experience are substantially equal to or better than those of the personnel listed in the Schedule.

7.2**. Schedule of KeyPersonnel:**

The successful tenderer shall have to employ the following technical staff on full time basis to be available at site.

Cost of work(Technical sanction amount)	**Qualification of Technical Staff**
1	2
Rs.10000.00 lakhs and above	Six Graduate Engineers

7.3. Employment of technical personnel shall be with reference to the estimate cost of work put totender.

7.4. The appointment of technical staff shall be on full timebasis.

The Technical staff shall be available at work site for supervising the work including quality checking of all items from time to time. Failure to employ the required technical personnel by the contractor, amounts will be recovered from the contractor over and above the provision made in part two of schedule-A from the contractor’s bills.

7.5. The technical personnel should be on full time and available at site whenever required by Engineer in Charge to takeinstructions.

7.6. The names of the technical personnel to be employed by the contractor should be furnished in the statement enclosedseparately.

7.7. In case the contractor is already having more than one work on hand and has undertaken more than one work at the same time, he should employ separate technical personnel on each work.

7.8. If the contractor fails to employ technical personnel the work will be suspended or KIIDCwill engage technical personnel and recover the cost thereof from thecontractor.

7.9. If the Engineer-in-charge / Employer / Employer's Representative asks the Contractor to remove a person who is a member of Contractor's staff or his work force stating the reasons the Contractor shall ensure that the person leaves the site forthwith and has no further connection with the work in thecontract.
7.10. The Engineer-in-charge is the sole judgeto decide whether qualified technical staff is actually supervising thework to decide the actual period of absence of such staff which requires the above recovery to be enforced and his decision is final and binding on thecontractor.
7.11. The technical agents appointed by the contractor shall have to maintain properly all the records required by the KIIDCunder safe custody at site, like checklists, calibration registers/records, Quality Test Registers, Test reports file, site order book, etc. and make signatures at appropriate places towards proof of verifications, conduction of tests, compliance to instructions etc.
7.12. Failure to employ the required technical personnel by the contractor the following amounts will be recovered from the contractor over and above the provision made in Schedule-B from the contractor's bills.
7.13**.** The List of Key Personnel to be deployed on this project is mentioned in Annexure–A.

Contractor'sRisks:

All risks of loss of or damage to physical property and of personnel injury and death, which arise during and in consequence of the performance of the contract, are theresponsibilityof the contractor.

The Rate quoted is Final and Lump sum for the fulfillment of the entire project detailed earlier. Escalation or hike in prices of whatever kind will not be allowed later.

Insurance:

9.1. Submission of insurance at the time of Concluding Agreement is dispensed forth with.
9.2. The Contractor shall provide, in the name of the Department / KIIDC, insurance cover for personal injury or death of persons employed for construction to the Managing Director at the time of concluding agreement of thework
9.3. The Contractor shall provide, in the joint names of the KIIDCandthe contractor, insurance cover from the Start Date to the end of the Defects Liability Period i.e., 60 months after completion for the following events which are due to the Contractor's risks.
a) Loss of or damage to the Works, Plant and Materials;
b) Loss of or damage to the Equipment;
c) Loss of or damage of property in connection with the Contract; and
d) Personalinjuryordeathof persons employed for construction.
e) **Professionalliability Insurance**: The Contractor shall affect professional indemnity insurance, which shall covertheriskof professional negligence in the design of the works. This insurance shall be for a limit of not less than **Rs. 20.00 Lakh**. The Contractor shall use his best endeavor to maintain the professional indemnity insurance in full force and effect until defect liability period. The Contractor undertakes to notify the Employer promptly of any difficulty in extending, renewingorreinstating thisinsurance.
9.4. Policies and certificates of insurance shall be delivered by the Contractor to the Engineer-in-charge / Employer / Employer's Representative at the time of concluding Agreement. All such insurance shall provide for compensation to be payable to rectify the loss or damageincurred.
i) The contractor shall furnish insurance policy in force in accordance with proposal furnished in the Tender and approved by the KIIDCAuthority/KIIDC

forconcludingtheagreement.
The contractor shall also pay regularly the subsequent insurance premium and produce necessary receipt to the Engineer-in-Charge / Employer / Employer's Representative, well inadvance.
In case of failure to act in the above said manner the KIIDCAuthority/KIIDC will pay the premium and the same will be recovered from the Contractor'spayments.
9.5. Alterations to the terms of insurance shall not be made without the approval of the Engineer-in-Charge/ Employer / Employer'sRepresentative.

Site Inspections:

10.1. The contractor should inspect the site and also proposed quarries of choice for materials source of water and quote his percentage including quarrying, conveyance and all other chargesetc.
10.2. The responsibility for arranging the land for borrow area rests with the Contractor and no separate payment will be made for procurement or otherwise. The contractor's quoted percentage will be inclusive of landcost.

Contractor to Construct the Works:

11.1. The Contractor shall construct and Commission the Work in accordance with the specifications andDrawings.

Diversion of streams / Vagus/Drains.

The contractor shall at all-time carry out construction of cross drainage works in a manner creating least interference to the natural flow of water while consistent with the satisfactory execution of work. A temporary diversion shall be formed by the contractor at his cost where necessary. Noextrapayment shall be made for this work.

12.2 No separate payment for bailing out sub-soils, water drainage or locked up rain waterfordiversion, shoring, foundations, bailing of pumping water either from excavation of soils from foundations or such other incidental will be paid. The percentage to be quotedby the contractor is for the finished item of work in situ and including all the incidental charges. The borrow pits are also to be de-watered bythecontractorhimself at his expense, ifthat should be foundnecessary.
12.3. The work of diversion arrangements should be carefully planned and prepared by the contractor and forwarded to the **MD, KIIDC**, technically substantiating the proposals and approval of the **MD, KIIDC**, obtained forexecution.
12.4. The contractor has to arrange for bailing out water, protection to the work in progress and the portion of works already completed and safety measures for men and materials and all necessary arrangements to complete thework.
12.5. All the arrangements so required should be carried outand maintained at the cost of the contractor and no separate or additional payment isadmissible.
12.6. CofferDams
Necessary coffer dams and ring bunds have to be constructed at the cost of contractor and same are to be removed after the completion of the work at the discretion of the department

Power Supply.

13.1. The contractor shall make his own arrangements for obtaining power from the Electricity dept., at his own cost. The contractor will pay the bills of Electricity for the cost of power consumed byhim.
13.2. The contractor shall satisfy all the conditions and rules required as per Indian Electricity Act 1910 and under Rule-45(I) of the Indian Electricity Rules, 1956 as amended from time to time and other pertinentrules.
The power shall be used for bonafideDepartmental/ KIIDC Authority workonly.

Temporary Diversions (Works on Highways / Municipal Roads)

14.1. The contractor shall at all-time carryout work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all works involving improvements to the existing highway, the contractor shall in accordance with the directions of the Engineer-in-charge provide and maintain during the execution of the work a passage for traffic, either along a part of the existing carriage way under improvement or along a temporary diversion constructed close to the highway.

14.2. If in the opinion of the Engineer-in-Charge/ Employer / Employer's Representative, it is not possible to pass the traffic on part width of the carriageway for any reason, a temporary diversion close to the highway shall be constructed as directed. It shall be paved with the materials such as hard morrum, gravel and stone, metal to the specified thickness as directed by the Engineer-in-Charge / Employer / Employer's Representative. In all cases, the alignment, gradients and surface type of the diversion including its junctions, shall be approved by the Engineer-in-charge/ Employer / Employer's Representative before the highway is closed totraffic.

14.3. The contractor shall take all necessary measures for the safety of traffic during construction and provide erect and maintain such barricades, including signs, markings, flags lights and information and protection of traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, an agreed phased programmeforthediversion of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge/Employer/Employer'sRepresentative.

14.4. The barricades erected on either side of the carriage way portion of the carriage way closed to traffic, shall be of strong design to resist violation and painted with alternative black andwhite stripe. Red lanterns or warnings lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset tosunrise.

Ramps:

15.1. Ramps required during execution may be formed wherever necessary and same are to be removed after completion of the work. No separate payment will be made for this purpose.

Monsoon Damages:

16.1. Damages due to rain or flood either in cutting or in banks shall have to be made good by the contractor till the work is handed over to the Department / KIIDC. The responsibility of de-silting and making good the damages due to rain or flood rests with the contractor. No extra payment is payable for such operations and the contractor shall therefore, had to take all necessary precautions to protect the work done during the construction period.

The works to be completed by the intended completion date:

17.1. The contractor may commence execution of the works on the start date and shall carry out the works in accordance with the programmesubmitted by the contractor, as updated with the approval of the Engineer-in-Charge / Employer / Employer's Representative, and complete the work by the Intended completiondate.

Safety:

18.1. The Contractor shall be responsible for the safety of all activities onthesite.

Discoveries:

19.1. Anything of historical or other interest or of significant value unexpectedly discovered ontheSite is the property of the Government / KIIDC. The Contractor is to notify the Engineer-in-charge / Employer / Employer's Representative of such Representative instructions for dealing with them.

Possession of the Site.

20.1. The KIIDCshall give possession of the site to the Contractor. If discoveries and carry out the Engineer-in-Charge's / Employer / Employer's possession of a part site is given, the KIIDCwill ensure that the part

20.2. Additional land acquisition, if required, in few isolated stretches is foreseen in this project. The Contractor shall submit relevant L.A. proposals as required and pursue with the authorities concerned to acquire the land. The Department will assist the Contractor in this regard and if any compensation has tobepaid, department will arrange to pay the same. Site so handedover is amenable to carryout the work at site by the Contractor.

20.3. The Site for the execution of the work will be available as soon as the work is awarded. In case it is not possible for the department to make entire site available on the award of the work, due to any unforeseen reasons like court orders etc., the contractor will have to modify his working programme accordingly. No claim whatsoever for not giving the entire site in one stretch on award of work, (or) for handing over the site in phases will be tenable.

Access to theSite:

21.1. The Contractor shall provide the Engineer-in-Charge / Employer / Employer's Representative and any person authorized by the Engineer-in-Charge, access to the site and to any place where work in connection with the Contract is being carried out or is intended to be carriedout.

Instructions:

22.1. The Contractor shall carry out all instructions of the Engineer-in-charge / Employer / Employer's Representative and complies with all the applicable local laws where the Site is located.

Site Order Book:

23.1. A site order book shall be maintained on the site and it shall be the property of the Employer and the Contractor shall promptly sign orders given therein by the Engineer or his authorized representative and comply with them. The compliance shall be reported by Contractor to the Engineer in good time so that it can be checked. The blank site order book with machine numbered pages in quadruplicate with perforated sheet for three copies to be detached will be provided by the Engineer for this purpose. Whenever any instructions are written in the site order book, the Contractor will be supplied the first carbon copy.

Settlement of disputes:

24.1. If any dispute of difference of any kind whatsoever arises between the KIIDCandthe Contractor in connection with, or arising out of the Contract, whether during the progress oftheworksor after their completion and whether before or after the termination, abandonment or breach of the Contract, it shall in the first place, be referred to and settled by the Engineer-in-charge / Employer / Employer's Representative who shall, within a period of 30 (Thirty) days after being requested by the Contractor to do so, give written notice of his decision to the Contractor. Upon receipt of the written notice of the decision of the Engineer-in-Charge the Contractor shall promptly proceed without delay to comply with such noticeofdecision.

24.2. If the Engineer-in-Charge / Employer / Employer's Representative fails to give notice of his decision in writing within a period of thirty days after being requested or if the Contractor is dissatisfied with the notice of the decision of the Engineer-in-Charge/ Employer / Employer's Representative, the Contractor may within thirty days after receiving the notice of decision appeal to the KIIDCwho shall offer an opportunity to the contractor to be heard and to offer evidence in support of his appeal, the KIIDCshall give

notice of his decision within a period of thirty days after the Contractor has given the said evidence in support of his appeal, subject to arbitration, as hereinafter provided. Such decision of theDepartment/ KIIDC in respect of every matter so referred shall be final and binding upon the Contractor and shall forthwith be given effect to by the Contractor, who shall proceed with the execution of the works with all due diligence whether he requires arbitration as hereinafter provided, or not. If the KIIDChave given written notice of his decision to the Contractor and no claim to arbitration, has been communicated to him by the Contractor within a period of thirty days from receipt of such notice the said decision shall remain final and binding upon the Contractor. If the KIIDCfail to give notice of his decision, as aforesaid within a period of thirty days after being requested as aforesaid, or if the Contractor be dissatisfied with any such decision, then and in any such case the contractor within thirty days after the expiration of the first named period of thirty days as the case may be, require that the matter or matters in dispute be referred to arbitration as detailed below:

SETTLEMENT OF CLAIMS:

All claims to be settled by a Civil Court of competent jurisdiction by way of Civil suit and not by arbitration.

A reference for adjudication under this clause shall be made by the contractor within six months from the date of intimating the contractor of the preparation of final bill or his having accepted payment whichever is earlier.

Arbitration shall not be a means of settlement of any dispute or claim out of this contract. All disputes and differences arising out of the contract may be resolved through discussions between the Employer and the Contractor within the purview of the contract agreement. If such discussions are not fruitful, the disputes shall be settled only by the Civil Court in whose jurisdiction the work covered by the contract is situated, or in whose jurisdiction the contract was entered into in case the work extended to the jurisdiction of more than one court.

TIME FOR COMPLETION

Program:

25.1. The total period of completion is (as specified in the NIT) inclusive of Monsoon Period from the date of entering with agreement toproceed including rainy season. Keeping in view, the schedule for handing over of site given in condition below, the work should be programmed such as to achieve the milestones as in "Rate of progress statement" Mile StoneswillbedrawnbytheagencywhichshouldbeacceptabletotheDepartment.

25.2. The attention of the bidder is directed to the contract requirement at the time of beginning of the work, the rate of progress and the dates for the whole work and its several parts as per mile stone. The following rate of progress and proportionate value of work done from time to time as will be indicated by the MD, KIIDC's Certificate for the value of work done will be required. Date of commencementoftheir programmewillbethedateforconcludingagreementbutnotthedateofhandingoversite.

25.3. After signing the agreement, the contractor shall forthwith begin the work, shallregularlyand continuously proceed with them.

25.4. **Rate of progress**:

Work programme of achieving the milestones (Statement).

The contractor/EPC agency shall be subject to the following Key activities to carry out its operations as indicated below during design, construction and operation period of 5 years including "Defect Liability Period" (5years).

Sl. No.	Sectional Milestone	Time from stipulated date of contract start(days)	Event of start	Activities
1	Mobilization	15	Contract signing	
Irrigation works:				
2	Completion of allSurvey, investigation work.Submission of Quality assurance plan	45	Contract signing	Including all surveys, QAP
3	Submission of Systematic investment plan (SIP)	60	Contract signing	Including Designs,BOQ, implementation and phasing program and methodology
4	Approval of SIP	60	Contract signing	
5	Supply, fabricating and laying and erecting MS pipe, lift Irrigation scheme, renovation of pond, soil investigation.	730	Contract signing	Implementation of the project.

Site schedule of programmeofhanding over site to the contractor site will be handed over to the contractor in stages according to the progress of work. (Statement)
The contractor shall achieve the financial progress; otherwise Liquidated Damages shall be levied as per the conditions ofcontract.

25.5. The contractor shall commence the works on site within the period specified under condition 24.1 to 24.3 above after the receipt by him of a written order to this effect from the MD, KIIDC and shall proceed with the same with due expedition and without delay, except as may be expressly sanctioned or ordered by the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram,or be wholly beyond the contractor's control.

25.6. Save in so far as the contractor may prescribe, the extent of portions of the site of which the contractor is to be given possession from time to time and the order in which such portions shall be made available to him and, Subject to any requirement in the contract as to the order in which the works shall be executed, the Deputy General Manager will, with the MD, KIIDC 's written order to commence the works, give to the contractor possession of so much of the site as may be required to enable the contractor to commence proceed with the execution of the works in accordance with the programme if any, and otherwise in accordance with such reasonable proposals of the contractor as he shall by written notice to the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram, make and will from time to time as the works proceed, give to the contractor possession of such further portions of the site as may be required to enable the contractor to proceed with the execution of the

works with due dispatch in accordance with the said programmeorproposals as the case maybe ; if the contractor suffers delay or incurs cost from failure on the part of the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram, to give possession in accordance with the terms of this clause, the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram, shall grant an extension of time for the completion of works.

25.7. The contractor shall bear all costs and charges for special or temporary way leases required by him in connection with access to the site. The contractor shall also provide at his own cost any additional accommodation outside the site required by him for the purposes of the work.

25.8. Subject to any requirement in the contract as to completion of any section of the works before completion of the whole of the works shall be completed in accordance with provisions of clauses in the Schedule within the time stated in the contract calculated from the last day of the period named in the statement to the tender as that within which the works are to be commenced or such extended time as may be allowed.

25.9**. Delays and extension oftime**:

No claim for compensation on account of delays or hindrances to the work from any causes whatever shall lie, except as hereafter defined. Reasonable extension of time will be allowed by the officer competent to sanction the extension, for unavoidable delays, such as may result from causes, which in the opinion of the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram, and are undoubtedly beyond the control of the contract. The Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram shall assess the period of delay or hindrance caused by any written instructions issued by him, at twenty five percent in excess or the actual working period solost.

In the event of the Deputy General Manager failing to issue necessary instructions and thereby causing delay and hindrance to the contractor, the latter shall have the right to claim an assessment of such delay by the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram, whose decision will be final and binding. The contractor shall lodge in writing with the Deputy General Manager a statement of claim for any delay or hindrance referred to above, within fourteen days from its commencement, otherwise no extension of time will be allowed.

Whenever authorized alterations or additions made during the progress of the work are of such a nature in the opinion of the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram, as to justify an extension of time in consequence thereof. If there are valid reasons for extending the contract period, proposals for extension of time should be sent to the authority competent to accord administrative sanction, sufficiently in advance and in any case at least one month before the expiry of the contract period.

ConstructionProgramme:

26.1. The Contractor shall furnish within 15 days from the receipt of work order, the work programme showing the sequence in which he proposed to carry out the work, monthly progress expected to be achieved, also indicating date of procurement ofmaterialsplantand machinery. The schedule should be such that it is practicable to achieve completion of the whole work within the time limit fixed and in keeping with the Mile stone programme specified and shall obtain the approval of the Engineer-in-Charge/ Employer / Employer's Representative. Further rate of the progress as in the program shall be kept up to date. In case it is subsequently found necessary to alter this program, the contractor shall submit sufficiently in advance the revised program incorporating necessary modifications and get the same approved by the Engineer - in - Charge. No

revised program shall be operative with out approval of Engineer - in–Charge.
26.2. The Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram shall have all times the right, without any way violating this contract, or forming grounds for any claim, to alter the order of progress of the works or any part thereof and he contractor shall after receiving such directions proceed in the order directed. The contractor shall also report the progress to the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram, within 7 days of the Executive Engineers direction to alter the order of progress ofworks.
26.3. The contractor shall give written notice to the Engineer-in-Charge/ Employer / Employer's Representative whenever planning or progress of the works is likely to be delayed on disrupted unless any further drawings or order including a direction, instruction or approval is issued by the Engineer-in-Charge/ Employer / Employer's Representative within areasonable time. The notice shall include details of the drawing or order required and of why and by when it is required and of any delay or disruption likely to be suffered if it islate.

Speed of Work

27.1. The Contractor shall at all times maintain the progress of work to conform to the latest operative progress schedule approved by the Engineer-in-Charge/ Employer/Employer's Representative. The contractor should furnish progress report indicating the programme and progress once in a month. The Engineer-in-Charge/ Employer / Employer's Representative may at any time in writing direct the contractor to slow down any part or whole of the work for any reason (which shall not be questioned) whatsoever, and the contractor shall comply with such orders of the Engineer-in- Charge/ Employer / Employer's Representative. The compliance of such orders shall not entitle the contractor to any claim of compensation. Such orders of the Engineer-in- Charge/ Employer / Employer's Representative for slowing down the work will however be duly taken into account while granting extension of time if asked by the contractor for which no extra payment will beentertained.
27.2. Delays in Commencement or progress or neglect of work and forfeiture ofearnestmoney, Security deposit and withheldamounts:
If, at any time, the Engineer-in-Charge/ Employer / Employer's Representative shall be of the opinion that the contractor is delaying commencement of the work or violating any of the provisions of the contractor is neglecting or delaying the progress of the work as defined by the tabular statement. "Rate of progress" in the "Articles of Agreement", he shall so advise the contractor in writing and at the same time demand compliance in accordance with conditions of Tender Notice. If the contractor neglects to comply with such demand within seven days after receipt of notice, it shall then or at any time thereafter, be lawful for the Engineer-in-Charge/ Employer / Employer's Representative to take suitable action in accordance with Provisionsof KDSS

Suspension of works by the Contractor.

28.1. If the Contractor shall suspend the works, or sublet the work without sanction of the Engineer-in-Charge/ Employer / Employer's Representative, or in the opinion of the Engineer-in-Charge/ Employer / Employer's Representative shall neglect or fail to proceed with due diligence in the performance of his part of the Contract as laid down in the Schedule rate of progress, or if he shall continue to default or repeat such default in the respects mentioned in Provisionsofthe KDSS, Engineer - in - Charge shall take action in accordance with provisions of KDSS..
28.2. If the Contractor stops work for 28 days and the Stoppage has not been authorized by the Engineer - in - Charge the Contract will be terminated under Provisions of KDSS.
28.3. If the Contractor has delayed the completion of works the Contract will

beterminatedunderProvisions of KDSS.

29. Extension of the Intended Completion Date:

29.1. The Engineer - in - Charge shall extend or recommend for extension, in accordance with the Government / KIIDC Authority's orders in force, the Intended Completion Date if a Variation is issued which makes it impossible for Completion to be achieved by the Intended CompletionDate.

29.2. The Engineer-in-Charge/ Employer / Employer's Representative shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Engineer for a decision upon the effect of a Variation and submitting full supporting information.IftheContractorhas failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended CompletionDate.

30. Delays Ordered by the Engineer-in-Charge/ Employer /Employer'sRepresentative:

30.1. The Engineer-In-Charge / Employer / Employer's Representative mayinstructtheContractor to delay the start or progress of any activity within theWork.

Early Warning:

31.1. The contractor is to warn the Engineer-In-Charge / Employer / Employer's Representative at the earliest opportunity of specific likely future events or circumstances that may adversely affect the execution ofworks.

31.2. The Contractor shall cooperate with the Engineer-In-Charge / Employer / Employer's Representative in making and considering proposalsforhowthe effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Engineer-In-Charge/ Employer / Employer'sRepresentative.

Management Meetings:

32.1. The Engineer-In-Charge / Employer / Employer's Representative may require the Contractor to attend a management meeting. The business of a management meeting shall be to review the programmeforremainingworkand to deal with matters raised in accordance with the early warningprocedure.

QUALITYCONTROL

Identifying Defects:

33.1. The Engineer-in-Charge/ Employer/ Employer's Representative/ Project Management Consultant engaged by the client shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Engineer-in-Charge/ Employer / Employer's Representative may instruct the Contractor to verify the Defect and to uncover and test any work that the Engineer considers may be a Defect.

Tests:

34.1. **Laboratory for testing:**

The contractor shall for the purpose of testing the material shall establish a field laboratory of 40 sq. meter area. The contractor shall provide all equipment as per list in Annexure - D.

34.2. If the Engineer-In-Charge/ Employer / Employer's Representative instructs the contractor to carry out a test not specified in the specification to check whether any work has a defect and the contractor shall pay for the test and any samples.

Correction of Defects:

35.1. The Engineer-In-Charge / Employer / Employer's Representative shall give notice

to the contractor of any defects before the end of the defectsliabilityperiod, which begins on completion. The defects liability period shall be extended for as long as defects remain to be corrected by the contractor.

35.2. Every time notice of a defect when given, the contractor shall correct the notified defect within the length of time specified by the Engineer-In-Charge's / Employer / Employer's Representativenotice.

Uncorrected defects

36.1. If the contractor has not corrected the defect within the time specified in the Engineer- in-Charge/ Employer / Employer's Representative's notice, the Engineer-in-Charge/ Employer / Employer's Representative will assess the cost of having the defect corrected and the contractor will pay thisamount.

36.2. The Engineer-In-Charge / Employer / Employer's Representative shall introduce O.K cards and prescribed the formats there of. O.K cards shall relate to all major components of the work. The contractor/his authorized representative shall be required to initiate and fill in and present the O.K card to the construction staff that would check the respective items and send to the quality control staff for final check and clearance/O.K. Any defects pointed out by the construction supervision staff or by the Quality Control staff shall promptly be attended to by the contractors and the fact of doing so be duly recorded on the back of O.K Card.

36.3. The Engineer-In-Charge / Employer / Employer's Representative may also introduce check lists which shall be kept in Bound registers by the construction supervision staff. The contractor may be required to fill up these lists in the first instance and shall be subsequently checked by the Construction / Quality Control Engineers.

Quality Control:

37.1. In addition to the normal inspection by the regular staff in-charge of the construction of work, the work will also be inspected by the Executive Engineer/Superintending Engineer /Chief Engineer Quality control Circle or by the State or District level Vigilance Cell Unit and any other authorized external Agency if any sub-standard work or excess payments are noticed with reference to measurement books etc., during inspection, action will be taken based on their observations and these will be effected by the Engineer-in-Charge/ Employer / Employer's Representative of the execution of the work.

For all works costing more than Rs.2.00 Crores the Contractor shall submit quality plan and also show proof of owning quality lab or tie-up with an established quality lab.

COST CONTROL

Lump Sum Price:

38.1. The Contractor is paid for the quantity of the work done on prorate basis against each item as per Annexure-I, Volume-III.

38.2**. Variations in Scope of Work**: It shall be generally understood that the price quoted by the tenderer shall be all inclusive price for completion of scope of work detailed in the tender document and is for finished work at site in all respects including minor modifications where felt essential.

In an unlikely event, should the exigencies of work so demand that any major modifications are found essential in any component of the works, the payment for the corresponding variations shall be regulated as per Annexure II &III of Volume III. The variations, not covered by **Annexure II & III, rates of DSR 2019**willbe applied

38.3.**The extra items:**

38.3.1. In case of contingent items, approval shall be accorded by General Manager,

Kerala Irrigation Infrastructure Development Corporation Limited.
38.3.2. Non-contingent shall be approved by the committee constituted for the purpose.
38.3.3. Contingent but outside the scope of the original contract shall be approved by the committee constituted for this purpose.

Changes in the Scope:

39.1. The contractor is bound to execute all supplemental works that are found essential, incidental and inevitable during execution of main work.

Extra Items:

40.1. Extra items of work shall not vitiate the contract. The contractor shall be bound to execute extra items of work as directed by the Engineer - in – Charge. The rates for extra items shall be worked out by the Executive Engineer as per the conditions of the Contract and the same are binding on the Contractor.
40.2. The contractor shall before the 15th day of each month, submit in writing to the Executive Engineer a statement of extra items if any that they have executed during the preceding month failing which the contractor shall not be entitled to claim any.
40.3. **Entrustment of additional items:**
40.3.1. Where ever additional items not contingent on the main work and outside the scope of original agreement are to be entrusted to the original contractor dispensing with bids and if the value of such items exceeds the limits up to which the officer is empowered to entrust works initially to contractor without calling for tenders, approval of **next higher authority** shall be obtained. Entrustment of such items on nomination shall be at rates not exceeding the estimated rates.
40.3.2. Payment for the additional scope of work executed shall be decided based upon the following:
* Unit rates quoted and duly agreed by the Department.
* DSR 2016

Cash flow forecasts:

41.1. When the program is updated, the contractor is to provide the Engineer-in-Charge/ Employer / Employer's Representative with an updated cash flow forecast.
41.2. The contractor shall also provide to the Engineer-in-Charge/ Employer / Employer's Representative with a WBS (Work Brakedown Structure) in Micro Soft Project MSP which is to be updated periodically.

Payment Certificates:

42.1. The Contractor shall submit to the Engineer-In-Charge / Employer / Employer's Representative monthly statements of the estimated value of the work completed less the cumulative amount certified previously.
42.2. The Engineer-In-Charge / Employer / Employer's Representative shall check the Contractor's monthly statement within 14days.
42.3. The value of work executed shall be determined by the Engineer-In-Charge/ Employer/ Employer's Representative.
42.4. The Engineer-In-Charge / Employer / Employer's Representative mayexclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

Payments:

43.1. EPC Contractor's Application for Payment:
43.1.1.The EPC contractor shall abide the norms and guidlines stipulated by KIIFB, from time to time for Payment of Bill.
43.1.2 On the fifth Business Day of every month from the date of issue of the Notice to ProceedtheEPC Contractor may serve a notice in writing on the Employer's

Representative(Request for Payment) requesting payment of the sum which is considers being due on achievement of milestones as per the Annexure –I, Volume - 03. (Milestone Payment), less
the amount to be deducted as RetentionMoney
Advance payment in proportionate amounts commencing upon the submissions by the EPC Contractor of the Request for Payment for the fourth monthly period after the date of issue of the Notice to proceed and ending upon the date of the last Request for payment; and
(c) Any amounts due and owing from the EPC Contractor to the Employer pursuant to thisAgreement.
43.1.3. The Request for Payment shall be:
(a)Prepared on forms in the form indicated by the Employer's representative and at the expense of the EPC Contractor, the number of copies therefore shall be as the Employer's Representative may determine;and
(b)Accompanied by such supporting documentation as the Employer's Representative may require to establish the value of the work property designed and Executed as referred to in the Request for payment and reasonableness of the amounts added in respect of goods andmaterials.
43.2.**Certificates of Payment**
43.2.1 Within fourteen (14) Business Days after the receipt of the Request for payment, the Employer's Representative shall, subject to the EPC Contractor's compliance withArticle43.2inspect the relevant parts of the Works and the relevant goods and materials in order to satisfy him that the request for payment is correct.
If the Employer's Representative is so satisfied, he shall issue a Certificate of Payment certifying what amounts are due to the EPC Contractor pursuant to this Article 43 subject to the provisions of Article 43.2.2 to 43.2.3 after giving credit to the Employer for any sums to which the Employer is entitled under this Agreement.
43.2.2.No sum shall be included in the Certificate of Payment in respect of goods and materials yet to be incorporated into the payment works unless the employers' Representative is satisfied and has approved in writingthat:
(a) Such goods and materials have been properly acquired and properly and not prematurely delivered to the ProjectSite;
(b) Such goods plant and materials are properly stored on the project site; and fully protected against loss, damage ordeterioration;
(c) The EPC Contractor's records of the requisitions, orders, receipts and use of any goods and materials are kept in a form approved by the Employer's Representative, and such records are available for inspection by the Employer's Representative;and
(d) The EPC Contractor has submitted a proper statement of the cost ofacquiringthegoods and materials together with such documents as may be required for evidencing suchcost.

43.2.3. In the event that the Employer's Representative ascertains that the value of the works properly designed and Executed in the relevant period is less than the Milestone Payment for the period, he shall include in the Certificate of payment, the value of the works and goods and materials so ascertained by him.
43.2.4. All Certificates of Payment shall specify the amount, which the Employer proposes to pay to the EPC Contractor and the basis on which that amount was calculated. Such amount shall become due on the issue of the said Certificate ofPayment.
43.2.5. **5%** of the interim payment certificate shall bepaid within **7 days** & balance shall be paid within 14 days of receipt from theEngineer.
43.2.6. The final payment certificate (statement at completion) shall be paid within **84**

days of receiptfromtheEngineer.

Certificate of Completion of works:

44.1. Certificate of Completion of works:

44.1.1. When the whole of the work has been completed and has satisfactory passed any final test that may be prescribed by the Contract, the Contractor may give a notice to that effect to the Engineer-in-Charge/ Employer / Employer's Representative accompanied by an undertaking to carry out any rectification work during the period of maintenance, such notice and undertaking shall be in writing and shall be deemed to be request by the Contractor for the Engineer-in-Charge/ Employer / Employer's Representative to issue a Certificate of completion in respect of the Works.

The Engineer-in-Charge/ Employer / Employer's Representative shall, within twenty one days of the date of delivery of such notice either issue to the Contractor, a certificate of completion stating the date on which, in his opinion, the works were completed in accordance with the Contract or give instructions in writing to the Contractor specifying all the Works which, in the Engineer-in-Charge/ Employer / Employer's Representative'' opinion, required to be done by the Contractor before the issue of such Certificate. The Engineer-in-Charge/ Employer / Employer's Representative shall also notify the Contractor of any defects in the Works affecting completion that may appear after such instructions and before completion of the Works specified there in. The Contractor shall be entitled to receive such Certificate of the Completion within twenty one days of completion to the satisfaction of the Engineer-in-Charge/ Employer / Employer's Representative of the Works so specified and making good of any defects so notified.

44.1.2. Similarly, the Contractor may requestandthe Engineer-in-Charge/ Employer / Employer's Representative shall issue a Certificate of Completion in respect of:

(a) Any section of the permanent works in respect of which a separate time for completion is provided in the Contract and

(b) Any substantial part of the permanent works which has been both completed to the satisfaction of the Engineer-in-Charge/ Employer / Employer's Representative and occupied or used by the KIIDCAuthority.

44.1.3. If any part of the Permanent Works shall have been completed and shall have satisfactorily passed any final test that may be prescribed by the Contract, the Engineer-in-Charge/ Employer / Employer's Representative may issue such certificate, and the Contractor shall be deemed to have undertaken to complete any outstanding work in that part of the Works during the period of Maintenance.

Taxes

45.1. The percentage quoted by the contractor shall be inclusive of Goods and Service Tax (GST) and other statutory taxes on all materials that the contractor will have to purchase for performance of this contract.

45.2. All Taxes such as GST, seignorage, royalties, tools, control, etc., in respect of materials to be consumed on the work and also in the finished item of work etc., must be borne by the contractors.

45.3**Interest on Money due to the Contractor:**

45.3.1No omission by the Deputy General Manager or the sub-divisional officer to pay the amount due upon certificates shall vitiate or make void the contract, nor shall the contractor be entitled to interest upon any guarantee fund or payments in arrears, nor upon any balance which may, on the final settlement of his accounts, found to be due to him.

45.4. **Income Tax:**

45.4.1.As per section 194-C of income tax act 1961, deduction at the rate of 2.24% in respect of individual contractors and 2.30% in respect of firms on the gross amounts of payments will be made towards income tax. The tax will be recovered at the rates as per

the income tax act during course of execution.
45.4.2. The income tax will be deducted as per rules in force from the contract or bills
45.4.3. Income Tax clearance certificate should be furnished before the payment of final Bill.
45.4.4. The contractor's staff, personal and labour will be liable to pay personnel income taxes in respect of their salaries and wages as are chargeable underthe Laws and regulations for the time being in force and the contractor shall perform such duties in regard to such deductions there of as may be imposed on him by such laws and regulations.

SeignorageCharges

45.5.1 Seignoragecharges will be recovered as perrules
45.5.2 The Seignorage charges will be recovered from the contractors bills as per rules or as per the rates fixed by the Mines & Geology Department from time to time as on Date of recording measurements in measurement books whichever is higher for the materials consumed theoretically on the workonly.

45.6**. GST/VAT:**

45.6.1. GST/VAT on Running Bills will be recovered as per rules

PriceAdjustment:

46.1.1 Price adjustment for steel, cement, bitumen, POL and other pipe materials is applicable as per Government Orders inforce and issued from time totime.

TERMS OFPAYMENT

The payment will be made to the contractor as per Provisions of KDSS. PaymentSchedule to be approved by EPC Committee:
The Payment Terms are given in Volume IV

Note: The EPC agency shall furnish the detailed estimates, BoQs based on approved drawings as per provisions of the Deliverables. The above payment schedule can be sub divided into various sub-components with appropriate percentage break up as per the estimate &BoQsapprovedbythe Departmental authorities but within the overall percentage break up of each component as approved by EPC Committee-I.

Retention

48.1. The KIIDCshall retain from each payment duetothecontractor@ the rate of 10 % of bill amount until completion of the whole of theWorks.
48.2. On completion of the whole of the Works half (5%)ofthetotal amount retained including 2.5% Performance Guaranteeisre-paid to the Contractor and balance half (5%) when the Defects Liability Period has passed and the Employer/ Employer's representative has certified that all the Defects notified by the Employer/ Employer's representative to the Contractor before the end of this period have beencorrected.
48.3. On completion of the Defects Liability Period half (5%)of the total amount retained including 2.5% Performance Guarantee is re-paid to the Contractor and the Employer/ Employer's representative has certified that all the Defects notified by the Employer/ Employer's representative to the Contractor before the end of this period have been corrected. While the balance half (5%) shall be paid on completion of O&Mperiod.
48.4. On completion of the whole works, the Contractor may substitute retention money with an **"on demand"** BankGuarantee.

LiquidatedDamages

49.1. If for any reason, which does not entitle the contractor to an extension of item, the rate of progress of works, or any section is at any time, in the opinion of the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram too slow to ensure completion by the prescribed time or extended time for completion Managing Director, Kerala Irrigation Infrastructure Development

Corporation Limited, Thiruvananthapuram shall so notify the contractor in writing and the contractor shall there upon take such steps as are necessary and the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram may approve to expedite progress so as to complete the works or such section by the prescribed time or extended time. The contractor shall not be entitled toany additional payment for taking such steps. If as a result of any notice given by the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram under this clause the contractor shall seek the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram permission to do any work at night or on Sundays, if locally recognized as days or rest, or their locally recognized equivalent, such permission shall not beunreasonablyrefused.

49.2. If the contractor fails to complete whole of the works or any part thereof or section of the works within the stipulated periods of individual milestones (including any bonafide extensions allowed by the competent authority without levying liquidated damages), the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram may without prejudice to any other method of recovery will deduct one tenth of one percent of contract value per calendar day or part of the day for the period of delays subject to a maximum of 10% of the contract value not as a penalty from any monies in his hands due or which may become due to the contractor. The payment or deductions of such damages shall not relieve the contractor from his obligation to complete the works, or from any other of his obligations and liabilities under thecontract.

49.3. The liquidated damages for the whole of the work will be filed up at the time of concluding agreement:

Mile stone	**By the end of**	**Percentage of work**	**Cumulative Percentage of Work**	**Liquidated Damages**
1	3rdmonth	05 %	05%	Rs.50.00 per day per lakh on Delayed value of work.
2	6thmonth	10 %	15%	Rs.50.00 per day per lakh on Delayed value of work.
3	9thmonth	15 %	30 %	Rs.50.00 per day per lakh on Delayed value of work.
4	12thmonth	15%.	45 %	Rs.50.00 per day per lakh on Delayed value of work.
5	15thmonth	15%.	60 %	Rs.50.00 per day per lakh on Delayed value of work.
6	18thmonth	15%.	75 %	Rs.50.00 per day per lakh on Delayed value of work.
7	21st month	15 %	90 %	Rs.50.00 per day per lakh on Delayed value of work.
8	24th month	10 %	100 %	Rs.50.00 per day per lakh on Delayed value of work.

49.4. The contractor/EPC Agency shall be subject to the following penalties for failure to carry out its operations as indicated below during “Performance Based O&M period” (5years including DLP of 5 years) under Normal Operating Conditions. The Key Performance Indicators (KPIs) are as follows. The KPIs will be monitored through the

Padasekhara Committee of Ayacut area or the project Engineers of the Department and accordingly the EPC Agency will bepenalizedfornot complying with the following KPIs.

Sl. No.	Basis of Penalty	Benchmark	Penalty Value for each Parameter specified in the bid document
1	Road Restoration / Trenchfilling Complaints recorded at ULB or officers concerned in-charge of the project pertaining to the scope of work contemplated in this project	Complaints rectifiedwithin 24 Hours	No Penalty
		Rectified beyond 24 Hours and up to 48 Hours	Rs.2,000/- per Complaint per day
		Rectified beyond 48 Hours & up to 72 Hours	Rs.5,000/- per Complaint per day
		Rectified beyond 72 Hours	Rs.10,000/- per complaint per day or termination of the Contract.

49.5. **Construction Period**:
Damages for delay shall be Five Percent (5 %) of the cost of incomplete work of each milestone per month / as per project schedule. However, if the contractor catches with the progress of work the same will be released in Interim Payment Certificates on contractor achieving subsequent milestone(s)
The maximum amount of liquidated damages for the whole of the works is ten percent of final contract price.
The milestones will however be firmed up at the time of agreement after obtaining a program of the work from the bidder.

MobilizationAdvance

As per the guidelines stipulated in the KIIFB order
50.1. The contractors are permitted to avail the facility of Mobilization advance up to 10% of the tendered value, strictly based on the assessment of the need thereof, if applied by the contractor within one month from the date of award of contract. This advance is facilitating the contractor to mobilize the work at site by deployment of machinery and various resources. Advance can be released in two or more installments as considered appropriate and installments subsequent to the first installments shall be released after obtaining proof of utilization of the advance already released.

50.2. The request for mobilization advance after the stipulated time period of one month will be considered on furnishing proper clarification for the delay and by delegating the power of Engineer – in Charge

50.3.Bank guarantees not exceeding 6 numbers from any nationalized/scheduled bank for 110% of the value of advance amount considered for release and valid till recovery of the advance shall be obtained prior to release of each installment of mobilization advance. The available Bank guarantee shall not be less than110% of

the outstanding mobilization advance for recovery at any stage.

50.4. The contractor should furnish clarification regarding the renewal of Bank guarantee must be included if the initial guarantee is for full amount

50.5.The interest rate will be the two percentages higher than the prevailing PLR of State Bank of India, as on the date of sanction of the mobilization advanceand levied along with each installment of recovery of the advance.

50.6. A form of Bank Guarantee acceptable to Executive Engineer is indicated at Volume -4 Format of Securities. The advance mobilization loan shall be used by the contractor exclusively for Labour and material mobilization expenditures, in connections with the works.

50.7. Should the contractor misappropriate any portion of the advance loan, it shall become due to the Employer/ Employer's representative and payable immediately in one lump by the contractor and no further loan will be consideredthereafter.

50.8. The interest rate will be the two percentages higher than the prevailing PLR of State Bank of India, as on the date of sanction of the mobilization advance. The interest on the amounts paid as advance is chargeable from the date the amount is paid. However, if completion is delayed by circumstances beyond control of the contractor for which an extension has been granted by the Executive Engineer the interest charges on such advances shall be waived for the period of extension.

50.9. In case of contractor not maintaining the progress of works as per agreed programmetheinterestof mobilization advance shall be levied at prevailing SBI PLR+4% per annum for the period in which the progress is not maintained. In case the progressis made good as per the programme the rate of interest shall be two percentages higher than the prevailing PLR of State Bank of India, as on the date of sanction of the mobilization advance.

50.10. The value of Bank Guarantee for the advance payment given to the contractor can be progressively reduced by the amount repaid by the contractor as certified by the ExecutiveEngineer.

50.7 The clauses 120 to 126 of Vol.1 the Tender Procedures may also be perused for the mobilization advance.

50.8.**Recovery of advances:**

Recovery of advance shall be made on pro-rata basis to the gross value of work and interest shall be affected from the contractor's bill after the first 10% of the gross value of work has been executed and paid for. The entire advance to be recovered by the time 80% of the gross value of the contract is executed and paid for

Securities:

51.1 The Bid Security and Performance Guarantee (for discount tender percentage beyond **25%)** shall be provided to the KIIDCnotlater than the date specified in the Letter of Acceptance and shall be issued in an amount and form and by a bank acceptable to the Department / KIIDC. The Bid Security shall be valid until a date 28 days from the date of expiry of Defects Liability Period and the additional Security shall be valid until a date 28 days from the date of issue of the certificate of completion.

Cost ofRepairs:

52.1. Loss or damage to the works or materials to the works between the start date and the end of the defect correction periods shall be remedied by the contractor at the contractor's cost if the loss or damage arises from the contractor's acts or omissions.

FINISHING THE CONTRACT

Completion:

The Contractor shall request the Engineer-In-Charge/ Employer / Employer's Representative to issue a Certificate of completion of the Works and the Engineer-In-Charge/ Employer / Employer's Representative will do so upon deciding that the work is completed.

Taking Over:

54.1. The KIIDCshall takes over the Site and the Works within seven days of the Engineer-in-Charge/ Employer / Employer's Representative issuing a certificate of Completion.

54.2. Except as stated in clause 53 the works shall be taken over by the Employer when they have been completed in accordance with the Contract (except as described in sub-paragraph (a) below), have passed the Tests on Completion and a taking-over Certificate for the works has been issued, or has deemed to have been issued in accordance with this Sub-Clause. If the works are divided into sections, the Contractor shall be entitled to applyfora Taking-over certificate for each section. The Contractor may apply by notice to the Employer's Representative for a taking-over certificate not earlier than 14 days before the works or section (as the case may be) will, in the contractor's opinion, be complete and ready for taking over. **"The request for taking over shall be accompanied by as built drawings."** The employer's representativeshall, within 28days after the receipt of the contractor's application:

issue the taking-over certificate to the contractor, stating the date on which the works or section were completed in accordance with the contract (except for minor outstanding work that does not affect the use of the works or section for their intended purpose) including passing the tests on completion: or

reject the application, giving his reasons and specifying the work required to be done by the contractor to enable the taking-over certificate to be issued: the contractor shall then complete such work before issuing a further notice under this sub-clause.

If the Employer's representative fails to issue the taking over certificate or to reject the Contractors application within the period of 28 days, and if the works or section (as the case may be) is substantially in accordance with the contract, the taking-over certificate shall be deemed to have been issued on the last day of that period.

54.3.**Use by the Employer**

The Employee shall not use any part of the works unless the employer's representative has issued a taking-over certificate for such part. If a taking-over certificate has been issued for any part of the works (other than a section), the liquidated damages for delay in completion of the reminder of the works (and of the section of which it forms part) shall, for any period of delay after the date stated in such taking-over certificate, be reduced in the proportion which the value of the part so certified bears to the value of the works or section (as the case may be), such values shall be determined by the Employer's Representative.. The provisions of this paragraph shall only apply to the rate of liquidated damages, and shall not affect the limit of such damages.

If the Employer does use any part of the works before the taking-over certificate is issued:

the part which is used shall be deemed to have been taken over at the date on which it issued,

the Employer's Representative shall, when requested by the Contractor, issue taking-over certificate accordingly, and

thecontractor shall cease to be liable for the care of such part from such date, when responsibility shall pass to the Employer.

After the Employer's Representative has issued a taking-over certificate for a part of the works, the contractor shall be given the earliest opportunity to take such steps as may be necessary to carry out any outstanding tests on completion, and the contractor shall carry

out such tests on completion, and the contractor shall carry out such tests on completion as soon as practicable, before the expiry of the contract period.

54.4. **Interference with Tests onCompletion**

If the contractor is prevented from carrying out the tests on completion by a cause for which the Employer (or another contractor employed by the Employer) is responsible, the employer shall be deemed to have taken over the works or section (as the case may be) on the date when the Tests on Completion would otherwise have been completed. The Employer's Representative shall then issuea taking-over certificate accordingly, and the contractor shall carry out the tests on completion as soon as practicable, before the expiry of the contract period. The Employer's Representative shall require the tests on completion to be carried out by 14 days' notice and in accordance with the relevant provisions of the Contract. If the contractor incurs additional cost as a result of this delay in carrying out the tests on completion, such cost plusreasonable profit shall be determined by the employer's Representative and shall be added to the contractprice.

Final Account:

55.1 The Contractor shall supply to the Engineer-in-Charge/ Employer / Employer's Representative a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Engineer-in-Charge/ Employer / Employer's Representative shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Engineer-in-Charge/ Employer/ Employer's Representative shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the final Account is still unsatisfactory after it has been resubmitted, the Engineer-in-Charge/ Employer / Employer's Representative shall decide on the amount payable to the Contractor and issue a payment certificate within 56 days of receiving the Contractor's revised account.

Termination:

56.1. The KIIDC may terminate the Contract if the contractor causes a fundamental breach of the Contract.

56.2. Fundamental breaches of Contract include, butshall not be limited to thefollowing.

The Contractor stops work for 28 days when no stoppage of work is shown on the current program and the stoppage has not been authorized by the Engineer- in-Charge/ Employer / Employer's Representative.

The Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation.

The Engineer-in-Charge/ Employer / Employer's Representative gives Notice that failure to correct a particular Defect is a fundamental breach ofContractandthe Contractor fails to correct it within a reasonable period of time determined by the Engineer-in-Charge/ Employer / Employer's Representativeand

The Contractor does not maintain a Security which is requiredand

The Contractor has delayed the completion of works by the number of days for which the maximum amount of liquidated damages can be paid as defined.

If the contractor, in the judgment of the KIIDC has engaged in corrupt or fraudulent practices in competing for or in the executing the contract.

For the purpose ofthisparagraph: "corrupt practice" means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution. "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Government and includes collusive practice among Tenderers (prior to or after Tender submission) designed to establish Tender prices at

artificial non-competitive levels and to deprive the Government of the benefits of free and opencompetition.

56.3. Notwithstanding the above the KIIDCmay terminate the contract forconvenience.

56.4. If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secured leave the Site as soon as reasonablypossible.

Payment upon Termination:

57.1. If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer-in-Charge/ Employer/ Employer's Representative shall issue a certificate for the value of the work done less advance payments received upon the date of the issue of the certificate, less other recoveries due in terms of the Contract, less taxes due to be deducted at source as per applicable law and less the percentage toapplytothe work not completed. Additional Liquidated Damages shall not apply. If the total amount due to the KIIDCexceeds any payment due to the Contractorthedifference shall be a debt payable to the Department / KIIDC.

Property:

58.1 All materials on the Site, Plant, Equipment, Temporary Works and Works are deemed to be the property of the KIIDCif the Contract is terminated because of Contractor's default.

Release from Performance:

59.1. If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of the KIIDCorthe Contractor the Engineer- in-Charge/ Employer / Employer's Representative shall certify that the contract has been frustrated. The Contractor shall make the site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all works carried out before receiving it and for anywork carried out after wards to which commitment was made.

Section 3: Special Conditions

SECTION - 3: SPECIAL CONDITIONS

Water Supply:

The Contractor has to make his own arrangements for water required for the work and to the colonies and work sites, which are to be established by the Contractor.

Electrical Power:

The Contractors will have to make their own arrangements for drawing electric power from the nearest power line after obtaining permission from the Kerala State Electricity Board at his own cost. In case of failure of electricity, the Contractor has to make alternative arrangements for supply of electricity by Diesel Generator sets of suitable capacity at place of work. If the supply is arranged by the KIIDCAuthority, necessary Tariff rates shall have to be paid based on the prevailing rates. The contractor will pay the bills of Electricity Board for the cost of power consumed by him.

The contractor shall satisfy all the conditions and rules required as per Indian Electricity Act 1910 and under rule –45(I) of the Indian Electricity Rules, 1956 as amended from time to time and other pertinent rules.

The power shall be used for bonafide Departmental works only.

61.1**Electric Power for Domestic Supply**:

(a) The contractor has to make his own arrangements for the supply of electric power for domestic purposes and the charges for this purpose have to be paid by him at the rates as fixed by the Kerala State Electricity Board from time to time.

(b) The contractor will have to make his own arrangements to lay and maintain the necessary distribution lines and wiring for the camp at his own cost. The layout and the methods of laying the lines and wiring shall have the prior approval of the Engineer-in-Charge/ Employer / Employer's Representative. All camp area shall be properly electrified. All lines, streets, approaches for the camp etc., shall be sufficiently lighted for the safety of staff and labourofthecontractor, at the cost of the Contractor and it will be subject to the approval of the Engineer-in-Charge/ Employer / Employer's Representative.

62.Land:

62.1 LandforContractor's use:

The contractor will be permitted to use Government / KIIDC land for execution of work. The contractor shall have to make his own arrangements for acquiring and clearing the site, leveling, providing drainage and other facilities for labour staff colonies, site office, work-shoporstores and for related activities. The Contractor shall apply to the KIIDCAuthority within a reasonable time after the award of the contract and at least 30 days in advance of its use, the details of land required by him for the work at site and the land required for his camp and should any private land which has not been acquired, be required by the contractor for his use. The same may be acquired by the contractor at his own cost by private negotiations and no claim shall be admissible to him on this account. The Engineer-in-Charge/ Employer / Employer's Representative reserves the right to refuse permission for use of any government land for which no claim or compensation shall be admissible to the contractor. The contractor shall, however, not be required to pay cost or any rent for the Government land given to him.

62.2**Surrenderofoccupied land**

The Government land as here in before mentioned shall be surrendered to the Engineer-in-Charge/ Employer / Employer's Representative within seven days, after issue of completion certificate. Also no land shall be held by the contractor longer than the Engineer-in-Charge/ Employer / Employer's Representative shall deem necessary and the contractor shall on the receipt of due notice from the Engineer-in-Charge/Employer/

Employer's Representative, vacate and surrender the land which the Engineer-in- Charge/ Employer / Employer's Representative may certify as no longer required by the Contractor for the purpose of the work.

ThecontractorshallmakegoodtothesatisfactionoftheEngineer-in-Charge/Employer/ Employer's Representative any damage to areas, which he has to return or to other property or land handed over to him for purpose of this work. Temporary structures may be erected by the contractor for storage sheds, offices, residences etc., for non-commercial use, with the permission of the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram on the land handed over to him at his own cost. At the completion of the work these structures shall be dismantled site cleared and handed over to the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram. The land required for providing amenities will be given free of cost from Government lands if available otherwise the contractor shall have to make his own arrangements.

62.3. **Contractor not to dispose of Spoiletc.**

The contractor shall not dispose of or remove except for the purpose of fulfillment ofthis contract, sand, stone, clay ballast, earth, trees and shrubs or other materials obtained in the excavation made or lying on the site of the work, and all such materials and produce shall remain property of the Government. The Department / KIIDCmayuponrequestfrom the contractoror if so, stipulated in the conditions of the contract allow the contractor to use any of the above materials for the works either free of cost or after payment as may be specifically mentioned or considered necessary during the execution of the work.

63. Roads:

In addition to existing public roads and roads Constructed by Government, if any, in work area all additional approach roads inside work area and camp required by the Contractor shall be constructed and maintained by him at his own cost. The layout design, construction and maintenance etc. of the roads shall be subject to the approval of the Engineer-in-Charge/ Employer / Employer's Representative. The contractor shall permit the use of these roads by the Government free of charge.

It is possible that work at, or in the vicinity of the work site will be performed by the Government or by other contractors engaged in work for the Government during the contract period. The contractor shall without charge permit the government and such other contractor and other workmen to use the access facilities including roads and other facilities, constructed and acquired by the contractor for use in the performance of the works.

The contractor's heavy construction traffic or tracked equipment shall not traverse any public roads or bridges unless the contractor has made arrangement with the authority concerned. In case contractor's heavy construction traffic or tracked equipment is not allowed to traverse any public roads or bridges and the contractor is required to make some alternative arrangements, no claim on this account shall be entertained. The contractor is cautioned to take necessary precautions in transportation of construction materials to avoid accidents.

64. Payment for Camp Construction

No payment will be made to the contractor for construction, operation and maintenance of camp and other camp facilities and the entire cost of such work shall be deemed to have been included in the tendered rate for the various items of work in the schedule of quantities and bids.

65. Explosive and Fuel Storage Tanks

No explosive shall be stored within 1/2 (half) KM of the limit of the camp sites. The storage of gasoline and other fuel oils or of Butane, Propane and other liquefied petroleum gases, shall confirm to the regulations of Kerala State Government and Government of India. The tanks, above ground and having capacity in excess of2000 liters, shall not be located within the camp area, nor within 200m, of any building.

66. Labour:

The contractor shall, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.

Labour importation and amenities to labour and contractor's staff shall be to the contractor's account. His quoted percentage shall include the expenditure towards importation of labour amenities to labour and staff;

The contractor shall, if required by the Engineer-in-Charge/ Employer / Employer's Representative, deliver to the Engineer-in-Charge/ Employer / Employer's Representative a written in detail, is such form and at such intervals as the Engineer-in-Charge/ Employer / Employer's Representative may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the contractor on the Site and such information respecting Contractor's Equipment as the Engineer-in-Charge/ Employer / Employer's Representative may require.

66.1. **Transportation of Labour**:

The contractor shall make his own arrangement for the daily transportation of the labour and staff from labour camps colonies to the work spot and no labourerstaffofthe contractor shall stay at the work spot. No extra payment will be made to the contractor for the above transportation of the labourand his quoted percentage to the work shall include the transportation charges of labour from colonies to work spot and back.

The contractor will at all times duly observe the provisions of employment of children Act XXVI of 1938 and any enactment or modification of the same and will not employ or permit any person to do any work for the purpose under the provisions of this agreement in contravention of said Act. The contractor here by agrees to indemnify the KIIDCfrom and against all claims, penalties which may be suffered by the KIIDCorany person employed by the KIIDCbyany default on the part of the contractor in the observance and performance of the provisions of the employment of children Act. XXVI of 1938 or any enactment or modification of thesame.

The contractor shall obtain the insurance at his own cost to cover the risk on the works to labour engaged by him during period of execution against fire and other usual risks and produce the same to the Executive Engineer concerned before commencement of work.

67. Safety Measures:

The contractor shall take necessary precautions for safety of the workers and preserving their health while working in such jobs, which require special protection and precautions. The following are some of the measures listed but they are not exhaustive and contractor shall add to and augment these precautions on his own initiative where necessary and shall comply with directions issued by the Executive Engineer or on his behalf from time to time and at all times.

Providing protective foot wear to workers situations like mixing and placing of mortar or concrete sand in quarries and places where the work is done under much wet conditions.

Providing protective head wear to workers at places like underground excavations to protect them against rock falls.

Providing masks to workers at granulates or at other locations where too much fine dust is floating about and sprinkling water at frequent intervals by water hoses on all stone crushing area and storage bins abate to dust.

Getting the workers in such jobs periodically examined for chest trouble due to too much

breathing in to fine dust. Taking such normal precautions like fencing and lightening in excavation of trenches, not allowing rolls and metal parts of useless timber spread around, making danger areas for blasting providing whistlesetc.
Supply work men with proper belts, ropes etc., when working in precarious slopesetc.
Avoiding named electrical wire etc., as they would electrocute theworks.
Taking necessary steps towards training the workers concerned on the machinery before they are allowed tohandle them independently and taking all necessary precautions in around the areaswheremachines hoists and similar units areworking.

68.Fair Wage Clause:

Thecontractorshallpaynotlessthanfairwagestolaboursengagedbyhimonthework.
"Fair" wages meanswageswhether for time of piecework notified by the Government from time in the area in which the work is situated.
The contractor shall not with-standing the revisions of any contract to the contrary cause to be paid to the labour, in directly engaged on the work including any labour engaged by the sub-contractor in connection with the said work, as if the labours had been directly employed by him.
In respect of labour directly or indirectly employed in the works for the purpose of the contractor's part of the agreement the contractor shall comply with the rules and regulations on the maintenance of suitable records prescribed for this purpose from time to time by the Government. He shall maintain his accounts and vouchers on the payment of wages to the labourstothesatisfaction of the Executive Engineer.
The Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram shall have the right to call for such record as required to satisfy himself on the payment of fair wages to the labours and shall have the right to deduct from the contract amount a suitable amount for making good the loss suffered by the worker or workers by reason of the "fair wages" clause to the workers.
The contractor shall be primarily liable for all payments to be made and for the observance of the regulations framed by the Government from time to time without prejudice to his right to claim indemnity from his sub-contractors.
As per contract labour (Regulation and abolition) Act. 1970 the contractor has to produce the license obtained from the licensing officers of the labour Department along with the tender or at the time of agreement.
Any violation of the conditions above shall be deemed to be a breach of his contract.
Equal wages are to be paid for both men and women if the nature of work is same and similar.
The contractor shall arrange for the recruitment of skilled and unskilled labour local and imported to the extent necessary to complete the work within the agreed period as directed by the Engineer-In-Charge / Employer / Employer's Representative in writing.

69.Indemnity Bond:

NAME OF WORK: "ChittoorMoolathara Right Bank Canal extension from Korayar to Varattayar and Performance based Operation and Maintenance for 3 years within the Defect Liability Period [DLP] of 5 years in KozhinjamparaFirka in Palakkad District, Kerala"

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contractor

S/o. aged----------

I, Resident of…..do hereby bind myself to pay all the claims may come (a) under Workmen's Compensation Act. 1933 with any statutory modification thereof and rules there under or otherwise for or in respect of any damage or compensation payable in connection with

any accident or injury sustained (b) under Minimum wages Act 1948 (c) under payment of wages Act.1936 (d) under the Contractor labour (Regulation and Abolition) Act. 1970 by workmen engaged for the performance of the business relating to the above contract i.e. failing such payment of claims of workmen engaged in the above work, I abide in accepting for the recovery of such claims, affected from any of my assets with the Departments.

Signature of the tenderer

70.Compliance with LabourRegulations:

During continuance of the contract, the contractor and his sub-contractors shall abide at all times by all existing labour enactments and rules made there under regulations, notifications and bye laws of the State or Central Government or local authority and any otherlabour law (including rules), regulations, bye laws that may be passed or notifications that may be issued under any labour law in future either by the State or the Central Government or the local authority and also applicable labourregulations, health and sanitary arrangements for workmen, insurance and other benefits. Salient features of some of the major labour laws that are applicable to construction industry are given below. The contractor shall keep the Department indemnified in case any action is taken against Department by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments.

If the Department is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provision stipulated in the notifications/bye laws/Acts/Rules/regulations including amendments, if any, on the part of the contractor, the Engineer-in-Charge/ Employer / Employer's Representative/Department shall have the right to deduct any money due to the contractor including his amount of performance Security. The Department /Engineer-in-Charge/ Employer / Employer's Representative shall also have right to recover from the contractor any sum required or estimated to be required for making good the loss or damage suffered by the Department.

The employees of the Contractor and the Sub-contractor in no case shall be treated as the Department of the Department at any point of time.

Salient features of some major labourlawsapplicableto establishment engaged in buildings and other construction work:

Workmen compensation Act 1923: The Act provides for compensation in case if injury by accident arising out of and during the course of employment.

Payment of Gratuity Act 1972: Gratuity is payable to an employee under the Acton satisfaction of certain conditions on separation if any employee has completed 5 years' service or more, or on death, the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments, employing 10 or more employees.

EmployeesP.F. and Miscellaneous provision Act 1952: The Act provides for monthly contributions by the Department plus workers @ 10% or 8.33%. The benefits payable under the Act are:

Pension or family pension on retirement or death, as the case maybe.

Deposit linked insurance on the death in harness of the worker.

Payment of P.F. accumulation on retirement/deathetc.,

Maternity Benefit Act 1951: The Act provides for leave and some other benefits to women employees in case of confinements or miscarriageetc.

Contract Labour (Regulation & Abolition) Act1970: The Act provides for certain welfare measures to be provided by the contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided by the Principal Department by Law. The Principal Department is required to take certificate of Registration and the contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Department if they employ 20 or more contractlabour.

Minimum wages Act 1948: The Department is supposed to pay not less than the Minimum wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment construction of Buildings, Roads, Runways are scheduledemployments.

Payment of wages Act 1936: It lays down as to by what date the wages are to be paid, whenitwillbepaidandwhatdeductionscanbemadefromthewagesoftheworkers.

Equal RemunerationAct1979: The Act provides for payment of equal wages for work of equal nature to Male or Female workers and for not making discrimination against Female employee in the matters of transfers, training and promotionsetc.

Payment of Bonus Act 1965: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payment of annual bonus subject to aminimum of8.33% of wages and maximum of 20% of wages to employees drawing Rs. 3500/- per month or less. The bonus to be paid to employees getting Rs.2500/- per months or above and up to Rs.3500/- per month shall be worked out by taking wages as Rs.2500/- per monthly only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.

Industrial DisputesAct1947: The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock- out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

Industrial Employment (Standing Orders) Act 1946: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the State and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Department on matters provided in the Act and getsthe same certified by the designated Authority.

Trade Unions Act 1926: The Act lays down the procedure for registration of trade unions of workmen and Departments. The Trade Unions registered under the act have been given certain immunities from civil and criminal liabilities.

Child Labour (Prohibition &Regulation) Act 1986: The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes; EmploymentChildLabourisprohibitedinBuildingandConstructionindustry.

Inter-State Migrant workmen's (Regulation of Employment & Conditions of service) Act 1979: The Act applicable to an establishment, which employs 5 or more inter-state migrant workmenthroughan intermediary (who has recruited workmen in one state for employment in the establishment situated in another State). The inter State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home up to the establishment and back, etc.

The Building and Other Construction workers (regulation of Employment and Conditionsofservice) Act 1996 and the CessAct of 1996: All the establishments Who

carryon any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cessattheratenotexceeding 2% of the cost of construction as may be modified by the Government. The Department of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-aid facilities, Ambulance, Housing accommodations for workers near thework place etc. The Department to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by theGovernment.

Factories Act 1948: The Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 person or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

Liabilities of the Contractor

Accident Relief and workmen compensation:

The contractor should make all necessary arrangements for the safety of workmen on the occurrence of the accident, which results in the injury or death of any of the workmen employed by the contractor, the contractor shall within 24 hours of the happenings of the accident and such accidents should intimate in writing to the concerned Asst. Engineer / Asst. Executive Engineer of the KIIDCtheact of such accident. The contractor shall indemnify Government/ KIIDC against all loss or damage sustained by the Government / KIIDC resulting directly or indirectly from his failure to give intimation in the manner aforesaid including the penalties or fines if any payable by Govt. as a consequence of Govt. failure to give notice under workmen's compensation Act or otherwise conform to the provisions of the said Act in regard to suchaccident.

b. In the event of an accident in respect of which compensation may become payable under the workmen's compensation Act VIII 23 whether by the contractor, by the Government it shall be lawful for the Executive Engineer to retain such sum of money which may in the opinion of the Executive Engineer be sufficient to meet such liability. The opinion of theExecutiveEngineershallbefinalinregardtoallmattersarisingunderthisclause.

c. The contractor shall at all times indemnify the Govt. of Kerala, against all claims which may be made under the workmen's compensation act or any statutory modification thereafter or rules there under or otherwise consequent of any damage or compensation payable in consequent of any accident or injuries sustained or death of any workmen engaged in the performance of the business relating to thecontractor.

d. Contractor's Staff, Representatives and Labour:

The contractor shall, at all times, maintain on the works, staff of qualified Engineers, and Supervisors of sufficient experience of similar other jobs to assure that the quality of work turned out shall be as intended in the specifications. The contractor shall also maintain at the works, a Work Manager or sufficient status, experience and office and duly authorize him to deal with all aspects of the day-today work. All communications to any commitments by the Work Manager shall be considered as binding on the Contractor.

The Contractor shall at all times submit details of skilled and unskilled labour and equipment employed to the Engineer-in-Charge/ Employer / Employer's Representative in prescribed proforma as he may require to assess and ensure the proper progress of work.

If the contractor does not employ the technical person agreed to on the work a fine of Rs.25, 000/- will be imposed. If he does not employ for 30 days, thereafter it becomes a fundamental breach of contract.

e. **Accommodation and food:**

The contractor should arrange accommodation he needs, at his own cost. The contractor shall make his own arrangements for supply of food grains, fuel and other provision to his staff and labours including controlled commodities.

72 Relationship:

Contractor shall have to furnish information along with tender, about the relationship he is having with any officer of the Department, Government of Kerala / KIIDC of the rank Assistant Engineer and above engaged in the work and any officer of the rank of Assistant Secretary and above of the Department of Government of Kerala / KIIDC

73 Protection of adjoining premises:

The contractor shall protect adjoining sites against structural, decorative and other damages that could be caused by the execution of these works and make good at his cost any such damages.

74 Work during night or on Sundays and holidays:

The works can be allowed to be carried out during night, Sundays or authorized holidays in order to enable him to meet the schedule targets and the work shall require almost round the clock working keeping in view:

The provisions of relevant labour laws being adheredto:

Adequate lighting, supervision and safety measures are established to the satisfaction of the Engineer-in-Charge/ Employer / Employer's Representative and

The construction programme given by the Contractor and agreed upon by the Engineer-in-Charge/ Employer / Employer's Representative envisages such night working or working during Sundays or authorized holidays.

Layout of materials stacks:

The contractor shall deposit materials for the purpose of the work on such parts only of the ground as may be approved by the Engineer-in-Charge/ Employer / Employer's Representative before starting work. A detailed survey, clearly indicating position and areas where materials shall be stacked and sheds built is to be conducted by the contractor at his own cost and only after obtaining necessary approval of the plan for use of sites by the Engineer-in-Charge/ Employer / Employer's Representative, the Contractor can use the sitesaccordingly.

Use of blasting materials:

Procurement of blasting materials and its storage is the responsibility of the contractor. The contractor shall engage licensed blaster for blasting operation. The contractor is to act in accordance with Indian Explosive Act and other rules prevailing, during the execution of work. It is the responsibility of the contractor to see, that works by other agencies in the vicinity are not hampered, in such cases if any claim is made by other agencies that should be borne by the contractor. Carriage of blasting materials, from the magazine to the work site, is the responsibility of the contractor.

Plant and Equipment:

77.1. The contractor shall have sufficient equipment and labour and shall work such hours and shifts as may be necessary to maintain the progress on the work as per the approval progress schedule. The working and shifts hours shall comply with the Govt. Regulations inforce.

77.2. It is too expressly and clearly understood that contractor shall make his own arrangements to equip himself with all machinery and special tools and plant for the speedy and proper execution of the work and the KIIDCdoes not undertake responsibility

towards theirsupply.

77.3. The KIIDCshall supply such of the machinery that may be available on hire basis but their supply cannot be demanded as matter of right and no delay in progress can be attributed to such non-supply of the plant by the KIIDCandthe KIIDCcannotbe made liable for any damage to the contractor. The Contractor shall be responsible for safe custody of the Departmental / KIIDC machinery supplied to him (which will be delivered to contractor at the machinery yard at site of work) and he has to make good all damages and losses if any other than fire, wear and tear to bring it to the conditions that existed at the time of issue to the contractor before handing over the same to the Department/KIIDC. The hire charges for the machinery handed over to the contractor will be recovered at the rate prevalent at the time of supply. The contractor will have to execute supplemental agreement with Executive Engineer at the time of supply of themachinery.

77.4. The acceptance of Departmental / KIIDC machinery on hire is optional to the contractor.

Steel/Plywood forms:

Steel/ Plywood forms should be used for all items involving and use of centering and shuttering shall be single plane without any dents and undulations.

Inconvenience to public:

The contractor shall not deposit materials at any site, which will cause inconvenience to public. The Engineer-in-Charge/ Employer / Employer's Representative may direct the contractor to remove such materials or may undertake the job at the cost of the contractor.

Conflict of interest:

Any bribe, commission, gift or advantage given, promised or offered by on behalf of contractor or his partner, agent or servant or any one on his behalf to any officer, servant, representatives, agents of Engineer-in-Charge/ Employer / Employer's Representative, or any persons on their behalf, in relation to the obtaining or to executionofthis, or any other contract with Engineer-in-Charge/ Employer / Employer's Representative shallin addition to any criminal liability, which it may occur, subject to the cancellation of this or all other contracts and also to payment of any loss or damage resulting from any such cancellation. Engineer-in-Charge/ Employer / Employer's Representative shall then be entitled to deduct the amount, so payable from any money, otherwise due to the contractor under this or any other contract.

Contract documents and materials to be treated as confidential:

All documents, correspondences, decisions and orders, concerning the contract shall be considered as confidential and/or restricted in nature by the contractor and he shall not divulge or allow access to them by any unauthorized person.

General obligations of Contractor:

82.1. The contractor shall, subject to the provision of the contract and with due care and diligence, execute and maintain theworks in accordance with specificationsanddrawings.

82.2The contractor shall promptly inform the KIIDCandtheEngineer-in-Charge/ Employer / Employer's Representative of any error, omission, fault and such defect in the design of or specifications for the works which are discovered when reviewing the contract documents or in the process of execution of the works.

82.3If Contractor believes that a decision taken by the Engineer-in-Charge/ Employer /Employer's Representative was either outside the authority given to the Engineer-in-Charge/ Employer / Employer's Representative by the Contract or that the decision was wrongly taken, the decision shall be referred to the technical expert within 14 days of the notification of the Engineer-in-Charge/ Employer / Employer's Representative's decisions.

82.4Pending finalization of disputes, the contractor shall proceed with execution of work with all due diligence.

Security measures:

Securityrequirementsforthework shall be in accordance with the Government's general requirements including provisions of this clause and the Contractor shall conform to such requirements and shall be held responsible for the actions of all his staff, employees and the staff and employees of hissub-contractors.

All contractors' employees, representatives and sub-contractor's employees shall wear identifications badges provided by the contractor. Badges shall identify the contractor, showing and employee's number and shall be worn at all times while at the site. Individual labour will not be required to wear identification badges.

All vehicles used by the contractor shall be clearly marked with contractor's name.

The contractor shall be responsible for the Securityoftheworksfor the duration of the contract and shall provide and maintain continuously adequate Security personnel to fulfill these obligations. The requirements of Security measures shall include, but not limited to maintenance of order on the site, provision of all lighting, fencing, guard flagmen and all other measures necessary for the protection of the works within the colonies, camps and elsewhere on the site, all materials delivered to the site, all persons employed in connection with the works continuously throughout working and non-working period including nights, Sundays and holidays for duration of the contract.

Other contractors working on the site concurrently with the contractor will provide Securityfortheir own plant and materials. However, their Security provisions shall in no way relieve the contractor of his responsibilities in thisrespect

Separate payment will not be made for provision of Security services.

Firefighting measures:

The contractor shall provide and maintain adequate firefighting equipment and take adequate fire precaution measures for the safety of all personnel and temporary and permanent works and shall take action to prevent damage to destruction by fire of trees shrubs and grasses.

Separatepaymentwillnotbemadefortheprovisionoffireprevention measures

Sanitation:

The contractor shall implement the sanitary and watch and ward rules and regulations for all forces employed under this contract and if the Contractor fails to enforce these rules, the Engineer-in-Charge/ Employer / Employer's Representative may enforce them at the expenses of the Contractor.

Training of personnel:

The contractor, shall, if and as directed by the Engineer-in-Charge/ Employer / Employer's Representative provide free of any charge adequate facilities, for vocational training of Government Officers, students, Engineers, supervisors, foremen, skilled workmen etc. not exceeding six in number at any one time on the contractor's work. Their salaries, allowances etc. will be borne by the Government and the training schemes will be drawn up by the Engineer-in-Charge/ Employer / Employer's Representative in consultation with thecontractor.

Ecological balance:

The contractor shall maintain ecological balance by preventing de-forestation, water pollution and defacing of natural landscape. The contractor shall so conduct his construction operation as to prevent any unnecessary destruction, scarring, or defacing of the natural surroundings in the vicinity of the work. In respect of the ecological balance,

Contractor shall observe the followinginstructions.

Where unnecessary destruction, scarring, damageordefacing may occur, as result of the operation, the same shall be repaired replanted or otherwise corrected at the contractor's expense. The contractor shall adopt precautions when using explosives, which will prevent scattering of rocks or other debris outside the work area. All work area including borrow areas shall be smoothened and graded in a manner to conform to the natural appearances of the landscape as directed by the Engineer-in-Charge/ Employer / Employer's Representative.

All trees and shrubbery which are not specifically required to be cleared or removed for construction purposes shall be preserved and shall be protected from any damage that may be caused by the contractor's construction operation and equipment. The removal of trees and shrubs will be permitted only after prior approval by the Engineer-in-Charge/ Employer / Employer's Representative. Special care shall be exercised where trees or shrubs are exposed to injuries by construction equipment, blasting, excavating, dumping, chemical damage or other operation and the contractor shall adequately protect such trees by use of protective barriers or other methods approval by the Engineer-in-Charge/ Employer / Employer's Representative. Trees shall not be used for anchorages. The contractor shall be responsible for injuries to trees andshrubscausedbyhis operations. The term "injury" shall include, without limitation bruising, scarring, tearing and breaking of roots, trunks or branches. All injured trees and shrubs are restored as nearly as practicable without delay to their original condition at the contractor'sexpense.

The contractor's construction activities shall be performed by methods that will present entrance or accidental spillage of solid matter contaminants, debris and other objectionable pollutants and wastage into river. Such pollutant and waste include earth and earth products, garbage, cement concrete, sewage effluent, industrial wastes, radio-active substances, mercury, oil and other petroleum products, aggregate processing, mineral salts and thermal pollution. Pollutants and wastes shall be disposed offin a manner and at sites approved by the Engineer-in-Charge/ Employer / Employer'sRepresentative.

In conduct of construction activities and operation of equipmentthecontractor shall utilize such practicablemethodsand devices as are reasonably available to control, prevent and otherwise minimize the air pollution. The excessive omission of dust in totheatmosphere will not be permitted during the manufacture, handling and storage of concrete aggregates and the contractor shall use such methods and equipment asa necessary for collection and disposal or prevention of dust during these operations. The contractor's methods of storing and handling cement shall also include meansofeliminatingatmospheric discharges of dust, equipment and vehicles that give objectionable omission of exhaust gases shall not be operated. Burning of materials resulting from clearing of trees, bushes, combustible construction materials and rubbish may be permitted only when atmospheric conditions for burning are considered favourable.

Separate payment will not be made for complying with the provisions of this clause and all cost shall be deemed to have been included in the unit rates and prices included in the contract if any provision is not complied with within a reasonable time even after issue of a notice in this respect, the necessary operations would be carried out by the Engineer-in-Charge/ Employer / Employer's Representative at the cost of the Contractor, Orders of the Engineer-in-Charge/ Employer/ Employer's Representative in this respect would be final and binding on thecontractor.

Preservation of existing Vegetation:

The contractor will preserve and protect all existing vegetation such as trees, on or

adjacent to the site which do not unreasonably interfere with the construction as may be determined by the Engineer-in-Charge/ Employer / Employer's Representative. The contractor will be held responsible for all unauthorized cutting or damage of trees, including damage due to careless operation of equipment, stockpiling of materials or tracking of grass areas by equipment. Care shall be taken by the Contractor in felling trees authorized for removal to avoid any unnecessary damages to vegetation and tress that are to remain in place and to structures under construction or in existence and to workmen.

All the produce from such cutting of trees by the contractor shall remain the property of Government and shall be properly stacked atsite, approved by the Engineer-in-Charge/ Employer / Employer's Representative. No payment whatsoever shall be madeforsuch cutting and its stacking by the Contractor. If any produce from such cutting is not handed over to the Government by the contractor, he shall be charged for the same at the rates to be decided by the Engineer-in-Charge/ Employer / Employer's Representative. The recovery of this amount shall be made in full fromthe intermediate bill thatfollows.

The contractor shall also make arrangementsoffuel deposits for supply of required fuel for the labourer to be employed for cooking purpose at his own cost in order to prevent destruction of vegetation growth in the surrounding area of the worksite.

Possession prior to Completion:

The Engineer-in-Charge/ Employer/ Employer's Representative shallhavethe right to take possession of or use any completed part of work or works or any part thereof under construction either temporarily or permanently. Such possession or use shall not be deemed as an acceptance of any work either completed or not completed in accordance with the contract with in the interest of Provisions of KDSS except where expressly otherwise specified by the Engineer-in-Charge/ Employer / Employer'sRepresentative.

Payment upon Termination:

If the contract is terminated because of a fundamental breach of contract by the contractor, the Engineer-in-Charge/ Employer / Employer's Representative shall issue a certificate for the value of the work done less advance payment received upon the date of the issue of the certificate and less the percentage to apply to the work not completed as indicated in the contract data. Additional liquidated damages shall not apply. If the total amount due to the KIIDCexceeds any payment due to the contractor the difference shall be a debt payable to the Department/ KIIDC. In case of default for payment within 28 days from the date of issue of notice to the above effect, the contractor shall be liable to pay interest at 12% per annum for the period of delay.

91.Access to the contractor's books:

Whenever it is considered necessary by the Engineer-in-Charge/ Employer / Employer's Representative to ascertain the actual cost of execution of any particular extra item of work or supply of the plant or material on which advance is to be made or of extra items or claims, he shall direct the contractor to produce the relevant documents such as payrolls, records of personnel, invoices of materials and any or all data relevant to the item or necessary to by the Employer/ Employer's representative and the Engineer-in-Charge's representative and by any other persons authorized by the Employer/ Employer's representative in writing.

Drawing to be kept at site:

One copy of the drawings furnished to the contractor shall be kept by the contractor on the site and the same shall at all reasonable time be available for inspection and use by the Engineer-in-Charge/ Employer / Employer's Representative and the Engineer-in-Charge/ Employer / Employer's Representative's representative and by any other persons authorized by the Engineer-in-Charge/ Employer / Employer's Representative in writing.

B.I.S. [I.S.I.] books, MoRT&H/ KDSS to be kept at site:

A complete set of Indian Standard specification, MoRT&H Specification (4threvision referred to in "Technical Specifications" and KDSS shall be kept at site for reference.

Site Order Book:

An order book shall be kept at the site of the work. As far as possible, all orders regarding the work are to be entered in this book. All entries shall be signed and dated by the Department Officer / KIIDC in direct charge of the work and by the contractor or by his representative. In important cases, the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram will countersign the entries, which have been made. The order book shall not be removed from the work, except with the written permission of the Executive Engineer.

Variations by way of modification, omissionsor additions:

For all modifications, omissions from or additions to the drawings and specifications, the Employer / Employer's Representative, KIIDC Thiruvananthapuram will issue revised plans, or written instructions, or both and no modification, omission or addition shall be made unless so authorized and directed by the Employer / Employer's Representative in writing.

The Employer / Employer's Representative shall have the privilege of ordering modifications, omission or additions at any time before the completion of the work and such orders shall not operate to annual those portions of the specifications with which said changes do not conflict.

Engineer-In-Charge/ Employer / Employer's Representative's Decision:

It shall be accepted as in separable part of the contract that in matters regarding materials, workmanship, removal of improper work, interpretation of the contract drawings and contract specification, mode of the procedure and the carrying out the work, the decision of the Engineer-in-Charge/ Employer / Employer's Representative, which shall be given in writing, shall be binding on the contractor.

Care and diversion of River/Stream:

The contractor shall submit details regarding the diversion and care of river or stream during construction of the work along with a separate print-out of the time tableshowing earliest and latest start and finish dates of various activities. He should submit a detailed layout plan with drawings for the diversion and care of river during construction of work. The above arrangements shall be at contractor's cost.

Incometax;

During the currency of the contract deduction of income tax shall be made from the gross value of each bill of the contract, the contract value of which is in excess of Rs.10, 000/- for deduction of tax procedure stipulated under section194-C (4) of Income Tax Act, 1961 and applicable as per the prevailing Government Orders &Circulars on total value of the contract.

Income Tax will be recovered as per rules in force.

IncomeTaxclearancecertificateshouldbefurnishedbeforethepaymentoffinal bill.

The contractor's staff, personnel and labour will be liable to pay personnel income taxes in respect of their salaries and wages as are chargeable under the laws and regulations for the time being in force, and the contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such laws and regulations.

Seignorage charges:

98.1. Seignorage charges will be recovered as per rules or as per the rates fixed by the Mines & Geology Department from the work bills of the contract [i.e., time to time as on Date of recording measurements in measurement books] or based on the theoretical requirement of materials whichever is higher for the materials consumed theoretically on

the work only.

98.2. The rates are liable to be revised and amended from time to time by the State Government, by notification in the 'Kerala Gazette'. If the revised Seignorage fee is more than the above mentioned, the recovery from the contractor's bills is as per revisedrates.

98.3. The percentage quoted by the Contractor is exclusive of Seignorage charges on all materials that the contractor will have to purchase for performanceof this contract.

Goods and Services Tax (GST):

100.1. Tax during thecurrencyof the contract, deduction according to which tax has tobededucted.

100.2. The tax to be deducted at source as per GST 2017 applicable as per the prevailing Government Orders & Circulars on total value of the contract. – Any changes made in the GST structure from time to time shall beconsidered.

100.3. GST component as per applicable of the estimate shall be added in each bill of the Contractor and recovered

100.4. The Contractor should produce a valid Sales Tax Clearance Certificate before the payment of the final bill; otherwise payments to the contractor willbewithheld

Labour CESS:

As per the Building and other Construction Workers Welfare CESS Act, 1996, Section 3 of CESS Act, read with rule 4(3) of the cases rules and in accordance with S.O.No.2899, dt.28-03-1996 of Government of India, 1% CESS will be deducted from the bills paid for works from the contractor.

Supply of construction materials:

The contractor has to make his own arrangements for procurements, supply and use of construction materials.

[Any other special conditions applicable to the work put to Tender]

In respect of EPC works the conventional Schedule- A giving the quantities against each item of work is dispensed with. Only project information regarding project features, major components as available are given in project profile of bid documents. Scope of work and basic project parameters of the project and deliverables shall be defined in the bid documents. The bidders shall review the data / information provided in bid documents and satisfies them. Any doubts shall be got cleared in pre bid meeting. The contractor shall quote the bid price in lump-sum after careful analysis of cost involved for the performance work considering all basic parameters, specifications and conditions of contract. The bid offer shall be for the whole work and not for individual item / part of work. The bidder shall quote for the entire work on a single source responsibility basis. The cost of all items of work necessary to achieve the objective as set out in the basic parameters shall be included in the bid price. The total cost of work shall be mentioned. In respect of EPC works the execution shall be strictly in accordance with bid conditions. Contractors shall not deviate from basic parameters of the project to reduce his costs. EPC being a turnkey system extra items / financial claims on the department contingent to the work other than price adjustments shall not be considered.

In respect of EPC, the Internal Bench Mark (IBM) put to tender value shall be the basis for comparison of tenders.

The agency shall furnish the detailed estimates prepared based on approved drawings as per provision of agreement.

Drawings given, listed and indexed in bid documents are indicative. The above drawings show the system, as a whole .The contractor shall carry out investigation to prepare detailed layout, designs and drawings of all components of the work within the stipulated time period, to be approved by consultant/ departmental authority. The contractor shall follow all relevant BIS codes / circulars issued by the department from time to time for

various components of the works. In case of difference of opinion on technical matters between the contractor and the Engineer-in-charge, the decision of the appellate authority shall be final and binding on the contractor.

The appellate authority is the Technical Committee constituted for the purpose of according Technical sanction for the related Project, in respect of designs and drawings approved by Engineer-in-charge.

The appellate authority is the Technical Committee constituted for the purpose of according Technical sanction for the related Project, in respect of designs and drawings approved by General Manager, KIIDC.

In case of EPCworks, if the prime contract or desires to sub let apart of the work, he shouldsubmit the same at the time of filing bids (itself) or during execution, giving the name of the proposed sub-contractor, along with details of his qualification and experience. The bid accepting authority should verify the experience of the sub-contractor and if the sub- contractor satisfies the qualification criteria in proportion to the value of work proposed to be sublet, including his past track record of completion and quality of work, he may permit the same. The aggregate value of works to be awarded on subletting shall not exceed 50% of contract value. The extent of subletting shall be added to the experience of the sub - contractor and to that extent deducted from that of the main contractor.

The Chief Engineer, KIIDC shall permit grant of extension of time up to six months and the State level Committee constituted by the Govt. for beyond six months, subject to levying liquidated damages wherever necessary and the employer conveys the same to the agency.

Termination of contact shall also be as per condition No.55 of General Conditions of EPC contract.

Entrustment of additional items of work contingent to main work and outside the scope of the contract will be authorized by the employer with the prior approval of the Committee constituted by the Government and the contractor shallbebound to execute such additional items and shall be compensated at the price decided by the Committee formulated by the Government.

Whenever additional items not contingent on the main work and outside the scope of original contract are entrusted to the contractor, entrustment of such items and the price to be paid shall be referred to the Committee formulated by Government for final decision.

In respect of open category tenders, technical evaluation shall be done first following the criteria specified in the bid document and financial bid evaluation shall be done in respect of those who are qualified in technical bid evaluation.

In addition to the four methods of execution viz., (i) the departmental method (ii) the piece work contract method (iii) the lump sum contract method and (iv) the schedule contract method , (v) fifth method is introduced for execution of EPC works by an agreement in the form approved by Government for EPC works.

In regard to method (v) the details are set forth clearly in the form of articles of agreement, tender notice and tender documents approvedbycommittees constituted by Government.

In case of EPC works, measurements shall be recorded by EPC agency in M Books and L.F. Books issued by the concerned EE duly numbered and certified. The M. Books and L.F. Books have tobemaintained by the EPC agency through authorized graduateengineersas per procedure prescribed in Code and finally to be handed over to the department (Engineer-in-charge).

Wherever Quality Control agencies are in existence, such agency has to record its findings in M Books/LF Books besides furnishing certificates as prescribed separately.

Contractors are permitted to avail the facility ofMobilization advance up to 10% of the tendered value, strictly based on the assessment of the need thereof, if applied by the contractor within one month from the date of award of contract. This advance is facilitating the contractor to mobilize the work at site by deployment of machinery and various resources. Advance can be released in two or more installments as considered appropriate and installments subsequent to the first installments shall be released after obtaining proof of utilization of the advance already released.

The Mobilization advance of 5% towards Labour Mobilization be paid in two installments as detailed below

1% after concluding the agreement and submission of QAP and project schedule

4% at the time of commencement of work (After completion of investigation, survey & designs).

Mobilization advance on Machinery is payable against the production of invoices in proof of purchase of the machinery by the contractor /firm.

The invoices should be on the name of the contractor / firm only and the machinery should have been purchased only after the date of conclusion of the agreement for the work on which the payment of mobilization advance is proposed.

Mobilization advance is payable against copies of bills in respect of new machinery purchased @ 100% value as prescribed in the agreement. The same is payable in respect of old machinery at 50% of the value (as prescribed in the agreement) as per the registered sale deed.

No Mobilization advance is payable on the pre-ownedmachinery prior to conclusion of the agreement for the work or leased machinery or purchased by the contractor.

Recovery of mobilization advance along with interest shall be made as per provisions of the contract. The interest rate will be two percent higher than the prevailing PLR of State Bank of India, as on date of sanction of the mobilization advance.

The estimate shall be prepared based on available preliminary data, the scope of works and project parameters taking into consideration

General Manager, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram should prepare project profile and basic project parameters with project cost under EPC turnkey System. The same shall be approved by the Committee constituted for the purpose.

If that cost of estimate is found to exceed the Administrative approval, revised administrative approval must be obtained before according Technical sanction.

In case of EPC works the designs are to be submitted by the executing agency which shall be approved by the competent authority. The EPC agency responsible for the technical features of designs.

In addition to the three methods of execution, fourth method is introduced for execution of EPC works. (iv) Byanagreementinthe form approved by Government forEPC.

In regard to method (iv), The details are set forth clearly in the form of articles of agreement, tender notice and bid documents approved by Government.

Contract documents approved by the Committee constituted by Government for EPC works in terms of Para 153 of "D" Code shall be followed whenever tenders are invited for EPC works.

In respect of EPC works limited/ open tender system shall be followed.

In respect of EPC works, M. Books and L.F. Books have tobe issued by the Executive Engineer to EPC agency duly certified and numbered for recording measurements and levels. The M. Books and L.F. Books shall be maintained by EPC Agency and bills are to be submitted to the Engineer in Charge by the EPC agency along with a true extract of the entiresetforcheckingandmakingpayment.TheEngineer-in-chargehastokeepthefull set

of true extract with him and return the originals to the agency for further use. The entire original record shall be finally handled over for record to the Engineer-in-charge by the EPC Agency.

In respect of EPC works, EPC Agency shall prepare monthly work bills based on measurements of work done and submit toEngineer-in-charge.

InrespectofEPCworks, paymentsshallberegulatedinaccordancewithAnnexure-II-Schedule of Payments component wise

The components may be further divided into appropriate subcomponents and stages. The payment of each stage of sub component shall be expressed as percentage of total cost of approved bid which shall also be approved by the General Manager and shall form part of contract. Sum of all such stages of particular component shall be equal to the percentageofthatcomponentshowninAnnexure-IIof ScheduleofPayments.

The percentage fixed for sub component shall be correlated to the main component and volume of the work.

The eligibility for payment shall be limited to completed portions of works, subject to other conditions envisaged in the agreement andexecutive instructions from time totime.

Schedule-A indicates only firm lump-sum amount of thecontract.

Bidder shall quote lump sum amount for the work as awhole.

Percentages of components shall be indicated by the department in Annexure-II to ScheduleA.

The Chief Engineer is empowered to modify the percentage of components; stage wise based on the detailed investigation, detailed drawings, and detailed estimation done by the EPC agency keeping the total price bidunaltered.

The General Manager is empowered to modify the sub-components reach- wise/stage-wise keeping the percentages of componentunaltered.

The Sub Divisional Officer and Engineer-in-charge shall exercise check to see that the bill submitted by EPC agency is in accordance with agreement conditions and certified by the departmental Quality Control Authorities (or) 3rd Party Quality Control Agency (or) by both if both are deployed on thework.

Engineer-in-charge (EE) should check the claim with reference to the measurements recorded to see that the percentage at which the bill is claimed is clearly traceable into the documents on which payments are to be made. Payments shall be adjusted for recovery of advance payments, liquidated damages in terms of agreement conditions, Security deposit fordue fulfillment of the contract. Recoveries shall be affected towards Seignoragecharges on the materials used and VAT and other statutory recoveries as per State and Central Government Rules and Acts.

In relaxation of provisions contained in KDSS, D-code, Financial Code, Accounts code, the following shall be applicable to the EPC turnkey system:

Definitions:

The employer is The Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, Thiruvananthapuram i.e., the agreement concludingauthority.

“Engineer-in-Charge” is the Deputy General Manager in charge ofexecution.

In respect of EPC works the conventional Schedule- A giving the quantities against each item of work is dispensed with. Only project information regarding project features, major components as available are given in project profile of bid documents. Scope of work and basic project parameters of the project and deliverables shall be defined in the bid documents. The bidders shall review the data / information provided in bid documents and satisfiesthem. Any doubts shall be got cleared in pre bid meeting. The contractor shall quote the bid price in lump-sum after careful analysis of cost involved for the performance work considering all basic parameters, specifications and conditions of

contract. The bid offer shall be for the whole work and not for individual item / part of work. The bidder shall quote for the entire work on a single source responsibility basis. The cost of all items of work necessary to achieve the objective as set out in the basic parameters shall be included in the bid price. The total cost of work shall be mentioned.
The execution shall be strictly in accordance with bid conditions. Contractors shall not deviate from basic parameters of the project to reduce his costs. EPC being a turnkey system extra items / financial claims on the department contingent to the work other than price adjustments shall not be considered.
In respect of EPC works drawings given, listed and indexed in bid documents are indicative. The above drawings show the system as a whole .The contractor shall carry out investigation to prepare detailed layout, designs and drawings of all components of the work within the stipulated time period, to be approved by consultant/ departmental authority. The contractor shall follow all relevant BIS codes / circulars issued by the department from time to time for various components of the works. In case of difference of opinion on technical matters between the contractor and the Engineer-in-charge, the decisionoftheappellateauthority shallbefinalandbindingonthecontractor.

NOTE ON ROLES AND RESPONSIBILITES OF CONSTRUCTION STAFF, QUALITY CONTROL WING AND THIRD-PARTY QUALITY CONTROL AGENCY IN EXECUTION OF PROJECT TAKEN UP UNDER EPC TURNKEY SYSTEM.

As the projects are to sustain for number of decades, Quality Control assumes an important role. Maintenance of Quality of Projects is a continuous process and has to be ensured and assured by the executing agency under EPC System, construction staff, Department Quality Control and the third-party Quality Control agencies wherever appointed.
The following guidelines are drafted with reference to the roles and responsibilities of fieldstaff, quality control staff and 3rd party quality control agencies, procedure for recording of work executed in M Books for making payments to the contractors for the work executed every month including maintenance of records and certification of quality of work executed and the same may be followed to have a uniform procedure in maintaining the quality controls / assurance in the project taken up under EPC turnkey system
A**) The roles and responsibilities**offield staff, Quality Control Staff and 3rd Party Quality Control Agencies.
FIELDSTAFF
The field staff (construction staff) has to associate with the EPC agency while conducting the tests. In case of necessity they may conduct tests independently whenever required. Under EPC system the field staff plays a vital role in quality assurance of theworks.
The field staff shall invariably check and produce all the following Records and OK **cards maintained by EPC Agency at the site to the InspectingOfficers.**
A) Registers
i) SiteOrder
Register of BenchMarks
Material OKRegister
Register ofFoundations
Register of placement for concrete, Embankment, reinforcement and other test reports.
Register of laying pipelines, testing.

Register of test reports of comprehensive strength of concrete specimens
Cement DayBook
In case of Earthwork excavation embankment, the field staff has to check and record the pre levels 25% of the pre levels taken by the EPC agency. In case of cut-off and foundations the field staffs have to check and record 100%levels.

Department Quality Control Staff

The Department Quality Control staff shall verify the records maintained at site by EPC agency and the third party quality control agency. The field quality control staff has to check 25% of works such as pipes, laying, jointing, and testing including pumping machinery and recordindependently.

Regarding the tests and frequency of tests, the field quality control staffs have to conduct / associate with construction staff as mentioned in Annexure – D. In case of ambiguity, they shall conduct tests in KERI/ independent laboratory approved by employer.

Wherever the Third Partyqualitycontrol agency is not appointed, the Department Quality Control staffs have to issue the quality certificates for releasing payment to the EPC agency during construction and othercompletion.

III Third Party Quality Control Agency

The Third Party Quality Control agency should possess all the testing facilities as per agreement and conduct independent testing to assure the quality of work. They should also verify 10% of the tests being done by the EPC agency independently.

The third party quality control agency has to submit the reports and records to the Engineer-in-Charge vide appendixE.

BRecording of measurements and certifying payments to the EPCAgency.

Measurements are to be recorded by the EPC Agency in the Measurement Book and LFBooks.

The measurement book and LF book are to be issued by the concerned Executive Engineer duly certified andnumbered.

Field Engineer (AE/AEEs) has to check and record 25% of pre levels and 100% for finallevels.

Field Engineer (AE/AEEs) has to check measure 20% of finalmeasurement.

Field Dy. EEs have to check the measure 25% of the levels and measurements spread over the entirework

Field EE/SEs has to check measure as per Codal provisions and rules invogue.

The measurement books and LF books have to be maintained by the EPC agency and finally to be handed over the Department (Engineer-in-Charge)

The Department QC Staff have to check 25% of the work such as pipes, laying, jointing, testing, concrete work, etc.

Measurement will be recorded by the EPC agency for the finished work dulycertifying that all tests are conducted and work done by the agency in accordance with specifications and contracts conditions by using the material specified in the contract.

The EPC Agency shall prepare monthly work bills based on the recorded measurement ofwork done and submit to the Engineer-in-charge duly signed by them or his authorized signature forarranging

The Engineer-in-Charge shallrecommendforrelease of payment duly ensuring quality certificate by the third partyquality control agency / Department quality control staff (in absence of third party quality control).

NOTE: The above guidelines have to be followed duly inter relating with the relevant conditions / clauses of the respective Agreements concluded.

Reporting procedure foradverse remarks of 3rd party Quality Control Agency and Departmental Quality Control Staff.

Reporting procedure shall be followed as per Appendix E.

The third party quality control agency shall submit reports in four sets for specific cases of deficiencies for corrective action to the Engineer-in-charge soon after verification. The sub-standard material shall be rejected and got them removed from the site. In case necessity, Engineer-in-Charge shall arrange to stop the work till the deficiencies are rectified to the satisfaction of the 3 rdparty Quality control Agency / departmental qualitystaff.

The Engineer-in-Charge shall communicate the above remarks of 3rdparty quality control agency to the EPC agency for compliance of correctiveaction.

The EPC agency shall furnish compliance report to the Engineer-in-Charge, who in turn forwardsthesame to the third party quality control agency / department quality control as the case may be forverification.

Soon after receipt of report on the compliance to the remarks of the third party quality control agency by the EPC agency, evidence of compliance of corrective action has to be furnished to the Engineer-in-Charge to proceed with further work.

In addition to the above, the observations made by the third party quality control and the Department quality control staff have to be invariably completed with before the next bill is present for payment and certificate to that effect has to be recorded in bills presented by the EPC agency duly countersigned by their field construction staff before makingpayments.

On completion of the works, the third party control agency and Department Quality Control staff have to certify that the work has been executed as per design and specifications satisfying intended scope of project as indicated in the agreement before making final payments to the EPC Agency.

All Quality Control Units inclusive of 3rdparty agency shall be under the Technical Control of Chief Engineer, KIIDC

Salient points on the Duties of the Construction Engineers under EPC System:

Under E.P.C. System, the field Engineers are primarily responsibleforQuality Assurance oftheworkexecutedbythemandconductallfieldtestsbeforeallowingfurtherwork.

Shall check and produce to inspecting officers the following Records and O.K. Cards maintained by the EPC Agency.

Registers:-

Siteorder.

Register of BenchMarks.

Material O.K. Register.

Register of pipes, laying, jointing, andtesting.

Register offoundations.

Register of placement of concrete, Embankment, Reinforcement and other test reports.

Register of test reports of compressive strength of concrete specimens. E. Es/S.Es hastocheckmeasureas per Codal provisions and rules in vogue.

The Measurement records have tobemaintained by E.P.C. Agency and finally handed over to theEngineer-in-Charge.

The observations made by Third party Quality Control; Departmental Quality Control Staff have to be invariably complied with before the next bill for payment is presented. To that effect certificate has toberecorded by E.P.C. Agency and countersigned by the field Engineers.

Under E.P.C. System of contract, fortnightly Management Meetings with E.P.C. Agency by the Superintending Engineer shall invariably discuss the Quality Assistance Aspects and records in the Minutes of Meeting regularly.

Salient Points on the Duties of Departmental Quality Control Staff.

Shall verify the records maintained @ site by the E.P.C. agency and the Third Party Quality Control agency.

Shallcheck25%of the pipe laying, testing, final levels/measurementsof Earthwork, revetment, leveling, concrete, linear dimensions of important structures, etc.

Shall conduct/Associate with construction staff with regard to Test &Frequency of Tests as stipulated in the Annexure 'D' of Committee on Q.C. Recommendations.

In case of Ambiguity of Test Results, they shall conduct tests in KERI independently.

Shall issue quality certificates for releasing payment in absence of Third-Party Quality Control to the E.P.C. Agency during construction and aftercompletion.

Shall certify that the work has been executed as per designs &Specifications, (Agreement) before final payment to E.P.C. Agency.

Third Party Quality Control Agency

The Third Party Quality Control Agency should possess all the testing facilities as per Agreement and conduct independent testing to assure the Quality of Work.

Shall verify 10% of the tests done by the EPCAgency.

Shall submit the Reports and Records to Engineer-in-Charge as per agreement with the Department.

Shall give Quality Control Certificate for each work bill executed by the EPC Agency.

On completion of the work, the Third Party Quality Control Agency shall certify that the work has been executed as per Design and specifications indicated in theagreement satisfying intended scope project before marking final payment to the EPC. Agency.

Volume 2: Technical Bid

Section - 4: Setting out of Works, Design criteria, Obligatory Requirements and Specifications

SECTION – IV

SETTING OUT OF WORKS, DESIGNCRITERIA, OBLIGATORY REQUIREMENTS AND SPECIFICATIONS

4.01General &Approach to Work Site

The general site particulars are shown in the Drawings enclosed in the Tender Document. The scope of topographic survey for the contractor consist of establishing bench mark stations, carrying out traverses, topographic survey for provision of Water Supply Pipe lines.

4.02 Topographic Survey, Bench Marks&Setting out of Works

The contents of the topographic survey drawing covering topographic details, bench marks and coordinates is for reference. The Department does not take responsibility about the correctness of the details in thedrawing.

Contractor shall carry out detailed topographic survey by carrying out horizontal and vertical traverse followed by capturing of topographic survey details. Contractor shall establish one Permanent Control Point at the project site connected with at least three inter-visible points. Contractor shall alsoestablish at least two Bench mark stations in all the arms of the junctions, with the distance between two bench mark stations not exceeding 400m. Control Point and Bench mark station shall be in precast RCC Pillar with a minimum dimensions with length and width of 150mm and total depth of 600mm with 400mm standing height above the top of existing road / ground level.

Contractor shall conduct horizontal traverse for the project using Total Station of 1 sec least count connecting stations in the form of loop and the traverse closure shall be better than 1 in 20000 accuracy and the disclosure error shall be distributed. In case, the traverse closure is above 1 in 20000, the contractor shall re-conduct the traverse until the closure is within the permissible value of 1 in 20000 or better. Vertical traverse shall be conducted using Auto Level from Survey of India benchmark which shall be transferred to the permanent control point of the project. Vertical data recordings shall be based on double tertiary measurements of the three cross hair readings of the instrument. The closure error shall be checked for the permissible limits of 12 x sqrt (K) in millimeters, where K is the distance in Km. The error shall be distributed within to all the bench marks in the loop. In case, the error is more than the permissible limits, then the survey shall be reconducted.

Contractor shall be solely responsible for the correctness of the traverses data. The reduced levels shall be painted on all the bench marks.

The Contractor shall be responsible for the true and proper setting out of the works and for the correctness of the positions, levels and dimensions and alignments of all parts of the works and for the provision of all necessary instruments, appliances and labour in connection therewith. Setting out of piers/ abutments / RE wall edges and other obligatory points / locations as desired by Employer / Employer's representative shall be secured at ground with nails and painted the point with circle along with identification. The Contractor shall give at least 24 hours' notice to the Employer / Employer's Representative of his intention to set out or give levels.

If at any time during the progress of the work, any error may appear or arise in the positions, levels, dimensions of alignments of any part of the work, the Contractor shall at his own expenses, rectify such errors to the satisfaction of the Employer / Employer's Representative at no additional cost and time.

All duties concerning establishment of a set of bench marks, permanent stations for setting up total stations, center line pillars, etc. for performing all the functions necessary at the commencement and during the progress of work till the physical completion of all the items of the work in his scope, shall be carried out by the Contractor at his own

cost.

The center line and edges of Major Bridge / Road, and the foundations shall be established by total station and the center line marks shall be engraved on smoothly finished masonry or concrete pillars of such dimensions and constructed at such intervals and places as may be directed by the Employer / Employer's Representative and shall be maintained in proper manner throughout the period of construction. The Contractor shall submit a drawing showing the Major Bridge / Road alignment and wall locations within 15 (fifteen) days from the date of signing of agreement.

The contractor shall also keep proper record of such permanent Bench marks established denoting therein their correct levels.

The work of establishment of all such Bench Marks shall be carried out by only experienced staff of the Contractor with the help of precise instruments suitable for this type of work. The instruments used shall be checked for their accuracy and for permanent adjustments before the commencement of the work and also at frequent intervals during the progress of the work.

All such Bench marks established by the Contractor shall be subjected to check and approval of the Employer / Employer's Representative or his representative as and when required, and any variations noticed in the work as a result of improper establishment and maintenance of such Bench Marks shall be rectified at the Contractor's risk and expense.

4.03 Design Criteria

4.03.01 **Submission of Design and Drawings**

The design should be submitted in sufficient details and as lucidly as possible so as toenablequick proof checking by the Consultants. The designs and drawings will be proof checked and commented generally within 15 days of submission. All the design calculations after incorporating the comments of the proof checking consultants along with corresponding construction drawings marked "Good for Construction" shall be submitted, got approved by the proof consultants for use at site within 7 days thereafter. If the designs and drawings are not submitted within the time frame, then a penalty at the rate of Rs. 5,000/- (Rupees FiveThousand Only) per day shall be charged for every day of delay.

Any other component which required redesigning on account of exigencies of the site like redesigning the foundations for utilities, etc., during the duration of the works shall be approved as expeditiously as possible. Such designs should be submitted within 10days of taking a decision to redesign the component.

Analysis and design as far as possible shall be done using computer with recognized software. The contractor shall submit with design, the detailed description of method of analysis with explanatory notes and submit sample manual calculations for adequate number of typical cases. The Computer Programme as submitted will be further tested by comparison with solutions of worked examples.

Drawings and designs shall be in metric units. Calculations shall be neat and clear, preferably typed and printed and supplemented by full explanatory notes and sketches wherever required. All construction drawings of initial submissions and final approval shall be in AutoCAD only.

If during the scrutiny of detailed design calculations and working drawings, any changes therein which are found necessary in the opinion of the Employer / Employer's Representative, the same shall be incorporated without altering the lump sum quotations. It is entirely the responsibility of the contractor to submit properly prepared and completed designs in good time to enable the Employer / Employer's Representative to approve them in time.

Bar bending schedule of reinforcement, shop drawings of pre-stressing tendons and other elements and average quantity of reinforcement per Cum. of concrete quantity (and also percentage with respect to gross cross sectional area of the component) should also be shown on the relevant drawings.

Eight sets of prints of approved working drawings including one set on reproduction tracing, floppy diskette of the AutoCAD/Felixcad drawing and 4 sets of approved design calculations shall then be supplied by the contractor which will be formally authenticated by the Employer / Employer's Representative (one set of design calculations and working drawings shall be returned to the contractor after verifying and the remaining shall be retained by the Employer / Employer's Representative). The design calculations and drawings shall be submitted in plastic files and plastic folders free of cost.

After completion of each stage of work, 3 sets of record plans and one set of final design calculations based on the work as actually executed on site shall be supplied by the Contractor in bound volumes, to the Employer / Employer's Representative.

Approval to drawings and designs and design calculations by the Employer / Employer's Representative shall not in any way relieve the Contractor of his responsibility for the correctness, soundness and structural stability and safety of the structure.

The approved drawings and the design calculations of all Structures and all components of the Projectshallbe the property of the Department.

The Contractor's designer or consultant shall attend all the review meetings conducted by Employer / Employer's Representative from time to time without any extra cost and shall also remain present as and when required during the checking of designs for clarifications if required.

Documentation, instrumentation, etc.

All drawings shall be made in latest version of AutoCAD and the soft copies on CDs and six copies of prints of all approved drawings and "as built" drawings shallbesuppliedbytheContractorfreeofcostaspertheagreedprogramme.

Floppy diskettes CDs and six copies of all design calculation shall be submitted as per agreed programme.

"Maintenance Manual" describing access arrangements, important obligatory precautions from the point of view of structural safety, and procedure for minor and major repairs of each component of the Major Bridge, renewals of finishes and treatments periodically shall be supplied bytheContractor free of cost.

A "Quality Assurance Manual" covering designs and drawings, mix-designs, materials, testing, soil and rock properties, statistical quality control, etc. shall be prepared by the Contractor free of cost well before starting the work.

A "Construction manual" covering various aspects of construction methods, difficulties faced and how they are overcome during execution etc. shall be supplied by the contractor free of cost at the time of finalization of work.

The Contractor shall install fixtures and fastenings provided by the Department for housing any instrumentation that may be useful for the Department at his cost.

Fixing arrangement for internal and external lighting shall be got approved from Employer / Employer's Representative and executed.

Specifications for Design and Codes to be followed

Sl. No.	Description	
A) **CIVIL WORKS:**		
Division – 1	…	General Specifications
Division – 2	…	Site Work
Division – 3	…	Earth Work Excavation
Division – 4	…	Masonry
Division – 5	…	Plastering and Pointing
Division – 6	…	Concrete
Division -10		Tunneling
Division -11		Cross drainage works
Division -12		Sub surface Irrigation
B) **IRRIGATION/WATER SUPPLY**		
Division – 7	…	Materials Required for Pipeline Works
Division – 8	…	Laying and Jointing of Pipelines
Division – 9	…	Pumping Machinery
Division – 12	…	Pump house, Quarters
Division – 13	…	Specification for Centrifugal Cast (Spun D.I Pipes) for Water, Gas and Sewage

Note: The EPC contractor is bound to follow the Technical and General Specification, stipulated by Central Water Commission.

The following Guidelines also form the part of this document.

Guide lines for Planning and Design of Piped Irrigation Network Part I & II

Publication from Ministry of Water resources –RiverDevelopment & Ganga Rejuvenation, Central Water Commission, Government of India – July 2017

National Mission for Micro Irrigation (NMMI) - Operational Guide lines – November 2010 under Ministry of Agriculture& Cooperation, Government of India

Orderofprecedenceincaseofconflicts

In case of conflicts between the different partners of the tender, the following order of precedence shall prevail.

Design Criteria as specified in theTender

Special conditions ofcontract

General conditions ofcontract

Standard Codes ofpractice

Vol 2 Technical bid also, or its relevant parts.

Disputes

In case of disputes arising between the Contractor and the authority approvingthe designs, the matter may be referred to the Employer / Employer's Representative. The decision of the Employer / Employer's Representative shall be final and binding on the contractor.

DIVISION – 1
GENERALSPECIFICATIONS

The I.S. Codes shall be those indicated or subsequent amendments thereon.

LIST OF INDIAN STANDARDS

Sl. No.	Description	I.S. No.
I	**CEMENT**	
1	Ordinary and Low Heat Portland Cement	269 – 1976
2	Pozzolana Portland Cement	1489 – 1976
3	43 Grade or 53 Grade Cement	8112–12269 Respectively
I I	**AGGREGATES**	
1	Aggregates, Coarse & Fine from natural resources for Concrete.	383 – 1970
2	Sand for Masonry Mortar	2116 – 1965
3	Methods of tests for aggregates for concrete	2386 - 1963
	Part – I Particle size and shape	2386 – 1963 (Part – I)
	Part – II Estimation of deleterious Materials & Organic Impurities	2386 – 1963
	Part–III Soundness	2386 – 1963
4	Specification for test sieves. Part – I: Wire Cloth test sieves.	460 – 1978 (Part – I)
I	**BRICKS**	
1	Common burnt clay building bricks	1077 – 1976
I V	**STEEL**	

1	Mild steel and medium tensile steel bars and hard drawn steel wire, concrete reinforcement. Part – I Mild Steel & Medium tensile Steel Bars.	432 – 1982
2	High strength deformed steel bars and wires for concrete Reinforcement	1786 – 1985
3	High Tensile Steel for PSC Pipes.	1784 – 1986 (Part-I)
4	Hand Drawn Wire	432 – 1953
5	Bending and Flexing of Bars for Concrete reinforcement	2502 – 1963
6	Recommendations for detailing of reinforcement in reinforced concrete works	5525 – 1969
V	**CONCRETE**	
1	Plain and reinforced concrete, code of practice for	456 –2000
2	Laying in Situ cement concrete flooring	2571 – 1970
3	Sampling and analysis of Concrete	IRC : 15-2002
4	Code of practice for liquid retaining structures	3370 – 1967
5	Code of practice of concrete roads	IRC : 15 – 2002
VI	**MASONRY**	
1	Brick Masonry	2212 – 1962
2	Construction of Stone Masonry	1597 – 1967
VII	**PIPES AND FITTINGS**	
1	Asbestos cement pressure pipes	1592 – 1980
2	Concrete pipes with and without reinforcement	458 – 1988
3	P.S.C. Pipes (including fittings)	1343 – 1960
4	Method of tests for concrete pipes	458 –1988, 3597 –1985
5	Materials for M.S. Specials	226 – 1976 & 2062 – 1980
6	Specifications for M.S. Specials for P.S.C. Pipes-	
7	Specifications for Steel cylinders reinforced Concrete pipes	1916 – 1963
8	Methods of tests of concrete pipes	3597 – 1985
9	Centrifugally Cast (Spun) iron pressure pipes for water gasand sewage including fittings	1536 – 1976 784 – 1978
10	Specifications for Centrifugally Cast (Spun) D.I. Pipes forWater, Gas and Sewage.	8329 – 1980

11	D. I. Fittings for pipes for water, gas and sewage	9523 – 1980
	a) D.I. AIR Valves	3896 -1985(Part – II) 1538-1985
	b) D.I. Valves	14846-2000
	c) Surge Protection Valves	14846-2000
	d) DI Pipes	8329-2000
	e) DI Specials	9523-2000
	f) DI Laying & Jointing	12288-1987
	g) DI Rubber Rings	5382-1985
12	MS Pipes	3589 -2001
	a) MS Flanges	1538-1993
	b) MS Specials	1538-1993
13	Dimensional requirements of rubber gaskets for Mechanicaljoints and push on joints for the use with C. I. D.I. Pipes	12820 – 1989
14	C.I. Specials for Mechanical and push on flexible for pressurepipe lines for water gas and Sewage	13382 – 1992
15	Horizontally cast iron double flanged pipes for Water, gas andSewage	7181 – 1986
16	Cast iron fittings for pressure pipes for Water, gas and sewage	1538 – 1976
17	Cast iron detachable joints for use with Asbestos cement pressure pipes	8794 – 1988
18	a) Rubber rings for jointing C.I. Pipes, RCC Pipes and A.C.Pipes.	5382 – 1969
	b) Rubber rings for jointing PSC Pipes	5382 – 1985
	c) Rubber rings for jointing AC Pipes with AC couplings	10292-1986
19	Pig Lead	782 – 1978
20	Hemp Yarn	6587 – 1966
21	Rubber insertion to be used in jointing C.I.D.F. Pipes	638 – 1955
22	Bolts & Nuts to be used in jointing C.I.D.F. Pipes	1363 – 1967
VIII	**WATER SUPPLY FITTINGS**	
1	Sluice valves for water works purposes (50 to 300 mm dia. size)	14846-2000
2	Sluice valves for water works purposes (300 to 1200 mm dia. size)	14846 - 2000
3	Surface boxes for sluice valves	3950 – 1966

4	Manhole covers and frames, cast-iron	1726 – 1974
IX	**LAYING OF PIPES**	
1	Laying of Asbestos Cement Pressures Pipes	6530 – 1972
2	Laying of Concrete Pipes	783 – 1959
3	Laying of Cast-Iron Pipes	3114 – 1965
4	Laying of PSC Pipes	783 – 1985
5	Laying of D.I. Pipes	3114 – 1965
X	**MACHINERY**	
1	Batch type concrete mixer	1791 – 1968
2	Sheep foot roller	4616 – 1968
XI.	**SAFETY**	
1	Safety code for excavation works	3764 – 1966
2	Safety Code for scaffolds and ladders	
	Part – I – Scaffolds	3696 – 1966 (Part – I)
	Part – II – Ladders	3696 – 1966 (Part – I)
XII	**FILTRATION PLANTS**	
1	Guide lines for flauculator devices	7208 – 1992
2	Guide lines for rapid mixing devices	7090 – 1985
3	Recommendations for handling and dousing devices for chemicals for water treatment	9222 – 1990 Part I
4	Requirements of Chlorination equipment's	10553 – 1983 (Part – I)
5	Requirements of Settling Tank (Clarified Equipment for Water Treatment Plant)	10313 – 1982 (Part – IV)
6	Requirement for Water Filtration Equipment	8419 – 77 (Part – I & II)

DIVISION-2
SITEWORK

Intimation about commencement of work:
Before commencing the works and also during progress the bidder shall give due notice to the concerned authorities, the Municipality, the Roads and Buildings and Electricity Board, Telephone Department, the Traffic Department attached to the Police, other Departments and companies as may be required to the effect that the work is being taken up in a particular locality and that necessary diversion of traffic may be arranged for. The

bidder shall cooperate with the Departments concerned and provide for necessary barricading of roads, protections to existing underground mains, cables etc.

2.2 Cross Drainage:

The bidder shall handle all flows from natural drainage channels intercepted by the work under these specifications, perform any additional excavation and grading for drainage as directed and maintain any temporary construction required to bypass or otherwise cause the flows to be harmless to the work and property. When the temporary construction is no longer needed and prior to acceptance of the work, the bidder shall remove the temporary construction and restore the site to its original condition as approved by the Engineer-in-Charge. The cost of all work and materials required by this paragraph shall be included by the bidder in the unit prices quoted in the section 6 of Vol. III (bill of quantities) and no separate payment will be made for the same.

2.3 Stacking of Excavated Material:

Where the location of the work is such and does not permit the deposition of excavated earth while digging trenches for laying pipes, the excavated earth should be conveyed to a convenient place and deposited there temporarily, as directed by the Engineer-in-Charge. Such deposited earth shall be reconveyed to the site of work for the purpose of refilling of trenches, if such deposited soil is suitable for refilling. The unit rate for trench work of excavation and refilling shall include the cost of such operations.

2.4 Disposal of Surplus Earth:

The rate for excavation of trench work, shall include charges of shoring, strutting, any of these contingent works. While bailing out water care should be taken to see that the bailed out water is properly channelized to flow away without stagnation or inundating the adjoining road surfaces and properties.

2.5. Shoring, Strutting and Bailing out Water:

The rate for excavation of trench work shall include charges of shoring, strutting, bailing out water wherever necessary and no extra payment will be made for any of these contingent works. While bailing out water care should be taken to see that the bailed out water is properly channelized to flow away without stagnation or inundating the adjoining road surfaces and properties.

DIVISION-3
EARTH WORK

EARTH WORK -GENERAL:

3.1.1. **Earth work diagrams and Data**:

To the extent that they exist plans and earth work data prepared for the Government's (that is Government of Kerala) studies of earth work for construction of the related works will be available for Inspection by the bidders in the Office of the concerned Engineer-in-Charge.

Such information is made available solely for the convenience of bidders. The Government does not represent that this information is accurate or complete. Bidders are cautioned that this information is subject to revision and that the Government disclaims responsibility for any interpretations, deductions or conclusions which may be made there from. It is not intended that this earth work information will limit or prescribe the excavation and handling procedure of the contractor, and the Government reserves the right to utilize and distribute earth work materials during the progress of work as best serves the interest of the Government.

3.1.2 **Compacting Earth Materials:**

Where compacting of earth materials is required, the materials shall be deposited in horizontal layers and compacted as specified in this paragraph. The excavation, placing, moistening and compacting operations shall be such that the materials will be uniformly compacted throughout the required section and will be homogeneous, free from lenses, pockets, streaks, voids, lamination or other imperfections. The compaction shall be carried out in accordance with the relevant clauses of I.S 4701 – 1982.

3.2EXCAVATION:

Classification of Excavation:

Except, as other-wise provided in these specifications, material excavated will be measured in excavation to the lines shown on the drawings or as provided in these specifications, and all materials so required to be excavated will be paid for at the applicable prices bid in the schedule for excavation. No additional allowance above the price bid in the schedule will be made on account of any of the material being wet. Bidders and the contractors must assume all responsibility for deducting and concluding as to the nature of the materials to be excavated and the difficulties of making and maintaining the required excavation. The Government does not represent that the excavation can be performed or maintained at the pay lines described in these specifications or shown on the drawings.

Excavation for removal of debris and deposited earth on berms while forming roads is to be carried out as specified in relevant clauses of IS: 4701-1982 as compared before lying of berms with the same setting of roads.

Excavation for Structures:

General:

Excavation for the foundation of structures shall be to the elevation shown on the drawings or as directed by the Engineer-in-Charge. In so far as practicable, the material removed in excavation for structures shall be used for back fill and embankments. Otherwise it shall be disposed off as specified in paragraph 2.4.

Foundations for Structures:

The Contractor shall prepare the foundations at structure/sites by methods which will provide firm foundation for the structures. The bottom and side slopes of common excavation upon or against which the structure is to be placed shall be finished to the prescribed dimensions and the surfaces so prepared shall be moistened and tamped with suitable tools to form firm foundation upon or against which to place the structure. The Contractor shall prepare the foundation for the structures as shown on respective drawings. The natural foundation material beneath, the required excavation shall be moistened if required and compacted in place.

Separate payment will not be made to the contractor for Moistening and compacting the foundation of structures. The contractor shall include cost thereof in the price bid per cubic meter of the item of the Bill of quantities for preparation of foundations.

Whenever unsuitable material is encountered in the foundation for a structure the Engineer-in-Charge will direct additional excavation to remove the unsuitable material. The cost of such additional excavation shall be paid at the unit price bid in the Bill of quantities for earth. The additional excavation shall be refilled by selected bedding material and compacted.

Over Excavation:

If at any point in common excavation the foundation material is excavated beyond the lines required to receive the structure, or if at any point in common excavation the natural foundation material is disturbed or loosened during the excavation process, it shall be

compacted in place or where directed, it shall be removed and replaced as follows. In excavation soils, the over excavation shall be filled in by selected bedding material and compacted. In excavation in rock it shall be filled with M5 grade cement concrete. Any and all excess excavation or over excavation performed by the Contractor for any purpose or reason except for additional excavation as may be prescribed by the Engineer-in-Charge and whether or not due to the fault of the contractor shall be at the expense of the contractor. Filling for such excess excavation or over excavation shall be at the expense of the contractor.

Measurement for payment:

Excavation for structures will be measured for payment, for box cutting with vertical sides of foundation dimensions. The contractor will have to make his own arrangement for shoring, strutting, provision of adequate slopes for the sides to prevent slips etc., and no separate charge will be paid for any incidental charges arising either during excavation of foundation or construction of the structure.

Payment:

Payment for excavation for structures will be made at the unit price per cubic meter bid there for in the Bill of quantities for excavation for structures. The unit price bid in the bill of quantities for excavation for structures shall include the cost of all labour and materials for coffer dam and other temporary construction, of all pumping and dewatering, of all other work necessary to maintain the excavation in good order during construction, of removing such temporary construction where required and shall include the cost of disposal of the excavated material.

3.3 BACKFILL:

Back fill around structures

General:

The item of the schedule for backfill around structures including pipe portions of structures includes all backfill required to be placed under these specifications.

Materials:

The type of material used for backfill, the amount thereof, and the manner of depositing the material shall be subject to approval of Engineer-in-Charge. In so far as practicable backfill material shall be obtained from material removed in required excavations for structures. But when sufficient suitable material is not available from this source, additional material shall be obtained from approved borrow-areas. The borrow pit excavation shall be in accordance with clause-9.1 to 9.3 of IS: 4701-1982.

Backfill material shall contain no stones larger than 80 millimeters in diameter. If the excavation for the foundation of the structure is in swelling soils, a layer of cohesive non-swelling soil conforming to I.S.9451-1980 should be interposed between the swelling soil of the structure and compacted to at least 95% standard proctor's density.

Placing Backfill:

Backfill shall be placed to the lines and grades shown on the drawings as prescribed in this paragraph or as directed by the Engineer-in-Charge. All backfill shall be placed carefully and spread in uniform layers not exceeding 150 mm, so that all spaces about rocks and clods will be filled. Each layer shall be watered and well compacted before the succeeding layer is laid, care being taken not to disturb the constructed structure. Backfill shall be brought up as uniformly as practicable on both sides of walls and all sides of structure to prevent unequal loading. Backfill shall be placed to about the same elevation on both sides of the pipe positions of the structures to prevent unequal loading and displacement of the pipe.

Measurement and Payment:

Excavation refill required to be placed about structures that is within the pay line limits

for excavation for the structures, will be measured in place for payment as backfill about structure provided that where the contractor elects not to excavate material which is outside the limits of the actual structure or pipe, but within the pay line limits of excavation, all such material will be included in the measurement for payment of backfill. The unit price bid therefore in the Bill of quantities for excavation of foundation of structure shall include cost of backfilling above the structure up to ground level. No separate payment will be made for backfill of foundation.
Refill of excavation performed outside the established pay lines for excavation for structures shall be placed in the same manner as specified for the adjacent backfill and such refill shall be placed at the expense of the contractor.

DIVISION-4
MASONRY

MATERIALS:
Stone for Masonry:
General:
The stones used for stone masonry shall conform to the relevant specifications of Clause 10 of IS: 1597 (Part-I) 1967 code of practice for construction of stone Masonry Part-I Rubble Stonemasonry.
The stone of the required quality shall be obtained from the quarries specified in the lead chart appended to the Schedule. The common types of natural stones which are generally used are Granite and other ingenious rocks, and shall be free from defects like decay, cavities, cracks, flaws, sand, holes, soft seams, veins, and patches of soft or loose materials or any other deleterious materials like iron oxide Organic Impurities etc. They shall be free from rounded, worn or weathered surfaces or skin or coating which prevents the adherence of mortar. All stones used shall be clean of uniform color and texture, strong, hard and durable.
The percent of water absorption shall not exceed 5% by weight as determined in accordance with IS: 1124-1974.
The approval of the quarries by the Engineer-in-Charge shall not be constructed as constituting approval of all or any of the stones collected from the deposits; and the bidder will be held responsible for suitability of the stones used in the work.
Cost:
The cost of collecting the stones for masonry will not be paid for separately and their cost including the cost of quarrying, transporting, stacking, royalty Seignorage charges shall be included in the unit price per cubic meter bid there for in the relevant item in the bill of quantities.

4.1.2 Brick for Masonry

(a) General:
Bricks used for brick masonry shall conform to the relevant specifications of I.S. 1077-1986 common burnt clay building bricks.

Bricks shall be hand or machine moulded. They shall be sound, hard, and homogeneous in texture well burnt and shall give a clear ringing sound when struck. They shall be clean, free from warping, distortion, cracks, chips, flaws, stones and nodules of free lime. Unless otherwise specified the sizes of the bricks shall be 190 x 90 x 90 mm. The compressive strength shall not be less than 40 Kg/Cm^2. The percentage of water absorption shall not be more than 20 per cent by weight after 24 hours immersion in cold

water.

(b) **Cost:**

The cost of collecting the bricks for masonry will not be paid for separately and their cost including the cost of transporting, stacking, royalty Seignoragecharges shall be included in the unit price per cubic meter bid therefore in the relevant item in the bill of quantities.

4.1.3 Sand for Masonry:

(a) General:

Sand shall generally conform to specifications given in paragraph 6.2.5 except that the sand for mortar shall conform to the grading of sand given in clause 4 of I.S.2116 -1189 as detailed below in Table 4(b).

(b)Grading of Sand for use in Masonry Mortars:

Table 4 :

I.S Sieve Designation	**Percentage passing by Mass**
4.75 mm	100
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

A sand whose grading falls out-side the specified limits due to excess or deficiency of coarse or fine particles may be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable size and particles.

The procurement of sand for masonry shall confirm to the specifications given in paragraph 6.2.5.

Cost:

The cost of sand for masonry will not be measured and paid separately and the cost of sand including the cost of stripping, transporting and storing and royalty charges shall be included in the unit price per cubic meter bid there for in the relevant item of work in the bill of quantities for which this and is required.

4.1.4Cement:

General:

As per clause 4 of I.S. 456-1978 for the purposes of these specifications, cement used shall be any of the following with the prior approval of the Engineer-in-Charge Ordinary Portland (OPC) – GRADES 43 & 53 Conforming to BIS : 811 : 12269 respectively (or) Portland Pozzolanacement conforming to I.S. 1489 relevant amendments up to date. The provisions of this paragraph apply to cement for use in cast-in-place concrete required under these specifications. Portland cement required for items such as concrete pipes, precast concrete structural members and other precast concrete products, for grout and mortar and for other item is provided for in the applicable paragraphs of these specifications covering the items for which such Portland cement is required.

4.1.5Water

The water used in making and curing of concrete, mortar and grout shall be free from

objectionable quantities of silt, organic matter, injurious amounts of oils, acids, salts, and other impuritiesetc., as per I.S. specification No.456-1978. The Engineer-in-Charge will determine whether or not such quantities of impurities are objectionable.

Such determination will usually be made by comparison of compressive strength, water requirement, time of set and other properties of concrete made with distilled or very clean water and concrete made with the water proposed for use. Permissible limits for solids when tested in accordance with IS: 3025-1964 shall be as tabulated below.

Permissible limit for Solids:

		Maximum permissible limit	
1.		200	Mg/liter
	Organic		
2.		3000	mg/liter
	Inorganic		
3.		500	mg/liter
	Sulphates(asSO_4)		
4.		2000	mg/liter for plain concrete work and
	Chlorides (asCL)		
		1000	mg/liter for R.C.C. work
5.		2000	mg/liter
	Suspended matter		

If any water to be used in concrete, mortar or grout is suspected by the Engineer-in-Charge of exceeding the permissible limits of solids, samples of water will be obtained and tested by the Engineer-in-Charge in accordance with I.S. 3025-1964.

4.2MORTAR

4.2.1**Preparation of Mortar**:

Unless otherwise specified, the cement mortar used in Masonry works shall be cement mortar mix MM5 (1:5) grade using minimum 288 Kgs. of cement per cubic meter of mortar.

Mixing shall be done thoroughly preferably in a mechanical mixer. In such cases, the cement and sand in the specified proportions shall be mixed dry thoroughly in the mixer operated manually or by power.

Water shall be added gradually and wet mixing continued at least for 3 minutes. Water should not be more than that required for bringing the mortar to the required working consistency of 90 to 130 millimeters as required in clause 9.11 of I.S. 2250-1981. The mix shall be clean and free from injurious kind of soil, acid, alkali, organic matter or deleterious substances.

4.2.2**Time of use of Cement Mortar:**

Cement mortar shall be used as soon as possible after mixing and before it has begun to set, within 30 minutes after the water is added to the dry mixture.

Mortar unused for more than 30 minutes should not be used and shall be removed from the site of work. The cost of such wasted mortar shall be borne by the bidder. The use of retempered mortar will not be permitted to be used for the masonry.

4.2.3**Tests of Mortar:**

Mortar Test cubes shall be cast for the mortar used on the work and shall be tested in

accordance with Appendix-A of I.S.2250-1965 code of practice for preparation and use of Masonry Mortars. Such cubes shall develop a compressive strength of at least 50 Kgs/square centimeter for MM5 (1:5) Grade cement mortar mix, 75 Kgs/square centimeter for MM 7.5 (1:4) grade cement mortar mix and 30 Kgs/ square centimeter for MM-3 grade cement mortar mix.
Mortar not conforming to the specifications will be rejected, and the cost of such wasted mortar shall be borne by the bidder.

4.2.4**Measurement and Payment:**
Cement Mortar will not be measured and paid separately and its cost, including cost of materials, transporting and placing shall be included in the unit price per cubic meter bid therefore in the bill of quantities of the contractor for the relevant finished item of work or which cement mortar mix mentioned in the above paragraph is required.
4.2.5**Dismantling of Structures:**
During course of excavation of drainage works certain dismantling of brick masonry/ R.R. Masonry retaining walls in CM C.C M10 grade leveling course are to be carried out. These have to be carried out as specified under Provisions of KDSS, and as per directions of Engineer-in-Charge and site cleared before facing up actual execution.

DIVISION-5
PLASTERING & POINTING
5.1 SECTION –MATERIALS:
Sand for Mortar for Plastering and Pointing:
General:
The sand for preparation of Mortar for plastering and pointing shall confirm to the following gradation, shown in Table 5(A).
TABLE 5 (A)
REQUIREMENTS OF GRADING FOR SANDS FOR EXTERNAL PLASTERING AND RENDERING

I.S.	Percentage by weight passing I.S., Sieve		
	SIEVE		
	Designation	Class – A	Class - B
	4.75 MM	100	100
	2.36 MM	90 to 100	90 to 100
	1.18 mm	70 to 100	70 to 100
	600 Microns	40 to 85	40 to 95
	300 Microns	5 to 50	10 to 65
	150 Microns	0 to 10	0 to 10

For the purpose of indicating the suitability for use, the sand is classified as Class A and Class B in accordance with the limits of grading. Class ‘A’ sands shall be used generally

for plastering and pointing, and when they are not available, Class 'B' sands may be used with the approval of Engineer-in-Charge.

The procurement of sand for Mortar for plastering and pointing shall conform to the specifications given in paragraph 6.2.5.

Cost:

The cost of sand for mortar for plastering and pointing will not be measured and paid separately, and the cost of sand including the cost of stripping, transporting and storing and royalty charges shall be included in the unit price per Cubic meter bid there for in the relevant item of work in the Schedule 'A' for which this sand is required.

5.1.3**Cement:**

The specifications and conditions specified for supply for cement in paragraph 4.1.4 shall be applicable here also.

Portland pozzolana cement conforming to I.S. 1489-1976 shall be used for preparation of mortar for plastering and pointing work. Ordinary Portland cement – Grades 43 & 53 may also be used in the event of non-availability of P.P.C.

5.1.4**Water:**

The specifications and conditions specified for procurement of water in paragraph 4.1.5 shall be applicable here also.

5.2 SECTION –MORTAR:

Preparation of Mortar for Plastering work:

Unless otherwise specified, the cement mortar used in plastering work shall be in cement mortar mix of MM. 7.5 (1:4) grade, using minimum 360 Kgs. of cement per cubic meter of mortar.

The other specifications and conditions enunciated in paragraph 4.2.1 shall apply for this mortar for plastering work also.

5.2.2 **Preparation of Mortar for Pointing:**

The cement mortar used in pointing work shall be cement mortar mix of M.M 7.5 grade, using 480 Kgs. of cement per cubic meter of mortar.

The other specifications and conditions enunciated in paragraph 4.2.1 shall apply for this mortar for pointing work also.

5.3 SECTION – PLASTERING WITH CEMENT MORTAR MIX. MM 7.5 GRADE 20 MM THICK:

5.3.1**Preparation ofSurface:**

The roughening of the background improves the bond of plaster. All joints shall be thoroughly raked. After roughening the surface, care shall be taken to moisten the surface sufficiently before plastering as otherwise rashly exposed surface may tend to absorb considerable amount of water from the plaster. The surface shall be wetted evenly before applying the plaster. Care shall be taken to see that the surface is not too dry as this may cause lack of adhesion or excessive suction of water from the plaster. A fog spray may be used for this work. As far as possible, the plaster work shall be doneunder shade.

5.3.2**Laying of Plastering with Cement Mortar Mix MM.7.5 grade 20 mm thick:**

The mortar used for plastering shall be stiff enough to cling and hold when laid. To ensure even thickness and true surface, plaster shall be applied in patches of 150 mm x150 mm of neither the required 20 mm thickness at nor more than 2 meters intervals horizontally and vertically over the entire surface to serve as guides. The surface of these guides shall be truly in the plane of the furnished plaster surface and truly plumb. The mortar shall then be applied to the surface to be plastered between the guides with a trowel. Each trowel full of mortar shall overlap and sufficient pressure shall be used to force it into thorough contact with the surface. On relatively smooth surfaces, the mortar shall be dashed on with the trowel to ensure adequate bond. The mortar shall be applied to a

thickness slightly more than that specified, using a string, stretched out between the guides. This shall then be brought to a true surface by working with a long wooden float with small sawing motion. The surface shall be periodically checked with a string stretched across it. Finally the surface shall be rendered smooth with a small wooden float, over working shall be avoided. All corners, arises, and junctions shall be brought truly to a line with any necessary rounding or chamfering.

If it is necessary to suspend the work at the end of the day, it shall be left in a clean horizontal or vertical line not nearer than 150 millimeters for any corner or arises or on parapet tops or on copings etc. When recommending the work, the edges of the old work shall be scraped clean and treated with cement slurry before the new plaster is laid adjacent to it. After the first coat is done, it shall be kept undisturbed for the next 24 hours and thereafter kept moist and not permitted to dry until the final rendering is applied.

After the plaster has sufficiently hardened cement slurry with cream like consistency shall be applied as thinly and evenly and rubbed to a fine condition.

The finished surface shall be cured with water for a period of 10 days.

5.4 SECTION – POINTING TO STONE MASONRY WITH CEMENT MORTAR MIX MM.75 GRADE

The joints in the masonry shall be raked out to a depth not less than the width of the joint or as directed when the mortar is green. Joints are to be brushed clean of dust and loose particles with a stiff brush. The area shall then be washed and the joints thoroughly wetted before pointing is commenced.

5.4.2**Flush Pointing with Cement Mortar Mix MM. 7.5 Grade for Rubble Masonry:**

The pointing to be done shall be flush pointing with cement mortar mix MM. 7.5 grade. The mortar shall be pressed into the raked-out joints according to the types of pointing required. The mortar shall not be spread over the corners, edges or surface of the masonry. The pointing shall then be finished as detailed below. The mortar shall be finished off flush and level with the edges of the stones, so as to give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge.

The pointing shall be cured for seven days.

5.5 SECTION – MEASUREMENT AND PAYMENT:

Plastering:

The measurement of plastering will be in units of square meters, and it shall be paid at the relevant unit price bid per ten square meters of Plastering in the schedule Bill of Quantities which unit price shall include the cost of materials, their conveyance, charges for preparation of mortar including mixing charges and charges for performing the plastering work as illustrated in this division, including curing.

Pointing:

The measurement for pointing will be in units of square meters, and it shall be paid at the relevant unit prices per ten square meters bid in the schedule Bill of quantities which unit price shall include the cost of materials, their conveyance, charges for preparation of mortar including mixing charges and charges for performing the pointing work as illustrated in this division, including curing.

DIVISION-6
CONCRETE

6.1CONCRETESTRUCTURES:

6.1.1**ConcreteStructures:**

(a) Concrete in structures shall conform to the requirements of Paragraph6.2

(b) Measurement and payment for concrete in structures will be made as prescribed in paragraphs6.3 &6.4.

6.1.2**Construction ofStructures:**

Cast-in-place concrete for the structures shall conform to the requirements of section. The structures shall be built to the lines, grades and dimensions shown on the drawings. The dimensions of each structure as shown on the drawings will be subject to such modifications as may be found necessary by the Engineer-in-Charge to adopt the structure to the conditions disclosed by the excavation or to meet other conditions. Where the thickness of any portion of a concrete structure is variable, it shall vary uniformly between the dimensions shown.

Where necessary, as determined by the Engineer-in-Charge, the Contractor will be furnished additional detailed drawings of the structures to be constructed. The bidder will not be entitled to any additional allowances above the prices bid in the schedule by reason of the dimensions fixed by the Engineer-in-Charge or by reasons of any modifications or extensions of a minor character to adopt a structure to a structure at site, as determined by the Engineer-in-Charge.

The cost of furnishing all materials and performing all work for installing timber, metal and other accessories for which specific prices are not provided in the schedule, shall be included in the applicable prices bid in the schedule for the work to which such items are appurtenant.

6.2 GENERAL CONCRETEREQUIREMENTS:

6.2.1**Composition:**

(a) General:

Concrete shall be composed of cement, sand, coarse aggregate, water and admixtures (if any) as specified, all well mixed and brought to the proper consistency.

(b)Nominal maximum size of Aggregates:

In coarse aggregates to be used in concrete shall be as large as practicable, consistent with required strength, spacing of reinforcement and embedded items, and placement thickness. The size of the coarse aggregate to be used will be determined by the Engineer-in-Charge and may vary incrementally according to the conditions encountered in each concrete placement. Nominal maximum size of aggregate for concrete in structures shall be as indicated in the relevant drawings appended to the contract documents. Smaller coarse aggregate than specified shall be used where in the opinion of the Engineer-in-Charge that proper placement of concrete is impracticable with the size of the aggregate specified in the drawings.

Mix Proportions:

The proportions of various ingredients to be used in the concrete for different parts of the work will be established by proper mix design by the Engineer-in-Charge during the progress of the work. In proportioning concrete, the quantity of both cement and aggregate should be determined by mass as per clause 9.2 of I.S. 456 -1978, water shall be either measured by volume in calibrated tanks or weighted. All measuring equipment shall be maintained in a clean serviceable condition and their accuracy periodically

checked. Adjustments shall be made as directed to obtain concrete having suitable workability, impermeability, density, strength and durability without use of excessive cement. The acceptance or rejection of concrete shall be as per the acceptance criteria laid down in clause 15 of IS: 456-1978.

The mix design and average concrete strength shall be adjusted according to the cube strength test results conforming to clauses 14.2, 14.3, 14.4, 14.5 of I.S. 456-1978. The bidder shall not be entitled for any additional allowances above the prices bid in the schedule due to adjustments of the mix proportions.

The net water cement ratio exclusive of water absorbed by the aggregate shall be sufficiently low to provide adequate durability in concrete. The water-cement ratio for various grades of concrete shall be as determined and ordered by the Engineer-in- Charge.

Consistencies:

The slump of concrete at the placement shall be as follows: Reinforced Cement Concrete:

Sl. No.	**Placing Condition**	**Degree of Workability**	**Value of Workability**
1.	Concreting of lightly reinforced sectionswithout vibration or heavily reinforced sections with vibration	Medium	25 mm to 75 mm slump for 20 mm aggregate
2.	Concreting of heavily reinforced sectionwithout vibration	High	75 mm to 125 mm slump for 20mm aggregate

ii)

For plane concrete work, slump requirements mentioned in item - (i) above are applicable.

If the specified slump is exceeded at the placement, the concrete is unacceptable. The Engineer-in-Charge reserves the right to require lesser slump whenever concrete of such lesser slump can be consolidated readily into place by means of vibration specified by the Engineer-in-Charge. The use of any equipment which will not readily handle and place concrete of the specified slump will not be permitted.

To maintain concrete at proper consistency, the amount of water and sand batched for concrete shall be adjusted to compensate for any variation in the moisture content or grading of the aggregates as they enter the mixer. Addition of water to compensate for stiffening of the concrete after mixing but before placing will not be permitted. Uniformity in concrete consistency from batch to batch will be required.

6.2.2**ConcreteQuality Control Measuresand ConcreteQuality Assurance Test Programme.**

Concrete Quality Control Measures: The bidder shall be responsible for providing quality concrete to ensure compliance of the bid requirements.

Concrete Quality Assurance Programme: The concrete samples will be taken bytheDepartmental Engineers and its quality will be tested in the departmental laboratory as per the relevant Indian Standard Specifications IS: No. 516 -1959 and IS: 1199-1959.

Tests: The Government will obtain samples and conduct tests as specified in IS: 456 - 1978, IS: 1199-1959 and IS: 516-1959.

Test Facilities: The bidders shall furnish free of cost samples of all ingredients of

concrete for testing and obtain approval from the Engineer-in-Charge. He should also supply free of cost, the samples of all the ingredients of concrete for conducting the required tests.

6.2.3**Cement:**

General: Shall conform to paragraph 4.1.4.

6.2.4**Water:** Shall conform to paragraph4.1.5

6.2.5**Sand (Fine Aggregate):**

General:

The term sand is used to designate aggregate most of which passes 4.75 millimeter I.S. Sieve and contains only so much coarser material as permitted inClause4.3 of IS:383-1970. Sand shallbepredominantly natural sand which may be supplemented with crushed sand to make up deficiencies in the natural sand grading. All sand shall be furnished by the bidder from any source approved by Engineer-in- Charge.

Sand as delivered shall have uniform and stable moisture content. Determination of moisture content shall be made as frequently as possible, the frequency for a given job being determined by the Engineer-in-Charge according to weather conditions (IS: 456-1978).

Quality:

The sand shall consist of clean, dense, durable, un-coated rock fragments, as per IS: 383- 1970. Sand may be rejected if it fails to meet any of the following quality requirements. Organic impurities in Sand: Color no darker than the specified standard in clause 6.2.2 of

IS: 2386 (Part-II) 1963. (Indian Standard method of test for aggregates for clearance Part-II estimation of deleterious materials and organic impurities).

Sodium Sulphate Test for Soundness: The sand to be used shall pass a Sodium of Magnesium Sulphateaccelerated test as specified in I.S. 2386 (Part-V) 1963 for limiting loss of weight.

SpecificGravity: 2.6minimum

Deleterious Substances:

The amounts of deleterious substances in sand shall not exceed the maximum permissible limits prescribed in Table I Clause 3.2.1 of IS: 383 -1970 (Indian Standard specification for coarse and fine aggregate from natural sources for concrete when tested in accordance with IS: 2386-1963.

Grading:

The sand as batched shall be well graded and when tested by means of standards sieves shall conform to the limits given in Table-4 of I.S. 383-1970, and shall be described as fine aggregates, grading zones-I, II, III and IV. Sand complying with the requirements of any of the four grading zones is suitable for concrete. But, sand conforming to the requirements of grading Zone-IV shall not be used for reinforced cement concrete work.

6.2.6**Coarse Aggregate:**

General:

For the purposes of these specifications, the term “Coarse Aggregate” designates clean well grade aggregate most of which is retained on 4.75 mm I.S. Sieve containing only so much finer material as permitted for various types described under clause 2.2 of I.S 383-1970. Coarse aggregate for concrete shall consist of uncrushed, crushed and partially crushedstone.

Coarse Aggregate for concrete shall be furnished by the Contractor from the sources approved by the Engineer-in-Charge.

Coarse Aggregate as delivered shall generally have uniform and stable moisture content. In case of variations, clause 9.2.3 of IS: 456-1978 shall govern during batching.

Quality:

The Coarse aggregate shall consist of natural occurring (crushed or uncrushed) stones, and shall be hard, strong, durable, clear and free from veins and adherent coating, and free from injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious materials.

Coarse aggregate for concrete shall be separated into various nominal maximum sizes specified in the relevant drawings. Separation of the coarse aggregate into the specified sizes shall conform to the grading requirements specified in Table-2 of IS: 383-1970, when tested in accordance with IS: 2386-(Part-I) 1963 (Method of test for aggregates for concrete Part-I Particle size and shape).

Coarse aggregate for mass concrete may be separated as previously herein specified. Separation of the coarse aggregate into the various sizes shall be such that when tested in accordance with IS: 2386 (Part-I) 1963 shall conform to the requirements specified in Table-3 of IS: 383-1970.

Sieves used in grading tests will be standard mesh sieves conforming to IS: 460 (Part-I)– 1978 (Specification for test sieves Part-I wire cloth test sieves).

6.2.7**Mixing:**

General:

The concrete ingredients shall be thoroughly mixed in mechanical mixers designed to positively insure uniform distribution of all the component materials throughout the concrete at the end of the mixing period. Mixing shall be done as per clause 9.3 of IS: 456-1978. The mixer should comply with IS: 1971-1968 (I.S. Specifications for batch type concrete mixers).

The concrete as discharged from the mixer, shall be uniform in composition and consistency from batch to batch. Workability shall be checked at frequent intervals as per IS: 1199-1969. Mixers will be examined regularly by the Engineer-in-Charge for changes in conditions due to accumulation of hardened concrete or mortar or to wear of blades. The mixing shall be continued until there is a uniform distribution of the materials so that the mass is uniform in color and consistency and to the satisfaction of the Engineer-in-Charge. If there is segregation after unloading, the concrete should be remixed.

Any mixer that at any time produces unsatisfactory mix, shall not be used until repaired. If repair attempts are unsuccessful, a defective mixer shall be replaced. Batch size shall beat least 10% of, but not in excess of the rate capacity of the mixer unless otherwise authorized by the Engineer-in-Charge.

Concrete Mixers:

Water shall be admitted prior to and during charging of mixer with all other concrete ingredients. After all materials are in the mixer, each batch shall be mixed for not less than the time specified by the Engineer-in-Charge. The minimum mixing time shall be 2 minutes. The minimum mixing time specified is based on average mixer performance. The Engineer-in-Charge will adjust the minimum mixing time as required by the observations of the mix delivered from mixer. Excessive over mixing which require addition of water to maintain the required concrete consistency will not be permitted.

6.2.8**Forms:**

General:

Forms shall be used wherever necessary, to confine the concrete and shape it to the required lines. The bidder shall set and maintain concrete forms so as to insure completed work is within the applicable to clearance limits prescribed in clause 10 of

I.S 456-1978. If a type of form does not consistently perform in an acceptable manner, as determined by the Engineer-in-Charge, the type of form shall be changed and method of erection shall be modified by the bidder subject to approval by the Engineer-in-Charge. Plumb and string lines shall be installed before, and maintained during concrete placement. Such lines shall be used by the bidder's personnel and by the Engineer-in-Charge and shall be in sufficient number and properly installed as determined by the Engineer-in-Charge. During concrete placement, the bidder shall continuously monitor plumb, and string line, form positions and immediately correct deficiencies.

Forms shall have sufficient strength to with standthepressure resulting from placement and vibration of the concrete and shall be maintained rigidly in position. Where form vibrators are to be used, forms shall be sufficiently rigid to effectively transmit, energy, form the form vibrators to the concrete, while not damaging or altering the positions of forms. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Chamfer strips shall be placed in the corners of forms and at the top of walls placements to produce leveled edges on permanently exposed concrete surfaces. Interior angle of intersecting concrete surface and edges of construction joints shall not be leveled except where indicated on thedrawings.

Suitable struts or stiffeners or ties shall be used for the form work wherever necessary. All supports shall be braced and cross braced in two directions. All splices and braces shall be secured by bolting unless specially intended otherwise. All struts shall be firmly supported against settlement and slipping by suitable means as directed. All supports shall be cut square at both ends and firmly supported against settlement and slipping. When the form work is supported on soils, planks, sleepers etc., shall be used to properly disperse the loads. In case, the supports rest on already completed beam or slab, suitable props shall be provided under thelatter.

The form work shall be of well-seasoned timber or steel. When timber forms are used, they shall be lined with M.S sheet or other suitable smooth faced non-absorbent material as specified. Supports may be of timber or steel. Suitable wedges in pairs to facilitate adjustment and subsequent releasing of forms shall be provided preferably at the upper end of the supports. The details of the proposed form work and supports shall be submitted to the Engineer-in-Charge and got approved before erection.

In case of columns, retaining walls or deep vertical component, the height of the column shall facilitate any placement and compaction of concrete and suitable arrangement may be made for securing the form to the already poured concrete for placing the subsequent lifts. No steel ties or wires used for securing this form work shall be left exposed on the face of the finished work.

Suitable inserts for block outs for electrical and other service fixtures where necessary shall be provided in the required locations as specified.

Cleaning and Oiling of Forms:

At the time the concrete is placed informs, the surfaces of the forms shall be free from encrustation of mortar, grout or other foreign materials. Before concrete is placed, the surface of the forms shall be oiled with commercial forms of oil.

Removal of Forms:

The stripping of form work shall be conforming to clause 10.3 of I.S. 456 -1978. The bidder shall be liable for damage and injury caused by removing forms before the concrete has gained sufficient strength. Forms on upper sloping faces of concrete such as forms on the water sides of warped transitions, shall be removed as soon as the concrete has attained sufficient to prevent sagging. Any needed repairs or treatment required on such sloping surfaces shall be performed at once and be followed immediately by the specified curing.

To avoid excessive stresses in concrete that might result from swelling of forms, wood forms for wall openings shall be loosened as soon as the loosening can be accomplished without damaged to the concrete. Forms shall be removed with careso as to avoid injury to the concrete, and any concrete so damaged shall be repaired in accordance with paragraph 6.2.16.

Cost:

The cost of furnishing all materials and performing all work for constructing forms, including any necessary treatment or coating of forms shall be included in the applicable prices bid in the schedule for the items of concrete for which the forms are used.

6.2.9 **Concrete Surface Irregularities:**

Surface Irregularities:

General:

Bulges, depressions and offsets are defined as concrete surface irregularities. Concrete surface irregularities are classified as “abrupt” or “gradual” and are measured relative to the actual concrete surface.

Abrupt Surface Irregularities:

Abrupt surface irregularities are defined herein as offsets such as those caused by misplaced or loose forms, loose knots in form Lumber, or other similar forming faults. Abrupt surface irregularities are measured using a straight edge held firmly against the concrete surface over the irregularity and the magnitude of the offset is determined by direct measurement.

Gradual Surface Irregularities:

Gradual surface irregularities are defined here in as bulges and depressions resulting in gradual changes on the concrete surface. Gradual surface irregularities are measured using a suitable template conforming to the design profile of the concrete surface being examined. The magnitude of the gradual surface irregularities is defined herein as a measure of the rate of change in slopes of the concrete surface.

The surface irregularities shall not exceed 6 mm for bottom slab and12 mm for side slopes when tested with a straight edge of 1.5 meters in length. The magnitude of gradual surface irregularities on concrete shall be checked by the bidder to insurethat the surfaces are within the specified to tolerances. The Engineer-in-Charge will also make such checks to hardened concrete surfaces as determined necessary to ensure compliance with thesespecifications.

Repair of Hardened Concrete not within specified tolerance:

Hardened concrete which is not within specified tolerances shall be repaired to bring it within those tolerances. Such repair shall be in accordance with paragraph 6.2.16 and shall be accomplished in a manner approved by the Engineer-in-Charge. Concrete repair to bring concrete within the tolerances shall be done only after consultation with a representative of Engineer-in-Charge regarding the method of repair. The Government shall be notified as to the time when repair will be performed.

Concrete which will be exposed to public view shall be repaired in a manner which will result in a concrete surface with a uniform appearance. Grinding of concrete surface exposed to view shall be limited in depth such that no aggregate particles are exposed to view shall be limited in a depth such that no aggregate particles are exposed more than1.5 millimeters at the finished surface. Where grinding causes exposure of aggregate particles greater than 1.5 millimeters at the finished surface, Concrete shall be repaired by excavating and replacing the concrete.

Prevention of Repeated failure to meet tolerances:

When concrete placements result in hardened concrete that does not meet the specified tolerances, the bidder shall submit to the Government an outline of all preventive actions

such as modification to forms, modified procedure for setting screeds, and different finishing techniques to be implemented by the bidder to avoid repeated failures.
The Government reserves the right to delay concrete placement until the bidder implements such preventive actions which are approved by the Engineer-in-Charge.

6.2.10**Reinforcing Bars:**

General:

Reinforcing bars shall be placed in the concrete as shown in the drawings or as directed.

Materials:

Unless shown otherwise on the drawings, the reinforcement to be used shall be or High Yield strength deformed (H.Y.S.D) bars of grade Fe-415 conforming to IS: 1786-1979 (IS. Specifications for High Yield strength deformed steel bars and wires for concrete reinforcement).

Placing:

Reinforcement shall be bent and fixed in accordance with the procedure specified in I.S. 2502-1963 (code of practice for bending and fixing of bars for concrete reinforcement).
All reinforcement shall be placed and maintained in the position shown in the drawings; splices shall be located where shown on the drawings provided that the location of the splices may be altered subject to the written approval of the Engineer-in-Charge.
Subject to the written approval of the Engineer-in-Charge, the bidder may for his convenience, splice bars at additional locations other than those shown on the drawings. All additional splices allowed shall be at the expense of the bidder. In order to me et design and space limitation. On splicing, some bent bars may exceed usual clearance cutting and bending of such bars from stock lengths may be required at the site.
Unless otherwise prescribed, placement dimensions shall be to the center lines of the bars. Reinforcement will be inspected for compliance with requirements as to size, shape, length, splicing, position, and amount after it has been placed, but before being covered with concrete.
Before reinforcement is embedded in concrete, the surfaces of the bars and the surfaces of any supports shall be cleaned of heavy flaky rust, loose mill scale, dirt, grease or other foreign substances which in the opinion of the Engineer-in-Charge, are objectionable. Heavy flaky rust that can be removed by firm rubbing with burlap, or equivalent treatment is considered objectionable.
As specified in Clause 11.3 of IS: 456-1978 unless otherwise specified by the Engineer-in-Charge, reinforcement shall be placed within the following tolerances:
For effective depth 200 mm or less-$\pm$ 10mm
For effective depth more than299m-$\pm$ 15mm
The cover in no case be reduced by more than one third of specified over or 5 mm whichever is less.
Reinforcement shall be securely held in position so that it will not be displaced during the placing of the concrete and special care shall be exercised to prevent any disturbance of the reinforcement in concrete that has already been placed. Welding of bars shall be done as directed by the Engineer-in-Charge and in conformity with the requirements of clause 11.4 of IS: 456-1978. Chairs, hangers, spacers and other supports for reinforcement shall be of concrete, metal or other approved material. Concrete over shall be as shown on thedrawings.

Reinforcement Drawings:

The Government will supply drawings of reinforcement details and bar bending schedules for adoption.

Measurement and Payment:

Measurement for payment of reinforcement bars will be based on the weight of the bars

placed in the concrete in accordance with the drawings supplied by the Government when conformance with these specifications drawings has been determined at the time of embedment. Except as otherwise provided below, payment for furnishing and placing reinforcing bars will be made at the unit price per one kilogram bid in the bill of quantities for furnishing and placing reinforcing bars which unit price shall include the cost of reinforcing bars, attaching wire ties or other approved supports and of cutting, bending, cleaning, securing and maintaining in position reinforcing bars as shown on the drawings.

6.2.1 1**Preparation for Placing:**

General:

No concrete shall be placed until all form work, installation of items to be embedded, and preparation of surface involved in the placement have been approved.

All surfaces of forms embedded materials shall be free from curing compound, dried mortar from previous placement, and other foreign substances before the adjacent or surroundings concrete placement is begun.

Prior to beginning concrete placement, the bidder shall make ready, a sufficient number ofproperly operating vibrators and operators, and shall have readily available additional vibrators to replace defective ones during theprogressofthe placement. The Engineer's representative at the placement may require that thebidderdelaythestartof the concrete placement until the number of working vibrators available isacceptable.

Foundation Surface:

All surfaces upon or against which concrete is to be placed shall be free from frost, ice, water, mud anddebris.

Rock surfaces shall be free from oil, objectionable coatings, and loose, semidetached and unsound fragments. Immediately prior to placement of concrete, surfaces of rock shall be washed with an air water jet and shall be brought to a uniform surface dry condition.

Earth foundation surfaces shall be wet to a depth of 15 cm. or to impermeable material whichever is lessbefore concrete is placed.

Construction Joint:

Construction joints are defined as concrete surface upon or against which concrete is to be placed and to which new concrete is to adhere but which have become so rigid that the new concrete cannot be incorporated integrally which that previously placed. The provision of construction joints shall conform to clauses 12.4.1 and 12 .4.2 of I.S. 456-1978.

When the work has to be resumed on a surface which has hardened such surface shall be roughened. It shall be swept clean and thoroughly wetted. For vertical joints neat cement slurry shall be applied on the surface before it is dry. For horizontal joints the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry or mortar shall be freshly mixed and applied immediately before placing of the concrete.

Where the concrete has not fully hardened all balance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgment of particles of aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry. On this surface, a layer of concrete not exceeding 150 mm in thickness shall first be placed and shall be well rammed against old work, particular attention being paid to corners and close spots, and work thereafter shall proceed in the normal way.

6.2.12**Placing:**

General:

The Bidder shall notify the Engineer-in-Charge before batching begins for placement of concrete. Placing shall be performed only in the presence of an authorized Engineer's representative. Placement shall not begin until after all preparations are complete to the satisfaction of the Engineer-in-Charge.

All surfaces upon or against which concrete is to be placed shall be prepared in accordance with paragraph 6.2.11.

Retamperingof concrete will not be permitted. Any concrete which has becomes so stiff that proper placing cannot be assured shall be wasted.

Concretes shall not be placed in standing water except with written permission of the Engineer-in-Charge and the method of placing shall be subject to approval. Concrete shall not be placed in running water and shall not be subjected to running water until after the concrete has hardened.

Concrete shall be deposited as nearly as practical in its final position and shall not be allowed to flow in such a manner that the lateral movement will cause segregation of the coarse aggregate from the concrete mass. Methods and equipment employed in depositing concrete informs shall minimize clusters of coarse aggregate. Clusters that occur shall be scattered before the concrete is vibrated.

Forms shall be constantly monitored and their position adjusted as necessary during concrete placement in accordance with paragraph 6.2.8.

All concrete shall be placed in approximately horizontal layers. The depth of layers shall not exceed 25 cm. The Engineer-in-Charge reserves the right to require lesser depths of layers where concrete cannot otherwise be placed and consolidated in accordance with the requirements of these specifications. All construction joints which intersect exposed concrete surface shall be made straight and level to plumb as shown otherwise on the drawings.

The placing of concrete shall be in accordance with clause 12.2 of I.S.456-1978.

If concrete is placed monolithically around openings havingvertical dimensions greater than 60 cm. or if concrete in decks, floor slabs or other similar parts of structures is placed monolithically with supporting concrete, the following requirements shall be strictly observed.

Concrete shall be placed up to the top of the formed openings at which point further placement will be delayed to accommodate settlement of fresh concrete. If levels are specified beneath nearly horizontal structural members such as decks, floor slabs, beams and girders, such bevels being between the nearly horizontal members and the vertical supporting concrete below, concrete shall be placed to the bottom of the levels before delay of placement.

The last 60 cm or more of concrete placed below horizontal members of levels shall be placed with a 50 mm or less slump and shall be thoroughly consolidated.

In placing concrete on unformed slopes so steep as to make internal vibration of the concrete impractical without forming, the concrete shall be placed ahead of non- vibrating slip form screed extending approximately 0.75 meters back from its leading edge. Concrete ahead of the slip form screed shall be consolidated by internal vibrators so as to insure complete filling under the slip form.

A cold joint is an unplanned joint resulting when a concrete surface hardens before the next batch is placed against it. Cold joints will be allowed only in the event of equipment breakdown or other unavoidable prolonged interruption of continuous placing. If such unavoidable delays in placing occur which make it appear that unconsolidated concrete may harden to the extent that alter vibration will not fully consolidate it, the Bidder shall

immediately consolidate such concrete to a stable and uniform slope. If delay of placement is then short enough to permit penetration of the underlying concrete, placement shall resume with particular care being taken to thoroughly penetrate and reverberate the concrete surface placed before the delay. If concrete cannot be penetrated with vibrator, the cold joint shall be then treated as a construction joint.

Care shall be taken to prevent cold joints when placing concrete in any part of the work. The concrete placing rate shall insure concrete is placed while the previously placed adjacent concrete is plastic so that the concrete can be made monolithic by normal use ofvibrators.

Concrete shall not be placed in rain sufficiently heavy or prolonged to wash mortar from concrete. A cold joint may neccessary result from prolonged heavy rainfall.

Thebiddershallnot been titled to any additional payment, over the unit prices bidintheschedulefor concrete, by reason of any limitation in the placing of concrete required undertheprovisions of thisparagraph.

Transportation:

The transportation of concrete shall confirm to clause 12.1 of I.S.456-1978.

Consolidation:

The consolidation of concrete shall conform to clause 12.3 of I.S. 456 -1978

Concrete shall be consolidated by vibrators. The vibration shall be sufficient to remove the undesirable air voids from the concrete, including the air voids trapped against the forms. After consolidation, the concrete shall be free of rock pockets and honey bomb areas and shall be closed snugly against all surfaces of forms and embedded materials. All concrete shall be properly consolidated before it hardens.

Except as hereinafter provided, consolidation of all concrete shall be by immersion type vibrators. Immersion type vibratorsshall be operated in nearly vertical position and the vibrating head shall penetrate and reverberate the concrete in the upper portion of the underlying layer. Care shall be exercised to avoid contact of the vibrating head with embedded items and with formed surfaces which will later be exposed to view. Concrete shall not be placed upon either plastic concrete until the previously placed concrete has been thoroughly consolidated.

6.2.13**FinishedandFinishing:**

The requirements for finishing of concrete surface shall be as specified in this paragraph, paragraph 6.2.9 or as otherwise indicated on the drawings. The bidder shall notify the Engineer-in-Charge before finishing concrete. Unless inspection is waived, in each specific case, finishing of concrete shall be performed only when an Engineer's representative is present. Finished concrete which is not within the specified tolerances shallberepaired in accordance with paragraph6.2.16.

Interior surface shall be sloped for drainage where shown on the drawings or as directed. Surfaces which will be exposed to the weather, and which would normally be level, shall be sloped for drainage.

Floating may be performed by use of hand or power driver equipment. Floating shall be started as soon as the screeded surface has stiffened sufficiently and shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Joints and edge shall be tooled where shown on the drawings or as directed.

6.2.14 **Protection:**

The bidder shall protect all concrete against damage until final acceptance by the Engineer-in-Charge.

The Bidder shall provide protection to prevent erosion to fresh concrete whenever precipitation either periodic or sustaining is imminent or occurring.

When precipitation appears imminent, the bidder shall immediately make ready at the placement site all materials, which may be required for protection of fresh concrete. The Engineer-in-Charge may delay placement of concrete until adequate provisions for protection against weather are made.

All fresh concrete surfaces shall be protected from contamination and from foot traffic until the concrete has hardened. Hardened concrete surfaces which have to receive finish shall be protected against damage from foot traffic and other construction activity by covering with protective mats, ply-wood, or by other effective means. Methods of protection shall be subject to approval by the Engineer-in-Charge.

Concrete curing membranes shall be kept intact and other curing materials and process shall be maintained as necessary to assure continuous curing for a minimum specified curing time. Protection of curing membranes and other curing methods shall be as described in paragraph 6.2.15.

Curing:

General:

The Bidder shall furnish all materials and perform all work required for curing concrete. The curing of concrete shall conform to clause 12.5 to I.S. 456 -1978 and clause 5.8 to IS: 3873 –1978.

Concrete shall be cured by water curing.

The unformed top surfaces of bridges or culvert decks shall be cured for 28 days with damp sand cover or curing mat cover. The sand or curing mats shall not be kept so wet as to allow water to drain from them and stain other concrete. The sand or curing mats shall be removed after the expiry of the curing period.

All concrete surfaces shall be treated as specified to prevent loss of moisture from the concrete until the required curing period elapsed or until immediately prior to placement of other concrete or back fill against those surfaces. Only sufficient time to prepare construction joint surfaces and to bring them to a surface dry condition shall be allowed between discontinuance of curing and placement of adjacent concrete.

Forms shall be removed within 24 hours after the concrete has hardened sufficiently conforming to clause 10.3 of I.S. 456-1978, to prevent structural collapse or other damage by careful from removal. Where required, repair of all minor surface imperfections shall be made immediately after form removal and prior to curing. Minor surface repair shall be completed within 2 hours after from removal and shall be immediately followed by the initiation of curing by the applicable method specified herein. Concrete surfaces shall be kept continuously moist after from removal until initiation of curing.

Materials:

Concrete cured with water shall be kept wet for at least 28 days from the time the concrete has obtained sufficient set to prevent detrimentaleffects to the concrete surfaces. The concrete surfaces to be cured shall be kept wet by covering them with water-saturated material by using a system of perforated pipes, mechanical sprinklers or porous-hose, or by other methods which will keep all surfaces continuously (not periodically) wet. All curing methods are subjected to approval of Engineer-in-Charge.

Cost:

The cost of furnishing all materials and performing all work for curing concrete shall be included in the price bid in bill of quantities for the concrete on which the particular curing methods are required.

Repair ofConcrete:

General:

Concrete shall be repaired in accordance with clause 5.7 to IS: 3873 -1978. Imperfections and irregularities on concrete surface shall be corrected in accordance with paragraph

6.2.9 and clause 5.7of IS: 3873 -1978.

Types of Repair:

All repairs shall be made with concrete. Repairs to concrete surfaces and addition were required shall be made by cutting regular opening into the concrete and placing fresh concrete to the required lines. The chipped openings shall be sharp and shall not be less than 70mm in depth. The fresh concrete shall be reinforced and chipped and trawled to the surface to the surface of the openings. The mortar shall be placed in layers not more than 20 mm in thickness after being compacted and each layer shall be compacted thoroughly. All exposed concrete surfaces shall be cleaned of impurities, lumps of mortar or grout and unsightly stains.

Cost:

The cost of furnishing all materials and performing all work required in the repair of concrete shall be borne by the Bidder.

6.3 Measurement of Concrete:

Measurement for payment of concrete required to be placed directly upon or against surfaces of excavation will be made to the lines for which payment for excavation is made.

Measurement for payment of all concrete will be made to the neat lines of the structures, unless otherwise specifically shown on the drawings prescribed in these specifications. The unit of measurement will be cubic meter. In measuring concrete for payment, the volume of all openings, embedded pipes and metal work, each of which is larger than 0.1 square meter in cross section will be deducted.

6.4 Payment for Concrete:

Payment for concrete in the various parts of the work will be made at the applicable, unit prices bid therefore in the schedule, which unit price shall include the cost of furnishing all materials and performing allworksrequiredfor the concrete construction, except that payment for furnishing and placing reinforcing bars will be made at the respective unit prices bid therefore in theschedule.

DIVISION-7
MATERIALS REQUIRED FOR PIPELINE WORKS

7.1 Pipes:

The Pipes required to be supplied for the works shall conform to the following I.S. specifications depending upon the nature of material for pipe specified in the bid document.

IS: 1592 of 1980 for A.C. Pressure Pipes.
IS: 458 of 1988 for R.C.C. Spun Pipes.
IS: 1536 of 1976 for C.I. Spun Pipes.
IS: 7181 of 1986 for C.I. double flanged pipes.
IS: 8329 – 2000 for D.I K9/K7 pipes.
IS: 4984 – 1995 for HDPE pipes.
IS: 3589-2001 for M.S. pipes.

The pipes supplied shall be subjected to all the tests specified in the relevant I.S. specifications before delivering at site and the manufacturer's test certificate to this effect shall accompany each consignment delivered at site. In addition, the pipes shall be got tested by the Inspectorate of Director General of Supplies and Disposals at the manufacturer's factory site and the relevant test certificate shall also be produced along with each consignment. The charges for conducting the tests shall be borne by the bidder only and these charges are not reimbursable by the employer. For PSC pipes the test

indicated in clause of IS: 784-59, 458-88 and 3597-85 are to be followed.
A list of firms that are on the approved list of suppliers to the Department will be supplied on request. The bidder is at liberty to procure the pipes from any of the firms in the approved list of suppliers but the responsibility for the pipes conforming to the relevant IS. Specifications shall solely rest with the bidder only.
The bidder's rates for relevant items shall include not only the cost of pipes and taxes thereon and testing charges but also the charges for transportation to site and all subsequent handling and other incidental charges.

7.2 Cast-Iron-Specials:

7.2.1 The C.I. specials to be supplied for use on the work shall conform to I.S. 1538 of 1976.

7.2.2 The M.S. special required for use on P.S.C. pipes are to be manufactured as per IS: 1916 – 63the material for manufacture of M.S. specials should continue to IS: 226-75, 2062-80.

7.2.3 The caste-iron specials required onthejob are indicated in the relevant plans contained in Vol-IV of bid documents. While sufficient care is taken by the Employer to furnish as accurately as possible the specials required, the bidder is advised to inspect the alignments and satisfy himself about the sufficiency or otherwise of the special indicated, before quoting for the work. Any additional specials required on the work not arising out of any changes made by the employer in terms of Section 2, CI. 28.1 of Vol.1 shall be provided by the bidder at no extra cost.

7.2.4 A list of firms which are on the approved list of suppliers to the Department will be issued on request. The bidder is at liberty to procure the specials from any of the firms in the approved list of suppliers but the responsibility for the specials conforming to the relevant I.S. specifications shall solely rest with the bidder only. The other conditions contained in paragraphs 7.1 above shall be applicable to the C.I.specials also.

7.3 SluiceValves:

The C.I. sluice valves to be supplied for use on the work shall conform to I.S. 780 of 1969 and I.S. 2906 of 1969 and contain the I.S. certification mark. The valves shall be of non-rising inside screw type; provided with C.I. cap or wheel as the case may be and valve key rod.
The other conditions contained in paragraphs above shall be applicable to the sluice valves also.

7.4 AirValves:

7.4.1.The air valves to be supplied for use on the work shall conform to the description of air valves maintained in Section B of Glenfied and Kennedy catalogue for water works purposes unless otherwise specified; only double air valves shall be supplied and installed on the pipe lines.
The size of valve to be used shall be related to the diameters of pipelines as indicated below:

Diameter of Pipe (in mm)	Size of A.V. to be use (in mm)
Up to 100	40
125 to 200	50
225 to 350	80
400 to 500	100
600 to 900	150

1000 to 1200	200

7.4.2 The other conditions contained in paragraphs 7.1.4. shall beapplicable to the air valves also.

7.5 C.I. DetachableJoints:

The C.I. detachable joins to be supplied for jointing A.C. – pressure pipes shall conform to IS: 8794 of 1988.

A list of firms which are on the approved list of suppliers to the department is given in Appendix 'C'. The bidder is at liberty to procure the C.I. detachable joints from any of the firms in the approved list of suppliers, but the responsibility for their conformity to the I.S. Specifications and giving a water tight joint shall solely rest with the bidder only. The other conditions contained in paragraphs 7.1 shall be applicable to the C.I. detachable joints also.

7.6 RubberRings:

The rubber rings to be used for the jointing of various types of pipes shall conform to the following I.S. Specifications.

IS: 5382of1969:For C.I. Pipes, R.C.C. Pies, and A.C. Pipes withC.I.D. joints.
IS: 10292of 1986:For A.C. pipe with A.C. Couplings.
IS: 5382of2000:For D I. Pipes.
IS: 5382of1969:For P.S.C Pipes

7.7 PigLead:

The Pig Lead to be used for jointing the C.I. Spun Pipes shall conform to I.S. 782 of 1978.

7.8 Hemp Yarn:

The Hemp Yarn to be used in jointing of various types of pipes shall conform to I.S. 6587 of 1966.

7.9 RubberInsertion:

The Rubber Insertion to be used for jointing Cast - Iron double flanged pipes shall conform to I.S. 638 of 1955.

7.10 Bolts and Nuts:

The Bolts and Nuts to be used for jointing the C.I. double flanged pipes shall conform to I.S. 1363-1967.

7.11C.I. Surface Boxes:

The C.I. Surface boxes to be used shall conform to I.S. 3950 -1966.

7.12C.I. Manhole Frames andCovers:

The C.I. Manhole frames and coves to be used shall conform to I.S. 1726 of 1974.

DIVISION -8
LAYING AND JOINTING OF PIPE LINES

8.1 Pipes

The contract envisages civil works namely excavation of earth, laying, jointing and testing of pipelines and construction of masonry pits including fixing of valves such as sluice valves, scour valves, double air valves and surface boxes and auxiliary specials required for different types of pipe viz., A.C. pressure pipes, concrete pipes with socket and spigot ends and C.I. spun pipes with socket and spigot ends of flanged ends of different dia.

8.2 Materials:

The materials used shall conform to the relevant specifications mentioned in Division-7. The surplus materials if any, left over due to additional purchase against possible breakages etc. will not be takeover by the department and payment will be restricted to the materials actually used on work.

8.3 Trench Work:

The trenches shall be so dug that the pipes may be laid to the required alignment gradient and depth. The width of trench above pipeline level shall be as small as possible but provide sufficient space necessary for jointing pipes. The walls of trenches shall be cut according to the slopes mentioned in relevant I.S. specifications. The trenches shall be kept free from water while laying and jointing the pipes and specials.
The relevant clauses that govern the trench work and preparation of base for laying of various types of pipes are as detailed below:
A.C. Pressure pipe-Clause 4 of IS: 6530of1972.
R.C.C. pipes-Clause 9 of IS: 783of1959.
C.P. pipes and D.I. Pipes. P.S.C. pipes– Clause 3 of IS:783-85

8.4 Handling and LayingofPipes:
Reasonable care shall be exercised in Loading, Transporting and Unloading of pipes and specials. The pipes shall be lowered into the trench carefully and shall be laid true to alignment and gradient as specified and as per instructions of the Engineer-in-Charge. The sections of the pipe shall be jointed together in such a manner that there shall be as little unevenness as possible a long inside of the pipes. Necessary precautions shall be taken while laying as per the relevant I.S. specifications for the type of pipes used, as mentioned below:
A.C.PressurePipes– Clause 5 of IS 6530 of1972.
R.C.C. Pipes– Clause 9 of IS 783 of1959.
C.I. Pipes & D.I. Pipes – Clause 3 of IS 3114 of 1965.
PSC Pipes- Clause 9 of IS 783 of 85
MS Pipes- IS 5822 of1994

8.5 Jointing:
Before commencing jointing, the pipes shall be cleaned; the joints and the ends of the pipes shall be cleaned, preferably with a hard wire brash to remove loose particles. Where jointing is done using rubber ring, care should be taken to see that the rubber ring does not get twisted or deformed while pushing the ring into position. The jointing for various types of pipes shall conform to the requirements of the relevant I.S. specifications as detailed below:
1. A.C.PressurePipes Clause 6 of I.S. 6530 of1972.
2. R.C.C.Pipes Clause 10 of I.S. 783 of1959
3. C.I.pipes &D.I. Pipes Clause 5 of I.S. 3114 of1965.
4. PSCPipes Clause 10 of I.S. of 1985.
5. I.S. 12709 – 1994 for G.R.P. pipes.
6. I.S. 4984 – 1995 for HDPE pipes.
7. I.S. 5822 – 1994 for MSpipes.

8.6 Anchor and Thrust Blocks:
Thrust blocks, suitably designed shall be provided wherever necessary to transmit hydraulic pressure as laid down in the relevant I.S. specification. Where the hydraulic thrust is in an upward direction, anchor blocks of sufficient weight shall be provided, to which the pipes shall be secured with steel strips.

8.7 Testing:
After the pipes are laid and jointed as mentioned in 8.3nd 8.4above, the pipe lines are to be subjected to hydrostatic pressure test. The procedure for conducting the hydrostatic pressure test is detailed in the relevant I.S. specifications for various types of pipes, as indicated below:

1 A.C. Pressure Pipes Clause 11 of I.S. 5530 of1972.
2. R.C.C.Pipes Clause 11 of I.S. 783 of1959

3. C.I. pipes &D.I. pipes Clause 6 of I.S. 3114 of1965.
4. PSCPipes Clause 11 of I.S. 783 of 1985.
5. HDPE Pipes I.S. 4984-1995
6. MSPipes I.S.5822-1994

In portions of the pipelines, where the pipes have developed cracks or sweating, such pipes shall be removed and re-laid with new pipes and the pipelines re-tested to the entire satisfaction of the Engineer-in-Charge. No extra payment will be made on this account. The bidder has to make his own arrangement for procurement of the required testing apparatus. The pressure gauge used with the testing apparatus shall be subjected to such test as the Engineer-in-Charge deems fit to ensure the accuracy of the gauge.

8.8Appurtenant Works:

All the valves should be checked before fixing in position to verify whether they are closing and opening freely or not. Masonry pits for enclosing the sluice valves, scour valve, and double air valves are to be constructed after fixing the valves in position at the locations shown in the drawings contained in Volume-IV of bid documents. The earth work excavation, layingofplain cement concrete, construction of brick masonry and plastering, laying R.C.C. cover slabs shall conform to the relevant specifications contained in this volume. Fixing of valves and the specials shall conform to I.S. 3114 of 1965 and as specified in the drawings appended. The pits should be cleaned and surroundings leveled with excavated earth and the bid price shall include cost of all theseoperations.

8.9 Refilling:

After the pipelines are laid, jointed and tested in conformity to the relevant I.S. specifications and to the satisfaction of Engineer-in-Charge the pipeline trenches should be refilled with excavated earth in layers of 6 inches. The colds should be broken, sufficiently watered and consolidated. The surface should be brought to the original condition by using the excavated material to the extent possible and using additional quantities of gravel and metal as the case may be. The extra earth after bringing back to the original condition should be disposed off as stipulated in paragraph 2.4.

DIVISION-9

PUMPING MACHINERY

The pumping machinery of the prescribed type and capacity should be supplied erected and commissioned including maintenance for a period of 30 days working @ 8 hours per day at optimum conditions so as to perform the required characteristics. The scope includes getting approval to the lay out drawings etc. by Chief Electrical Inspector and incoming and outgoing power connections.

9.1.1. **CENTRIFUGAL PUMPS:**

The centrifugal pumps should be of reputed make preferably Kirloskar /Mather& Platt /Jyothi / Best & Crompton / WPIL (or) any other reputed make specifically approved by Department conforming to relevant I.S. Specifications (1520-198) & ISO 9000 Certification.

The motor should be of reputed make, preferably Crompton Greaves / G.E.C. / N.G.E.F. / Kiroloskar Jyothi /Jyothi / ABB / Siemens (or) any other reputed make specifically approved by Department confirming to IS 12615-2011.

Vacuum gauge on the suction side and pressure gauge on the deliver side of suitable range shall be fixed.

Suitable Valves: - Air Valve / Gate Valves / Surge Valves of Make VAG / Sigma Flow / ARI / AVK / Durga any other reputed make specifically approved by Department

Pumping Machinery:-ISO 9001 Certification Essential.

ACCESSORIES:
The pumps should be supplied with all the necessary accessories duly mounted and inter connected on a suitable sized control panel made out of M.S. angle irons and M.S. sheets as given below. The accessories should be of reputed make and best quality and preferably as given below:
D.O.L / Star Delta / Auto transformer Starter of L & T / BCH / Siemens / Kirloskar Make (or) any other reputed make approved by Department.
Ammeter of MICO / AE make Voltmeter of MICO / AE make.
Power factor meter of best quality.
Indicator Lamps.
H.R.C. Fuses.
Incoming and outgoing switches.
Dry running preventer Vaibhav / Minilec / Safe guard.
Capacitor of B.E.L. make.
Single phase preventer Vaibhav / Minilec / Safe guard
Water level guard.
PVC/Submersible cables of Finolex / ICC / HC make for incoming, outgoing connections.
Required spares for motors, pumps, starters and switches for continuous operation for a period of three years shall be supplied.
Operating tools as detailed below for routine maintenance of the pumps and motors shall be supplied. The tools shall be mounted on T.W. board and shall be provided with a door with weld mesh and lock and key arrangement.
Tools are:
Ring spanner 3/16 "to 1" set double ended spanners.
3/16 "to 1" – set.
pipe wrenches 18" long –1
pipe Wrenches 24" long-1",
Insulated cutting plier (8",10") – 2 Nos,
2 Kg hammer – 1 Kg. 1 No,
nose plier 8"-1,
flat rough file with handle 10"-1,
half round smooth file with handle 10"-1,
Round rough file with handle 10"-1,
Adjustable spanner 6"-1,
Adjustable spanner 10"-1.

9.3 ERECTION:
9.3.1 In the case of centrifugal pumps the pump set should be fixed on to the standard base plate fixed over concrete bed as per drawing and specified in division 6. The pumps should be erected on a perfect horizontal plane without any tilt. The pipes, specials, valves required for suction and delivery connections shall conform to I.S. specifications, as specified in Division 7. The suction and delivery pipes should be fixed without any eccentricity duly cleaned. All the joints should be water tight without any loss of pressure. The submersible pump (if required) should be erected to perfect plumb and safely clamped on the top. A non-return valve should be fixed on the delivery main along with a pressure gauge.

9.4 EARTHING:
All electrical fixtures shall be suitably earthed in accordance with I.E. Act, 1910 and Rules there under as amended from time to time.

9.5 TESTING ANDCOMMISSIONING:
9.5.1 After completion of erection thepipe connections shall be cleaned and painted with

two coats of anti-corrosive paint.
The pump after erection should be commissioned and tested working for 8 hours/day for a continuous period of 30 days so as to perform the designed characteristics. It should deliver the required discharge at the designed delivery head only and the pressure head should not be higher than that which will detrimental to the pumping mains.

9.6 PIPECONNECTIONS:

Velocity of flow in suction and delivery pipes shall be limited to 1.5 to 2.0.

DIVISION 10
TUNNELING

10.1 Route Studies

Often, a tunnel is proposed as a sustainable alternative to a bridge or a surface road. In a tunnel route study, the following issues should be considered:
Subsurface, geological, and geo-hydraulic conditions
Constructability
Long-term environmental impact
Seismicity
Land use restrictions
Potential air right developments
Life expectancy
Economic benefits and life cycle cost
Operation and maintenance
Security
Sustainability

10.2 Financial Studies

The financial viability of a tunnel depends on its life cycle cost analysis. Traditionally, tunnels are designed for a life of 100 to 125 years. However, existing old tunnels (over 100 years old) still operate successfully throughout the world. Recent trends have been to design tunnels for 150 years life. To facilitate comparison with a surface facility or a bridge, all costs should be expressed in terms of life-cycle costs. In evaluating the life cycle cost of a tunnel, costs should include construction, operation and maintenance, and financing (if any) using Net Present Value. In addition, a cost-benefit analysis should be performed with considerations given to intangibles such as environmental benefits, aesthetics, noise and vibration, air quality, right of way, real estate, potential air right developments, etc.

10.3 Geotechnical Investigations

Geotechnical investigations are critical for proper planning of a tunnel. Selection of the alignment, cross section, and construction methods is influenced by the geological and geotechnical conditions, as well as the site constraints. Good knowledge of the expected geological conditions is essential. The type of the ground encountered along the alignment would affect the selection of the tunnel type and its method of construction. The selection of the tunnel profile must therefore take into account potential ground movements and avoid locations where such movements or settlements could cause surface problems to existing utilities or surface facilities and mitigation measures should be provided.

Risk assessment is an important factor in selecting a tunnel alignment. Construction risks include risks related the construction of the tunnel itself, or

related to the impact of the tunnel construction on existing facilities. Some methods of tunneling are inherently more risky than others or may cause excessive ground movements. Sensitive existing structures may make use of such construction methods in their vicinity undesirable. Similarly, hard spots (rock, for example) beneath parts of a tunnel can also cause undesirable effects and alignment changes may obviate that. Therefore, it is important to conduct risk analysis as early as possible to identify potential risks due to the tunnel alignment and to identify measures to reduce or manage such risks.

10.4 Environmental and Community Issues

In planning for a tunnel, the construction impact on the community and the environment is important and must be addressed. Issues such as impact on traffic, businesses, institutional facilities, sensitive installations, hospitals, utilities, and residences should be addressed. Construction noise, dust, vibration, water quality, aesthetic, and traffic congestion are important issues to be addressed and any potentially adverse impact should be mitigated. For example, a cut-and -cover tunnel requires surface excavation impacting traffic, utilities, and potentially nearby facilities. When completed, it leaves a swath of disturbed surface-level ground that may need landscaping and restoration. In urban situations or close to properties, cut-and -cover tunnels can be disruptive and may cut off access and utilities temporarily. Alternative access and utilities to existing facilities may need to be provided during construction or, alternatively, staged construction to allow access and to maintain the utilities would be required. Sometimes, top-down construction rather than bottom-up construction can help to ameliorate the disruption and reduce its duration. Rigid excavation support systems and ground improvement techniques may be required to minimize potential settlements and lateral ground deformations, and their impact on adjacent structures. When excavation and dewatering are near contaminated ground, special measures may be required to prevent migration of the groundwater contaminated plume into the excavation or adjacent basements. Dust suppression and wheel washing facilities for vehicles leaving the construction site are often used, especially in urban areas.

10.5 Operational Issues

In planning a tunnel, provisions should be made to address the operational and maintenance aspects of the tunnel and its facilities.

10.6 Sustainability

Tunnels by definition are sustainable features. They typically have longer life expectancy than a surface facility (125 versus 75 years). Tunnels also provide opportunities for land development for residential, commercial, or recreational facilities. They enhance the area and potentially increase property values.

10.7

TUNNEL TYPE

10.7.1 **General Description of Various Tunnel Types**

The principal types and methods of tunnel construction that are in use are:

Cut-and-cover tunnels are built by excavating a trench, constructing the concrete structure in the trench, and covering it with soil. The tunnels may be constructed in place or by using precast sections.

Bored or mined tunnels, built without excavating the ground surface. These tunnels are usually labeled according to the type of material being excavated.

Sometimes a tunnel passes through the boundary between different types of material; this often results in a difficult construction known as mixed face
Rock tunnels are excavated through the rock by drilled and blasting, by mechanized excavators in softer rock, or by using rock tunnel boring machines (TBM). In certain conditions, Sequential Excavation Method (SEM) is used.
Soft ground tunnels are excavated in soil using a shield or pressurized face TBM (principally earth pressure balance or slurry types), or by mining methods, known as either the sequential excavation method (SEM).
Immersed tunnels are made from very large precast concrete or concrete-filled steel elements that are fabricated in the dry, floated to the site, placed in a prepared trench below water, and connected to the previous elements, and then covered up with backfill.
Jacked box tunnels are prefabricated box structures jacked horizontally through the soil using methods to reduce surface friction; jacked tunnels are often used where they are very shallow but the surface must not be disturbed, for example beneath runways or railroads embankments

10.8Design Process

The basic process used in the design of a road tunnel is:
a. Define the functional requirements, including design life and durability requirements;
b. Carry out the necessary investigations and analyses of the geologic, geotechnical and geo-hydrological data
c. Conduct environmental, cultural, and institutional studies to assess how they impact the design and construction of the tunnel;
d. Perform tunnel type studies to determine the most appropriate method of tunneling.
e. Establish design criteria and perform the design of the various tunnel elements.
f. Appropriate initial and final ground support and lining systems are critical for the tunnel design, considering both ground conditions and the proposed method of construction. Perform the design in Preliminary and Final design phases. Interim reviews should be made if indicated by ongoing design issues.
g. Establish tunnel alignment, profile and cross-section
h. Determine potential modes of failure, including construction events, unsatisfactory long-term performance, and failure to meet environmental requirements. Obtain any necessary data and analyze these modes of failure;
i. Perform risk analysis and identify mitigation measures and implement those measures in the design
j. Prepare project documents including construction plans, specifications, schedules, estimates, and geotechnical baseline report (GBR).

10.9 Groundwater Control

Building a dry tunnel is a primary concern of the owner, user, and operator alike. A dry tunnel provides a safer and friendlier environment and significantly reduces operation and maintenance costs. Advancements in tunneling technology in the last few decades in general and in the waterproofing field in particular have facilitated the implementation of strict water infiltration criteria and the ability to build dry tunnels.

Allowable Infiltration

Tunnels	0.002 gal/sq. ft/day
Underground public space	0.001 gal/sq. ft/day

In addition, no dripping or visible leakage from a single location shall be permitted.

10.9.1 There are two basic types of waterproofing systems: drained (open) and undrained (closed). Various waterproofing materials are available for these systems. Open waterproofing systems allow groundwater inflow into a tunnel drainage system. The open system is commonly used in rock tunnels where water infiltration rates are low. This system is commonly installed between an initial tunnel support (initial lining) and the secondary or final support (permanent lining). The open waterproofing system generally allows for a more economical secondary lining and invert design as the hydrostatic load is greatly reduced or eliminated.

Closed waterproofing systems (closed system), often referred to as tanked systems, extend around the entire tunnel perimeter and aim at excluding the groundwater from flowing into the tunnel drainage system completely. Thus, no groundwater drainage is provided. The secondary linings therefore have to be designed for full hydrostatic water pressures. These systems are often applied in permeable soils where groundwater discharge into the tunnels would be significant and would otherwise cause a lowering of the groundwater table and possibly cause surface settlements.

For precast segmental lining, the segments are usually equipped with gaskets to seal the joints between segments and thus provide a watertight tunnel. For cut and cover tunnels under the groundwater table and for immersed tunnels, waterproofing membranes encapsulating the structures are recommended.

The waterproofing system should be addressed as early as possible and design criteria for water infiltration should be established during the process.

10.10 Tunnel Portals

Portals and ventilation shafts should be located such that they satisfy environmental and air quality requirements as well as the geometrical configuration of the tunnel. The portal should be located at a point where the depth of the tunnel is suitably covered. This depends on the type of construction, the crossing configuration, and the geometry of the tunnel. For example, in a cut and cover tunnel, the portal can be as close to the surface as the roof of the tunnel can be placed with sufficient clearance for traffic. On the other hand, in TBM mined tunnels, the portal will be placed at a location where there is sufficient ground cover to start the TBM. In mountain tunnels the portal can be as close to the face of the mountain as practically constructible.

10.11 Emergency Egress

Emergency egress for persons using the tunnel to a place of refuge should be provided at regular intervals. Throughout the tunnel, functional, clearly-marked escape routes should be provided for use in an emergency. Exits should be clearly marked, and the spacing of exits into escape routes should not exceed 1000 feet (300 m). Emergency exits should be provided to safe, secure locations

10.12 Emergency Ventilation, Lighting and Communication

An emergency ventilation system should be provided to control smoke and to provide fresh air for the evacuation of passengers and for support to the emergency responders. The emergency ventilation system is often the normal ventilation system operated at higher speeds. Emergency ventilation scenarios should be developed and the operation of the fans would be based on the location of the fire and the direction of the tunnel evacuation.

10.13 RISK ANALYSIS AND MANAGEMENT

Risk analysis and management is essential for any underground project. A risk register should be established as early as possible in the project development. The risk register would identify potential risks, their probability of occurrence and their consequences. A risk management plan should be established to deal with the various risks either by eliminating them or reducing their consequences by planning, design, or by operational provisions. For risks that cannot be mitigated, provisions must be made to reduce their consequences and to manage them. An integrated risk management plan should be regularly updated to identify all risks associated with the design, execution and completion of the tunnel.

The plan should include all reasonable risks associated with design, procurement and construction. It should also include risks related to health and safety, the public and to the environment.

Major risk categories include construction failures, public impact, schedule delay, environmental commitments, failure of the intended operation and maintenance, technological challenges, unforeseen geotechnical conditions, and cost escalation.

Operation and maintenance

10.14.1 **General**

Operation and maintenance should ensure that the level of safety in the tunnel is up- held by maintaining the assumed functional requirements and functional safety.

Important elements in this connection are:

Resource use based on needs is constantly checked, changed and adapted to the actual needs

The necessary level of qualifications and skill are found at all levels in the organization.

As far as possible, operations and maintenance should be carried out systematically and at appropriate intervals. The life-cycle considerations of both construction and technical equipment shall be taken into account when determining maintenance routines. Optimized maintenance frequency will reduce the probability for costly replacements

10.14.2

Methods of maintenance

10.14.2.1**General**

All operational and maintenance tasks carried out, both planned and unforeseen, shall be documented with the aid of an appropriate registration programmefor management, operation and maintenance. This should be able to verify the standard noted and any deviation from required standards. The documentation may also beusedtoverifytheneedforinternalcontrol. If, exceptionally, a manual control system is used, a signature should be obtained to confirm that the task has been duly carried out.

The systematic use of an administrative computer-based programme will enable experience to be registered such that at any given time the tunnel operator/owner will be able to initiate measures for more efficient maintenance.

10.14.2.2**Calendar-based maintenance**

Calendar-based maintenance involves standardized working instructions to be carried out periodically. This may be weekly, monthly, every second month, etc. The periods are determined by what is normal for the individual routines.

10.14.2.3 **Operational-base maintenance.**

Generally, operational-based maintenance is based upon the same principles as calendar-based routines, although the time interval will vary according to the time that equipment is used.
The working instructions are based upon the components having automatic registration systems in the form of time counters. Based on estimations of the time when the specified control has to be carried out, working instructions are issued describing the tasks that are to be done.

10.14.2.4 **Situation-based maintenance based on visual inspection**

Situation-based maintenance is based on the registration of specific conditions and that maintenance is planned based on the results. Some installations will have regular routines for maintenance ensuring that unnecessary wear-and-tear is avoided. This requires a routine for regular inspection, service and maintenance etc., becarried out according to need rather than at fixed intervals.
Maintenance may be carried out as the result of an inspection. The results are registered and evaluated and the decision made whether maintenance shall be carriedout immediately oralternativelypostponed until the nextinspection.

10.14.2.5 **Situation-based maintenance based on registration**

This is similar to the above situation but instead of inspection, measurements are made of the condition of the various components. The results of the measurements are used similarly to the results of inspections in order to determine when maintenance operations shall be carried out.

10.14.2.6 **Maintenance manual**

In order to ensure that maintenance is carried out systematically, a maintenance manual should be prepared such that the same routines are followed by everybody involved in operations and maintenance of the tunnel. Recommended procedures made by the suppliers shall be included in the basis for the manual. Information from suppliers should be available electronically.

10.15 Standard Specifications

PART1 GeneralSubmission

Submit following
Shop drawings for tunnel linings showing sizes, shapes, methods of attachment, and connection details including location and details of groutholes.
Shop drawings of hold-down assemblies for carrierpipe.
Shop drawings of bulkheads when indicated onDrawings.
Shop drawings of access manholes indicated onDrawings.
Design mixes for concrete, grout, and flowablefill.
Tunnel Method of Construction: Tunnel Boring Machine (TBM) or hand excavation.
Working Drawings and written procedure describing in detail proposed tunnel method and entire operation for information only, toinclude:
Tunnel shafts and support.
Dewatering.
Ground stabilization if proposed.
Excavationprocedures.
Support of excavated tunnel and tunnelface.
Grouting procedures.
Detection of surfacemovement.
Procedure for installingpipe.
Supports and anchors.

Placement of material between pipe and tunnel liner whenrequired.
Temporary bulkhead details used duringconstruction.
Procedures for maintaining line andgrade.
If modifications to methods are required during construction, submit working drawings delineating modifications, including reasons forthem.
Submit following before delivery of materials.
Certified TestReports:
Tunnel liner plate segments for tunnellining.
Tunnel liner plateconnectors.

Delivery, Storage and Handling

Unload and handle materials with equipment of adequate capacity, equipped with slings to protect materials fromdamage.
Store materials on site in reasonably level, well-drained area free frombrush.
Store individual pieces and bundles with safe walking space between to allow full view for inspection purposes.

Project Conditions

Construct tunnel so as not to interfere with, interrupt, or endanger surface and activity thereon.
Minimize subsidence of surface, structures, and utilities above and in vicinity of tunnel.
Support ground continuously to prevent loss of ground and keep perimeters and face of tunnel, passages, and shaftsstable.
Be responsible for settlement resulting from tunneloperations.
Repair and restore damaged property to its original condition before being disturbed at no cost to theCommission.
Follow applicable ordinances, codes, statutes, rules, and regulations of State of Kerala, “Safety Requirements for Tunnels, Shafts, and Caissons.”

Additional Criteria for work under rail roads

Do not schedule tunnel construction within and adjacent to Railroad property until Engineer and Rail road approve submittals, including proper Rail roadinsurance.
Approval does not relieve Contractor of responsibility for adequacy and safety of procedure.
Give Rail road advance written notice as described in permit and copied to Engineer before entering and working on Railroad property.
Place in effect, before work proceeds, safety, precautionary and protective devices and services required byRail/road.

PART2 Products

Material

LinerPlates.

Tolerances:
Variation in thickness of liner plates: Maximum, plus or minus 0.01inch.
Fabricate similar segments to be interchangeable in individual rings in similar segments of otherrings.
Space holes accurately so 2 rings may be bolted in any relative position with same size bolts in every bolthole.
Tolerance of diameter to bolt holes: Plus or minus 0.02 inch from specified diameter.
Replace segments not complying with tolerancesindicated.

Steel Liner Skin:

Use liner plate steel with minimum mechanical properties of flat plate before coldforming:
Tensile strength: 42,000psi.
Yield strength: 28,000 psi.
Elongation, 2 inches: 30percent.
Minimum liner plate thickness shown onDrawings.
If tunnel method of construction includes procedure to use installed liner plate for jacking purposes, increase liner plate thickness to withstand jacking pressure to beimposed.

Coatings.

Liner plate coatings are not required on tunnels where annular space between liner plates and carrier pipe is filled with grout, concrete, or flowable fill. When annular space is not filled, coat linerplate:
Liner Plate: Hot dipped galvanized
Bolts and Nuts: Galvanized
Liner plate shop-applied bituminous coal: fully bituminous coated; and use prime coat to assure compatibility with galvanizedsurface.
Protect coatings from damage during storage and transportation to Contract site.
Bolts and Nuts: Grade A, with rolled threads onbolts.
Grout Holes for Each Ring of Liner Plate: Unless otherwise indicated on Drawings, use 2minimum.
Other Type Tunnel LinerMaterials.
Steel Pipe: Smooth walled steel pipe with minimum yield strength of 35,000psi.
Minimum wall thickness: 3/8 inch or as indicated onDrawings.
Joints: Fully welded around circumference ofpipe.
Weld of sufficient strength to withstand forces at pipe joints without distortion ofpipes.
Minimum welds: Follow WSSC StandardDetail.
Coating: None.
Reinforced Concrete Pipe (RCP): minimum Class IV, with concrete joint and smooth exterior without jointbulge.
Use resilient material for placement in joint to prevent concrete damage when jacking forces areapplied.

Grout.

Voids between Tunnel Liner and Existing Ground: Minimum compressive strength of 100 psi, attained within 24 hours, and sufficiently fluid to inject through lining and fill voids, with prompt setting to control groutflow.
For Carrier Pipe Bedding and Filling Annular Space between Tunnel Liner and Carrier Pipe: 3 parts sand, to 1part cement.
Concrete: For Cradle and Filling Void Between Tunnel Liner and Carrier Pipe:
Dielectric Material.
Thermoplastic: Minimum strength of 400 volts for each mil, and water absorption less than 0.02 percent (24-hourperiod).
Access Manhole: When required on Drawings and following StandardDetails.
Bulkhead: Follow Drawings or StandardDetails.

PART3 Execution

General

Review and interpret available geotechnical reports and investigate work site soil conditions before bidding.
Encountering rock or water will not entitle Contractor to additionalcompensation.

Dewatering: When water is encountered, develop and maintain dewatering system of sufficient capacity to remove water continuously, keeping excavations free of water until backfill operation is in progress.
Keep removal of soils particles tominimum.
Dewater into sediment trap following
Observe settlement or displacement of surface facilities due todewatering.
Should settlement or displacement be detected, notify Engineer immediately and act to maintain safe conditions and preventdamage.

Preparation
Excavate shafts following Working Drawings.
Perform preliminary work, including constructing backstop (when used), placing guide timbers, and placing tunnelequipment.
Shaft Construction
Design, construct, maintain, and remove shaft, including damage attributed to shaft construction. Meet requirements of MOSH for tunnel shafts and ingress and egress to tunnel.
Construct shafts following working drawings.
Excavate, backfill, and grade following Section 02315 and to requirements specified herein.
Tunnel Equipment
Operate power machinery and tools within tunnel by electricity, compressed air, diesel with approved scrubber, or other approvedpower.
Ground electrical tools and equipment following latest requirements ofNEC.
Use temporary electric lights to properly and safely illuminate tunnel construction area, including special illumination at workingface.
Thoroughly insulate and separate lighting circuits from power circuits, and enclose lights in wirecages.
Secure electrical permits required for successful completion of thiswork.
Ventilation and Air quality
For duration of tunnel project, operate and maintain installed ventilation system to meet safety and requirements.
Tunnel Operation
Control tunnel face using spaced support procedures such as breast plates, poling plates, face jacks, sliding tables, either singly or in combination.
When using liner plates, advance excavation in increments sufficient for placement of 1 ring of liners and install liner plates immediately after each increment ofexcavation.
Excavate so voids behind liner plates areminimized.
Completely fill voids with grout followed immediately by grout placed under pressure specified below underGROUTING.
Whenever tunnel operation is suspended, support tunnel face by positive means and keep dewatering systemoperating.
Monitor conditions daily that might threaten tunnel stability by qualified personnel.
Installation of Tunnel LinerPlates
Install liner plates to avoid damage to liner plates orcoating.
Replace damaged liner plates and repair damaged coating to Engineer's acceptance.
Clean foreign matter from surfaces of flanges, which will be in contact with each

other, avoiding damage to coating in cleaningprocess.
Keep surfaces free from material that could interfere with proper bearing and water tightness.
Bolt liner plates following liner plate manufacturer'srecommendations.

Grouting

Fill voids between earth and tunnel liner withgrout.
Grout with pump and injection system that will deliver grout in smooth even flow without surge.
Develop uniform pressure at grout hole connection sufficient to fill voids without disturbing liner plates, adjacent utilities, structures, orroadways.
Use hoses having minimum inside diameter of 1-1/2-inches and minimum capacity of 1/2 cubic yards.
Grouting Procedure.
Grout between liner plates and excavation as soon as practicable, but at no time leave more than 2 liner plate ringsungrouted.
Leave no rings ungrouted when work is interrupted or at end of workshift.
Grout each adjacent set of holes progressively.
Install bulkheads or similar devices in order to grout ringscomplete.
Proceed from lowest grout hole of each ring, grouting progressivelyupward.
When going from lower to higher grout holes, do not make connection to higher holes until grout has completely filled spacebelow.
Continue grouting until grout appears in next set of grout holes, which shall be kept open during grouting to permit escape of air andwater.

Detection of Movement

Surface SettlementMarkers.

Unless otherwise specified, shown on Drawings or directed by Engineer, locate surface settlement markers according to a grid, spaced 10 feet by 10 feet and extending as shown on Drawings, but not less than 20 feet either side of the tunnel centerline.
Establish elevation of settlement markers to bench marks unaffected by tunnel operations.
Take readings and permanentlyrecord:
Before start of dewatering operations and/or shaftexcavation.
After steel casing has been advanced beyond pavement limits of each roadway.
Take elevation measurements to nearest 0.01 foot, and furnish reports to Engineer.
In event of settlement or heave on anymarker:
Immediately cease work and take immediate action to prevent further settlement or heave and concurrently report settlement or movement to Engineer
Restore surface elevations to that existing before start of tunnel operations at no cost to theCommission.

SubsurfaceIndicators.

When shown on Drawings, install subsurface settlement indicators following Standard Details before start of dewatering ortunneling.
Monitor movements of indicators to accuracy of 0.01 foot following approved schedule.
Whenever tunneling occurs within 50 feet of indicator, monitor movements of indicator before and after each advance of tunnel face within 50 feet ofindicator.
Report settlement or movement immediately to Engineer and take immediate remedial action, at no cost to the Commission, except when from dewateringoperations.

Field QualityControl

Tunnel Liner Plates.

Inside dimensions of ring measured along diameter at anylocation.

Do not vary more than 3 percent of liner platediameter.

Construct tunnel to line and grade following Drawings to allow minimum concrete cradle thickness of 4 inches measured from face of flange to outside of carrierpipe.

Installation of Carrier Pipe: Follow Standard Details, and Drawings.

Use thermoplastic or other dielectric material (except wood) between carrier pipe and tunnel liner plate or steel sleeve to prevent metal-to-metal contact and damage to pipe and coating duringplacement.

Hold Down Method in Tunnel.

Water mains, force mains, and pressure sewer mains: Concrete invert and hold down assembly following Standard Details andDrawings.

Gravity sewer: Fill annular space between pipe and tunnel lining with concrete, grout, or flowable fill following Standard Details andDrawings.

Bulkhead: FollowDrawings.

Access Manhole: Install at each end of tunnel liner when required on Drawings and following Standard Details.

PART4 MeasurementsandPayment

Tunnel Liners

Measurement: By linear metre followingDrawings.

Payment: At unit price for each linear foot listed in BidSchedule.

Payment includes excavation, backfill, access shafts, disposal of excess excavated material, providing tunnel liner, grout, concrete invert with anchors, subsurface settlement indicators, settlement markers, bulkheads, and filling annular space where indicated.

Carrier pipe installed inside tunnel liner is measured and paid for as described elsewhere inSpecifications.

Access Manhole

Measurement: By vertical meter measured from top of base slab to bottom of frame of various types and sizes installed complete, in place, including installation of Commission furnished frame andcover.

Payment: At unit price for each vertical metre as listed in BidSchedule.

Payment includes excavation, bedding and backfill, and provision of manhole complete.

The following Indian Standards may be referred to:-

47561978		Safety Code for Tunneling work (first revision) (Reaffirmed2007)
4880		Code of practice for design of tunnels conveying water-
4880	(Pt.I)-1987	General design(Reaffirmed1999)
4880	(Pt. II)-1976	Geometric design (first revision) (Reaffirmed2000)
4880	(Pt. III)-1976	Hydraulic design (first revision) (Reaffirmed2000)
4880	(Pt. IV)-1971	Structural design of concrete lining in rock (Reaffirmed2000)
4880	(Pt. V)-1972	Structural design of concrete lining in soft strata and Soils (Reaffirmed2000).

4880	(Pt. VI)-1971	Tunnel supports(Reaffirmed2000)
4880	(Pt. VII)-1975	Structural design of steel lining(Reaffirmed2000)
5878		Code of practice for construction of tunnels-
5878	(Pt. I)-1971	Precision survey and setting out(Reaffirmed2000)
5878	(Pt. II/Sec1)-1970	Underground excavation in rock, section 1-Drilling and blasting(Reaffirmed2000)
5878	(Pt. II/Sec2)-1971	Underground excavation in rock, section 2-Ventilation, lighting Mucking and dewatering(Reaffirmed2000)
5878	(Pt. II/Sec 3)-1971	Underground excavation in rock, section 3- Tunneling Method for steeply inclined tunnels, shafts and underground power houses. (Reaffirmed2000)
5878	(Pt. III)-1972	Underground excavation in soft strata(Reaffirmed2000)
5878	(Pt. IV)-1971	Tunnel supports(Reaffirmed2000)
5878	(Pt. V)-1976	Concrete lining (first revision) (Reaffirmed2000)
5878	(Pt. VI)-1975	Steel lining(Reaffirmed2000)
5878	(Pt. VII)-1972	Grouting(Reaffirmed2000)
64331972		Guniting equipment (Reaffirmed2005)
150262002		Tunneling Methods in Rock Masses –Guidelines

DIVISION 11

CROSS DRAINAGE WORKS

11.1 Introduction

A canal conveying water from the headworks has to run for large distances and has to maintain the water levels appropriately, as designed along its length. It has to run through terrains which generally would have a different slope small than the canal. The surrounding areas would invariably have it's own drainage system ranging from small streams to large rivers.The canal has to carry the water across these water bodies as well as a cross artificial obstacles like railway line or roads.

The main structures of a canal system for conveyance of canal flow and control of water levels are as follows.

1. Pipe conduits, culverts and inverted syphons to carry flow under railways and highways.

2. Aqueducts, syphon aqueducts, super-passage, canal siphon or level crossings across natural drainage courses or other depressions.

3. Transitions at changes in cross sections.

11.2 Structures for crossing canals across roads and rail way lines

These are structural elements to convey canal water under roads or railway lines. For small roads, carrying relatively less traffic, the pipe conduit is sufficient. For canals crossing under major highways and railway tracks, reinforced concrete culverts are more commonly adopted. These roads or railway crossings are usually having a straight profile along its length. The water level in the canal for this type of crossing is lower than the level of the obstruction it crosses and the flow through the pipe may be free or under mild pressure.

Pipe road crossings are relatively economical, easily designed and built, and have proven are liable means of conveying water under a roadway. Pipe installations are normally installed by cut and cover method below minor roads but for important roads, where traffic cannot be interrupted, it may be accomplished by jacking the pipe through the road way foundation.

The inverted syphons are structures for canal water conveyance below roads, railway lines and other structures. The longitudinal profileisnot exactly ina straight line and the central portion is seen to sag beneath the object to be crossed. The inverted syphon, therefore, is provided where the water level in the canal is about the same as the level of the obstruction.

The inverted syphon isa closed conduit designed to run full and under pressure.If made of pressure pipes, they should be able to withstand the load of cover and wheel from outside and the hydrostatic head from inside. Transitions for changes in cross sections are nearly always used at inlet and outlet of a siphon to reduce head losses and prevent erosion in unlined canals caused by the velocity changes between the canal and the pipe.

11.3 Structures for crossing canals across natural streams (cross drainage works)

These structural elements are required for conveying the canals across natural drainage. When a canal layout is planned, itis usually seen to cross a number of channels draining the area, varying from small and shallow depressions to large rivers. It is not generally possible to construct cross-drainage structures for each of the small streams. Some of the small drainage courses are, therefore, diverted into one big channel and allowed to cross the canal. However, for larger streams and river, where the cost of diversion becomes costlier than providing a separate cross-drainage work, individual structures to cross the canal across the stream is provided.

There could bea variety of combinations of the relative position of the canal with respect the natural channel that is to be crossed. The notations used in the figures are as follows:

(a) CBL: Canal Bed Level;
(b) SBL: Stream Bed Level;
(c) FSL: Canal Full Supply Level; and

(d) HFL: Stream High Flood Level

11.4 Structures to carry canal water over a natural stream

Conveying a canal over a natural water course may be accomplished in two ways:
(a) Normal canal section is reduced to a rectangular section and carried across the natural stream in the form of a bridge resting on piers and foundations. This type of structure is called a***trough type aqueduct.***
(b) Normal canal section is continued across the natural streambut the stream section is flumed to pass through 'barrels' or rectangular passages. This type is called a***barrel type aqueduct***.
For the aqueducts, the HFL of the natural stream is lower than the bottom of the trough (or the roof of the barrel). Inthis case, the flow isnot under pressure, that is, it has a free surface exposed to atmospheric pressure.
In case the HFL of the natural stream goes above the ***trough bottom level*** (TBL) or the ***barrel roof level*** (BRL), then the flow in the natural water course would be pressured and the sections are modified to form which is known as ***syphon aqueducts***

It may be observed that the trough type aqueduct or syphon aqueduct would be suitable for the canal crossing a larger stream or river, where as the barrel type is suitable if the natural stream is rather small. The relative economics of the two types has to beestablished on case to case basis.

Further, the following points may be noted for the two types of aqueducts or siphon aqueducts:
a. Trough type: The canal is flumed to not less than 75 percent of the bed width keeping in view the permissible head loss in the canal. Transitions 3:1 on the upstream and 5:1 on the downstream side are provided to join the flumed section to the normal canal section. For the trough-type syphon aqueduct the designer must consider the upward thrust also that might act during high floods in the natural stream when the stream water flows under pressure below the trough base and for worst condition, the canal may be assumed to be dry at that time. The dead weight of the trough may be made more than that of the up ward thrust or it may be suitably anchored to the piers in order to may be counteract the uplift condition mentioned.
b. Barrel type: The barrel may be made up of RCC, which could be single or multi-cell,circular or rectangular in cross section. Many of the earlier structures were made of masonry walls and arch roofing. Precast RCC pipes may be economical for small discharges. For barrel-type syphon aqueducts, the barrel is horizontal in the central portion but slopes upwards on the upstream and downstream side at about an inclination of 3H:1V and 4H:1V respectively. A self-cleaning velocity of 6m/s and3m/s is considered while designing RCC and masonry barrels respectively.

11.5 Structures to carry canal water below a natural stream

A canal can be conveyed below a natural stream with the help of structures like a super- ***passage*** or a siphon. These are exactly opposite in function to that of the aqueducts and siphon aqueducts, which are used to carry the canal water above the natural stream. The natural stream is flumed and made to pass ina trough above the canal. If the canal water flows with a free surface, that is, without touching the bottom of the trough, itis called a ***super-passage***. Else, when the canal passes below the trough as a pressure flow, then itis termed as a***syphon*** or a***canal syphon***.

Instead of a trough, the canal flow may be conveyed below the natural stream using small pre-cast RCC pipes (for small discharges) and rectangular or circular barrels, either in single or multiple cells, may be used (for large discharges).

11.6 Structures to carry canal water at the same level as a natural stream

A structure in which the water of the stream is allowed to flow into the canal from one side and allowed to leave from the other, known as a***level crossing***, falls into this category. This type of structure is provided when a canal approaches a large sized drainage with high flood discharges at almost the same level. The flow control is usually provided on either side of the canal and on the outlet side of the drain. As such, this type of arrangement is very similar to canal head-works with a barrage. Advantage may be taken of the flow of the natural drainage to augment the flow of the outgoing canal. The barrage type regulatoris kept closed during low flows to head up the water and allows the lean season drainage flow to enter the outgoing canal. During flood seasons, the barrage gates may be opened to allow much of the silt-laden drainage discharge to flow down.

Another structure, called an ***inlet***, is sometimes provided which allows the entry of the stream water into the canal through an opening in the canal bank, suitably protected by pitching the bed and sides for a certain distance upstream and downstream of the inlet. If the natural stream water isnot utilized in the canal then an ***outlet,*** which is an opening ontheopposite bank of the canal is provided. The canal bed and sides suitably pitched for protection.

11.7 Transitions at changes in canal cross-sections

A canal cross section may change gradually, in which case suitable flaring of the walls may be made to match the two sections

For more abrupt changes, like a normal canal section being changed to a vertical walled aqueduct, suitable transitions have been designed which would avoid formation of any hydraulic with consequent loss of energy.

11.8 Selection of a Suitable Type of Cross-Drainage Work

The relative bed levels, water levels, and discharge of the canal and the drainage are the primary factors which govern and dictate the type of cross drainage work that may prove to be most suitable at a particular place. For example, if the bed level of the canal is sufficiently above the HFL of the drain, an aqueduct is the

first and obvious choice. But, if the bed level of the drain is sufficiently above the canal FSL, a super passage may be constructed. Similarly, when a canal carries a small discharge compared to the drain, the canal may be taken below the drain by constructing a syphon, as against a siphon aqueduct which is adopted when the drain with smaller discharge can be taken below a large canal.
However, in actual field, such ideal conditions may not be available and the choice would then depend upon many other factors, such as:
(i) Suitable canal alignment.
(ii) Nature of available foundation.
(iii) Position of water table and availability of dewatering equipment. (iv) Suitability of soil for embankment.
(v)Permissible head loss in canal.
(vi) Availability of funds.
The relative bed levels of the canal and the drainage may be changed and manipulated by suitably changing the canal alignment, so that the point of crossing is shifted upstream or downstream of the drainage. For example, if the canal alignment is such that sufficient Headway is not available between HFL of drain and bed of the canal, (although canal bed is higher) a syphon aqueduct has to be normally adopted. But, however, if other conditions are not favourable for the construction of a syphon-aqueduct, the canal alignment may be changed so that the crossing is shifted tothedownstreamwheredrainage bedislowandthussufficientheadwaybecomes available for constructing an aqueduct in place of siphon aqueduct.
Compared to an aqueduct, a super passage is inferior and should be avoided when-ever possible. Similarly, a syphon-aqueduct (unless large drop in drainage bed is required) is superior to a syphon. A level crossing may become inevitable in certain cases. For example, when a large canal crosses a large torrent at almost equal bed levels, a level crossing may remain to be the only answer. An inlet may be adopted when a small drain crosses the canal with its bed level equal to canal FSL or slightly higher than it (i.*e.* bed conditions similar to those favouring the choice of a siphon or a super passage). Inlets, though cheaper, are not preferred these days because their performance has not been very satisfactory.

11.9 Design Considerations for Cross Drainage Works

The following steps may be involved in the design of an aqueduct or a syphon-aqueduct. The design of a super passage and a syphon is done on the same lines as to aqueducts and siphon aqueducts, respectively,since hydraulically there is not much difference between them, except that the canal and the drainage are interchanged by each other

11.9.1 **Determination of Maximum Flood Discharge.** The high flood discharge for smaller drains may be worked out by using empirical formulas; and for large drains, other reliable methods such as Hydrograph analysis, Rational formula, etc. may be used.

11.9.2 **Fixing the Waterway Requirements for Aqueducts and Syphon-** Aqueducts. An approximate value of required waterway for the drain may be obtained by using the Lacey's equation.

11.9.3 **Size of the Barrels.**After having fixed the waterway width & number of compartments (bays) the height of the drain barrels has to be fixed. In

case of an aqueduct, the canal trough is carried clear above the drain HFL, and drain bed is not to be depressed. Hence, the height of bay openings is automatically fixed in aqueducts, as equal to the difference between HFL and DBL of drain.

However, in syphon-aqueducts, the required area of the drainage waterway can be obtained by dividing the drainage discharge by the permissible velocity through the barrels. This velocity through the barrels is generally limited to 2 to 3 m/sec. The waterway area is then divided by the decided waterway width of the drain openings to compute the height of the openings, and the extent of depressed floor.
Due to the reduction in the width of the drainage, afflux is produced near the work site. The afflux will increase more and more, if the waterway is reduced more and more. The value of afflux is limited, so that there is no flooding of the country-side. The afflux maybe calculated by using Unwin's formula.

11.9.5 **Afflux and Head Loss through Syphon Barrels.** It was stated earlier that the velocity through siphon barrels is limited to a scouring value of about 2 to 3m/sec. A higher velocity may cause quick abrasion of the barrel surfaces by rolling particles, etc. and shall definitely result in higher amount of afflux on the upstream side of the syphon or syphon- aqueduct, and thus, requiring higher and longer marginal banks.

11.10Fluming of the Canal. The contraction in the waterway of the canal *(i.e.* fluming of the canal) will reduce the length of barrels or the width of the aqueduct. This is likely to produce economy in many cases. The fluming of the canal is generally not done when the canal section is in earthen bank. The maximum fluming is generally governed by the extent that the velocity in the trough should remain subcritical (of the order of 3 m/sec). Because, if supercritical velocities are generated, then the transition back to the normal section on the downstream side of the work may involve the possibility of the formation of a hydraulic jump. This hydraulic jump, where not specifically required and designed for, would lead to undue loss of head and large stresses on the work. The extent of fluming is further governed by the economy and permissible loss of head. The greater is the fluming, the greater is the length of transition wings upstream as well as downstream. This extra cost of transition wings is balanced by the saving obtained due to the reduction in the width of the aqueduct. Hence, an economic balance has to be worked out for any proposed design.

11.10 Provision of Joints and Water Bars in R.C.C. Ducts of Aqueducts and Super Passages

R.C.C. box troughs (or ducts) carry water in aqueducts and super-passages, as explained in the previous articles. The box trough will span across the drain or the canal, rested at suitable intervals (spans) on piers or abutments. The construction of such R.C.C. troughs will involve various types of joints, such as *construction joints, expansion joints,* etc. Water will leak through these joints, unless proper arrangements are made to prevent such leakages. *Water bars* or *water-stops* are provided to stop such leakages through the joints. The water bars may be made of metals like copper sheets or galvanized iron sheets, or of rubbers (natural as well as synthetic), or of P.V.C., etc.

11.11 Types of Joints in R.C.C. Constructions. The various types of joints that may be involved in R.C.C. constructions can be divided into the following types:
(1)Movement joints including the:

Contraction joints, (ii) Expansion joints, and (iii) Sliding joints, and

(2) Construction joints.

These joints are discussed below:

1(i) Contraction joints. It is a movement joint with a deliberate discontinuity but no initial gap between the concrete on either side of the joint, the joint being intended to accommodate contraction of concrete.
1(ii) Expansion joints, A movement joint with complete discontinuity in both reinforcement and concrete and intended to accommodate either expansion or contraction of the structure
1(iii) Sliding joints. A movement joint with complete discontinuity in both reinforcement and concrete at which special provision is made to facilitate relative movement in place of the joint is known as a sliding joint
2) Construction joints. A joint in the concrete introduced for convenience in construction at which special measures are taken to achieve subsequent continuity without provision for further relative movement
11.12 Spacing of Joints in R.C.C. Structures. Unless alternative effective means are taken to avoid cracks by allowing for the additional stresses that may be induced by temperatureor shrinkage changes or by unequal settlement, movement joints should be provided at the following spacing's:

a. In reinforced concrete floors, movement joints should be spaced at not more than 7.5 m apart in two directions at right angles. The wall and floor joint should be in line, except were sliding joints occur at the base of the wall, in which case correspondence is not so important.
b. For floors with only nominal percentage of reinforcement (smaller than the minimum

c. floor should be cast in panels with sides not mere than 4.5m.
d. In concrete walls, the vertical movement joints should normally be placed at a maximum spacing of 7.5m in reinforced walls and 6m in unreinforced walls. The maximumlengthdesirablebetweenverticalmovementjointswilldepend upon the tensile strength of the walls, and may be increased by suitable reinforcement. Thus when a sliding layer is placed at the foundation of a wall, the length of wall that can be kept free of cracks depends upon the capacity of wall section to resist the friction induced at the plane of sliding. Approximately, the wall has to stand the effect of a force at the plane of sliding equal to weight or half the length of wall multiplied by the coefficient of friction.

E Among the movement joints in floor sand walls as mentioned above, expansion joints should normally be provided at a spacing of not more than 30 m between successive expansion joints or between the end of the structure and the next expansion joint, all other joints being of the contraction type.

f. When, however, the temperature changes to be accommodated are abnormal or occur more frequently than usual as in the case of storage of warm liquids or in uninsulated roof slabs, a smaller spacing than 30 m should be adopted, (that is a greater proportion of the movement joints should be of the expansion type). When the range of temperature is small, for example, in certain covered structures, or where restraint is small, for example, in certain elevated structures, none of the movement joints provided in small structures up to 45 m length need be of the expansion type. Where sliding joints are provided between the walls and either the floor or roof, the provision of movement joints in each element can be considered independently.

11.13 Width of Gap in Expansion Joint. An expansion joint requires the provision of as initialgap between the concrete faces on the two sides of the joint. The initial width of this gap should be sufficient to accommodate freely the maximum expansion of the structure.

In determining this initial width, consideration should be given to the requirements of the jointing materials. These will normally require the maintenance of certain minimum width of gap during maximum expansion of the structure. The joint should also be suitably treated as to maintain water tightness during movement of the joint.

11.14 Jointing Materials. Jointing materials may be classified as follows:

{i)jointfillers;

(ii) Water bars and joint cover plates, and

(iii)Joint sealing compounds

(i) **Joint fillers.** Joint fillers are usually compressible sheet or strip materials used as spacers. They are fixed to the face of the first placed concrete and against which the second placed concrete is cast. With an initial gap of about 30 mm, the maximum expansion or contraction that the filler materials may allow may be of the order of 10Joint fillers, as at present available, cannot by themselves function as watertightexpansion joints. They may be used as support for an effective joint sealing compound in floor and floor joints. But they can only be relied upon as spacers to provide the gap in an expansion joint, the gap being bridged by waterbar

[ii) **Waterbars**.Waterbarsor*waterstops*arethepreformedstripsofimpermeable materials which are embedded in concrete during construction, so as to span across the joint, as to provide a permanent watertight seal during the whole range of joint movement.

The water bars are usually made of metalsheets like copper,galvanized iron etc.;or may be made of *rubber*(naturalorsynthetic);orofplasticslike*P.V.C.* (Polyvinylchloride):*Metalbars*canbeusedinwaterconveyancestructuresor dams,wherethefoundationsarenotexpectedtoyieldappreciably;otherwise theywillsnap.*Annealedcopper*isthemostcommonmetalusedforwaterstops, inthicknessnotlessthan1.5mm;butitislikelytobecomebrittleincourseof timeandmaythencrack.*Monelmetal*isconsideredmoredurablethough sometimes20gauge*galvanized iron*or*steelstrips*arealsoused.

The most usual shape of metal bars is in the form of strips with central longitudinal corrugation, to obtain a V, U or M shape. The total width of the water bar may range from 150 mm to 300 mm. For box aqueducts etc., 180 to 225 mm wide water bar may suffice; while for dams, 300 mm wide bars may be preferred. *Rubber*

water bars are, however, preferred to metal bars for their economy, and suitability to somewhat yielding foundations. Metal and rubber water bars are invariably used in ducts of aqueducts and super-passages- in expansion joints; *PVC water bars,* on the other hand, are, usually adopted in contraction and construction joints.

MostCommonlyuseddimensions&shapesof*metalwaterstops*(Z-shapeandV-shape),*rubberwaterstop*(dumbwellwithcentralbulbtypeshape)forexpansion joints;andofPVCwaterstopforconstructionjointsofaqueductsandsuper-passages.

With all water bars, it is 'important to ensure proper compaction of the concrete. The "bar should have such shape and width that the water path through the concrete rounds the bar should not be unduly short.

Theholessometimesprovidedonthewingsofcopperwaterbarstoincrease bond,shortenthewaterpathandmaybedisadvantageous.*Thewaterbarshould either be placed centrally in the thickness of the wall,orits distance from either faceofthewallshouldnotbelessthanhalfthewidthofthebar.Thefullconcrete covertoallreinforcementshouldbemaintained.*

The strip water bars at present available in the newer materials need to be passed through the end shutter of the first-placed concrete. It can be appreciated, however, that the use of the newer materials makes possible a variety of shapes or sections. Some of these designs, those with several projections would not need to be passed through the end shutter and by occupying a bigger proportion of the thickness of the joint, would also lengthen the shortest alternative water path through the concrete.

(iib)**JointCoverPlates.**Jointcoverplatesaresometimesusedinexpansionjointsto avoidtheriskofafault-in-embeddedwaterbar.Thecoverplatemaybeofcopper orsheetlead.Ifcoppercoverplateisused,itshouldbeclampedtotheconcrete faceoneachsideofthejointusingsuitablegasketstoensurewatertightness.If sheetleadisused,theedgesmayreturnintogroovesformedintheconcreteand be made completely watertightbyleadcaulking.Facesofthe concreteto whichsheet lead istobefixedshouldbepaintedwith bituminous or other suitable composition,andtheleadsheetshouldbesimilarlycoatedbeforefixing.

(iii)**JointSealingCompounds**.Jointsealingcompoundsareimpermeableductile materialswhicharerequiredtoprovideawatertightsealbyadhesiontothe concrete throughout the range of joint movement. The commonly used materials are based on asphalt, bitumen, or coal tar pitch with or without fillers, such a slime stone or slate dust, asbestos fibre, chopped hemp, rubber or other suitable material. These are usually applied after construction or just before the reservoir are put into service by pouring in the hot or cold state, by trowelling or gunning or as performed strips ironed into position. They may also be applied during construction, such as by packing round the corrugation of a water bar. A primer is often used to assist adhesion and some local drying of the concrete surface with the help of a blow lamp is advisable. The length of the shortest water path through the concrete should be extended by suitably painting the surface of the concrete on either side of the joint.

The main difficulties experienced with this class of material are in obtaining permanent adhesion to the concrete during movement of the joint, whilst at the same time ensuring that the material does not slump or is not extruded from the joint.

In floor joints, the sealing compound is usually applied in a chase formed

in the surface of the concrete along the line of the joint. The actual minimum width will depend on the known characteristics of the material. In the case of an expansion joint, the lower part of the joint is occupied by joint filler. This type of joint is generally quite successful, since retention of the material is assisted by gravity and, in many cases, sealing can be delayed until just before the reservoir is put into service so that the amount of joint opening subsequently to be accommodated is quite small. The chase should not be too narrow or too deep to hinder complete filling and the length of the shortest water path through the concrete should be extended by suitably painting the surface of the concrete on either side of the joint. Here again a wider joint demands a smaller percentage distortion in the material.
An arrangement incorporating a cover slabmay be advantageous in reducing dependence on the adhesion of the sealing compound in direct tension.

Use of sealing compounds for vertical joints is not very successful. A stepped-joint instead of a straight through-joint with a water bar incorporated in the joint and sealing compound packed round the corrugation of the water bar would be much more successful

11.15 Design of Bank Connections. Two set of wings are required in aqueducts and syphon aqueducts. These are:
Canal Wings or Land Wings.
Drainage Wings or WaterWings.

(i) Canal wings or Land wings. These wings provide a strong connection between the masonry or concrete sides of a canal trough and earthen canal banks. These wings are generally warped in plan so as to change the canal section from trapezoidal to rectangular. They should be extended up to the end of splay. These wings may be designed as retaining walls for maximum differential earth pressure likely to come on them with no water in the canal. The foundations of these wings should not be left on filled earth. They should be taking deep enough to give safe creep length.
(ii)Drainage wings or Water wings or River wings. These wing walls retain and protect the earthen slopes of the canal, guide the drainage water entering and leaving the work, and join it to guide banks and also provide a vertical cut-off for the water seeping from the canal into the drainage bed. The foundations of these wing walls should be taken below the deepest anticipated scour in the river. The sections of these wing walls should be capableofwithstandingthe maximum differential earth pressure likely to come on them.
The layouts of these sets of wings depend on the extent of contraction of canal and drainage waterways, and the general arrangement of the work.

11.16 Provision of Joints and Water Bars in R.C.C. Ducts of Aqueducts and SuperPassages
The box trough will span across the drain or the canal, rested at suitable intervals (spans) on piers or abutments. The construction of such R.C.C. troughs will involve various types of joints, such as *construction joints, expansion joints,* etc. Water will leak through these joints, unless proper arrangements are made to prevent such leakages. *Water bars* or *water-stops* are provided to stop such leakages through the joints. The water bars may be made of metals like

copper sheets or galvanized iron sheets, or of rubbers (natural as well as synthetic), or of P.V.C., etc.

11.17 IS Standards

1IS:7784 "Code of practice for design of cross drainage works"

(a)Part1-1975 General features (Reaffirmed 1987)

(b)Part2-1983 Specific requirements (Reaffirmed1992) Section1Aqueducts
(c)Part2-1980 Specific requirements (Reaffirmed1992) Section2 .Super passage
(d)Part2-1981Specific requirements (Reaffirmed1992) Section3.Canal-syphons
(e)Part2-1980 Specific requirements (Reaffirmed1992) Section4.Level-crossings
(f)Part2-1980 Specific requirements (Reaffirmed1992)
Section5.Syphonaqueducts
2.IS:11385-1985 "Code of practice for subsurface exploration for canals and crossdrainage works" (Reaffirmed1990)

IS:9913- 1981 "Code of practice for construction of cross drainage works" (Reaffirmed1992)

DIVISION 12
SUB SURFACE IRRIGATION

12.1 General

As suggested by the name, the application of water to fields in this type of irrigation system is below the ground surface so that it is supplied directly to the root zone of the plants. The main advantages of these types of irrigation is reduction of evaporation losses and less hindrance to cultivation works which takes place on the surface.

There may be two ways by which irrigation water may be applied below ground and these are termed as:

- Natural sub-surface irrigation method
- Artificial sub-surface irrigation method

Natural Sub-surface irrigation method

Under favorable conditions of topography and soil conditions, the water table may be close enough to the root zone of the field of crops which gets its moisture due to the upward capillary movement of water from the water table. The natural presence of the water table may not be able to supply the requisite water throughout the crop growing season. However, it may be done artificially by constructing deep channels in the field which may be filled with water at all times to ensure the presence of water table at a desired elevation below the root zone depth. Though this method of irrigation is excellent from both water distribution and labour saving points of view, it is favorable mostly for the following

- The soil in the root zone should be quite permeable
- There should be an impermeable substratum below the water table to prevent deep percolation of water.
- There must be abundant supply of quality water that is one which is salt free; otherwise there are chances of upward movement of these salts along with the

moisture likely to lead the conditions of salt incrustation on the surface.

12.2 Artificial subsurface irrigation method

The concept of maintaining a suitable water table just below the root zone is obtained by providing perforated pipes laid in a network pattern below the soil surface at a desired depth. This method of irrigation will function only if the soil in the root zone has high horizontal permeability to permit free lateral movement of water and low vertical permeability to prevent deep percolation of water. For uniform distribution of water percolating into the soil, the pipes are required to be very closely spaced, say at about 0.5m. Further, in order to avoid interference with cultivation the pipes have to be buried not less than about 0.4m below the ground surface. This method of irrigation is not very popular because of the high expenses involved, unsuitable distribution of subsurface moisture in many cases, and possibility of clogging of the perforation of the pipes.

12.3 Sprinkler Irrigation System

Sprinkler irrigation is a method of applying water which is similar to natural rainfall but spread uniformly over the land surface just when needed and at a rate less than the infiltration rate of the soil so as to avoid surface runoff from irrigation. This is achieved by distributing water through a system of pipes usually by pumping which is then sprayed into the air through sprinklers so that it breaks up into small water drops which fall to the ground. The system of irrigation is suitable for undulating lands, with poor water availability, sandy or shallow soils, or where uniform application of water is desired. No land leveling is required as with the surface irrigation methods. Sprinklers are, however, not suitable for soils which easily form a crust. The water that is pumped through the pump pipe sprinkler system must be free of suspended sediments. As otherwise there would be chances of blockage of the sprinkler nozzles.

A typical sprinkler irrigation system consists of the following components:

- *Pump unit*
- *Mainline and sometimes sub mainlines*
- *Laterals*
- *Sprinklers*

The pump unit is usually a centrifugal pump which takes water from a source and provides adequate pressure for delivery into the pipe system.

The mainline and sub mainlines are pipes which deliver water from the pump to the laterals. In some cases, these pipelines are permanent and are laid on the soil surface or buried below ground. In other cases, they are temporary, and can be moved from field to field. The main pipe materials include asbestos cement, plastic or aluminum alloy.

The laterals deliver water from the mainlines or sub mainlines to the sprinklers. They can be permanent but more often they are portable and made of aluminum alloy or plastic so that they can be moved easily.

12.3.1 The most common types of sprinklers that are used are:

- **Perforated pipe system:** This consists of holes perforated in the lateral irrigation pipes in specially designed pattern to distribute water fairly uniformly. The sprays emanating from the perforations are directed in both sided of the pipe and can cover a strip of land 6 m to 15m wide.

Rotating head system: Here small sized nozzles are placed on riser pipes fixed at uniform intervals along the length of the lateral pipe. The lateral pipes are usually laid on the ground surface. The nozzle of the sprinkler rotates due to a small mechanical arrangement which utilizes the thrust of the issuing water.

As such, sprinkler irrigation is suited for most rows, field as tree crops and water can be sprayed over or under the crop canopy. However, large sprinklers are not recommended for irrigation of delicate crops such as lettuce because the large water drops produced by the sprinklers may damage the crop.

Sprinkler irrigation has high efficiency. It however, varies according to climatic conditions; 60% in warm climate; 70% in moderate climate and 80% in humid or cool climate.

The average growth rate of sprinkler irrigated area in India is about 25 percent. The cost of installation of sprinkler irrigation depends on a number of factors such as type of crop, the distance from water source.

12.4 Drip Irrigation System

Drip irrigation is an efficient method of providing water directly to the root zone, minimizing conventional losses such as deep percolation, runoff and soil erosion. Unlike surface irrigation, drip irrigation is more suitable and economical if it is introduced in water scarce areas with undulating topography, shallow and sandy soils and for widely spaced high value crops. It also permits the utilization of fertilizers, pesticides and other water-soluble chemicals along with irrigation water, resulting in higher profit and better yields and quality of product.

Drip Irrigation system is sometimes called trickle irrigation and involves dripping water onto the soil at very low rates (2-20 litres per hour) from a system of small diameter plastic pipes filled with outlets called emitters or drippers. Water is applied close to the plants so that only part of the soil in which the roots grow is wetted, unlike surface and sprinkler irrigation, which involves wetting the whole soil profile. With drip irrigation water, applications are more frequent than with other methods and this provides a very favourable high moisture level in the soil in which plants can flourish.

A typical drip irrigation system consists of the following components:

- Pump unit
- Control Head
- Main and sub main lines
- Laterals
- Emitters and drippers

The drip irrigation system is particularly suited to areas where water quality is marginal, land is steeply sloping or undulating and of poor quality, where water or labour are expensive, or where high value crops require frequent water applications. It is more economical for orchard crops than for other crops and vegetables since in the orchards plants as well as rows are widely spaced. Drip irrigation limits the water supplied for consumptive use of plants. By maintaining a minimum soil moisture in the root zone, thereby maximizing the water saving. A unique feature of drip irrigation is its excellent adaptability to saline water. Since the frequency of irrigation is quite high, the plant base always remains wet which keeps the salt concentration in the plant zone below the critical. Irrigation efficiency of a drip irrigation system is more than 90 percent.

12.5 System components

The components of drip irrigation system can be grouped into two major heads viz. Control head and Distribution network.

Control head

The control head of drip irrigation includes the following components:

Pump / Overhead Tank

Pump or an overhead tank is required to provide sufficient pressure in the system.

Centrifugal pumps are generally used for low pressure trickle systems. They are easily adjusted to provide constant pressure and have the added safety measure of non-overloading head characteristic. Pumps are generally recommended for larger areas under drip irrigation, undulating topography, closely spaced crops or where water requirement is comparatively high.

Instead of connecting directly to the pump, an overhead tank having a height of about 3 meters can also be used in certain types of drip system. Overhead tank is generally used for small areas of orchard crops with comparatively lesser water requirement.

Filters

The hazard of blocking or clogging necessitates the use of filters for efficient and trouble free operation of the drip system. The different types of filters include:

Media filter

Media filter consists of fine gravel and sand of selected sizes placed in a pressurized tank. It is required to remove organic matter such as algae mass and other vegetative material present in the water. The filters are made up of a circular tank filled with layers of coarse sand and different sizes of gravel with a provision of valves for flushing the filter assembly in case of clogging. The media filters are available in different sizes ranging from 500 to 900 mm diameter with an output of 15to 50 Cum respectively.

Hydro- cyclones or Centrifugal filters

If the irrigation water is having more sand, hydro-cyclone type filters are required to remove the sand; it is also known as vortex sand separator. Hydro-cyclone type filters are produced in various sizes for different discharges and have been found most suitable for removing particles from water before it enters the drip irrigation system. Hydro-cyclones must be followed by a screen filter as a safeguard.

Screen Filter

The screen filter is fitted in series with the gravel filter in order to further remove the solid impurities like fine sand, dust etc. from the water. In general, the screen filter consists of a single or double perforated cylinders placed in a plastic or metallic container for removing the impurities. Generally, 100 to 200 mesh screens are used in this type of filters. It must be cleaned and inspected periodically for satisfactory operation of any drip system.

Disc Filter

A disc filter is a type of water filter used primarily in irrigation, similar to a screen filter, except that the filter cartridge is made of a number of plastic discs stacked on top of each other like a pile of poker chips. Each disc is covered with small grooves or bumps. The discs (or rings) each have a hole in the middle, forming a hollow cylinder in the middle of the stack. The water passes through the small passages in between and the impurities are trapped behind.

The filtration quality is based on the quantity and size of particles that the filtering element is able to retain. Higher quality filtration simply means cleaner water. This depends on the geometry of the channels, including the size, length, angle, and number of generated intersection points. The discs are typically color coded to denote the level of filtration. Filtration quality is usually measured in microns, based on the smallest size particle filtered. The typical range is from 25 microns for the finest level of filtration to 400 microns for the coarsest. Sometimes the filtration quality is given as the equivalent mesh size of a comparable screen filter. Typical mesh sizes range from 40 to 600. When using mesh sizes, 40 are the coarsest and 600 is the finest or highest level of filtration.

Disc filters range in size from small units with a 3/4" inlet and outlet used for landscape drip irrigation systems to very large banks of multiple filters manifold together used for filtering large volumes of water for agricultural and industrial applications.

Some disc filters, especially the smaller ones, must be taken apart and cleaned by hand. Many of the larger ones can be back flushed in such a way that the discs are able to separate and spin during the cleaning cycle. In some cases, a booster pump may be required for back flushing. Disc filters can be used for many types of contaminants, including fine sand and organic matter`. However, when used to filter organic matter, they will clog more quickly than a media filter and will have to be cleaned more often. One advantage that the disc filter has over the media filter is that it can back flush more quickly with less flush water.

Fertilizer Applicators/Fertigation

The direct application of fertilizer through drip irrigation has increased the efficient use of fertilizer along with saving in labour and money. Application of fertilizer into pressurized irrigation system is done by either a by-pass pressure tank, or by venture pump or direct injection system. In by-pass system, by closing main system valve, certain quantity-generally 10% of flow quantity is allowed to by-pass through fertilizer tank. Then the by-passed water along with dissolved fertilizer goes into the system. In the venture-pump type fertilizer application, some water is passed through the venture (decreasing the diameter in taper form) where velocity head is created, due to increase in velocity at the place. This will create a suction head and will suck the fertilizer solution in the system. In direct infection type, pumps of piston type or diaphragm type are used. These pumps operated by the system pressure only, give fixed quantity of fertilizer in the water throughout irrigation.

Pressure Regulators

Pressure regulators are generally used to decrease the higher system pressure to the lower required system pressure. It controls pressures in one way only i.e. high to low. Pressure regulators are required on a large scale designfor undulating terrain and sloppy land etc. For normal small system, a simple by-pass valve can be used to control pressure in the system.

Valves or gauges

A zone system using valves to open and close various lines can be used to water several fields or sections of fields from one water source. A backflow/anti-siphon valve is a necessity for a system using a well or municipal source if fertilizers or chemicals are to be injected into the line. Hand-operated gate or ball valves or electric solenoid valves can be used to automate the system using a time clock, water need sensor, or automatic controller box.

Distribution Network

The distribution network mainly constitutes main line, sub-main line and laterals with dripper and other accessories.

Main and Sub-main Line

Generally Rigid PVC and High-Density Polyethylene (HDPE) pipes are used as main line. Pipes of 65 mm diameter and above with a pressure rating of 4 to 6 Kg/sq.cm are recommended for main pipes. These pipes laid underground, offer a long life of more than 20 years. For sub-main pipes, Rigid PVC, HDPE or LDPE (Low Density Polyethylene) are recommended. Pipes having an outer diameter

ranging from 32 mm to 75 mm with a pressure rating of 2.5 kg/sq.cm are used as sub-mains. These pipes may be laid above the ground or underground.

Laterals

The laterals/drip lines are normally manufactured from LDPE (Low Density Polyethylene). These pipes are generally laid above the ground. Recently a better material than the presently used LDPE i.e., Linear Low Density Polyethylene gives more protection against ultra violet rays and longer life of pipe than LDPE. Generally pipes having 10,12,16,20 mm internal diameter with wall thickness varying from 1 to 3 mm are used in drip system.

Drippers / Emitters

Drippers function as energy dissipaters, reducing the inlet pressure head (0.5 to 1.5 atmosphere) to zero atmosphere at the outlet. These drippers are generally manufactured from poly-propylene material.

Pressure Compensating Drippers

This type of dripper gives fairly uniform discharge at pressure varying from 0.3 to 3.5 atm. Generally, the drippers give 2,3,4,8 liters/hrdischarges at varying pressure. This type of rippers is provided with a high quality rubber diaphragm to control pressure. The pressure compensating type drippers are most suitable on slopes and difficult topographic terrains.

Other Accessories

The other accessories include take out/starter, rubber grommet, end plug, joints, tees, manifolds etc.

12.7 Irrigation Efficiency

Irrigation efficiency (Ea) is the amount of water stored in the crop root zone compared to the amount of irrigation water applied expressed as percentage. The irrigation efficiency of all the surface flood irrigation methods is a well below the 60 %.

Irrigation Efficiencies (%)	**Method of Irrigation**		
	Surface	**Sprinkler**	**Drip**
Conveyance Efficiency (%)	40-50 (canal) 60-70 (well)	-	-
Application Efficiency (%)	60-70	70-80	**90**
Surface water moisture evaporation (%)	30-40	30-40	**20-25**
Overall efficiency (%)	30-35	50-60	**80-90**

12.8 Bureau of Indian standards

Polythene pipe for irrigation – Laterals and Amendment Number -5 **IS 12786-1989 (reaffirmed 1998)**

Emitters **IS 13487: 1992**

Emitting pipe System **IS 13488: 2008**

Strainer type filters **IS 12785: 1994**

Irrigation Equipment rotating Sprinkler Part II, Test method for uniformity of distribution (1st revision) (amendment 1) (including Rain gun) **IS 12232: (part II) 1995**

Polythene micro tubes for DRIP Irrigation System **IS 14482:1997**

Fertilizer and Chemicals Injection System Part I Venturi Injector IS **14483: (Part 1) 1997**

Micro sprayers **IS 14605: 1998**
Media Filters **IS 14606: 1998**
Hydro Cyclone Separators **IS 14743: 1999**
PVC Pipe for Water supply **IS 4985: 1999**
Irrigation equipment Sprinkler pipes specifications (Part I) Polythene pipes **IS 14151: (Part II) 1999**
Irrigation equipment Sprinkler pipes specifications (Part II) Quick couples Polythene pipes **IS 14151: (Part II) 1999**
Quality of Irrigation Water **IS 11624: 1986**
HDPE pipe **IS 4984: 1995**
Moulded PVC Fittings **IS 7834: 1987**
CI and MS Fittings **IS 1879: 1987**
GM valves **IS 778: 1984**
CI non return valves **IS 778: 1984**
Fabricated PVC Fittings **IS 10124: 1928**
GI pipes **IS 1879: 1987**
Sluice valves **IS 780: 1984**
PE Fabricated Fittings **IS 8360: 1977**
PE Moulded Fittings **IS 808: 2003**
PVC Foot Valves and NRC **IS 10805: 1986**
Irrigation equipment rotating Sprinkler Part I Design and Operational requirement **IS 12232: (Part II) 1996**
Design Installation and Field evaluation of MIS **IS 10799: 1999**
Prevention and treatment of Blockage problems in Drip Irrigation Systems IS **14791: 2000**

DIVISION-13
CENTRIFUGALLY CAST (SPUN D.I. PIPES) FOR WATER, GAS AND SEWAGE

13.1 Pipes:

13.1.1 The pipes required to be supplied for the works shall confirm totheI.S. 8329:1994.

13.1.2 The pipes supplied shall be subjected to all the tests specified in Section 9 and 10 of IS 8329:1994before delivery at site and the manufacturer's tests certificate to this effect shall accompany each consignment delivered at site. In additionthepipes shall be got tested by the Inspectorate of D.G.S & D at the manufacturer's factory site and the relevant test certificate shall also be produced along with each consignment. The charges for conducting the test shall be borne by the bidder only and these charges are not reimbursable by the employer.

Joints:

The type of joints shall be flexible push on Tyton joint with elastomeric gasket and it should confirm to Sec. 5 of IS No. 8329:1994.

13.1.4 The size and mass of the pipes shall confirm strictly to clause 11of I.S. 8329:1994.

13.1.5 The standard working length of the pipe shall confirm to clause 12 of IS 8329:1994.

13.1.6 A list of firms which are on the approved list of suppliers to the department is given in Section '7'. The bidder is at liberty to procure the pipes from any of the firm in the approved list of suppliers but the responsibility for the pipes confirming to the relevant is specifications shall solely rest with the bidder only.

13.1.7 Thebidder'srateforrelevantitemsshall include not only the cost of pipes and Texas thereon and testing charges but also the charges for transportation to site and all subsequent handling and other incidental charges.

13.2 Specials:

13.2.1 The D.I. /C.I. specials to be supplied for use on the work shall confirm to IS 9523:1980 and 1538:1986respectively

13.2.2 The D.I. /C.I. specials required onthejob are indicated in the relevant plans contained in Vol4 of bid documents while sufficient care is taken by the employer to furnish and accurately as possible the specials required, the bidder is advised to inspect the alignment and satisfy himself about the sufficiency or other wise of the specials indicated before quoting for the work. Any additional specials required on the work not arising out of any changes made by the employer in terms of Sec.2. Clause 28.1 of Vol.1 shall be provided by the bidder at no extra cost.

13.2.3A list of firms which are on the approved list of suppliers to the department is given in Section '7'. The bidder is at liberty to procure the specials from any of the firms in the approved list of suppliers but the responsibility for the specials confirmation to the relevant I.S. specifications shall solely rest with the bidder only. The other conditions contained in Para 7.1.4 above shall be applicable to C.I. special also.

13.3 Sluice Valves:

The specification of sluice valves and other conditions for supply shall confirm to clause7.3. Division Vol.2.

13.4 Air Valves:

The specification for air valves and other conditions for supply shall confirm to clause 7.4., Division 4 of Vol2.

13.5 Surface Boxes:

The specifications for surface boxes and supply shall confirm to clause 7.11, Division 7 of Vol 2.

13.6 C.I. Manhole frames and covers:

The specification for C.I. manhole frames and covers and their supply shall confirm to clause 7.12, Division 7.

DIVISION-14

HIGH DENSITY POLYETHYLENE PIPES FOR WATER SUPPLY

14 .1 Pipes:

14.1.1 The pipes required to be supplied for the works shall confirm to the I.S. 4984:1995.

14.1.2 The pipes supplied shall be subjected to all the tests specified in IS 4985:1995 before delivery at site and the manufacturer's tests certificate to this effect shall accompany each consignment delivered at site. In additionthepipes shall be got tested by the Inspectorate of D.G.S & D at the manufacturer's factory site and the relevant test certificate shall also be produced along with each consignment. The charges for conducting the test shall be borne by the bidder only and these charges are not reimbursable by the employer.

Joints:

The type of joints shall be done by Electro Fusion/Butt Fusion Welding confirming to ISO 12176-1:1998 and ISO12176-2:2000

14.1.4 The size and mass of the pipes shall confirm strictly to I.S.4984:1995.

14.1.5 The standard working length of the pipe shall confirm to IS4984:1995.
14.1.6 A list of firms which are on the approved list of suppliers to the department is given in Section '7'. The bidder is at liberty to procure the pipes from any of the firm in the approved list of suppliers but the responsibility for the pipes confirming to the relevant is specifications shall solely rest with the bidder only.
14.1.7 Thebidder'srate for relevant items shall include not only the cost of pipes and Texas thereon and testing charges but also the charges for transportation to site and all subsequent handling and other incidental charges.

14.2 Specials:

14.2.1 The HDPE specials to be supplied for use on the work shall confirm to IS 8001 (Part I to IX)
14.2.2 The HDPE specials required on the job are indicated in the relevant plans contained in Vol4 of bid documents while sufficient care is taken by the employer to furnish and accurately as possible the specials required, the bidder is advised to inspect the alignment and satisfy himself about the sufficiency or other wise of the specials indicated before quoting for the work. Any additional specials required on the work not arising out of any changes made by the employer in terms of Sec.2. Clause 28.1 of Vol.1 shall be provided by the bidder at no extra cost.
14.2.3 A list of firms which are on the approved list of suppliers to the department is given in Section '7'. The bidder is at liberty to procure the specials from any of the firms in the approved list of suppliers but the responsibility for the specials confirmation to the relevant I.S. specifications shall solely rest with the bidder only.

Section - 5: Materials, Plant and Machinery

SECTION V

MATERIALS, PLANT & MACHINERY

5.1 MATERIAL

a. **General**

All materials to be provided by the Contractors shall be in conformity with the specifications, laid down in the contract and the Contractor shall if required by the Employer / Employer's Representative furnish proof about their suitability and fitness to the entire satisfaction of the Employer / Employer's Representative.

b. **Storage of Materials**

i. All materials brought and kept at site of work by the Contractor or by his orders for the purpose of forming part of the works are to be considered to be the property of the Department and the same shall not to be removed or taken away by the Contractor or any other person without the written permission of the Employer / Employer's Representative, but the Employer / Employer's Representative shall not to be responsible for any loss or damage which may occur to or in respect of any such work or materials either by the same being lost or stolen or damaged by weather or otherwise including natural calamities (flood, earthquake, rains, riots, fire etc.).

ii. Materials required for the works shall be stored by the Contractor only at places, in standard profiles and in the manner as approved by the Employer / Employer's Representative. Storage and safe custody of all materials shall be the sole responsibility of the Contractor. Special care should be taken as per relevant specification for storage of bitumen etc.

iii. Steel reinforcement shall be stored in such a way as to avoid distortion and to prevent deterioration by corrosion where directed by the Employer / Employer's Representative in charge, the reinforcing bars shall be given cement wash before stacking to prevent scale and rust at the expense of the Contractor and nothing extra shall be paid by the department for these accounts.

iv. The Contractor shall construct suitable go down at the site of work for storing the material safe against damage due to sun, rain, dampness, fire, theft etc. He shall also employ necessary watch and ward for the purpose and no extra claim whatsoever shall be entertained on this account.

v. Cement in bags shall be stored in separate go down with pucca floor and water proof roofs etc. The cement bags shall be stacked and stored in accordance with standard codes of practice.

vi. From commencement till completion, all materials and works shall be under the safe custody of Contractor. The Contractor is solely responsible for and to make good all injuries, damages and repairs accrued to or rendered necessary to the same by fire, storm, rain, traffic or other causes and to hold the Employer / Employer's Representative indemnified from any claim for injuries to person or for structural damage to property occurring from any neglect, default, want of proper care or misconduct on the part of Contractor.

vii. The Contractor shall be required to produce samples of all materials to be procured by him sufficiently in advance to obtain approval of the Employer / Employer's Representative. Subsequently the materials to be used in the actual execution of the work shall strictly conform to the quality of samples approved. In case of variation in quality, such materials shall be liable for rejection. The rejected material shall be immediately removed from the site of work by the Contractor at his own cost. If the Contractor fails to remove the rejected material from the site within 48 hours of their rejection, the Employer / Employer's Representative shall be authorized to remove the same at the risk and cost of the Contractor.

c. **Quality control and Testing of Material**

i. The Contractor at his own expense shall establish field laboratory with necessary equipment to carry out tests such as grading of aggregate, fineness modulus of sand, bulking of sand, silt content in sand, tests on cement and concrete etc. at the Site of work. The Contractor shall be required to provide appliances at site, such as weighing scale, graduated cylinder, standard sieves, thermometers etc. in order to enable the Employer / Employer's Representative to conduct field tests, whenever required by him to ensure that the quality is consistent with the prescribed specification. Similarly, well-equipped laboratory for testing of bitumen and asphaltic work including earth work shall be provided by the Contractor at site of work.

ii. The materials such as water, sand, cement, aggregates, etc., to be used in the works like concrete, masonry, etc. shall comply with the requirements of the Employer / Employer's Representative and shall pass all the tests and analysis required by him or as per particular specifications as applicable or such recognized specifications as acceptable to the Employer / Employer's Representative.

iii. All the necessary tests/the number of tests shall be conducted in the laboratory established at site by the Contractor or in any recognized laboratory approved by the Employer / Employer's Representative. The samples shall be taken for carrying out all or any of the tests stipulated in the particular specifications or as directed by the Employer / Employer's Representative or his authorized representative. The Contractor shall at his risk and cost make all arrangements and shall provide all such facilities as the Employer / Employer's Representative may require for collecting, preparing, forwarding the required number of samples for tests and for analysis as per the frequency of test stipulated in the contract specifications or as considered necessary by the Employer / Employer's Representative, at such time and to such places, as directed by the Employer / Employer's Representative.

iv. The decision of the Employer / Employer's Representative regarding type of tests, their frequency, and suitability of any of the materials to be used in the work shall be final and binding on the Contractor notwithstanding any other provision elsewhere in the tender documents.

The Contractor or his authorized representative shall associate in collection, preparation, forwarding and testing of such samples. Even if he or his authorized representative is not present or does not associate him, the result of such tests and consequences thereon shall be binding on the Contractor. The Contractor or his authorized representative shall remain in contact with the Employer / Employer's Representative or his authorized representative for associating for all such operations.

vi. The Contractor shall give not less than 7 days' notice of all tests in order that the Employer / Employer's Representative may be present. Two copies of all test certificates shall be supplied by the Contractor to the Employer / Employer's Representative for approval, immediately after the completion of the tests. Test certificates shall invariably be supplied to the Employer / Employer's Representative before the materials or components are used in the works, unless the Employer / Employer's Representative directs otherwise.

vii. All materials which are specified to be tested at the place of manufacture shall satisfactorily pass the tests before being used in the works**.**

viii. The contractor shall have all the minimum equipment's/apparatus in the field laboratory but not limited to the following:

- Set of sieves as per IS for sieving sand and aggregate
- Aggregate crushing strength apparatus
- Graduated cylinder

- Weighing scale
- Cube moulds
- Compression testing machine
- Vibrators
- Humidity Chamber
- Lechattlier apparatus
- Tension tester
- Slump cone with tamping rod
- Proctor compaction moulds, hammer, etc.
- Rapid moisture meter
- Weighing scale 0.1 gmaccuracy
- Weighing scale 10kg
- Core cutter, sand replacement units
- Hot air oven
- Pycnometer bottle and conical brass cap and washer
- Liquid limit device
- Proctor Compaction needle
- Apparatus for testing of bitumen and asphalting work

d. **Other Materials**

Any material, for whichthereis no relevant Indian Standard, shall be the best of their kind and to the approval of the Employer / Employer's Representative. Contractor shall at his own expense, submit to the Employer / Employer's Representative for approval, samples of any of the materials and components to be used. The quality of materials and components subsequently used in the works shall not be inferior to the approved samples.

5.2. **Quality control of concrete works**

a. The Contractor at his own expense shall establish a field laboratory to carry out all preliminary tests, work tests and also to work out grading and proportioning of aggregates in order to obtain and maintain uniform quality of work. A compression testing machine of suitable capacity as indicated by the Employer / Employer's Representative shallbeinstalledby the Contractor at his own expense to ascertain the strength of concrete at his own expense from time to time. The Contractor shall supply all materials, labour and testing machines for preparing and testing sample as required by the Employer / Employer's Representative. The concrete shall also be got tested in an independent laboratory approved by the Employer / Employer's Representative at the discretion of the Employer / Employer's Representative or his authorizedrepresentative.

b. Number of concrete cubes shall be taken as per clause 1716 of MORT&H specifications for Road and Bridge Works (Fourth Revision) published by Indian Roads Congress, New Delhi reprinted in March 2002 or as directed by the Employer / Employer's Representative.

c. These tests shall be carried out in accordance with the procedure as laid down inI.S 516 or other relevant specifications

d. The testing machine should also be recalibrated at regular intervals to detect errors periodically. The moulds for cubes shall also be checked at frequent intervals and are made to conform to the standard prescribed in I.S. 516.

e. Permeability test shall be carried out as per 1716.5 of MORT&H specifications for Road and Bridge Works (Fourth Revision) published by Indian Roads Congress, New Delhi reprinted in March 2002.

5.3 **Construction Equipment**

a. The methodology and equipment to be used on the project shall be furnished by the

Contractor to the Employer / Employer's Representative well in advance of commencement of work and approval obtained prior to its adoption and use.

b. The Contractor shall give a trial run of the equipment for establishing the capability to achieve the laid down specification and tolerance to the satisfaction oftheEmployer / Employer's Representative before commencement of work.

c. All equipment provided shall be of proven efficiency and shall be operated and maintained at all times in a good working condition.

d. No equipment orpersonnel will be removed from the site without prior permission of the Employer / Employer's Representative.

e. No tools and plants will be supplied by the department and the Contractor will have to make his own arrangements at his expense.

f. All construction tools, plant and machineries provided by the Contractor shall, when brought to the site, be deemed to be exclusively intended for the construction and completion of this work and the Contractor shall not remove the same or any part thereof (save for the purpose of moving it from one part of the site to another) without the written permission of the Employer / Employer's Representative.

g. Incase concrete is procured from Ready Mixed Concrete (RMC) plants, the contractorhasto obtain prior approval of the Employer / Employer's Representative. Quality controlling at Batching Plant has tobecarried out by the Contractor at his own cost.

Section - 6: Supplementary Specifications

SECTION – VI
Supplementary Specifications

Preamble

This section contains the specifications for proposed work and shall be read in conjunction with the various other sections forming the contract namely Notification Inviting Applications, Instructions to Tenderers, General Conditions, Special Conditions, Drawings and other related documents mentioned in this Tender Document together with any Addendum issued thereto.

General Specifications: As mentioned in Section-IV of Volume-II

Supplementary Specifications: As mentioned in Section-IVof Volume- II

Section - 7: List of Approved Makes

SECTION – VII
List of Approved Makes

Sl. No.	Item/Equipment	Specified Makes
Pipes		
1	DI Pipes	Jindal Saw/TATA Metaliks/Kubota/Electro steel
2	DI Fitting/ Specials	Jindal /Bharat Industrial Corporation/Oriental Castings/Electro steel Castings/TISCO/Kejriwal Casting
3	HDPE/MDPE Pipes	Jain Irrigation /Kimplas/Timeplast/Duraline
4	HDPE Fittings	Kimplas /George Fischer/Aviva/Presto
5	MS Pipes	Essar Steel/ Surya Global steel tubes Pvt. Ltd./ Jindal/ Tata
6	PVC Pipes	Supreme/Prince/Finolex
7	Dismantling Joints	Bharat Industrial Corporation/Oriental Castings/Electro Steel Castings/TISCO/Kejriwal Castings
Pumps, Motors		
8	Centrifugal Water Pump Sets	Kirloskar/Jyoti/M&P(WILO)/FBM(Pentair)/Aqua/WPIL/ KSB/Flow More
9	Motors	Kirloskar/ Seimens/ABB
10	Switch fuses and MCCB's	L&T/English Electric/Siemens/Control and switch gear/ BhartiaCuttler& hammer/Crompton Greaves
11	Lighting Fixtures	Philips/Bajaj/Crompton/Wipro
Valves and Gates		
12	DI Resilient Soft Seated Sluice Valve	FOURESS/IVC/KIRLOSKAR/VAG/TALIS/Durga/AVK
13	Butterfly Valve	FOURESS/IVC/KIRLOSKAR/VAG/TALIS/Durga/AVK/ ADVANCE
14	Air Valve	FOURESS/IVC/KIRLOSKAR/VAG/TALIS/Durga/AVK/ ADVANCE
15	Swing type non return valves	IVC/ Glenfield/ VAG/ KBL
16	Ball Valves	Jainson Industries/ L&T
Cranes		
17	HOT Crane	Brady & Morris Engineering Co./Hercules hoists Ltd./Sharp Engineering Pvt. Ltd.
18	EOT Crane	Eddy Cranes/Electromech/Consolidated Hoist/Brady & Morris Engineering Co./Hercules Hoist Ltd./JAPS Project
19	Chain pulley block	Safex/Brady & Morris Engineering Co./Hercules hoists Ltd/Reva Engineering/Indef Engineering
Others		
20	Reinforcement Steel	SAIL/VIZAG STEEL/TATA
21	Cement	ACC/AMBUJA/ULTRATECH/LAFARGE

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Section - 8: Additional Specifications

SECTION – VIII
Additional Specifications

TABLE OF CONTENT

PART 1 – GENERAL SPECIFICATIONS

GENERAL

1.1 Reference mentioned herein shall be applicable to all sections to the extent the context permits and are intended to supplement the provisions in the particular section. In case of any discrepancy/deviation, the provisions in the particular section shall take precedence.

INTERPRETATIONS

2.1 The Employer/Engineer-in-charge shall be the sole deciding authority as to the meaning, interpretation and implications for various provisions of the specifications. His decision in writing shall be final.

2.2 Wherever any reference is made to any Indian Standard, it shall be taken as reference to the latest edition with all amendments issued thereto. In the event of any variation between the Kerala Detailed Standard Specifications, CPWD specifications and the Indian Standard, the former shall take precedence over the latter.

2.3 In case the specification of an item is not available in this document or documents specified in Clause no 2.2, Contractor shall be permitted to use following alternative specification subject to the following conditions:

a. He shall demonstrate that the proposed specification conforms to any of the following international Standards, Codes of Practice, Specifications, Guidelines, etc.

b. it shall delivering an equal or better product and shall fulfill the intentoftheproduct.

1. International standard organization (ISO)
2. British Standards
3. American Society for Testing of Materials (ASTM)
4. German Standards
5. Euro Codes

DEFINITIONS

The following terms and expressions in the specifications shall have the meaning or implication hereby assigned to them unless otherwise specified elsewhere.

Contractor: The Contractor shall mean the individual or firm or company whether incorporated or not undertaking the works and shall include the legal personal representatives of such individual or the persons composing such firm or company, or the successors of such individual or firm or company and the permitted assignees of such individual or firm of company.

Engineer-in-Charge: The 'Engineer-in-Charge' means the Engineer officer who shall supervise and be in-charge of the work and who shall sign the contract on behalf of the President.

Site: The 'site' shall mean the land/ or other places on, in, into or through which the work is to be executed under the contract or any adjacent land, path or street through which the work is to be executed under the contract, or any adjacent land, path or street which may be allotted or used for the purpose of carrying out the contract.

Store: The 'store' shall mean the place of issue of materials.

IS: The standards, specification and code of practices issued by the Bureau of Indian Standards.

Best: The word 'best' when used shall mean that in the opinion of the Engineer-in-Charge, there is no superior material/ article and workmanship obtainable in the market and trade respectively. As far as possible the standard required shall be specified in preference to the word 'best'.

Department: 'Department' shall be KIIDC

Floor 1 is the lowest floor above the ground level in the building unless otherwise

specified in a particular case. The floors above floor 1 shall be numbered in sequence as floor 2, floor 3 and so on. The number shall increase upwards.
Floor level: For floor 1, top level of finished floor shall be the floor level and for all other floors above floor 1, top level of the structural slabs shall be the floor level.
Plinth level: Floor 1 level or 1.2 m above the ground level whichever is lower shall be the plinth level.

3.1 Special Structures

For structures like retaining walls, wing walls, chimneys, overhead reservoirs/ tanks and other elevated structures, where elevations/ heights above a defined datum level have not been specified and identification of floors cannot be done as in case of building. Level, at 1.2 m above the ground level shall be the floor 1 level as well as plinth level. Level at a height of 3.5 m above floor 1 level will be reckoned as floor 2 level and level at a height of 3.5 m above the floor 2 level will be floor 3 level and so on, where the total height above floor 1 level is not a whole number multiple of 3.5 metre. Top most floor level shall be the next in sequence to the floor level below even if the difference in height between the two upper most floor levels is less than 3.5 metres

FOUNDATION AND PLINTH

The work in foundation and plinth shall include:
For buildings: All works up to1.2 metreabove ground level or up to floor1 level whichever is lower:
For abutments, piers and well steining: all works up to1.2 m above the bed level:
For retaining wall, wing walls, compound walls, chimneys, overhead reservoirs/ tanks and other elevated structures: All works upto1.2 metreabove the ground level:
For reservoirs/ tanks (other than overhead reservoirs/ tanks): All works up to 1.2 metreabove the ground level:
For basements: All works upto1.2 m above ground level or up tofloor1 level whichever is lower.
Note: Specific provision shall be made in the estimate for such situations where the foundation level is more than 3 (three) metre depth from the plinth for all types of structures mentioned above.

MEASUREMENTS

5.1 In booking dimensions, the order shall be consistent and in the sequence of length, width and height or depth or thickness.
5.2 Rounding off: Rounding off where required shall bedone in accordance with IS: 2-1960. The number of significant places rounded in the rounded off value should be as specified.

MATERIALS

6.1 Samples of all materials to be used on the work shall be got approved by the contractor from the Engineer-in-Charge well in time. The approved samples duly authenticated and sealed shall be kept in the custody of the Engineer-in-Charge till the completion of the work. All materials to be provided by the contractor shall be brand new and as per the samples approved by the Engineer-in-Charge.
6.2 Materials obtained by the contractor from the sources approved by the Department shall be subjected to the Mandatory tests. Where such materials do not conform to the relevant specifications, the matter shall be taken up by the Engineer-in-Charge for appropriate action against the defaulters. In all such cases, necessary documents in original and proof of payment relating to the procurement of materials shall bemadeavailableby the contractor to the Engineer-in-Charge.
6.3 All the Materials incorporated in the Works shall be the most suitable for the duty concerned and shall be new and of first class commercial quality, free from imperfections

and selected for long life and minimum maintenance. These may be tested according to relevant Indian Standards (IS) or International Standards Organization (ISO) standards in qualified labs and certificates produced to the satisfaction of the Employer's Representative.

6.4 The objectives of the specifications given are to specify the details pertaining to the designs, drawings, and selection of equipment or product. The equipment or product supplied shall be of high standard of quality and best engineering practices and shall comply with all currently applicable standards, regulationsand codes.

6.5 All necessary safety measures and precautions (including those laid down in the various relevant Indian Standards) shall be taken as also of the work itself.

6.6 The materials, supplied by the client shall be deemed to be complying with the specifications.

6.7 Contractor shall submit sample of the material and get written approval of the Employer/Engineer – charge before placing the order. Any work executed without approval of sample shall be deemed rejected.

6.8 All work shall be executed as per approved drawing only

6.9 Approval to any of the executed items for the work does not in any way relieve the Contractor of his responsibility for the correctness, soundness and strength of the structure as per the drawings and specifications.

6.10 All works shall be carried out strictly as per detailed technical specification provided in the tender. If not specified, the work shall be executed according to relevant applicable IS codes and standard engineering practice. In such case decision of the Engineer-in-charge shall be final and binding to the Contractor and in no case the Contractor will claim any extra for the same.

6.11 If the specifications for a particular item are not given by the Employer, the Standard Specifications of Kerala/CPWD specification/Indian standard shall be followed. In all the conditions, direction of Engineer in charge shall be final binding upon the contractor.

6.12 Materials stored at site, depending upon the individual characteristics, shall be protected from atmospheric effects due to rain, sun, wind and moisture to avoid deterioration.

6.13 Materials like timber, paints etc. shall be stored in such a way that there may not be any possibility of fire hazards. Inflammable materials and explosives shall be stored in accordance with the relevant rules and regulations or as approved by Engineer-in-Charge in writing so as to ensure desired safety during storage.

6.14 The unit weight of materials unless otherwise specified shallbereckoned as given in IS: 1911-1967.

SAMPLES AND TESTS OF MATERIALS

All tests as required, both at the factory i.e. Factory Acceptance Test (FAT) before dispatch, and at site after installation i.e. Site Acceptance Tests (SAT), shall be carried out. Detailed Test reports and certificates shall be submitted.

The Contractor shall submit samples of such materials as may be required by Engineer in charge and shall carry out the specified tests directed by KIIDC/ Engineer in charge at the Site, at the supplier's premises or at a laboratory approved by KIIDC/ Engineer in charge. All other incidental expenditure to be incurred for testing of samples e.g. packaging, sealing transportation, loading, unloading etc. testing charges shall be borne by the contractor.

Employer may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests.

Samples shall be submitted and tests carried out sufficiently early to enable further

samples to be submitted and tested if required by KIIDC/ Engineer in charge. The Contractor shall give seven days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the supplier's premises or at a laboratory approved by Employer. Representative of Employer shall attend the test at the appointed place within seven days of the said date on which the materials are expected to be ready for testing or inspection according to the Contractor, failing which the test may proceed in his absence unless instructed by Employer to carry out such a test on a mutually agreed date in his presence. Prior to testing, all relevant documentation and sufficient briefing about the tests shall be given to Employer's Representatives who would witness the testing. The Contractor shall in any case submit to KIIDC/ Engineer in charge within seven days of every test such number of certified copies (minimum six) of the test results as KIIDC/ Engineer in charge may require. Approval by KIIDC/ Engineer in charge as to the placing of orders for materials or as to samples or tests shall not prejudice any powers under the Contract. The provisions of this clause shall also apply fully to materials supplied under any nominated sub-contract.

SAFETY IN CONSTRUCTION

8.1 The contractor shall employ only such methods of construction, tools and plant as are appropriate for the type of work or as approved by Engineer-in-Charge in writing.

8.2 The contractor shall take all precautions and measures to ensure safety of works and workman and shall be fully responsible for the same. Safety pertaining to construction works such as excavation, centering andshuttering, trenching, blasting, demolition, electric connections, scaffolds, ladders, working platforms, gangway, mixing of bituminous materials, electric and gas welding, use of hoisting and construction machinery shall be governed by CPWD safety code, relevant safety codes and the direction of Engineer-in- Charge.

ABBREVIATIONS

The following abbreviations wherever theyappear in the specifications shall have the meaning or implication hereby assigned to them:

Mm - Millimetre
Cm - Centimetre
M - Metre
Km - Kilometre
Mm2/sqmm - Square Milimetre
Cm2/sqcm - Square centimetre
Dm2/sqdm - Square decimetre
M2/sqm - Square metre
Cm3/cubic cm - Cubic centimetre
Dm3/cubic dm- Cubic decimetre
M3/cum - Cubic metre
Ml - Milli litre
Kl - Kilo litre
Gm - Gram
Kg - Kilogram
Q - Quintal
T - Tonne
FPSsystem - Foot pound second system
°C - Degree Celsius temperature
Fig - Figure
Re/Rs - Rupee/Rupees
No - Number

Dia - Diameter
AC - Asbestos cement
CI - Cast Iron
GC - Galvanized corrugated
GP - Galvanized plain
GI- Galvanized Iron
PVC - Polyvinylchloride
RCC - Reinforced cement concrete
SWG - Standard wire Gauge

CAPEX	Capital Expenditure
OPEX	Operating Expenditure
KPI	Key Performance Indicator
BHN	Brinell Hardness number
HDPE	High Density Poly Ethylene
LTHS	Long Term Hydrostatic Strength
MFR	Melt Flow Rate
OD	Outer Diameter
RT	Radiography Test
EPDM	Ethylene Propylene Diene Monomer (A synthetic Rubber)
SBR	Styrene Butadine Rubber
DI	Ductile Iron
PE	Poly Ethylene
ISO	International Organization for Standardization
AWWA	American Water Works Association
NPSH	Net positive Suction Head
WMM	Wet Mix Macadam
PIU	Project Implementation Unit
IBM	International Business Machines
EN	European Norms
NBR	Nitrile Butadine Number
VFD	Variable Frequency Drive
SCADA	Supervisory Control and Data Acquisition

PART 2 - GENERAL (MATERIAL) SPECIFICATIONS

1.1 GENERAL

Materials to be used in the work shall conform to the specifications mentioned on the drawings, the requirements laid down in this section and specifications for relevant items of work covered under these specifications.

If any material, not covered in these specifications, is required to be used in the work, it shall conform to relevant Indian Standards, if there are any, or to the requirements specified by the Engineer.

1.2 SOURCES OF MATERIAL

The Contractor shall notify the Engineer of his proposed sources of materials prior to delivery. If it is found after trial that sources of supply previously approved do not produce uniform and satisfactory products, or if the product from any other source proves unacceptable at any time, the Contractor shall furnish acceptable material from other sources at his own expense.

BRICKS

The bricks shall be modular type class designation – 25, kiln-burnt bricks of regular and uniform size, shape and colour, well burnt throughout. They shall be free from cracks or other flaws viz. lumps of lime, laminations, soluble salts causing efflorescence, air-holes which may in any way impair their strength durability, appearance etc. They shall give a clear metallic ringing sound when struck together.

After absorbing water the bricks shall not exceed 20% of their dry weight as per IS: 1077 - 1992. According to IS: 1077 - 1992 crushing load shall not be less than 25 Kg. /Sq. Cm. Samples of bricks shall also be subjected to the following tests:

Dimensional tolerance.

Water absorption.

Efflorescence.

Compressive strength.

STONES

Stones shall be of the type specified. It shall be hard, sound, and free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used.

The stones, when immersed in water for 24 hours, shall not absorb water by more than 5 per cent of their dry weight when tested in accordance with IS: 1124 -1972.

The length of stones shall not exceed 3 times its height nor shall they be less than twice its height plus one joint. No stone shall be less in width than the height and width on the base shall not be greater than three-fourth of the thickness of the wall nor less than 150 mm.

CAST IRON

Cast iron shall conform to IS: 210-2009. The grade number of the material shall not be less than 14.

CEMENT

Cement to be used in the works shall be any of the following types with the prior approval of the Engineer:

Ordinary Portland cement, 43 Grade, conforming to IS: 8112-1989.

Rapid Hardening Portland Cement, conforming to IS: 8041-1990.

SulphateResistant Portland cement, conforming to IS: 12330-1988.

Cement conforming to IS: 8112-1989 and IS: 12269-1987 may be used provided the minimum cement content mentioned elsewhere from durability considerations is not

reduced. From strength considerations, these cements shall be used with a certain caution as high early strengths of cement in the 1 to 28–day range can be achieved by finer grinding and higher constituent ratio of C_3S/C_2S, where C_3S is Tricalcium Silicate and C_2S is Di calcium Silicate. In such cements, the further growth of strength beyond say 4 weeks may be much lower than that traditionally expected. Therefore, further strength tests shall be carried out for 56 and 90 days to fine tune the mix design from strength considerations.

Cement conforming to IS: 12330-1988 shall be used when sodium sulphateand magnesium sulphateare present in large enough concentration to be aggressive to concrete. The recommended threshold values as per IS: 456-2000 are sulphate concentration in excess of0.2 per cent in soil sub-strata or300 ppm (0.03 per cent) in ground water. Tests to confirm actual values of sulphateconcentration are essential whenthestructure is located near the sea coast, chemical factories, and agricultural land using chemical fertilizers and sites where there are effluent discharges or where soluble sulphate bearing ground water level is high. Cement conforming to IS: 12330-1988 shall be carefully selected from strength considerations to ensure that the minimum required design strength can be achieved without exceeding the maximum permissible cement content of 540 kg/cu.mofconcrete.

Cement conforming to IS: 8041-1990 shall be used only for precast concrete products after specific approval of the Engineer.

Total chloride content in cement shall in no case exceed 0.05 per cent by mass of cement. Also, total sulphur content calculated as sulphuric anhydride (SO_3) shall in no case exceed 2.5 per cent and 3.0 per cent when tri-calcium aluminate percent by mass is up to 5 or greater than 5 respectively.

COARSE AGGREGATES

For plain and reinforced cement concrete (PCC and RCC) works, coarse aggregate shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone, crushed gravel, natural gravel or a suitable combination thereof or other approved inert material. They shall not contain pieces of disintegrated stones, soft, flaky, elongated particles, salt, alkali, vegetable matter or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the steel reinforcement. Coarse aggregate having positive alkali-silica reaction shall not be used. All coarse aggregates shall conform to IS: 383 - 1970 and tests for conformity shall be carried out as per IS: 2386 -1963, Parts I to VIII.

The contractor shall submit for the approval of the Engineer, the entire information indicated in Appendix A ofIS: 383-1970.

The maximum value for flakiness index for coarse aggregate shall not exceed 35 per cent. The coarse aggregate shall satisfy the following requirements of grading:

REQUIREMENTS OF COARSE AGGREGATE

IS Sieve Size	**Per cent Weight Passing the Sieve**		
	40 mm	**20 mm**	**12.5 mm**
63 mm	100	-	-
40 mm	95-100	100	-
20 mm	30-70	95-100	100

12.5 mm	-	-	90-100
10 mm	10-35	25-55	40-85
4.75 mm	0-5	0-10	0-10

SAND/FINE AGGREGATES

For masonry work, sand shall conform to the requirements of IS: 2116-1980.

For plain and reinforced cement (PCC and RCC) or Pre-stressed Concrete (PSC) works, fine aggregate shall consist of clean, hard, strong and durable pieces of crushed stone, crushed gravel, or a suitable combination of natural sand, crushed stone or gravel. They shall not contain dust, lumps, soft or flaky, materials, mica or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the embedded steel. Motorized sand washing machines should be used to remove impurities from sand. Fine aggregate having positive alkali-silica reaction shall not be used. All fine aggregates shall conform to IS: 383-1980 and tests for conformity shall be carried out as per IS: 2386-1963, (Parts I to VIII). The Contractor shall submit to the Engineer the entire information indicated in Appendix A of IS: 383-1980. The fineness modulus of fine aggregate shall neither be less than2.0 nor greater than 3.5.

Sand/fine aggregate for structural concrete shall conform to the following grading requirements:

IS Sieve Size	**Per cent by Weight Passing the Sieve**		
	Zone I	**Zone II**	**Zone III**
10 mm	100	100	100
4.75 mm	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 micron	15-34	35-59	60-79
300 micron	5-20	8-30	12-40
150 micron	0-10	0-10	0-10

1.9 STEEL

1.9.1 Cast Steel

The use of cast steel shall be limited to bearings and other similar parts. Steel for castings shall conform to Grade 280-520N of IS: 1030-1998. In case where subsequent welding is unavoidable in the relevant cast steel components, the letter N at the end of the grade designation of the steel casting shall be replaced by letter W. 0.3 per cent to 0.5 per cent copper may be added to increase the corrosion resistance properties.

Reinforcement/ UntensionedSteel

For plain and reinforced cement concrete (PCC and RCC), the reinforcement/untensioned steel as the case may be shall consist of the following grades of reinforcing bars.

Grade Designation	**Bar Type conforming to governing ISSpecification**	Characteristic **Strength fy MPa**	**Elastic Modulus GPa**

S 240	IS: 432- 1982 Part IMild Steel Bar	240	200
S 415	IS: 1786- 2008 High Yield Strength Deformed Bars (HYSD)	415	200

Other grades of bars conforming to IS: 432-1982 and IS: 1786-2008 shall not be permitted. All steel shall be procured from original producers; no re-rolled steel shall be incorporated in the work.

Only new steel shall be delivered to the site. Every bar shall be inspected before assembling on the work and defective, brittle or burnt bar shall be discarded. Cracked ends of bars shall be discarded.

Fusion-bonded epoxy coated reinforcing bars shall meet the requirements of IS: 13620 - 1993. Additional requirements for the use of such reinforcement bars have been given below:

Patch up materials shall be procured in sealed containers with certificates from the agency who has supplied the fusion bonded epoxy bars.

PVC coated G.I. blinding wires of 18G shall only be used in conjunction with fusion bonded epoxy bars.

Chairs for supporting the reinforcement shall also be of fusion bonded epoxy coated bars.

The cuts ends and damaged portions shall be touched up with repair patch up material.

The bars shall be cut by saw-cutting rather than flame cutting.

While bending the bars, the pins of work benches shall be provided with PVC or plastic sleeves.

The coated steel shall not be directly exposed to sun rays or rains and shall be protected with opaque polyethylene sheets or such other approved materials.

While concreting, the workmen or trolleys shall not directly move on coated bars but can move on wooden planks placed on the bars.

When specified in the contract, protective coating prescribed by CECRI shall be provided in conformance to specifications given in *Appendix 1000/I*. The CECRI coating process shall be allowed to be implemented at the site of works provided a representative of the Institute is present throughout the duration of the coating process who shall certify that the materials and workmanship are in accordance with prescribed specifications developed by the Institute.

Grey Iron Castings

Grey Iron castings to be used for bearings shall have the following minimum properties:

(i) Minimum ultimate tensile strength- 370MPa
(ii) Modulus of Elasticity147000MPa
(iii) Brinell Hardness 230MPa
(iv) Shear strength 370MPa
(v) Compressive Strength1370 MPa

The testing shall be as specified in IS: 210.

Steel Forgings

Forged steel pins shall comply with clause3, 3A or 4 of IS: 1875-1992 and steel forgings shall comply with clause 3, 3A or 4 of IS: 2004-1991. Raw materials of the forging will be taken as per IS: 1875-1992 with minimum reduction ratio of 1.8:1. Alternatively, if forging is made from ingot a minimum reduction ratio between the ingot and forging will be 4:1. Forging shall be normalized.

Structural Steel

Unless otherwise permitted herein, all structural steel shall, before fabrication, comply with the requirements of the following Indian Standards:
IS: 2062-2011:Hot Rolled Medium and High Tensile Structural Steel
IS:2062-2011:Wieldable Structural Steel
IS:1148-2009:Hot rolled rivet bars for structural purposes
IS:1161-1998:Steel tubes for structural purposes
IS: 4923-1997:Hollow Steel sections

For structural use
IS: 11587-1986: Structural weather resistant steel
IS: 808-1989:Specifications for Rolled Steel Beam, Channel and Angle Sections
IS: 1239-2004:Mild Steel Tubes
IS: 1730-1989:Dimension for Steel Plate, sheet and strip for structural and general engineering purposes
IS:1732-1989:Dimension for round and square steel bars for structural and general engineering purposes
IS: 1852-1985:Rolling and cutting tolerances for hot rolled steel products
The use of structural steel not covered by the above standards may be permitted with the specific approval of the client/Engineer-in-charge.

Stainless Steel

Stainless steel shall be austenitic chromium-nickel steel, possessing rust, acid and heat resistant properties conforming to IS: 6603-2001 and IS: 6911-1992. Mechanical properties/ grade for such stainless steel shall be as specified by the accepting authority, but in no case be inferior to mild steel. Generally, stainless steel is available as per ISI grades. ISI 304 which is equivalent to grade 04Cr18Ni110 of IS: 6911 satisfies the requirements of mechanical properties of structural steel. Other grades of stainless steel for specific purposes may be provided as per specific requirements. For application in adverse/corrosive environment, stainless steel shall conform to 02G17 Ni Mo2 of IS: 6911 -1992.

WATER

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials orother substances that may be deleterious to concrete or steel. Potable water is generally considered satisfactory for mixing concrete. Mixing and curing with sea water shall not be permitted. As a guide, the following concentrations represent the maximum permissible values:
To neutralize 200 ml sample of water, using phenolphthalein as an indicator, it should not require more than 2 ml of 0.1 normalNaOH.
To neutralize 200 ml sample of water, using methyl orange as an indicator, it should not require more than 10 ml of 0.1 normal HCI.
The permissible limits for solids shall be as follows when tested in accordance with IS: 3025:
Permissible Limits (max)
Organic 200mg/lit
Inorganic 3000mg/lit
Sulphate(SO_4) - 500mg/lit
Chlorides(CI) - 500 mg/lit*
Suspended matter - 2000mg/lit
In case of structures of lengths 30 m and below, the permissible limit of chlorides may be increased up to 1000mg/lit.
All samples of water (including potable water) shall be tested and suitable measures taken

where necessary to ensure conformity of the water to the requirements stated herein.
The pH value shall not be less than 6.

1.9.8 **TIMBER**

The timber used for structural purposes shall conform to IS: 883-1994.

CONCRETE ADMIXTURES

General

Admixtures are materials added to the concrete before or during mixing with a view to modify one or more of the properties of concrete in the plastic or hardened state.

Concrete admixtures are proprietary items of manufacture and shall be obtained only from established manufacturers with proven track record, quality assurance and full -fledged laboratory facilities for the manufacture and testing of concrete.

The contractor shall provide the following information concerning each admixture after obtaining the same from the manufacturer:

Normal dosage and detrimental effects, if any, of under dosage and over dosage.

The chemical names of the main ingredients in the admixtures.

The chloride content, if any, expressed as a percentage by the weight of the admixture.

Values of dry material content, ash content and relative density of the admixture which can be used for Uniformity Tests.

Whether or not the admixture leads to the entertainment of air when used as per the manufacturer's recommended dosage, and if so to what extent.

Where two or more admixtures are proposed to be used in any one mix, confirmation as to their compatibility.

There would be no increase in risk of corrosion of the reinforcement or other embedment as a result ofusingthe admixture.

Physical and Chemical Requirements

Admixtures shall conform to the requirements of IS: 9103 -1999. In addition, the following conditions shall be satisfied:

"Plasticizers" and "Super–Plasticizers" shall meet the requirements indicated for "Water reducing Admixture".

Except where resistance to freezing and thawing and to disruptive action of deicing salts is necessary, the air content of freshly mixed concrete in accordance with the pressure method given in IS: 1199-1959 shall not be more than 2 per cent higher than that of the corresponding control mix and in any case not more than 3 per cent of the test mix.

The chloride content of the admixture shall not exceed 0.2 per cent when tested in accordance with IS: 6925-1973.

Uniformity tests on the admixtures are essential to compare qualitatively the composition of different samples taken from batch to batch or from the same batch at different times.

The tests that shall be performed along with permissible variations in the same are indicated below:

Dry Material Content: to be within 3 per cent and 5 per cent of liquid and solid admixtures respectively of the value stated by themanufacturer.

Ash content: to be within 1 per cent of the value stated by the manufacturer.

Relative Density (for liquid admixtures): to be within 2 per cent of the value stated by the manufacturer.

All tests relating to the concretesadmixturesshall be conducted periodically at an independent laboratory and compared with the data given by the manufacturer.

STORAGE OFMATERIALS

General

All materials may be stored at proper places so as to prevent their deterioration or intrusion

by foreign matter and to ensure their satisfactory quality and fitness for the work. The storage space must also permit easy inspection, removal and restorageofthe materials. All such materials even though stored in approved godowns/places, must be subjected to acceptance test prior to their immediate use.

1.10.2 **Brick**

Bricks shall not be dumped at site. They shall be stacked in regular tiers as they are unloaded, to minimize breakage and defacement. The supply of bricks shall be available at site at any time. Bricks selected for use in different situations shall be stacked separately.

Aggregates

Aggregate stockpiles may be made on ground that is denuded of vegetation, is hard and well drained. If necessary, the ground shall be covered with 50 mm plank.

Coarse aggregates, unless otherwise agreed bytheEngineer in writing shall be delivered to the site in separate sizes (2 sizes when nominal size is 25 mm or less and 3 sizes when the nominal size is 32 mm or more). Aggregates placed directly on the ground shall not be removed from the stockpile within 30 cm of the ground until the final cleaning up of the work, and then only the clean aggregate will be permitted to be used.

In the case of line aggregates, these shall be deposited at the mixing site not less than 8 hours before use and shall have been tested and approved by the Engineer.

Cement

Cement shall be transported, handled and stored on the site in such a manner as to avoid deterioration or contamination. Cement shall be stored above ground level in perfectly dry and water–tight sheds and shall be stacked not more than eight bags high. Wherever bulk storage containers are used their capacity should be sufficient to cater to the requirement at site and should be cleaned at least once every 3 to 4 months.

Each consignment shall be stored separately so that it may be readily identified and inspected and cement shall be used in the sequence in which it is delivered at site. Any consignment or part of a consignment of cement which had deteriorated in any way, during storage, shall not be used in the works and shall be removed from the site by the Contractor without charge to the Employer.

The Contractor shall prepare and maintain proper records on site in respect of delivery, handling, storage and use of cement and these records shall be available for inspection by the Engineer at all times.

The Contractor shall make a monthly return to the Engineer on the date corresponding to the interim certificate date, showing the quantities of cement received and issued during the month and in stock at the end of the month.

Reinforcement/UntensionedSteel

The reinforcement bars, when delivered on the job, shall be stored above the surface of the ground upon platforms, skids, or other supports, and shall be protected from mechanical injury and from deterioration by exposure.

Pre-stressing Materials

All pre-stressing steel, sheathing, anchorages and sleeves or coupling must be protected during transportation, handling and storage. The pre-stressing steel, sheathing and other accessories must be stored under cover from rain or damp ground and protected from the ambient atmosphere if it is likely to be aggressive. Storage at site must be kept to the absolute minimum.

Tendon:

Wire, strand and bar from which tendons are to be fabricated shall be stored about 300 mm above the ground in a suitably covered and closed space so as to avoid direct climatic influences and to protect them from splashes from any other materials and from the cutting operation of an oxy–acetylene torch or arc welding process in the vicinity. Under no

circumstances, tendon material shall be subjected to any welding operation or on site heat treatment or metallic coating such as galvanizing. Storage facilities and the procedures for transporting material into or out of store shall be such that the material does not become kinked or notched. Wire or strand shall be stored in large diameter coils which enable the tendons to be laid out straight. As a guide, for wires above 5 mm dia, coils of about 2 m dia without breaks or joints shall be obtained from manufacturer andstored. Protective wrapping for tendons shall be chemically neutral. All pre-stressing steel must be provided withtemporaryprotection during storage.

Anchorage Components:

The handling and storing procedures shall maintain the anchorage components in a condition in which they can subsequently perform their function to an adequate degree. Components shall be handled and stored so that mechanical damage and detrimental corrosion are prevented. The corrosion of the gripping and securing system shall be prevented. The use of correctly formulated oils and greases or of other corrosion preventing material is recommended where prolonged storage is required. Such protective material shall be guaranteed by the producer to be non–aggressive and non–degrading.

Pre-stressing steel shall be stored in a closed store having single door with double locking arrangements and no windows. Also, the air inside the store shall be kept dry as far as possible by using various means to the satisfaction of the Engineer. Also, instrument measuring the air humidity shall be installed inside the store. This is with a view to eliminating the possibility of initial rusting of pre-stressing steel during storage. The pre-stressing steel shall be coated with water solvable grease. The pre-stressing steel should beabsolutely clean and without any signs of rust.

All pre-stressing steel shall be stored at least 30 cm above ground level and it shall be invariably wrapped by protective cover of tar paper or polythene or any other approved material. The Contractor should see that pre-stressing steel shall be used within 3 months of its manufacture. He should chalk out his programmein this respect precisely, so as to avoid initial corrosion before placing in position.

Water

Water shall be stored in containers/tanks covered at top and cleaned at regular intervals in order to prevent intrusion by foreign matter or growth of organic matter. Water from shallow, muddy or marshy surface shall not be permitted. The intake pipe shall be enclosed to exclude silt, mud, grass and other solid materials and there shall be a minimum depth of 0.60 m of water below the intake at all times.

TESTS AND STANDARD OF ACCEPTANCE

All materials, even though stored in an approved manner shall be subjected to an acceptance test prior to their immediate use.

Independent testing of cement for every consignment shall be done by the Contractor at site in the laboratory approved by the Engineer before use. Any cement with lower quality than those shown in manufacturer's certificate shall be debarred from use. In case of imported cement, the same series of tests shall be carried out before acceptance.

Testing and Approval of Material

The Contractor shall furnish test certificates from the manufacturer/supplier of materials along with each batch of material(s) delivered to site.

The Contractor shall set up a field laboratory with necessary equipment for testing of all materials, finished products used in the construction as per requirements of conditions of contract and the relevant specifications. The testing of all the materials shall be carried out by the Engineer or his representative for whom the Contractor shall make all the necessary arrangements and bear the entire cost.

Tests which cannot be carried out in the field laboratory have to be got done at the

Contractor's cost at any recognized laboratory/testing establishments approvedby the Engineer.

Sampling of Materials

Samples provided to the Engineer or his representatives for their retention are to be in labeled boxes suitable for storage.

Samples required for approval and testing must be supplied well in advance by at least 48 hours or minimum period required for carrying out relevant tests to allow for testing and approval. Delay to works arising from the late submission of samples will not be acceptable as a reason for delay in the completion of the works.

If materials are brought from abroad, the cost of sampling/testing whether in India or abroad shall be borne by the Contractor.

Rejection of Materials not conforming to the Specifications

Any stack or batch of material(s) of which sample(s) does not conform to the prescribed tests and quality shall be rejected by the engineer or his representative and such materials shall be removed from site by the contractor at his own cost. Such rejected materials shall not be made acceptable by any modifications.

Testing and Approval of Plant and Equipment

All plants and equipment used for preparing, testing and production of materials for incorporation into the permanent works shall be in accordance with manufacturer's specifications and shall be got approved by the Engineer before use.

STEEL REINFORCEMENT

Description

This work shall consist of furnishing and placing coated or uncoated mild steel or high strength deformed reinforcement bars (untensioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer.

General

Steel for reinforcement shall meet with the requirements of Section 1000 under road work specification**.** Reinforcements may be either mild steel/medium tensile steel or high strength deformed bars. They may be uncoated or coated with epoxy or with approved protective coatings.

Protection of Reinforcement

Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oilorpaints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc., as directed by the Engineer. Reinforcements shall be stored on block, racksorplatforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.

Portions of uncoated reinforcing steel and dowels projecting from concrete shall be protected within one week after initial placing of concrete with a brush coat of neat cement mixed with water to a consistency of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged duringtransportation or handling and cannot be repaired, the same shall be rejected.

Bending of Reinforcement

Bar bending schedule shall be furnished by the Contractor and got approved by the Engineer before start of work. Reinforcing steel shall conform to the dimensions and shapes given in the approved Bar Bending Schedules. Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer using a proper bar bender, operated by hand

or power to obtain the correct radii of bends and shape. Bars shall not be bent or straightened in a manner that will damage the parent material or the coating. Bars bent during transport or handling shall be straightened before being used on work and shall not be heated to facilitate straightening.

Placing of Reinforcement

The reinforcement cage should generally be fabricated in the yard at ground level and then shifted and placed in position. The reinforcement shall be placed strictly in accordance with the drawings and shall be assembled in position only when the structure is otherwise ready for placing of concrete. Prolonged time gap between assembling of reinforcements and casting of concrete, which may result in rust formation on the surface, shall not be permitted.

Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS: 280-2006 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1mm.

Bars shall be kept in position usually by the following methods:

(i) In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

(ii) In case of dowels for columns and walls, the vertical reinforcement shall be kept in position by means of timber templates with slots cut in them accurately, or with cover blocks tied to the reinforcement. Timber templates shall be removed after the concreting has progressed up to a level just below their location.

(iii) Layers of reinforcements shall be separated by spacer bars at approximately one metre intervals. The minimum diameter of spacer bars shall be 12 mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.

(iv) Necessary stays, blocks, metal chairs, spacers, metal hangers, supporting wires etc., or other subsidiary reinforcement shall be provided tofixthereinforcements firmly in its correct position.

(v) Use of pebbles, broken stone, metal pipe, brick, mortar orwooden blocks etc., as devices for positioning reinforcement shall not be permitted.

(d) Bars coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic-coated binding wires especially manufactured for the purpose. Reference shall be made to Section 1000 for other requirements.

(e) Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concrete is deposited.

BAR SPLICES

Lapping

All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, will be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or1.25times the maximum size of coarse aggregate, whichever

is greater.Ifthis is not feasibleoverlappingbarsshallbe bound with annealedsteel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

Welding

Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or great than that of the bars connected.

While welding may be permitted for mild steel reinforcing bars conforming to IS: 432 - 1982, welding of deformed bars conforming to IS: 1786-2008 shall in general be prohibited. Welding may be permitted in case of bars other than S 240 grade including special welding grade of S 415 grade bars conforming to IS: 1786-2008, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:

$CE = C + (Mn/6) + (Cr+Mg+V)/5 + (Ni + Cu)/15$ is 0.4 or less.

The method of welding shall conform to IS: 2751-1979 and IS: 9417-1989 and to any supplemental specifications to the satisfaction of the Engineer.

Welding may be carried out by metal arc welding process. Oxyacetylene welding shall not be permissible. Any other process may be used subject to the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on overheating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

All bars shall be butt welded except for smaller diameter bars (diameter of less than 20 mm) which may be lap welded. Single-V or Double-V butt joints may generally be used. For vertical bars single bevel or double bevel joints may be used. Welded joints shall be located well away from bends and not less than twice the bar diameter away from a bend. Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment, process, consumables, operators, welding procedure are adequate to produce and maintain uniform quality at par with that attainable in shop welding to the satisfaction of the Engineer.

Joint welding procedures which are to be employed shall invariably be established by a procedure specification. All welders and welding operators to be employed shall have to be qualified by tests prescribed in IS: 2751-1979. Inspection of welds shall conform to IS: 822- 1970 and destructive or non-destructive testingmay be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection shall not be accepted.

Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in 2 or 3 stages, previous surface shall be cleaned properly. Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Only competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars. M.S. electrodes used for welding shall conform to IS: 814 -2004.

Welded joints shall preferably be located at points where steel will not be subject to more than 75 per cent of the maximum permissible stresses and welds so staggered that at any one section, not more than 20 per cent of the bars are welded.

Welded pieces of reinforcement shall be tested. Specimens shall be taken from the site and the number and frequency of tests shall be as directed by the Engineer.

Mechanical Coupling of Bars

Bars may be jointed with approved patented mechanical devices as indicated on the drawing or as approved by the Engineer e.g. by special grade steel sleeves swaged on to bars in end to end contact or by screwed couplers. In case such devices are permitted by the Engineer, they shall develop at least 125 per cent of the characteristic strength of the reinforcement bar.

TESTING AND ACCEPTANCE

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. Additional tests, if required, will be got carried out by the Contractor at his own cost.

The fabrication, furnishing and placing of reinforcement shall be in accordance with these specifications and shall be checked and accepted by the Engineer.

MEASUREMENTS FOR PAYMENT

Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in tones on the basis ofIS: 1732-1989. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

RATE

The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, fabricating, transporting, storing, bending, placing, binding and fixing in position as shown on the drawings as per these specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision. The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. The rate shall also cover sampling, testing and supervision required for the work.

PART A – WATER PIPE LINE SPECIFICATIONS

The contractor shall Design and construct the lift Irrigation system on continuous running basis, along with installation of valves, scour valves, air release valves, thrust blocks etc. as required. The Contractor shall furnish all required tools, plant, instruments, materials including water, electricity, labor, consumables, etc., and everything necessary for construction of the works, whether or not such items are specifically stated elsewhere in this bid.Allvalves shall be electrically actuated at inlet and outlet of the pipeline network. In general, this work shall include designing, providing, laying, jointing and testing of all PE-100 HDPE/ DI pipes and specials/ fittings, interconnections, Valves, pump sets, house connections, etc.

1.1 REFERENCES AND STANDARDS

1.1.1 Except where otherwise specified the works under this project shall comply with the requirements of relevant Indian Standards (IS), CPWD specifications and manufacturer's instruction manual. If required reference is not available, for any of the work(s) mentioned in the specifications and tender, in IS code(s) then relevant clauses of either British Standards (BS) or ISO Standards shall be followed. The following standards and the amendments made thereto till date and any other IS code provisions found to be applicable to this work shall be binding on the bidders (bidding and executing the work). All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions and amendments of the standards.

The bidders are therefore advised to refer and follow all relevant IS codes and amendments along with relevant ISO codes till date regarding supplying, testing, commissioning of DI/HDPE pipes and fittings, their testing, dimensions and measurement, composition of raw material, physical properties, mechanical characteristics, laying, jointing and their performance requirements, sampling and conformity criteria, marking and certification, etc.

1.12 If there are varying or conflicting provisions made in any one document forming part of the contract, the Accepting Authority shall be the deciding authority with regard to the intention of the document and his decision shall be final and binding on the contractor.

1.13 Action where no Specifications are specified

1.1.4 In the case of any class of work for which there is no such specification, such work shall be carried out in accordance with the Bureau of Indian Standards Specifications. In case there is no such specification in Bureau of India Standards, the work shall be carried out as per manufacturer's specifications. In case there are no such specifications as required above, the work shall be carried out in all respects in accordance with the instructions and requirements of the Employers Engineer.

1.1.5 All materials and workmanship not fully specified herein or not covered by an approved relevant standard shall be of such kind as is used in first class work and suitable to the climate in the project area.

1.2 DUCTILE IRON (DI) PIPES

1.2.1. Manufacture of pipe

DI pipes and fittings (Class K7 and K9) shall be in accordance with IS: 8329 and IS: 9523. The pressure rating of the pipes shall be governed by the design but in no case pipes of rating less than K-7 and K-9 shall be provided. Pipes and fittings shall be procured from reputed manufacturers with Employer's Engineer's approval. The Employer's 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 for witnessing the test and manufacturing.

All tests specified either in this specification or in the relevant Indian Standards specified above shall be performed by the Manufacturer/ Operator at his own cost and in presence of Employer's Engineer if desired. For this, sufficient notice before testing of the pipes and fittings shall be given to Employer's Engineer If the test is found unsatisfactory, Employer's Engineer may reject any or all pipes and fittings of that lot. The decision of Employer's Engineer in this matter shall be final and binding on the Operator and not subject to any arbitration or appeal. The pipes and fittings shall be striped, with all precautions necessary to avoid warping or shrinking defects. The pipes and fittings shall be free from defects. Any defect in pipes and fittings in the opinion of Employer's Engineer shall be rejected and shall be replaced by new one.

In the case of spigot and socket pipes and fittings, the socket shall be without the Centre ring. In the case of flanged pipes, the flanges shall be at the right angles to the axis of the pipe and machined on face. The bolt holes shall be drilled and located symmetrically of the Centre line. The bolt hole shall be concentric with the bore and bolt holesequallyspaced. The flanges shall be integrally cast with the pipes and fittings and the two flanges of the pipe shall be correctly aligned.

1.2.2 Reference and standards

IS 8329–2000 - Centrifugally Cast (spun) Ductile Iron Pressure Pipes for water, gas and sewerage – Specification

IS 9523:1980 - Ductile Iron fittings for pressure pipes for water,sewerage and gas

IS 11606:1986 - Methods of sampling of cast iron pipes and fittings

IS 13382:1992 - Cast iron specials for mechanical and push-on-flexibleJoints for pressure pipe linesfor water, gas and sewerage
ISO 2531:1998 - Ductile iron pipes, fittings and accessories and their joints for water or gas application

Materials

The materials used in the manufacture of pipes and fittings shall comply with requirements specified in IS: 8329 and IS: 9523.

Dimensions and Tolerances

The internal diameter, thickness and length of barrel, dimensions of pipes and fittings shall be as per relevant tables of IS: 8329/IS: 9523 for different class of pipes and fittings. Each pipe shall be of uniform thickness throughout its length.

The tolerances for pipes and fittings regarding dimensions, mass, ovality and deviations from straight line in case of pipes shall be as per IS: 8329/IS: 9523.

Coatings

Unless otherwise specified, DI pipes and fittings shall be coated with Bitumen in accordance with relevant IS Specifications. Coating shall not be applied to pipe and fittings unless its surface is clean, dry and free from rust. Pipe coatings shall be inspected at site and any damage or defective areas shall be made good to the satisfaction of the Employer's Engineer.

Bitumen coating shall be of normal thickness of 75 microns unless otherwise specified. It shall be cold applied compound complying with the requirements of relevant Indian standards, suitable for tropical climates, factory applied in accordance with the manufacturer's instructions. Damaged areas ofcoating shall be repainted on site after removing any remaining loose coating and wire brushing any rusted areas of pipe.

Polythene Sleeving:

Wherepolythenesleeving is specified to be applied in addition to bitumen coating; it shall comply with ISO 8180. Site applied sleeving shall be stored under cover out of direct sunlight and its exposure to sunlight shall be kept to a minimum. Pipes having a factory applied sleeving must be stored in the same conditions. Joints in the sleeving shall be properly overlapped and taped in accordance with manufacturer's instructions to provide continuous sleeving.

Cement mortar lining:

All pipes and fittings shall be internally lined with cement mortar in accordance with relevant IS. The cement used shall be Sulphate Resisting Cement confirming to IS: 12330. No admixtures in the mortar shall be used without the approval of the Employer's Engineer.

Pipe linings shall be inspected on site and any damage or defective areas shall be made good to the satisfaction of the Employer's Engineer. Lining shall be uniform in thickness all along the pipe. The minimum thickness of factory applied cement mortar lining shall be as per IS: 11906.

Testing of pipes at manufacturing unit

During manufacture, tests on pipes shall be carried out in accordance with these technical specifications by the Third party inspecting agency.

Marking

Marking shall be done as per IS: 8329 and IS: 9523 or any other relevant IS codes approved by the Employer's Engineer. The following information shall be clearly marked on each pipe,

Internal diameter of pipe.

Class of pipe.

Date of manufacture and
Name of manufacture or his registered trade-markorboth.

Carting & Handling

Carting and handling of D.I. pipes and fittings shall be in accordance with the specifications in this section.

Trenching

Trenching includes all excavation which shall be carried out either by hand or by machine and shall be carried out in accordance with all requirements of -Earth work excavations clause. Wherever a socket or collar of pipe or fitting / special occurs, a grip is to be cut in the bottom of the trench or concrete bed to a depth of at least 75 mm below the bed of the pipe so that the pipe may have a fair bearing on its shaft and does not rest upon its socket. Such grip shall be of sufficient size in every respect to admit the hand all-round the socket in order to make the joint and the grip shall be maintained clear, until the joint has been approved by Employer's Engineer.

Wherever D.I. pipes are laid over pillar supports for nala crossings etc. the pipes shall be placed as per the construction drawings and as directed by the Employer's Engineer.

Bedding

The type of bedding (granular, concrete cradle, concrete arch etc.) shall be as per approved construction drawings and specifications in this section.

Laying of the pipe

LayingofDIpipes shall conform to the Code of practice of IS: 12288. Pipes shall be laid as per the requirement in the drawing and as directed by the Employer's Engineer. Layingofpipes shall be as per IS specified in Bill of Quantities and approved construction drawings. All pipes, fittings and material shall be tested andapprovedby the Employer's Engineer beforebeingl aid. Anypipes, fittings or material placed before they are tested and approved shall be removed and replaced with tested and approved material. Before laying the pipe, necessary bedding shall be provided wherever required. Polyethylene sleeves wounded pipes shall be used for water logged areas as per specification and as directed by the Employer's Engineer.

Jointing of pipes

Jointing of DI pipes and fittings shall be done as per IS: 12288 and manufacturer's recommendations. After jointing, extraneous material, if any, shall be removed from the inside of the pipe. Rubber sealing rings/gaskets used for jointing shall conform to IS: 638, IS: 12820 and IS: 5382.

Spigot and Socket joints:

These shall have sockets, which are integral with the pipe and incorporate an electrometric rubber ring gasket conforming to IS: 12820.The gaskets/sealant used for joints shall be suitable for water conveyance. In jointing DI pipes and fittings, the Operator shall take into account the manufacturer's recommendations as to the methods and equipment to be used in assembling the joints. In particular the Operator shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, so that the rubber ring as per IS: 12820 and IS: 5382 is correctly positioned in line, before the joint is made. The rubber rings and any recommended lubricant shall be obtained only through the approved supplier and as directed by the Employer's Engineer.

Gaskets for Flanges

All gaskets used between flanges of pipes shall be of natural rubber conforming to IS: 638 of thickness 3 mm suitable for potable water conveyance and as specified by manufacturer. While conveying potable water, the gaskets should not deteriorate the quality of water and should not impart any taste or foul odour.

Flanged joints

These shall be of minimum PN 1.0 rating and shall comply with dimensions and drilling details as specified in IS: 8329. These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts. All material shall be supplied by a reputed manufacturer and shall be approved by the Employer's Engineer.

Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively. The recommended bolting torque to be followed for assembling flanges shall be as specified in manufacturer's instructions. The practice of fully tightening the bolts one after another is highly undesirable. The bolts shall be of mild steel unless otherwise specified.

HIGH DENSITY POLYETHYLENE PIPES (HDPE)Pipes

GENERAL:

This specification covers the requirements for successfully designing, manufacturing, supplying, laying, jointing and testing at works and site of High Density Polyethylene Pipes used for water supply.

APPLICABLE CODES

The manufacturing, testing, supplying, laying, jointing and testing at work sites of HDPE pipes shall comply with all currently applicable statutes, regulations, standards and Codes. In Particular, thefollowing 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 standards / Codes, this Specification shall govern. Others Codes not specifically mentioned here but pertaining to the use of HDPE pipes form part of these Specifications.

IS: 4984 High Density Polyethylene Pipes for Water Supply

IS: 2530 Methods of test for polyethylene mouldingmaterialsandpolyethylene compounds

IS: 5382 Rubber sealing rings for gas mains, water mains and sewers. Methods for random sampling

IS: 7328 High density polyethylene materials for moulding and extrusion

IS: 7634 Laying & Jointing of Polyethylene (HDPE) Pipes

IS: 9845 Method of analysis for the determination of specific and/or overall migration of constituents of plastics material and articles intended to come into contact with foodstuffs

IS:10141 Positive lists of constituents of polyethylene in contact with food stuffs, pharmaceuticals and drinking water.

IS:10146 Polyethylene for its safe use in contact with foodstuff, Pharmaceuticals and drinking water.

IS4905:1968 Methods for random sampling

IS 8360 (part-I):1977 "Specification for Fabricated High Density Polyethylene Fittings for Potable water supplies - General Requirements"

IS 8360 (part-II):1977 "Specification for Fabricated High DensityPolyethyleneFittingsforPotable water supplies-Specific Requirements for 90 Deg Tee"

IS 8360 (part-III):1977 "Specification for Fabricated High Density Polyethylene Fittings for Potable water supplies Specific Requirements for 90 Deg. Bends"

IS 8008 (part-I):2003 "Injection Moulded / Machine High Density Poly ethylene (HDPE) FittingsforPotable Water Supplies–Specification– General Requirements for fittings"

DESIGNATION

Pipes shall be designated as per IS 4984, according to the grade of material, followed by pressure rating and nominal diameter, for example, PE-100 PN 6 DN 200 indicates a pipe pertaining to material grade 100 having a pressure rating 0.6 MPa and outside nominal

diameter 200mm.

All HDPE Pipes of the same size, same pressure rating and same grade and also manufacture essentially under similar conditions of manufacture, shall constitute a lot Materials

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

RAW MATERIAL

Raw material used to manufacture the HDPE pipes shall be 100% virgin PE compound or Natural black PE resin confirming to IS: 4984, IS: 7328 and ISO: 4427 for this a certification has to be given by the resin manufacturer as per clause 3.2.3 of IS: 4984. 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.

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 IS7328 The value of the density shall also not differ from the nominal value by more than 3 kg/ 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 determinedby method prescribed in IS 2530. The MFR of the material shall also be within ± 20 percent 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 ±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 percent by mass of finished resin. The anti-oxidant used shall be physiologically harmless and shall be selected from the list given in IS: 10141

REWORKED MATERIAL

No addition of Reworked/ Recycled Material from the manufacturer's own rework material resulting from the manufacture of pipes is permissible and the vendor is required to use only 100% virgin resin compound.

EFFECT OF NATURE OF SOIL ON PIPE PERFORMANCE

The bidder shall provide certified information, as per IS code of practice about the performance of HDPE pipes, if laid in corrosive soils, below water table or under saturated conditions or rocky strata, etc. The necessary precautions, as per IS code of practice, to be taken like painting or bitumen coating or providing special bedding or crossing any feature under hanging, etc. to encounter such conditions shall be mentioned

and accounted for in the bid cost by thebidder.

MAXIMUM OVALITY OF PIPE

The outside diameter of pipes, tolerance on the same and ovalityofpipe shall be as given in table 2 of IS 4984. 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. For pipes to be coiled the ovality shall be measured prior to coiling. For coiled pipes, however, re-rounding of pipes shall be carried out prior to the measurement of ovality.

WALL THICKNESS

The minimum &maximum wall thickness of pipe for the three grades of materials, namely PE63, PE80, and PE100 shall be as given in table 3, 4, & 5 respectively in IS:4984.

LENGTH OF STRAIGHT PIPE

The length of straight pipe used shall be more than 6 m or as agreed by Employer's Engineer in charge. Short lengths of 3 meter (minimum) up to a maximum of 10% of the total supply may be permitted.

COILING

The pipes supplied in coils shall be coiled on drums of minimum diameter of 25 times the nominal diameter of the pipe ensuring that kinking of pipe is prevented. Pipe beyond 110mm dia shall be supplied in straight length not less than 6m.

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.

1.3.13 **PHYSICAL, MECHANICAL, THERMAL AND OTHER PROPERTIES OF HDPE PIPES**

The bidder shall provide the certified information (as per BIS) about the properties of PE-100 material as stated in the document for manufacturing the pipes for this project. Density, flexural strength, compressive strength, modulus of elasticity, short term and long term yield value, allowable circumferential stress in pipes intended for 40 -50 years of service at normal temperature, volume resistivity, thermal conductivity, specific heat, linear coefficient of expansion, ignition by flame, burning rate, maximum operating temperature (under pressure) and any other properties which may affect the serviceability of pipe at project site.

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 (including all amendments) and any amendments made to till date. Each straight length of pipe shall be clearly marked and should cover the following:

The manufacturers name and trademark,
Outside diameter,
IS classification,
Stiffness class
Lot number / Batch number

HANDLING, TRANSPORTATION, STORAGE AND LOWERING OF PIPES

During handling, transportation, storage and lowering, all sections shall be handled by such means and in such a manner that no distortion or damages done to the section or tothepipes as a whole. The following procedures should be followed so as to eliminate potential damage to pipes and fittings and to maintain maximum safety during unloading, lifting and lowering.

1.3.15.1 Handling

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 are 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.

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

Scores or scratches to a depth of greater than10% or more of wall thickness are not permissible; any pipes having such defects should be strictly rejected.

13.15.2 **Transportation**

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 2.5m.

Side supports should not be lessthan1.5m 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.

The truck used for transportation of the PE pipes shall be exclusively used of PE pipes only with no other material loaded – especially no metallic, glass and wooden items.

13.15.3 **Storage**

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

Pipes must not be stored or transported where they are exposed to heat sources likely to exceed60^{0}C.

When pipes are stored outside in climates having high ambient temperatures (greater than 23 ^{0}C), the following is recommended:

The height of the stacks should not exceed 1m;

All stacks should be shielded from continuous and direct sunlight and shall be arranged to allow the free passage of air around thepipes;

Specials & fittings should always be stored in boxes or sacks manufactured so as topermit the free passage of air.

When pipes are stacked in theformof rigid bundles, a maximumofthreebundleshavinga height of 1 m each should be stacked on top of each other.

Pipes shall be stored such that they are not in contact with direct sunlight, lubricating or hydraulic oils, petrol, solvents and other aggressive materials.

Damages during transit, handling, storage will be to the Contractor's account and replacement for such pipes has tobemade by the Contractor without any extra cost as directed by the Employer's Engineer.

LOWERING, LAYING OF PIPES

Each pipe shall be thoroughly checked for any damages before laying and only the pipes which are approved by the Employer's Engineer shall be laid. While installing the pipes in trenches, the bed of the trench should be level and free from sharp edged stones. In

most cases, the bedding is not required, as long as the sharp and protruding stones are removed, by sieving the dug earth, before using the same a backfill material. While laying in rocky areas suitable bed of sand or gravel should be provided. The fill to about 10 to 15 cm above the pipe should be fine sand or screened excavated material. Where hard rock is met with, bed concrete M15, 15 cm or 20cm thick sand bed as approved by the Employer's Engineer may be provided

As PE pipes are flexible, long lengths of fusion-jointed pipes having joints made above ground can be rolled or snaked into narrow trenches. Such trenches can be excavated by narrow buckets. During the pipe layingofcontinuous fusion jointed systems, due care and allowance should be made for the movements likely to occur due to the thermal expansion/contraction of the material. This effect is most pronounced at end connections to fixed positions (such as valves etc.) and at branch connections.

Care should be taken in fixing by finishing the connections at a time the length of the pipe is minimal (lower temperature times of the day.) For summer time installations with two fixed connection points, a slightly longer length of PE pipe may be required to compensate for contraction of the pipe in the cooler trench bottom. The final tie-in connections should be deferred until the thermal stability of the pipeline is achieved. The flexibility of polyethylene pipes allows the pipe to be cold bend. The fusion jointed PE pipe is also flexible as the plain Pipe. Thus, the total system enables directional changes within the trench without recourse to the provision of special bends or anchor blocks. However, the pipe should not be cold bend to a radius less than 25 times the OD of the pipe.

The Installation of flanged fittings such as connections to sluice/air/gate valves and hydrant tees etc., requires the use of stub ends (collars/flange adaptors complete with backingrings and gaskets. Care should be taken when tightening theseflanges to provide even and balance torque. Provision should be made at all heavy fittings installation points for supports (such as anchoring of the flange in the soil) for the flange joint to avoid the transfer of valve wheel turning torque onto the PE flange joint. PE pipe is lighter than water. Hence care should be taken for normal installations where there could be a possibility of flooding of the trench thus the trench shall be kept free of water till the jointing has been properly done When flooded, some soils may lose cohesiveness, which may allow the PE pipe to float out of the ground. Several design checks are necessary to see if groundwater flotation may be a concern. Obviously, if the pipeline typically runs full or nearly full of liquid, or if groundwater is always below the pipe, flotation may not be a significant concern.

However, weights by way of concrete blocks (anchors) are to be provided so that the PE pipe does not float when suddenly the trench is flooded and the soil surrounding the pipe is washed away. Thus, site conditions study is necessary to ensure the avoidance of flotation. Pipe embedment backfill shall be stone-free excavated material placed and compacted to the 95% maximum dry density.

JOINTING OF PIPES

The pipe shall have a jointing system that shall provide for fluid tightness for the intended service conditions. Appropriate jointing for HDPE pipe as per IS 4984 shall be selected considering site and working condition, pressure and flow of liquids

(i) All joints shall be made as per relevant IS code, in practice, and manufacturer's installation manual or instructions. All joints shall betestedfortheir performance as per provisions made in relevant IS codes. Joints thatshowleakage 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 dichloride-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 12176-1:1998Plastics pipes and fittings - Equipment for fusion jointing polyethylene systems - Part 1: Butt fusion and ISO12176-2:2000 Plastics pipes and fittings - Equipment for fusion jointing polyethylene systems - Part 2: Electro fusion shall be followed for the same.
However to join HDPE with other pipe/valves flanges/ 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.

BEDDING, BACKFILLING ANDCOMPACTION

1.3.18.1 **BEDDING**

In case of sandy strata, no separate bedding is required. Howeverthebottom face/ trench bed where pipe shall be placed shall be compacted to provide a minimum compaction corresponding to 95% of maximum dry density. The pipe bedding should beplacedso as to give complete contact between the bottom of the trench and the pipe.

1.3 18.2 **BACKFILLING**

Backfilling should be placed in layers not exceeding 15cm thickness per layer, and should be compacted to a minimum of 95% maximum dry density. The refilling should be done on both sides of pipe together & height difference in earth fill on each side should not be more to cause lateral movement of pipe. Most coarse-grained soil is acceptable. This may comprise of gravel or sand. However silty sand, clayey sand, silty and clayey gravel shall not be used unless proposed to be used in conjunction with gravel or clean sand.
It is very important that the pipe zone backfill material does not wash away or migrate in to the native soil. Likewise, potential migration of the native soil in to the pipe zone backfill must also be prevented. Heavy earth moving equipment used for backfilling should not be brought until the minimum cover over the pipe is 90 cm in the case of wide tracked bulldozers or 120 cm in the case of wheeled roaders or roller compactors.

1.3 18.3 **COMPACTION**

Vibratory methods should be used for compaction. Compaction within distances of 15 cm to 45 cm from the pipe should be usually done with hand tempers. The backfill material should be compacted not less than 95% of maximum dry density.

FITTINGS & SPECIALS

Injection moulded HDPE fittings shall be as per IS: 8008 (Part I to IX). All fittings/specials shall be injection moulded at factory only. General requirement of Injection moulded HDPE fittings conforming to IS: 8008 Part I.

1.3.19.1 **BENDS**

HDPE bends shall be conforming to IS: 8008 Part II Specifications.

1.3.19.2 **TEES**

HDPE Tees shall be conforming to IS: 8008 Part III Specifications.

1.3.19.3 **REDUCERS**

HDPE Reducers shall be conforming to IS: 8008 Part IV Specifications.

1.3.19.4 **FLANGED HDPE PIPE ENDS**

HDPE Stub ends shall be square ended conforming to IS: 8008 Part I & VI Specifications. Stub ends will be welded on the pipe. Flange will be of slip on flange type as described below:

1.3.19.5 **SLIP-ON FLANGES**

Slip-on flanges shall be metallic flanges covered by epoxy coating or plastic powder

coating. Slip-on-flanges shall be conforming to standard mating relevant flange of valves, pipes etc. Nominal pressure ratings of flanges will be PN10.

WELDING PROCEDURE

Jointing between HDPE pipes and specials shall be done as per the latest IS: 7634 part II. Method of jointing between the pipes to pipes and pipes to specials shall be with fusion welding using automatic or semi-automatic, hydraulically operated, superior quality fusion machines which will ensure good quality fusion welding of HDPE pipes. If approved by the concerned Employer's Engineer, jointing with PP compression fittings may be carried out for smaller diameters of PE pipes (up to 110mm).

TESTS TO ESTABLISH POTABILITY OF WATER

Pipe specimen shall be subjected to tests specified below in order to establish the suitability of these pipes for use in carrying potable water:

Smell of the extract

Clarity of the colouroftheextract

Acidity and alkalinity

Global migration UV absorbing material Heavy metals

Un-reacted monomers (styrene) and Biological tests

HYDRAULIC TESTING

Pipes shall be given different hydraulic tests for ensuring quality of manufacture as per clause IS code. 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 Employers Engineer and a report shall be made by the contractor and the same shall be signed by the contractor's representative and Employers Engineer and submit the same to Employer after the successful completion of the hydro test.

All the necessary consumables, equipment, 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.

MEASUREMENT

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm. Specials shall be excluded and measured and paid separately under the relevant item. The portion of the pipe at the joints (inside the joints) shall not be included in the length of pipe work. Excavation, refilling, masonry and concrete work wherever required shall be measured and paid for separately under relevant items of work.

Payment shall be made as per relevant items in Payment Schedule

RATE

The rate shall include the cost of materials and labour involved in all the operations described above except for the items measured/enumerated separately under clause Measurements, which shall be paid for separately.

JOINTING MATERIAL: DETACHABLE JOINTS

1.3.25.1 **PUSH ON JOINTS**

For Push-on joints the rubber ring will be inserted through the chamfered spigot end of the pipe. The two pipes shall be aligned properly in the trench and the spigot end shall be pushed axially into the socket either manually or with a suitable tool specially designed for the assembly of pipes and as recommended by the manufacturer. The spigot is to be

inserted up to the insertion mark on the pipe spigot. After insertion, the correct position of the socket has tobetested with a feeler blade. A penetration gauge shall be used to check each joint after assembly, to ensure that the rubber ring is properly seated. When it is desired to deflect push-on joint pipe in order to form a long-radius curve, the amount of deflection shall be as per the instructions of the manufacturer and approved by the Employer's Engineer. It is important that in making the joint the pipes are maintained in a straight line and the deflection introduced after the joint has been assembled. However, it is preferable that such deflection will not exceed 75% of the permissible deflection at a single joint as stipulated by the manufacturer of the pipe.

1.3.25.2 **MECHANICAL JOINTS**

Bolts shall be tightened alternately on opposite ends of joint diameter and in rotation around the pipe. When properly assembled the gland shall be equidistant from the socket face at all joints. Under no conditions shall extension wrenches or pipe-over-handle or ordinary ratchet wrenches be used to secure greater leverage.

FLANGED JOINTS

Flanged joint pipes and fittings shall be firmly and fully bolted with machine bolts provided by the manufacturer. Standard flange drilling of flanged pipes and fittings shall be in accordance with IS: 1538. The nuts and bolts to be used for jointing shall be made of MS for size up to 27 x 120 mm and high tensile steel of approved make for higher sizes. Gaskets used between flanges of pipes shall be compressed fibre board or natural/synthetic rubber of thickness between 2.5 mm to 3 mm in conformity with IS:3114. The fibre board shall be impregnated with chemically neutral mineral oil and shall have a smooth and hard surface. Its weight per sqm shall not be less than 12 gram/mm thickness. Slip-on flanges shall be double welded to the pipe with a strength weld jointing the flange hub to the pipe and seal fillet weld inside the flanges at the pipe end. All flanges of the same diameter shall be compatible.

MS Pipelines, Appurtenances, Specials etc.

SCOPE

This specification covers the general requirements for supply, fabrication, delivery at site laying, jointing, testing and commissioning of all welded M.S pipeline, appurtenances, specials etc. above/below ground, including Civil works required for the same.

APPLICABLE CODES & SPECIFICATIONS

The following specifications, standards and codes are made a part of the specification. All standards, tentative specifications, specifications, codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

Sl. No.	Code Number	Description
1	IS: 2062	Steel for general structural purposes.
2	IS : 808	Dimensions for hot rolled steel beam, column, channel and angle sections.
3	IS : 814	Covered Electrodes for manual Metal Arc Welding of carbon and C- Mn steel.
4	IS : 3613	Acceptance Tests for Wire Flux combinations for Submerged – Arc Welding.
5	IS: 1367	Technical Supply Conditions for Threaded Fasteners (Parts 1 to 3).

6	IS: 2016	Plain Washers.
7	IS: 2074	Ready Mixed Paint, Red Oxide Zinc Chrome and Priming.
8	IS: 102	Ready Mixed Paint, Brushing, Red Lead, no setting, Priming.
9	IS: 1786	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement
10	IS : 432	Specification for Mild Steel & (Part-I) Medium Tensile bars and hard drawn steel wire for concrete reinforcement : mild Steel & Medium tensile steel bars
11	IS.432	Specification for mild steel & (Part-II) Medium Tensile steel bars and hard drawn steel wires for concrete reinforcement : Hard drawn steel wire
12	IS : 269	Specification for Ordinary and Low heat Portland cement
13	IS : 8041	Specification for Rapid hardening Portland Cement
14	IS : 383	Specification for coarse and fine aggregate from natural source for concrete
15	IS :12330	Specification for Sulphate Resisting Portland Cement
16	IS : 456	Code of practice for plain and reinforced concrete
17	IS : 800	Code of practice for General Construction in Steel.
18	IS : 816	Code of practice for use of Metal Arc Welding for General Construction in mild steel.
19	IS : 4353	Submerged Arc Welding of Mild Steel & Low Alloy Steels – Recommendations.
20	IS: 817	Code of practice for Training and Testing of Metal Arc Welders.
21	IS: 1182	Recommended practice for Radiographic examination of Fusion -Welded Butt Joints in steel plants
22	IS: 2595	Code of Practice for Radiographic Testing.
23	IS: 3658	Code of Practice for Liquid Penetrate Flaw Detection
24	IS: 5334	Code of practice for Magnetic Particle Flaw Detection of welds.
25	IS: 3600	Methods of Testing Fusion Welded Joints and weld metal in steel (Parts 1 to 9)
26	IS: 4853	Recommended Practice for Radiographic Inspection of Fusion Welded Butt Joints in Steel Pipes
27	IS: 1239	Seamless or Electrically welded steel pipes for Water Gas and Sewage (Up to 166.5 mm Outside Diameter)
28	IS: 3589	Seamless or Electrically welded steel pipes for Water Gas and Sewage (168.3 to 2540 Outside Diameter)
29	IS: 6631	Steel pipes for Hydraulic Purposes
30	IS: 7343	Code of practice for ultrasonic Testing of Ferrous Welded Pipes and Tubular Products
31	IS: 2598	Safety Code for Industrial Radiographic Practice

32	IS: 5822	Code of Practice for Laying of Electrically Welded steel pipes for water supply
33	IS: 1608	Mechanical testing of Metals.
34	IS: 9595	Metal Arc welding of Carbon and Carbon-Manganese Steels.
35	IS: 2825	Code of unfired Pressure Vessels
36	IS: 5504	Code for Spiral Welded PIPES(457mm to 3250mm Outside Diameter)
37	IS: 10748	Requirements for Weld able Hot Rolled Carbon Steel Strip in Coils.
38	IS: 10234	Recommendation for radiography for general pipeline welding.
39	API-1104	Welding of pipeline & related facilities
40	ASTME 94	Guide for Radiographic Testing
41	STME709	Guides for Magnetic Particle Examination.
42	ASTM E 165	Test Method for Liquid Penetrate Examination.
43	AWS:A-5.1	Specification for Mild Steel Covered Arc Welding Electrodes.
44	AWS: A-5.17	Specification for Bare Mild Steel Electrodes and Fluxes for Submerged Arc Welding
45	BS EN 499	Welding Consumables. Covered Electrodes for Manual Metal Arc Welding of Non Alloy and Fine Grain Steel. Classification

MATERIALS

Steel Coils - The steel Coils for pipes, fittings, specials and stiffeners shall be of mild steel conforming to IS: 10748 grade III and shall bear ISI mark

Welding Consumables - such as electrodes, filler rods and wires shall conform to IS: 814, IS: 3613, IS: 6419 and IS: 7280 and shall be of KIIDC approved make (If any).

Before fabrication of pipes and specials/fittings is commenced, the copies of the mill sheets and the MANUFACTURER's test certificates for Coils and other materials required for the fabrication shall be submitted by the Contractor to the Engineer for his approval.

When requested by the Engineer, the Contractor shall supply free of charge to the Employer, for testing suitable samples of the materials to be used/used in the Works. The cost of such tests shall be borne by the Contractor and shall be included in his item rates.

INSPECTION

All works and material under specification will be rigidly inspected during all phases of manufacture and testing and such inspection shall not relieve the Contractor of his responsibility to furnish materials and performed work in accordance with this specification. The Contractor shall notify the Engineer, in advance of the production of materials and fabrication thereof, in order that the Employer may arrange for mill and shop inspection.

The Engineer may reject any or all materials or works that do not meet with any of the requirements of this specification. The Contractor shall rectify or replace such rejected material/performed work at his own cost, to the satisfaction of the Engineer.

The Engineer shall have free access to those parts of all plants or any other premises and sites that are concerned with the furnishing of materials or the performance of work under this specification.
The Contractor shall furnish to the Employer's inspector reasonable facilities and space without charge for inspection, testing and obtaining of any information he desires in respect of the character of material used and the progress and manner of the work.
The Contractor shall supply free of cost required specimen of materials for testing by the Owner at any time during the progress of work and shall bear the cost of all such tests or retests to the satisfaction of Engineer.
The Contractor shall provide 2 (two) sets of accurate `Go' and `No Go' ring gauges to measure the diameter of pipes specials and fitting for the use of the Engineer at no extra cost.

FABRICATION OFPIPE

1.4.5.1 **General**

All Pipes (ISI Marked) and specials shall be manufactured as per IS: 1239 part 1/ IS: 3589 and IS: 5504 out of new mild steel HR Coils (IS: 10748 grade-III) which shall be free from any cracks, surface flaws, laminations, excessive fittings or any other defects. The pipes shall be truly cylindrical, and straight in axis. The ends shall be accurately cut and prepared for field welding. The external circumference of the pipe pieces which are to be fixed adjacent to flange adapter with fixed outer diameter shall not deviate from theoretical one by more than 1 mm. To obtain this accuracy the pipe shall be rolled several times, if necessary, as pipe pieces should be truly cylindrical. The external longitudinal welding of this pipe shall be ground smooth flush with surface to the satisfaction of the Engineer, for a length of 200 mm. No extra cost shall be charged by the Contractor for this grinding work. However, the pipe shall be manufactured as per tender specification.
Minor repair by welding or otherwise shall be permitted at the discretion of the Engineer, but such repairs shall be done only after obtaining the previous permission of the Engineer. Any pipe or part thereof which develops injurious defects during shop welding or other operations shall be rejected.

1.4.5.2 **Permissible Stress**

The permissible stress in the pipe shell shall be related to yield stress (f_y) of pipe material making due allowance for weld efficiency of the joint.
Working stress for combined bending and direct tensile stress shall not exceed 60% of yield stress ofthe material making due allowance for efficiency of welded joint (as per IWWA M- 1).
Working stress for combined bending and direct compressive stress shall notexceed 50% of yield stress making due allowance for weld efficiency.
It is also necessary to check the shell thickness for adequate factor of safety against failure by buckling.
For field welded joint, efficiency factor of 80% is generally adopted, while for shop welding joint 90% efficiency is allowed (as per IS 5822).

1.4.6 **FABRICATION**

The Contractor shall get the fabrication work done in a duly valid licensed factory of his own or that of an approved nominated sub-contractor. This factory meant for fabrication of pipes, specials etc. shall also be involved with testing etc., machining as well as painting. For completing the work under the present contract within the contract period, the factory shall be equipped with adequate number of various equipment and plant such as:
Plate bending machines for rolling of pipe drums

Automatic welding machines (suitable for circumferential welding)
Hydraulic Testing Machines
Travelling gantry or crane of capacity 10 Tones or above.
Mobile cranes for loading/unloading of Coils, pipes etc. 15 tones capacity each
Lathe for machining of the flanges, rings, Coils etc.
Equipment for sand blasting and applying paint by spray gun.
Equipment for cold pressing of Coils up to 25 mm thick to the required curvature (specials, plug Coils etc.)
Bending machine of adequate capacity for manufacturing ring girders and other necessary equipment.
The factory shall have adequate area, and shall also have stacking yard for the stacking of Coils, structural, fabricated pipes etc. and the scrap.
The Bidder may establish pipe fabrication factory within the project site for minimizing the transportation of pipes after fabrication to bring the pipes to the trench where pipes are to be laid. Contractor shall furnish with his bid the details of the factory where he intends to get the fabrication done, such as its location within the project site and the equipment, plant and other facilities available in the factory for the manufacture of M.S. Pipes and special required under this contract. This shall be as per the MOU executed with the pipe MANUFACTURER.

CUTTING OF COILS OR FROM COIL ROLLED AS PER REQUIRED SIZES

The Coils shall be indented in such length as to have minimum wastage and so as to make the pipe as far as possible.
Before cutting, all the edges of the Coils shall be cleaned by brushing/grinding on both the sides. After the Coils are cut, the edges shall be made smooth and even by polishing with an electrical or pneumatic grinder toremove all inequalities. Care shall be taken to see that the cut edges of the plate are perfectly straight. Jigs to be used for this purpose shall depend upon the types of cutting machine used. The Coils cut to the required shape shall be checked for correctness before they are rolled into pipe drums. If any corrections are required, the Contractor shall do the same by re-cutting, if necessary.

ROLLING OF COILS

The Coils prepared as mentioned above are cut to the exact size shall be put into a rolling machine to form a pipe of the required diameter as under:
The Contractor shall adjust the rolling machine so as to give a uniform curvature to the pipe throughout its circumference.
The curvature obtained shall be checked by the Contractor's foreman during the process of rolling and if proper curvature is not obtained at any place including the ends, the rolling operation shall be repeated at this stage
Heating of Coils to obtain the desired curvature shall not be permitted.

WELDING

All components of a standard shell, either straight or bent etc. shall be welded, wherever possible by use of automatic arc welding machine by Submerged Arc Welding Process with alternating current. Generally, hand welding shall not be permitted except specific cases, where it is absolutely necessary. This should be done in consent with client’s representative. Hand welding shall also not be permitted except for sealing runs and such other minor works at the discretion of the Engineer-in-charge. The strength of the joint shall be at least equal to that of the parent material.
The Contractor shall use electrodes of approved make and size, the size depending on the thickness of coil and the type of joint. It shall also be used with standard current and arc voltage required for the machine in use with such modifications as may be found necessary after experimental welding. For this purpose, samples of welded joints shall be

prepared and tested in the presence of the Engineer. The values once determined shallbemaintainedthroughoutthework and if any modifications are to be made, a written permission of the Engineer shall be obtained. In the case of thin sheets, electric arc welding may not give satisfactory results and gas welding shall be resorted to. Gas welding shall be subject tothesame specifications and tests as thoseforelectric welds. Welding should be carried out inside as well as outside.

All the shop and field joints shall be welded, all welding shall conform to the requirements of IS 9595 and IS 4353.

All circumferential joints shall be double welded butt joints. Field joints shall be from outside, with a sealing weld from inside. End preparation for such welding shall conform to IS: 2825.

All circumferential welds involving Coils of unequal thickness shall be so kept that the inside surfaces of Coils match to provide stream lined joints without alteration in the internal diameter. As far as practicable, welding of dissimilar thickness of shells shall be carried out in the shops.

The welding shall be of the best workmanship free from flaws, burns, etc. and the Contractor shall provide for his own electrodes and equipment, ovens to keep the electrodes at the desired temperatures and dry. In order to maintain a good standard in welding, welders shall be tested by the Contractor with prior intimation to the client before they are entrusted with the job. Qualification standard for welding procedures, welders and welding operation shall conform to the requirements of IS: 7307 and IS: 7310 (latest). Periodical tests as regards their efficiency shall also be taken at intervals of about 6 months and those found inefficient shall be removed from the job. Only those who pass the test shall be posted on the job. If an incompetent welder has already welded some pipes, all welding done by him previously shall be fully checked by X- ray in addition to the regular X-ray inspections. The defects if any shall be set right to the satisfaction of the Engineer. All such check tests and rectification of defects shall be entirely at the cost of the Contractor. No pipes or steel sections shall be erected unless the work of the welder concerned has been proved to be satisfactory. Specially selected welders shall do site welds.

A record shall be maintained showing the names of welders and operators who have worked on each individual joint. Hand-welding shall preferably be carried out by a pair of welders (parallel welding putting two welders at a time both will be working in diametrically opposite side of the curvature. Welding shall be divided into 4 quadrants shall be welded simultaneously, so that by observing proper sequence, distortion can be avoided. A joint entrusted to a particular individual or a pair shall be as far as possible, completed by them in all respects, including sealing run. No helper or other unauthorized person shall be permitted to do any welding whatsoever. In case of infringement of above, the persons shall be punished as directed by the Engineer.

The welded joint after welding should not become brittle or sensitive to blows and there should be no loss of toughness due to welding or heat treatment. The material after welding and heat treatment is to be tougher than the base metal and is to retain its original ductility. No allowance will be made for thinning of weld and the weld should in no point be less than the nominal thickness of plate.

Upon receipt of the order and prior to the start of fabrication, the Contractor shall submit to the Engineer for his approval the ``welding procedure'' he intends to use in the shop work. Similarly, prior to the start of the field welding, procedure for the field welding must be submitted to the Engineer for his approval. Manual welding shall be adopted only when machine welding is not possible.

ULTRASONIC & RADIOGRAPHIC TEST OF WELDEDJOINTS

1.4.10.1 **Manufactured in Site Factory/Workshop**

For the mild steel pipes manufactured in site factory/workshop, fabricated from mild steel Coils, 100 % of weld length of each pipe shall be subjected to Ultrasonic Test either on-line or off-line. For the mild steel pipes manufactured in site Factory/Workshop fabricated from mild steel coils, 15% of weld length of each pipe shall be subjected to Radiography Test by Digital Image/ X-Ray Film Method. (IS: 10234)

FIELD WELDED JOINTS

For Field welded joints, 100% of each welded joint shall be examined by Ultrasonic Test either online or offline and 15% weld length of each welded joint shall be examined by Radiography Test.

In case of failure of any of the joint during RT, the contractor is to carry out radiography of thrice the number of field joints which includes 1 Repair and 2 Penalty shots.

Subsequent to RT of thrice the number of field joints, if anyone of the joint fails the Contractor has to carry out RT of all field welded joints i.e. 100 % basis. All these testings shall be carried out by the contractor at his own risk and cost.

The weld ripples or weld surface irregularities, on both inside and outside shall be removed by any suitable mechanical process to a degree such that resulting radiographic contact due to any remaining irregularities cannot mark or be confused with that of objectionable defect. The radiograph shall be made in strict accordance with the latest requirements and as per the latest and most efficient technique either with X-ray or gamma ray equipment.

The photographs are to be marked in such a way that the corresponding portion of the welded seam can be readily identified. All radiographs will be reviewed by the Engineer to identify the defect and determine those which must be removed. Defects that are not acceptable shall be removed by chipping, machiningorflame gouging to sound metal and the resulting cavities shall be welded. After rectification, the joint is to be radio graphed again to prove the quality of the repair. The Engineer based on the latest standards prescribed by Indian Standard specification will judge the radiographs as acceptable or unacceptable.

All X-ray shall be made with equipment and by personnel furnished by the Contractor. Films shall be developed within 24 hours of exposure and be readily accessible at all times for inspection by the Engineer. The Contractor shall provide for the use of the Engineer suitable X- ray viewing equipment. X-ray films shall be properly maintained by the Contractor and shall be handed over to the department on completion of the Contract. All films shall be identified by the No. and chart prepared indicating location of the joint each X-ray photo represents. In the event of additional radiographic inspections required of any work associated with the pipe erection, the Radiographer at the discretion of the Engineer shall perform such inspection.

RADIOGRAPHIC INSPECTION

1.4.12.1 **General**

The Engineer shall assure himself that the welding procedure employed in the construction of pipes has been qualified. The Contractor shall submit evidence to the Engineer that the requirements have been met. The Contractor shall certify that the welding of pipes has been done only by qualified welders and welding operators and the Engineer shall ensure himself that only qualified welders and welding operators have been used.

The Contractor shall make available to the Engineer a certified copy of the records of the qualification tests of each welder and welding operator. The Engineer shall have the right at anytimeto call for and witness tests of welding procedure or of the ability of any welder

and welding operator.

Radiographic Inspection of welded joints

All welded joints to be radio graphed shall be examined in accordance with codes as specified below:

Sl. No.	Code Number	Description
1	**IS : 2595**	Code of Practice for Radiographic Testing
2	**IS : 4853**	Recommended Practice for Radiographic Inspection of Fusion Welded Butt joints in Steel Pipes.
3	**IS :1182**	Recommended Practice for Radiographic Examination of Fusion Welded Butt-Joints in steel Coils.

The reinforcement on each side of all butt welded joints shall not exceed 1.5 mm. A complete set of radiographs and records as described in IS: 2595 for each job shall be retained by the Contractor and kept on file for a period of at least five years. Radiographers performing radiograph shall be qualified in accordance with SNT-TC-1A. Supplements and Appendices ``Recommended Practice for Non-destructive Testing Personnel Qualification and Certification" published by the American Society for Non-destructive Testing as applicable for the technique and methods used.

Final acceptance of radiographs shall be based on the ability to see the prescribed pentameter image and the specified hole.

The acceptance criteria for radiography of the joint shall be as per IS-10234

1.4.13 **THERMAL STRESS RELEIVING**

Not applicable

TOLERANCE

The shell in the completed work shall be substantially round. The difference between maximum and minimum inside diameters at any cross section shall not exceed 1% of the nominal diameter of the cross section under consideration subject to a maximum of 10 mm.

Machined parts shall be within the limits specified by IS 3589.

Straight pipes shall have their faces perpendicular to the axis of the section with a maximum deviation of 2 mm on either side of the plane. Pipe ends shall be beveled as per IS: 3589. The pipes shall be supplied in length of 10.5 m to 12.5 m.

For the shell thickness, no negative tolerances are acceptable.

SHOP TESTING

After fabrication, but before application of protective coatings all pipes and specials shall be subjected to a shop hydraulic test (100%). Standard lengths ofpipes shall be directly subjected to test and non-standard pipe and elbows can be tested as standard pipe before being cut to size.

1.4.16 **FIELD HYDRAULIC TESTING**

The Pipeline after lying at site shall be subjected to 100% Hydro testing. The test pressure shall be 1.5 times working pressure or 6 kg/cm2 whichever is higher. The pressure shall be maintained for a period of 24 hours. The length of pipe for hydro testing shall be generally 5 km as directed by Engineer-In-Charge.

Each pipe shall be filled with water and the pressure slowly and uniformly increased until the required test pressure is reached.

The pipe to be tested shall be given a serial no. which shall be painted on its inside together with details such as pipe No. Shell thickness, diameter, length etc. as directed. It

shall be entered in the register to be maintained by the Contractor.
Prior to testing, the pipe shall be inspected thoroughly and all the apparent defects in welding such as jumps, porosity etc. shall be repaired by gouge and re-welding.
The hydraulic test shall be carried out under cover at the fabrication shop, in the presence of and to the satisfaction of the Engineer or the inspection agency appointed by the Employer.
For indicating the pressure inside the pipe an accurate pressure gauge of approved make duly tested and calibrated for the accuracy of readings shall be mounted on one of the closures which close the pipe ends.
The pressures shall be applied gradually by approved means and shall be maintained for a period of 24 hours. The pipe shall be hammered throughout its length with sharp blows, by means of a 1 kg. hand hammer.
The pipe shall withstand the test without showing any sign of weakness, leakage, oozing or sweating. If any leak or sweating is observed in the welded joints, the same shall be repaired by gouging and re-welding after dewatering the pipe. The repaired pipe shall be re-tested to conform to the specified pressure.
If any leak or sweating is observed in pipe shell the pipe under test shall be rejected temporarily. The Contractor shall stack such rejected pipesseparately in his yard. TheEngineershall inspect the same and after taking cuts if necessary, shall determine the nature of repairs to be carried out thereon and shall then decide as to how and where they shall be used. No payment shall be made for handling or carrying out repairs, but, payment for the fabrication and hydraulic testing of the pipe shall be released only after acceptance of the pipe with necessary repairs and subsequent testing etc. are carried out by the Contractor to the satisfaction of the Engineer. The Engineer shall be supplied with two copies of the results of all the tests carried out.
The Mechanical Tests for Pipe material at Manufacturers work shall be carried as per approved Quality Assurance Plan(QAP) and tests shall be as per IS:1239/ IS:3589/IS:5504.

1.4.16.1 **Testing of Site Welded Joints**

The welded joints at site shall be tested for Tensile test, Bend test &Tre-panned plug in accordance with procedure laid down in as per the latest edition of IS No. 3600 “code of procedure for testing of fusion welded joints and weld metals in steel”.
Test pieces shall be taken by the contractors from the welded joints at the position on fabricated pipes pointed out by the Engineer in-charge.
The sample so taken shall then be cut to the exact shape and dimensions and machined as described below and handed over to the Engineer-in-charge for testing. All the work up to and including machining and arranging for test shall be done by the contractors.

SUBMISSION OF DAILY PROGRESS REPORT

The Contractor shall submit to the Engineer a daily progress report in the proforma approved by the Engineer, wherein all the details of the work carried out in the factory shall be fully recorded. Similarly, works done in the various units in the factory shall be separately mentioned. The Contractor shall maintain a register of all the finished materials giving dates of carrying out important operations such as testing, transport, etc. The registershallbepresented at least once a week to the Engineer who shall initial the entries after verification.

TRANSPORTING OF PIPES, SPECIALS etc.

All pipes and specials fabricated in the site factory / workshop and temporarily stacked in the Contractor's yard shall be transported to the site of laying after cleaning them internally, etc. The loading in the factory shall be carried out by means of either a crane, gantry or shear legs, so as not to cause any damage to the finished material. Similarly,

while unloading and stacking, great care shall be taken to ensure that the material is not damaged or dented. The contrivances to be used for unloading will be different in different situations and in each case the one approved by the Engineer shall be adopted. The material stacked at site shall be jointly inspected by the Engineer and the Contractor and defect or damage noticed shall be repaired to the satisfaction of the Engineer before payment is admitted.

Props of approved designs for maintaining circularity having M.S. Angle/Pipe at both ends to avoid metal to metal contact shall be fixed to the pipes during transit to avoid undue sagging and consequent distortion. After the pipes are carefully stacked, props should be retained till pipes are joined in trenches and then props are re-used for subsequent similar operations. The stacking ground, both in the Contractor's yard and at the site of laying shallbeselected in such a way as not to get waterlogged during monsoon. If this cannot be done, the pipes shall be supported on sleepers to avoid contact with wet earth and subsequent rusting. In order to prevent sagging during transit, savings of steel Coils can be utilized by cutting to the required length and tacking the same to the pipe ends, in placeofprops, if approved by the Engineer.

As explained in earlier paragraphs, materials such as pipes, tapers, etc. may be transported to the site of laying as soon as the material is finished in all respects with the permission of the Engineer to avoid congestion in the Contractor's yard. However, materials such as expansion joints, composite bends, `T' branches and other complicated materials shall be stacked in the Contractor's yard until they are required for laying in the field. In view of this, the work of fabrication of such materials shall be properly synchronized as far as possible with the laying operations.

Fabricated materials such as specials, appurtenances, bolts, nuts, distance pipes, flanges, saddles, collars bypass arrangements etc. shall be transported to the site of laying from the fabrication shop according to the needs of the laying operations only. In regards access roads, the Contractor shall note that access road may lead up to some points on the alignment the Contractor shall have to make his own arrangement for connecting approaches to transport the pipes cross country to the actual site of laying at his own cost. Whatever may be the mode of transport he uses it shall be incumbent on the Contractor to carry and stack the pipes and specials along the alignment as close as possible to the site of laying.

PROCEDURE FOR RECEIVING STEEL PIPES

1.4.19.1 **General**

To ensure that the work of erecting pipes is not held up at any stage and place, the Contract or shall maintain an adequate stock of standard specials, flange rings, plug Coils, manhole covers, etc. and short length of smaller diameter pipelines, etc. at site in his field stores, in consultation with the Engineer. Wherever possible, the Contractor shall arrange one full month's requirement of pipes, specials, etc. stacked along the alignment.

1.4.19.2 **Stacking of Pipes, etc. and Inspection**

The Contractor shall keep in each section a responsible representative to take delivery of the pipes, specials and appurtenances, etc. transported from the fabricating stockyard or received from any other work site to the site of laying and to stack along the route on timber skids. Padding shall be provided between coated pipes and timber skids to avoid damage to the coating. Suitable gaps in the pipes stacked shall be left at intervals to permit access from one side to the other. The pipes, specials, appurtenances so received on site shall be jointly inspected and defects recorded, if any, such as protrusions, grooves, dents, notches, damage to the internal coating etc. shall be pointed out immediately to the Engineer at the site and in the acknowledgement challans. Such defects shall be rectified or repaired to the satisfaction of the Engineer entirely at the

Contractor's risk and cost.

1.4.19.3 Handling of Pipes, Special Appurtenances etc.

It is essential to avoid damage to the pipes, fittings and specials, etc. or their coatings at all stages during handling. The pipes and specials shall be handled in such a manner as not to distort their circularity or cause any damage to their surface treatment. Pipes shall not be thrown down from the trucks nor shall they be dragged or rolled along hard surfaces. Slings of canvas or equally non-abrasive materials of suitable width of special attachment shaped to fit the pipe ends shall be used to lift and lower coated pipes to prevent damage to the coating.

Great care shall be taken in handling the pipe right from the first operation of manufacture until they are laid and jointed. The Contractor will provide temporary props as described earlier in order to prevent any sagging of the pipes while they are stacked in their yard and while transporting to the site of delivery, i.e. laying. The props shall be retained until the pipes are laid and welded. If at any time these props are found to be dislodged or disturbed, the Contractor shall immediately reinstate them in such a way that the true shape of the pipe shell or specials is maintained to the satisfaction of the Engineer. No defective or damaged pipe or special shall be allowed to be used in the work without rectification to the satisfaction of the Engineer. Any damage to the coating shall be repaired by the Contractor at his own cost to the satisfaction of the Engineer.

1.4.19.4 **Dents**

Whenever any dent, i.e. a significant alteration of the curvature of the pipe shell is noticed, the depth of the dent shall be measured between the lowest point of the dent and the pipe shell curvature line. All dents exceeding 2 percent of the outer diameter of the pipe shall be removed by cutting out a cylindrical portion of the pipe and replacing the same by an undamaged piece of the pipe. The Engineer may permit insert patching if the diameter of the patch is less than 25 percent of the nominal diameter of the pipe. Repairs by hammering with or without heating shall not be permitted. Any damage to the coating shall also be carefully examined and rectified.

1.4.19.5 **Marking**

The component parts of the pipes shall be carefully marked for identification in the field. The marking shall be on the side which will be the inside of the pipe after bending.

The marking operation shall be conducted with full size rulers. Only blunt nose punches should be used.

The Coils used for fabrication of pipes shall be laid out in such a way that when the shells are completed one set of original identification markings for the material will be plainly visible. In case these markings are unavoidably cut out, they shall be accurately transferred by the Contractor to a location where these markings will be visible on the completed work.

After the hydraulic tests on the specials and other items, the number of the shell in the line as it will be erected and the direction of flow shall be stamped in a prominent manner on each piece.

A register shall be maintained in suitable Performa giving the following information for each shell tested:

Serial No.

Shell No.

Date of test

Thickness and specification of steel Weight of shell tested

Maximum test pressure

Details of test performance Details of radiographic examination of welds

Name of Engineer's representative witnessing tests

A copy of these details shall be furnished to the owner free of cost.
No separate payment will be made for these markings and the rates for the items concerned shall be deemed to include the cost of such markings.

LAYING OF PIPELINE

1.4.20.1 **General**

Unless specified otherwise, the pipeline shall be buried with minimum cover at top, as shown on drawings. No material shall be erected unless it has been previously passed by the Engineer. Pipe shall be protected from outside with rock shield mesh/soft murrum/Sand wherever required/as directed by Engineer-In-Charge. In such cases, the depth of soft murrum/sand shall be 300mm above top of pipe. The mesh shall be manufactured from HDPE material with weight per metre not less than 750 grams. The size of mesh shall be as per requirement of Engineer-in- Charge. The mesh shall be of such strength to protect the external coating from impact of rock during back filling. The height of falling of rock shall range from 3 to 5 m over top of pipe. The mesh shall be spirally wrapped over pipe with suitable overlap and properly tied with non - metallic ties. The mesh shall be spirally wrapped over pipe with suitable overlap. After field joints and at all specials also shall be wrapped by rock shield protection mesh

Erection of fabricated shells shall be carried out by the Contractor who shall equip himself, at his cost, with all necessary tools, machinery, labour, etc. required for the purpose.

1.4.20.2 **Welding**

Except for routine welding of joints, no other work shall be done in the absence of Contractor's engineer, either during the day time or at night. Chipping shall not be kept in arrears for more than 15 joints.

1.4.20.3 **Temperature**

The components of the pipeline such as base Coils, top Coils and pedestals have been so designed that the centres of the Coils and pedestals shall coincide at the Mean Temperature (30°).

For this reason, all works such as fixing flanges, base plate etc. in true alignment and in correct position and tack welding pipes shall be done at the mean temperature.

For ascertaining the temperature, the Contractor shall provide mercury cups and fix them to the pipe shell from outside and shall also provide thermometers of the required type and range. No extra payment shall be made for this.

1.4.20.4 **Saddle supports**

Unless, otherwise, specified, pipeline shall be underground. However at unavoidable reaches it shall be on R.C.C. saddles spaced at about 6 m centre to centre. The material and construction of R.C.C./Steel structures such as saddles, anchor blocks, crossings etc. associated with the work of pipe line shall conform to the relevant IS codes, good engineering practice and as directed by the Engineer. The pipes to be laid on saddle supports shall be erected at mean temperature. Saddle supports shall either be sliding type or fixed type. For both the types of supports a 10mm thick double plate shall be welded to the part circumference of the pipeline that will make contact with the saddle and another similar plate shall also be embedded in the concrete saddle with necessary arrangement to facilitate welding it to the double plate welded to the pipe, in case of fixed support. In case of sliding support, the pipe shall be allowed to slide freely over the plate embedded in the saddle. Alternatively to achieve fixity, the pipe shall be anchored by providing suitable anchor block. The rate for laying the pipe on saddle support shall include for laying, aligning, tack welding, provision of rigging screws with screw eyes etc., complete.

In addition to above, the pipe shall be held in position on saddles with two numbers 50mm

x 8mm thick holding down traps fixed to the saddles with holding down bolts and nuts.

1.4.20.5 **Erection of Shells**

The erection shall be true to position, lines and grade of the trench prepared or as modified by the Engineer. The Contractor shall provide at his cost necessary saddles, pads, spider etc., all necessary instruments and other materials and labour required for proper erection of shells in position and for the Engineer in checking the correctness of the erection. Alignment of sections at edges to be butt welded shall be such that the maximum offset is not greater than the values given below:

Thickness 't' (mm)	**Offset in Longitudinal joints (mm)**	**Offset in Girth joints (mm)**
Up to 12	0.25 t	0.25 t
12 to 20	3 mm	0.25 t
20 to 40	3 mm	5 mm
40 to 50	3 mm	1/8 t
Over 50	Lesser of 0.0625 t or 10mm	Lesser of 0.125 t or 20mm

The best of welders as selected from their work in the Contractor's workshop shall be selected for in-situ welding of the shells. The relevant provision under welding such as qualification standard for welding procedures, tests on welder's work and removal of defects etc., shall also apply to in-situ welding.

General Sequence of Operations

Before commencing the work of pipe laying, the Contractor shall study the L -section of the pipeline for the section concerned. He shall also study the details of laying i.e. underground or aboveground. The underground pipeline shall be laid on sand cushioning/ bedding as shown on the drawing. The difference in depth due to uneven excavations shall be made up by sand cushioning.

Pipe laying shall generally start from the fixity points on either side, the expansion joints if required for pipeline aboveground being provided last. Fixing points are at all anchor blocks. Where such blocks are not required for long lengths, fixity shall be achieved by fixing the pipeline to the special type of R.C.C. or steel saddles as specified. The distance between successive fixity points shall not exceed 300 m.

Thrust and Anchor blocks shall be constructed before commencing the pipe laying work in any section. The construction of the blocks shall be carried out in 3 stages: in the first stage the lower part up to 150 mm below the invert of the pipeline including concrete chairs to support it shall be constructed; in the second stage the pipeline on this part of the block shall be laid; and lastly, the remaining block around and over the pipeline shall be constructed.

The fixity saddles and ordinary saddles if the pipeline is aboveground shall be cast-at least 3 weeks before the pipeline is laid on them. After all saddles between successive fixity points have been cast, a line plan showing the actual position thereof shall be prepared, after taking levels and measuring distances. In case of any errors in casting the pedestals, corrections shall be applied. The pipe laying work shall then start from the fixity points and shall proceed towards the expansion joints. The method of jointing the pipes and erecting them on previously cast

R.C.C. saddles shall be determined by the Contractor depending upon the type of plant equipment and personnel available with them.

The pipe strakes shall be assembled in position on the saddles either by the cranes, portable gantries, shear legs or any other equipment approved by the Engineer. Normally, not more than two pipes shall be aligned, tacked and kept in position on temporary

supports. The Contractor shall not proceed with further work, until the circumferential joints of these pipes are fully welded. During assembly, the pipeline shall be supported on wooden sleepers and wedges, with the free end of the pipeline held in position by slings to avoid deflection due to temperature variations during the day. In general, the assembly of pipe strakes and one run of welding shall be done during the day time while full welding including the external gouging and sealing runs shall be done after 5 p.m. or so. The Contractor shall maintain the continuity of the work by adding two more pipes on the second day in a similar manner, after full welding of the previous joints is completed during the night. While this new work is being done, the Contractor shall proceed with the work of providing permanent supports for the pipeline assembled and welded previously.

Fixing Expansion Joint

The work of laying pipeline at above the ground, laying starts from the fixed points and proceeds towards the expansion joints. It shall be continued until the gap between the pipe ends is less than the lengths of the expansion joint plus pipe strake length. At this stage, the exact gap between the pipe ends shall be measured at mean temperature of that locality. Let it be `X'. Similarly, the exact length of the pipe strake and the expansion joint bought at site shall be measured at the same temperature let these be `Y' and `Z' respectively. Normally, the length of the expansion joint (`Z') is standard.

1.4.22.1 **Case when `Y' plus `Z' is more than `X' or equal to `X' (i.e. fixing of expansion joint without strip)**

At mean temperature the exact gap between pipes shall be measured. Free ends of pipes shall be brought in a correct line and level; lateral movement, if any, shall be corrected. Then the gap between the free ends shall be made equal to the exact length of the expansion joint by cutting one of the pipe ends. Choice of the end to be cut must be made from the point of view of bringing the expansion joint to a central position.

The expansion joints are normally supplied without packing. The normal length of the expansion joint shall be reduced by about 100 mm by cutting the inside locks and inserting the inner strake by means of turn buckles. At mean temperature this expansion joint shall be inserted inside the gap (care being taken to keep the tapered portion on the down-stream side), and both ends shall be tack welded to the pipe ends, after pulling the expansion joint. (Tacks of these two joints shall be of longer length, approximately 100 mm long).

Welding of these two joints of the expansion joints shall be started only after it is ascertained by taking observations that the expansion joint is functioning properly. The procedure to be followed for taking observations as specified.

1.4.22.2 **Case when `Y' plus `Z' is less than `X' (i.e. fixing of expansion joints with strap)**

The expansion joint shall be laid in locked position. Before laying the pipes adjacent to the expansion joint, the exact gap between the pipes shall be calculated by taking measurements of the first pipe (upstream of the expansion joint), and the second pipe (downstream of the expansion joint) at Mean Temperature.

If the gap is less than 100 mm, the second pipe shall be cut to make the desired gap of at least 100 mm. If the gap is more than 200 mm, suitable distance piece of not less than 600 mm shall be inserted after cutting necessary length of the first pipe.

The second pipe shall then be laid in position. Then a strap of length equal to three times the gap length shall be welded to the pipe, overlapping the second pipe by the gap length. The other end of the strip shall be kept free.

At mean temperature the other end of the strap shall be tacked to the first pipe, after checking of the line and level. Simultaneously, all the locks of the expansion joint shall

be removed and chipped off properly.
Welding of the joints between the strap and the first pipe shall be started only after observations are over and it is ascertained that the expansion joint is functioning properly.

1.4.22.3 **Observations**

Before fixing the expansion joint, two mercury cups - one on the left and the other on the right side - shall be fixed on the pipe near the upstream side of the expansion joint.
Immediately after the expansion joint in case (a) above or the strap in case (b) above is tack welded, observations for total expansion or contraction shall be started and continued for 48 hours round the clock. Similarly, the central and end fixity pedestals shall be kept constantly under observation.
The expansion and contraction shall be measured by making a temporary marking on the inner strake (on the upstream side) and measuring the distance between this mark and the edge of the gland of the expansion joint.
The observations shall be recorded in the following Performa;

Reading No.	Time	Shell temp on upstream side	Shell tempon downstream side	Atmospheric temperature	Distance between edge of gland and marking
1	2	3	4	5	6

In case the pipeline is laid in trenches as shown on the drawing, after welding and field testing, the trench shall be filled with selected material up to 300 mm above pipes. This backfill shall be provided in layers not more than 150 mm, with a density more than 70 to 80% of the standard proctor density. Samples shall be tested as directed by the Engineer. Remaining depth of trenches shall be filled with ground backfill material.

Specials

1.4.23.1 **General**

Specials, such as tees, Y-pieces, bends (single or composite), tapers, etc. shall necessarily be in steel and shall be manufactured as per standards and tested and laid in the same manner as the pipes. Small branches, single piece bends, etc. may be fabricated at site, care being taken to ensure that the fabricated fittings have at least the same strength as the pipeline to which they are to be jointed.

1.4.23.2 **Bends**

Bends shall be fabricated taking into accountthevertical and horizontal angles for each case.
The bends shall have welded joints and the upstream and downstream ends of each bend shall have a straight piece of variable lengths as required.
Bends shall be designed with deflection angle of maximum 10 deg. between segments.
When the point of intersection of a horizontal angle coincides with that of a vertical angle, or when these points can be made to coincide, a single combined or compound bend shall be used, designed to accommodate both the angles. The combined bend should have a pipe angle equal to the developed angle, arrived at from appropriate formula.
All joints in bends shall be thermally stress relieved as specified.
Details of thrust collars anchor bolts, holding down straps, saddle Coils should be furnished together with full specifications in Contractor's fabrication drawing.

1.4.23.3 **Manholes**

Manholes of 750-mm dia. shall be provided at both the sides of butterfly valves and as

directed by Engineer-In-Charge. Manholes in the pipeline shall be placed in suitable position in the top quadrant. The Contractor shall fabricate different parts of manhole in conformity with relevant IS Specification, well-established practices and as directed by the Engineer.

1.4.23.4 **Closing or Makeup sections**

Closing or make up sections shall be furnished at appropriate locations on the line to permit field adjustments in pipeline length to compensate for shrinkage in field welded joints, differences between actual and theoretical lengths and discrepancies in measurements.

1.4.23.5 **Heads**

Test heads may be ellipsoidal, standard dished as per ASME code or hemispherical heads. They shall be welded in the shop and removed after the test. Allowance should be made in the length of the pipe section receiving the test head for the welding and removal of the head and preparation of the plate edges for the final weld after testing.

No separate payment will be made for such test heads. The rate quoted for the hydraulic test shall be deemed to cover the cost of such installations.

1.4.23.6 **Walkways, Stairs, Ladders, Hand Rails etc.**

Walkways, stairs, rungs, ladders, hand rails, etc. shall be provided as shown in the drawings and/or as directed by the Engineer. They shall conform to well established design and construction for each accessory concerned.

1.4.23.7 **Flanges**

Flanges shall be provided at the end of pipes or special where sluice valves, blank flanges, tapers, etc. have to be introduced. The flanges received from the MANUFACTURERs will have necessary bolt holes drilled. The Contractor shall assemble the flanges in the exact position by marginal cutting, if necessary, so as to get the desired position of the sluice valves, etc. either vertical or horizontal and shall then fully weld the flanges from both sides in such a way that no part of the welding protrudes beyond the face of the flanges. In case the welding protrudes beyond the flanges and if the Engineer orders that such protrusions shall be removed, the Contractor shall file or chip them off. If required and when ordered by the Engineer, the Contractor shall provide and weld gusset stiffeners, as directed on site. The drilling pattern shall be matching with the drilling pattern of flanges of valves.

1.4.23.8 **Blank Flanges**

Blank flanges shall be provided at all ends left unattended for the temporary closure of work and alsoforcommissioning a section of the pipeline or for testing the pipeline laid. For temporary closures, non-pressure blank flanges consisting of mild steel Coils, tack welded at the pipe ends may be used. For pipes subjected to pressures, the blank flanges or domes suitably designed as per Engineer's requirements shall be provided.

1.4.23.9 **Stiffener Rings**

The Contractor shall provide stiffener rings wherever required by design. The Contractor shall weld the same to the pipes with one circumferential run on each side.

All fillet welds shall have a throat thickness of not less than 0.7 times the width of welding.

Field Hydraulic Test

After erection at site and after the concrete Thrust/anchor blocks have been constructed, the pipeline shall be subjected toa 100% hydraulic test. The pressure test shall be conducted in as per IS-5822.

During the test, the pipe shall be struck sharp blows with 1 Kg hammer. Water shall not spout, oozeorsweat either through joints-welded or bolted or the body of the pipe. If any leakage noticed shall be repaired by the Contractor, which shall include coating and

repairing of the damaged portion. Repairs and replacements and further testing including the cost of the Coils and other raw materials shall be carried out by the Contractor at his own cost. If any leakages are observed during the defectsliabilityperiod due to defective workmanship or material supplied by the Contractor, he shall repair the same to the entire satisfaction of the Employer, at his own cost.

KIIDC shall assist the contractor in identifying the source & in obtaining permission for drawl of water for field-testing of pipe. The contractor shall pay for the water and carry the water to the test location at his cost. The cost of hydraulic testing of the installation by providing necessary testing equipment, pumping the water, creating and maintaining pressure, and the necessary bulk heads and their fixtures, and their subsequent removal and restoring the installation to working trim shall be included in the rate for laying and testing of the pipe. KIIDC may also provide water for testing and civil construction work from its adjacent pipeline at a rate of Rs. 4/- per Kiloliter, if feasible. Contractor shall seek prior permission of department in writing and shall water meter at his own expense.

Progress in Laying

The TENDERER shall submit along with the tender his detailed bar chart for manufacturing and laying of the pipeline. While preparing his bar chart, the Tenderer shall plan his activities such that the laying of pipes shall closely follow the manufacturing schedule and no pipes shall remain stacked in factory or at site for a period more than two months.

It is mandatory that he shall submit an approach note on how he will carry out this Work within the contractual period and on the compatible resources in terms of construction equipment and other facilities that he shall utilize to complete the tendered Work.

Field Destruction Test

Contractor shall perform destruction test of any section of MS Pipeline which Engineer selects at every 5 KM pipeline laid and shall submit its result to him. The testing shall be done in the NABL approved laboratory in the presence of representative of the employer.

1.5 PROPERTY CONNECTION

Connection to the building shall be throughan Electro fusion PP saddle and no direct connection shall be made on the MDPE pipe. This is necessary to prevent leakages and any contamination in the potable water network.

1.6 PIPE LINE GENERAL

1.6.1 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 belocated 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-

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 at least 20 mg/1. A properlyadjustedhypochlorite solution injected intothemain with a hypo-chlorinator, 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 upstream under flowing water condition, and then the area shall be blocked after make sure to reaching more than 20 mg/l. 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.

1.6.2 **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 where 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 flangesshall also be fitted where a water barrier is required. All puddle flanges shall be clearly shown on the drawings and theresultantthrust clearly indicated. Puddle flanges shall only be fitted with the prior approval of the Employers Engineer.

1.6.3 **Flanges**

Flanges shall be provided at the end of pipes or special where valves, blank flanges, tapers/reducer, etc. have tobeintroduced. The flanges received from the manufacturers shall have necessary bolt holes drilled. The Contractor shall assemble the flanges in the exact position by marginal cutting if necessary, so as to get the desired position of the valves, etc. either vertical or horizontal and shall then fully weld the flanges from both sides in such a way that no part of the welding protrudes beyond the face of the flanges. In case the welding protrudes beyond the flanges and if the Employer's Engineer orders that such protrusions shall be removed, the Contractor shall file or chip them off. If required and when directed by the Employer's Engineer, the Contractor shall provide and weld gusset stiffeners, as directed on site.

1.6.4 **Blank Flanges**

Blank flanges shall be provided at all ends left unattended for the temporary closure of work and alsoforcommissioning a section of the pipeline or for testing the pipeline laid. For temporary closure, non-pressure blank flanges consisting of mild steel plates, tack welded at the pipe ends may be used. For pipes subjected to pressures, the blank flanges or domes suitably designed as per Employer's Engineer's requirements shall be provided.

1.6.5 **Flanged Pipes**

The gaskets used between flanges of pipes shall be EPDM of min 5 mm thick. 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.

1.6.7 **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.

1.7 Valves: General

Valves shall be suitable for use with the fluid being conveyed at the temperatures and pressures required for the application. Generally, pressure designation shall not be less than PN 16. Valves shall have integral flanges drilled as specified in BS 4504 where applicable. Flanges to other standards shall be used only if approved and provided that any differences do not affect mating dimensions. Back faces of flanges shall be machined. Sluice valves and butterfly valves shall be suitable for flow in either direction.

Sluice valves shall comply with IS 14846 or BS 5150 or 5163 as appropriate Butterfly valves shall comply with IS 13095 or BS 5155 / AWWA-C-504/1980

Valves shall be suitable for frequent operation and for infrequent operation after long periods of standing either open or closed.

Rubber used in valves shall be ethylene propylene rubber (EPDM or EPM) or styrene butadiene rubber (SBR). It shall comply with the requirements of IS 13095 or Appendix B of BS 5155, be suitable for making a long term flexible seals, and be resistant to

anything causing deterioration of the flexible seal.

1.8 Sluice valves

P it is a resi Manufacturing, supply and delivery of DI D/F non-rising spindle soft seated glandless Gate Valves with body and bonnet of Ductile cast iron of grade GGG-40, wedge with fully encapsulated EPDM rubber W-270 (approved for drinking water) and seals of NBR. The valves should be with replaceable stem nut and replaceable sliding shoes. Valve stems shall be of single piece thread rolled. Valve shall have 3 ―O‖ rings of NBR for stem sealing. Gate valve shall be compatible for buried applications without valve chamber. Face-to-face dimensions as per BS 5163-89/IS 14846-PD/EN 558F4 and flange connections as per IS 1538, Maximum Valve operating torque should be at least 40% less than the torque as stated in the standard EN 1074. Electrostatic epoxy powder/liquid coating (EP-P) inside and outside color blue RAL 5005 with minimum coating thickness of 250 microns. The EPDM rubber & Epoxy Powder should be approved by W270. (EP-P, it is a resicoat powder approved for drinking water application, applied through fusion bonding technology process by dipping the shot-blasted casted components heated up to 200 Deg C). The valves should be should beeither with manually operated /electric actuators along with gearbox arrangement and SCADA system remote operations as per the requirement.

1.8.1 Material of Construction

Body, Bonnet	Ductile Iron GGG 40 (EN-JS- 1030) / Spherical Graphite Iron IS: 1865 Gr 400/12
Wedge (fully rubber encapsulated)	Ductile Iron GGG 40 (EN-JS- 1030) / Spheroidal Graphite Iron IS: 1865Gr 400/12 encapsulated with EPDM rubber - W270 approved grade.
Spindle/Stem	SS: IS: 6603 12Cr13/22Cr 13; AISI 410/AISI 420
Stem Nut	Brass
Bonnet Gasket	EPDM rubber - W270 approved grade
Internal Fasteners	Stainless Steel SS316/304
Stem Sealing	Toroidal NBR sealing rings (Min 03 _O’ Rings)
Coating	Inside & Outside epoxy powder coated; DFT minimum250 micron, shade RAL 5005 (BLUE)

1.9 Butterfly valves

Manufacturing, supply and delivery DI D/F Resilient Seated Vacuum tightButterflyValve suitable for bidirectional flow with Body and disc made of DI GGG40. Disk shall conform to double eccentric with specially designed (Dove tail Shape) pressure supported sealing system made of EPDM approvedby DVGW Clause W270. The Body seat shall be fusion bonded nickel chromium weld overlay and micro finished. Closed Disk Eye with dry shaft design made of Stainless steel with 13% chromium of grade 1.4021 connected with Medium free bearing of Bronze with double O-ring sealing of EPDM. The shaft shall be connected to the disc by riveted pin or taper pin with lock. The Valve shall be compatible for Buried application without chamber. The Coating and the rubber parts shall comply with DVGW and KTW standards. The gearbox shall be with self-locking, fully enclosed, maintenance-free lubricated for life, worm gear including mechanical position indicator. The Valve shall be according to EN593/IS 5163, the face-to-face length shall be EN 588-1, basic series 14/BS 5155(Long Body)/ IS13095 (Long Body) and drilling according to EN 1092-2/IS 6418. Epoxy Powder or liquid Epoxy coating with minimum thickness of

250 micron applied inside and outside of both body and disc. it is a resi- coat powder approved for drinking water application, applied through fusion bonding technology process by dipping the shot-blasted castedcomponents heated up to 200 Deg C). The valves should be capable of integration with electric actuators and SCADA system remote operation.

1.9.1 **Material of Construction**

Body	Ductile iron to EN-JS 1030 (GGG-40)
Disc, Retainer Ring	Ductile iron to EN-JS 1030 (GGG-40)
Shaft	Stainless Steel 420 with 13% chromium (1.4021)
Shaft Bearing Bushes	Bronze
Seat	Integral Ni-Cr weldoverlay, (Ni > 67% Cr =19.5 %) micro-finished
Disc Sealing & O' rings	EPDM Rubber [W 270 Clause]
Surface Protection	Epoxy powder coating or epoxy liquid lacquer min. 250 microns thickness, colour RAL 5005 Blue

1.10 Kinetic Air Valve

The valve shall be capable of exhausting air from pipe work automatically when been filled. Air being released at a sufficiently higher rate, to prevent the restriction of the Inflow rate. Similarly, the valve shall be capable of ventilating pipe work automatically when being emptied. The air inflow rate is being sufficiently high to prevent the development of a vacuum in pipeline. The valve shall automatically release air accumulating in pipe line work during normal working condition.

Air valve shall be of double orifice type with a large orifice for ventilation for exhaust of the pipeline and small orifice for release of air under working pressure. The valve shall be suitable for maximum working pressure in the system. All air valves shall be provided with isolating sluice valve and flanged end connection.

Air valve shall be design to prevent premature closure prior to all air having been discharge from the line. The orifice shall be positively sealed in the close position but float (Ball) shall only be raised by the liquid and not by mixer of air and liquid. The sealing shall be design to prevent the floats striking after long period in the close position.

All branched outlets including outlets for Air valves will be with compensation pads (DiaofMainFor branch Dia ratio greater than 3). Diameter of compensation pad will not be less than1.75 times the O.D. of the branched outlet. Plate thickness for pads will be same as that of the main.

For outlets with above ratio less than three, then the joints will be of plate reinforcement type. The aperture of valves must be properly designed for which the contractor shall submit design calculations for necessary approvals before the procurement of valves.

The air valve should be as per IS: 14845 of minimum PN 1.0 rating.

All branched outlets including air valve tees will be provided with one 15mm BSP coupling duly plugged for measurement of pressure in due course. The closing plug will be in Stainless Steel (AISI 304 or equivalent) with Hex. Head and will be provided with copper washer for sealing. All flanges will be drilled as per I.S.1538.

The gaskets shall be of nitrile rubber.

1.11 Dismantling Joints

DI Double flanged Dismantling joints shall be installed in such a manner that valves can be dismantled without stress to the joints. Dismantling joints shall be suitable for installation with all valves of different diameters.

The dismantling joint shall be designed for a hydrostatic pressure of 10 kg/sq.cm. The sliding flange shall be machined smooth and shall slide at least 30 mm to disengage fully mating flange. All the fasteners for the dismantling joint shall be of SS 304. These shall be completely leak proof with proper gasket arrangement. Flange dimensions shall conform to latest relevant IS code. Flanged specials shall be supplied with required nuts, bolts and rubber gaskets. The dismantling joint shall be internally and externally coated with hot applied (dip) bituminous paint.

1.12 Ball Valves

Ball valves shall conform where applicable to IS 9890-2003 or BS5159.
Multi-piece bodies shall be used where work on the ball and seats when installed may be needed. If valves need removal for servicing, one-piece bodies may be used.
Seat materials shall be chosen for long life, with erosion and corrosion resistance.
Ball supports shall be of the floating ball or trunnion type. If line pressure is too low to ensure a positive leak-free seal, built-in seat loading devices, or specially shapedseating shall be used to ensure sealing

1.13 PRESSURE REDUCING VALVES

The Pressure Reducing Valve should be capable of reducing higher pressure to lower pre -set downstream pressure irrespective of flow or varying upstream pressure fluctuations. The valve shall be globe/inline or angular pattern design. The body shall have a replaceable, raised, stainless steel seat ring. The valve shall have an unobstructed flow path with no stem guides, bearings, or supporting ribs. The body and cover shall be ductile iron. All external bolts, nuts, and studs shall be Duplex coated. All valve components shall be accessible andserviceable without removing the valve from the pipeline. The main valve body internals shall consist of only three parts i.e. body, diaphragm and top cover thus minimizing maintenance. The diaphragm shall provide uniform pressure distribution around the sealing area and prevents deformation to diaphragm to ensure longer maintenance free operation.
The valves should be of single/double chamber, self-actuating automatic valves and no other external means either electrical/pneumatic should be required to operate the valve. The entire actuator assembly (seal disk to top cover) shall be removable from the valve as an integral unit. The internal valve component shall be accessible, removable and repairable without removing the valve body from the pipeline. The stainless steel valve shaft shall be center guided by a bearing in the separating partition. The valves should be pilot operated, 2-way adjustable, capable of being preset at a constant outlet pressure from a higher upstream pressure and they shall be drop-tight under no-flow conditions.
A pressure gauge shall be provided toindicate downstream pressure over the operating range of the valve. Valve operation shall be controlled by the interaction of the inlet pressure, outlet pressure and an intermediate pressure produced by a pilot valve or relay system acting on the upper side of the main valve. Valves shall be flanged and drilled to BS 4504 for the operating pressure required. The valve manufacturer shall be certified according to the ISO 9001 Quality Assurance Standard. The valve should be of proven design and should have been successfully installed and running in similar projects, credentials should be submitted to prove the same, subject to approval of the owner.
Valves shall be flanged and drilled to BS 4504 for the operating pressure required.

1.13.1 **Material of Construction**

Component	**Material**
Body and cover	Ductile iron

Internal valve	Gunmetal with bronze liner, cups and facing rings in leather
Relay valve	Bronze with stainless steel shaft and nylon valve face
Diaphragm	Reinforced synthetic rubber/EPDM
Loading spring, If employed	Spring steel
Tubing	Copper/Stainless steel

Flow Control Valves

This specification lays down broad requirements of control/flow set valves required in the gravity distribution network.

Common reservoirs are used to supply water to different areas/zones. The rate of flow of water at inlet to each zone/parts of zone must be limited, so that all zones/areas get the allocated demand, corresponding to that particular area.

Hence the network shall be provided with Flow rate control/set valve which will have following function:

Flow rate limiting function: This function in the valve will ensure that the flow rate across the valve will not exceed a set flow rate limit. This flow rate limit is set with the help of a specially designed orifice installed at the downstream of the control valve.

Vendor/Manufacturer has to guarantee in their design of product that in case of any failure of pilot or the complete hydraulically operated valve, the valves should by default close and isolate the line from the OHT. It must not remain open under any kind of failure.

Any other appurtenances like strainers, isolation valves, upstream and downstream reducer/tapers, complete setofnuts, bolts washers, and gasket etc. for fixing valve to main pipe line shall be in vendor's scope of supply. Drill std. of flanged ends shall be as IS: 9523 table 4/5 for PN1.0 and PN1.6 rating for nominal sizes of 80mm and above. Below nominal size of 80mm, drill std. shall be as per IS: 6392 table17.

All kinds of pilot line/tapping line with fittingsand piping components necessary for operating pilot for the hydraulic valves from pipe/tank bottom etc. shall be completely in vendor's scope of supply. The control valve will have an orifice plate installed inside a housed chamber (provided by the valve manufacturer). The control valve is normally open when the flow rate passes through the valve. When there is an increase in flow rate, the flow rate pilot senses the increased pressure drop across the orifice plate and tends to close themair valve, thus reducing flow rate to set point.

The control valve shall be diaphragm type (self-medium operated). The hydraulic valve shall be a flow rate limit/set valve provided with 2 way differential metal pilots. The valve shall be globe/inline or angular pattern type. The main valve body internals shall consist of only three parts i.e. body, diaphragm and top cover thus minimizing maintenance. The diaphragm shall provide uniform pressure distribution around the sealing area and prevents deformation to diaphragm to ensure longer maintenance free operation. The diaphragm shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separation operating pressure from line pressure. The diaphragm should seat on the body itself. Packing glands or stuffing boxes or pistons shall not be permitted. The control tubing of SS/copper including the brass pilot/s shall ensure that the hydraulic valve functions as per customer requirement. The valve shall have a self-cleaning filter to avoid any possibility of dirt build up in the control tubing.

The valves shall have coating of RILSAN grade T BLUE 7443 MAC and EPDM diaphragm (reinforced with nylon mesh)

1.14.1 Material of Construction:

Body	EN-GJS-450-10 (Ductile Iron)
Cover	EN-GJS-450-10 (Ductile Iron)
Diaphragm	EPDM
Pilot	Brass body with nylon reinforced rubber diaphragm inside
Control tubing	Stainless Steel/Copper
Control fittings	Brass

1.15 Valve Chambers

All valve chambers shall be of an adequate size to facilitate ease in maintenance and operation. The base slab of valve chambers shall slope towards a cut-out in the slab which shall be filled with gravel so that water can percolate inside the ground and keep the chamber dry. All valve chambers shall be constructed in reinforced concrete. Minimum thickness of the base slab shall be 150mm. Chambers shall be equipped with removable SFRCcovers, approach ladders/ rungs and valve supports as appropriate.

PART B - GENERAL MECHANICAL REQUIREMENTS

1.1 INTRODUCTION

This part of the Employer's Requirements sets out the general standards for mechanical equipment to be provided by the contractor within the existing pumping stations. Reference to any specific item does not necessarily imply that such plant is to be included in the Works. All machinery/ equipment used for the Works shall, unless otherwise specified, comply with the provisions of this chapter and shall always conform to the latest applicable codes and standards. All pumps shall be energy efficient pumps with VFD drives.

1.2 CODES AND STANDARDS

The design, manufacture and performance of the pumps specified herein shall comply with the requirements of the applicable Codes and Standards, as follows, but not limited to

Sl. No.	Standard	Title
1	IS 6595(Part II)	Horizontal centrifugal pumps for clear, cold and freshwater.
2	IS 9137	Code for Acceptance Tests for Centrifugal, Mixed flow and
3	IS13537	Axial pumps.
4	ISO5199	Standards of the Hydraulic Institute of USA. Balancing of
5	ISO2373	impeller.
6	IS 5120	Performance test of pumps
7	IS 11732	

1.3 FEATURES OF CONSTRUCTION

1.3.1 IMPELLER

The impeller shall be an enclosed impeller, made in one piece and securely keyed on the shaft. The installation will include means to prevent loosening of the impeller during operation, including rotating in the reverse direction. The impeller shall be statically and

dynamically balanced to prevent vibration, as per ISO 2373.

1.3.2 **CASING RING**

The pump shall be provided with a renewable type casing ring, to offer wearing resistance. Hardness of the casing ring shall be 50 BHN (Brinell Hardness Number Units), lower than the impeller ring.

1.3.3 **IMPELLERRING**

The pump impeller shall be provided a renewable type impeller ring on both ends. The material of construction of these rings shall be similar to that of impeller and these shall be hot push fit on impeller. The rings hardness shall be equal to impeller and 50 BHN more than the casing rings.

1.3.4 **SHAFT**

Single integral shaft, shall be designed to withstand thetorque loads throughout the whole range of operating conditions, for the selected particular impeller diameter as well as all the impeller diameters covered between minimum and maximum impeller diameters when coupled to the motor shaft through flexible coupling. The shaft design should also include the possibility of running the pump with an electric motor of higher power rating meant for future expansion with increased impeller diameters.

1.3.5 **SHAFT SLEEVES**

Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing boxes. The end of the shaft sleeve assembly shall extend through the packing gland. Shaft sleeves shall be securely locked or keyed to the shaft to prevent loosening. Shaft and shaft sleeve assembly shall ensure concentric rotation.

1.3.6 **STUFFING BOXES**

Stuffing boxes at driving end and non-driving end shall be of such design that they can be re-packed, without removing any part, other than the gland and lantern ring. An axially split gland should be used to facilitate changing the gland packing. Sufficient space shall be available for maintenance purposes.

1.3.7 **AIR RELEASE VALVES**

Pump shall be provided with arrangement of valve to vent air, which may get accumulated in the pump.

1.3.8 **SEALING**

Self-sealing water connections should be provided.

1.3.9 **FLANGES**

Flanges shall be machined flat, with flange faces vertical and at right angles to the pump mounting surface. Cast iron flange drilling and thickness shall conform to IS 1538, (part IV and VI) for ID up to 1500mm and to IS 6392 for ID greater than 1500mm.

1.3.10 **BEARINGS**

Bearings shall be either grease or oil lubricated and should absorb the radial and axial thrusts, under all operating conditions. Anti-friction bearing shall be of standard type and shall be selected to give 20,000 hours continuous operation at rated operating conditions. The rise in bearing oil/grease temperature with continuous running of the pump shall be within the allowable limits which shall not exceed 20°C for grease and 30°C for oil lubricated bearings above ambient temperature. Cooling arrangements shall be provided if required. Bush bearings will not be acceptable.

1.3.11 **BASE PLATE**

The common base plate for pump and motor shall be fabricated from mild steel sections and have sufficient rigidity to resist vibration and distortion. Suitable holes shall be provided for grouting and they shall be so located that the base will be able to be grouted in place, without disturbing the pump and motor. All pumps and motors shall be properly and accurately aligned, bolted and doweled to the base plate. Adequate space shall be

provided between pump drain connections and base plate for installation of minimum 20 mm diameter drain pipe. Foundation bolts shall be complete with nuts and flat and shake proof washers.

COUPLING

A flexible pin bush type coupling shall be provided, duly bored and keyed to the pump and motor shafts.

The coupling and the pump shafts have to be designed so that the breaking load of the coupling system is slightly below that of the shaft.

1.3.12 **ACCESSORIES**

All specified accessories and any other standard accessories required for correct and safe operation of the pump shall be furnished with the pumps. All incidental piping (including valves) required for sealing, lubrication and cooling of stuffing box packing and/or pump bearing shall be furnished by the Contractor.

A mild steel fabricated coupling guardshall be provided to provide a safeguard against the open rotating parts of the pump and motor.

Eye bolts (as many as required for safety), shall be provided for ease of lifting and installation.

1.4. TECHNICAL PARTICULARS

MATERIAL OF CONSTRUCTION		
1	Casing	Cast Iron IS: 210, Grade FG260
2	Gland	Cast Iron IS: 210, Grade FG260
3	Impeller Material	Stainless Steel, AISI CF8M
4	Wear Rings/Inter stage rings	Phosphor Bronze
5	Shaft	Stainless Steel SS410
6	Shaft Sleeve, Neck ring	Bronze
7	Packing material	Graphite Asbestos
8	Base plate	MS with Epoxy coated
9	All Fasteners including anchor bolts, foundation bolts, washers, nuts, etc. in both wet and dry areas.	Stainless Steel SS316
Note:	**Material Test certified shall be provided for all components**	

1.4.2 **Drive Data**

Sl No.	Motor	TEFC Squirrel Cage Induction Motors, Foot mounted, IP:55 protection, continuous rated with Class "F" insulation confirming to IS: 325, suitable for site conditions and temperature of50° C

1.5 Documents required from pump supplier during detailed engineering stage

During detailed engineering the Bidder shall submit the following:

CompletefilledupTechnicalDatasheetofPumpandmotorsprovidedwithPR.

Performance curves of individual pumps @ 50Hz frequency superimposed on system

curve at rated rpm.
Performance curves of individual pumps @ 53Hz frequency superimposed on system curve at rated rpm
Pumps General arrangement drawing
Foundation Detail arrangement
Pump Cross section drawing
Motor technical datasheet
Motor performance curves
Motor General arrangement drawing
Motor cross section drawing
DRIVER TORQUE VS SPEED SUPERIMPOSED ON LOAD TORQUE VS SPEEDCURVE
SPEED VSCURRENT
WITHSTAND TIME VS MOTOR CURRENT
EFFCIENCY VS % OF LOAD
POWER FACTOR VS % OF LOAD
TERMINAL BOX GA
RESISTANCE VS TEMPARATURE

1.6 Accessories and scope of supply

The supply of pumps and accessories shall include the following but not limited to
Pumps complete with casing and volute assembly and impeller, Motor, shafts, Shaft sleeves, Gland packing, Bearing assembly, Coupling, Coupling guard, Base plate, Foundation bolts, fittings, Fasteners, Inserts, Name plates, Companion flanges etc. complete for successful commissioning of pumps.
Consumables, Commissioning spares, lubricants, Mandatory spares, surface preparation, painting, shop testing, site testing, shop testing facilities
Compound and Pressure Gauge: 150/200 mm Dia. of suitable range with stainless steel connecting pipes, gooseneck, cocks etc. complete.

Priming Cock.

Suitable piping for collection and leading off gland leaks etc. up to discharge point. Priming Cock.
At least one working and one standby unit of vacuum pump + motor of suitable capacity and rating for priming arrangements of main pumps complete with all piping accessories and connection and potable water tank.

1.7 Pump Performance Guarantees

The pump performance guarantee shall relate to the flow rate, the total head and the efficiency of the pump when tested at the manufacturer's work and shall obtain approval of Engineer.
The pump shall operate at its design point within acceptance tolerances for flow rate and total head laid down in BS EN ISO 9906:2000.
Each pump shall be tested at the manufacturer's factory in accordance with BS EN ISO 9906:2000 or other relevant standards in conjunction with one of the contract motors.
This test shall be carried out on at least one pump set using the flexible coupling and contract drive shaft arrangement to establish that the drive arrangement with supports and couplings operates satisfactorily under all operating conditions.
Where similar drive shaft arrangements have been installed by the Contractor and have been proven satisfactory in service this requirement may be withdrawn subject to the approval of the Engineer.
A test shall be carried out of the performance from closed valve to the maximum quantity that can be delivered under abnormally low discharge heads.

Sufficient readings shall be taken at each test to produce accurate curves of the heads, flow, pump speed and power required at pump coupling throughout the operating range of the pump. Vibration and noise dB (A) levels shall be measured and shown to be acceptable and shall have Engineer's approval. The Contractor shall have Engineer approval and provide acceptable test certificates, showing the NPSH requirement for the pump is at least 2 m less than the NPSH available under all working conditions.

In the absence of the approved test certificates the supplier shall carry out a test on one pump of each type to verify the NPSH requirement based upon the 3% output drop criterion and shall take approval of Employers Engineer.

Test Certificates in duplicate shall be submitted to the Engineer immediately following each of the tests mentioned above. Performance curves shall also be incorporated in the Operation and Maintenance Manual.

Single Pump Operation

Head/quantity curve
Motor kW input/quantity curve
Overall efficiency/quantity curve
NPSH required/quantity curve
Vibration and Noise dB (A)levels

Parallel Pump Operation

Head/quantity curves
Motor kW input/quantity curve
Overall efficiency/quantity curve
NPSH required/quantity curve
Vibration and noise dB(A) levels

may be made from pressed sheet steel with roller type guarding. Gears shall be cut from solid cast or forged steel blanks or shall be stress – relieved welded steel construction. Pinions shall be of forged carbon or heat treatedalloy steel. Strength, Quality of Steel, heat treatment, face, pitch of teeth and design shall confirm to BS-436, BS-545 and BS-721. Spur and helical gears must comply with B.S. 436 and worm with B.S. 721. Bearing must be ball and roller type conforming to I.S. 2513/B.S.2525-32:1954. Proper lubricating arrangements are to be provided for bearings and pinions. The brake for the lifting gear shall be automatic and always inaction. The proof testing of each chain pulley block is to be carried out as per latest applicable standards. The safe working load is to be marked in such way that is clearly visible from the operating level.

PART C – ROAD RESTORATION

Road restoration is a critical activity which requires special attention of the contractor. Following guidelines should be followed:

The contractor shall have to restore the road up to WMM stage including refilling trench in layers, watering, rolling and compacting to within 10days after trenching is completed in a particular street/reach. The contractor shall ensure that uncovered WBM length in total does not exceed 5.0KM at any stage of work and will complete the bituminous work regularly.

Contractor shall erect informatory board at his own cost showing type of work, inconvenience expected & timeline for various construction activities going to take place in a particular streetora particular reach of road as per direction of Engineer in charge.

Contractor shall deploy a community outreach team headed by a qualified social expert (post graduate in sociology) having minimum 3 years' experience of social activity work with government recognized NGO or other government institutes to make strong relation

with public prior to start of work in a particular ward/area.
The contractor shall have to do the sequencing of activities as per direction of engineer in charge to synchronize pipe line work to minimize the road excavation and restoration in the street which will have pipelines.
The cutting of existing C.C. pavement shall be done by using mechanical cutter to ensure cutting in regular line and the laying of C.C pavement shall be done below 30 degreeambient temperature.
All Work shall be as per MoRTHspecifications.

Provisions of road restoration:

(i) **For laying water supply pipe on B/T Surface**

For road width up to 4 m, restoration up to WMM stage in trench width and bituminous work (wearing surface) in full width of the Existing Road.
For road width 4 m to7 m, restoration up to WMM stage in trench width and bituminous work (wearing surface) in entire road width up to 7 m.

For road width more than 7 m, restoration limited to 7 m (2 lanes) to cover the trenches (may be one lane over each trench).

(ii) For laying water supply pipe on CC Road:-

For road width less than 4.0m, restoration up to PCC stage (lean concrete) will be in trench width & CC pavement of M-30 grade in full width.
For road width more than 4.0m, restoration by lean concrete and pavement in M-30grade in trench width only.
In Bituminous road restoration, Use of Paver is mandatory for carriage way width above 3.75m of road restoration
Notwithstanding all which has been laid down on road restoration, Employer's representative with reasons recorded and prior permission of PIU in charge will be authorized to come up with the site specific solution based on prevailing ground situation.

PART D – BUILDINGS/CIVIL

The work should be carried out as per the approved design, drawings and specifications.
The contractor should follow Kerala Detailed Standard Specifications and Central Public Works Department (CPWD) Specifications.
All relevant provisions of IS codes should be strictly adhered.

Volume 3: Financial Bid

Section - 9: Financial Forms

SECTION – IX

Financial Forms

FORM OF TENDER (Price Bid)

(To be quoted by the Bidder)

Name of Contract "KIIFB – KIIDC – Extension of Moolathara Right Bank Canal from Korayar to Varattayar."

To,

The Managing Director,

Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC),

PARVATHY, TC 36 /1, NH 66 Service Road, Eanchakkal, Chakkai P O,

Thiruvananthapuram -696024, Kerala

Email: iiidctvm@gmail.com

Having examined the Conditions of Contract, Specifications, Drawings and Addenda for the execution of the above named Works, we, the undersigned, offer to survey, design, execute and complete such Works and remedy any defects therein in conformity with the Conditions of Contract, Specifications, Drawings, Design Criteria, Scope of Work and Addenda for the sum of Rs. …….. (In words: Rupees ……..) or such other sum as may be ascertained in accordance with the said Conditions.

We acknowledge that the Volume I, Volume II, Volume III and Volume – IV form part of Tender.

We undertake, if our Tender is accepted, to commence the Works as soon as is reasonably possible after the receipt of the Engineer's notice to commence, and to complete the whole of the Works comprised in the contract within 30months as stipulated in the Tender.

We agree to abide by this Tender for the period of 180 days from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiration of thatperiod.

The contract is not complete and binding between us unless and until a formal Agreement is prepared and executed for this Tender, together with your written acceptancethereof.

We understand that you are not bound to accept the lowest or any tender you may receive.

Dated this……day of

2020

Signature ……in the capacity of ……

Duly authorized to sign tenders for and on behalf of ……

Address……

Occupation. ……..

ANNEXURE - I
BILLING SCHEDULE FOR INTERIM PAYMENTS

Tentative Billing Schedule for Interim Payments:
Note: The EPC agency shall furnish detailed estimates, BOQs based on approved drawings as per provisions of the Deliverables. The above payment schedule can be sub divided in to various subcomponents with appropriate percentage breakup as per the estimate and BoQs approved by the Departmental Authorities but within the overall percentage breakup of each component as approved by EPC Committee-I.
The contractor/EPC Agency shall be subject to the following penalties for failure to carry out its operations as indicated below during "Performance Based O&M period" (3 years within the DLP of 5 years) under Normal Operating Conditions. The Key Performance Indicators (KPIs) are as follows. The KPIs will be monitored through the padasekarasamithi of Ayacut area or the Project Engineers of the Department and accordingly the EPC Agency will be penalized for not complying with the following KPIs.

Sl. No.	**Basis of Penalty**	**Benchmark**	**Penalty Value for each Parameter specified in the bid document**
1	Road Restoration / Trench filling Complaints recorded at ULB or officers concerned in-charge of the project pertaining to the scope of work contemplated in this project	Complaints rectified within 24 Hours	No Penalty
		Rectified beyond 24 Hours and up to 48 Hours	Rs.2,000/- per Complaint perDay
		Rectified beyond 48 Hours & up to 72 Hours	Rs.5,000/- per Complaint perDay
		Rectified beyond 72 Hours	Rs.10,000/- per complaint perday or termination of the Contract.

NOTE: 1. For intermediate stage under each of the above items, payment can be made on a pro rata basis.
2. No payment shall be made for ancillary works which do not form part of the scope of work.
Dated this……day of

2020
Signature ……in the capacity of ……
Duly authorized to sign tenders for and on behalf of ……
Address…..……
Occupation. ……..

ANNEXURE - II
BILLING SCHEDULE FOR INTERIM PAYMENTS
(To be quoted by the Bidder)

Unit Rates :

Sl. No.	Brief Description of Item with specifications	Unit	Rate	
			(In Figures)	(In Words)
a)				
b)				
c)				
d)				
e)				

The Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited (KIIDC), reserves the right to approve / reject the above quoted rates.
The Bidder shall accept the unit rates as per the following order of priority.
As per prevailing Market rate analysis.
The bidders need to submit a detailed quantity and unit costs for all the items involved in the project as a support document for the lump sum price quoted by them. The rate structure will be reviewed and approved by the Employer / Employer's Representative (Refer to Clause 11. Iii, SECTION I: INSTRUCTIONS TO TENDERERS of Volume -1). The approved unit rates will form the basis for payments for addition or reduction in scope of works.
Dated this……day of

2020
Signature ……in the capacity of ……
Duly authorized to sign tenders for and on behalf of ……
Address…..……
Occupation. ……..

ANNEXURE – III PRICE BID
(To be quoted by the Bidder)

Name of Contract "KIIFB –KIIDC - Extension of **Molathara** Right Bank Canal from Korayar to Varattayar

Sub Head	**Description**	**Units**	**Amount** (In Rs. Lakh)	
			In Figure	**In Words**
A.	Project cost (excluding all taxes)	Amount		

Datedthis……day of2020
Signature ……in the capacity of ……
Duly authorized to sign tenders for and on behalf of ……
Address…..……
Occupation. ……..

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Volume 4: Bidder Model Forms

In model forms data to be filled by the Bidder.

If need be additional sheets can be added.

Section - 10: Bidding Forms

SECTION – X
Bidding Forms

DATA SHEET –1
Bidder's Appreciation of the Project

This should also consist of a report on the Bidder's appreciation of the project, which should include a section on the site inspection carried out prior to bidding, and demonstrate awareness and understanding of all the principle technical and logistic aspects related to project construction.

DATA SHEET –2
Bidder's Organizational Setup for the Project

The bidder should provide the following information

A. Preliminary organization chart
   for Overall project management
   Surveys and detailed
   investigation Design and
   engineering services
   Execution of Civil works, water supply pipe lines and road works.
   Quality assurance system
   Testing and commissioning
B. Narrative description of organization chart
C. Description of relationship between Head office and site management.

DATA SHEET –3
Drawings to be submitted

The bidder shall submit, descriptions of proposed project components, adhering to the basic parameters indicated in the bid document along with relevant drawings. The information should be submitted in sufficient details to allow an assessment of the general adequacy of the Bidder's proposals, Sketches, drawings and diagrams along with salient design details, where necessary should be included.

DATA SHEET –4
Management of Design and Engineering Services

The bidder shall submit descriptions of proposed management of Surveys, Detailed investigation, Design and Engineering services and sequences to be used for the same. Key surveys, detailed investigation and soil exploration activities, key design and engineering activities, Key experts for the same and their deployment schedule should be identified and described. This information shall be given separately for water supply, sewerage and road works.

DATA SHEET –5
Construction Methodology of different structural components

The bidder shall submit in brief descriptions of proposed methods, sequences, facilities and layouts to be used for execution of water supply, sewerage and road works. This should cover the following.

Working facilities

Infrastructure works Civil

works

Water supply

Road work

The information submitted should be such as to allow an assessment of the general adequacy of the Bidder's proposal. The information shall include number and classification of manpower, equipment and materials proposed to be deployed for each of the branch activities.

DATA SHEET –6
Proposed Deployment of Key Personnel

For specific positions essential to contract implementation, the bidder should provide the proposed deployment of key personnel (for Surveys, Detailed Investigation, Soil Exploration, Design and Engineering, Civil construction, Hydro-mechanical works, E & M works). Bio-Data of each of the personnel proposed to be deployed for various activities shall be included in separate sheets for each candidate.

Name of Tenderer

Sl. No.	Name of Person	Designation/ Post Held/ Status	Academic Qualifications and Experiences in Similar Works.	Remarks

Signature of Tenderer

DATA SHEET –7
Proposed Deployment Construction Equipment

Name of Tenderer

The bidder should list out all major equipment, which he proposes to use for construction works. This should include their numbers, capacities and whether equipment proposed is to be purchased new or existing equipment is to be used. In respect of existing equipment, year of manufacture and current ownership is to be stated. Numbers of above equipment to be deployed during various periods of construction as necessary considering the construction programme shall also be included.

The following format shall be used for this

purpose: Activity

Description of equipment (type, model, make)

Capacity / performance factor

No. of each equipment Year of manufacture Period of deployment

Source *

* Indicate availability e.g. owned, leased or to be purchased new.

S. No.	Name of Equipment	No. of Units	Kind and Make	Capacity	Age of Machinery	Present condition of Machinery	Present Location with name and address of organization where machinery is in use	Whether the machinery is hypothecated to any bank or institution
1	2	3	4	5	6	7	8	9

Signature of Tenderer

DATA SHEET –8
Proposed Sub-contractors

The bidder shall list out the proposed subcontractors. The information shall be submitted in the following format. The subcontractors (s) proposed to be associated for respective category of work, must have experience of planning and construction of similar type of work at least in one project costing not less than 50% of the proposed value of work proposed to be sublet.

Section of works
Name (s) address (es) of sub contractors
Description & location of similar works previously executed*

DATA SHEET –9
Proposed Sourcing of Key Engineering Materials

The bidder shall submit, in outline, descriptions of proposed sourcing of key materials.

DATA SHEET –10
Proposed Construction Schedule for the Project

The bidder shall submit a construction program in bar chart from – together with corresponding critical path network, which starts at the date of commencement and shows in details all the key activities.

DATA SHEET –11
Quality Control and Quality Assurance System

The bidder shall submit, in outline, description of proposed quality control and quality assurance system for the implementation of the project. This shall also include the proposed testing laboratories with the testing equipment, key personnel for filed quality control and inspection and laboratory work.

QUALIFICATION INFORMATION CHECKLIST TO ACOMPANY THE TENDER

Sl. No	Description	Remarks
1	**2**	**3**
1	Copy of Contractors valid registration under appropriate Class with Government of Kerala	Yes/No
2	BID SECURITY certificate	Yes/No
3	Transaction fee certificate	Yes/No
4	Copy of PAN card along with a copy of latest Income Tax returns submittedalong with proof of receipt	Yes/No
5	Copies of GST Registration certificate in the prescribed proforma	Yes/No
6	Details ofcivil engineering works executed during the last ten financialyears on thetenderer'sname in Statement - I with supporting certificates	Yes/No
7	Details of similar works (i.e., water supply system, irrigation system, canals, micro irrigation etc.) completed as prime contractor (in the same name) during thelasttenfinanciall years in Statement-II with supporting certificates	Yes/No
8	Quantities of works executed in water supply system, irrigation system, canals, micro irrigation works as prime contractor (in the same name) during the last ten financial years in Statement - III with supporting certificates	Yes/No
9	Details of existing commitments i.e., works on hand and works forwhichtenders are submitted in Statement - IV with supporting certificates	Yes/No
10	Availability of critical equipment in Statement – V	Yes/No
11	Scanned copy of declaration on critical equipment on non-judicial stamppaper worth of Rs.200/-	Yes/No
12	Availability of key personnel in Statement – VI	Yes/No
13	Litigation history in Statement – VII	Yes/No
14	Proof of liquid assets in the shape of Solvency certificates etc., for therequired amount	Yes/No
15	Declaration in on line stating that the soft copies uploaded by themareGenuine	Yes/No
16	Any other certificates required as per NIT	Yes/No

Notes:
All the statements copiesofthe certificates, documents etc., shall be given page numbers on the right corner of each certificate, which will be indicated in column (4) against each item. The statements furnished shall be in the formats appended tothetender document.

The information shall be filled-in by the Tenderer in the checklist and statements I to VII, for the purposes of verification as well as evaluation of the tenderer's Compliance to the qualification criteria as provided in the Tender document.
The tenderers are requestedto upload the specified documents as per NIT only to facilitate for easy evaluation of tender.
The bidders shall sign on all the statements, documents, certificates, uploaded by him, owning responsibility for their correctness/authenticity.

DECLARATION

I/WE…….have gone through carefully allthe tender conditions and solemnly declare that I/we will abide by any penal action such as disqualification or black listing or determination of contract or any other action deemed fit, taken by, the KIIDCagainst us, if it is found that the statements, documents, certificates produced by us are false/fabricated. I/WE hereby declare that, I/WE have not been blacklisted/debarred/Suspended/ demoted in any Department/ KIIDC in Kerala or in any State due to any reasons.

Signature of the Tenderer

LETTER OF TENDER
Date: ……

To
The Managing Director,
KIIDC,
Thiruvananthapuram

Sir,
I/We do hereby tender and if this tender be accepted, under take to execute the following work viz "KIIFB – KIIDC - Extension of Moolathara Right Bank Canal from Korayar to Varattayar"

as shown in the drawings and described in the specifications deposited in the office of the MD, KIIDC, with such variations by way of alterations or additions to, and omissions from the said works and method of payment as provided for in the "conditions of the contract" for the sum of **IBM** or such other sum as may be arrived under the clause of the standard preliminary specifications relating to "Payment on lump-sum basis or by final measurement at unit rates"

I/WE have also quoted percentage excess or less on IBM in Schedule 'A' (in words and figures) for which I/We agree to execute the work when the lumpsum payment under the terms of the agreement is varied by payment on measurement quantities.
I/WE agreed to keep the offer in this tender valid a period of **180 (One Hundred and Eighty) days**, from the date fixed for tender openingmentioned in the tender notice and not to modify the whole or any part of it for any reason within above period. If the tender is withdrawn by me/us for any reasons whatsoever, the earnest money paid by me/us will be forfeited to Government I/WE hereby distinctly and expressly, declare and acknowledge that, before the submission of my/our tender I/We have carefully followed the instructions in the tender notice and have read the MoRT&H(4threvision) / KDSS and the preliminary specifications therein and the KDSS. addenda volume and that I/We have made such examination of the contract documents and the plans, specifications and quantities and of the location where the said work is to be done, and such investigation of the work required to be done, and in regard to the material required to be furnished as to enable me/us to thoroughly understand the intention of same and the requirements, covenants, agreements, stipulations and restrictions contained in the contract, and in the said plans and specifications and distinctly agree that I/We will not hereafter make any claim or demand upon the Government/KIIDC based upon or arising out of any alleged misunderstanding or misconception /or mistake on my/or our part of the said requirement, covenants, agreements, stipulations, restrictions and conditions.
I / WE enclosed to my/our application for tender schedule, a crossed demand draft/Bank Guarantee No……..dated:) forRs: ……as earnest money not to bear interest.
I / WE shall not assign the contractor or sublet any portion of the same. In case if it becomes necessary such subletting with the permission of the Executive Engineer shall be limited to (1) Labour contract, (2) Material contract, (3) Transport contract and (4) Engaging specialists for special item of work enjoined in KDSS

IF MY / OUR tender is not accepted the sum shall be returned to me/us on application when intimation is sent to me/us of rejection or at the expiration of **180 (One Hundred and Eighty) days** from date fixed for tender opening, whichever is earlier. If my/our tender is accepted the earnest money shall be retained by the Government/KIIDC as Security for the due fulfillment of this contract. If upon written intimation to me/us by the **MD, KIIDC**/Superintending Engineer / Executive Engineer's Office, I/We fail to attend the said office on the date herein fixed or if upon intimation being given to me/us by the MD, KIIDC /Superintending Engineer/ Executive Engineer or acceptance of my/our tender, and if I/We fail to make the additional Security deposit or to enter into the required agreement of the tender notice, then I/We agree the forfeiture of the earnest money. Any notice required to be served on me/us here under shall be sufficiently served on me/us if delivered to me/us hereunder shall be sufficiently served on me/us if delivered to me/us personally or forwarded to me/us by post to (registered or ordinary) or left at my/our address given herein. Such notice shall if sent by post be deemed to have been served on me/us at the time when in due course of post it would be delivered at the address to which it is sent.

I/WE fully understand that the written agreement to be entered into between me/us and **KIIDC** shall be the foundation of the rights of the both the parties and the contract shall not be deemed to be complete until the agreement has first been signed by me/us and then by the proper officer authorized to enter into contract on behalf of Government/KIIDC.

I AM/WE ARE professionally qualified and my/our qualifications are given below:

Name	Qualified

I/WE will employ the following technical staff for supervising the work and will see that one of them is always at site during working hours, personally checking all items of works and pay extra attention to such works as required special attention (eg) Reinforced concrete work.

Name of members of technical staff proposed to be employed	Qualification.

I/WE declare that I/WE agree to recover the salaries of the technical staff actually engaged on the work by the Department / KIIDC, from the work bills, if I/We fail to employ technical staff as per the tender condition.

TENDERERS / CONTRACTOR'S CERTIFICATE

I/WE hereby declare that I/We have perused in detail and examined closely the MoRT&H (4th Revision) and Kerala Standard Specifications, all clauses of the preliminary specifications with all amendments and have either examined all the standards specifications or will examine all the standard specifications for items for which I/We tender, before I/We submit such tender and agree to be bound and comply with all such specifications for this agreement which I/We execute.

I/WE certify that I/We have inspected the site of the work before quoting my Percentage excess or less on ECV, I /We have satisfied about the quality, availability and transport facilities for coarse aggregate, sand and other materials.

I / WE am/are prepared tofurnishdetaileddatain support of all my quoted rates, if and when called upon to do so without any reservations.

I / WE hereby declare that I / We will pay an Additional Security Deposit (ASD) in terms of condition 3.6 of instructions to tenderers.

I / WE hereby declare that I am / we are accepting to reject my tender in terms of condition 3.7 of instructions to tenderers.

I / WE hereby declare that I / We will not claim any price escalation.
I / WE hereby declare that I am / We are accepting for the defect liability period as 30 months.
I / WE declare that I/WE will procure the required construction materials including earth and use for the work after approval of the Engineer-in-Charge. The responsibility for arranging and obtaining the land for borrowing or exploitation in any other way shall rest with me/us for the materials for construction, I/WE shall ensure smooth and un-interrupted supply of materials.
I / WE declare that the responsibility for arranging and obtaining the land for disposalofspoil/soilnotusefulforconstructionpurposesshallrestwithme/us.
I / WE declare that I / WE shall not claim any compensation or any payment for the land so arranged for disposal of soil and the land for borrow area. My/our quoted percentage excess or less ECV are inclusive of the land so arranged and I/We will hand over the land so arranged for disposal of soil to the KIIDCAuthority after completion of work.
I / WE declare that I / WE will not claim any extra amount towards any material used for the work other than the quoted works for respective schedule 'A' items.
I / WE declare that I / WE will execute the work as per the mile stone programme, and if I / WE fail to complete the work as per the mile stone programme I abide by the condition to recover liquidated damages as per the tender conditions.
I / WE declare that I / WE will abide for settlement of disputes as per the tender conditions.

DECLARATION OF THE TENDERER

I/WE have not been black listed in any KIIDCinKerala due to any reasons.
I/WE have not been demoted to the next lower category for not filing the tenders after buying the tender schedules in a whole year and my/our registration has not been cancelled for a similar default in two consecutive years.
I/WE agree to disqualify me/us for any wrong declaration in respect of the above and to summarily reject my/our tender.
I/WE have gone through carefully all the tender conditions and solemnly declare that I/WE will abide by any penal action such as disqualification or black listing or determination of contract or any other action deemed fit, taken by, the Department against us, if it is found that the statements, documents, certificates produced by us are false/fabricated.
I/WE hereby declare that, I/WE have not been blacklisted/ debarred/ Suspended/ demoted in any Department in Kerala ordinary State due to any reasons.

Address of the Tenderer: Signature of the tenderer

Phone No.:

Fax No.:

TECHNICAL BID
QUALIFICATION INFORMATION

The information shall be filled in by the Tenderer in the check slip and statements I to VI and enclosed to the Technical bid/Tender schedules which will be sued for the purposes of verification of adequacy of information as well as evaluating the tenderer's Compliance to the qualification criteria as provided in the Tender in the Tender Schedule. All the Statement and check-slip shall be submitted by the tenderer in scaled cover 'A'.

STATUS OF BIDDER

Individual/Partnership Firm

:

Place of Registration:

Principal Place of Business:

Registration particulars withGovernment of Kerala:

Authorized signatory to sign theTender document in case the firm is:
the Tenderer (enclose copy of such authorization)

Check-slip duly filled in:Enclosed / Not enclosed

Signature of the Tenderer.

BIDDER INFORMATION FORM

Date: _____

Tender No. and Title:_____
Page_____of___pages

Bidder's name
In case of Joint Venture (JV), name of each member:
Bidder's actual or intended country of registration: *[indicate country of Constitution]*
Bidder's actual or intended year of incorporation:
Bidder's legal address [in country of registration]:
Bidder's authorized representative information
Name:_____ _
Address: _____
Telephone/Faxnumbers:
___
E-mail address:
____ ___ ___
1. Attached are copies of original documents ofArticles of Incorporation (or equivalent documents of constitution or association), and/or documents of registration of the legal entity named above In case of JV, letter of intent to form JV or Agreement In case of Government-ownedenterpriseor institution, documents establishing: Legal and financial autonomy Operation under commercial law Establishing that the Bidder is not dependent agency of the Employer 2. Included are the organizational chart, a list of Board of Directors, and the beneficial ownership.

Form of Bid-Securing Declaration

Date: [insert date (as day, month and year)]
Bid No.: [insert number of bidding process]
Alternative No.: [insert identification No if this is a Bid for an alternative]
To: [insert complete name of Employer]
We, the undersigned, declare that:

We understand that, according to your conditions, bids must be supported by a Bid-Securing Declaration.
We accept that we will automatically be suspended from being eligible for bidding in any contract with the entity that invited Bids for the period of time of [insert number of months or years] starting on [insert date], if we are in breach of our obligation(s) under the bid conditions, because we:
Have withdrawn our Bid during the period of bid validity specified in the LetterofBid; or having been notified of the acceptance of our Bid by the Employer during the period of bid validity, (i) fail or refuse to execute the Contract, if required, or (ii) fail or refuse to furnish the Performance Security, in accordance with the Instructions to Tenderers.
We understand this Bid-Securing Declaration shall expire if we are not the successful Bidder, upon the earlier of (i) our receipt of your notification to us of the name of the successful Bidder; or (ii) twenty-eight days after the expiration of our Bid.

Name of the Bidder***** _____
[insert complete name of person signing the Bid]
Name of the person duly authorized to sign the Bid on behalf of the Bidder **** [insert complete name of person duly authorized to sign the Bid]**
Title of the person signing the Bid **[insert complete title of the person signing the Bid]**

Signature of the person named above
[insert signature of person whose name and capacity are shown above]
Date signed **[insert date of signing]** day of **[insert month]**, **[insert year]**

*****: In the case of the Bid submitted by joint venture specify the name of the Joint Venture as Bidder
**: Person signing the Bid shall have the power of attorney given by the Bidder to be attached with the Bid [Note: In case of a Joint Venture, the Bid-Securing Declaration must be in the name of all members to the Joint Venture that submits the bid.]

Section XI: Bid Statement

SECTION – XI

Bid Statement

Table of Forms

Bidder's Qualification

Statement I: Details of Civil Engineering Works executed during the Last Five (5) Financial Years onthe Tenderer's Name

Statement II: Details of Similar Works (i.e., Canals/ Tunnels/ Dams/ Regulators)Completed as Prime Contractor (In the Same Name) DuringtheLast Five (5)FinancialYears

Signature of theTenderer

Statement III

Quantities of works executed in Canals/Tunnels/Dams/Regulators etcasprime contractor (in the same name)duringthe last five financial years

Statement IV

Details of Existing Commitments i.e., Works on hand and works for which tenders are submitted

Statement -V

Availability of Critical Equipment

Statement-VI

Availability of Key Personnel

Statement-VII

Litigation History

Bidder’s Qualification

To establish its qualifications to perform the contract, the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder

Statement I: Details of Civil Engineering Works Executed during the Last Five (5) Financial Years on the Tenderer's Name

Bidder's Name:
Date:_____
Joint VentureMember'sName:_
Tender No. and Title:__
Page____of__pages

Starting Year	Ending Year	Contract Identification	Role of Bidder
		Contract name: _____ Brief Description of the Works performed by theBidder:_____ Amount of contract:__ Name of Employer: _____ Address: _____ ___	
		Contract name: _____ *Brief Description of the Works performed by theBidder:*_____ *Amount of contract:*__ *Name of Employer:* _____ *Address:* _____	

Maximum value of Civil Engineering works executed in any one year during the last (5) Financial years by the Tenderer.

Sl. No.	**Financial Year**	**Value in Rs. Update to the Price level 2018-19**
1. 2.		

Attach certificate(s) issued by the Executive Engineer concerned and counter signed by Superintending Engineer showing work wise / year wise value of work done in respect of all the works executed by the Tenderer during last ten years **OR**
Certificate from Chartered Accountant supported with Annual Balance Sheet tallying with I.T. Clearance certificate.

Signature of the Tenderer

<u>Statement II</u>: Details of Similar Works (i.e., External Development and Landscape/ Park Development) Completed as Prime Contractor (In the Same Name) During the Last Five (5) Financial Years

Bidder'sName:_

Date:___

Joint Venture Member's Name:_

NA

Tender No. and Title:_

_

Page____

_of_

_pages

Similar Contract No.	**Information**			
Contract Identification				
Award date				
Actual date of completion				
Stipulated date of Completion date				
Role in Contract	Prime Contractor Member in JV	Management Contractor	Sub-contractor ub	
Total Contract Amount			INR*	
If member in a JV or sub-contractor, specify participation in total Contract amount			*	
Employer's Name:				
Address: Telephone/fax number E-mail:				

Details of similar works completed in the Name of the Tenderer during the last ten

financial years.

Sl. No	Name of the work	Address of Agt. Concluding Authority	Agreement No. & dated.	Value of Contract
1	2	3	4	5

Stipulated period of completion	Actual date of completion	Value of work had done year wise during the last 'Five' years.					Total value of work done.
		1st Year	2nd Year	3rd Year	4th Year	5thYear	
6	7	9	10	11	12	13	14

Attach certificates issued by the Executive Engineer concerned and countersigned by the Superintending Engineer showing work wise / year wise value of work done and date of completion.

Signature of the Tenderer

Details ofSimilarWorks (i.e., External Development and Landscape/ Park Development) Completed as Prime Contractor (In the Same Name) During the Last Five (5) Financial Years (*cont'd)*

Similar Contract No.	**Information**
Description of the similarity	
1. Amount	
2.Physicalsizeofrequiredworksitems	
3. Complexity	
4. Methods/Technology	
5. Construction rate for key activities	
6. Other Characteristics	

Signature of the Tenderer

Statement III

Quantities of works executed in construction of Canal/Tunnel/ Dam/ Regulator etc, as prime contractor (in the same name) during the last five financial years

Physical quantities executed by the Tenderer in the last ten financial years. [Work wise / year wise].

Sl. No.	Financial year	Name of work	Agt. No	Quantities executed / Year wise.					Any other items.
1	2	3	4	5	6	7	8	9	10
1									
2									
3									
4									
5									

Attach certificates in support of the above quantities issued by the Executive Engineer concerned and countersigned by the Superintending Engineer duly showing the quantities executed year wise.

Signature of the Tenderer

Statement IV

Details of Existing Commitments i.e., Works on hand and works for which tenders are submitted

Details of works on hand and, yet to be completed as on the date of submission of the Tender and works for which Tenders has been submitted are to be furnished.

Existing Commitments on ongoing works:

Sl. No	Name of work	Address of Agt. Concluding authority	Agt. No. & Date	Value of contract	Stipulated period of completion	Value of work done so far.	Balance Value of works to be completed	Anticipated date of completion	Updated value of balance work
1	2	3	4	5	6	7	8	9	10

Attach certificates issued by the Executive Engineer concerned and countersigned by Superintending Engineer, indicating the balance work to be done, and likely period of completion.

Signature of the Tenderer

Details of works for which Tenders are submitted [awarded / likely to be awarded]

Sl. No.	Name of work	Address of Agt. Concluding authority	Estimated value of work	Stipulated period of completion	Date on which tender was submitted	Present stage of Tender.
1	2	3	4	5	6	7

Signature of the Tenderer

Statement – V

Availability of Critical Equipment

Availability of Critical Equipment

The tenderer should furnish the information required below, regarding the availability of the equipment, required for construction / quality control.

Sl. No.	Details of Equipment	Number required	Number		
			Owned	Leased	To be procured
1	2	3	4	5	6

Signature of the Tenderer

A declaration regarding the equipment owned shall be produced by the Tenderer on a non-judicial stamp paper of Rs. as below;

DECLARATION

"I

do hereby solemnly affirm and declare that I /we ownthe following equipment for using on the subject work and also declare that I / We will abide by any action such as disqualification or determination of Contract or blacklisting or any action deemed fit, if the department detects at any stage that I/we do not possess the equipment listed below.

Sl. No.	Details of each equipment	Year of purchase	Regn. Number	Capacity	Any other data.	Is it in working condition
1	2	3	4	5	6	7

Signature of the Tenderer

Statement - VI
Availability of Key Personnel
Availability of Key Personnel
Qualification and experience of Key Personnel proposed to be deployed for execution of the Contract.

Sl. No	Name	Designation	Qualification	Total Experience	Working with the Tenderer since.
1	2	3	4	5	6

Signature of the Tenderer

Statement – VII

Litigation History

Information on litigation history in which Tenderer is the Petitioner.

S. No	Case No. / Year	Court where filed.	Subject Matter / Prayer in the case.	Respondents i.e., SE / CE	Present Stage.
1	2	3	4	5	6

Signature of the Tenderer

Section XII: Format of Securities

SECTION – XII
Format of Securities

PROFORMA

BANK GUARANTEE FORBID SECURITY DEPOSIT

In accordance with the provisions and conditions of Bid Notice for the work of "

", Sri.

(Name &Address of the Contractor) shall deposit with the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, (a bank guarantee to guarantee his proper and faithful Performance under the said contract an amount of (Amount of Guarantee) (in words)

We, the

(Bank or Financial Institution) as requested by the contractor, agree unconditionally and irrevocably to guarantee as primary obligatory and as surety merely, the payment to the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, on his demand without what so ever right of objection on our part and without his first claim to the Executive Engineer,…….Division, for recovery of the whole or part of the Bid Security from the contractor under the contract.

We further agree to change add to or other modifications of the forms of the contract or of works to be performed there under or of any of the contract document which may be made between the Managing Director, Kerala Irrigation Infrastructure Development Corporation Limited, and the contractor shall in any way release us from any liability under this guarantee and we here by waive notice of any such change, addition or modification.

THE CONDITIONS of this obligation are: -

If after Bid opening the tenderer withdraws or modifies his Bid during the period of bid validity specified in the Form of Tender.

If the Tenderer having been notified of the acceptance of his bid by the Department during the period of validity.

Fails or refuses to execute the Form of Agreement in accordance with the Instructions to Tenderers, if required; or

Fails or refuses to furnish the balance Bid Security and additional performance Security in accordance with the instructions of Tenderers.

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

This Guarantee will remain in force up to and including the date**

after the deadline for submission of Tenders as such deadline is stated in the Instructions to Tenders or as it may be extended by the Department, 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.

Yours truly,

Signature & Seal (Name of the Bank)

WITNESS…….. SEAL……..

(Signature, Name and Address)

*****

The Tenderer should insert the amount of the Bid Security in words and figures denominated in Indian Rupee. This figure should be the same as shown in the NIT.

******

6 months from the deadline date for submission of Tender [As specified in NIT].

PROFORMA

BANK GUARANTEE FOR BALANCE "BID SECURITY."

(name& address of Department)

WHEREAS

(Nameand address of Contractor) (herein after called "the Contractor") has undertaken, in pursuance of Contract No.

dated:

to execute the workof----------[name of work];

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a Schedule bank for the sum specified therein as balance BID SECURITY / PERFORMANCE GAURANTEE for compliance with his obligations in accordance with the Contract;

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

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of

[amount of guarantee]

[in words], such sum being payable and we undertake to pay you, upon your 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 anyway release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification. This guarantee shall be valid up to

i.e., until 28 days from the date of
expiry of the Defects Liability period.
Signature & seal of the Guarantor

_____

_____

Name of Bank

_____

_____

_____

Address

_____

_____

Date

_____

PROFORMA
BANK GUARANTEE FOR ADDITIONAL FURTHER PERFORMANCE GAURANTEE

(Name and address ofDepartment)

WHEREAS

(name and address of Contractor) (hereinafter called "the Contractor") has undertaken, in pursuanceofContract No.

dated:

toexecute

[nameofContract and brief description of works] (herein after called "the Contractor");
AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a Schedule bank for the sum specified therein as Additional further Security bank guarantee for compliance with his obligations in accordance with the Contract;
AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;
NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of *Rs.*

[Amount of guarantee]

[in words], such sum being payable and we undertake to pay you, upon your 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 up to and until 28 days from the date completion.

Signature & seal of the Guarantor

Name of Bank

Address

Date

PROFORMA
BANK GUARANTEE FOR MOBILISATION ADVANCE

(name & Address of Agreement Authority)
Sub:-

(name of the work)
Gentlemen:
In accordance with the provisions of the Conditions of Contract, Mobilization advance for the above-mentioned Contract,

[Name and address of Contractor]
(herein after called "the Contractor") shall deposit with ----------[name ofDepartment] a bank guarantee to guaranteehisproper and faithful performance under the said Contract for an amount of Rs. ----------[Amount of guarantee][1]

(In words).
We, the

[bank], as instructed by the Contractor, agree unconditionally and irrevocably toguaranteeas primary obligator and not as Surety merely, the payment to

[name of Department] on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, for the amount not exceeding (amount of guarantee)[3] _____(In words).
We further agree that no change or addition to or other modification of the terms of the Contract or of works to be performed there under or of any of the Contractor documents which may bemadebetween

[name of Department] 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 remain valid andin full effect from the date of the advance payment under the Contract until

[name of Department] receives full repayment of the same amount from the Contractor.
Yours truly,

Signature and seal:
Name of Bank/Financial Institution:

Address:
Date:

1 An amount shall be inserted by the bank representing the amount of the Advance Payment, and denominated in Indian Rupees.

AFFIDAVIT

I/We have submitted a bank guarantee for the work

(Name of work)
Agreement
No……dated……
……
……. from

(Name of the Bank with full address).
To the General Manager, KIIDC, ----------

(Name of Division)
with a view seek exemption from payment of Security deposit/performance guarantee in cash. This bank guarantee expires on……

I/We undertake to keep the validity of the bank guarantee intact by getting it extended for time to time at my/our own initiative up to a period of

months after the recorded date of completion of the work or as directed by the Employer.
I/We also indemnify the Government against any losses arising out of non-encashment of back guarantee, if any.

Deponent

Signature of Contractor

Note: The affidavit is to be given by the Executant before a first class Magistrate.

Section XIII: Annexures

SECTION – XIII

Annexures

Annexure – A - LIST OF KEY PERSONNEL TO BE DEPLOYED

Name of Contract: "KIIFB- Extension of MoolatharaRight Bank Canal from Korayar to Varattayar

Position	Qualification	No. of Persons	Total Work Experience (Min) [years]	Experience In Similar Work [years]
Project Manager	B.E. Civil Experience in Civil Engineering (5 years as Project Manager should have O&M experience)	1 Nos	20	12
A. Design Phase				
Civil Engineering Expert	B.E. Civil (8 years' experience inDesign of Civil Engineering Project)	1 Nos	15	10
Draftsman	ITI Draftsman/ Diploma CivilEngineering	1 Nos	5	5
B. Construction Phase				
Construction Manager	B.E. Civil	1 Nos	15	5
Project Engineer	Diploma Civil (3 years in Civil Engineering Projects)	2 Nos	10	8
Agriculturist	With minimum 15 years experiance			
C. Operation and Maintenance Phase				
Project Engineer – Civil	B.E. Civil	1 Nos	5	3
Mech. / Equip. Maintenance Engineer	B.E. Mechanical with O & M of watersupply project experience	1 Nos	5	3
Electrical / Instrumentation Engineer	B.E. Electrical / instrumentation with O & M of Civil Engineering project	1 Nos	5	3

Annexure – B - Soil Investigation

Name of Contract	KIIFB- KIIDC - Extension of Moolathara Right Bank Canal from Korayar to Varattayar

Annexure – C – Machinery Required

Name of Contract **"**KIIFB- KIIDC - Extension of Moolathara Right Bank Canal from Korayar to Varattayar"

Critical Equipment Required	
Equipment Required	**Quantity Required**
Mini Excavator for Trenching	02 Nos
JCB / Hitachi	03 Nos
Concrete Hopper Miller	03 Nos
Pin Vibrator	03 Nos
Pan Vibrator	03 Nos
Water Tanker	02 Nos
Trucks / Tractors / Tippers	10 Nos
Cranes	02 Nos
Tunnel Boring machine	02 Nos
DG Set 125KVA-200KVA	02 Nos

Annexure – D – LABORATORY EQUIPMENT AT SITE DURING CONSTRUCTION

Name of Contract "KIIFB-KIIDC - Extension of Moolathara Right Bank Canal from Korayar to Varattayar"

Slump Test Equipment :2Nos.

15cm X 15cm X 15cmCubicMoulds :24Nos.

Compressive Strength Testing Equipment :2Nos.

I.S.I Sieves for sand and Metal :2Sets.

I.S.I ServicingforSoils :2Sets.

Necessary Measuring Equipment Required :1Set.
Electric oven :1No.
Field density measuring equipment :1No.
Core cutter equipment. :1 No.
Simple balance/Electronic Equipment least count up to 0.01Grams.

Annexure – E – REPORTING REQUIREMENTS

Name of Contract "KIIFB-KIIDC - Extension of Moolathara Right Bank Canal from Korayar to Varattayar"

Reports and Records in four sets are to submitted to the Engineer-in-Charge by the EPC Agency.

(The Reports and Records shall have to be decided according to the nature of the Project and will be approved by the IBM State Level)

Volume 5: Drawings

DRAWINGS

DRAWINGS:

The plans enclosed with the tender are liable to the altered during execution of work as per necessity of site conditions. The premium quoted by the contractor for various items shall hold good for execution of work even with altered plans.

One set of drawings, on the basis of which actual execution of the work is to proceed shall be furnished free of cost to the contractor by the Executive Engineer progressively according to the work program submitted by the contractor and accepted by the Executive Engineer. Drawings for any particular activity shall be issued to the contractor at least 30 days in advance of the scheduled date of the start of the activity. However, no extra claims by the contractor toward any delay in issue of drawing or issue of any revision / change to the drawings issued earlier shall be admissible. The Chief Engineer shall intimate the contractor 7 days in advance regarding any delay to issue of drawings, for any particular stageofworks. If work gets affected due to delay to issueofdrawings, for any particular stage of work the contractor shall be granted extension of time in terms of condition of tender notice.

Signed drawings above shall not be deemed to be an order for work unless they entered in the agreement or schedule of drawings under proper alterations of the contractor and Executive Engineer or unless they have been sent of the contractor by the Executive Engineer with a covering letter confirming that the drawing in and authority for work in contract.

1.0 DISCREPANCIES:

In case of discrepancies between documents the following order of procedure shall apply:-

Between the written description of written dimensions in the drawings and the corresponding one in the specifications, the latter shall apply.

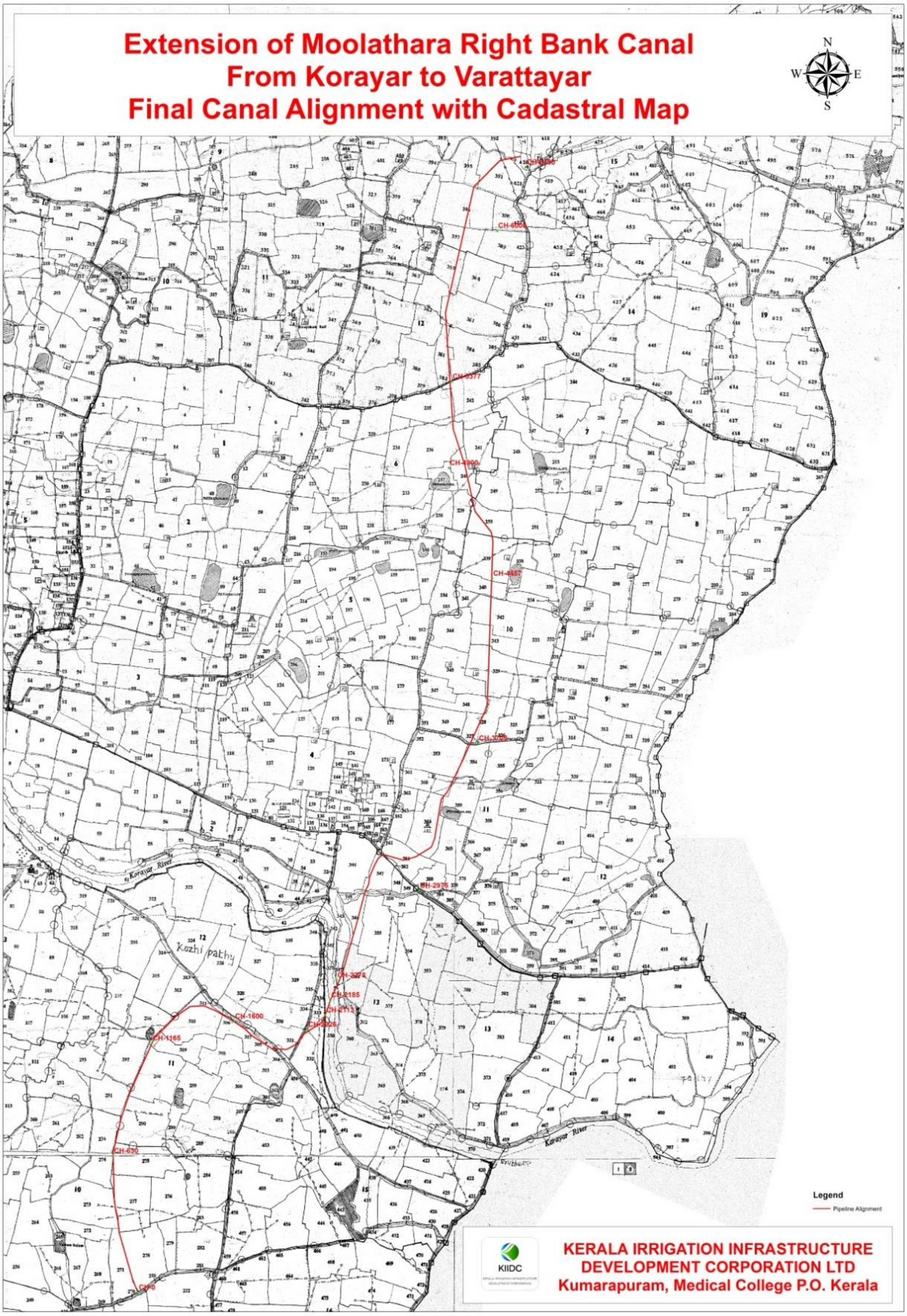
Figured dimensions shall supersede scaled dimensions. The drawings on a larger scale shall take precedence over those on a smaller scale.

Drawings issued as construction drawings from time to time shall supersede tender drawings and alsothecorrespondence drawings previously issued

Note: The contractor should not execute any component of work without obtaining the working drawings. Any work done without drawings shall be at the contractor's responsibility only. Acceptance for such work will be at the discretion of the Executive Engineer

2.0SECRECY CLAUSE

The drawings and specifications made available to the tenderer shall exclusively be used on the work and they are retained from passing on each plan to any unauthorized hand either in parts or in full under the provisions of Section-3 and 5 of the official secrets Act 1923. Any violation in this regard will entail suitable action under appropriate clause or official secret Act 1923.


Extension of Moolathara Right Bank Canal
From Korayar to Varattayar
Final Canal Alignment with Cadastral Map
N
W
E
S
Legend
Pipeline Alignment
KERALA IRRIGATION INFRASTRUCTURE
DEVELOPMENT CORPORATION LTD
Kumarapuram, Medical College P.O. Kerala

Volume 6: Bill of Quantities

KIIDC

KIIFB

Bill of Quantities (BoQ)

NAME OF WORK:- "KIIFB-KIIDC -Extension of Moolathara Right Bank Canal from Korayar to Varattayar"

S No.	Description of work	Remarks
1	The bidder has to do ETS Survey, Investigation, Design, Build, Commissioning, operation and maintenance of the entire system for a period of 5 years including Defect Liability Period of 5 years. The bidder should get the entire area surveyed using total station and prepare the L.S, C.S and block levels of each component, land plan schedule, TBMs and design the entire project and shall be got approved by the department. Soil investigation should be carried out for all the components for designanalysis The economic size of Pumping mains should be designed duly considering the static head, frictional losses and surge head as per IS codes. The transmission main shall be designed for surge protection as per latest proven methods and standards and protected against surge pressure by providing suitable protection system like Air vessels/ Bladder Vessels, Air Valves, Air cushion valves, Scour valves as per design and sluice valves including all allied works shall be located for fixing at appropriate places as per deigns and longitudinal sections and got approved from the Department. The designs and plans (LS as well as alignment plan) of all the components under the above scheme, shall indicate all the salient features such as details of ground levels, HGL, invert levels of the pipes, size andmaterial of the pipes and required MWL, LWL and HGLalso indicating the location of valves and all other allied parts. These shall be preparedandgot approved by theEngineer-Incharge All the pumping mains and gravity mains shall be designed for ultimate demand taking into account static head, friction losses other losses and surge as per IS codes. Surge control devices such as air cushion valves as per design are to be placed at appropriate places as per necessity. Designs shall be got approved by the department and got executed by the agency as per the approved designs. Pumps of ISI make Kirloskar/Mather & Platt/ Jyothi/WPIL/Best & Crompton/ Grundfos or any other reputed make specifically approved by the department with relevant ISO Certification to draw	The EPC Agencyshallconductdetailed investigation and come upwithdetailed designs and Drawings whichshallbe approvedbythe Engineer-In-charge withintheoverall objectivesofthe scheme. The designs and drawings shall be done using state of the art software for Civil, Structuraland Hydraulic engineering and the best practices shall be followed in compatible with BIS/ GoI Directives/ NEC/ ISO etc. If there is any conflict of specifications, the competent authorities' decision shall be final

	raw /clear water with suitable motors of make Crompton Greaves/ GEC/N.G.E.F/Kirloskar/Jyothi/Seimens/ ABB or any other reputed make specifically approved by the Department with shall be provided for prospective demand as per design and to have minimum operation and maintenance cost as approved by Department. The combined efficiency must be not less than 75% and the pumps should also comply with Hydraulic Institute Standards. Motors shall be of high efficiency (Energy) efficient motors complying with relevant IS codes. The floor levels of the pumping station and water level in the sumps are to be fixed for the positive suction where everpossible. All the components should be provided with name boards as directed by the departmental officers. All the surplus excavated earth of each item is to be conveyed and leveled as directed by the departmental officers. All the Excavated trenches shall be restored to original condition as per the existing road pavement structure. The entire scheme should be completed and commissioned in 30 months.	
	The bidder should provide as-built drawings after successful completion of the scheme (CAPEX component) and should submit updated as-built drawings after completion of O&M period (OPEX component) in consultation with Engineer – in – Charge and as per directions of the department. The bidder should handover the scheme after successful completion ofwork. All Statutory charges payable to line Departments like Irrigation, R&B etc. will be borne by the department except electrical inspectorate Charges. All approvals required for execution of work shall be taken up bycontractor. 1.13.4 The bidder has to make arrangements for traffic Management & Safety Management during the execution asrequired.	

	Conducting topographical survey, conducting soil investigation, design and preparation of drawings and construction/**laying pipe line** through the acquired land and keeping the approved hydraulic particulars **(+175.221m at Ch.0.000m to +170.05m at Ch. 6430m)**, adopting the latest technologies in an economical as well as practically viable way to suit the topography of the area and to provide micro irrigation to the envisaged ayacut, approval of design from the competent Authority, and implementing the project within a period of 36 months, testing and commissioning of the project, etc. complete from Korayar to Varattayar. (**Extension of Moolathara Right Bank canal for a length of 6430km**). The project should be completed in all aspects, within a period of 30 months, including the construction of different hydraulic structures such as **conduit, aqueduct, siphon, tunnel**etc. to suit the topography of the area and to feed the entire ayacut area of the scheme, including the protective measures to river banks, abutment of piers of aqueducts, hydraulic structures such as inspection chamber, manhole, surplus escape, controlling regulators as well as sluices to feed ayacut area etc.	**6430m**
	Design, Preparing drawings and Providing **Lift Irrigation Scheme**to the high elevated area of field, where gravitational flow is not possible, including constructing sump at the suitable place, near the entrance area of Tunnel, Pump House, Cistern/Overhead tank at the Highest elevated area, design and installing motor and pump set, including taking into the consideration of the feasibility of conventional/ natural source of Energy, delivery line from pump set to overhead tank (approximate length of 1500m), suction pipe line, installation of transformer, if found necessary, electrical works, sanction from competent authorities such as Electrical Inspectorate etc. complete. The project should be inclusive of all aspects of works related to testing and commissioning of lift irrigation scheme, including provision for taking delivery of water at intermediate points to feed the ayacut through gravity flow, if found viable etc. complete. The entire project should be completed within the project period of 30 months.	**1 unit**

	Repairing and **Renovating the existing MRBC** from beginning to the end (approximate length of 7000m in total length of 12645m, wherever necessary) so as prevent the seepage of water from the canal, including re-construction of 91 Sluices, providing M S shutters and screw gear arrangement etc. complete including cost and conveyance of materials, labour charges etc. complete. The work should be completed in such a way that the water distribution through the existing canal should not be disturbed, during the water distribution period.	**1 unit**
	Design and installation of **Micro Irrigation System** with electronically controlled valve in the project area (approximately3575Ha), including conducting Contour Survey, Individual Farm Boundary Survey, Preparation of Design and Drawings, Preparation of Operation Manual, formation of Water Users Association, Training to the farmers, Cost of related all accessories such as Primary Filtration, Feeder Main, In field Valve, Safety Accessories and Drip System, Fertigation Equipment, Main and Sub main PVC, Pressure Regulator, Drip Manifold Accessories, Construction of store rooms, Installation of Pump set and Motor, electrical accessories including installation of transformer, if necessary, or using other mode of energy such as solar etc., contruction of control rooms wherever requiredand Operation and Maintenance for a period of 5 years, from the date of issue of completion certificate.	**3575 Ha**
	Improving 14 Nos of Public ponds, within the project area, by removing silt and deepening the pond and protecting the banks so as to enhance the capacity of tanks, providing feeder channel, pipe line with control valves etc to the tanks from main canal, if possible etc. complete	**14 Nos**

KIIDC

KIIFB

KIIDC

KIIFB