

DELHI JAL BOARD

(GOVT. OF NCT OF DELHI)



Name of Work: Rehabilitation of 1600/1200 mm dia trunk sewer line from Amichand chowk to Old kalyanpuri SPS by open technology Method (Structurally Stand Alone Pipe) under EE(C)Dr-VIII

TENDER DOCUMENT

**DELHI JAL BOARD, GOVT. OF N.C.T. OF DELHI
OFFICE OF THE EXECUTIVE ENGINEER (C)Dr-VIII
STP, Yamuna Vihar, Delhi-110094**

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Executive Engineer (C)Dr-VIII

	DELHI JAL BOARD, GOVT. OF N.C.T. OF DELHI OFFICE OF THE EXECUTIVE ENGINEER (C)Dr-VIII STP, Yamuna Vihar, Delhi-110094 E Mail.ID eecdr8@gmail.com

NIT No. 1(2026-2027)

On behalf of Delhi Jal Board, EE(C)DR-VIII invites online Item rate tenders from eligible registered contractors in DJB, Railways, CPWD, MES, BSNL, MCD, DDA, NDMC, DUSIB and irrigation & Flood control Dept., Delhi, Central/State Govt. Department Undertakings/Development Authorities etc. / specialized firms, who are essentially registered on Delhi Govt. e-procurement system [<http://govtprocurement.delhi.govt.in>] and who have successfully completed similar types of works and fulfil the eligibility criteria as per tender documents, for the following work, from eligible firms (proprietorship, partnership firms, companies, corporations, consortia), either individually as a bidder or as a joint venture firm, in the prescribed bid documents under two bid system i.e. Technical bid (Technical Proposal Part A (Eligibility Criteria) and Financial Proposal Part B (Financial bid). The contractor shall abide by all NIT conditions, guidelines, memorandums, which have been issued time to time by Delhi Jal Board.

Date & Time of Pre-Bid Meeting	:	10.06.2026 at 11:30 A.M.
Last date and time for tender download	:	25.06.2026 up to 2:00 P.M.
Last date and time for online submission of tender	:	25.06.2026 up to 3:00 P.M.
Date and Time for opening of Part A (Technical Bid)	:	25.06.2026 at 3:30 P.M.
Date/Time for opening of Part B (Financial Bid)	:	After completion of scrutiny of the received Technical Bids.

Sr. No.	Name Of work	Amount Put to Tender (Rs.)	EMD (Rs.)	Completion Period	Non-Refundable Tender processing fee (Rs)	Validity of Tender
1.	Rehabilitation of 1600/1200 mm dia trunk sewer line from Amichand chowk to Old kalyanpuri SPS by open technology Method (Structurally Stand Alone Pipe) under EE(C)Dr-VIII.	Item Rate	47,23,500/-	18 Months	1500/-	180 days (As reckoned from the last date of online submission of bids including extension if any.)

NOTE:

- Validity of proposal is 180 days from the last date of receipt of tenders. NIT along with all the terms & conditions is available on Delhi Govt. Web Site <https://govtprocurement.delhi.gov.in> Agencies may contact the office of EE (C)Dr-VIII for additional information/any clarification.
- Any future amendment/ Corrigendum made in this NIT can only be seen on the website <http://govtprocurement.delhi.govt.in>;

3. The lining Provision of Central Goods and Services Tax Act, 2017 ('GST Act, 2017') shall have the superseding effect over the all earlier taxes like VAT/WCT/Service Tax/other like taxes as contemplated in the Act. Accordingly, the terms VAT/WCT/Service Tax etc. appearing anywhere in the bid document may be read as the applicable tax under the GST Act, 2017.
4. Successful bidders shall comply with the Employees' Provident Funds and Miscellaneous Provisions Act, 1952 ('EPF & MP Act.1952'), along with other labour laws.
5. The work includes various activities which are to be taken up simultaneously for there should be arrangement for sufficient labour and T&P.
6. Tender Fee should be deposited through the Bidder's banker to SBI Bank, Tis Hazari, Delhi Branch on this link:- https://services.sabpaisa.in/pages/demo/djboard.html#ChildVerticalTab_12
7. Tender fee is non-refundable.
12. The pre-bid meeting will be held in the office of Chief Engineer (Dr.) Proj-II , Room No. 12, Varunalaya Building, Phase- I, Jhandewalan, Karol Bagh, New Delhi-110005. The details of the tender can be seen on (<https://govtprocurement.delhi.gov.in>) or from the office of the undersigned which will be available on the web site till expiry of Last date and time for online submission of tender. Any modification /corrigendum shall be displayed on the above-mentioned website only.

**Sd/
EXECUTIVE ENGINEER (C)Dr-VIII**

NO.F.DJB/EE(C)Dr-VIII/2026-27/

Dated:

Copy to:

1. PS to Chairman, Delhi Jal Board.
2. PS to Vice –Chairman DJB/ All Members DJB
3. PS to C.E.O./CVO / Director (F&A)
4. CE (DR) P-I/II/All CE (Civil)
5. All SE (Civil)
6. All Executive Engineer's (Civil) /Dr./(P)/SR/(Pl.)Dr
7. EE(EDP) with request to display at DJB website.
8. Jt. Dir. (S&DM)/Sr. A.O. (C)Dr-VIII
9. PRO
10. All AE's (C)Dr-VIII/ A.A.O. (C) Dr. VIII/TC/Notice Board.
11. Manager, Indian Bank, Copernicus Marg, Delhi,
e-mail: bhabesh.jha@srslive.in / Contact No.011-23386843
12. Contractor's Registered in appropriate category in DJB.
13. Work Contract Cell, Sale tax/T&T Department
14. Contractor Association, 36, Block-BA, Paschimi Shalimar Bagh, NewDelhi-88
15. Contractor welfare Association, WZ-485,10B/1st floor Basai Darapur, new Delhi-110055

EXECUTIVE ENGINEER (C)Dr-VIII

ADDITIONAL INFORMATION OF NIT

Name of work: Rehabilitation of 1600/1200 mm dia trunk sewer line from Amichand chowk to Old kalyanpuri SPS by open technology Method (Structurally Stand Alone Pipe) under EE(C)Dr-VIII.

1. The tenderer must be fully conversant with the documents to form part of contract agreement i.e. Instructions to bidders. Special Conditions, General Conditions, Specification, Clauses of contract, Safety codes, Model Rules, CPWD contractor labour regulations (Standard documents) available on web site. However, these are not to be attached with tender documents.
2. The bidder or his authorized representative shall attend the Pre Bid Meeting as per the specified schedule mentioned in the NIT in the chamber of Chief Engineer (Dr.) Proj-II , Room No. 12, Varunalaya Building Phase-I, Jhandewalan, New Delhi - 110005 dated 10.06.2026 at 11:30 AM. The bidders are requested to submit their queries at E-mail: eecdr8@gmail.com (in Word file & PDF file both) by 05:30 PM on the same day. Minutes of the Meeting including text of queries along with addendum/corrigendum (if any) will be uploaded only on the website. Non-attendance at the Pre Bid Meeting will not be a reason for disqualification of the bidder. The bidder shall submit the offer under two bid system i.e. Bid Part - A (Technical) & Bid Part - B (Financial).
3. Bid Part- A should contain scanned documents giving details of Tender Fee (Non-refundable), Earnest Money Deposit ('EMD') and Eligibility Criteria.
4. The Delhi Jal Board hereafter referred to as "The Board" will receive tenders for the work mentioned in NIT.
5. Part-1 OF EMD: Rs. 20,00,000/- (Rupees Twenty Lakhs Only) shall be deposited as the EMD amount through electronic mode on or before the last date & time of bid submission in DJB EMD account- "For DJB Tender Fees & EMD" only on DJB web Portal (<https://services.sabpaisa.in/pages/demo/djboard.html>). The said link is attached with DJB account at Allahabad Bank, Baroda House, Copernicus Marg Branch, New Delhi. The EMD/ tender Fee shall not be accepted if it is not deposited online on said link. The EMD/ tender Fee deposited elsewhere bid will not be considered and rejected.
6. Part-2 OF EMD: Rs. 47,23,400/- will have to be submitted in the form of a Bank Guarantee (BG) issued by any Nationalised/Scheduled Bank, approved by RBI, located in India, in favour of Delhi Jal Board, payable at New Delhi. The validity of submitted BG should be at least for a period of 180 days as reckoned from the date of submission of bid including extension, if any. For deposition of Earnest Money Fixed Deposit Receipt (FDR) of all Scheduled Banks shall also be accepted. It should be ensured that FDR is pledged in favour of Tender Inviting Authority. Bidders shall not submit FDRs along with the bid but shall have to submit them within 01 working day of the opening of Technical bids so that the same can be considered for the opening of financial bids. It is clarified the provision of FDR as EMD is in addition to existing method of deposition.

Note -It is clarified the provision of FDR as EMD is in addition to existing method of deposition.
Bank Name: Indian Bank
Branch: Baroda House
Account Number : 50448339804
IFSC Code: IDIB000B677

7. Bidder shall submit the Tender Fees amount electronically on or before the last date & time of bid submission through this link <https://services.sabpaisa.in/pages/demo/djboard.html> at Bidder's bankers. Bidder must upload the scanned copy of RTGS customer payment confirmation along with the Technical Bid. Bids submitted without the exact amount of EMD and as per requirements prescribed above shall be liable for rejection without any further notice. For any further assistance, the bidder may be advised to contact, Manager/ Sr. Manager/Representative, through CS email id tender@srslive.in, CS Tel. No. 011- 41733223, CS contact 1st point of contact- Nishant Jha (9599627266).
8. Bidder must upload the scanned copy of e-receipt clearly mentioning the transaction ID customer payment confirmation along with the Bid document, before the date and time of closing of the bids.
9. Bidder shall submit Financial Bid (Part-B) of the tender online only in prescribed format.
10. Tenders/Bid will be received only online on the above scheduled date and time and also submit the **2 Numbers of hard copy (One original+ one copy)** of the technical bid within **48 hours from the last date and time of online Submission** of tender as mentioned in NIT. If any of the above dates happens to be holiday, the next working day will be considered for all purposes. Conditional tender shall not be considered.
11. Tender shall be valid for 180 days from the last date of submission of tender. The DJB reserves the right to reject any or all tenders without assigning any reason.
12. In cases where the quoted L-1 rates are below more than 25% of the justified cost, the Additional Performance Bank Guarantee will be 25% of the quoted rates below 25%. However, it may be upto maximum of 10% of the value of the contract including Additional PBG for the projects costing above Rs. 5 crores. The PBG may be accepted in the form of bank guarantee or other acceptable form as per existing CPWD guidelines and must be submitted by the L-1 firm within the time period prescribed for performance guarantee. In the cases where rates are exceptionally below the Engineer-in-charge and his supervisory officers will strictly monitor the execution of such works.

Forfeiture of earnest money

- (1) The forfeiture of earnest money shall be done as per the General condition of contract.
- (2) If the contractor fails to furnish the prescribed performance guarantee within the prescribed period or failed to execute the contract agreement within prescribed limit then the 100% earnest money will be absolutely forfeited to the department automatically without any notice.
- (3) If there is any discrepancy/mislead information found in the submitted Performance Guarantee, then the 100% earnest money is absolutely forfeited to the department automatically without any notice.
- (4) If any tenderers withdraws his tender or makes any modification in the terms & conditions of the tender which is not acceptable to the department within 7 days after last date of submission of bids, then the Government shall without prejudice to any other right or remedy, be at liberty to forfeit 50% of earnest money absolutely irrespective of letter of acceptance for the work is issued or not.

(5) If any tenderers withdraws his tender or makes any modification in the terms & conditions of the tender which is not acceptable to the department after expiry of 7 days after last date of submission of bids, then the Government shall without prejudice to any other right or remedy, be at liberty to forfeit 100% of the earnest money absolutely irrespective of letter of acceptance for the work is issued or not.

(6) In case of forfeiture of earnest money as prescribed above, the bidder shall not be allowed to participate in the re-tendering process of the work.

The following documents also need to be submitted:

1. Scanned Copy of Non-refundable Tender Fee, Earnest Money and Bank Guarantee must be uploaded with the bid before the specified last date and time of submission of the bids.
2. Scanned copies of all the documents as per tender conditions must be uploaded with the bid before the date and time of closing of the bids.
3. The non-refundable tender fee shall be paid separately following the same procedure as mentioned against Part 1 of EMD and the Earnest Money/ Non-refundable tender fee needs to be deposited through electronic mode on the link available at DJB website/sub paisa portal.
4. The bidder shall submit scanned copies of Company's MOU, Partnership Deed, ownership deed/sole proprietorship/power of attorney as applicable.
5. Scanned copy of J.V. Agreement, if applicable.
6. The bidder shall submit scanned copies of power of attorney authorizing the signatory of the bid.
7. Scanned copies of any other incidental documents that DJB may specify.
8. Scanned copy of GSTN Number and its latest receipt as issued by GST Department.
9. The bidder shall have to submit the GST registration certificate and the latest GST Return.
10. The bidder shall submit scanned copy of an undertaking on company letter head on a prescribed format that the applicant has not been Debarred/black listed as on date in any department. The date of undertaking must be after the issue of NIT.
11. Scanned copies of Checklist in support of Eligibility Criteria.
12. Tenders will be received only through online mode as per schedule mentioned in the NIT. Bid Part-B shall also be opened after opening of technical bid only for those bidders, who have qualified technically submitted in Bid Part-A.
13. Scanned copy of any litigation or arbitration resulting from contract by him as per NIT/Tender Document.
14. Scanned copy of Notarized affidavit regarding acceptance of all terms and conditions of NIT/Tender Document.
15. Scanned copy of Notarized affidavit regarding that bidder/ all members of JV has not been bankruptcy and insolvent in last three financial years
16. Scanned copy of an affidavit regarding employment of their close relatives in DJB which may include

the relatives in Blood, Uncles (paternal or maternal), cousins (Paternal or maternal), Father, Mother, son, Daughter, Mother-in-law, Brother-in-law, Sister-in-Law, Nephew and Niece etc. (This list is not exhaustive).

17. Scanned copies of provisional methodology, programme and other detail as mentioned in clause 3.9 (General Conditions of contract) completion of the various items of the Works (in the form of Bar chart). The programme must be consistent with the proposed deployment of equipment (type and number), personnel and site organization furnished by the bidder.
18. Earnest Money Deposit declaration (attached at Annexure -I) duly signed by the contractor on company's letter head.
19. Noncompliance with above mentioned criteria including that mentioned in complete uploaded NIT on website, shall render the submitted bid ineligible & part B for such bids shall not be considered for further process.
20. A Notarized affidavit, that "I/we have gone through the NIT/Tender Document Conditions i.e. Instructions to bidders, General conditions of contract, Eligibility Criteria, Technical Specification, Model Rules, CPWD Contractor's Labours Regulation, Special Conditions/execution of work, PEMS Act, BOQ etc. and any amendment by DJB. I/we further confirm of having full knowledge that the above conditions are to form a part of the contract agreement executed with the successful bidder".
21. For the technology of rehabilitation adopted, the bidder should submit an affidavit on Rs 300 stamp papers duly notarized, that the design of liner for rehabilitation (Structurally stand alone) is for a minimum 50 year service life under continuous extreme loading conditions.
22. Bidders shall submit a Notarized affidavit for correctness of all submitted documents related to this bid and duly numbered all pages with proper Index.
23. The hardcopies of Technical Bids one original and one photocopy are to be submitted on the following day of submission.
24. Clause 10 CA for Price Variation shall be applicable for all Contracts. Please refer Annexure I.
25. In case of extension in the date of completion of works, the compensation under price variation shall not be limited to indices prevailing at the time of stipulated period of completion. The indices for calculation of compensation shall be limited to the indices prevailing in the month up to the justified delays.
26. For deposition of Earnest Money Fixed Deposit Receipt (FDR) of all scheduled banks shall also be accepted. It should be ensured that FDR is pledged in favour of Tender Inviting Authority. Bidders shall not submit FDRs along with the bid but shall have to submit them within one working day of the opening of Technical bids so that the same can be considered for the opening of the financial bid. It is clarified the provision of FDR as EMD is in addition to existing method of deposition.
27. All register contractor(s) in a particular category shall be allowed to participate up to their tendering limits without checking their financial and technical credentials except bidding capacity, the status of debarring and undertaking regarding litigation/ arbitration, etc. They shall be exempted from submitting all documents related to financial and technical eligible category mentioned in GCC except what is required including bidding capacity and status of debarring along with other documents such

as undertaking regarding litigation/ arbitration etc.

28. The DJB reserves the right to reject any or all tenders without assigning any reason.
29. Bidders shall submit an MOU duly notarized on stamp paper of Rs. 300/- with manufacturer of MWSL/ CIPP/GRP or any proven profile/technology issued in the name of said tender.
30. Bidders undergoing insolvency proceedings or under Corporate Debt Restructuring (CDR shall not be considered.
31. The bidders should give an affidavit that firm has not been bankrupted/insolvent in the last financial year.
32. Bidders blacklisted / debarred/ penalised for delayed work completion & lack of quality work by DJB or Central Govt department or state govt department , Central or State PSU or municipal corporation shall not be considered. An affidavit has to be submitted in this regard.

Online Bid Part-B tender shall consist of the Bill of Quantities.

EXECUTIVE ENGINEER (C)Dr-VIII

Following clause shall be added in the GCC

• NEW CLAUSE IN GCC: Payment Due To Variation in Price of Materials after Receipt of Tender (DELETED)

If after submission of the tender, the price of material – CI/DI/HDPE/MS Pipes and specials, Steel, Cement, increases / decreases beyond the price(s) prevailing at the time of the last stipulated date for receipt of tenders (including extension, if any) for the work, then the amount of the contract shall accordingly be varied and provided further that any such variation shall be effected for stipulated period of contract including the justified period extended under the provisions of Clause 10.3 of the contract without any action under Clause 11.1, 11.2, 11.3 and 11.4

However the work done during the justified period extended as above, will be limited to indices prevailing at the time of stipulated date of completion or as prevailing for the period under consideration, whichever is less.

The increase / decrease in prices shall be determined by the All India Wholesale Price Indices of material as published by Economic Advisor to Government of India, Ministry of Commerce and Industry and base price for materials as issued under the authority of Director General (Works), CPWD as valid on the last stipulated date of receipt of tender, including extension if any and for the period under consideration. In case, price index of a particular material is not issued by the Ministry of Commerce and Industry, then the price index of nearest similar material as indicated in table below, be followed.

The amount of the contract shall accordingly be varied for all such material and will be worked out as per the formula given below for individual material:-

Adjustment for component for individual material:-

$$V = P \times Q \times \{CI - CI_o\} / CI_o$$

Where,

V = Variation in material cost i.e. increase or decrease in the amount in rupees to be paid or recovered.

P = Base price of material as issued under authority of DG(W),CPWD valid at the time of the last stipulated date of receipt of tender including extensions, if any.

Q = Quantity of material used in the works since previous bill.

CI_o=All India whole sale price Index for the material as published by the Economic Advisor to Government of India, Ministry of Industry and Commerce as valid on the last stipulated date of receipt of tenders including extension, if any.

CI: All India whole sale price Index for material for period under consideration as published by Economic Advisor to Government of India, Ministry of Industry and Commerce.

The following nearest material under the Clause 10 CA of contract shall be included:

S.No.	Material Covered under the Clause	Nearest Material for which All India Whole Sale Price Index is to be followed
1.	Cement @ Rs. 5078.13 per MT (OPC) Cement @ Rs. 4453.13 per MT (PPC)	OPC/PPC Cement
2.	Reinforcement Bars @ Rs. 55800/- MT	Reinforcement Bars
3.	CI pipes and Specials	Pig Iron
4.	DI pipes and Specials	Pig Iron
5.	MS pipes and Specials	HRC
6.	P54A001A G-LEX HDPE-1 @ Rs. 100250/- Per Tonne	P54A001A G-LEX HDPE-1

1.2 ELIGIBILITY CRITERIA

(Applicable for all projects with ECV (Estimated Contract Value) greater than INR 3 Crores)

Check List

S. No.	Description	Bidder's Response
1.	Constituent of Bidder	
	i) Individual (Submit Memorandum of Articles).	
	ii) Joint Venture (Submit JV Agreement).	
	iii) Wholly owned Indian Subsidiary of a foreign firm (Submit undertaking from Parent Company).	
2.	(A) Financial Eligibility Criteria	
	i) Average Annual Construction Turnover details (as per Format 1).	
	ii) Net Worth Details (as per Format 2).	
	iii) Profitability Details (as per Format 3).	
	iv) Available Bidding Capacity Details (as per Format 4A, 4B & 4C).	
	v) Working Capital Details (as per Format 5).	
	vi) Litigation Details (as per Format 6).	
	(B) Technical Eligibility Criteria	
	i) Experience Certificate.	
	ii) Particular Experience if any.	
3.	Supportive Documents	
	i) Audited balance sheet and Profit and loss statements for past 3 years.	
	ii) Declaration by the bidder on Rs. 10/- stamp paper in original stating that the bidder's firm (s) is neither blacklisted nor debarred from any Indian government department as on the date of submission of Bid.	
	iii) Affidavit for the correctness of information submitted along with Bid.	

1.2.1 General Eligibility Criteria

Eligible Applicants:

The tenders for this contract will be considered only from those bidders (proprietorship firms, partnerships firms, companies, corporations, consortia or joint ventures) who meet requisite eligibility criteria prescribed as under:

JV (Joint venture) conditions and conflict of interest

- (i) In the case of a JV or Consortium, all members of the group shall be jointly and severally liable for the performance of whole contract.
- (ii) A technically qualified non-Indian firm is permitted to bid only in a consortium Arrangement or Joint Venture, with its wholly owned Indian subsidiary or any other Indian firm, registered in India under The Companies Act, 1956. However, in both the cases, Indian Firm/ Indian subsidiary shall be the lead member and shall solely meet the financial eligibility criteria.
- (iii) Bidders shall not have a conflict of interest that affects the Bidding Process, either during the process or thereafter. Any Bidder found to have a conflict of interest shall be disqualified from the bid process. In the event of disqualification, the Authority shall be entitled to forfeit and appropriate the BID Security or the Performance Security, as the case may be towards any loss or damage incurred or likely to be suffered by the Authority on account of such disqualification. Bidders shall be considered to have conflict of interest that affects the Bidding Process, if:
 - a) such Bidder (or any constituent thereof) and any other Bidder (or any constituent thereof) have common controlling shareholders or other ownership interest. Control is defined by The Institute of Chartered Accountants of India Accounting under Standard (AS)21, Consolidated Financial Statements as:
 - (i) the ownership, directly or indirectly through subsidiary(ies), of more than one-half of the voting power of an enterprise; or
 - (ii) Control of the composition of the board of directors in the case of a company or of the composition of the corresponding governing body in case of any other enterprise so as to obtain economic benefits from its activities.
 - b) Bidder shall be liable for disqualification if any legal, financial or technical adviser, including but not limited to a consultant, of the Employer (DJB) in relation to the Project is engaged by the Bidder in any manner for matters related to or incidental to the Project and which will affect the bidding process thereof; Employer shall itself publish the list of its legal, financial or technical adviser engaged by it for the said projects; or
 - c) such Bidder has participated/ worked as a consultant in the preparation of documents, design or technical specifications or any other tender related activity for the works; or
 - d) such Bidder applies for bid both as an individual firm and as a part of JV or consortium; or
 - e) a bidder or any constituent of one consortium is also a constituent of another consortium/

bidder; or

- f) Such Bidder submits more than one application in this bidding process
- (iv) In a tender, either the Indian agent on behalf of the Principal/ OEM or Principal/ OEM itself can bid but both cannot bid simultaneously.
- (v) If an Indian agent submits bid on behalf of Principal/ OEM, the same agent shall not Submit a bid on behalf of another Principal/ OEM in the same tender.
- (vi) A firm, who has purchased the tender document, if applicable, in its name, can submit the bid either as individual firm or in joint venture/ consortium. However in joint venture/ consortium:
 - a) The members shall jointly fulfill the general and particular experience criteria as mentioned above. However, part qualification of any individual technical criteria related to project capacity shall not be permitted (example: If the criteria is EPC experience of 10 MGD of water treatment plant, two members having EPC experience of 5MGD of water treatment plant each shall not be qualified). Further, each member shall at least qualify one eligibility criteria financial, general and particular.
 - b) The lead member shall fulfill the financial eligibility criteria solely.
 - c) Members having less than 26 % participation shall be termed as non-substantial members and shall not be considered for evaluation which means their financial capability and work experience will not be considered for evaluation of JV/ consortium.
 - d) Copy of the Joint Venture Agreement (JVA) entered into by the members shall be submitted along with the bid as per the format attached. The JVA shall include among other things, the joint venture's objectives, percentage participation of each member, the role of each member in the joint venture operation, the commitment of the members to joint and several liability for due performance, recourse/ sanctions with the joint venture in the event of default or withdrawal of any member(s).
 - e) In any case, number of JV/ consortium members shall not exceed 2 (two).
 - f) **For non-DBO/non-PPP projects:** In case of JV/ consortium, no change in constitution of percentage participation is allowed.
- (vii) Bidder (individual or any member in case of JV/ consortium) shall not have suffered bankruptcy/ insolvency during the last 3 financial years from the date of submission of bid.
- (viii) Any bidder which has been barred by the Central or State government, or any entity controlled by them (controlling stake) from participating in any project and the bar commence/ subsists as on the date of submission of bid including extension if any, the bidder shall not be eligible to submit the bid, either individually or as a member of consortium and if the bids are already submitted the

same shall be rendered invalid.

- (ix) If the firm claiming Technical Eligibility Criteria for the works has completed any of the works in joint venture with any other company then, along with the experience certificates, the firm shall submit the joint venture agreement for that particular work. Experience certificates not accompanied by joint venture agreement shall not be considered for evaluation. The credit for the firm which has completed a work in joint venture is allocated as follows:
- a) If the firm has completed the work as a Lead member in the project then the firm can claim credit for the entire scope of work.
 - b) If the firm has completed the work as a member in the project then the firm can claim credit for the entire scope of the work in proportion to the stake (e.g. if the capacity of the WWPS executed is 30 MGD and if the firm has executed the project as member with a 40% stake then the firm can claim credit for $(40\% \times 30 \text{MGD})$ 12 MGD works. A statutory auditor certificate specifying the payments received for the project should be submitted. In the event of percentage participation in the project calculated through the statutory auditor certificate differs from the percentage in the JVA, the percentage participation calculated through payments received shall be considered for evaluation purposes.

Observations:

- (i) Bidders are normally not required to furnish along with the bid any memorandum of understanding with any supplier prior to award of the contract. However, if an MOU is felt necessary, say to ensure tie up with a technology vendor, the same has to be submitted with bid in which case, no withdrawal of the MOU shall be permitted later on and the vendor withdrawing the MOU will be blacklisted by Employer for a period of 2 years.
- (ii) The bid shall remain valid for a period of 180 (one hundred eighty) days from the last date of submission of bid. In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request in writing that the bidders extend the period of validity for a specified additional period. At this stage, a bidder may refuse to extend the validity of his bid without forfeiting his bid security. However, a bidder agreeing to the request shall not be required or permitted to modify its bid in any manner and shall be required to extend the validity of its bid security correspondingly for the period of the extension. The Employer shall not be required to give any reason for requesting such an extension. Failure of a bidder to extend the bid validity and bid security upon request shall not be a ground for its disqualification.
- (iii) The value of total EMD as mentioned in NIT to be submitted along with the bid will be:
 - a) For Works with ECV (estimated contract value) upto Rs. 10 (Ten) crores: 2% (two percent) of ECV

- b) For Works with ECV exceeding Rs. 10 (Ten) crores: Rs. 20 lakhs + 1% (one percent) of ECV in excess of Rs. 10 crores.

Further, EMD amounts up to Rs. 20 (Twenty) lakhs shall be deposited through RTGS to Employer's designated account as specified in the tender. For EMD amounts exceeding Rs. 20 (Twenty) lakhs, bidders shall deposit Rs. 20 lakhs through RTGS and the balance amount in the form of Bank Guarantee (BG) issued by a Scheduled Commercial Bank in the format prescribed in the bidding documents. Bidders shall scan the original BG and upload the same in the e-tendering portal of Employer along with their bids. The original BG must be submitted in physical form at the Employer's office on the next working day following the last date of submission of bid (within office hours), but not before. Failure to submit the original BG as stipulated here, shall result in forfeiture of the EMD amount of Rs 20 (Twenty) lakhs deposited through RTGS. The Employer reserves the right to verify the authenticity of any Bank Guarantee submitted. If the BG is found to be forged, fraudulent or otherwise invalid, DJB shall forfeit the EMD amount of Rs 20 (Twenty) lakh deposited through RTGS and the bidder may be liable for debarment and other legal action as per applicable rules.

- (iv) Bidders are also required to submit, along with their bids, a complete list of all works in accordance with Annexure 1A and Annexure 1B, executed or under execution, during last 10 years for sewer line from the date of publication of NIT whether in Individual capacity or in JV/ Consortium with another contractor or as a sub-contractor, as per the annexure format attached. Bidders should also submit an affidavit on non-judicial stamp paper of Rs. 100/- in original confirming that the details of all such works executed/under execution either being executed in their name or being executed as joint venture within India or abroad (bidder's share) have been provided in the Annexure 1A and 1B and is correct. In case of any concealment, misrepresentation or falsification of information, the bidder's bid shall be summarily rejected and the bidder shall be liable for forfeiture of bid security and/or debarment or blacklisting, as per applicable Government rules. Please note that the affidavit as mentioned above should be duly notarized and submitted along with the bid. **No relaxation in this criteria is permitted.**

1. Wholly owned subsidiary defined as a company whose common stock is 100% owned by another company (parent company)
2. Lead member is a member of consortium nominated by the other members to lead the project in terms of responsibilities as well as to act as primary interface between the Employer and the consortium. It shall be noted that being a lead member does not signify a participation interest in the project of more than 50% and any member with a participation interest in the project of more than 26% can be a lead member.
3. AS 21 can be accessed at http://220.227.161.86/265accounting_standards_as21new.p
4. For Item rate, Percentage rate and (EPC/DBO) type of contracts, ECV shall only include the estimated capital cost. However, for exclusive O&M contracts, the EMD shall be deposited at total cost of O&M works for entire period.

Joint Venture Agreement for Consortium

(On Non – judicial stamp paper of Rs 300/- duly attested by notary public)

This Joint Venture Agreement (Agreement) entered into this day of 201_ at _____

Among

_____ (hereinafter referred as"----- ") and having office at _____

Party of the First Part

_____ (hereinafter referred as"----- ") and having office at _____

Party of the Second Part

_____ (hereinafter referred as"----- ") and having office at _____

Party of the Third Part

The parties are individually referred to as **Party** and collectively as **Parties**.

Whereas DELHI JAL BOARD (the "Employer") has invited Proposals from interested Firms and/or Consortiums for Appointment of Private operator for Project[s].

AND WHEREAS the Parties have had discussions for formation of a Consortium for bidding for the said Project and have reached an understanding on the following points with respect to the Parties rights and obligations towards each other and their working relationship.

IT IS HEREBY AS MUTUAL UNDERSTANDING OF THE PARTIES AGREED AND DECLARED AS FOLLOWS:

1. That M/s _____ who is the Lead Member of the Consortium commits to hold a minimum stake equal to __% of the Consortium at all times during the Contract Period.
2. That any dilution of participation interest by the Parties in the consortium shall be as per the provisions of the Contract.
3. That the Parties shall carry out all responsibilities as per terms of the Contract.
4. That the roles and the responsibilities of each Party at each stage of the Bidding shall be as follows:

Name of Consortium Member	Role (Lead Member or Member)	Percentage Share in JV/ Consortium	Responsibilities

No changes in the percentage share in JV/ consortium shall be allowed thereof, except in accordance with the provisions of the Contract document.

5. That the Parties affirm that they shall implement the Project in good faith and shall take all

necessary steps to see the Project through expeditiously. They shall not negotiate with any other party for this Project.

6. That the parties shall be jointly and severally liable for execution of the project.
7. In case of default of member(s) the following recourse shall be applicable:
8. That this Agreement shall be governed in accordance with the laws of India and courts in Delhi shall have exclusive jurisdiction to adjudicate disputes arising from the terms herein.

In witness whereof the Parties affirm that the information provided is accurate and true and have caused this Agreement to be duly executed on the date and year above mentioned.

Name, Designation and Signature of

Authorized signatory of Party of the first part:

Authorized signatory of Party of the second part:

Authorized signatory of Party of the third part:

Witness 1

Witness

2

1.2.2 Financial Eligibility Criteria

The single entity or lead member, in case of a Joint Venture, should individually satisfy the following set of eligibility criteria completely.

ECV of the Project is 57.23 Cr.

1. **Annual Turnover** as per Format 1 (applicable for all projects with ECV greater than INR 3 Cr.) 30% of ECV

Minimum average annual financial turnover on construction works should be at least Rs. 17.17 Cr. Crores-during the immediate last three consecutive financial years i.e. 2024-2025, 2023-24, 2022-23. The value of annual turnover figures shall be brought to current value by enhancing the actual turnover figures at a simple rate of 7% per annum.

2. **Net Worth** as per Format 2 (applicable for all projects with ECV greater than INR 3 Cr.) 40% ECV

The Bankers Certificate from a Commercial Bank amount should be equal to 40% i.e. Rs. 22.89 Cr. or more of the estimated cost put to tender.

OR

A Net-worth Certificate of minimum 10% i.e. Rs 5.72 Cr of the estimated cost put to tender issued by certified Chartered Accountant with Unique Document Identification Number (UDIN).

Net Worth is defined as:

Net Worth = (Subscribed and Paid-up equity capital + Reserves) – (Revaluation reserves

+ miscellaneous expenditure not written-off + reserves not available for distribution to equity shareholder)

Example:

Sources of Fund		Application of Fund	
Subscribed and Paid-up equity Capital	100	Fixed Assets	200
Reserves	120	Current Assets	100
Retained Profits	50	Investments	35
Share Premium	50	Miscellaneous Expenditure written-off	5
Revaluation Reserves	10		
Reserves not available for distribution	10		

to equity shareholder			
Loans	100		
Other Payables	20		
	340		340

(all values in INR crores)

Net Worth = (Subscribed and Paid-up equity capital + Reserves) – (Revaluation reserves

+ miscellaneous expenditure not written-off + reserves not available for distribution to equity shareholder)

Net worth= (100 + 120) - (10+10+5) = Rs. 195 crores

Note: The solvency certificate should be in the form of Bankers certificate from a scheduled bank on its letter head issued within a period of 12 months preceding the date of submission of tender. Its format shall be as under:

FORM OF BANKERS' CERTIFICATE FROM A SCHEDULED BANK

This is to certify that to the best of our knowledge and information that M/s./

Sh..... having marginally noted address,

a customer of our bank are/is respectable and can be treated as good for any engagement upto a limit of Rs..... .

(Rupees... ..)

This

certificate is issued without any guarantee or responsibility on the bank or any of the officers.

(Signature) For the Bank

NOTE. (1) In case of partnership firm, certificate should include names of all partners as recorded with the Bank..

3. Profitability

A certificate from CA based on Audited balance sheets for the last three years shall be submitted certifying the current soundness of the bidder's financial position and its perspective long term profitability. It should be positive.

4. Available bidding capacity as per Format 4A (applicable for all projects with ECV greater than INR 25 Cr.) 100 % of ECV (Circular issued vide no. DJB/CEO/2022/D-1109 DATED 14.03.2022)

The available bidding capacity shall be worked out by the following formula

Bidding Capacity = $(A \times N^3) - B$

where,

A= Maximum value of construction works executed in any one year during the last five financial years i.e. 20XX-XX, 20XX-XX, 20XX-XX, 20XX-XX and 20XX-XX taking into account the completed as well as works in progress (updated to the current price level), rate of inflation has been taken as 10% compounded per year).

N = Number of years prescribed for completion of works for which bids has been invited).

B= Value at current price level of existing commitments and ongoing works to be completed during the next XX years (period of completion of work for which bids have been invited). Bidders will give a calculation for the same.

(Note: Specify the years for which the value of construction works is to be checked. For bids announced in Q1 or Q2 of a financial year, data for penultimate financial year and its 4 preceding financial years will be demanded. For bids announced in Q3 or Q4 of a financial year, data for 5 preceding financial years will be demanded. Example: if a bid is announced in May 2011, then data for FY 2009-10, 2008-09, 2007-08, 2006-07 and 2005-06 will be demanded. And, if a bid is announced in Nov 2011, then data for FY 2010-11, 2009-10, 2008- 09, 2007-08 and 2006-07 will be demanded)

Example:

1. For calculating “A” – let’s assume the maximum value of construction turnover in last 5 financial years is Rs. 100 cr in FY 2009-10. Then taking 10% as given inflation rate, the present value of the maximum construction turnover in FY 2010-11 shall be Rs 110cr [=100*(1+10%)].

For “N”, let’s assume the current project duration to be 3 years.

2. For “B”, let’s assume that value for existing commitments and ongoing work 2010-11, 2011-12 and 2012-13 be Rs. 100 cr., Rs. 150 cr. and Rs. 200 cr. respectively. Then taking 10% as given discount rate, the current price level of existing commitments and ongoing works shall be Rs. 401.65 cr. [= {100/(1+10%)^0} + {150/(1+10%)^1} + {200/(1+10%)^2}].

$$\begin{aligned}\text{Bidding Capacity} &= (A*N^3) - B \\ &= (110*3^3) - 401.65 = \text{Rs. } 258.35 \text{ cr.}\end{aligned}$$

5. Working Capital as per Format 5 (applicable for all projects with ECV greater than INR 3Cr.)

(for estimated contract value; ECV < INR 100 Cr.) 15% of ECV

The bidder shall demonstrate that it has access to, or has available liquid assets (aggregate of working capital, cash in hand) and/or lines of credit sufficient to meet the construction cash flow requirements, minimum estimated as Rs. 8.58 Crore as on 31 March, 2025.

6. Litigation (applicable for all projects with ECV greater than INR 3 Cr.)

Bidder shall submit along with the bid details of all pending litigation as per attached Format 6. The maximum possible legal liability arising out of all the pending litigation should not exceed 50% of net worth of the bidder.

Note: All the financial calculations required under clauses 1 to 6 shall be done by the Contractor and shall be certified by its statutory auditor, else the information will not be considered for evaluation.

Format 1

Information on Average Annual Construction Turnover⁵

{To be printed on the authorized Letterhead of the Bidder or the Lead JV/ Consortium Member, including full postal address, telephone, faxes and e-mail address}

Individual bidder or lead member of a JV must fill in this form

Annual Turnover Data for the Last 3 Years (Construction only)	
Year	Amount (in INR)
2024-25	
2023-24	
2022-23	
Average Annual Construction Turnover	

{This format should be certified by the Statutory Auditor of the Bidder / lead member, in case of JV/ consortium}

Format 2

Information on Net-worth

To be printed on the authorized Letterhead of the Bidder or the Lead JV/ Consortium Member, including full postal address, telephone, faxes and e-mail address}

	Financial Information (in INR)	FY 2024-2025
1	Subscribed and Paid-up equity capital	
2	Reserves	
3	Revaluation Reserves	
4	Miscellaneous Expenditure not written off	
5	Reserves not available for distribution to equity shareholder	
	Net worth (1+2) - (3+4+5)	

Net Worth of the bidder as on date 31 March 2025 as specified in bid document = (Amount in INR)

{This format should be certified by the Statutory Auditor of the Bidder / lead member, in case of JV/ consortium}

Format 3

Information on Profitability

To be printed on the authorized Letterhead of the Bidder or the Lead JV/ Consortium Member, including full postal address, telephone, faxes and e-mail address}

Individual bidder or lead member of a JV must fill in this form

Profit Before Tax Data for the Last 5 Years	
Year	Amount (in INR
2024-25	
2023-24	
2022-23	
2021-22	

{This format should be certified by the Statutory Auditor of the Bidder / lead member, in case of JV/ consortium}

Format 4A

Information on Available Bidding Capacity

To be printed on the authorized Letterhead of the Bidder or the Lead JV/ Consortium Member, including full postal address, telephone, faxes and e-mail address}

Individual bidder or lead member of a JV must fill in this form. Refer original clause for clarification

Description	Value
Maximum value of construction works executed in any one year during the last five years updated to the current price level ; A Note:- Bidders to fill information in the Exhibit 4B to Provide details of construction works in last 5 years	(value in IndianRupees)
Duration of Contract; N= 4 years	(value in years. To be specified by Employer to Avoid ambiguity)
Value of existing commitment for next [N] years at current price level; B Note:- Bidders to fill information in the Format 4C to Provide details of existing Commitments	(value in IndianRupees)
Available Bidding Capacity = (A*N*3 - B)	(value in IndianRupees)

{This format should be certified by the Statutory Auditor of the Bidder / lead member, in case of JV/ consortium}

Format 4B

{To be printed on the authorized Letterhead of the Bidder or the Lead JV/ Consortium Member, including full postal address, telephone, faxes and e-mail address}

Form to be filled for each of last 5 financial years

Form for FY 2024-25, 2023-24, 2022-23, 2021-22, 2020-21

S.No.	Project Name	Brief Scope of Work	Contract Value (in INR)	Starting Date	Stipulated Completion Date	Value of the executed work in FY 20XX-XX (in INR)
1						
2						
3						
4						
5						
	Total value of construction work in FY 2024-25, 2023-24, 2022-23, 2021-22, 2020-21 (in INR)					

{This format should be certified by the Statutory Auditor of the Bidder / lead member, in case of JV/ consortium}

Format 4C

{To be printed on the authorized Letterhead of the Bidder or the Lead JV/Consortium Member, including full postal address, telephone, faxes and e-mail address}

S.No.	Description of Work (include scope of work, location, technology used, etc.)	Postal Address of Client & details of Officer-in-Charge	Contract Value (in INR) ¹	Starting Date	Scheduled Completion Date	Value of the work to be completed in [N] years (in INR)	Remarks
1							
2							
3							
4							
5							
Total (in INR)							

{This format should be certified by the Statutory Auditor of the Bidder / lead member, in case of JV/consortium}

¹ RBI exchange rate for the year of award to be referred for conversion in INR

Format 5

Information on Working Capital

To be printed on the authorized Letterhead of the Bidder or the Lead JV/ Consortium Member, including full postal address, telephone, faxes and e-mail address}

Working Capital Available with the bidder as on 31st March 2025= (Amount in INR)

{This format should be certified by the Statutory Auditor of the Bidder / lead member, in case of JV/ consortium}

⁶ RBI exchange rates for the year of award to be referred for conversion in INR

Format 6

Information on Litigation

To be printed on the authorized Letterhead of the Bidder or the Lead JV/ Consortium Member, including full postal address, telephone, faxes and e-mail address}

{To be provided for each firm/JV/consortium member}

S. No.	Name of applicant / JV/ consortium Member	Name of agency with which litigation and brief subject	Estimated financial Liability	Present Status

{This format should be certified by the Statutory Auditor of the Bidder / lead member, in case of JV/ consortium}

1.2.3 Technical Eligibility General Conditions:

- a. Bidders shall submit experience certificates as per the required format, in Annexure 1A and Annexure 2, wherever relevant, to meet eligibility criteria and particular conditions mentioned in this NIT.
- b. If a bidder claims technical eligibility through based on a project executed as a part of a consortium/ JV with other firm, it shall, along with the experience certificates, submit the joint venture agreement executed with the other member and the contract agreement with the client for that particular work. The documents must clearly indicate the bidder's role, scope of work, and share of contract value in the JV/Consortium.
- c. All experience certificates (in original as well as an English translation copy) produced by overseas companies should be attested/ apostle from the Indian Embassy in the country where the project was executed OR Embassy of the country (where project was executed) in India. The designation, email id and telephone numbers of the concerned Embassy official attesting the documents shall also be mentioned. In case any certificate is found to be forged, falsified or otherwise invalid, the bid shall be summarily rejected, and the bidder shall be debarred from participating in tenders of the Employer for a period of one (1) year, without prejudice to any other action that may be taken under applicable law.
- d. All certificates uploaded on the e-procurement site and in hard copy (which shall be true and identical copies of the uploaded documents) must be clearly legible. Any certificate found to be illegible or in deviation to the soft copy shall not be considered for evaluation purposes. No clarification or rectification shall be permitted in this regard.
- e. Operation & maintenance experience, for the purpose of evaluation, shall be counted post commissioning only. In case there is any overlap in the DLP and O&M period, benefit of both will be given for the period of overlap.

1.2.4 **Technical Eligibility Criteria:-**

Sewer rehabilitation/ Deep sewer work/Peripheral/Trunk sewer:

Part-A

Project Description	Sewer rehabilitation
Type of Contract	Item rate
Unit of Capacity	Length in meters
General Eligibility Criteria For Sewer rehabilitation	Sewer rehabilitation/ Deep sewer work/Peripheral/Trunk sewer: GENERAL CONDITIONS The bidder is required to have experience either of such works either sewer reahbilitation/deep sewer work/ Peripheral/Trunk sewer i.e. such work contracts awarded and commissioned successfully during the last Ten years ending last day of month previous to the one in which tenders are invited are as under: a) One commissioned completed & work of sewer rehabilitation of cost not less than the amount equal to 80% of the estimated cost put to tender or more. OR (b)Two completed commissioned works & of sewer rehabilitation of each costing not less than the amount equal to 60% of the estimated cost put to tender OR (c)Three completed & commissioned works of sewer rehabilitation of each costing not less than the amount equal to 40% of the estimated cost put to tender. The value of executed work(s) shall be brought to the current costing level by enhancing the actual value of work at a simple rate of 7% per annum(without compounding); calculated from the date of completion of work to the previous day of the last day of submission of tenders. Particular Conditions 1. Experience of successfully completing at least 1 (one contract of SEWER NETWORK system with minimum diameter and length as D and L in single work where, D-2/3rd diameter of maximum pipe diameter (in mm) as proposed in the bid= 1066.66~ 1100mm. L-40% of proposed length of maximum diameter as specified.
OR	
Part B: One time relaxation in following GCC clause applicable upto 30.06.2026 only,	
Technical Eligibility criteria	Sewer rehabilitation of sewer line / deep sewer line work/ peripheral /Trunk sewer: Eligibility criteria: The bidder as per their tendering limit in appropriate category is required to have similar nature of work experience i.e. rehabilitation of trunk sewer /peripheral line of 2/3rd of max dia (1100mm)or more in the minimum length of 300 meter in a single completed works during the last 10 years ending last day of month previous to the one in which tenders are invited

Annexure – 1 A: Total Work Experience in DJB-type of Activities**Name of contractor/executing agency:**Works Executed during last 7 years Technical/Financial Qualification

Work category		CAP-EX		OP-EX (i/c Electricity, Manpower, Chemical etc.)		Total Cost in Rs. Crores
		Nos.	Cost in Rs. Crores	Nos.	Cost in Rs. Crores	
1	Sewer Main (Dia/Length)					

Annexure – 1B: Total Work Experience in DJB type of Activities

Project Data Sheet Give list of all completed/ ongoing projects in last 10 years:

S. No.	Description	Details				
1.	Name of Project, Location					
2.	Description of work					
3.	Contract Value (in crores)	Civil Cost	E & M Cost	O & M Cost including Electricity, Manpower, Chemicals etc.	Business Model (Item Rate/ Percentage Rate/ EPC/DBO/PPP) (With Percentage financial contribution if any in CAPEX and OPEX)	Total Cost
	a) Awarded					
	b) Final Executed					
4.	Name of client, Postal Address, Phone/ Fax No./ E – mail					
5.	Designed Capacity/ Length					
6.	Treatment Process used, if Applicable					
7.	Technology Used if Applicable					
8.	Influent characteristics, if applicable					
9.	Effluent characteristics, if applicable					
10.	Applicable KPIs					
11.	Year in which KPI achieved					
12.	Other salient features, if any					
13.	Completion Dates	Date of award Scheduled Starting Date Scheduled completion date Actual Completion date Delay in months, if any Reasons for delay, if any Scheduled commissioning date Actual commissioning date Delay in months, if any Reasons for Delay, if any Defect Liability Period, Start Date Defect Liability Period, End Date Operation & Maintenance period, if applicable, Start Date				

S. No.	Description	Details
		Operation & Maintenance, End Date
9.	*Scope of work executed by Bidder's organization	
10.	Basis of Execution	• INDIVIDUAL • CONSORTIUM / JOINT VENTURE
11.	Details of lead member in case of JV	
12.	Details of other members in case of JV	

*Actual scope of work done by the JV partner who is applying for this tender.

Certificate not as per above format will not be considered for evaluation

(Signature & official stamp of the bidder)

Note 1: Separate data sheet has to be filled for individual projects.

Note 2: The previous contracts against which experience is not claimed as part of eligibility for this tender can be self-certified.

Note 3: Self attested copies of client certificates shall be enclosed.

Annexure – 2A: Requirement to meet Technical Eligibility Criteria

The Contractor should submit the experience certificates from the respective clients containing the following information:

1. Name of Work
2. Location
3. Scope of Work
4. Capacity
5. Cost of Work
6. Name of Client
7. Details of Client (Department, address, telephone number, email id)
8. Duration of Work
9. Scheduled date of start of Work
10. Schedule date of completion of Work
11. Actual date of start of Work
12. Actual date of completion of Work
13. Delay, if any
14. Amount of penalty, if any
15. Present status of Work
16. Performance of Work

**Annexure-2B: Total work Experience /Requirement to meet Technical Eligibility Criteria
Project Data Sheet give list of all completed/ongoing projects in last 10
years:**

S.NO.	DESCRIPTION	DETAILS	
1.	Name of project, location		
2.	Description of work		
3	Contract value in crores		
	a) Award		
	b) Final Executed		
4.	Name of client , postal Address, Phone/Fax no./e-mail		
5	Details of diameters, length & materials	DIA LENGTH MATERIAL OF SEWER PIPE	
6	Technology used, if any		
7	Other salient features, if any		
8	Completion dates	Date of award Scheduled starting date Scheduled completion date Actual completion date Delay in months, if any Scheduled commissioning date Actual commissioning date Delay in months, if any Reasons for delay, if any Amount of penalty, if any Defect liability period, start date Defect liability period, end date Operation & Maintenance end date	
9	Scope of work executed by bidder's organization		
10	Basic of execution	Individual	
		Consortium/joint venture	
11	Details of lead member in case of JV		
12	Details of other members in case of JV		

Annexure 3: lowest life cycle (only for information)

Annexure – 3: Lowest Life Cycle – Summary

Sr. No.	Description	Reference	Amount (Rs.)
1	Capital Cost		
(a)	Plant and Mandatory Spare Parts Supplied from Abroad	Schedule-1	
(b)	Plant and Mandatory Spare Parts Supplied from within the India	Schedule-2	
(c)	Design Services		
(d)	Installation and Other Services	Schedule-3	
(e)	Technical Deviations (if allowed in the bid)		
2	Works Contract Price	In Figure	[1(a)+1(b)+1(c)+1(d)) (+/-) 1e]
	(Capital Cost of Project) (Cp)	In Words	
3	Present Value for Energy Cost		
5	Evaluated Bid Price	In Figure	
		In Words	
6	Provisional Sum (predetermined by DJB to cover incidental cost)		
	Grand Total to be carried forward to Letter of Bid		

Name of Bidder

Signature of Bidder

Format for Schedule 1 & 2: Recommended Spare Parts(only for information)

Item	Description	Qty.	Unit Price In Indian Rupees at Site	Total Price in Indian Rupees
1	2	3	4	5 = 3 x 4
TOTAL Columns 5 to be carried forward to Schedule No. 1 and 2, as applicable in Summary				
Name of Bidder Signature of Bidder				

Format for Schedule 3: Installations, Commissioning and Other Services(only for information)

Item	Description	Qty.	Unit Price In Indian Rupees at Site	Total Price in Indian Rupees at site
1	2	3	4	5 = 3 x 4
1.0	Mechanical Works			
2.0	Electrical Works			
3.0	Civil Works			
4.0	Miscellaneous			
TOTAL Columns 5 to be carried forward to Schedule No. 3 in Summary				
Name of Bidder Signature of Bidder				

Annexure – 5: Affidavit to be filed by the Bidder (on a non-judicial stamp paper of Rs.100)

From:

(Contractor's Detail)

To

Delhi Jal Board, Govt of NCT of Delhi,

Office of the Executive Engineer (C)Dr-VIII,

STP, Yamuna Vihar, Delhi-110094E

Mail.ID eeedr8@gmail.com

Dear Sir,

I/We have annexed to this Bid the following documents:

- I. Original Power of Attorney or other proof of authority of the person who has signed the Bid or Copy of Power of Attorney or other authority duly certified by a Gazetted Officer or a Notary Public in proof of authority of the person who has signed the Bid:
- II. Audited Balance sheet of the Bidder for the last 5 (Five) years.
- III. Letter of award and completion certificates for the eligible projects
- IV. Documents as per the eligibility criteria
- V. Any additional documents as listed below:

I/We hereby undertake that the statements made in the bid and the information given in Annexure referred to above are true in all respects and that in the event of any such statement or information being found to be incorrect in any particular, the same may be construed to be a misrepresentation entitling Delhi Jal Board to cancel the bid or terminate any resultant Contract.

I/We undertake that we have no conflict of interest as specified in the bidding documents for the above Contract and that if found otherwise, Delhi Jal Board can take all requisite measures, including but not limited to cancellation of bid or terminate any resultant Contract, as per provisions of Contract.

I/We further undertake as and when called upon by Delhi Jal Board to produce for its inspection, original(s) of the documents(s) of which copies have been annexed hereto.

Yours faithfully,

(Signature(s) of the Bidders(s))

Name & Designation of authorized person signing the Bid on behalf of the

Bidder(s) Full Name and address of the Bidder(s)

INSTRUCTIONS TO BIDDERS

1. Invitation to Tender:

The Delhi Jal Board hereafter referred to as “the Board” will receive tenders for the works mentioned in NIT.

2. Earnest Money:

Bidder shall submit the EMD amount electronically on or before the last date & time of bid submission in DJB A/c No.50448339804 at Indian Bank, Copernicus Marg, New Delhi Baroda House Branch (IFSC Code No. IDIB000B677) through electronically mode only through sub paisa only on or before last date and time of bid submission on DJB sub Paisa portal on DJB website. Bidder shall fill up the detail of deposit of Tender Fee/Earnest Money in format available on the website of DJB. The link provided by EDP Cell as Tender on portal on Home page of DJB Web site (delhijalboard.nic.in).

DETAILS OF APPLICANT		
A	Account No.	
B	Name	NIT NO, Item No., Earnest Money, Name of Division, closing date & time of tender, Bidder's Name
C	Address	Bidder's Address

(a) Bids submitted without the exact amount of EMD and the requirements prescribed above shall be Liable for rejection.

(b) Bidder must upload the scanned copy of RTGS customer payment confirmation along with the Bid, before the date and time of closing of the bids.

(c) The EMD of all the participating firms except first lowest bidders will be returned after the opening of price bid. For successful bidder it will be adjusted against retention/security deposit.

3.Tender Fee.

Bidder shall submit non-refundable Tender Fee amount electronically on or before the last date & time of bid submission in DJB A/c No.50448339804 at Indian Bank, Copernicus Marg, New Delhi Baroda House Branch (IFSC Code No. IDIB000B677) through Bidder's bankers. Bidder shall fill up the detail of deposit of Tender Fee/Earnest Money in format available on the website of DJB. The link provided by EDP Cell as Tender on portal on Home page of DJB Web site (delhijalboard.nic.in).While submitting Tender Fee through RTGS mode (RTGS timing are 10:00 hrs to 16.00 hrs on all working days except Saturday, (timing for Saturday are 10:00 hrs to 13:00 hrs), Bidder must mention NIT No., Name of Division, closing date & time of tender and Bidder's Name and address in the Applicant details column in the RTGS form as shown in the example below:-

DETAILS OF APPLICANT		
A	Account No.	
B	Name	NIT NO, Item No., Tender Fee Amount , Name of Division, closing date & time of tender, Bidder's Name
C	Address	Bidder's Address

(a) Bids submitted without the exact amount of Tender Fee and the requirements prescribed above shall be Liable for rejection.

4. The tenderer shall submit the offer under two bid system i.e. Bid Part-A (Technical) & Part-B (Financial Bid)

Bid Part-A (Technical)

Bid Part-A should contain scanned documents giving detail of Eligibility Criteria as Annexure-A.

Annexure-A :-

A) Scan copy of Registration certificate.

B) Scan Copy of Mandate form duly filled and Singed by Firm Owner.

C) Scan copy of Registration of GST. Scan copy of latest GSTR. Scan copy of latest ITR.

D) Scan copy of Performance Certificate for Similar nature of works, not older than 05years.

E) Scan copy of under taking for not been debar/ blacklisted as on date in any depart.

F) Scanned copies RTGS details of Tender Fees and EMD.

G) The bidder/agency shall submit scanned copy of Non-Judicial Stamp paper affidavit regarding employment of their close relatives in DJB which may include the relatives in Blood, Uncles (paternal or maternal), cousins (Paternal or maternal), Father, Mother, son, Daughter, Mother-in-law, Brother-in-law, Sister-in-Law, Nephew and Niece etc. (This list is not exhaustive)

Bid Part B: Financial Bid):

Online Bid Part-B tender shall consist of tender form Annexure B & the bill of quantity. The bidders are required to fill all the columns of the priced bid as uploaded. Financial bids of only those bidders would be opened whose bid is substantially responsive to the NIT/Addendum/pre-bid replies issued by department. Tenders will be received only online on Date up to Time and Part A shall open on Date & Time for further scrutiny. Bid part-B shall also be opened after the completion of technical bid only for those bidders, who fulfill the eligibility criteria/the required documents if found in order under bid part-A. If any of the above date happens to be holiday, the next working day will be considered for all purposes. Conditional tender shall not be considered.

100% Earnest Money Shall Stand forfeited in Case :- A) if contractor withdraws the offer within the Validity Period of bid. (B) The Contractor who neither executes the C.A. Within Stipulated period as stated in work order nor takes up the execution of work even after lapse of date of start of work.

5. Submission of tenders: The tenders are to be submitted through electronic tendering process. The bidders shall download the entire document and upload only the scanned copies supporting their experience and other details as has been asked in different sections of the document. The Bidder shall be deemed to have read and examined the Tender Documents before quoting the rates in all the formats given in the bid document. The drawing(s), Specifications, Clauses and Conditions, etc are to be considered as explanatory of each other and no advantage shall be taken of any omission in Tender Documents. Before submission of tender, the bidders are advised to go through the eligibility criteria, terms & conditions and specifications given in tender documents carefully. The complete tender document is available on the web Site <http://govtprocurement.delhi.com> which shall form the part of contract agreement with the successful bidder. The tenders are to be submitted in two parts i.e. Part A & Part B. The part A of the tender is technical bid and part B as financial bid. The bidders are required to upload the scanned copies of the certificates and other supporting documents as technical bid. The requirement of documents for uploading is given in the tender document. The price schedule as per formats given under BOQ, is required to be filled in on line as a financial bid. The tenders shall be submitted online only.

6. Validity of tender : The validity of rate shall 180 days counted from the next day of submission of Bids. (Validity Period of rates mentioned in the NIT)

7. FORFEITURE OF EARNEST MONEY:

As Already mentioned and on non submission of Additional PBG and BG as applicable within given time period.

8.0 OPENING AND EVALUATION OF TENDER:

The Tender received will be opened as per the specified program in the office as mentioned in the Tender notice in the presence of intending bidder or their authorized representatives who choose to remain present on the opening day at the scheduled time. Following procedure will be adopted for opening of the tender: EMD and its contents will be verified and scrutinized. The Technical Bid of the bidders whose EMD submitted was found in order will be opened. The Delhi Jal Board, if needed, will obtain clarifications by requesting such information from any or all the Bidders in writing (through e mail) as may be necessary. The Bidder will not be permitted to change the substance of his tender after it has been opened. Non-compliance with this provision within prescribed time could be a cause for disqualification. In comparing the tenders, the Delhi Jal Board will consider such factors as compliance with the Tender Specification, past experience, after sales service facilities and the Bidder's capacity to perform shall form the basis for evaluating the prices. In addition, specific aspects, if any, mentioned elsewhere in Tender Specifications will also be considered. The Delhi Jal Board reserves the right to reject any or all the Tenders without assigning any reason.

9. AWARD OF CONTRACT:

The contract will be awarded to the Bidder whose Tender is adjudged in accordance with this Tender Specification, to be in the best interest of the Delhi Jal Board. The successful bidder shall submit the documents like Constitution of firm, Partnership deed, power of attorney of authorized representative signing the documents etc, Non Judicial Stamp Paper of Rs.100/-, Downloaded Bid documents i/c corrigendum, addendum etc, if any, as applicable for execution of Contract Agreement within 15 days from the Notification of Award of work. The authorized representative will present himself in the office of Delhi Jal Board with seals etc. for signing of documents.

10. DOCUMENTS:

Bidders shall carefully examine the Tender Specification and fully inform themselves as to all the conditions and matters, which may in any way affect the work or the cost thereof. Should a Bidder find discrepancies in or omissions from the Tender Specification or should he be in doubt as to their meaning, he should at once address a query to the DJB with a copy to the Consulting Engineers two days before scheduled date of receipt of tender. Any resulting interpretation or modifications of the Tender Specification shall be issued as an Addendum.

DJB reserves the right to cancel the work order in case of failure of bidder to meet the time and quality specifications and may transfer the order to any other qualified bidder or retender the balance part of scope of contract.

11. Non refundable fee for processing of tender documents – vide Order No. DJB/JD(F&A)-II /2015/87228 dated 16.07.2015 of Director (F&A) tender processing fees will be applicable as under

- (A) Works costing upto Rs. 1 lakh: Rs. 150.00
- (B) Works costing between Rs. 1 lakh and Rs. 50 lakh Rs 500.00

(C) Works costing more than Rs. 50 lakh and upto Rs. 2 Crore:Rs 1000.00 (D) Works costing above Rs. 2 Crore Rs 1500.00

12. In case trees are encountered close to the alignments earmarked for laying of pipelines the contractor shall take necessary precautions to protect the roots of the trees and work at site be carried out with utmost caution in close coordination with the officer of the forest department. It will be more appropriate if an assessment of site situation is made by taking into consideration the minimum width of the trench required by laying of the pipeline and if it is felt that trees existing on the alignment require felling permission for the same must be obtained from the concerned authority before taking up the work along that stretch of the alignment.

13. No display board or markets shall be fixed on the trees. Any violation shall make the concerned liable for prosecution by the authorities in accordance with the relevant law.

14. The contractor shall ensure a damage free liability to the trees in the area upto the date of completion of the work.

15. The contractor will retain photographs of the area worked upon before and after the work showing the conditions of the trees in the area upto the date of completion of the work.

16. USE OF FLY ASH AND FLY ASH BASED PRODUCTS IN DJB as per the order SE(Plg.) Dr. No. F.10/DJB/SE(P)Dr./2017/237 to 346 dated: 06.12.2017.

16.1 OPC 43 Grade /PPC shall be used in all construction works.

16.2 Fly ash bricks shall be mandatorily used in all construction work except in manhole Construction where sewer bricks shall be used.

17. The man entry in the manhole/pipeline is strictly prohibited. In case of any emergency or any other suitable alternate manual entry may be permitted with the written permission of the Engineer-in-Charge by using all safety equipments i/c full body suit as prescribed in the guidelines issued the NHRC.

18. The minimum wages to the labour shall be paid strictly as per the latest orders of the Govt of NCT Delhi with time to time amendments in this regard.

19. For Sewer works, the successful bidder shall ensure the safety measures mentioned in the Contract Conditions and PEMS Act and their rehabilitation rules 2013 are strictly followed. In this regard, Hon'ble Supreme Court writ petition no. 583 of 2003 (Safai Karamchari Andolan and Others. V/s Union of India and Ors.) verdict Dt. 27.03.2014 is applicable, in which, in case of death of any worker, minimum compensation of Rs. 10.00 Lakh has to be paid by the Firm immediately. The successful bidder has to submit an insurance cover of Rs. 10.00 Lakh for each worker likely to be engaged for the successful completion of that work. The Insurance cover must mention the Name of Work and Nos of Labour likely to be engaged for the entire completion period.

20. Disposal of sewage /sludge taken out from the sewer manholes shall be as per the decision of Engineer-in-Charge. 21. If the work is to be carried out by the opening of manhole covers on the road. It is responsibility of firm to ensure the safety of the public during execution of the work as well as proper closing of the manhole covers after completing the daily task.

22. In case of condition or specifications mentioned at different places in the bid document, the most stringent shall be applicable.

23. The DJB reserve the right to reject any or all tenders without assigning any reason.

24. Use of Mechanical Machine cutter for road cutting for laying of water line / Water/Sewer connections is mandatory. No extra cutting of Road allowed.

24.1 It Shall be the responsibility of working agency to keep construction site free from water stagnation all the time to avoid mosquito breeding. Engineer in-charge shall ensure the compliances. (Member(WS) Instruction Order dated 12.07.2022).

24.2 ADDRESSES FOR CORRESPONDENCE:

Any correspondence pertaining to this Tender will be addressed to Delhi Jal Board at the address given below:

Delhi Jal Board, Govt of NCT of Delhi,

Office of the Executive Engineer (C) Dr-VIII,

STP, Yamuna Vihar, Delhi-110094

Email id:- eecdr8@gmail.com

Special Conditions of Contract (SCC)

The special conditions of contract (SCC) supersedes, the conditions mentioned elsewhere in the NIT for similar conditions.

N.O.W is “Rehabilitation of 1600/1200 mm dia trunk sewer line from Amichand chowk to Old kalyanpuri SPS by open technology method (Structurally Stand Alone Pipe) under EE(C)Dr-VIII”

1. The Technology provider to the bidder must meet proven Technology of Rehabilitation (Structurally Stand Alone) in the last 10 year and experience certificate for the works executed of Rehabilitation of sewer lines should be issued by an officer not below the rank of Executive engineer or Equivalent.
2. The experience certificate issued from DJB or any other Government Agency not below the rank of Executive engineer or Equivalent, in favour of sub-contractor will be accepted.
3. Prior to the installation of the rehabilitation product as per the proven and adopted technology, the design thickness and design calculations shall be get vetted from IIT Delhi/ DTU/IIT Roorkee or equivalent. Nothing shall be paid extra on vetting.
4. Bidder should submit and got approved the QAP from Engineer-in-charge for the proven and adopted technology of Rehabilitation of sewer and sewer pipe, prior to execution of work.
5. The bidder should have his own 2 Nos. Super Sucker Machine with 4 silt loader in firm name for de-silting purposes and copies of purchase invoices are to be submitted. Original documents shall be shown on demand. The bidder also has to disclose in his bid, the present liability of the work on these machines.
6. The rehabilitation lining in NP3/ NP4 pipe of sunken sewer replacement shall be as per decision of engineer in charge.
7. The sewer lines to be rehabilitated/ replaced shall be excluding to those which already replaced by the maintenance division of DJB and the contractor shall work in close coordination with concerned maintenance division of DJB.
8. The barricading shall not be paid for ideal at site when there will be no activity at site, however barricades shall remain installed as per the safety requirements of site.
9. No man entry in the manhole shall be done by the contractor without taking prior approval/ work permit in written from the engineer-in-charge.

10. No pit/trench excavation shall be done by the contractor without sufficient shoring/ barricading / night warning illumination/ night guard and taking prior approval/ NOC in written from the engineer-in-charge.
11. The contractor shall take all road cutting / traffic permission of on its own. DJB shall however assist him by writing letters to the concerned agencies. Further, the agency deposits the requisite road cutting/ security charges to the road owning agencies to maintain pace in the work. However, the charges must be approved by DJB prior to deposition by contractor and charges so deposited shall be reimbursed to the agency by DJB.
12. In case of variation in diameter of existing pipe or design thickness of liner, that taken in the Bill of Quantity, the rate shall be applicable as worked out on proportionate basis as under:-
 - i. Circumference in case of liner thickness.
 - ii. Cross-sectional area in case of flow diversion and de-silting.
13. In case of siltation both on higher or lower side, then Pro-rata rates shall be adopted, provided the siltation percentage shall be duly supported by sonar survey for which nothing shall be paid extra.
14. The agency shall dump silts on its own in environment friendly manners and following laws of municipal bodies. However, if site available, DJB may permit the agency to dump the silt at DJB STPs with terms and conditions as applicable.
15. In case of encounter of ground water table during the work, the contractor shall make the drawn-down to the desirable level and the contractor shall include the cost in their rates and nothing extra shall be paid on account of this.
16. The rehabilitation lining system shall be anyone of the following, as per the BOQ
 - i. UV cured CIPP
 - ii. Hot water cured CIPP
 - iii. GRP
 - iv. MWSL
 - v. Or any other proven technology of lining.
17. Bidders are required to submit a MOU duly notarized on stamp paper of Rs. 300/- with a manufacturer of any proven profile/ technology for structurally stand alone, issued in the name of said tender.
18. The test of the rehabilitation lining sample/ profile shall be done at every 500 meters of length or change of diameter less whichever is specified in the tender elsewhere.

19. Defect liability period

For pipe networks related to both water and sewerage with an expected projects cost greater than 3 crore, the defect liability period is 05 years and for all the other works, the defect liability period is 02 year.

20. Mobilization advance clause 15.3 of the General Conditions of Contract (GCC)
DELETED

21. Incentive for early completion 10.2 of the General Conditions of Contract (GCC)
DELETED

22. Payment of running bills 12.2 of the General Conditions of Contract (GCC)
The sub clause 12.2.2 is deleted.

GENERAL CONTRACT CONDITIONS

1.0 Definitions & Interpretations

1.1 Definitions

“Commencement Date” means the date of commencement of the Works and shall generally be from the 10th day of issue of Work Order or unless otherwise specified in the Contract.

“Completion Certificate” means the certificate issued by the Engineer-in-Charge to the Contractor, on request after successful completion of Works, pursuant to clause 15.1.

“Completion Date” means the actual date of completion or commissioning of the Works, whichever is later, as recorded by the Engineer-in-Charge.

“Contract” means the present Contract Agreement, Letter of Intent, Work Order, Tender, Special Conditions of Contract, these Conditions, the Technical Specifications, the Drawings, the Schedules and such other documents as may be expressly incorporated in the present Contract Agreement.

“Contractor” means a person or a corporate body and the legal successor in title to such person whose bid to carry out the Works has been accepted by the Employer and the Contract is signed.

“Contractor’s Bid” means the completed bidding document submitted by the Contractor to the Employer.

“Contract Price” means the agreed price for executing the Works as defined in Letter of Acceptance/ Work Order, and includes any adjustments in accordance with the Contract, thereafter.

“Cost” means all expenditure reasonably incurred (or to be incurred) by the Contractor, whether on or off the Site, including overhead and similar charges, but does not include profit.

“Defects” means any part of the Works not completed in accordance with the Contract, or completed with deficiencies and flaws and includes deficiencies, flaws, etc. developed during

the execution of Works and during the Defect Liability Period.

“Defects Liability Period” means the period from the Completion Date as certified by the Engineer-in-Charge and specified in clause 16.1.

“Drawings” mean maps, drawings, plans, tracings or prints thereof, calculations and technical information of a like nature provided by the Employer to the Contractor or annexed to the Contract, and any modifications of such drawings and further drawings that may be issued by the Engineer-in-Charge from time to time or approved by the

Engineer-in-Charge in writing and includes such other drawings as are made from time to time and furnished by the Contractor and approved by the Engineer-in-Charge.

“Employer” means the Board of the Delhi Jal Board (DJB), New Delhi, having its registered office at Varunalaya Complex, Jhandewalan, Karol Bagh, New Delhi, constituted through an Act of the Delhi Legislative Assembly on 6th April, 1998, acting through its Chief Executive Officer or any other officer so nominated by the Chief Executive Officer and shall include their legal successors and permitted assignees.

“Engineer-in-Charge” means the person appointed by the Employer, with due notification to the Contractor, who is responsible for signing the Contract, supervising the Contractor, administering the Contract, release of payments due to the Contractor as per Contract provisions, and taking any other decisions as per provisions of Contract. Any other approval including, but not limited to, extension of time, imposition of damages/ penalty, approval of additional scope, approval of any other deviations will be done as per extant delegation of power of Employer.

“Good Engineering Practice” means, Works carried out in accordance with the following standards/ specifications,

As specified in BIS, ISO or relevant standards of particular product Work done as per norms of relevant work described in CPHHEO, PHED, CPWD, Electricity Board, amongst others.

Manufacturers’ instructional manual for construction, erection, O & M of respective products Specification prepared drafted & approved by Engineer-in-Charge for undertaking the work, if not specified in above

“Good Industry Practice” means the practices, methods, techniques, designs, standards, skills, diligence, efficiency, reliability and prudence which are generally and reasonably expected from a reasonably skilled and experienced Contractor engaged in the same type of undertaking as envisaged under this Contract and which would be expected to result in the performance of its obligations by the Contractor in accordance with this Contract, Applicable Laws and Applicable Permits in reliable, safe, economical and efficient manner.

“Letter of Acceptance” means the letter from the Employer or the Engineer-in-Charge, or a person nominated by them on their behalf for this purpose, to the Contractor, conveying acceptance of the Tender, subject to any modifications agreed to between the parties and includes advance acceptance of the tender.

“Materials” means all equipment, components, fittings, and other materials including consumables, raw materials etc. required to execute and complete the Works.

“Parties” means Employer or the Contractor or both, as the context requires.

“Physical Completion of Works” means completion of construction of all physical structures such that it is ready to use for all intended purposes.

“Schedule” means the document(s) entitled schedule, completed by the Contractor and submitted with the Letter of Tender, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.

“Site” means the places provided by the Employer where the Works are to be executed and any other places as may be specifically designated in the Contract as forming part of the Site.

“Specification” means the specifications of the Works included in the Contract and any modification or addition of such Works and approved by the Engineer-in-Charge.

“Special Conditions of Contract” means terms and conditions that sets out the rights and obligations of the parties that are peculiar to a specific contract, or as necessitated by the circumstances of specific works, and that forms a part of the Contract as laid out in clause 1.4.

“Stipulated Date of Completion” means date of completion of the Contract as specified in the Work Order.

“Stipulated Period of Completion” means the time period for completion of Contract as specified in the Work Order. This period shall start from the Commencement Date and shall end at the Stipulated Date of Completion.

“Sub Contractor” means a person or corporate body who has a Contract with the Contractor to carry out a part of the Works in the Contract.

“Taxes” means any Indian taxes and duties including excise duties, customs duties, value added tax, sales tax, local taxes, cess and any impost or surcharge of like nature (whether Central, State or local) on the goods, material, equipment and services incorporated in and forming part of the Works charged, levied or imposed by any Government Instrumentality, but excluding any interest, penalties and other sums in relation thereto imposed on any account whatsoever. For the avoidance of doubt, Taxes shall not include taxes on corporate income;

“Variation” means any change to the Works which is instructed or approved as variation by Engineer-in-Charge, which causes a variation in the scope of work from what is contained in the Contract.

“Works” means permanent and/or temporary work to be executed by the Contractor in accordance with the Contract.

“Work Order” means the document of the Employer communicating its decision to award the Works to the Contractor at the agreed Contract Price and specifying the Commencement Date and Stipulated period of Completion.

“Writing” means any hand-written, type-written or printed communication, email when followed by written confirmation, including facsimile transmission resulting in a permanent record in Contract.

1.2 Interpretation of documents

In this Contract, unless the context otherwise requires:

- (i) references to any legislation or any provision thereof shall include amendment or re-enactment or consolidation of such legislation or any provision thereof so far as such amendment or re-enactment or consolidation applies or is capable of applying to any transaction entered into hereunder;

- (ii) references to laws of India or Indian law or regulation having the force of law shall include the laws, acts, ordinances, rules, regulations, bye laws or notifications which have the force of law in the territory of India and as from time to time may be amended, modified, supplemented, extended or reenacted;
- (iii) references to a “person” and words denoting a natural person shall be construed as a reference to any individual, firm, company, corporation, society, trust, government, state or agency of a state or any association or partnership (whether or not having separate legal personality) of two or more of the above and shall include successors and assigns;
- (iv) the table of contents, headings or sub-headings in this Contract are for convenience of reference only and shall not be used in, and shall not affect, the construction or interpretation of this Contract;
- (v) the words “include” and “including” are to be construed without limitation and shall be deemed to be followed by “without limitation” or “but not limited to” whether or not they are followed by such phrases;
- (vi) references to “construction” or “building” include, unless the context otherwise requires, survey and investigation, design, developing, engineering, procurement, supply of Plant, Materials, Equipment, labour, delivery, transportation, installation, processing, fabrication, testing, commissioning and maintenance of the project (water/ waste water, networks, treatment and storage as applicable) including removing of Defects, if any, and other activities incidental to the construction and “construct” or “build” shall be construed accordingly;
- (vii) references to “development” include, unless the context otherwise requires, construction, renovation, refurbishing, augmentation, up-gradation and other activities incidental thereto, and “develop” shall be construed accordingly;
- (viii) any reference to any period of time shall mean a reference to that according to Indian Standard Time;
- (ix) any reference to day shall mean a reference to a calendar day as per the Gregorian calendar;
- (x) references to a “business day” shall be construed as a reference to a day (other than Sundays and other holidays for Employer) on which banks in [Delhi] are generally open for business;
- (xi) any reference to month shall mean a reference to a calendar month as per the Gregorian calendar;
- (xii) references to any date, period or project milestone shall mean and include such date, period or project milestone as may be extended pursuant to this Contract;
- (xiii) any reference to any period commencing “from” a specified day or date and “till” or “until” a specified day or date shall include both such days or dates; provided that if the last day of any period computed under this Contract is not a business day, then the period shall run until the end of the next business day;
- (xiv) the words importing singular shall include plural and vice versa;
- (xv) references to any gender shall include the other and the neutral gender;

- (xvi) "lakh" means a hundred thousand (100,000) and "crore" means ten million (10,000,000); (xvii) "indebtedness" shall be construed so as to include any obligation (whether incurred as principal or surety) for the payment or repayment of money, whether present or future, actual or contingent;
- (xviii) references to the "winding-up", "dissolution", "insolvency", or "reorganization" of a company or corporation shall be construed so as to include any equivalent or analogous proceedings under the jurisdiction of law in which such company or corporation is incorporated or any jurisdiction in which such company or corporation carries on business including the seeking of liquidation, winding-up, reorganization, dissolution, arrangement, protection or relief of debtors;
- (xix) save and except as otherwise provided in this Contract, any reference, at any time, to any agreement, deed, instrument, license or document of any description shall be construed as reference to that agreement, deed, instrument, license or other document as amended, varied, supplemented, modified or suspended at the time of such reference; provided that this sub clause shall not operate so as to increase liabilities or obligations of the Employer hereunder or pursuant hereto in any manner whatsoever;
- (xx) any agreement, consent, approval, authorization, notice, communication, information or report required under or pursuant to this Contract from or by any Parties or the Engineer-in-Charge shall be valid and effective only if it is in writing under the hand of a duly authorized representative of such Parties or the Engineer-in-Charge, as the case may be, in this behalf and not otherwise;
- (xxi) the Schedules and Recitals to this Contract form an integral part of this Contract and will be in full force and effect as though they were expressly set out in the body of this Contract;
- (xxii) references to Recitals, Articles, clauses, Sub-clauses or Schedules in this Contract shall, except where the context otherwise requires, mean references to Recitals, Articles, clauses, Sub-clauses and Schedules of or to this Contract, and references to a Paragraph shall, subject to any contrary indication, be construed as a reference to a Paragraph of this Contract or of the Schedule in which such reference appears; and
- (xxiii) the damages payable by either Parties to the other of them, as set forth in this Contract, whether on per diem basis or otherwise, are mutually agreed genuine pre-estimated loss and damage likely to be suffered and incurred by the Parties entitled to receive the same and are not by way of penalty (the "Damages")
- (xxiv) Time shall be of the essence in the performance of the Parties' respective obligations. If any time period specified herein is extended, such extended time shall also be of the essence.

1.3 Ambiguities and Discrepancies

In case of ambiguities or discrepancies within this Contract, the following shall apply:

- (i) between two or more clauses of this Contract, the provisions of a specific clause relevant to the issue under consideration shall prevail over those in other clauses;

- (ii) between the clauses of this Contract and the Schedules, the clauses shall prevail and between Schedules and Annexes, the Schedules shall prevail;
- (iii) between any two Schedules, the Schedule relevant to the issue shall prevail;
- (iv) between the written description on the Drawings and the technical specifications, the latter shall prevail;
- (v) between the standard in CPWD manual and the relevant standard, the latter shall prevail;
- (vi) between the dimension scaled from the Drawing and its specific written dimension, the latter shall prevail;
- (vii) between any value written in numerals and that in words, the latter shall prevail;
- (viii) for any discrepancy in the Contract relating to BOQ (Bill of Quantities), the nomenclature as given in CPWD manual/ DSR/ EMPLOYER analyzed rates, as the case may be, shall prevail, unless specified in the Contract

1.4 Order of precedence

The Contract Agreement shall comprise the following documents in the given order of precedence:-

- (i) Agreement on non judicial stamp paper
- (ii) Work order
- (iii) Letter of Acceptance
- (iv) Correspondence between parties
- (v) Corrigendum/ Addendum issued, including bidders' queries
- (vi) Special Conditions of Contract (vii) General Conditions of Contract (viii) Technical Specifications
- (ix) Accepted bid
- (x) NIT or any other document

1.5 Correlation of document

The Contract documents are complementary and what is called for by any one of them shall be as binding as if called for by all of them.

1.6 Signing of Contract

The Contract should be signed by either parties within 21 (twenty one) days of issue of Work Order or any such time period as decided by the Employer, failing which the Employer shall have the right to forfeit the Earnest Money deposited during the bidding stage. The Employer shall also have the right to forfeit the Performance Guarantee, submitted as per

clause 6.1, in case Contractor fails to sign the Contract in the stipulated time. However, Employer shall give a 10 days' notice before forfeiting the Performance Guarantee. Further, the Contractor shall not be allowed to participate in retendering, if any, for the Works.

1.7 Communication

All notices, communications, references and representation by either Parties to the Contract shall be in writing only.

1.8 Language

The Contract document shall be drawn up in English.

1.9 Law governing the Contract

The Contract shall be governed by the laws of India, including but not limited to laws of GNCTD and DWB act, in force and as amended from time to time and the Courts in Delhi shall have exclusive jurisdiction in all matters under the Contract.

1.10 Compliance with bylaws and regulations

The Contractor shall comply with the provisions of any statute relating to the Works, regulations and by-laws of any local authority and undertaking, including those controlling the utilities such as, but not limited to, roads, railways, telephones and power supply, in whose area / jurisdiction the Works is to be executed. The Contractor shall also comply with court directives, if any after signing of Contract.

2.0 Engineer-in-Charge & its representatives

2.1 Duties and authority of Engineer-in-Charge and its representatives

2.1.1 The Engineer-in-Charge shall carry out the duties specified or implied in the Contract including issue of instructions, decisions, certificates and orders, for administration of the Contract and expeditious and timely completion of the Work. Should the Engineer-in-Charge exercise any specific authority for which, as per the terms of his appointment, he has to obtain the approval of the Employer, the Contractor shall deem such approval to have been given by the Employer. Further, the Engineer-in-Charge may be assigned any other duty by the Employer in interest of Work.

Duties and Authority of Engineer-in-Charge's representative

- (i) The Engineer-in-Charge's representative shall be appointed by and be responsible to the Engineer-in-Charge and shall carry out such duties and exercise such authority as may be delegated to him by the Engineer-in-Charge including the duty to supervise the Works and to test and examine any materials to be used or workmanship employed in connection with the Works.

Provided that the Engineer-in Charge's representative shall have no authority to relieve the Contractor of any of his duties or obligations under the Contract, or to order any work involving delay or any extra payment by the Employer, or to make any variation of or in the Works, except as expressly provided in the Contract.

- (ii) The Engineer-in-Charge may, from time to time, in writing delegate to the Engineer-in-Charge's representative, any of the powers and authorities vested in the Engineer-in-Charge, and he may any time revoke such delegation. Any such delegation or revocation shall be in writing and the Engineer-in charge shall furnish to the Contractor and to the Employer, a copy of all such written delegation or revocation of powers and authorities. Any written instruction, decision or approval given by the Engineer-in-Charge's representative to the Contractor within the terms of such delegation, but not otherwise, shall bind the Contractor and the Employer, as though it had been given by the Engineer-in-Charge. Provided always as follows:

Failure of the Engineer-in-Charge's representative or his assistants, to disapprove any Works or materials shall not prejudice the authority of the Engineer-in-Charge or Employer thereafter, to disapprove such Works or materials or plant and order the pulling down, removal or breaking up or replacement thereof. The Engineer-in-Charge's representative shall have similar authority to disapprove any Works or material or plant passed by his Assistants, appointed in terms of provision of sub-clause 2.1.2 herein.

If the Contractor shall be dissatisfied by reason of any instruction or decision of the Engineer-in-Charge's representative, or questions any communication of the Engineer-in-Charge's representative, he may refer the matter to the Engineer-in-Charge, who shall thereupon confirm, reverse or vary such decision or vary the contents of such communication. The Engineer-in-Charge's representative shall have similar authority to confirm, vary, or, reverse any instructions and decisions issued by his Assistants, appointed in terms of sub-clause 2.1.2 herein.

2.1.2 The Engineer-in-Charge or his representative may appoint any number of persons to assist them in carrying out their duties under Sub-clause 2.1.1. The Engineer-in-Charge or his representative shall notify to the Contractor the names, duties and scope of authority of such persons. Such persons/assistants shall have the authority to issue instructions / give decisions to the extent of duties assigned and powers delegated to them.

2.2 Works to be executed under direction of Engineer-in-Charge

All Works to be executed under the Contract shall be executed under the direction and subject to the approval of the Engineer-in-Charge. The Engineer-in-Charge shall be entitled to direct at what point or points and in what manner the Works are to be commenced and scheduled.

2.3 Instructions in writing

2.3.1 The instructions issued by Engineer-in-Charge shall be in writing or through email. However, if the Engineer-in-Charge issues any oral instructions to the Contractor, the Contractor shall comply with them.

Provided that the Engineer-in charge shall confirm in writing the oral instructions within 2 [two] working days of issuing them.

2.3.2 In case the Contractor does not receive the written confirmation of the oral instruction within the time prescribed in Sub-clause 2.3.1, the Contractor shall seek the written confirmation of the oral instructions from the Engineer-in-Charge who issued the oral instructions. In case of failure of the Engineer-in-Charge to reply to the Contractor within

2 (two) working days of the receipt of the communication from the Contractor, the Contractor shall not carry out the instruction.

2.4 Time Compensation for delay in handing over the site

2.4.1 The Employer shall ordinarily grant the Contractor the Right of Way which may, however, not be exclusive to the Contractor:

- (i) on the date(s) stated in Special Conditions of Contract; and
- (ii) In the event Special Conditions of Contract does not specify any time schedule for providing the Right of Way for any part of the Site, the Employer shall provide to the Contractor the Right of Way to such part(s) within 30 (thirty) days of the Start Date.

2.4.2 Where Right of Way of a part of the Site is not given within fourteen days of the date specified in sub-clause 2.4.1 for any reason other than Force Majeure or breach of this Contract by the Contractor, the Contractor shall be entitled to extension of time. The extension of time shall be equal to the period of delay in handing over the possession of the Site provided that if delays involve time overlaps, the overlaps shall not be additive.

2.4.3 The Special Conditions of Contract shall state the present status of all clearances, including land availability, obtained or awaited, as the case may be, indicating the expected dates of obtaining clearances.

2.4.4 The Contractor shall allow access to and use of the Site and/or the Works for laying/installing telegraph lines, electric lines or for such other public purposes as the Employer may require.

3.0 Contractor & Contractor's obligations

3.1 Contractor and its representatives

3.1.1 A Contractor may be an individual, firm, company, corporation, Joint Venture, or consortium whether incorporated or not, who enters into the Contract with the Employer, and shall include his heirs, his executors, administrators, successors, legal representatives, as the case may be.

3.1.2 Contractor's representative shall mean a person in supervisory capacity who shall be so declared by the Contractor and who shall be authorized under a duly executed power of attorney to comply with the instructions and to receive materials issued by the Engineer-in Charge to the Contractor for Works. He shall be capable of taking responsibility for proper execution of Contract.

3.2 Subcontracting

3.2.1 A minimum of following activities shall be performed by the Contractor and shall not be sub contracted:

- (i) Project Management
- (ii) Planning, Scheduling, Monitoring
- (iii) Quality Assurance

3.2.2 Prior approval of Employer shall be required before subcontracting any portion of Contract. The approval shall be based on competency of subcontractor to do similar kind of activity which is to be subcontracted.

3.2.3 Where the Contractor fails to comply with instructions under sub-clauses 3.2.1, the Engineer-in-Charge shall have the power to adopt the course specified in clause 11.1 and in the event of such course being adopted, the consequences specified in the said clause 11.1 shall ensue.

3.2.4 The Contractor shall, at all times, be responsible and liable for all its obligations under this Contract notwithstanding anything contained in the agreements with its Sub-contractors or any other agreement that may be entered into by the Contractor, and no default under any such agreement shall excuse the Contractor from its obligations or liability hereunder.

3.3 Removal of worker or subcontractor by Employer

The appointment of key personnel and subcontractor for the Contract shall be authenticated by the Employer.

The Engineer-in-Charge may require the Contractor to dismiss or remove from the Site any person or persons or sub-contractor who is found to be incompetent or indulging in misconduct and the Contractor shall forthwith comply with such requirements within 21 days of such notice from the Engineer-in-Charge. Such person(s) shall not be employed again at Site without the written permission of the Engineer-in-Charge and the person(s) so removed shall be replaced as soon as possible by competent substitutes. The decision of Engineer-in- Charge shall be final and binding.

3.4 Contractor to keep Site clean

During the progress of Works, the Contractor shall keep the Site reasonably free from obstructions and shall store neatly any construction equipment and surplus materials and clear away and remove from Site any rubbish or temporary work no longer required. On completion of the Works, the Contractor shall clear away and remove from Site all construction equipment, surplus material and temporary work. He should leave the whole of the Site and Works in a clean and tidy condition to the satisfaction of the Engineer-in- Charge.

Provided that where the Contractor fails to comply with the requirements of this clause, the Engineer-in-Charge shall have the right to get this Works done at the cost of the Contractor either departmentally or through any other agency. Before taking such action, the Engineer- in-Charge shall give ten days notice in writing to the Contractor.

It shall be the sole responsibility of Contractor to follow the provisions of Environment (Protection) Act, 1986 during the execution of Works and existence of this Contract.

3.5 Unauthorized occupancy at the construction site

It shall be the responsibility of the Contractor to see that the Site is not occupied by any unauthorized person during construction, and that Site is handed over to the Engineer-in- Charge with vacant possession of complete building or site, as applicable and free from all encumbrances. Provided that where such construction site is occupied illegally, and notwithstanding that the Works on the Site is executed by the Contractor, the Engineer-in- Charge shall have the option to refuse to accept the said site in that condition. Any delay in acceptance on this account will be treated as per provisions of clause 10.3, and the Contractor shall be liable to pay compensation for delays. Provided further that for such delay a levy up to maximum of 5% of Contract Price may be imposed by the Engineer-in- Charge whose decision shall be final both with regard to the justification and quantum of levy and shall be binding on the Contractor.

Provided further that the Engineer-in-Charge may require through a written notice removal of any illegal occupation of Site that comes into his/her knowledge at any time during the execution of the Contract.

3.6 Changes in firms constitution to be intimated

Where the Contractor is a partnership firm, the previous approval in writing of the Engineer- in-Charge shall be obtained before any change is made in the constitution of the firm. Where the Contractor is an individual or a Hindu Undivided Family business concern such approval shall likewise be obtained before the Contractor enters into any partnership agreement where under the partnership firm would have the right to carry out the Works hereby undertaken by the Contractor. If the said previous approval is not obtained, the Contract shall be deemed to have been assigned in contravention of clause 3.2 hereof and hence shall be liable for cancellation in which case the Employer shall have the authority to forfeit the Performance Guarantee submitted for the Contract.

3.7 Indemnity by Contractor

3.7.1 Indemnity against All Actions of Contractor

The Contractor shall hold and save harmless and indemnify the Employer, from and against all actions, suits, proceedings, loss, costs, damages, charges, claims and demands of every nature and description brought or recovered against the Employer, by reason of any act or omissions of the Contractor, his representative or his employees, in the execution of the Works or in the guarding of the same. All sums payable by way of compensation under any of these conditions, shall be considered as reasonable compensation payable to the Employer by Contractor, without reference to the actual loss or damage sustained, and whether or not any damage shall have been sustained.

3.7.2 Indemnity against All Claims of Patent Rights and Royalties

The Contractor shall hold and save harmless and indemnify the Employer, its agents and employees from and against all claims and proceedings, for or on account of infringement by the Contractor of copyright, any patent rights, design trademark or name, secret process, patented or unpatented invention, articles or appliances manufactured or used for or in connection with the Works and from and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto. Except where otherwise stated, the Contractor shall pay all royalties, rent and other payments or compensation, if any, for getting stone, sand, gravel, clay or other materials required for the Works.

3.8 Employment of technical staff and employees

The Contractor shall employ a qualified engineer(s) for supervision of the Works as under:-
For Works costing above Rs.50 lakhs - qualified graduate engineer(s) for the required domain
For Works upto 50 lakhs - A recognized diploma holder engineer(s) for the required domain
Where the Contractor fails to employ the qualified engineer as aforesaid he shall be liable to pay a sum of Rs.20,000/- (Rupees twenty thousand only) per week of default in the case of graduate engineer's and Rs.10,000/- (Rupees ten thousand only) per week of default in the case of diploma holder. The technical staff of the contractor should be available at Site on full time basis, to take instructions.

The Contractor shall provide all necessary superintendence during execution of the Works and for as long thereafter as may be necessary for proper fulfilling of the obligations under the Contract. The Contractor shall immediately after receiving Letter of Acceptance of the tender and before commencement of the work, intimate in writing to the Engineer-in-Charge the name, qualifications, experience, age, address and other particulars along with certificates, of the principal technical representative to be in charge of the work. Such qualifications and experience shall not be lower than specified in Special Conditions of Contract. The Engineer-in-Charge shall within 15 days of receipt of such communication intimate in writing his approval or otherwise of such a representative to the Contractor. Any such approval may at any time be withdrawn and in case of such withdrawal the Contractor shall appoint another such representative according to the provisions of this clause. Decision of the Employer shall be final and binding on the Contractor in this respect. Such a principal technical representative shall be appointed by the Contractor soon after receipt of the approval from Engineer-in-Charge and shall be available at Site within fifteen days of start of work.

Where the Contractor (or any partner in case of firm/company) himself has such qualifications, it will not be necessary for the said Contractor to appoint such a principal technical representative but the Contractor shall designate and appoint a responsible agent to represent him and to be present at the Works whenever the Contractor is not in a position to be so present. All the provisions applicable to the principal technical representative under the clause will also be applicable in such a case to Contractor or his responsible agent. The principal technical representative and/or the Contractor shall on receiving reasonable notice from the Engineer-in-Charge or his designated representative(s) in charge of the Works in writing or in person or otherwise, present himself to the Engineer-in-Charge and/or at the Site, as required, to take instructions. Instructions given to the principal technical representative or the responsible agent shall be deemed to have the same force as if these have been given to the Contractor. The principal technical representative and/or the Contractor or his responsible authorized agent shall be available at Site at least two working days every week. These days shall be determined in consultation with the Engineer-in-Charge.

The principal technical representative and/or the Contractor or his responsible authorized agent shall be present daily during important stages of execution of work, during recording of measurement of work and whenever so required by the Engineer-in-Charge by a notice as aforesaid and shall also note down instructions conveyed by the Engineer-in-Charge or his designated representative in the site order book and shall affix his signature in token of noting down the instructions and in token of acceptance of measurements.

There shall be no objection if the representative/agent looks after more than one Works and not more than three works provided these details are disclosed to the Engineer-in-

Charge and he shall be satisfied that the provisions and the purpose of this clause are fulfilled satisfactorily. Where the Engineer-in-Charge, whose decision in this respect is final and binding on the Contractor, is convinced that no such technical representative or agent is effectively appointed or is effectively attending or fulfilling the provision of this clause, a recovery shall be effected from the Contractor as specified in Special Conditions of Contract and the decision of the Engineer-in-Charge as recorded in the site order book and measurement recorded in measurement books shall be final and binding on the Contractor. Provided that if the Contractor fails to appoint a suitable technical representative or responsible agent and if such appointed persons are not effectively present or do not discharge their responsibilities satisfactorily, the Engineer-in-Charge shall have full powers to suspend the execution of the Works until such date as a suitable agent is appointed and the Contractor shall be held responsible for the delay so caused to the work. The Contractor shall submit a certificate of employment of the technical representative/responsible agent along with every account bill/fixed bill and shall produce evidence if at any time so required by the Engineer-in-Charge.

The Contractor shall provide and employ on the site only such technical assistants as are skilled and experienced in their respective fields and such foremen and supervisory staff as are competent to give proper supervision to the work.

The Contractor shall provide and employ skilled, semiskilled and unskilled labour as is necessary for proper and timely execution of the work.

3.9 Work Program Schedule

The Contractor shall within 10 days from the date of Work Order submit a detailed program for completion of Works within the stipulated period, in specified format, as categorized below, and covering all major activities.

Bar Chart: for Contract Price Rs. 1,00,00,000 - Rs. 3,00,00,000 (Indian Rupees one crore to three crores only)

Bar Chart and PERT chart: for Contract Price > Rs. 3,00,00,000 (Indian Rupees three crores only)

Non submission of above shall attract liquidated damages as described below:

- For projects with Contract Price $\leq$ Rs.100 Crore: Rs. 1000/- per day
- For projects with Contract Price > Rs.100 Crore: Rs. 5000/- per day

Modifications suggested by the Engineer-in-Charge shall be incorporated in the work program schedule.

It shall be the responsibility of the Contractor to upload the approved work program schedule in the PMS (Project Monitoring System)

The Contractor shall ensure that the time schedule as laid down in the aforesaid work program schedule is adhered to. Provided that on failure to achieve milestone requisite action shall be taken as per the provisions given under clause 10.3.

In the event of any rescheduling of milestone, it shall be responsibility of the Contractor to incorporate the same in work program schedule and resubmit the schedule within 10 days of receipt of such communication from the Engineer-in-Charge, failing which liquidated damages of Rs. 1000/- per day shall be levied on the Contractor.

3.10 Site office

- (i) **For Contract Price above Rs.50Crores:-**Within 42 days of issue of Work Order the Contractor shall provide the site office with air-conditioning and false ceiling of 3nos. of cabins for the Engineer-in-Charge and staff and meeting room (total area approximately 80 sq. m.) with pantry and toilet facilities. Facilities shall include basic furniture, required office equipments i.e. Fax, photocopy, internet/email, computer with colour laser printer, software (MS Projects, MS office, Primavera, AutoCAD), Laptops (1 no.) and orderly staff including one English stenographer. The location and layout of the site office shall be approved by the Engineer-in-Charge before providing the same.
- (ii) **For Contract Price between Rs.3toRs.50Crores:-**Within 42 days of issue of Work Order the Contractor shall provide the site office with air-conditioning and false ceiling of 2nos. of cabins for the Engineer-in-Charge and staff (total area approximately 40 sq. m.) with pantry, toilet facilities and basic furniture. The location and layout of the site office shall be approved by the Engineer-in-Charge before providing the same.
- (iii) **For Contract Price between 1to3Crores:-**Within 30 days of issue of Work Order the Contractor shall provide the site office for the Engineer-in-Charge and staff with total area approximately 30 sq. m. with toilet facilities and furniture.. The location and layout of the site office shall be approved by the Engineer – in- Charge before providing the same.

Two nos. of 4-seater vehicle with driver, maintenance and fuel shall be provided for Contract Price greater than Rs. 75 Crores.

If available, Employer shall provide the Contractor with space for site office at no charges. Otherwise, Contractor shall on his own arrange for space for site office at his cost.

Contractor shall also be responsible to arrange a store for proper storage of material in a weather proof environment as required for a particular kind of material.

Note: In case of supply projects there is no requirement of site office.

3.11 Sign Board/ Caution/ Diversion Board

The Contractor shall provide sign/ caution/ diversion board indicating complete name of work, date of start, date of completion, Contract Price, name of Employer, name of the Executive Engineer with office address and telephone number, name of the executive agency, at his own cost at the Site.

3.12 Benchmark

The Contractor shall establish at his own cost, at suitable points, additional reference points/lines, benchmarks as may be necessary. The Contractor shall remain responsible for the sufficiency and accuracy of all benchmarks and reference lines. The temporary benchmarks shall be connected with permanent standard benchmarks.

3.13 Responsibility of damage to person or property

3.13.1 The Contractor shall be responsible for all risks to the Works and for trespass and shall make good, at his own expense, all loss or damage to the Works themselves or to any other property of the Employer or the lives, persons and property of others from whatsoever cause in connection with Works until they are taken over by the Employer. In the event the Employer is called upon to make good any such costs, loss or damages, or to pay compensation, including that payable under the provisions of Workmen's Compensation Act or any statutory amendments thereof, to any person or persons sustaining damage as aforesaid by reason of any act, omission or negligence on the part of the Contractor the amount of any costs or charges, including costs and charges in connection with legal proceedings, which the Employer may incur in reference thereto, shall be charged to the Contractor. The Employer shall have the authority to pay or to defend or compromise any claim or threatened legal proceeding or in anticipation of legal proceedings being instituted consequent on the action or default of the Contractor, to take such steps as may be considered necessary or desirable to ward off or mitigate the effect of such proceedings, as aforesaid. Any sum or sums of money which may be paid and any expenses whether for reinstatement or otherwise which may be incurred and the propriety of any such payment, defence or compromise, and the incurring of any such expenses shall not be called in question by the Contractor.

3.13.2 The Contractor shall not disturb, damage or pull down any hedge, tree, building etc within the Site without the written permission of the Engineer-in-Charge.

3.13.3 In the event of any damage occurring to any work, life and property during the execution of Works included in the Contract clause due to settlement of ground slips, flooding from any sources breakage of water main/ sewer line or any other cause, the Contractor shall be solely responsible and must reconstruct, repair and make good all such at his own cost.

3.13.4 When the work is done near a place where there is risk of danger or accident, all necessary equipments shall be provided and kept ready for use, all necessary steps shall be taken for prompt rescue of any person in danger and adequate provision shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

3.13.5 If any accident occurs, the Contractor shall report to the Employer and Labor Commissioner under Workman's Compensation Act, within 24 hours of its occurrence.

3.13.6 Any compensation decided by the Labor Commissioner shall be borne by the Contractor.

3.14 Inconvenience caused to public

The Contractor shall not dump/deposit materials on Site which will seriously cause inconvenience to the public. The Engineer-in-Charge may require the Contractor to remove any materials which are considered by him to be of danger or inconvenience to public or cause them to be removed at the Contractor's cost.

3.15 Electricity for construction of Works

3.15.1 The Contractor shall arrange on his own, the electricity/power connection of required capacity for carrying out the Works only till Completion Date. The Employer shall issue the recommendation letter to concerned electrical authorities for getting the electrical power connection. In the event the authorities refuse to provide or sanction electric/ power in favour of Contractor, the connection shall be applied for by the Engineer-in- Charge. All the steps in this regard including the required payments, if any, shall be made by the Contractor. The Contractor shall pay all the charges towards security installation, consumption of electricity/power till Completion Date.

3.15.2 The payment of final bill to the Contractor shall be made by Employer on submission of no dues/clearance certificate from the electric supply authority/the authority in charge of the electric power.

3.15.3 The temporary electric fitting shall be provided and maintained as per the power sanctioning/maintaining authority rules and regulations by the Contractor at his own cost and nothing extra shall be paid by the EMPLOYER.

3.15.4 If for any reason of the feasibility or whatsoever the authorities are not in a position to sanction the electric connection, the Contractor shall make his own arrangements i.e. required numbers of generators etc. to execute the Works or in case the sanction of electric connection is delayed by the authority it shall also be the responsibility of the Contractor to arrange electricity and no claim whatsoever shall be entertained on this account.

3.15.5 The Contractor shall also make necessary arrangements of his own diesel generators for the Works, so that the same can be used by him during failure/non-availability of electricity/power. The quoted rates shall be inclusive of the POL (petroleum, oil and lubricants) cost and other miscellaneous expenditure including labour for running and maintaining, the generator. It shall be the Contractor's responsibility to obtain all approvals, consents and permissions from any of the authority as for example, CPCB/DPCC required for operating the generators in accordance with the statutory rules and regulations of the Government. No additional payment shall be made to the Contractor for the purposes of procuring all the applicable approvals, consents and permissions.

3.16 Supply of water

The Contractor shall make his own arrangements for water required for the Works and nothing extra will be paid for the same. The Contractor shall submit necessary proof such as tanker receipts, amongst others, if the water is arranged by him.

- (i) If Employer water is available, it shall be supplied to contractor for construction and drinking purposes and recovery @ 1% of the gross amount of Contract Price shall be made. The ferrule connection with the Employer's main and the pipe line upto the Site and adequate storage shall be provided by the Contractor at his own cost.

- (ii) In case the Employer is not able to make available Employer water due to non-availability, shortage of water or any other reasons, the Contractor will have to make his own arrangement of water as per standard by sinking tube well etc. for construction and drinking purposes.
- (iii) The water used by Contractor shall be fit for construction purposes and human consumption as per B.I.S standards IS 456-2000 and IS 3025 respectively.
- (iv) The water shall be tested from Employer laboratory before commencement of work and thereafter once in every 3 months till the completion of the work. The cost of testing shall be borne by the Contractor.
- (v) Water required for hydraulic testing shall be arranged by the Contractor and Employer will only facilitate the process of obtaining approvals or permissions as required.
- (vi) In case the Employer's water is not available as well as ground water at the Site is not found fit, the Contractor may arrange the water from other source. The water of the said source shall be tested from the Employer's laboratory at Contractor's own cost and may be allowed to be used only when found suitable for use. Necessary arrangements for carrying the water by tankers and its storage at the Site shall be made by the Contractor at his own cost. Any statutory requirements of registration/permissions for boring/installation of tube-wells either at the Site or elsewhere shall be taken by the Contractor at his own cost and nothing shall be payable.

Water when supplied to the Contractor by the Employer shall subject to the following conditions:

The Employer do not guarantee to maintain uninterrupted, supply of water and it shall be incumbent on the Contractor to make alternative arrangements for water at his/their own cost in the event of any temporary break down in Employer water main so that the progress of his/their Works is not held up for want of water. No claim of damage or refund of water charges will be entertained on account of such break down.

3.17 Clearance of site

The Site shall be cleared off all malba/ debris and other waste materials after completion of Works and shall ensure removal of temporary structure erected for execution of Works including hutments put up by his laborers at site, if any, before handing over the Site to the Employer in workable condition. No final payment for the Works shall be made to the Contractor till full satisfaction of the Engineer-in-Charge.

3.18 Relics and treasures

All gold, silver, coins, oil and other minerals of any description, and all precious stones of all kinds, treasures, antiques, fossils and other similar things, which shall be found in or at site, shall be the property of the Employer, and the Contractor shall duly preserve the same to the satisfaction of the Employer, and shall from time to time deliver the same to such person or persons, as the Employer may appoint to receive the same.

3.19 Excavated materials

The Contractor shall not sell or otherwise dispose off, or remove, except for the purpose of this Contract, sand, stone, clay, ballast, earth, rock or any other substance or materials, which may be obtained from any excavation made for the purpose of the Works, or any building or produce existing at the Site at the time of delivery of possession thereof. All such substances, materials, buildings and produce, shall be the property of the Employer; provided that the Contractor may with the permission of the Engineer-in-Charge use the same for the purpose of Works either free of cost or on payment of cost, as provided for under the Special Conditions of the Contract or in the absence of such conditions, as per mutually accepted terms and conditions.

3.20 Works during night, Sundays & National Holidays

Unless specifically provided in the Special Conditions of Contract, the Contractor shall not carry out any work between sunset and sunrise and/ or holidays without the prior permission of the Engineer-in-Charge. In case of any grave emergency or in order to avoid risk to property and life or to prevent damage to utilities or to restore them, work may be done at night also without the prior permission of the Engineer-in-Charge, but intimation to this effect should be sent to him immediately. No increase in rates or extra payments shall be admissible for night work.

The Contractor shall make adequate lighting and safety arrangements. He shall also be responsible for any claim on account of any injury to or loss of life, of any one, arising out of inadequate lighting and safety arrangements if work is done during night or holidays.

3.21 Care of work

Subject to the insurance obligations of the Parties, the Contractor shall bear full risk in and take full responsibility for the care of the Works and Materials, goods and equipment for incorporation therein from the Commencement Date until the Completion Certificate is issued, except and to the extent that any loss of or damage to the same shall arise out of any default or neglect of the Employer.

3.22 Employment of foreign nationals

The Contractor acknowledges, agrees and undertakes that employment of foreign personnel by the Contractor and/or its Sub-Contractors and their Sub-contractors shall be subject to grant of requisite regulatory permits and approvals including employment/residential visas and work permits, if any required, and the obligation to apply for and obtain the same shall and will always be of the Contractor. Notwithstanding anything to the contrary contained in this Contract, refusal of or inability to obtain any such permits and approvals by the Contractor or any of its Sub-Contractors or their sub-Contractors shall not in any manner excuse the Contractor from the performance and discharge of its obligations and liabilities under this Contract.

3.23 Precautions during execution

- (i) The Contractor shall comply with instructions issued by the Employer in respect of road maintenance and inter utility code of conduct for excavating trenches across and along various roads and other places, in all respects. In case of non-compliance the contractor shall be liable to pay liquidated damages for various lapses as indicated below:
 - a) Non-installation of boards on either ends of trenches: Rs. 500/- per day till implementation

- b) Non shoring of walls of trenches to prevent collapse of the excavated portion (beyond 1.5 m) and where proper stopping not proved: Rs. 1000/- per day till the shoring is fixed.
 - c) Digging of trenches beyond a stretch of 500 meter for Electrical Authority and Employer and otherwise 1000 meter in case of telephone: Rs. 500/- per day till the damage is restored.
 - d) Non barricading of trenches of more than 1.5 meter: Rs. 500/- per day till completed.
 - e) Excavation of trenches across and along roads during day time (at 8 AM to 8PM) without permission: Rs. 500/- per day.
 - f) Non removal of excess earth and other stones etc. which are causing inconvenience to the road users: Rs. 1000/- per day till completed.
 - g) Non consolidation of earth while back filling of trenches to the original level: Rs. 500/- per day till completed.
 - h) Non adherence to prescribed methodology for reinstatement of trenches: Rs. 500/- per day.
 - i) Road cutting without written or oral permission: Rs. 1250/- per day.
 - j) Non stacking of materials pipes etc. in an orderly manner during execution causing inconvenience to the road users: Rs. 1000/- per day.
- (ii) The contractor shall have to provide MS sheet barricading or as provided in BOQ up to a minimum height of 2 metres above ground level all around the Site of excavation and trenches as per direction of Engineer-in-Charge. Such barricading must be provided before taking up the excavation work and must remain in position till complete filling back of excavated trenches and resurfacing work, if any. The sheets must be painted in red & White stripes with fluorescent paint.
- (iii) Proper supporting of all underground services such as water mains, sewers, cables, drains, and water and sewer connections shall be provided by the contractor without any additional cost. If the services/connections are damaged the contractor will be responsible for the restoration of the same to original specifications at his own cost.
- (iv) Imposition of liquidated damages by Employer shall not absolve Contractor from any other civil/ criminal liabilities.
- (v) Contractor should maintain first aid box, electric shock recovery devices, safety equipment such as breathing apparatus, safety personal protective equipment and/ or other safety equipment as per NHRC guidelines and/ or factory act. The Engineer-in-Charge shall decide to impose suitable damages as mentioned under Clause 17.6.

4.0 The Site

4.1 Site description

The Site shall comprise the real estate described in Special Conditions of Contract in respect of which the right of way shall be provided by the Employer to the Contractor. The Employer shall be responsible to the Contractor for:

- (i) Acquiring and providing physical possession of the Site free from all encroachments and encumbrances, and free access thereto for the execution of the Contract; and
- (ii) Prior environment clearance for the Site as per the Environment Impact Assessment Notification 2006 under the Environment (Protection) Act, 1986, wherever applicable Unless specifically mentioned in the Contract, the Contractor shall be responsible to obtain all the necessary permits, permissions and/or approvals from the relevant department/ authority in relation to execution and completion of Works. The Employer shall only facilitate the process and will reimburse the charges paid by the Contractor after due verification.

4.2 Inspection of site

- (i) The Employer shall have made available to the Contractor with the tender documents such data on hydrological and sub-surface conditions as may have been obtained by or on behalf of the Employer from investigations undertaken relevant to the Works and the tender shall be deemed to have been based on such data, but the Contractor shall be responsible for his own interpretation thereof.
- (ii) The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied himself, so far as is practicable, before submitting his tender, as to the form and nature thereof, including the sub-surface conditions, the hydrological and climatic conditions, the extent and nature of work and materials necessary for the completion of the Works, the means of access to the Site and the accommodation he may require and, in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or affect his Tender.

5.0 Specifications & Drawings

5.1 Works To Be Executed In Accordance With Specifications, Drawings, Orders, Etc.

5.1.1 The Contractor shall execute the whole and every part of the Works in the most substantial and workman like manner in every respect and in strict accordance with the specifications. The Contractor shall also conform exactly, fully and faithfully to the design, drawings and instructions of the Engineer-in-Charge in respect of the work. The Contractor shall be furnished free of charge one copy of the Contract documents together with specifications, designs, drawings and instructions as are not included in the standard specifications of Employer specified in Special Conditions of Contract or in any BIS document.

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

necessity for providing these, is specified or is reasonably inferred from the Contract. The Contractor shall take full responsibility for adequacy, suitability and safety of all the Works and methods of construction.

5.2 Action in Case work Not Done as per Specifications

5.2.1 All work under or in course of execution or executed in pursuance of the Contract shall at all times be open and accessible to the inspection and supervision of the Engineer-in-Charge, his representatives and assistants in charge of the Works and all senior officers, officer of the quality control division of the Employer, third party hired by Employer, and of the chief technical examiner's office. The Contractor shall, at all times, during the usual working hours and at all other times at which reasonable notice of the visit of such officers has been given to the Contractor, either himself be present to receive orders and instructions or have his responsible agent, present for that purpose.

5.2.2 In the event it appears to the Engineer-in-Charge or his representative in charge of the Works or any nominated officer (as described above in this clause), that any work has been executed with unsound, imperfect, or unskillful workmanship, or is against Good Engineering Practice or with material or articles of a quality inferior to that contracted or otherwise not in accordance with the Contract, the Contractor shall, on demand in writing which shall be made during construction and upto six months after completion of the Works by the Engineer-in-Charge specifying the work, materials or articles complained (notwithstanding that the same may have been passed, certified and paid for forthwith) rectify, or remove and reconstruct the Works so specified in whole or in part, as the case may require, remove the materials or articles so specified and provide other proper and suitable materials or articles at his own charge and cost. In the event of failing to do so within a period specified by the Engineer-in-Charge in his demand aforesaid, the Contractor shall be liable to pay compensation at the same rate as under clause **10.3** of the Contract (for non-completion of the Works in time) for this default.

5.2.3 *Provided that in such an event* the Engineer-in-Charge may not accept the item of Works at the rates applicable under the Contract but may accept such items at reduced rates as the Employer may consider reasonable during the preparation of on-account bills or final bill if the item is so acceptable without detriment to the safety and utility of the item and the structure or he may reject the Works outright without any payment and/or get it and other connected and incidental items rectified, or removed and re-executed at the risk and cost of the Contractor. Decision of the Engineer-in-Charge to be conveyed in writing in respect of the same shall be final and binding on the Contractor.

5.3 Action where there are no Specifications

In the case of any class of work for which there is no such specifications as referred to in clause 5.2, such work shall be carried out in accordance with the CPWD/ Bureau of Indian Standards Specifications or any other applicable standards specific to the Works.

Provided that where there is no such specification in CPWD/ Bureau of Indian Standards, the Works shall be carried out as per manufacturers' specifications. Provided further that where there are no such specifications as required above, the Works shall be carried out in all respects in accordance with Good Engineering Practice and Site requirements under the instructions and requirements as communicated by the Engineer-in-Charge.

5.4 Estimates

The estimate is based on CPWD's DSR 2021 as applicable to Employer, analyzed rates of Employer and in other cases on market rates. The Works shall be carried out as per CPWD specifications /latest editions of the specifications, with upto date (on the date of issue of NIT) correction slips, for work at Delhi and other specifications laid down by Indian or other standards (CPHEEO, ASTM, WRC, etc.) and best practices being followed by Employer

5.5 Execution of work

5.5.1 The Works is to be carefully executed strictly in accordance with the approved drawing supplied to the Contractor or with such modifications as may be approved by the Engineer- in-Charge from time to time. Any additional amended, revised or detailed drawings that does not have a significant impact on the scope of work, issued by the Engineer-in-Charge or approved in writing by him during the progress of the Works are to be considered to form the part of the Works and as such being included in the Contract. No claim whatsoever shall be considered on this account.

5.5.2 The order of sequence of execution of Works and general condition of the Works shall be subject to the approval and direction of the Engineer-in-Charge. Any such approval or direction by the Engineer-in-Charge shall in no way relieve the Contractor of the responsibility for the proper and satisfactory execution of the Works according to the terms of Contract and within stipulated period. No claim of the Contractor whatsoever shall be considered on this account.

5.5.3 The information given in the drawing including the conditions of ground or the information regarding of the depth of water to be met with means of access, or any other such matter shall not relieve the Contractor from the fulfillment of the Contract.

5.5.4 The Contractor shall be responsible and must check and satisfy himself the accuracy of levels, lines positions, dimensions, sizes etc. of the finished Works in accordance with the Contract.

5.6 Contractor's understanding of documents

(i) The Contractor shall be deemed to have satisfied himself, before tendering, as to the correctness and sufficiency of his tender for the Works and of the rates and prices stated in the priced bill of quantities and the schedule of rates and prices, if any, all of which shall, except insofar as it is otherwise provided in the Contract, cover all his obligations under the Contract and all matters and things necessary for the proper execution and maintenance of the Works. If, however, during the execution of the Works, the Contractor shall encounter physical conditions, other than climatic conditions on the site, or artificial obstructions, which conditions or obstructions could, in his opinion, not have been reasonably foreseen by an experienced Contractor, the Contractor shall forthwith give written notice thereof to the Engineer-in-Charge and if, in the opinion of the Engineer-in-Charge, such conditions or artificial obstructions could not have been reasonably foreseen by an experienced Contractor, then the Engineer-in-Charge shall certify and the Employer shall pay reasonable additional cost to which the Contractor shall have been put by reason of such conditions in the following cases:

- a. for complying with any instruction which the Engineer-in-Charge may issue to the Contractor in connection therewith, and
 - b. For any proper and reasonable measures approved by the Engineer-in-Charge which the Contractor may take in the absence of specific instructions from the Engineer-in-Charge, as a result of such conditions or obstructions being encountered.
- (ii) The decision of the Employer as to the additional cost shall be final and binding.

6.0 Performance Guarantee and Security Deposit.

PERFORMANCE GUARANTEE (DELETED UPTO THE COST OF RS. 10.00 LACS) AS PER ORDER OF DIR.(F&A) DATED 29-04-2008).

6.1 Performance Guarantee

- (i) The Contractor shall submit an irrevocable Performance Guarantee of 5%(five percent) of the amount as specified in Clause 6.1 (iv), (v) and (vi) below, in addition to other deposits mentioned elsewhere in the Contract for his proper performance of the Contract, (not withstanding and / or without prejudice to any other provisions in the Contract) within 15 days of issue of Letter of Acceptance. This period can be further extended by Engineer-in-Charge up to a maximum period of 5 days on written request of the Contractor stating the reason for delays in procuring the Guarantee to the satisfaction of Engineer-in-Charge. This guarantee shall be in the form of Bank Guarantee from a scheduled bank of India as per the format attached with General Conditions of Contract.
- (ii) A Letter of Acceptance shall be issued in the first instance informing the Contractor of the decision of the Employer to accept his tender and the Work Order shall be issued only after the Performance Guarantee in prescribed form is received. In case of failure by the Contractor to furnish Performance Guarantee within the specified period Employer shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the Earnest Money absolutely and debar the Contractor to participate in the Works, if retendered
- (iii) The Performance Guarantee shall be initially valid up to 60 days beyond the Stipulated Date of Completion. In case the time for completion of Works gets enlarged the Contractor shall get the validity of Performance Guarantee extended within 30 days of receiving such notice from Engineer-in-Charge to cover such enlarged time plus 60 days. After recording of the Completion Certificate for the Works by the Employer, the Performance Guarantee shall be returned to the Contractor.
- (iv) For pure construction contracts (EPC, DB, etc.) the Performance Guarantee shall be calculated for capital construction cost only.
- (v) For pure O&M works, the Performance Guarantee shall be calculated for the complete value of O&M works which shall be reduced annually after adjusting the cost of O&M works for previous year. For example, the total Contract Value for a 10 years O&M contract is Rs. 100 Crores i.e. Rs. 10 Crores for each year. Then, the Performance Guarantee for Year 1 shall be 5% of Rs. 100 Crores, for Year 2 shall be 5% of Rs. 90 Crores, for Year 3 shall be 5% of Rs. 80 Crores and so on and so forth.
- (vi) For DBO contracts initially the Performance Guarantee shall be calculated for the capital construction cost. However, 2 months before the construction completion date, the Contractor shall submit another Performance Guarantee calculated for the

total operation cost which shall be reduced annually after deducting the cost of one year of O&M works in the manner as described in Clause 6.1 (v). The cost of complying with the requirements of this clause shall be borne by the Contractor, unless the Contract otherwise provides.

- (vii) The Engineer-in-Charge shall not make a claim under the Performance Guarantee except for amounts to which Employer is entitled under the Contract (notwithstanding and / or without prejudice to any other provisions in the Contract) in the event of:
 - a. Failure by the Contractor to extend the validity of the Performance Guarantee as described herein above within 30 days of receipt of notice from the Engineer-in-Charge, in which event the Engineer-in-Charge may claim the full amount of the Performance Guarantee.
 - b. Failure by the Contractor to pay Employer any amount due either as agreed by the Contractor or determined under any of the clauses / conditions of the Contract, within 30 days of the service of notice to this effect by Engineer-in-Charge.
 - c. In the event of the Contract being determined or rescinded under provision of any of the clause/ condition of the Contract the Performance Guarantee shall stand forfeited in full and shall be absolutely at the disposal of the Employer.

6.2 Security Deposit

- (i) The Contractor shall permit Employer at the time of making any payment to him for Works done under the Contract to deduct a sum at the rate of 10% of the gross amount of each running bill till the sum along with the sum already deposited as earnest money, will amount to 5% of the amount as specified under Clause 6.2 (ii), (iii) and (iv). Such deductions will be made and held by Employer by way of Security Deposit. The security deposit shall be in addition to the performance guarantee amount.
- (ii) For pure construction contracts (EPC, DB, etc.) the Security Deposit shall be calculated for capital construction cost only.
- (iii) For pure O&M works, the Security Deposit shall be calculated for the total value of O&M works. The deduction will be made from each running payment till such amount reaches 5% of the total value of O&M works.
- (iv) For DBO contracts, initially the Security Deposit shall be calculated for the capital construction cost. However, upon completion of capital works, the Security Deposit will be calculated for complete O&M works and deduction shall be made from each running payment till such amount reaches 5% of complete value of O&M works. The Security Deposit collected during the capital construction phase shall be released upon successful completion of DLP and the Security Deposit collected during the O&M phase shall be released 60 days after successful completion of the O&M works.
- (v) The Security Deposit as deducted above can be released against Bank Guarantee issued by a scheduled bank, on its accumulations to a minimum of

Rs. 5 lakhs for Contract Value upto Rs. 3 Crore

Rs. 10 lakhs for Contract Value between Rs. 3 Crore and Rs. 25 Crore

Rs. 25 lakhs for Contract Value greater than Rs. 25 Crore

Subject to the condition that amount of such Bank Guarantee, except last one shall not be less than the stipulated amount.

(For e.g. Suppose for a project the total Security Deposit deduction is Rs. 6 lakhs, to be deducted equally from running payment of 12 months. Hence a net deduction of Rs. 50,000 will be made from each running account bill. Till the 9th running bill a sum of Rs. 4.5 lakhs will be retained for Security Deposit. Then, in the 10th bill when the amount retained reaches Rs. 5 lakhs, the Contractor will submit a bank guarantee of Rs. 5 lakhs and will get the amount released. However, in the 12th bill (final bill) the amount retained will be only Rs. 1 lakh and hence the Contractor will submit a bank guarantee of Rs. 1 lakhs and will get the sum released.)

Provided further that the validity of Bank Guarantee shall be 60 days beyond the completion of Defect Liability Period or Stipulated Completion Date plus 60 days in case of O&M contract. Validity of such bank guarantee shall be extended from time to time depending upon extension of Contract granted under provisions of clause 10.3 and clause 10.4. It shall be responsibility of the Contractor to timely renew the bank guarantee submitted as per provision of clause 6.1 and 6.2 or as required under any other clause of the Contract.

- (vi) All compensations or the other sums of money payable by the Contractor under the terms of this Contract may be deducted from, or paid by the sale of a sufficient part of his Security Deposit or from any sums which may be due to or may become due to the Contractor by Employer on any account whatsoever and in the event of his Security Deposit being reduced by reason of any such deductions or sale as aforesaid, the Contractor shall within 10 days make good in cash the amount deducted from, or raised by sale of his Security Deposit or any part thereof. The Security Deposit shall be collected from the running bills of the Contractor at the rates mentioned above and the earnest money if deposited in cash at the time of tenders will be treated a part of the Security Deposit.

6.3 Refund of Security Deposit

The Security Deposit shall be returned to the Contractor on certification after the Engineer-in-Charge has satisfied himself that all the terms of this Contract have been duly and faithfully carried out by the Contractor or 60 (sixty) days after successful completion of Defect Liability Period as per clause 16.1 and on submission of the following :

- (i) No demand/claim certificate of the Contractor for executed value of the Contract.
- (ii) Material and Payment reconciliation and no recovery certificate of the Engineer-in-Charge.
- (iii) Labour clearance certificate of the Contractor issued by the labour officer as per clause 15.1.2.
- (iv) Statutory requirement compliance certificate of the Engineer-in-Charge.

- (v) Completion Certificate of the Engineer-in-Charge.
- (vi) Insurance Policy release certificate of the Engineer-in-Charge.
- (vii) Updated recording of the PMS reports
- (viii) Submission of all required GIS details, O&M plans, etc.
- (ix) Any other requirement as per Contract.

7.0 Reporting, Inspection & Quality

7.1 Quality Control Systems

7.1.1 The Contractor shall establish a suitable quality control mechanism to ensure compliance with the requirements of the Specifications and Standards in accordance with the provisions of this Contract (the “**Quality Assurance Plan**” or “**QAP**”).

7.1.2 The Contractor shall, within 21 days of the issue of Work Order, submit to the Engineer-in-Charge and upload in the Employer’s PMS (Project Monitoring System) for approval, the proposed Quality Assurance Plan which shall include the following:

- (i) organization, duties and responsibilities, procedures, inspections, documentation;
- (ii) quality control mechanism including sampling and testing of materials, plant, project assets, test frequencies, standards, acceptance criteria, testing facilities, reporting, recording and interpretation of test results, approvals, check list for site activities, proform as for testing and calibration; and
- (iii) Internal quality audit system.

7.1.3 The Contractor shall provide and procure all reasonable assistance, documents, apparatus and instruments, fuel, consumables, water, electricity, labour, Material, samples, and qualified personnel as are necessary for examining and testing the Works and workmanship in accordance with the Quality Assurance Plan.

7.1.4 The cost of supplying samples and testing of Works and workmanship for the tests provided for in the Quality Assurance Plan or in the Contract shall be borne by the Contractor. Provided that the testing charges will be reimbursed to Contractor by Employer at actual on verification of proof submitted.

7.1.5 The Contractor shall on the directions issued by the Engineer-in-Charge carry out such tests including those not provided for in the Contract that are in accordance with the good and sound industry practice to assess the quality of the Works or workmanship. The Contractor shall bear the cost of the tests and samples if the quality of the Works or workmanship is not in compliance with the Specifications and Standards. In any other case, the cost of test shall be a determined by the Engineer-in-Charge and shall be payable by the Employer.

7.1.6 It shall be the responsibility of the Contractor to attend to the defects pointed out/observation made by the senior officers of the Employer during their inspections in

respect of the required quality of material, mandatory test for materials, items of the Works, fittings and on specifications of the work being executed.

7.2 Reporting, inspection and checking of Works

7.2.1 The Contractor shall enter the online progress reports in the format of project management system (for quality monitoring, physical and financial progress monitoring) on 1st and 15th of every month during the Contract. The Contractor shall have to upload DPR/ other report/ Bar or PERT Chart/ site photographs, amongst others, with date of submission by 8th and 23rd of every month. The Engineer-in-Charge shall verify the entries made. No payment shall be released if the progress has not been entered at the prescribed frequency and in the prescribed format. If so required, Contractor (for quality monitoring) may seek help of Engineer-in-Charge for getting 1 (one) person trained for the purpose.

7.2.2 The record of inspections carried out by the Chief Engineer/SE/EE and checking of the Works as per the check features as given in the Contract and a few samples shall be maintained at the Site for taking necessary action by the executing agency.

7.2.3 The stages of inspections for S.E. / C.E. are given as under: -

- (i) up to 3rd running bill
- (ii) 4th to 6th bill
- (iii) 7th to 9th running bill
- (iv) And so on.

The Engineer-in-Charge shall upload in PMS the observations made by the S.E./ C.E. during the inspections made by them.

7.2.4 Sample check features (over and above the check features given in the Contract for reference of inspecting officers and compliance to the observations by the Contractor.

- (i) To check the hindrance at Site and the hindrance register
- (ii) To check the observations and instructions issued by the field staff on the site order book and compliance.
- (iii) To check the adequacy of mandatory test being carried out, maintenance of test records in the proper format.
- (iv) To check whether the samples are being filled by the competent officer, AE/JE and the field test are being carried out at the required frequencies.
- (v) To check whether the water being used is tested and the number of test have been carried quarterly
- (vi) To have a look (if applicable) at the cubes strength, Honey combing, cover to reinforcement, adequacy of Lap length, filling of mortar in brick work, jointing of pipes, water tightness, quality of pipes, gradient, bedding under sewer line, workmanship etc.

7.2.5 For electrical & mechanical supply items, the inspection tests at manufacturers' work will be in accordance with Employer's specifications, BIS specifications and suppliers' norms, as applicable.

7.2.6 The Works valued Rs.500 lakhs and above may be subjected to inspection and checking by Chief Technical Examiner, Government of India (C.T.E.).

7.2.7 The Works is also liable to be inspected and checked by a 3rd party fixed by Employer /vigilance Wing of Employer or by any other statutory body. The Works may be checked by the agencies as mentioned above simultaneously, subsequently, jointly or

independently and the Contractor shall be responsible for removing of all defects/deficiencies pointed out by them at its own cost.

7.2.8 The inspection by one agency/ team shall not absolve the Contractor of his responsibility to the defects pointed out by the other agencies and rectification thereto.

Recoveries, if any, proposed by any of the inspection agency on account of short comings in respect of quality/quantity in the Works shall be recovered from the Contractor's payments or guarantees and deposits available with Employer.

8.0 Insurance

8.1 Insurance of Works

8.1.1 Requirements

Before commencing execution of Works, it shall be obligatory for the Contractor to obtain at his own cost stipulated insurance cover under the following requirements:

- (i) Contractor's All Risk and Third Party Cover.
- (ii) Liability under the Workmen's compensation Act, 1923, and other applicable labour laws.
- (iii) Accidents to staff, Engineer-in-Charge, Supervisors and others who are not governed by Workmen's Compensation) Act.
- (iv) Damage to material, machinery and Works due to fire, and theft.
- (v) Damage to existing assets, in case of a rehabilitation project. Employer shall provide the valuation of existing assets before submission of bids.
- (vi) The Contractor's equipments and other things brought onto the site by the Contractor, for a sum sufficient to provide for their replacement at the Site.
- (vii) Any other risk to be covered by Insurance as may be specified by the Employer in the Special Conditions of Contract.

8.1.2 Policy in joint names of Contractor and Employer

The policy referred to under sub-clause 8.1.1 shall be obtained in the joint names of the Contractor and the Employer and shall inter-alia provide coverage against the following, arising out of or in connection with execution of Works, its maintenance and performance of the Contract.

- (i) Loss of life or injury involving public, employee of the Contractor, or that of Employer and Engineer-in-Charge.
- (ii) Injury, loss or damages to the Works or property belonging to public, Government bodies, local authorities, utility organisations, Contractors, Employer or others.

8.1.3 Currency of Policy

The policies shall remain in force throughout the period of execution of the Works and till the expiry of the Defect Liability Period. The Contractor shall produce to the Engineer-in-Charge

or his representative the various insurance policies obtained by him and also the rates of premium and the premium paid by him to ensure the adequacy of the insurance at all times and ensure that the policies continue to be in force.

8.1.4 Remedy on Contractor's Failure to insure

If the Contractor fails to effect or keep in force or provide adequate cover in the insurance policies mentioned in sub-clause 8.1.1, or any other insurance it might be required to effect under the Contract, then in such cases, the Employer may effect and keep in force any such insurance or further insurance and the cost and expenses incurred by Employer in this regard shall be deductible from payments due to the Contractor or from the Contractor's Performance Security, Security Deposit or any other guarantees available with the Contractor.

9.0 Material & Workmanship

9.1 Materials supplied by Employer

9.1.1 Materials, which, Employer will supply, are provided in Special Conditions of Contract which, also stipulates quantum, place of issue and rate(s) to be charged in respect thereof. The Contractor shall be bound to procure them from the Engineer-in-Charge.

9.1.2 As soon as the Contract is awarded, the Contractor shall finalize the program for the completion of Works of this Contract and shall give his estimates of materials required on the basis of drawings/or Schedule of quantities of the work. The Contractor shall give in writing his requirement to the Engineer-in-Charge which shall be issued to him keeping in view the progress of Works as assessed by the Engineer-in-Charge, in accordance with the agreed phased program of Works indicating monthly requirements of various materials. The Contractor shall place his indent in writing for issue of such materials at least 7 days in advance of his requirement.

9.1.3 The material shall be provided within such timeframe as may enable the Contractor to complete the Works on the agreed Work Program Schedule. If there is any delay on part of the Employer in the supply of material or stores due to a cause not attributable to the Contractor, the Contractor shall be eligible for extension of time as per clause 10.4. If a part of the materials only has been supplied within the period then the Contractor shall be bound to do so much of the work as may be possible with the materials and stores supplied in the aforesaid period. For the completion of the rest of the work, the Contractor shall be entitled to such extension of time as may be determined by the Engineer-in-Charge whose decision in this regard shall be final and binding on the Contractor.

9.1.4 Such materials shall be supplied for the purpose of the Contract only and the value of the materials so supplied at the rates specified in the aforesaid Schedule shall be set off or deducted, as and when materials are consumed in items of work (including normal wastage)

for which payment is being made to the Contractor, from any sum then due or which may therefore become due to the Contractor under the Contract or otherwise or from the security deposit. At the time of submission of bills the Contractor shall certify that balance of materials supplied is available at Site in original good condition.

9.1.5 The Contractor shall bear the cost of getting the material issued, loading, transporting to site, unloading, storing under cover as required, cutting assembling and joining the several parts together as necessary. Notwithstanding anything to the contrary contained in any other clause of the Contract all stores/materials so supplied to the Contractor or procured with the assistance of the Employer shall remain the absolute property of Employer. The Contractor shall be the trustee of the stores/materials, and the said stores/materials shall not be removed/disposed off from the Site on any account and shall

be at all times open to inspection by the Engineer-in- Charge or his authorized agent. Any such stores/materials remaining unused shall be returned to the Engineer-in-Charge in as good a condition in which they were originally supplied at a place directed by him, at a place of issue or any other place specified by him as he shall require, but in case it is decided not to take back the stores/materials the Contractor shall have no claim for compensation on any account of such stores/materials so supplied to' him as aforesaid and not used by him or for any wastage in or damage to in such stores/ materials.

9.1.6 The Contractor shall submit along with every running bill (on account or interim bill) material-wise reconciliation statements supported by complete calculations reconciling total issue, total consumption and certified balance (diameter/section-wise in the case of steel) and resulting variations and reasons therefore. Engineer-in- Charge shall (whose decision shall be final and binding on the Contractor) be within his rights to follow the procedure of recovery in clause 9.6 at any stage of the Works if reconciliation is not found to be satisfactory.

9.1.7 The Contractor shall see that only the required quantities of materials are issued. Any such material remaining unused and in perfectly good/original condition at the time of completion or determination of the Contract shall be returned to the Engineer-in-Charge at the stores from which it was issued or at a place directed by him by a notice in writing. The Contractor shall not be entitled for loading, transporting, unloading and storing of such unused material except for the extra lead, if any involved, beyond the original place of issue. The Contractor shall hand over the stores/ materials at such price as the Engineer-in-Charge shall determine, having due regard to the condition of the stores/materials. The price allowed for credit to the Contractor, however, shall be at the prevailing market rate not exceeding the amount charged to him, excluding the storage charge, if any. The decision of the Engineer-in-Charge shall be final and conclusive. In the event of breach of this clause, the Contractor shall in addition to being in contravention of the terms of the licenses or permit and/or for criminal breach of trust, be liable to Employer for all advantages or profits resulting or which in the usual course would have resulted to him by reason of such breach. Provided that the Contractor shall in no case be entitled to any compensation or damages on account of any delay in supply or non-supply thereof of all or any such materials and stores.

9.2 Materials to be supplied by Contractor

9.2.1 The Contractor shall, at his own expense, provide all materials, required for the Works other than those, which are stipulated, to be supplied by the Employer.

9.2.2 The Contractor shall, at his own expense and without delay; supply to the Engineer-in-Charge samples of materials to be used on the Works and shall get these approved in advance. All such materials to be provided by the Contractor shall be in conformity with the specifications laid down or referred to in the Contract. The Contractor shall, if requested by the Engineer-in-Charge furnish proof, to the satisfaction of the Engineer-in-Charge that the materials so comply. The Engineer-in-Charge shall within 30 (thirty) days of supply of samples, intimate the Contractor in writing whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the Engineer- in-Charge for his approval fresh samples complying with the specifications laid down in the Contract. When materials are required to be tested in accordance with specifications, approval of the Engineer-in-Charge shall be issued after the test results are received.

9.2.3 The Contractor shall at his risk and cost submit the samples of materials to be tested or analyzed and shall not make use of or incorporate in the Works any materials represented by the samples until the required tests or analysis have been made and materials

finally accepted by the Engineer-in-Charge. The Contractor shall not be eligible for any claim or compensation either arising out of any delay in the Works or due to any corrective measures required to be taken on account of and as a result of testing of materials.

9.2.4 The Contractor shall, at his risk and cost, make all arrangements and shall provide all facilities as the Engineer-in-Charge may require for collecting, and preparing the required number of samples for such tests at such time and to such place or places as may be directed by the Engineer-in-Charge and bear all charges and cost of testing unless specifically provided for otherwise elsewhere in the Contract or specifications. The Engineer-in-Charge or his authorized representative shall at all times have access to the works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery are being obtained for the Works and the Contractor shall afford every facility and every assistance in obtaining the right to such access.

9.2.5 The Engineer-in-Charge shall have full powers to require the removal from the premises of all materials which in his opinion are not in accordance with the specifications and in case of default the Engineer-in-Charge shall be at liberty to employ at the expense of the Contractor, other persons to remove the same without being answerable or accountable for any loss or damage that may happen or arise to such materials. The Engineer-in-Charge shall also have full powers to require other proper materials to be substituted thereof and in case of default the Engineer-in-Charge may cause the same to be supplied and all costs which may attend such removal and substitution shall be borne by the Contractor.

9.3 Dismantled Material

The Contractor shall treat all materials (including bricks, scarp, stone soling, trees, etc.) obtained during dismantling of a structure, excavation of the Site, etc. as Employer's property and such materials shall be disposed off to the best advantage of Employer according to the instructions in writing issued by the Engineer-in-Charge.

Further, the following material will be made available to Contractor, at the following specified rates or as circulated from time to time:

- (i) Bricks: Rs 2900/ 1000 bricks**
- (ii) CI/ MS Scrap: Rs 30/ kg**
- (iii) Stone soling: Rs 1050/ m³**
- (iv) Hard rock--- Rs 850/- per cum**
- (v) Soft rock -- Rs 750/- Per cum.**

9.4 Contractor to supply tools & plants etc.

The Contractor shall provide at his own cost all materials (except such special materials If any, as may in accordance with the Contract be supplied from the Employer) stores, plants, tools, appliances, implements, ladders, cordage, tackle, scaffolding and temporary work required for the proper execution of the work, whether original, altered or substituted and whether included in the specification or other documents forming part of the Contract or referred to in these conditions or not, or which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer-in-Charge. The Contractor shall also supply without charge the requisite number of persons with the means and

materials, necessary for the purpose of setting out Works, and counting, weighing and assisting the measurement for examination at any time of the Works or materials. In the event the Contractor fails to supply such requisite number of persons with the means and materials the same may be provided by the Engineer-in-Charge at the expense of the Contractor and the expenses may be deducted, from any money due to the Contractor, under this Contract or otherwise and/or from his security deposit or the proceeds of sale thereof, or of a sufficient portions thereof.

9.5 Hire of plant and machinery

- (i) The Contractor shall arrange at his own expense all tools, plant, machinery or equipment (hereinafter referred to as T&P) required for execution of the Works except for the Plant & Machinery listed in Special Conditions of Contract and stipulated for issue to the Contractor. If the Contractor requires any item of T&P on hire from the T&P available with the Employer over and above the T&P stipulated for issue, the Employer will, if such item is available, hire it to the Contractor at rates to be agreed upon between him and the Engineer-in-Charge. In such a case all the conditions hereunder for issue of T&P shall also be applicable to such T&P as is agreed to be issued.
- (ii) Plant and Machinery when supplied on hire charges as shown in Special Conditions of Contract shall be taken from the departmental equipment yard/shed and the Contractor shall bear the cost of carriage from the place of issue to the Site and back. The Contractor shall be responsible to return the plant and machinery in the condition in which it was handed over to him, and shall be responsible for all damage caused to the said plant and machinery at the Site or elsewhere during operation and otherwise during transit including damage to or loss of plant and for all losses due to his failure to return the same, soon after the completion of the Works for which it was issued. The Engineer-in-Charge shall be the sole judge to determine the liability of the Contractor and its extent in this regard and his decision shall be final and binding on the Contractor
- (iii) The plant and machinery as stipulated above shall be issued as and when available and if required by the Contractor. The Contractor shall arrange his work program schedule according to the availability of the plant and machinery and no claim whatsoever will be entertained from him for any delay in supply by the Employer. If such re-arrangement results in delay in completion of work, and such delay, in the opinion of Engineer-in-Charge are unavoidable, the contractor shall be entitled to shall be eligible for extension of time as per clause 10.4.
- (iv) The hire charges shall be recovered at the prescribed rates from and inclusive of the date the plant and machinery made over up to and inclusive of the date of the return in good order even though the same may not have been working for any cause except major breakdown due to no fault of the Contractor or faulty use requiring more than three working days continuously (excluding intervening, holidays and Sundays) for bringing the plant in order. The Contractor shall immediately intimate in writing to the Engineer-in-Charge when any plant or machinery gets out of order requiring major repairs as aforesaid. The Engineer-in-Charge shall record the date and time of receipt of such intimation in the log sheet of the plant or machinery. Based on this if the breakdown occurs before lunch period or major

breakdown will be computed considering half a day's breakdown on the day of complaint. If the breakdown occurs in the post lunch period of major breakdown will be computed starting from the next working day. In case of any dispute under this clause the decision of the Engineer-in-Charge shall be final and binding on the Contractor.

- (v) The hire charges shown above are for each day of 8 hours (inclusive of the one hour lunch break) or part thereof.
- (vi) Hire charges shall include service of operating staff as required and also supply of lubricating oil and stores for cleaning purposes. Power fuel of approved type, firewood, kerosene oil etc. for running the plant and machinery' and also the full time chowkidar for guarding the plant and machinery against any loss or damage shall be arranged by the Contractor who shall be fully responsible for the safeguard and security of plant and machinery. The Contractor shall on or before the supply of plant and machinery sign an agreement indemnifying the Employer against any loss or damage caused to the plant and machinery either during transit or at Site.
- (vii) Ordinarily, no plant and machinery shall work for more than 8 hours a day inclusive of one hour lunch break. In case of an urgent work however, the Engineer-in-Charge may, at his discretion, allow the plant and machinery to be worked for more than normal period of 8 hours a day. In that case the hourly hire charges for overtime to be borne by the Contractor shall be 50% more than the normal proportionate hourly charges (1/8th of the daily charges) subject to a minimum of half day's normal charges on any particular day. For working out hire charges for overtime a period of half an hour and above will be charged as one hour and a period of less than half an hour will be ignored.
- (viii) The Contractor shall release the plant and machinery every 7 (seventh) day for periodical servicing and/or wash out which may take about three to four hours or more. Hire charges for full day shall be recovered from the Contractor for the day of servicing/ wash out irrespective of the period employed in servicing
- (ix) The plant and machinery once issued to the Contractor shall not be returned by him on account of lack of arrangements of labour and materials, etc. on his part, the same will be returned only when they are required for major repairs or when in the opinion of the Engineer-in- Charge the Works or a portion of Works for which the same was issued is completed.
- (x) Log Book for recording the hours of daily work for each of the plant and machinery supplied to the Contractor shall be maintained by the Employer and shall be countersigned by the Contractor or his responsible agent daily. In case the Contractor contests the correctness of the entries and/or fails to sign the Log Book, the decision of the Engineer-in- Charge shall be final and binding on him. Hire charges shall be calculated according to the entries in the Log Book and will be binding on the Contractor. Recovery on account of hire charges for road rollers shall be made for the minimum number of days worked out on the assumption that a roller can consolidate per day and maximum quantity of materials or area surfacing, the data for which shall be provided by Employer later on request. DJB may use GPS tracking devices for on-line monitoring of movements and recording of log book.

- (xi) In the case of concrete mixers, the Contractors shall arrange to get the hopper cleaned and the drum washed at the close of the work each day or each occasion. In case rollers for consolidation are employed by the Contractor himself, log book for such rollers shall be maintained in the same manner as is done in case of departmental rollers, maximum quantity of any items to be consolidated for each roller-day shall also be same as in data under clause 9.5(x). For less use of rollers recovery for the less roller days shall be made at the stipulated issue rate.
- (xii) The Contractor shall be responsible to return the plant and machinery in the condition in which it was handed over to him and he shall be responsible for all damage caused to the said plant and machinery at the Site or elsewhere in operation or otherwise or during transit including damage to or loss of parts, and for all losses due to his failure to return the same soon after the completion of the Works for which it was issued. The Engineer-in-Charge shall be the sole judge to determine the liability of the Contractor and its extent in this regard and his decision shall be final and binding on the Contractor.
- (xiii) The Contractor shall be exempted from levy of any hire charges for the number of days he is called upon in writing by the Engineer-in-Charge to suspend execution of the work, provided Employer plant and machinery in question have, in fact, remained idle with the Contractor because of the suspension.
- (xiv) In the event of the Contractor not requiring any item of plant and machinery issued by Employer though not stipulated for issue in Contract any time after taking delivery at the place of issue, he may return it after 2 (two) days written notice or at any time without notice if he agrees to pay hire charges for 2 (two) additional days without, in any way, affecting the right of the Engineer-in-Charge to use the said plant and machinery during the said period of 2 (two) days as he likes including hiring out to a third party.

9.6 Return of material and recovery for excess material issued

- (i) After completion of the Works and also at any intermediate stage in the event of non-reconciliation of materials issued, consumed and in balance (see clause 9.1), theoretical quantity materials issued by the Employer for use in the Works shall be calculated on the basis and method given hereunder:
 - a) Quantity of cement & bitumen shall be calculated on the basis of quantity of cement & bitumen required for different items of Works as shown in the schedule of rates mentioned in Special Conditions of Contract. In case any item is executed for which standard constants for the consumption of cement or bitumen are not available in the above mentioned schedule or cannot be derived from the same shall be calculated on the basis of standard formula to be laid down by the Engineer-in-Charge.
 - b) Theoretical quantity of steel reinforcement or structural steel sections shall be taken as the quantity required as per design or as authorized by Engineer-in-Charge, including authorized lap, chairs etc. plus 3% wastage due to cutting into pieces, such theoretical quantity being determined and compared with the actual issues each diameter wise, section wise and category wise separately.
 - c) Theoretical quantity of G.I. & C.I. or other pipes, conduits, wires and cables, pig lead and G.I./M.S. sheets shall be taken as quantity actually required and measured plus 2% for wastage due to cutting into pieces (except in the case of G.I./M.S. sheets it shall be 1.5%), such determination & comparison being made diameter wise & category wise.
 - d) For any other material as per actual requirements.

- (ii) Over the theoretical quantities of materials so computed a variation shall be allowed as specified in Special Conditions of Contract. The difference in the net quantities of material actually issued to the Contractor and the theoretical quantities including such authorized variation, if not returned by the Contractor or if not fully reconciled to the satisfaction of the Engineer-in-Charge within 15 (fifteen) days of the issue of written notice by the Engineer-in-Charge to this effect shall be recovered at the rates specified in Special Conditions of Contract, without prejudice to the provision of the relevant conditions regarding return of materials governing the Contract. The decision of Engineer-in-Charge in regard to theoretical quantities of materials, which should have been actually used as per the standard schedule of rates and recovery at rates specified in Special Conditions of Contract, shall be final & binding on the Contractor. For non-scheduled items, the decision of the Engineer-in-Charge regarding theoretical quantities of materials, which should have been actually used, shall be final and binding on the Contractor.
- (iii) Any action under this clause shall be without prejudice to the right of Employer to take action against the Contractor under any other conditions of Contract for not doing the Works according to the prescribed specifications.

9.7 Leveling instrument/ survey equipment.

The Contractor shall always make available and accurate leveling instrument at the Site. Necessary levels shall be given by the Contractor or his authorized site engineer and the same will be checked by the site staff of the Employer.

9.8 Material brought at site

Materials brought at Site consisting of plant, machinery, tools, tackles, raw material etc. required for execution of Works shall not be removed except for use in the Works unless permission in writing is given by the Engineer-in-Charge. The Contractor shall be responsible for loss or damage such materials and goods.

10.0 Suspension & Delays

10.1 Suspension of Work

10.1.1(i) The Contractor shall within 3 days of receipt of the order in writing of the Engineer-in-Charge, (whose decision shall be final and binding on the Contractor) suspend the progress of the work or any part thereof for such time and in such manner as the Engineer-in-Charge may consider necessary so as not to cause any damage the work already done or endanger the safety in general thereof for any of the following reasons:

- a. on account of any default on the part of the Contractor or;
- b. for proper execution of the Works or part thereof for reasons other than the default of the Contractor;
- c. for safety of the Works, public and or public property; or d. to avoid hindrance to other works; or
- e. as communicated by Engineer-in-Charge for any other reason.

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

(ii) If the suspension is ordered for reasons (b), (c), (d) or (e) in sub- Para (i) above:

a. The Contractor may be granted on merits an extension of time equal to the period of every such suspension plus 25% or 1 month, whichever is less, of period for mobilization and demobilization,

b. Further, the Contractor shall be compensated for any variation in price of material, labour, etc. as per provisions of clause 14.1 & 14.2.

(iii) If the Engineer-in-Charge orders for suspension of the Works or part of the Works for more than three months, when the suspension of the Works is ordered for reason as mentioned in sub-para (i) (b), (c), (d) or (e) hereinabove, the Contractor may serve a written notice on Engineer-in-Charge. The said notice issued by the Contractor shall be for requiring permission to proceed with the Works or part thereof in regard to which progress has been suspended. Within 15 [fifteen] days of receipt of such notification from Contractor the Engineer-in-Charge shall either grant the said permission OR shall explain in detail the reasons because of which work cannot be resumed for such suspended portions.

(iv) If the Engineer-in-Charge does not respond within the said time of 15 [fifteen] days, the Contractor, if he intends to treat the suspension:

(a) where it affects only a part of the Works as an omission of such part by Employer;
or

(b) where it affects whole of the Works, as an abandonment of the Works by Employer shall within 10 days of expiry of said period of 15 days give notice in writing of his intention to the Engineer-in-Charge.

10.1.2 In the event of the Contractor treating the suspension as an abandonment of the Contract by Employer, the Contractor shall have no claim to payment of any compensation on account of any profit or advantage which he might have derived from the execution of the Works in full but which he could not derive in consequence of the abandonment. The Contractor shall, however, be entitled to such compensation, as the Engineer-in-Charge may consider reasonable, in respect of salaries and/or wages paid by him to his employees and labour at site, remaining idle in consequence adding to the total thereof 2% to cover indirect expenses of the Contractor provided the Contractor submits his claim supported by details to the Engineer-in- Charge within 30 days of the expiry of the period of 3 months.

Provided, further, that the Contractor shall not be entitled to claim any compensation from Employer for the loss suffered by him on account of delay by Employer in the supply of materials as per the provisions of clause 9.1, where such delay is covered by difficulties relating to the supply of wagons, force majeure including non-allotment of such materials by controlling authorities, acts of enemies of the state/country or any reasonable cause beyond the control of the Employer.

10.2 Incentive for early completion

(for Contract Price more than Rs. 3 Crore only)

In case, the Contractor completes the Works ahead of Stipulated Date of Completion, a bonus @ 1% (one per cent) of the Contract Price per month computed on per day basis, shall be payable to the Contractor, subject to a maximum limit of 5% (five per cent) of the Contract Price. The amount of bonus, if payable, shall be paid along with final bill after completion of work.

Provided further that the provision for bonus shall not be applicable if there has been any modification or rescheduling of the Stipulated Date of Completion of the Contract, on any grounds.

10.3 Compensation for delays

10.3.1 In the event the Contractor fails to maintain the required progress in terms of clause 10.4 or to complete the Works and clear the Site on or before the Stipulated Date of Completion, he shall, without prejudice, to any other right or remedy available under the law to the Employer, on account of such breach, pay as agreed compensation the amount calculated at the rates stipulated below or as the Engineer-in-Charge (whose communication in writing shall be final and binding) may communicate on the Contract Price for every completed day/month (as applicable) that the progress remains below that specified in clause 10.4 or that the Works remains incomplete.

Provided that the same provision shall also apply to items or group of items for which a separate period of completion from that provided under clause 10.4 has been specified.

Compensation for delay of Works shall be @ 1.5% of Contract Price, for each month of delay to be computed on per day basis.

Provided always that the total amount of compensation for delay to be paid under this condition shall not exceed 10% of the Contract Price or the Contract Price of the item or group of items of Works for which a separate period of completion is given.

10.3.2 The amount of compensation may be adjusted or set-off against any sum payable to the Contractor under this or any other Contract with the Employer. In case, the Contractor fails to achieve a particular milestone mentioned in Special Conditions of Contract, or the rescheduled milestone(s) in terms of clause 10.4, the amount shown against that milestone shall be withheld, to be adjusted against the compensation to be levied for the final grant of extension of time. Withholding of this amount on failure to achieve milestones shall be automatic and without any notice to the Contractor.

Provided that if the Contractor catches up with the progress of Works on the subsequent milestone(s), the withheld amount shall be released.

Provided further that where the Contractor fails to make up for the delay in subsequent milestone(s), amount mentioned against each milestone missed subsequently also shall be withheld. No interest, whatsoever, shall be payable on such withheld amount.

10.4 Time extensions for delay

10.4.1 The time allowed for execution of the Works as specified in the Special Conditions of Contract or the extended time in accordance with these conditions shall be the essence of the Contract. The execution of the Works shall commence from the 10th calendar day or such time period as mentioned in Work Order. Where the Contractor commits default in commencing the execution of the Works, the Employer shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the earnest money & performance guarantee absolutely.

Within 10 days of date of award of work, the Contractor shall submit a work program schedule as required under clause 3.9 for each milestone and get it approved by the Engineer-in-Charge. The Schedule shall be prepared in direct relation to the time stated in the Contract for completion of items of the Works. It shall indicate the forecast of the dates of commencement and completion of various sections of the Works and may be amended as necessary by Contract between the Engineer-in-Charge and the Contractor within the time prescribed in the Contract. To ensure good progress during the execution of the Works, the Contractor shall in all cases in which the time allowed for any Works, exceeds one month, except for special jobs for any work where a separate program has been agreed upon, complete the Works as per milestone given below:

1/8th Works in 1/4th time

3/8th Works in 1/2th time

3/4th Works in 3/4th time full Works in full time

10.4.2 If the Works be delayed by:

- (i) Force majeure as defined under clause 10.5, or
- (ii) Delay on the part of other contractors or suppliers engaged by Engineer-in-Charge executing some other work not forming part of the Contract, or
- (iii) Non-availability of stores, if provided by Employer or
- (iv) Non-availability or break down of tools and plants, if being supplied or supplied by the Employer, or
- (v) Non-availability of Site as per clause 2.4
- (vi) Any other cause, but not including predictable events such as rainy season, clearance of site, etc. which in the opinion of the Engineer-in-Charge is beyond the Contractors control.

Then upon the happening of any such event causing delay, the Contractor shall within 7 (seven) days give notice thereof in writing to the Engineer-in-Charge but shall nevertheless use his best endeavours to prevent or make good the delay and shall undertake all delay mitigation measures to the satisfaction of the Engineer-in-Charge before proceeding with the Works. If neither Parties issues notice regarding the event within 7 (seven) days of occurrence of such event, the said event shall be deemed not to have occurred and the Contract will continue to have effect as such.

It shall be the responsibility of the Contractor to record any hindrance and reasons thereof in the PMS within 7 (seven) days of occurrence of such event.

Neither Parties shall by reason of such event be entitled to terminate the Contract or have claim for damages against the other in respect of such non-performance or delay in performance except as may be provided under provisions of clause 11.1.

10.4.3 Request for rescheduling of Milestones as specified in Special Conditions of Contract and extension of time, to be eligible for consideration, shall be made by the Contractor in writing within fourteen days of the happening of the event causing delay. The Contractor may also, wherever feasible, indicate in such a request the period for which extension is desired.

In any such case the Engineer-in-Charge may give a fair and reasonable extension of time and reschedule the milestones for completion of work. However, while according any such extension, the Contractor shall have to prove that the activity is lying on the critical path of the work program schedule as submitted under clause 3.9. Such extension shall be communicated to the Contractor by the Engineer-in-Charge in writing, within 3 months of the date of receipt of such request. The failure of the Contractor to apply in writing for the extension of time shall not be a bar for giving a fair and reasonable extension by the Engineer-in-Charge and such extension of time shall be binding on the Contractor.

10.5 Force Majeure

As used in this Contract, the expression "Force Majeure" or "Force Majeure Event" shall mean occurrence in India of any or all of Non-Political Event, Indirect Political Event and Political Event, as defined in clauses 10.5.1, 10.5.2, and 10.5.3 respectively, if it affects the performance by the Parties claiming the benefit of Force Majeure (the "Affected Party") of its obligations under this Contract and which act or event (i) is beyond the reasonable control of the Affected Party, and (ii) the Affected Party could not have prevented or overcome by exercise of due diligence and following Good Industry Practice, and (iii) has material adverse effect on the Affected Party.

10.5.1. Non-Political Event

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

- (i) act of God, epidemic, extremely adverse weather conditions, lightning, earthquake, landslide, cyclone, flood, volcanic eruption, chemical or radioactive contamination or ionising radiation, fire or explosion (to the extent of contamination or radiation or fire or explosion originating from a source external to the Site);
- (ii) strikes or boycotts (other than those involving the, Contractor, Subcontractors or their respective employees/representatives, or attributable to any act or omission of any of them) interrupting supplies and services to the Site for a continuous period of 24 (twenty four) hours and an aggregate period exceeding 7 (seven) days in an Accounting Year, and not being an Indirect Political Event set forth in clause 10.5.2;
- (iii) any failure or delay of a Sub-contractor/Contractor but only to the extent caused by another Non-Political Event and which does not result in any offsetting compensation being payable to the Employer by or on behalf of such Contractor;
- (iv) any judgement or order of any court of competent jurisdiction or statutory authority made against the Contractor in any proceedings for reasons other than

- (i) failure of the Contractor to comply with any Applicable Law or Applicable Permit, or (ii) on account of breach of any Applicable Law or Applicable Permit or of any contract, or (iii) enforcement of this Contract, or (iv) exercise of any of its rights under this Contract by the Employer;
- (v) the discovery of geological conditions, toxic contamination or archaeological remains on the Site that could not reasonably have been expected to be discovered through a site inspection; or
- (vi) any event or circumstances of a nature analogous to any of the foregoing.

10.5.2. Indirect Political Event

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

- (i) an act of war (whether declared or undeclared), invasion, armed conflict or act of foreign enemy, blockade, embargo, riot, insurrection, terrorist or military action, civil commotion or politically motivated sabotage;
- (ii) industry-wide or State-wide strikes or industrial action for a continuous period of 24(twenty four) hours and exceeding an aggregate period of 7 (seven) days in an Accounting Year;
- (iii) any civil commotion, boycott or political agitation which prevents construction of the Works by the Contractor for an aggregate period exceeding 7 (seven) days in an Accounting Year;
- (iv) any failure or delay of a Contractor to the extent caused by any Indirect Political Event and which does not result in any offsetting compensation being payable to the Employer by or on behalf of such Contractor;
- (v) any Indirect Political Event that causes a Non-Political Event; or
- (vi) any event or circumstances of a nature analogous to any of the foregoing.

10.5.3. Political Event

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

- (i) Change in Law, only if consequences thereof cannot be dealt with under and in accordance with the provisions of clause 14.3;
- (ii) compulsory acquisition in national interest or expropriation of any project assets or rights of the Contractor or of the Sub-Contractors;
- (iii) unlawful or unauthorised or without jurisdiction revocation of, or refusal to renew or grant without valid cause, any clearance, licence, permit, authorisation, no objection certificate, consent, approval or exemption required by the Contractor or any of the Sub-contractors to perform their respective obligations under this Contract; provided that such delay, modification, denial, refusal or revocation did not result from the Contractor's or any Sub-contractor's inability or failure to comply with any condition relating to grant, maintenance
- (iv) or renewal of such clearance, licence, authorisation, no objection certificate, exemption, consent, approval or permit;

(v) any failure or delay of a Contractor but only to the extent caused by another Political Event and which does not result in any offsetting compensation being payable to the Employer by or on behalf of such Contractor; or

(vi) any event or circumstance of a nature analogous to any of the foregoing.

10.5.4 Effect of Force Majeure

Neither Parties shall be considered to be in default or in breach of his obligations under the Contract to the extent that performance of such obligations is prevented by any circumstances of Force Majeure which arises after the date of the letter of Acceptance or the date when the Contract becomes effective, whichever is the earlier.

10.5.5 Notice of Occurrence

If either Parties considers that any circumstances of Force Majeure have occurred which may affect performance of his obligations he shall promptly notify the other Parties and the Engineer-in -Charge.

10.5.6 Performance to Continue

Upon the occurrence of any circumstance of Force Majeure the Contractor shall endeavour to continue to perform his obligations under the Contract so far as reasonable practicable. The Contractor shall notify the Engineer-in-Charge of the steps he proposes to take including any reasonable alternative means for performance which is not prevented by Force Majeure. The Contractor shall not take any such steps unless directed so to do by the Engineer-in- charge. Provided that if the Contractor incurs additional costs in complying with the Engineer-in-Charge's directions under this clause, the amount thereof shall be certified by the Engineer- in charge and added to the Contract Price.

11.0 Termination of Contract

11.1 When can Contract be terminated

11.1.1 Subject to other provisions contained in this clause the Engineer-in-Charge may, without prejudice to his any other rights or remedy against the Contractor in respect of any delay, inferior workmanship, any claims for damages and/or any other provisions of this Contract or otherwise, and whether the Completion Date has or has not elapsed, by notice in writing absolutely determine the Contract in any of the following cases, if the Contractor:

- (i) persistently neglects to carry out his obligations under the Contract and/or commits default in complying with any of the terms and conditions of the Contract and does not remedy it or take effective steps to remedy it within 7 days after a notice in writing is given to him in that behalf by the Engineer-in-Charge; or
- (ii) having been given by the Engineer-in-Charge a notice in writing to rectify, reconstruct or replace any defective work or that the Works is being performed in an inefficient or otherwise improper un-workman like" manner shall omit to comply with the requirement of such notice for a period of seven days thereafter, or
- (iii) has without reasonable cause, suspended the progress of the Works or has failed to proceed with the Works with due diligence so that in the opinion of the Engineer-in-Charge (which shall be final and binding) he will be unable to secure completion

of the Works by Completion Date and continues to do so after a notice in writing of seven days from the Engineer-in- Charge' or

- (iv) fails to complete the Works within the Completion Date or items of Works with individual date of completion, if any stipulated, on or before such date(s) of completion and does not complete them within the period specified in a notice given in writing in that behalf by the Engineer-in-Charge, or
- (v) being an individual, or if a firm, any partner thereof shall at any time be adjudged insolvent or have a receiving order or order for administration of his estate made against him or shall take any proceedings for liquidation or composition (other than a voluntary liquidation for the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or purport so to do, or if any application be made under any Insolvency Act for the time being in force for the sequestration of his estate or if a trust deed be executed by him for benefit of his creditors; or
- (vi) being a company shall pass a resolution or the court shall make an order that the company shall be wound up or if a receiver or a manager on behalf of a creditor shall be appointed or if circumstances shall arise which entitle the court or the creditor to appoint a receiver or a manager or which entitle the court to make a winding up order; or
- (vii) shall offer or give or agree to give to any person in Government service or to any other person on his behalf any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any act in relation to the obtaining or execution of this or any other Contract for Government; or
- (viii) shall obtain a Contract with Government as a result of wrong tendering 'or other non-bona-fide methods of competitive tendering; or
- (ix) shall suffer an execution being levied on his goods and allow it to be continued for a period of 21 days; or
- (x) assigns, transfers, sublets (engagement of labour on a piece-work basis or of labour with materials not to be incorporated in the Works, shall not be deemed to be subletting) or otherwise parts with or attempts to assign, transfer sublet or otherwise parts with the entire Works or any portion thereof without the prior written approval of the Employer doesn't start the Works within 1/8th of the stipulated time; or
- (xi) is found to have a conflict of interest. Conflict of interest is defined in the general eligibility criteria shared with the Contractor during the bidding stage.

11.1.2 When the Contractor has made himself liable for action under any of the cases aforesaid, the Engineer-in-Charge on behalf of Employer shall have powers:-

- (i) To determine or rescind the Contract as aforesaid (of which termination or rescission notice in writing to the Contractor under the hand of Engineer-In- Charge shall be conclusive evidence). Upon such determination or rescission, the Earnest Money Deposit, Security Deposit already recovered and performance guarantee under the Contract shall be liable to be forfeited and shall be absolutely at the disposal of the Employer

- (ii) "After giving notice to the Contractor to measure up the Works of the Contractor and to take such whole, or the balance or part thereof, as shall be un-executed out of his hands and to give it to another Contractor to complete the Works at risk and cost of the defaulting Contractor. The Contractor, whose Contract is determined or rescinded as above, shall not be allowed to participate in the tendering process for the balance Works besides being subject to appropriate legal action as per the provisions of Contract.

In the event of above course(s) being adopted by the Engineer-in-Charge, the Contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any material or entered into any engagements or made any advance on account or with a view to the execution of the Works or the performance of the Contract. And in case action is taken under any of the provision aforesaid the Contractor shall not be entitled to recover or be paid any sum for any work thereof or actually performed under this Contract unless and until the Engineer-in-Charge has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified.

11.2 Contractor liable to pay compensation even if action not taken under clause

11.1

In any case in which any of the powers conferred upon the Engineer-in-Charge by clause 11.1 thereof, shall have become exercisable and the same are not exercised, the non – exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the Contractor and the liability of the Contractor for compensation shall remain unaffected. In the event of the Engineer-in-Charge putting in force all or any of the powers vested in him under the preceding clause, he may, if he so desires after giving a notice in writing to the Contractor, take possession of (or at the sole discretion of the Engineer-in-Charge which shall be final and binding on the Contractor) use as on hire (the amount of the hire money being also in the final determination of the Engineer-in-Charge) all or any tools, plant, materials and stores, in or upon the Works, or the Site thereof belonging to the Contractor, or procured by the Contractor and intended to be used for the execution of the workflow any part thereof, paying or allowing for the same in account at the Contract rates or, in the case of these not being applicable, at current market rates to be certified by the Engineer-in- Charge, whose certificate thereof shall be final, and binding on the Contractor.

11.3 Cancellation of Contract in full or part

11.3.1 The Employer may, without prejudice to any other right or remedy which shall have accrued or shall accrue hereafter to Employer, by a notice in writing to cancel the Contract as a whole or only such item of Works in default from the Contractor due to occurrence of any of the events mentioned in clause 11.1 above.

The Engineer-in-Charge shall on such cancellation by the Employer have powers to:

- (i) Take possession of the Site and any materials, constructional plant, implements stores, etc., thereon; and/or
- (ii) Carry out the incomplete work by any means at the risk and cost of the Contractor, On cancellation of the Contract in full or in part, the Engineer-in-Charge shall determine what amount, if any, is recoverable from the Contractor for completion of the Works or part of the Works or in case the Works or part of the Works is not to be completed, the loss of damage suffered by Employer. In determining the amount, credit shall be given to the Contractor for the value of the Works executed by him up to the time of cancellation, the value of Contractor's materials taken over and incorporated in the Works and use of plant and machinery belonging to the Contractor.

11.3.2 Any excess expenditure incurred or to be incurred by Employer in completing the Works or part of the Works or the excess loss or damages suffered or may be suffered by Employer as aforesaid after allowing such credit shall without prejudice to any other right or remedy available to Employer in law be recovered from any money due to the Contractor on any account, and if such moneys are not sufficient the Contractor shall be called upon in writing and shall be liable to pay the same within 30 days.

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

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

11.4 Termination of Contract on death of Contractor/ Partner

If the Contractor is an individual or a sole proprietary concern, and the individual or the sole proprietor dies, or if the Contractor is a partnership concern and one of the partners dies, in that case unless the Employer is satisfied that the legal representative of the individual Contractor or of the sole proprietor, as the case may be, or in the case of a partnership firm, all surviving partners, are capable of carrying out and completing the Contract, the Employer shall be entitled to terminate the Contract as to its incomplete part. In that event, the Employer shall not be liable to pay any compensation to the legal heirs of the deceased Contractor and / or to the surviving partners of the Contractor's firm, on account of such cancellation of Contract. DJB's decision, as to whether the legal representatives of the deceased Contractor or surviving partners of the Contractor firm can or cannot carry out and complete the Contract, shall be final and binding on the parties. Any liability incurred by the deceased Contractor, or by the deceased partner of the contracting firm, before his

death, shall be recovered from the legal representatives of the deceased Contractor or from the surviving partners of the said contracting firm as the case may be.

11.5 Termination due to Force Majeure Event

11.5.1 If a Force Majeure Event, as specified under clause 10.5, subsists for a period of 60 days or more within a continuous period of 120 days, either Parties may in its discretion terminate this Contract by issuing a termination notice to the other Parties without being liable in any manner whatsoever, save as provided in provisions of clause 11.1. Upon issue of such termination notice, this Contract shall, notwithstanding anything to the contrary contained herein, stand terminated forthwith;

Provided that before issuing such termination notice, the Parties intending to issue the termination notice shall inform the other Parties of such intention and grant 15 (fifteen) days time to make a representation, and may after the expiry of such 15 (fifteen) days period, whether or not it is in receipt of such representation, in its sole discretion issue the termination notice.

11.5.2 In the event of the Contract being terminated under clause 11.5.1 on account of Force Majeure Event, the Engineer-in-Charge shall issue a payment certificate which shall include:

An amount equal to the value of the construction work less payments already made, less advance payments outstanding against the Contractor up to the date of issue of termination notice, less other recoveries due in terms of the Contract, less taxes due to be deducted at source in accordance with applicable Law the cost of plants and materials ordered for the Works which have been delivered to the Contractor. Provided that such Plants and Materials shall become property of Employer when paid for by the Employer and the Contractor shall place the same at the Employer's disposal and the Contractor's cost of protecting and securing the Works.

12.0 Measurement & Payments

12.1 Measurement of work done

12.1.1 The Engineer-in-Charge shall, except as otherwise provided, ascertain and determine, by measurement, the value of Works done in accordance with the Contract. Measurement of all items having financial value shall be entered in measurement book and/or level field book so that a complete record is obtained of all Works performed under the Contract. All measurements and levels shall be taken jointly by the Engineer-in-Charge or his authorized representative and by the Contractor or his responsible agent from time to time during the progress of the Works and such measurements shall be signed and dated by the Engineer-in-Charge and the Contractor or their representatives as token of their acceptance. If the Contractor objects to any of the measurements recorded, a note shall be made to that effect with reason and signed by both the parties.

12.1.2 If for any reason the Contractor or his responsible agent is not available and the work of recording measurements is suspended by the Engineer-in-Charge or his representative, the Engineer-in-Charge and the Employer shall not entertain any claim from Contractor for any loss or damages on this account. If the Contractor or his responsible agent does not remain present at the time of such measurements after the

Contractor or his responsible agent has been given a notice in writing three (3) days in advance or fails to countersign or to record objection within a week from the date of the measurement, then such measurements recorded in his absence by the Engineer-in-Charge or his representative shall be deemed to have been accepted by the Contractor.

12.1.3 The Contractor shall, without extra charge, provide all assistance with every instrument, labour and other things necessary for measurements and recording levels.

12.1.4 Except where any general or detailed description of the Works expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the technical specifications notwithstanding any provision in the relevant standard method of measurement or any general or local custom. In the case of items which are not covered by specifications, measurements shall be taken in accordance with the relevant standard method of measurement issued by the Bureau of Indian Standards and if for any item no such standard is available then a mutually agreed method shall be followed.

12.1.5 If any part of Works shall be covered up or placed beyond the reach of measurements without notice been given to the Engineer-in-Charge or without his consent being obtained in writing, the Works shall be uncovered at Contractor's expense, or in default thereof no payment or allowance shall be made for such Works or the materials with which the same was executed.

12.1.6 Engineer-in-Charge or his authorized representative may cause either themselves or another officer of the Employer to check the measurements recorded jointly or otherwise as aforesaid and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

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

12.2 Payments of running bills

12.2.1 The payment of the monthly running bill for the Works shall be released in 90 days from the date of recording of pay order. No excuse for delay in completion of work/prolongation of the Contract shall however be entertained on account of the reason of delay in payment. The bidder therefore, must take into consideration of its financial capability to carry out and to continue the work without any hindrances.

12.2.2 Stands Deleted

12.2.3 It shall be the contractual obligations on the part of the Contractor to submit with each running bill photocopies of the:-

- (i) Challans for the main items purchased for the Works like CI/DI/MS/RCC/PSC Pipes, E&M equipment, manhole frame and covers, footrests, sluice valves, fire hydrants and other fixtures and accessories used in the Works;
- (ii) Guarantee/ warranty certificates, wherever applicable;
- (iii) Manufacturer's test reports of cement, steel, MS plates, sluice valves etc.
- (iv) GIS maps of pipelines and other related key components (to be submitted only with the final bill)

Note: Contractor shall solely be responsible for the authenticity of the challans and other documents submitted along with each running and final bills.

12.2.4 The original challans shall be produced before the Engineer-in-Charge for verification, as and when desired by him.

12.3 Currency of payment

Unless specifically provided for in the Contract, all payments shall be in Indian rupees only. Unless specified otherwise, payment, if any, in foreign currencies, shall be made only to the extent and in the manner laid down in the Contract. In case of items of Works requiring payments in foreign exchange, the Contractor shall furnish the details in the Bill of Quantities. For such items, payments will be arranged in Foreign Currency.

12.4 Payment of Contractor's bills to banks

Payments due to the Contractor shall be made to his bank instead of direct to him.

The Contractor shall submit to the Engineer-in-Charge: (1) an authorization in form of a legally valid document such as a power of attorney conferring authority on the bank to receive payments and (2) his own acceptance of the correctness of the amount made out as being due to him by Employer or his signature on the bill or other claim preferred against Employer before settlement by the Engineer-in-Charge of the account or claim by payment to the bank, registered financial, cooperative or thrift societies or recognized financial institutions. While the receipt given by such bank; registered financial, cooperative or thrift societies or recognized financial institutions shall constitute a full and sufficient discharge for the payment, the Contractor shall whenever possible present his bills duly receipted and discharged through his bank, registered financial, cooperative or thrift societies or recognized financial institutions.

Nothing herein contained shall operate to create any rights or equities vis-à-vis Employer in favor of the bank.

12.5 Payment of final bill

The final bill shall be submitted by the Contractor within three months of Completion Date or within one month of the date of issue of Completion Certificate furnished by the Engineer-in-Charge whichever is earlier. In case commissioning is delayed beyond a period of one year from the Physical Completion of the Works, the final bill shall be settled upon completion of the Defect Liability Period, as per clause 16.1(iii), or upon successful commissioning whichever is earlier. No further claims shall be made by the Contractor

after submission of the final bill and these shall be deemed to have been waived and extinguished. Payments of those items of the bill in respect of which there is no dispute and of items in dispute, for quantities and rates as approved by Engineer-in Charge, will, as far as possible be made within the period specified herein under, the period being reckoned from the date of receipt of the bill by the Engineer-in-Charge or his representative, complete with account of materials issued by the Employer and dismantled materials.

12.6 Lump sum provisions in a composite tender

When the Contract Price is lump sum in respect of parts of the Works, the Contractor shall be entitled to payment in respect of the items of Works involved or the part of the Works in question at the same rates as are payable under this Contract for such items, or if the part of the Works in question is not in the opinion of the Engineer-in-Charge payable of measurement, the Engineer-in-Charge may at his discretion pay the lump-sum amount entered in the estimate, and the certificate in writing of the Engineer-In-Charge shall be final and conclusive against the Contractor with regard to any sum or sums payable to him under the provisions of the clause.

12.7 Withholding and lien in respect of sums due from Contractor

(i) Whenever any claim or claims for payment of a sum of money arises out of or under the Contract against the Contractor, the Engineer-in-Charge or the Employer shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from any sum or sums found payable or which may at any time thereafter become payable to the Contractor under the Contract. In the event of the payment from such sums being insufficient to cover the claimed amount, the Employer shall be entitled to withhold and have a lien to retain to the extent of such claimed amount from the security deposit, if any. Further, for the purpose of this clause, the Employer shall be entitled to withhold and also have a lien to retain to the extent of the claimed amount or amounts, from any sum or sums found payable or which may at any time thereafter become payable to the Contractor under any other Contract with the Engineer-in-Charge or the Employer pending finalization of adjudication of any such claim.

(ii) The sum of money or moneys so withheld or retained under the lien referred to above by the Engineer-in- Charge or Employer will be kept withheld or retained as such by the Engineer-in-Charge or Employer till the claim arising out of or under the Contract is determined by the arbitrator (if the Contract is governed by the arbitration clause) or by the competent 'court, as the case may be and that the Contractor will have no claim for interest or damages whatsoever on any account in respect of such withholding or retention under the lien referred to above and duly notified as such to the Contractor. For the purpose of this clause, where the Contractor is a partnership firm or a limited company, the Engineer-in-Charge or the Employer shall be entitled to withhold and also have a lien to retain towards such claimed amount or amounts in whole or in part from any sum found payable to any partner/limited company as the case may be, whether in his Individual capacity or otherwise.

- (iii) The Employer shall have the right to cause an audit and technical examination of the Works and the final bills of the Contractor including all supporting vouchers, abstract, etc., to be made after payment of the final bill. If as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the Contractor under the Contract or any work claimed to have been done by him under the Contract is found not to have been executed, the Contractor shall be liable to refund the amount of over-payment and it shall be lawful for Employer to recover the same from him in the manner prescribed in sub-clause (i) of this clause or in any other manner legally permissible; and if it is found that the Contractor *was* paid less than what was due to him under the Contract in respect if any work executed by him under it, the amount of such under payment shall be duly paid by Employer to the Contractor, without any interest thereon. Provided that the Employer shall not be entitled to recover any sum overpaid, nor the Contractor shall be entitled to payment of any sum paid short where such payment has been agreed upon between the Engineer-in-Charge on the one hand and the Contractor on the other under any term of the Contract permitting payment for Works after assessment by the Engineer-in-Charge.

12.8 Rates

- 12.8.1** The tendered rate (%age rate tender/item rate tender) for all items of the Works shall be considered inclusive of all leads and lifts, unless otherwise specified by BOQ, skilled or unskilled labour & material required for working at all heights and depths, making any shape of the masonry as per the drawings.
- 12.8.2** Nothing extra shall be paid unless otherwise specified on account of cutting of grass, bushes, leveling of undulation in the ground, existence of drain and temporary structures etc. requiring removal and difficulty due to space constraints.
- 12.8.3** Nothing extra shall be paid for working in foul conditions unless otherwise specified. The tendered rates shall not be subject to any revisions for want of any information.
- 12.8.4** Nothing extra shall be paid for Works required as per Good Engineering Practice, BIS, manufacturer recommendation even if it is not specifically provided in the Contract.

12.9 Levy / Taxes payable by Contractor

All taxes, duties, levies, cess, etc. in respect of this Contract shall be payable by the Contractor and the Employer shall not entertain any claim whatsoever in this respect.

- (i) The Contractor shall deposit royalty and obtain necessary permit for supply of the red bajri, stone, kankar, etc. from local authorities.
- (ii) Where pursuant to or under any law, notification or order any royalty, cess or the like becomes payable by the Employer and does not any time become payable by the Contractor to the State Government or Local authorities in respect of any material used by the Contractor in the Works, then in such a case, it shall be lawful to the Employer and it will have the right and be entitled to recover the amount paid in the circumstances as aforesaid from dues of the Contractor.

12.10 Taxes

12.10.1 Unless otherwise specified in Special Conditions of Contract, the Contract Price shall be inclusive of all the taxes, duties, cess/GST or any other taxes on the materials.

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

(ii)The successful tenderer who is liable to be registered under CGST/IGST/UTGST/SGST act shall submit GSTIN along with other details required under CGST/IGST/UTGST/SGST act to DJB immediately after the award of contract, without which no payment shall be released to the contractor. The contractor shall be responsible for deposition of applicable GST to the concerned authority.

(iii). Every tenderer/ bidders is required to be registered compulsorily himself under CGST/IGST/UTGST/SGST act.

(iv). TDS under the provision GST law shall be deducted from the bills and /or payment of advances as and when made applicable under the Act.

(v) Provision of GST Act 2017 shall have the superseding effect over the all earlier taxes like VAT/WCT/Service Tax/other like taxes as contemplated in the Act. Accordingly the terms VAT/WCT/Service Tax etc. appearing anywhere in the bid document may be read as the applicable tax under the GST Act 2017.

(vi) Any other statutory variation shall be applicable.

12.10.2 Service Tax: : STANDS DELETED

12.10.3 Excise Duty Exemption : STANDS DELETED

12.10.4 Form C Issuance: : STANDS DELETED

13.0 Alterations, Additions & Omissions

13.1 Deviations / Variation Extent and Pricing

13.1.1 The Engineer-in-Charge shall have power:

- (i) to make alteration , omissions , additions , or substitutions in the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work, and**
- (ii) to omit a part of the Works in case of non-availability of a portion of the Site or for any other reasons.**

The Contractor shall be bound to carry out the Works in accordance with any instructions given to him in writing signed by the Engineer-in-Charge and such alterations, omissions,

additions or substitutions shall form part of the Contract as if originally provided therein. Any altered, additional or substituted Works which the Contractor may be directed to do in the manner specified above as part of the Works, shall be carried out by the Contractor on the same conditions in all respects including price on which he agreed to do the Works except as hereafter provided.

Instructions for any variations shall be communicated to the Contractor by the Engineer-in-Charge in writing with a copy to the Employer.

13.1.2 The time for completion of the Works shall, in the event of any deviations resulting in additional cost over the Contract Price be extended, if requested by the Contractor, as follows:

(i) In the proportion which the additional cost of the altered, additional or substituted work, bears to the original Contract Price and

(ii) Upto 25% of the time calculated in (i) above or as may be considered reasonable by the Engineer-in-Charge.

13.1.3 If any extra item of material and/ or labour is involved during execution of work, the Contractor shall have to execute the same as per the direction of Engineer-in-Charge and the payment shall be made as per applicable DSR plus/ minus Contractor's enhancement as applicable. In case, the extra item of material and/ or labour is not available in the schedule of rate, the Contractor will be paid analyzed rates based on either DSR with Contractor's enhancement (+/-) or prevailing market rates plus 15% Contractor's profit but without Contractor's enhancement.

13.1.4 In case of reduction of scope due to action under clause 13.1.1, the reduction in payments shall be calculated based on schedule of rates for the Contract.

13.2 Foreclosure of Contract due to abandonment or reductions in scope of work

13.2.1 If at any time after issuance of Work Order, the Employer decides to abandon or reduce the scope of the Works for any reason whatsoever and hence not require the whole or any part of the Works to be carried out, the Engineer-in-Charge shall give notice in writing to that effect to the Contractor and the Contractor shall act accordingly in the matter. The Contractor shall have no claim to any payment of compensation or otherwise whatsoever, on account of any profit or advantage which he might have derived from the execution of the Works in full but which he did not derive in consequence of the fore closure of the whole or part of the Works.

13.2.2 The Contractor shall be paid at Contract rates full amount for Works executed at Site and, in addition, a reasonable amount as certified by the Engineer-in-Charge for the items hereunder mentioned which could not be utilized on the Works to the full extent in view of the foreclosure:

(i) Any expenditure incurred on preliminary site work, e.g. temporary access roads, temporary labour huts, staff quarters and site office, storage accommodation and water storage tanks.

(ii) Employer shall not take over Contractor's materials or any part thereof either brought to Site or of which the Contractor is legally bound to accept delivery from suppliers (for incorporation in or incidental to the work). However, the Engineer-in-Charge/ Employer may consider providing cost for such materials as deemed reasonable. The cost shall, however, take into account purchase price, salvage value, cost of transportation and deterioration or damage which may have been caused to materials whilst in the custody of the Contractor.

(iii) If any materials supplied by Employer are rendered surplus, the same except normal wastage shall be returned by the Contractor to Employer at rates not exceeding those at which these were originally issued less allowance for any deterioration or damage

which may have been caused whilst the materials were in the custody of the Contractor. In addition, cost of transporting such materials from Site to Employer's stores, if so required by Employer, shall be paid by the Employer.

(iv) Reasonable compensation for repatriation of Contractors site staff and imported labour to the extent necessary. The Contractor shall, if required by the Engineer-in-Charge furnish to him books of account, wage books, time sheets and other relevant documents and evidence as may be necessary to enable him to certify the reasonable amount payable under this condition.

The reasonable amount of items on (i) and (iv) above shall not be in excess of 2% of the cost of the Works remaining incomplete on the date of closure, i.e., total stipulated cost of the Works as per accepted tender less the cost of Works actually executed under the Contract. Provided always that against any payments due to the Contractor on this account or otherwise, the Engineer-in-Charge shall be entitled to recover or be credited with any outstanding balances due from the Contractor for advance paid in respect of any tool, plants and materials and any other sums which at the date of termination were recoverable by the Employer from the Contractor under the terms of the Contract.

13.3 Permissible variation in Cement & Steel

After completion of the Works, the theoretical quantity of cement/ steel to be used in Works shall be calculated on the basis of statement showing quantity of cement/ steel to be used in different items of Works as provided in Schedule of Rates. In case any item is executed for which the standard coefficient for the consumption of cement/ steel are not available in the above mentioned statement or cannot be derived, the same shall be calculated on the basis of analysis by the Engineer-in-Charge. Over this theoretical quantity of cement, a variation up to 2% (two percent) and for steel, a variation up to 3% (three percent) plus/minus for Works shall be allowed. In the event of it being discovered that the quantity of cement/ steel used is less than the quantity required (allowing variation on the minus side as stipulated above), the portion of Works executed will be rejected and the same shall be demolished and reconstructed by the Contractor at his own cost. The decision of concerned Engineer-in-Charge, in this regard, shall be final and binding on the Contractor. Provided that, cement/ steel used in excess over permissible variation shall not be payable.

14.0 Changes in Contract Price

14.1 Payments due to variation in prices of material, POL and labour after receipt of tender for Item Rate/ Percentage Contract

(Would apply for EPC/ DB/ DBO contracts also when exact quantity of material consumed is measured)

If during the operative period of the Contract, there shall be any variation in the prices of material (not being the material supplied by Employer as under clause 9.1 and/ or services rendered at fixed prices as under clause 9.5 and the material for which the price variation is being calculated for actual quantities used as under clause 14.1.3) and/ or in the wages of labour required for execution of Works and/ or in POL (fuel, oil and lubricant), the Contract Price shall be adjusted as per the provisions detailed below.

For working out the percentages of the values of material, labour and POL components in the work, the total of these three components should be taken as 100. Standard labour, material & POL components indicated in the table below can be used for the Works related to water supply and waste water projects.

14.1.A Payment due to variation in Price of Materials after Receipt of Tender

If after submission of the tender, the price of material specified in Schedule increases/ decreases beyond the price(s) prevailing at the time of the last stipulated date for receipt of tenders (including extension, if any) for the work, then the amount of the contract shall accordingly be varied and provided further that any such variation shall be effected for stipulated period of contract including the justified period extended under the provision of clause 10.3 of the contract without any action under clause 10.4.

However the work done during the justified period extended as above, it will be limited to indices prevailing at the time of stipulated date of completion or as prevailing for the period under consideration, whichever is less.

The increase/ decrease in prices shall be determined by the All India Wholesale Price Indices of material as published by Economic Adviser to Government of India. Ministry of Commerce and Industry and base price for materials as issued under the authority of Director General (Works), CPWD as valid on the last stipulated date of receipt of tender including extension if any and for the period under consideration. In case, price index of a particular material is not issued by the Ministry of Commerce 'F' shall be followed.

The amount of the contract shall accordingly be varied for all such material and will be worked out as per the formula given below for individual material :-

Adjustment for component for individual material :-

$$V = P \times Q \times \frac{(CI - C_{lo})}{C_{lo}}$$

Where,

V= Variation in material cost i.e. increase or decrease in the amount in rupees to paid or recovered

P= Base price of material as issued under authority of DG(W), CPWD valid at the time of the last stipulated date of receipt of tender including extensions, if any.

Q= Quantity of material used in the works since previous bill.

C_{lo} = All India whole sale price Index for the material as published by the Economics Advisor to Government of India. Ministry of Industry and Commerce as valid on the last stipulated date of receipt of tenders including extension, if any.

CI = All India whole sale price Index for material for period under consideration as published by Economic Advisor to Government of India, Ministry of Industry and Commerce.

(In respect of the justified period extended under the provision of clause 10.3 of the contract without any action under clause 10.4, the Index prevailing at the time stipulated date of completion or the prevailing index of the period under consideration, whichever is less, shall be considered)

14.1.1 Standard labour, material & POL components to be used for the Water and Waste water Supply Projects¹

Sr. No	Description	(k) Percentage to be used for component		
		Labour (K ₁)	Material (K ₂)	Petrol, oil & Lubricant (K ₃)

¹ The standard percentages are indicative in nature and has to be verified and confirmed by the concerned Chief Engineer before issuing the tender document to the bidders

1	River Head Works including approach bridges approach bunds, coffer dam etc	40	55	5
2	Raw & Pure water pumping main, Leading Mains, Distribution System etc	25	70	5
3	WTP M.B.R (Elevated R.C.C) E.S.R. R.C.C G.S.R	40	55	5
4	Wastewater pumping main, Leading Mains, Distribution	25	70	5
5	WWTP	40	55	5

14.1.2 Guiding formulae to be used to calculate Price Variation for different components of work

(i) Formula for Labour Component

$$V_L = 0.85 \times W \times \frac{K_1}{100} \times \frac{(L_1 - L_0)}{L_0}$$

where;

V_L = Amount (in INR) of price variation for the labour component

W = Cost of Work done during the quarter under consideration **minus** the cost of

the Bitumen, HYSD, Mild Steel reinforcement, Structural Steel, Mild Steel plates, Cement, Liquid Chlorine, Alum/ PAC and CI/DI/HDPE/MDPE pipes as covered under clause 14.1.3

K₁ = Percentage of labour component as indicated above

L₀ = Consumer Price Index for Industrial workers, published in the Reserve Bank

of India Bulletin, as applicable to Delhi area for the month in which the tender

was opened.

L₁ = Average of monthly Consumer Price Index for Industrial workers, published in the Reserve Bank of India Bulletin, as applicable to Delhi area for the quarter under consideration.

(ii) Formula for Material Component

$$V_M = 0.85 * W * \frac{K_2}{100} * \frac{(M_1 - M_0)}{M_0}$$

where;

V_M = Amount (in INR) of price variation for the material component

W = Cost of Work done during the quarter under consideration minus the cost of

the Bitumen, HYSD, Mild Steel reinforcement, Structural Steel, Mild Steel plates, Cement, Liquid Chlorine, Alum/ PAC and CI/DI/HDPE/MDPE pipes as

covered under clause 14.1.3

K₂ = Percentage of material component as indicated above

M₀ = Relevant All India Wholesale Price Index as published by Economic Advisor to

Govt. of India, Ministry of Industry and Commerce as valid on the base date.

M₁ = Average of relevant All India Wholesale Price Index as published by Economic Advisor to Govt. of India, Ministry of Industry and Commerce for the quarter under consideration.

(iii) Formula for POL Component

$$V_P = 0.85 * W * \frac{K_3}{100} * \frac{(P_1 - P_0)}{P_0}$$

where;

V_F = Amount (in INR) of price variation for the POL component

W = Cost of Work done during the quarter under consideration **minus** the cost of

the Bitumen, HYSD, Mild Steel reinforcement, Structural Steel, Mild Steel plates, Cement, Liquid Chlorine, Alum/ PAC and CI/DI/HDPE/MDPE pipes as covered under clause 14.1.3

K_3 = Percentage of POL component as indicated above

F_0 = All India Wholesale Price Index for High Speed Diesel as published by

Economic Advisor to Govt. of India, Ministry of Industry and Commerce as valid

on the base date.

F_1 = Average of All India Wholesale Price Index for High Speed Diesel as published by Economic Advisor to Govt. of India, Ministry of Industry and Commerce for the quarter under consideration.

14.1.3 Guiding formulae to calculate Price Variation in rupees for different material components as per actual quantities used

(i) Formulae for Bitumen Component

$$V_B = Q_B \cdot (B_1 - B_0)$$

where;

V_B = Amount of price variation in Rupees to be allowed for Bitumen Component.

Q_B = Quantity of Bitumen (Grade) in MT used in the permanent Works and

approved enabling Works during the quarter under consideration.

B_0 = Basic rate of Bitumen for the grade of bitumen under consideration in rupees per MT as considered in Tendered cost of work.

B_1 = Current, average Mathura refinery price per metric ton of Bitumen (Grade)

under consideration including taxes (octroi, excise, sales tax) during period

under consideration

(ii) Formula for HYSD, Mild Steel reinforcement, Structural Steel , Steel Plates

Component

$$V_H = T_1 * H_0 * \frac{(H_{11} - H_{10})}{H_{10}}$$

where;

V_H = Amount of price variation in Rupees to be allowed for HYSD / Mild Steel / Structural Steel / Steel Plates Component.

H_0 = Basic rate of HYSD / Mild Steel / Structural Steel / Steel Plates Component in rupees per MT as considered in Tendered cost of work.

H_{10} = Basic Wholesale Price Index for Stainless Steel & Alloys shall be the average

Wholesale Price Index ascertained as above on the base date.

H_{11} = Average Wholesale Price Index for Stainless Steel & Alloys ascertained as above during the period under consideration.

T_1 = Tonnage of steel used in the permanent Works for the period under

Consideration

(iii) Formula for Cement component

$$V_C = T_2 * C_0 * \frac{(C_{11} - C_{10})}{C_{10}}$$

where;

V_C = Amount of price variation in Rupees to be allowed for Cement component

C_0 = Basic rate of Cement Component in rupees per MT as considered in Tendered

cost of work.

C10 = Basic Wholesale Price Index for cement shall be the average Wholesale Price

Index ascertained as above on the base date.

C11 = Average Wholesale Price Index for cement ascertained as above during the period under consideration

T2 = Tonnage of cement used in the permanent Works for the period under

consideration

(iv) Formula for C.I./ D.I./ HDPE pipe component

$$VCD = T3 * D0 * \frac{(D11 - D10)}{D10}$$

where;

VCD = Amount of price variation in Rupees to be allowed for C.I./ D.I. pipe component

D0 = Basic rate of C.I./ D.I./ HDPE pipe Component in rupees per MT as considered in Tendered cost of work.

D10 = Basic Wholesale Price Index for Pig-Iron shall be the average Wholesale Price Index ascertained as above on the base date.

D11 = Average Wholesale Price Index for Pig-Iron ascertained as above during the period under consideration

T3 = Tonnage of C.I. / D.I./ HDPE pipe used in the permanent Works for the period under consideration

(v) Formula for Liquid Chlorine Component

$$VLC = T4 * LC0 * \frac{(LC11 - LC10)}{LC10}$$

where;

VLC = Amount of price variation in Rupees to be allowed for Liquid Chlorine component

LC0 = Basic rate of Liquid Chlorine Component in rupees per MT as considered in Tendered cost of work.

LC10 = Basic Wholesale Price Index for Chlorine shall be the average Wholesale Price Index ascertained as above on the base date.

LC11 = Average Wholesale Price Index for Chlorine ascertained as above during the period under consideration

T4 = Tonnage of Liquid Chlorine used in the permanent Works for the period under consideration

(vi) Formula for Alum/ PAC Component

$$V_A = T_5 * A_0 * \frac{(A_{11} - A_{10})}{A_{10}}$$

where;

V_A = Amount of price variation in Rupees to be allowed for Alum/ PAC component

A_0 = Basic rate of Alum/ PAC Component in rupees per MT as considered in Tendered cost of work.

A_{10} = Basic Wholesale Price Index for Basic Inorganic Chemicals shall be the average Wholesale Price Index ascertained as above on the base date.

A_{11} = Average Wholesale Price Index for Basic Inorganic Chemicals ascertained as above during the period under consideration

T_5 = Tonnage of Alum/ PAC used in the permanent Works for the period under consideration

14.1.4 The following conditions shall prevail

- (i) Price Variation shall not be applicable for Contracts with original Stipulated Period of Completion less than 12 months.
- (ii) For Contracts with original Stipulated Period of Completion greater than 12 months, Price Variation shall be applicable on the entire duration of Contract. No price variation will be made for Contracts where the extension in time is because of default of Contractor. The decision of Engineer-in-Charge shall be final and binding on the Contractor.
- (iii) The base date for the purpose of this clause shall be 7 days before the last date of submission of final bid.
- (iv) In case of extension in the date of completion of works, the compensation under price variation shall not be limited to indices prevailing at the time of Stipulated Period of Completion. The indices for calculation of compensation shall be limited to the indices prevailing in the month up to the justified delays.
- (v) Clause 14.1 is operative both ways, i.e. if the price variation as calculated above is on the plus side, payments on account of the price variations shall be allowed to the contractor and if it is on the negative side, the Employer shall be entitled to recover the same from the Contractor and the amount shall be deductible from any amounts due and payable under the Contract.
- (vi) To the extent that full compensation for any rise or fall in costs to the Contractor is not entirely covered by the provision of this or other clauses in the Contract, the unit rate and prices included in the Contract shall be deemed to include amounts to cover the contingency of such other actual rise or fall in costs.

14.1.5 For E&M (electrical & mechanical) tenders, price variation shall be made as per the latest publication and guidelines issued by IPMA/ IEEMA

14.2 Payments due to variation in prices of material, POL and labour after receipt of tender for EPC/ DB/ DBO contracts (Would apply for EPC/ DB/ DBO contracts when exact quantity of material consumed is not measured)

If during the operative period of the Contract, there shall be any variation in the prices of material (not being the material supplied by Employer as under clause 9.1 and/ or services rendered at fixed prices as under clause 9.5) and/ or in the wages of labour required for execution of Works and/ or in POL (fuel, oil and lubricant), the Contract Price shall be adjusted as per the provisions detailed below.

For working out the percentages of the values of material, labour and POL components in the work, the total of these three components should be taken as 100. Standard labour, material & POL components indicated in the table below can be used for the Works related to water supply and wastewater projects.

14.2.1 Standard labour, material & POL component to be used for the Water and Waste water Supply Projects

Sr. No	Description	(k) Percentage to be used for component		
		Labour (K ₁)	Material (K ₂)	Petrol, oil & Lubricant (K ₃)
1	River Head Works including approach bridges approach bunds, coffer dam etc	40	55	5
2	Raw & Pure water pumping main, Leading Mains, Distribution System etc	25	70	5
3	WTP M.B.R (Elevated R.C.C) E.S.R. R.C.C G.S.R	40	55	5
4	Wastewater pumping main, Leading Mains, Distribution System etc	25	70	5

² The standard percentages are indicative in nature and has to be verified and confirmed by the Engineer-in-Charge before issuing the tender document to the bidders

14.2.2 Guiding formulae to be used to calculate Price Variation for different components of work

(i) Formula for Labour Component

$$V_L = 0.85 * W * \frac{K_1}{100} * \frac{(L_1 - L_0)}{L_0}$$

where;

V_L = Amount (in INR) of price variation for the labour component

W = Cost of Work done during the quarter under consideration

K_1 = Percentage of labour component as indicated above

L_0 = Consumer Price Index for Industrial workers, published in the Reserve Bank of India Bulletin, as applicable to Delhi area for the month in which the tender was opened.

L_1 = Average of monthly Consumer Price Index for Industrial workers, published in the Reserve Bank of India Bulletin, as applicable to Delhi area for the quarter under consideration.

(ii) Formula for Material Component

$$V_M = 0.85 * W * \frac{K_2}{100} * \frac{(M_1 - M_0)}{M_0}$$

where;

V_M = Amount (in INR) of price variation for the material component

W = Cost of Work done during the quarter under consideration

K_2 = Percentage of material component as indicated above

M_0 = Relevant All India Wholesale Price Index as published by Economic Advisor to

Govt. of India, Ministry of Industry and Commerce as valid on the base date.

M_1 = Average of relevant All India Wholesale Price Index as published by Economic Advisor to Govt. of India, Ministry of Industry and Commerce for the quarter under consideration.

(iii) Formula for POL Component

$$V_P = 0.85 * W * \frac{K_3}{100} * \frac{(P_1 - P_0)}{P_0}$$

where;

V_P = Amount (in INR) of price variation for the POL component W = Cost of Work done during the quarter under consideration K_3 = Percentage of POL component as indicated above

P_0 = All India Wholesale Price Index for High Speed Diesel as published by Economic Advisor to Govt. of India, Ministry of Industry and Commerce as valid on the base date.

P_1 = Average of All India Wholesale Price Index for High Speed Diesel as published by Economic Advisor to Govt. of India, Ministry of Industry and Commerce for the quarter under consideration.

14.2.3 The following conditions shall prevail

- (i) Price Variation shall not be applicable for Contracts with original Stipulated Period of Completion less than 12 months.
- (ii) For Contracts with original Stipulated Period of Completion greater than 12 months, Price Variation shall be applicable on the entire duration of Contract. No price variation will be made for Contracts where the extension in time is because of default of Contractor. The decision of Engineer-in-Charge shall be final and binding on the Contractor.
- (iii) In case of extension in the date of completion of works, the compensation under price variation shall be limited to indices prevailing at the time of Stipulated Period of Completion or as prevailing for the period under consideration, whichever is less.
- (iv) The base date for the purpose of this clause shall be 7 days before the last date of submission of final bid.
- (v) The Clause 14.2 is operative both ways, i.e. if the price variation as calculated above is on the plus side, payments on account of the price variations shall be allowed to the contractor and if it is on the negative side, the Employer shall be entitled to recover the same from the Contractor and the amount shall be deductible from any amounts due and payable under the Contract.
- (vi) To the extent that full compensation for any rise or fall in costs to the Contractor is not entirely covered by the provision of this or other clauses in the Contract, the unit rate and prices included in the Contract shall be deemed to include amounts to cover the contingency of such other actual rise or fall in costs.

14.2.4 For E&M (electrical & mechanical) tenders, price variation shall be made as per the latest publication and guidelines issued by IPMA/ IEEMA

14.3 Change in law

14.3.1 "Change in Law" shall mean the occurrence of any of the following: (i) the enactment of any new Indian law and its entering into effect;

- (ii) the repeal, modification or re-enactment of any existing Indian law;
- (iii) a change in the interpretation or application of any Indian law by a judgement of a court of record which has become final, conclusive and binding, as compared to such interpretation or application by a court of record prior to the last date of submission of final bid; or
- (iv) any change in the rates of any of the Taxes or royalties on Materials that have a direct financial effect on the Contract;

14.3.2 If as a result of Change in Law, the Contractor suffers any additional costs for the execution of this Contract, save and except as expressly provided for in this clause 14.3 or in accordance with the provisions of this Contract, the Contractor shall, within 30 (thirty) days from the date he becomes reasonably aware of such addition in cost, notify the Employer with a copy to the Engineer-in-Charge of such additional cost due to Change in Law.

14.3.3 If as a result of Change in Law, the Contractor benefits from any reduction in costs for the execution of this Contract, save and except as expressly provided for in this clause 14.3 or in accordance with the provisions of this Contract, the Contractor shall, within 30 (thirty) days from the date he becomes reasonably aware of such reduction in cost, notify the Employer with a copy to the Engineer-in-Charge of such reduction in cost due to Change in Law.

14.3.4 The Contractor shall keep necessary books of accounts and other documents for the purpose of this condition as may be necessary and shall allow inspection of the same by Engineer-in-Charge and further shall furnish such other information/document as the Engineer-in-Charge may require from time to time.

14.3.5 Where as a result of Change in Law, the Contractor suffers any additional costs for the execution of this Contract or benefits from any reduction in costs under clause 14.3.2 or 14.3.3 as the case may be, such additional or reduced cost shall be determined by the Engineer-in-Charge, after due consultation with the Employer and the Contractor, and shall be added to or deducted from the Contract Price and the Engineer-in-Charge shall notify the Contractor accordingly, with a copy to the Employer.

14.3.6 Change in Law shall be applicable on original Stipulated Period of Completion and where such period increases for reasons other than those attributable to the Contractor or as defined under clause 10.4.2 only.

15.0 Certificates

15.1 Completion certificate

15.1.1 Within 10 (ten) days of the Physical Completion of the work, the Contractor shall give notice of such completion to the Engineer-in-Charge. Within 30 (thirty) days of the receipt of such notice, the Engineer-in-Charge shall inspect the Works and if there is no defect in the work, shall furnish the Contractor with a Completion Certificate, otherwise a provisional certificate of Physical Completion indicating defects:

- (i) to be rectified by the Contractor and/or
- (ii) for which payment will be made at reduced rates, shall be issued.

Provided that no Completion Certificate shall be issued, nor shall the Works be considered to be complete until the Contractor shall have removed from the Site all scaffolding, surplus materials, rubbish and all huts and sanitary arrangements required for his/their work people on the Site and cleaned off the dirt from site, shall have obtained clearance from

labour officer as under clause 15.1.2 and not until the Works shall have been measured by the Engineer-in-Charge. If the Contractor shall fail to comply with the requirements of this clause on or before the date fixed for the Physical Completion of work, the Engineer-in-Charge may at the expense of the Contractor remove such scaffolding, surplus materials and rubbish etc., and dispose of the same as he thinks fit and clean off such dirt as aforesaid, and the Contractor shall have no claim in respect of scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

15.1.2 Immediately after Physical Completion of Works, the Contractor shall apply to the labour officer concerned for issue of clearance certificate against the Contract under intimation to the Engineer-in-Charge.

On receipt of information from the Contractor, the Engineer-in-Charge shall also write to the labour officer concerned for issue of the clearance certificate. It shall be stipulated in the letter that the clearance certificate be given within a period of 30 days failing which it shall be presumed that there is no labour dispute against the Contract.

15.1.3 The Completion Certificate of Works referred to in clause 15.1.1 above shall not absolve the Contractor from his liability to make good defects, imperfections and shrinkages or faults, which may appear during the Defects Liability Period as per clause 16.1, arising in the opinion of the Engineer-in-Charge from materials or workmanship being not in accordance with drawings or specifications or instructions of the Engineer-in-Charge. These shall be amended and made good by the Contractor at his own cost. In case of default on the part of the Contractor, to so make good the defects or deficiencies, the Engineer-in-Charge may employ labour, plant and machinery and materials or appoint another agency or Contractor, to amend and make good such defects, imperfections, shrinkages and faults, and all expenses consequent thereto and incidental thereto, shall be borne by the Contractor and shall be recoverable from any moneys due to the Contractor under the Contract including the Performance Guarantee and/ or Security deposit amount or from any moneys payable to the Contractor by the Employer, under any other Contract.

15.2 Completion plans to be submitted by the Contractor

The Contractor shall submit completion plan, as built drawings and O&M (operation and maintenance) manuals, GIS details as required and as applicable within 30 (thirty) days of the completion of the work. In case, the Works involves creation of software, the source code and other user manual shall also be submitted by the Contractor.

In case, the Contractor fails to submit the completion plan as aforesaid, he shall be liable to pay a minimum sum equivalent to 2.5% of the Contract Price or as may be fixed by the Engineer-in-Charge concerned and in this respect the decision of the Engineer-in-Charge shall be final and binding on the Contractor.

15.3 Mobilization Advance – NOT APPLICABLE

16.0 Defect Liability and Maintenance

16.1 Defect Liability Period: Two year

- (i) The Contractor shall be responsible for all the Defects in the Works or any part thereof, as the case may be, during the execution of the Works and during the defects liability period.
- (ii) The Defect Liability Period for the Works shall be [2] two year or as defined as per nature of work from the Completion Date.
- (iii) In case commissioning happens within 2 (two) year from the Physical Completion of the Works, the Defects Liability Period shall start from the commissioning date. However, if the commissioning is delayed beyond 2 (two) year, the Defects Liability Period shall be [5] years from the date of Physical Completion of the Works.
- (iv) The Security Deposit, submitted as per clause 6.2, shall be refunded if no defects are noticed during the Defect Liability Period or the Defects pointed out are removed.
- (v) Contractor shall be responsible for security (watch and ward) of the project assets/ facilities for the period between Completion Date and commissioning.

17.0 Labour Laws

17.1 Recovery of Compensation Paid to Workman

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

17.2 Ensuring Payment and Amenities to Workers If Contractor Fails

In every case in which by virtue of the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and of the Contract labour {Regulation and Abolition) Central Rules, 1971, Employer is obliged to pay any amounts of wages to a workman employed by the Contractor in execution of the Works, or to incur any expenditure in providing welfare and health amenities required to be provided under the above said Act and the rules under clause 17.11 or under the Employer Contractor's Labour Regulations, or under the Rules framed by Employer from time to time for the protection of health and sanitary arrangements for workers employed by Employer's contractors. Employer will recover from the Contractor the amount of wages so paid or the amount of expenditure so incurred; and without prejudice to the rights of the Employer under subsection

(2) of Section 20, and sub- section (4) of Section 21, of the Contract Labour (Regulation and Abolition) Act, 1970, Employer shall be at liberty to recover such amount or any part thereof by deducting it from the Security Deposit or from any sum due by Employer to the Contractor whether under this Contract or otherwise Employer shall not be bound to contest any claim made against it under sub-section (1) of Section 20, sub-section (4) of Section 21, of the said Act, except on the written request of the Contractor and upon his giving to the Employer full security for all costs for which Employer might become liable in contesting such claim.

17.3 Labour Laws to Be Complied By the Contractor

The Contractor shall obtain a valid license under the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (Regulation and Abolition) Central Rules 1971, before the commencement of the work, and continue to have a valid license until the completion of the work. The Contractor shall also abide by the provisions of the Child Labour (Prohibition and Regulation) Act, 1986 and the Child Labour (Prohibition and Regulation) Rules, 1988. Any failure to fulfill this requirement shall attract the penal provisions of this Contract arising out of the resultant non-execution of the work.

17.4 Minimum age limit for labour

No labour below the age of 14 (fourteen) years shall be employed on the work.

17.5 Payment of Wages

- (i) The Contractor shall pay to labour employed by him either directly or through sub- Contractors, wages not less than fair wages as defined in the Employer's contractor's Labour Regulations or as per the provisions of the Contract Labour (Regulation and Abolition) Act 1970 and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.
- (ii) The Contractor shall, notwithstanding the provisions of any Contract to the contrary, cause to be paid fair wage to labour indirectly engaged on the work, including any labour engaged by his sub-Contractors in connection with the said work, as If the labour had been immediately employed by him.
- (iii) In respect of all labour directly or indirectly employed in the Works for performance of the Contractor's part of this Contract, the Contractor shall comply with or cause to be complied with the labour regulations made by central government from time to time in regard to payment of wages, wage period, deductions from wages recovery of wages not paid and deductions unauthorized made, maintenance of wage books or wage slips, publication of scale of wages and other terms of employment, inspection and submission of periodical returns and all other matters of the like nature or as per the provisions of the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.
- (iv) The Engineer-in-Charge concerned shall have the right to deduct from the moneys due to the Contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfilment of the conditions of the Contract for the benefit of the workers, non-payment of wages or of deductions made from his or their wages which are not justified by their terms of the Contract or non-observance of the Regulations.

- (v) Under the provisions of Minimum Wages (Central) Rules 1950, the Contractor is bound to allow to the labours directly or indirectly employed in the Works one-day rest for 6 days continuous work and pay wages at the same rate as for duty. In the event of default the Engineer-in-Charge shall have the right to deduct the sum or sums not paid on account of wages for weekly holidays to any labours and pay the same to the persons entitled thereto from any money due to the Contractor by the Engineer-in-Charge concerned. In the case of Union Territory of Delhi, however, as the all inclusive minimum daily wages fixed under notification of the Delhi Administration No.F.1 2(162) MWO/DAB/43884-91, dated 31-12-1979 as amended from time to time are inclusive of wages for the weekly day of rest, the question of extra payment for weekly holiday would not arise.
- (vi) The Contractor shall comply with the provisions of the Payment of Wages Act, 1936, Minimum. Wages Act, 1948, Employees Liability Act, 1938, Workmen's Compensation Act, 1923, Industrial Disputes Act, 1947, Maternity Benefit its Act, 1961, Factories Act, 1948 and the Contractor's Labour (Regulation and Abolition) Act 1970, or the modifications thereof or any other laws relating thereto and the rules made there under from time to time.
- (vii) The Contractor shall indemnify and keep indemnified Employer against payments to be made under and for the observance of the laws aforesaid and the Employer Contractor's Labour Regulations without prejudice to his right to claim indemnity from his sub-Contractors.
- (viii) The laws aforesaid shall be deemed to be a part of this Contract and any breach thereof shall be deemed to be a breach of this Contract.
- (ix) Whatever is the minimum wage for the time being, or if the wage payable is higher than such wage, such wage shall be paid by the Contractor to the workmen directly without the intervention of jamadar and that jamadar shall not be entitled to deduct or recover any amount from the minimum wage payable to the workmen as and by way of commission or otherwise.
- (x) The Contractor shall ensure that no amount by way of commission or otherwise is deducted or recovered by the jamadar from the wage of workmen.

17.6 Safety provisions for labour

In respect of all labour directly or indirectly employed in the Works for the performance of the Contractors part of this Contract, the Contractor shall at his own expense arrange for the safety provisions as per Employer's safety Code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the Contractor fails to make arrangement and provide necessary facilities as aforesaid he shall be liable to pay liquidated damages of Rs.200/- for each event of default subject to a maximum of 5% of Contract Value, and in addition the Engineer-in- Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in that behalf from the Contractor.

17.7 Submission of monthly record of labour

The Contractor shall submit by the 4th and 19th of every month, to the Engineering-Charge a true statement showing in respect of the second half of the preceding month and the first half of the current month respectively:

- (i) The number of labourers employed by him on the work,
- (ii) Their working hours,
- (iii) The wages paid to them,
- (iv) The accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage and injury caused by them, and
- (v) The number of female workers who have been allowed maternity benefit according to clause 17.9 and the amount paid to them.

Failing which the Contractor shall be liable to pay to Employer a sum not exceeding Rs.1000/- for each default or materially incorrect statement. The decision of divisional officer shall be final in deducting from any bill due to the Contract the amount levied as fine and be binding on the Contractor.

17.8 Compliance with health and sanitary arrangements for workers

In respect of all labour directly, or indirectly employed in the Works for the performance or the Contractor's part of this Contract, the Contractor shall comply with or cause to be complied with all the rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by the Employer and its Contractors.

Further, the Contractor is required to follow the Employer's Safety Code and guidelines published by National Human Rights Commission (N.H.R.C) attached with the tender.

17.9 Leave and pay for female workers

Leave and pay during leave shall be regulated as follows:

1. Leave:

- (i) In the case of delivery - maternity leave not exceeding 8 weeks. 4 weeks up to and including the day of delivery and 4 weeks following that day,
- (ii) In the case of miscarriage - up to 3 weeks from the date of miscarriage.

2. Pay In the case of delivery - leave pay during maternity leave will be at the rate of the women's average daily earnings, calculated on total wages earned on the days when full time work was done during a period of three months immediately preceding the date on which she gives notice that she expects to be confined.

- (ii) In the case of miscarriage - leave pay at the rate of average daily earning calculated on the total wages earned on the days when full time work was done during a period of three months immediately preceding the date of such miscarriage.
3. Conditions for the grant of Maternity Leave: No maternity leave benefit shall be admissible to a woman unless *she* has been employed for a total period of not less than six months immediately preceding the date on which she proceeds on leave.
4. The Contractor shall maintain a register of maternity (benefit) and the same shall be kept at the place of work.

17.10 Noncompliance with labour rules & regulations

17.10.1 In the event of the Contractor committing a default or breach of any of the provisions of the Employer, Contractor's labour Regulations and model rules for the protection of health and sanitary arrangements for the workers as amended from time to time or furnishing any information or submitting or filing any statement under the provisions of the above Regulations and Rules which is materially incorrect, he/they shall, without prejudice to any other liability, pay to the Employer a sum as liquidated damages equal to Rs 200/- for each event of default per day subject to a maximum of 5% of the Contract Value. In the event of the Contractor defaulting continuously in this respect the liquidated damages may be enhanced to Rs.2000/- per event for each day of default subject to a maximum of 5 % of the Contract Value. The decision of the Engineer-in-Charge shall be final and binding on the Contractor.

17.10.2 Should it appear to the Engineer-in-Charge that the Contractor is not properly observing and complying with the provisions of labour regulations and model Rules and the provisions of the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (Regulation and Abolition) Central Rules 1971, for the protection of health and sanitary arrangements for work-people employed by the Contractor (hereinafter referred as "the said Rules") the Engineer-in-Charge shall have power to give notice in writing to the Contractor requiring that the said Rules be complied with and the amenities prescribed therein be provided to the work-people within a reasonable time to be specified in the notice. If the Contractor shall fail within the period specified in the notice to comply with and/observe the said Rules and to provide the amenities to the work-people as aforesaid, the Engineer-in- Charge shall have the power to provide the amenities hereinbefore mentioned at the cost of the Contractor. The Contractor shall erect, make and maintain at its own expense and to approved standards all necessary huts and sanitary arrangements required for its worker on the Site in compliance with the execution of the Works, and if the same shall not have been erected or constructed, according to approved standards, the Engineer-in-Charge shall have power to give notice in writing to the Contractor requiring that the said huts and sanitary arrangement be remodeled and/or reconstructed according to approved standards, and if the Contractor shall fail to remodel or reconstruct such huts and sanitary arrangements according to approved standards within the period specified in the notice, the Engineer-in- Charge shall have the power to remodel or reconstruct such huts and sanitary arrangements according to approved standards at the cost of the Contractor.

17.11 Labour camps and huts

The Contractor shall at his/her own cost provide his/their labour with a sufficient number of huts (hereinafter referred to as the camp) of the following specifications on a suitable plot of land to be approved by the Engineer-in-Charge. In case adequate space is available, the Contractor shall provide labour camps at site, the Employer shall not charge anything for the same. If the space available is not sufficient to house the labour camp, the Contractor shall arrange the land beyond the Site as per his requirement. The Employer may extend help in getting permissions from the land owning agencies but it shall be the responsibility of the Contractor for arranging the same at his own cost. No excuse whatsoever shall be entertained.

- a. The minimum height of each hut at the eaves level shall be 2.10m (7 ft.) and the floor area to be provided will be at the rate of 2.7 sq.m. (30 sq.ft.) for each member of the worker's family staying with the labourer.
 - b. The Contractor shall in addition construct suitable cooking places having a minimum area of 1.80m x 1.50m (6'x5') adjacent to the hut for each family.
 - c. The Contractor shall also construct temporary latrines and urinals for the use of the labourers each on the scale of not less than four per each hundred of the total strength, separate latrines and urinals being provided for women.
 - d. The Contractor shall construct sufficient number of bathing and washing places, one unit for every 25 persons residing in the camp. These bathing and washing places shall be suitably screened.
 - a. All the huts shall have walls of sun-dried or burnt-bricks laid in mud mortar or other suitable local materials as may be approved by the Engineer-in- Charge. In case of sun-dried bricks, the walls should be plastered with mud gobri on both sides. The floor may be kutcha but plastered with mud gobri and shall at least 15cm (6") above the surrounding ground. The roofs shall be laid with thatch or any other materials as may be approved by the Engineer-in-Charge and the Contractor shall ensure that throughout the period of their occupation the roofs remain water-tight.
 - b. The Contractor shall provide each hut with proper ventilation.
 - c. All doors, windows, and ventilators shall be provided with suitable leaves for security purposes.
 - d. There shall be kept an open space of at least 7.2m (8 yards) between the rows of huts which may be reduced to 6m (20 ft.) according to the available of Site with the approval of the Engineer-in-Charge. Back to back construction will be allowed,
- (iii) Water Supply: The Contractor shall provide adequate supply of water for the use of labourers.
- (iv) The site selected for the camp shall be high ground, removed from Jungle.
- (v) Disposal of Excreta: The Contractor shall make necessary arrangements for the disposal of excreta from the latrines by trenching or Incineration, which shall according to the requirements lay down by the Local Health Authorities. If trenching or incineration is not allowed the Contractor shall make arrangements for removal of the excreta through the Municipal Committee/Employer and inform it about the number of labourers employed so that arrangements may be made by such committee/authority for the removal of the excreta. All charges on this account shall be borne by the Contractor and paid direct by

him to the Municipality/Employer. The Contractor shall provide one sweeper for every eight seats in case of dry system.

(vi) Drainage - The Contractor shall provide efficient arrangements for draining away a sullage water so as to keep the camp neat and tidy.

(vii) The Contractor shall make necessary arrangements for keeping the camp a sufficiently lighted to avoid accidents to the workers.

(viii) Sanitation - The Contractor (s) shall make arrangements for conservancy and sanitation in the labour camps according to the rules of the Local Public Health and Medical Authorities.

On completion of the Works the Contractor shall remove hutments failing which the Employer will dismantle and clear the site at his risk and cost.

17.12 Employment of Controlled Area Labour Not Permissible

17.12.1 The Contractor shall not employ controlled area labour falling under any category whatsoever on or in connection with the Works or recruit labour from area within a radius of 32 km (20 miles) of the controlled area. Subject as above the Contractor shall employ imported labour only i.e., deposit imported labour or labour imported by Contractors from area, from which import is permitted.

17.12.2 Where ceiling price for imported labour has been fixed by State or Regional Labour Committees not more than that ceiling price shall be paid to the labour by the Contractor.

17.12.3 The Contractor shall immediately remove any labourer who may be pointed out by the Engineer-in-Charge as being a coal mining or controlled area labourer. Failure to do so shall render the Contractor liable to pay to Employer a sum calculated at the rate of Rs.10/- per day per labourer. The certificate of the Engineer-in-Charge about the number of controlled area labourer and the number of days for which they worked shall be final and binding upon all parties to this Contract.

17.12.4 It is declared and agreed between the parties that the aforesaid stipulation in this clause is one in which the 'public are interested within the meaning of the explanation in Section 74 of Indian Contract Act, 1872.

Explanation: Controlled Area means the following areas:

District of Dhanbad, Hazaribagh, Jamtara - a sub Division under Santhal Pargana Commissioner, Districts of Bankura, Birbhum Burdwan District or Bilaspur. Any other area, which may be declared a Controlled Area by or with the approval of the Central Government.

17.13 Apprentices Act Provisions To Be Complied With

The Contractor shall comply with the provisions of the Apprentices Act, 1961, Apprenticeship Rules, 1992 and other rules and orders issued there under from time to time. If he fails to do so, his failure will be a breach of the Contract and the Engineer-in-Charge may, in his discretion, cancel the Contract. The Contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.

17.14 Labour disputes

17.14.1 The Contractor shall at all the times during the progress of Works take all requisite precautions and use his best endeavours for preventing any riotous or unlawful behaviour by or among the workers and other employees at work and shall preserve peace and protection of the inhabitants and the security of property in the neighbourhood of the Works.

17.14.2 In case of any disputes with labour (skilled or unskilled) and charges are claimed against the Contractor, the Engineer-in-Charge shall have the full authority to deduct the same from the bill of the Contractor, so as to enable him to settle the disputes.

18.0 Miscellaneous Clauses

18.1 Dispute Resolution

18.1.1 Amicable Resolution

- (i) Save where expressly stated to the contrary in this Contract, any dispute, difference or controversy of whatever nature between the Parties, howsoever arising under, out of or in relation to this Contract (the "Dispute") shall in the first instance be attempted to be resolved amicably with the Employer.

- (ii) In case of failure to amicably resolve the dispute under clause (i) above either Parties may require such Dispute be referred to a 3 member body consisting of Chief Secretary of the Government of NCT of Delhi or his representative, as Chairman, the Chief Executive Officer of the DJB, and a nominee representative of the Contractor for amicable settlement. Upon such reference, both the Parties shall be required by such three member body to meet at the earliest mutual convenience and in any event within 15 (fifteen) days of such reference to discuss and attempt to amicably resolve the Dispute. If the Dispute is not amicably settled within thirty days of such meeting between the Parties, either Party shall have liberty to take further action in accordance with the law. There is no Arbitration of Clause. The dispute will be settled in competent court of law.

18.2 If Relation Working in Employer then Contractor Not Allowed to Tender

The Contractor shall not be permitted to tender for Works in the Employer zone (responsible for award and execution of contracts) in which his near relative is posted as Divisional Accountant or as an officer in any capacity between the grades of the junior engineer and Chief engineer (both inclusive). He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any gazetted Officer with Employer. Any breach of this condition by the Contractor would render him liable to be removed from the approved list of Contractors of this Employer. NOTE: By the term "near relatives" is meant wife, husband, parents and grandparents, children and grand children, brothers and sisters.

18.3 No Gazetted Engineer to work as Contractor/ Consultant within one year of retirement/ resignation

No engineer of gazette rank or other gazette officer employed in engineering or administrative duties in an engineering department of the Government of Delhi shall work as a Contractor/ Consultant or employee of a Contractor/ Consultant for a period of one year after his retirement from government service without the previous permission of Employer in writing. This Contract is liable to be cancelled if either the Contractor/ Consultant or any of his employees is found at any time to be such a person who had not obtained the permission of Government of Delhi as aforesaid, before submission of the tender or engagement in the Contractor's/ Consultant's service, as the case may be.

18.4 Corruption or fraudulent practices

18.4.1 Employer defines, for the purposes of this provision, the terms set forth below as follows:

- (i) "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, and
- (ii) "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 Employer, and includes collusive practice among bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive them of the benefits of free and open competition;

18.4.2 The Employer will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the Contract.

18.5 Use of Explosives

Subject to the Applicable Laws and the Applicable Permits, the Contractor shall comply with the following:

- (i) the use of explosives by the Contractor shall be subject to the prior approval/authorization of the concerned Government Instrumentality;

- (ii) the Contractor shall at all times take all such safety measures as may be required for the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen to the full satisfaction of the Engineer-in-Charge.
- (iii) the Contractor shall, by a notice in writing, **15** days prior to the blasting operation, notify all parties including Government Instrumentalities, private parties concerned or affected or likely to be concerned or affected by blasting operations for their prior approval; and the Contractor shall pay all license fees and charges which may be required for storage of explosives or in respect of any other matter related thereto.
- (iv) All operations in which or for which explosives are employed shall be at the sole risk and responsibility of the Contractor and the Contractor shall indemnify the Employer in respect thereof.

18.6 Confidentiality and Publicity

The Contractor shall treat the details of the Contract as private and confidential save in so far as may be necessary for the purpose thereof, and shall not publish or disclose the same or any particulars thereof in any trade or technical paper or elsewhere without the previous consent in writing of the Employer. Publication of approved articles, photographs or similar materials shall carry acknowledgement to the Employer and state the name of the Engineer-in-Charge. If any dispute arises as to the necessity of any publication or disclosure for the purpose of the Contract the same shall be referred for decision to the Employer, whose decision shall be final.

Any advertising mentioning the subject of this Contract must be approved by the Employer prior to publication.

18.7 Individuals not personally Liable

No member or officer of the Employer nor the representative of Engineer-in-Charge nor any one of the respective staffs or the employees of the Employer shall be in any way personally liable for the acts or obligations of the Employer under the Contract or answerable for any default or omission of the Employer in the observance or performance of any of the acts, matters or things which are herein contained.

18.8 Limitation of Liability

18.8.1 Neither Parties shall be liable to the other Parties for loss of profit, loss of any Contract or for any indirect or consequential loss or damage which may be suffered by the other Parties in connection with the Contract, other than under clause 3.7 (Indemnity by Contractor) and Section 11 (Termination of Contract)

18.8.2 The total Liability of the Contractor to the Employer, under or in connection with the Contract, other than under clause 3.7 (Indemnity by Contractor), Clause 3.13 (Responsibility of damage to property and injury to persons) clause 3.15 (Electricity for construction of Works) and 3.16 (Supply of water) shall not exceed the Contract Price

18.8.3 This clause shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Parties. Further, this clause shall not limit any criminal action that may follow from any action.

18.9 Waiver and Consents Clause

18.9.1 Waiver by either Party of any default by other Party in the observance and performance of any provision of or obligations of or under this Contract

- i) shall not operate or be construed as a waiver of any other or subsequent default hereof or of other provisions of or obligations under this Contract;
- ii) shall not be effective unless it is in writing and executed by a duly authorized representative of the Party; and
- iii) shall not affect the validity or enforceability of this Contract in any manner.

18.9.2 Neither the failure by either Party to insist on any occasion upon the performance of the terms, conditions and provisions of this Contract or any obligation there under nor time or other indulgence granted by a Party to the other Party shall be treated or deemed as waiver of such breach or acceptance of any variation or the relinquishment of any such right hereunder.

18.9.3 Any such waiver or consent may be given subject to any conditions thought fit by the Party giving it and shall be effective only in the instance and for the purpose for which it is given.

Delhi Jal Board Safety Code

- 1.0 Suitable scaffolds should be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable footholds and hand-hold shall be provided on the ladder and the ladder shall be given an inclination not steeper than $\frac{1}{4}$ to 1 ($\frac{1}{4}$ horizontal and 1 vertical.)
- 2.0 Scaffolding of staging more than 3.6 m (12ft.) above the ground or floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached or bolted, braced and otherwise secured at least 90 cm. (3ft.) high above the floor, or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.
- 3.0 Working platforms, gangways and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6 m (12ft.) above ground level or floor level, they should be closely boarded; should have adequate width and should be suitably fastened as described in (2) above.
- 4.0 Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of person or materials by providing suitable fencing or railing whose minimum height shall be 90 cm. (3ft.)
- 5.0 Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9m. (30 ft.) in length while the width between side rails in rung ladder shall in no case be less than 29 cm. (1 11/2") for ladder up to and including 3 m. (10 ft.) in length. For longer ladders this width should be increased at least 1/4" for each additional 30 cm. (1 foot) of length. Uniform step spacing of not more than 30 cm shall be kept. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites or work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect the public from accident and shall be bound to bear the expenses of defense of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit, action or proceedings to any such person or which may, with the consent of the contractor, be paid to compensate any claim by any such person.

- 6.0 Excavation and Trenching - All trenches 1.2 m. (4ft.) or more in depth, shall at all times be supplied with at least one ladder for each 30 m. (100 ft.) in length or fraction thereof Ladder shall extend from bottom of the trench to at least 90 cm. (3ft.) above the surface of the ground. The sides of the trenches which are 1.5 m. (5ft.) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 m. (5ft) of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.
- 7.0 Demolition - Before any demolition work is commenced and also during the progress of the work,
- i) All roads and open areas adjacent to the work site shall either be closed or suitably protected
 - ii) No electric cable or apparatus which is liable to be a source of danger ore cable or apparatus used by the operator shall remain electrically charged.
 - iii) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.
- 8.0 All necessary personal safety equipment as considered adequate by the Engineer-in-Charge should be kept available for the use of the person employed on the site and maintained in a condition suitable for immediate use, and the contractor should take adequate steps to ensure proper use of equipment by those concerned:
- The following safety equipment shall invariably be provided.
- i) Workers employed on mixing asphalt materials, cement and lime mortars shall be provided with protective footwear and protective goggles.
 - ii) Those engaged in white washing and mixing or stacking of cement bags or any material which is injurious to the eyes shall be provided with protective goggles.
 - iii) Those engaged in welding works shall be-provided with welder's protective eye shields.
 - iv) Stone breaker shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
 - v) When workers are employed in sewers and manholes, which are in active use, the contractors shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public, in addition, the contractor shall ensure that the following safety measure are adhered to
 - a) Entry for workers into the line shall not be allowed except under supervision of the JE or any other higher officer.
 - b) At least 5 to 6 manholes upstream and downstream should be kept open for at least 2 to 3 hours before any man is allowed to enter into the manhole for working inside.

- c) Before entry presence of Toxic gases should be tested by inserting wet lead acetate paper which changes colour in the presence of such gases and gives indication of their presence.
- d) Presence of Oxygen should be verified by lowering a detector lamp into the manhole. In case, no Oxygen is found inside the sewer line, workers should be sent only with Oxygen kit.
- e) Safety belt with rope should be provided to the workers. While working inside the manholes such rope should be handled by two men standing outside to enable him to be pulled out during emergency.
- f) The area should be barricaded or cordoned off by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public whenever cleaning works are undertaken during night or day.
- g) No smoking or open flames shall be allowed near the blocked manhole being cleaned.
- h) The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of slippery nature of the malba
 - i) Workers should not be allowed to work inside the manhole continuously. He should be given rest intermittently.
 - j) The Engineer- in-Charge may decide the time up to which a Gas masks with Oxygen Cylinder should be kept at site for use in emergency.
- k) Air-blowers should be used for flow of fresh air through themanholes. Whenever called for portable air blowers are recommended for ventilating the manholes. The Motors for these shall be vapour proof and of totally enclosed type. Non sparking gas engines also could be used but they should be placed at least 2 meters away from the opening and on the leeward side protected from wind so that they will not be a source of friction on any inflammable gas that might be present.
- l) The workers engaged for cleaning the manholes/sewers should be properly trained before allowing working in the manhole
- m) The workers shall be provided with Gumboots or non sparkin shoes bump helmets and gloves non sparking tools safety lights and gas masks and portable air blowers (when necessary). They must be supplied with barrier cream for anointing the limbs before working inside the sewer lines.
- n) Workmen descending a manhole shall try each ladder stop or rung careful before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole well.
- o) If a man has received a physical injury, he should be brought out of the sewer immediately and adequate medical aid should be provided to him.
- p) The extents to which these precautions are to be taken depend on individual situation but the decision of the Engineer-in-Charge regarding the steps to be taken in this regard in an individual case will be final.
- vi) The Contractor shall not employ men and women below the age of 18 years on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following precaution should be taken:-
 - a) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

- b) Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scraped.
- c) Overalls shall be supplied by the contractors to the workmen and adequate facilities shall be provided to enable the working painters to wash during and on the cessation of work.

9.0 Contractor shall not employ women and men below the age of 18 on the work of painting with product containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following principles must be observed for such use:

- i) White lead, sulphate of lead or product containing these pigment, shall not be used in painting operation except in the form of pastes or paint ready for use.
- ii) Measures shall be taken, wherever required in order to prevent danger arising from the application of paint in the form of spray.
- iii) Measures shall be taken, wherever practicable, to prevent danger arising out of from dust caused by dry rubbing down and scraping
- iv) Adequate facilities shall be provided to enable working painters to wash during and on cessation of work.
- v) Overall shall be worn by working painters during the whole of working period.
- vi) Suitable arrangement shall be made to prevent clothing put off during working hours being spoiled by painting materials.
- vii) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by medical man appointed by competent authority of DJB
- viii) DJB may require, when necessary medical examination of workers.
- ix) Instructions with regard to special hygienic precautions to be taken in the painting.

10.0 When the work is done near any place where there is risk of drowning, all necessary equipments should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person In danger and adequate provision, should be made for prompt first aid treatment of all injuries likely to be obtained during the course of the work.

11.0 Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following standards or conditions

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

3. Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to operator.
 4. In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension the safe working load shall be ascertained by adequate means. Every hoisting machine and all parts referred to above shall be plainly marked with the safe working load. In case of a hoisting machine having a variable safe working load each safe working load and the condition under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.
 5. In case of departmental machines, the safe working load shall be notified by the Electrical Engineer-in-charge. As regards contractors machines the contractors shall notify the safe working load of the machine to the Engineer-in-charge whenever he brings any machinery to site of work and get it verified by the Electrical Engineer concerned.
- 12.0 Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, Insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided. The worker should not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.
- 13.0 All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.
- 14.0 These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place at work spot. The person responsible for compliance of the safety code shall be named therein by the contractor.
- 15.0 To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the contractor shall be open to inspection by the Labour Officer or Engineer-in-Charge of the department or their representatives.
- 16.0 Notwithstanding the above clauses from (1) to (15) there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force in the Republic of India.

SAFETY GUIDELINES AS PER DJB circular dated 12.06.09

Following guideline /instructions should be adhered to in true spirit:-

1. The door may be fixed at the entry of the stair case and the open portion of the stair case of sump well should be protected by grill up to the height of 7 feet and compartments of the sump well should be covered with jalls/grating or should be barricaded property. Sewage pumping station should be secured by providing and fixing barbed wire fencing over the boundary wall.
2. An inspection register should be placed at the sewage pump house in which all the inspecting officers may record their observations. No unauthorized entry should be allowed.
3. Caution board showing the restricted entry area and name of components and moving mechanical part should be displayed.
4. The entry to all DJB infrastructures should be restricted to the person /persons authorized by DJB or having I.D cards issued by the chief security officer.
5. Just after entering the premises do's and don'ts should be displayed at prominent places in all four languages.
6. Even authorized visitors should be provided proper uniform /visitor badges helmet and relevant safety gear and given instruction before showing such infrastructure.

No person below 18 years age should be allowed on the premises where chances of emission of toxic gases are extensive.

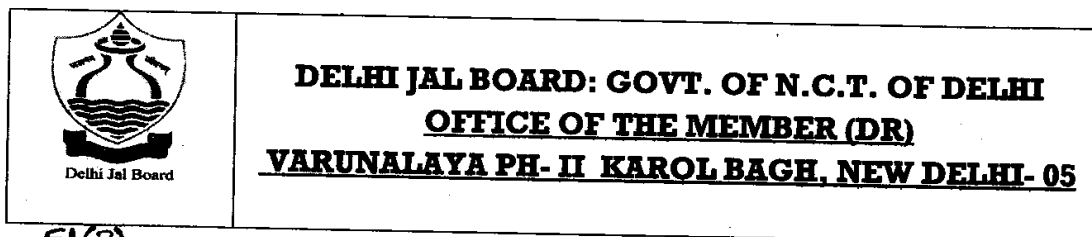
NHRC GUIDELINES

NHRC issued guidelines on safety code for operation/maintenance of sewerage system vide letter No.1069/30/2001-2002/F.C. dated 18.11.02. Same shall form part of agreement and has to be strictly followed during execution of work.

Direction given by Hon'ble Supreme Court in the matter of National Campaign for Dignity & Right of Sewerage & Allied workers.

1. The medical examination and medical treatment will be given free of charge to sewer workers and the treatment will continue for all such workers found to be suffering from an occupational disease, ailment or accident until the workman is cured or until death.
2. The services of the sewer workers are not to be terminated, either by the respondents or the contractors engaged by them during the period of illness and they shall be treated as if on duty and will be paid their wages.
3. The respondents shall pay on the death of any worker including any contract worker, an immediate ex-gratia solatium of One lakh with liberty to recover the same from contractors, if permissible in law.
4. The respondents shall pay/insure payment of all statutory dues such as Provident Fund, Gratuity and Bonus to all the sewer workers including contract workers, as applicable in law.
5. The respondents shall provide as soon as possible modern protective equipments to all the sewer workers in consultation with the petitioner organization.
6. The respondents shall provide soap and oil to all the workmen according to the present quota but on monthly basis and not at the end of the year.
7. The respondents shall provide all workmen including contract workmen with an accident-card-cum-wage-slip as set out in clause 8 of the CPWD/PWD(DA)/Delhi Jal Board Contractors Labour Regulations (for short "Labour Regulations").
8. The respondents shall authenticate by signing the payment of wages register for contract workers in terms of clause 5 of the Labour Regulations.

9. The Delhi Jal Board is directed to ensure that the ex-gratia payment in case of deaths of sewer workers has been paid to the families of deceased workmen.
- 10 The successful bidder shall ensure that the safety measures mentioned in the contract conditions and PEMS Act and their rehabilitation rule 2013 are followed strictly. In case of any accident, death, the contractor shall be liable to pay minimum compensation Rs. 10 lacs in accordance with the Hon'ble Supreme Court verdict dated 27.03.2014 in Writ petition No. 583 of 2003 (Safai Karamchari Andolan and Others Vs UOI & Ors.) and as provided in the PEMS Act 2013. In case of failure, DJB shall have the right to make the compensation & recover the amount from the contractor. Further DJB reserves the right to debar the firm from tendering/ black listing if the above condition is not adhered to be the firm/Contractor."



F1(3)

No. DJB/Member (Dr)/2017/

Dated: 30-08-2017

INSTRUCTIONAL ORDER

Subject: - Regarding safety of workers and implementation of PEMS Act and their Rehabilitation Rule, 2013.

In continuation to the instructional order issued from time to time, a comprehensive instructional order on the subject is hereby circulated with respect to strict implementation of PEMS Act and their Rehabilitation Rule, 2013.

1. **The rule 3 to 8 of the PEMS Act and their Rehabilitation Rule, 2013 should be strictly followed and the same are reproduced below: -**

Rule 3. (1) No person shall be allow to clean a sewer manually, with the protective gear and safety devices under these rules except :-

- (a) For the removal of the concrete or FRP (Fiber Reinforced Plastic) or damaged manhole door where mechanical equipments cannot be put into operation.
- (b) For inter- linking the newly laid sewer main with the existing sewer main, in case of sewer of size of more than 300 mm diameter.
- (c) For removal of submersible pump sets fixed at the bottom of the suction wells.
- (d) For the reconstruction of the manhole or rectification of the sewer main.
- (e) Any circumstance, when it is absolutely necessary to have manual sewage cleaning, after the CEO of the local authority has permitted

to do so after recording in writing the specific valid reasons for allowing such cleaning.

(2) For the purposes of clauses (c) and (d) of sub- rule (1), before allowing entry of a person in the sewer, sewage shall be totally emptied.

Rule 4. Any person engaged to clean a sewer or a septic tank shall be provided by his employer, protective gear and safety devices including, but not limited to the following :-

- (i) Air compressor for blower
- (ii) Air line breathing apparatus
- (iii) Air line respirator with manually operated air blower
- (iv) Air purifier gas mask/ chin corcege
- (v) Artificial respiration / Reticulate
- (vi) Barrier caution tape
- (vii) Barrier cram
- (viii) Barrier cone
- (ix) Blower
- (x) Breath mask
- (xi) Breathing Apparatus
- (xii) Caution board
- (xiii) Chlorine mask
- (xiv) Emergency medical oxygen resuscitator Kit
- (xv) First Aid Box
- (xvi) Face Mask
- (xvii) Gas Monitor (4 gases)
- (xviii) Guide Pipe Set
- (xix) Fully body Suit
- (xx) Fishing wader suit attached with boosts
- (xxi) Hand gloves
- (xxii) Head Lamp
- (xxiii) Helmet
- (xxiv) Helmet demolishing
- (xxv) Lead acetate paper
- (xxvi) Life guard pad

- (xxvii) Modula Airlines Supply Trolley System
- (xxviii) Normal face mask
- (xxix) Nylon rope ladder 5 metres
- (xxx) Nylon safety belt
- (xxxi) Pocket book
- (xxxii) Port oxy
- (xxxiii) Raincoat
- (xxxiv) Reflecting Jacket
- (xxxv) Safety Belt
- (xxxvi) Safety body clothing
- (xxxvii) Safety body harness
- (xxxviii) Safety goggles
- (xxxix) Safety Gumboots
- (xl) Safety helmet
- (xli) Safety showers
- (xlii) Safety torch
- (xliii) Safety Tripod Set
- (xliv) Search light

Rule 5. The local authority shall ensure that the following cleaning devices are used by persons engaged in cleaning sewer or septic tank including but not limited to the following :

- (i) Sewer Line Cleaning Bucketing Machine
- (ii) Jetting Machine
- (iii) Suction Machine (Gulley Emptier)
- (iv) Combined Machine (Jetting cum Suction)
- (v) Manual Hand Operated Grab Bucket
- (vi) Hydraulic Operated Trolley Mounted Grab Bucket
- (vii) Truck Mounted Mounted Grab Bucket
- (viii) Truck Mounted Motor and Winch Operated Grab Bucket Machine
- (ix) Fixed Structure Mounted Motor and Winch Operated Grab Bucket Machine
- (x) Rickshaw Mounted Winch and Motor Operated De-silting Machine for wet well

- (xi) Rickshaw Mounted Winch and Auxiliary Engine Operated De-silting Machine for Manhole
- (xii) Escort Hydra Crane Mounted Hydraulic Winch Operated Grab Bucket De-silting Machine
- (xiii) Manual rods, shovels, spades, drainage cleaning machines and steel scrapers with handles
- (xiv) Hoses and washing instruments.

Rule 6 (1) All protective gear and safety devices under these rules shall be checked every six months and necessary repair or replacements shall be made by the employer who engages a person for cleaning a sewer or a septic tank.

(2) Comfortable bodysuits shall be made available to the worker who has to enter sewers or septic tanks for their cleaning. The employer shall provide full body suits to workers entering manholes of depth less than five feet.

(3) The employer shall also ensure the following safety precautions before a person is engaged in the cleaning of a sewer or a septic tank, namely:-

- (a) There shall be a minimum of three employees present all the time, one of whom shall be a supervisor.
- (b) The atmosphere within the confined space shall be tested for oxygen deficiency and toxic and combustible gases including but not limited to poisonous gases like Hydrogen Sulphide, Carbon Monoxide, Methane, and gasoline vapors, through detection tests including the following :-
 - (i) Lowering a detector lamp into the manhole,
 - (ii) Inserting wet lead acetate paper which changes colour in the presence of hazardous gases.
 - (iii) Detection of gases through gas detector masks.

- (c) Before starting the cleaning under sub- rule (1) the supervisor referred to in clause (a) of sub- rule (3) has inspected and determined if the sewer serves any industries nearby to anticipate any hazardous atmosphere that may be encountered.
- (d) The condition of metal – rung ladders and the side walls of the manhole shall be checked to see if there is any danger of collapse.
- (e) Traffic and pedestrian barricades are provided all the times.
- (f) A flag man should be stationed at least 50 feet ahead of a site and should be visible to incoming traffic for at least 500 feet.
- (g) Regular medical checkup of sewage workers which shall include the examination of respiratory organs, skin injuries and other occupational diseases and injuries for their treatment to ensure that sewage workers afflicted with such diseases or injuries do not enter sewers for cleaning.
- (h) Regular vaccination against respiratory and skin diseases and other occupational diseases to which these workers are prone due to exposure to harmful substances and gases in sewers.
- (i) All employees who are present on- site during cleaning work are given training and adequately familiarized with the knowledge to operate all equipments involved in cleaning work, to avoid injuries or diseases associated with such work and to take necessary steps in case of emergency arising at the place of work and the training shall be conducted every two years and the employees shall be familiarized with any changes in method and technique with respect to the above.
- (j) The supervisor possesses and keeps handy the names, addresses and telephone numbers of the nearest hospitals or clinics.
- (k) Cleaning of sewer or a septic tank shall be done :-
 - i. Only in day light; and
 - ii. For duration not exceeding 90 minutes, at a stretch. There shall be a mandatory interval of 30 minutes between two stretches.

- (l) Identify and close off or reroute any lines that might carry harmful substances to, or through, the work area.
- (m) Ensure that written operating and rescue procedures are displayed at the entry site.
- (n) If the entry is made through a top opening, use a housing devices with a harness that suspends a person in an upright position and a mechanical device shall be available to retrieve personnel from vertical spaces more than five feet deep.
- (o) At least one person trained in first aid and cardiopulmonary resuscitation should be immediately available during any confined space job.
- (p) Oxygen content in the manhole must be at least 19.5% in the confined space of the manhole measures at all levels (bottom, middle and top) and no person enters the manhole if oxygen level is below 19.5% and more than 21%.
- (q) Ventilate the sewer line by opening at least two or three manholes on both sides where work is to be carried out.
- (r) Manhole shall be opened at least one hour before the start of operation
- (s) The opened manhole shall be properly fenced or barricaded to prevent any person, especially children, from accidentally falling into the sewer. Dummy cover with welded fabric or wire- net may be used
- (t) All works use the safety gear and safety devices before e entering the sewer line.
- (u) The person entering the manhole or sewer line must be monitored using signal or camera or CCTV etc, throughout the operation period.
- (v) Structural safety f manhole rungs or steps must be tested before entering the manhole.
- (w) Portable aluminum ladder is available during the work period during the work period where necessary and the portable ladder is properly seated of fixed during use.
- (x) No material or tools are located near the edge which can fall into the manhole and injure the workman.

- (y) Equipments used during sewer cleaning are explosion and fire-proof.
- (z) Smoking open flames are prohibited inside the manhole as well as in the immediate vicinity of open manholes.
- (aa) In the event of a sudden or unpredictable atmospheric change and emergency escape breathing apparatus with at least a 10 minutes air supply is worn.

Rule 7 The employer shall ensure the following safety precautions at the time when the person is engaged in the cleaning of a sewer or a septic tank:-

- (i) Portable fans and air blowers with batteries in good working condition with a back up capacity of more than the estimated duration of the entry of the person in the sewer shall be carried into sewers for ventilation and a ventilation source shall be installed at the mouth of the manhole.
- (ii) Flashlights and communication devices such as two- way radios shall be carried into sewers.
- (iii) Presence of the following rescue equipment at the site :-
 - (a) A tripod and harness system, or some other method ensuring maneuvering of an injured worker to the surface.
 - (b) A basket stretcher or similar device shall be available for moving the injured worker to emergency transportation.
 - (c) First aid equipment as given in Annexure- I and trained personnel shall be immediately available.
- (iv) The employer shall ensure availability of ambulance and follow-up in close proximity.
- (v) The employer shall ensure that the assigned person has life insurance policy of at least ten lakh rupees and the premium for which shall be paid by the employer.

Rule 8 The employer shall ensure the following post- cleaning safety precautions after and person engaged in the cleaning of a sewer or a septic tank comes out of the sewer or septic tank after a session of cleaning:-

- (i) Providing facilities for removal of contaminated clothing and for wash – up as well as cleaning dry clothing.
- (ii) Wash up material shall include but not be limited to water, soaps, hand sanitizers and adequate and medically authenticated skin cream for applying on the body for post cleaning safety.
- (iii) Any cuts / bruises on the skin or problems with a respiratory organ suffered on account of cleaning of sewer shall be immediately cured.

2. Further the Do's and Don't' issued vide instruction Order No. F1((9)/Dir. (S&DM)/2007/ dated 19.04.2007 by Member (DR) reproduced below be strictly followed: -

A comprehensive list of Do's and Don'ts for ensuring safety of the sewer workers while entering the sewer lines/ manholes has been prepared. It should be ensured by the Engineer in charge that it is followed invariably by all the sewer workers:-

Do's

1. Place easily readable and clear warning signals firmly embedded and supported well ahead of work area.
2. Provide Red Lanterns or electric light signals during night.
3. Place barricades or diversion boards indicating signs to channelize the traffic.
4. Barricade the opened manholes as well as trenches.
5. Keep a first aid box properly stocked including washing bottles to wash away skin and eyes.
6. Ventilate the sewer line by opening 2 or 3 manholes at least one hour before start of operations on both sides where work is carried out.
7. Test for hazardous gases before entry of a person into the sewer line and also in between if the operation is carried out for a longer time. Nobody should be allowed to go inside the manhole if the content of gases is beyond the permissible limits. The silt should be disturbed by suitable means to remove the entrapped gases. Wear gas masks as a precautionary measure.
8. Use the air blowers for ventilation or gas masks, if required.

9. Test and use the safety harness and life line before entering the sewer line.
10. Use safety helmets while working in the manhole.
11. Use protective body suit or use oil (Coconut or sweet oil) on the body before entering into the manhole and take bath immediately after completing the work.
12. Use rubber hand gloves and boots before entering into the manhole.
13. Keep finger nails short and well trimmed.
14. Try each ladder step or rung carefully before putting the full weight on it to guard against insecure fastening due to corrosion of the rung at the manhole.
15. Wash hands with soap and hot water before taking food or smoking and keep fingers out of nose, mouth and eyes.
16. Wash all contaminated parts of the body after the work is completed.
17. Mix the scum well with sewage before entering into the manhole.
18. Leave the manhole at once if there is an unusual or peculiar smell
19. Check carefully that all men have left the sewer of manhole.

DON'TS

1. Do not keep any material or tools near the edge which can fall into the manhole and injure the workman.
2. Do not enter the manhole without wearing your protective body suit, safety belts, gloves, gum boots etc.
3. Do not go inside the manhole during afternoon in summers when the temperature is high.
4. Do not work inside the manhole for more than 15 minutes at a stretch.
5. Do not smoke or use safety lamp inside the sewer or manhole.
6. Do not walk along a sewer inside without a lifeline with a person holding your lifeline standing outside.
7. Do not enter the manholes without written permission of ASI/ SI/ JE /ZE concerned.
8. Do not enter if the concentration of the hazardous gases is more than the permissible level.
9. Do not throw lighted match sticks in the manhole.
10. Do not leave any manhole or trench unmanned and /or properly barricaded.

The Don'ts may be read in conjunction with the Do's while entering the sewer line / manholes.

3. Instructional Order No. DJB/M(Dr.)/2012/89445 dated 23.08.2012 issued by Member (DR) reproduced below be strictly followed: -

Protection and Safeguard of its workers working in hazardous conditions like cleaning sewer etc. is obligatory on the part of DJB. To avoid accidents due to suffocation, drowning, physical injuries and exposure to toxic materials in the sewerage system, it is essential that the adequate safety measures are in place & proper precautions are taken. To ensure that all safety measures are taken, several instructional orders have been issued from time to time.

The following guidelines/ precautions are being reiterated and may be religiously followed to avoid any accidents: -

1. No man entry should be allowed in the manhole without issue of work permit by the competent authority.
2. All safety equipments like Helmets, Gum Boots, Hand Gloves, Full Body Suit, Hand Blowers, Gas Detectors, Folding Ladders, Safety Belt, Oxygen Cylinder etc. must be available in adequate numbers and maintained in working condition by the store in charge.
3. As far as possible, mechanized cleaning operations should be carried out in deep pit work stations should be procured in adequate numbers by the Executive Engineers as per their requirement. Work permit system must be followed regularly.
4. Man entry should be allowed only after checking that the level of poisonous gases in the manhole is within the permissible limits. Proper level of gases must be checked by the Gas Detector. The permissible limits of various gases are tabulated: -

S. No.	Gas	Maximum limit for 1 hour exposure	Maximum limit for 8 hour exposure
1	CO	0.04% by volume in air	0.005% by volume in air
2	H2S	0.02% by volume in air	0.001% by volume in

			air
3	CH4	Probably no limit provided oxygen percentage is sufficient	1% by volume in air
4	O2	Oxygen level should be 19.50-21% by volume in air.	

It would be safer to consider limit of 8 hours exposure.

5. Ventilation of the manhole must be maintained by opening 2-3 manholes upstream & downstream sides. Blowers, if necessary, must be operated at least 30 minutes before start and during cleaning operations.
6. The workers should not be allowed to work in sewer for more than 15 minutes in a single stretch. It should be ensured that all required safety equipments are available and are being used by the sewer workers.
7. In peak summer season, man entry in sewer manholes may not be allowed between 11 AM to 4 PM.
8. The equipments required in case of rescue of the workers should be available outside the manhole/work area.
9. First Aid Box with all required medicines (within expiry date) must be readily available in case of emergency.
10. Dos's and Don'ts for safe working in each unit should be displayed. Printed or written operating and maintenance schedule should be displayed near to each equipment in the language understood by all operating staff.
11. Proper ventilation is required to be made in raw sludge pump houses and return sludge pump houses and other buildings in the plant. Units should have sufficient number of exhaust fans.
12. Smoking or carrying open flames in and around digesters and gas holders should be prohibited.
13. All electrical installations, wiring etc. shall be provided and maintained as per Indian Electricity Rules and standards approved by the department.

Safety of the sewer workers is the collective responsibility of DJB. The safety & Disaster Management Cell conducts regular awareness programme/

training to educate the sewer workers about the hazards of working in sewers. It is obligatory on the part of every office of DJB involved in the sewer cleaning/hazardous operations to ensure that the sewer workers are working in safe working environment. It is instructed that the safety guidelines and instructional orders be followed in true spirit by all concerned.

4. Further following precautions circulated vide No. F-2(2)/M(DR)/2015/876-879 dated 10.12.2015 reproduced below be strictly followed: -

PRECAUTIONS TO BE TAKEN WHILE CLEANING OPERATIONS

i) Precautions before commencing the operation:

1. As far as possible mechanized cleaning should be undertaken at the work place. In case it is not feasible to do so, no single person should be allowed to undertake the work of cleaning of sewerage facility.
2. There should be minim. of two employees present all the time and one of them shall be trained and experienced. The supervisor shall remain present at all time.
3. If the peak summer season entry of the person into the sewer manhole/ septic tank should not be allowed between 11 AM to 4 PM when concentration of gases is expected to be high.
4. First aid box to meet the emergency should be available at the work place before commencing the work. Keep the emergency contact numbers of ambulance, Police, Fire Brigade handy for use to provide immediate relief in case of any accident.
5. It is the responsibility of the person who has engaged the labour to clean the septic tank/ sewage plant to apprise them about the "Do's and Don'ts" in advance to ensure safety.
6. Before undertaking the work, the manholes of the chamber/ septic tank/ sewers should be kept open for minimum 4 hr. Duration to ensure sufficient cross ventilation.
7. Before under taking the work it will be the duty of the employer to note down name of the person, his address, family whereabouts and emergency contact numbers of his near dear ones so that they can be contacted in case of emergency.

ii) Precautions during operations

8. The person engaged for cleaning the septic tanks / sewers is not allowed to consume alcohol or take any drugs. Also the persons who are not physically fit should not be allowed to undertake the work.
9. The persons engaged for the job will be essentially required to wear the protective gear as per requirement of the work place.
10. The protective gear and safety equipment shall comprise of the equipments mentioned in clause (d) of sub – section (1) of section (2) of MS Act, which is as following (i) Safety body clothing / safety body harness / safety belt (ii) Normal face mask (iii) Safety torch (iv) Hand gloves (v) safety goggles (vi) safety helmet (vii) Emergency medical oxygen resuscitator kit (viii) Gas Monitor (ix) Head lamp (x) Reflecting jacket (xi) Guide pipe set (xii) Safety tripod set (xiii) Wadder suit (xiv) Chlorine Mask (xvi) Air compressor for blower (xvii) Modular Airlines Supply Trolley System (xviii) Full face mask (xix) Safety Gumboots (xx) Raincoat.
11. If there is appearance of white foam and no live cockroach then there is strong possibility of presence of poisonous gases in that chamber. Use litmus paper /gas detector to confirm the same. Give sufficient time by opening the chamber to open sky and if possible use air blowers to allow the gases to escape before taking up the work.
12. Do not depend on the presence of the foot rests fixed in the chamber wall since there is a possibility that with passages of time grip/ hold of the footrest has given way and it may not be strong enough to take the load. Always us rope ladder after testing its carrying strength.
13. No person should be allowed to continue to work or stay in the chamber for more than 15 minutes at a stretch. The persons outside the chamber should remain in conversation with the person/ persons inside the chamber to ensure their well being in case of uneasiness to the person working inside the chamber a signal shall be given by shaking the rope attached his safety harness so that he can be pulled out of the chamber.
14. Smoking or carrying open fire flame in the near vicinity of the work place should not be allowed. Any electric installation should also be not

switched on or switched off near the place of work. If electric wires happen to be nearby, they should be properly insulated.

15. No tools or equipment should be placed near the edge of the manhole to avoid any injury to the worker due to sudden fall of the equipment inside the manhole.

iii). Precautions post operations

16. Do not leave the injured person alone and avoid gathering of mob around him.
17. Occurrence of any accident resulting into injury / death if any at septic tank /sewage plant shall be informed to labour / police deptt. immediately. Injuries/ death suffered while undertaking cleaning / maintenance/ repairs of the sewerage systems shall be dealt with either under ESI Act, 1948, if applicable or under "The Employees Compensation Act, 1923" or any other Group Insurance as the case may be for the purposes of compensation to the injured person / legal heirs as the case may be.
18. Compensation to be paid to the family members of the victims shall be in accordance with the Hon'ble Supreme Court verdict dated 27.03.2014 in Writ petition No. 583 of 2003 (Safai Karamchari Andolan and Others Vs UOI & Ors.).
19. The committee also recommends appointment of inspectors to identify the insanitary latrines as defined under section 20 of the MS Act.

5. **The Instructional Order issued vide No. DJB/M(Admn.)/2008/758 dated 18.03.2008 by Member (Admin) regarding issuance of work permit system be strictly followed. The copy of the format is enclosed as Annexure-I.**

6. A clause shall be added in the contract conditions of all sewer cleaning works that "The successful bidder shall ensure that the safety measures mentioned in the contract conditions and PEMS Act and their rehabilitation rule 2013 are followed strictly. In case of any accident/ death, the contractor shall be liable to pay minimum compensation Rs. 10 lacs in accordance with the Hon'ble Supreme Court verdict dated 27.03.2014 in Writ petition No. 583 of 2003 (Safai Karamchari Andolan and Others Vs UOI & Ors.) and as provided in

the PEMS Act 2013. In case of failure, DJB shall have the right to make the compensation & recover the amount from the contractor. Further DJB reserves the right to debar the firm from tendering/ black listing if the above condition is not adhered to be the firm/ contractor."

Sd/-
Sh. R S Negi
Member(Dr)

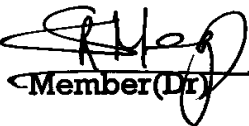
All CEs

All SEs

All EEs

Copy for information to :-

1. PS (UD)
2. Secretary SC/ST
3. Secretary to CEO
4. Member(WS)/ Member(A)/ Member(Finance)
5. CVO
6. EE(EDP)


Member(Dr)

दिल्ली जल बोर्ड, राष्ट्रीय राजधानी राज्यक्षेत्र, दिल्ली सरकार
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नई दिल्ली-110032

संख्या एफ.(17) सदस्य (प्रशासन)/2013/ 647

दिनांक : 18.9.13

निर्देशात्मक आदेश

निर्देशात्मक आदेश संख्या एफ (17)/सदस्य (प्रशासन)/2007/71164 दिनांक 18.7.2008 के अधिकमण में एतद्वारा आदेश दिया जाता है कि भविष्य में कर्मचारियों को किसी सीमित स्थान में प्रवेश/कोई जोखिम भरा कार्य करने के लिए वर्क परमिट (कार्य अनुमति पत्र) जारी करने के लिए निम्नलिखित अधिकारियों को अधिकृत किया जाता है :-

क. सं०	सीमित स्थान/अन्य स्थान जहां जोखिम पूर्ण स्थिति रहती है	वर्क परमिट जारी करने के लिए अधिकृत अधिकारी
1.	सीवर लाइन/मेनहोल	अधीक्षण अभियंता
2.	वह चैम्बर जिसमें पानी हो/जल शोधन संयंत्र/अवजल उपचार संयंत्र/भूमिगत जलाशय/बूस्टर पम्पिंग स्टेशन/सीवेज पम्पिंग स्टेशन आदि के गहरे चैम्बर/अति स्वेदन शील स्थान	अधीक्षण अभियंता
3.	गैस होल्डर/गैस डाईजेस्टर	अधीक्षण अभियंता
4.	विद्युत एवं यांत्रिक के छोटे * मरम्मत कार्य	फॉर्मैन
5.	विद्युत एवं यांत्रिक के बड़े * मरम्मत कार्य	कनिष्ठ अभियंता/ सहायक अभियंता

*अधिशाली अभियंता द्वारा नियमानुसार परिभाषित किये जायेंगे

आगे यह भी सुनिश्चित किया जाएगा कि सीवर लाइन में कर्मचारी के प्रवेश की अनुमति अधीक्षण अभियंता की स्वीकृति से केवल कुछ परिस्थितियों में ही दी जाएगी और प्रवेश सहायक अभियंता के स्तर के अधिकारी की उपस्थिति में होगा। सहायक अभियंता सभी सुरक्षा मापदंडों के अनुपालन को सुनिश्चित करेगा। साथ ही यह भी सुनिश्चित किया जाएगा कि उपरोक्त कार्यों में दिल्ली राजपत्र सं० 62 दिनांक 12.04.13 में दिए गये निर्देशों का पालन अनिवार्य रूप से हो रहा है।

(कार्य अनुमति पत्र) वर्क परमिट जारी करने के लिए संबंधित संलग्न प्रपत्र लागू किया जाएगा।

संलग्न : वर्क परमिट प्रपत्र

1. सीमित स्थान/सीवर में प्रवेश के लिए वर्क परमिट
2. जल उपचार संयंत्र/अवजल उपचार संयंत्र/भूमिगत जलाशय/बूस्टर पम्पिंग स्टेशन/सीवेज पम्पिंग स्टेशन आदि के कार्य करने हेतु वर्क परमिट।
3. विद्युत एवं यांत्रिकी कार्यों के लिए वर्क परमिट।

समस्त मुख्य अभियंता

सदस्य (प्रशासन)

प्रतिलिपि :

1. मुख्य कार्यकारी अधिकारी
2. सदस्य (जल)/सदस्य (ड्रेनेज)/सदस्य (बिज)
3. समस्त अधीक्षण अभियंता : कृपया उपरोक्त निर्देशात्मक आदेश को सभी अधिशासी अभियंता के मध्य प्रसारित करें ।
4. निदेशक (सुरक्षा एवं आपदा प्रबन्धन)
5. मास्टर फाईल


17.09.2013.
सदस्य (प्रशासन)

सीमित स्थान /सीवर में प्रवेश के लिए वर्क परमिट

1	स्टोर का नाम	
2	स्थल का नाम	
3	किये जाने वाले काम का विवरण /सीवर की गहराई	
4	क्लिष्ट अभियंता का नाम / सहायक अभियंता	
5	कार्य के लिए लगाये गये कर्मचारियों के नाम 1 सफाई निरीक्षक /सहायक सफाई/ निरीक्षक/ मेट/ मेषन आदि । 2 सीवर गैंग बेलदार 3 4 5	
6	व्यक्तिगत सुरक्षा उपकरण /वस्त्र उपलब्ध कराये गये 1 गैस मास्क 2 गम बूट 3 दस्ताने 4 शारीरिक सुरक्षा सूट 5 ऑक्सीजन सिलेन्डर गैस मास्क के साथ 6 एअर ब्लोअर	
7	सुरक्षा औजार /उपयोजन प्राणाली उपलब्ध कराना । 1 सेफटी बेल्ट 2 रस्सी 3	
8	स्थल के लिए कोई विशेष औजार/ उपकरण कराये गये है ।	
9	वतावरण जाँच की रिडिंग 1 कार्बन मोनो आक्साइड का स्तर 2 मेथेन स्तर 3 हाइड्रोजन सल्फाइड का स्तर 4 अन्य कोई नुशीले आवयव 5 ऑक्सीजन का स्तर	
10	क्या कर्मचारी प्रशिक्षित एवं जोखिम को समझने वाले हैं	
11	अन्य उपस्थित कर्मचारी 1 2 3	
12	क्या आपात कालीन प्रक्रियाएँ नियत स्थल पर है	
13	वर्क परमिट की वैधता	

अधिकरण एवं स्वीकृति :मैंने सुनिश्चित कर लिया है कि प्रत्येक पहचाने गये उपाय समुचित कर्मचारियों सहित उपलब्ध हैं ।धारक को वर्क परमिट की शर्तें स्पष्ट कर दी गई है, कार्य आरम्भ किया जाए ।

	नाम	पदनाम	हस्ताक्षर	समय	वर्क परमिट पंजिका में दर्ज की गयी क्रम संख्या पृष्ठ संख्या
वर्क परमिट जारी करना					
वर्क परमिट समाप्त करना					

MODEL RULES FOR THE PROTECTION OF HEALTH AND SANITARY ARRANGEMENTS FOR WORKERS EMPLOYED BY CPWD/ DELHI JAL BOARD OR ITS CONTRATORS

1. APPLICATION

These rules shall apply to all buildings and construction works in charge of C.P.W.D./Delhi Jal Board in which twenty or more workers are ordinarily employed or are proposed to be employed in any day during the period during which the contract work is in progress.

2. DEFINITION

Work place means a place where twenty or more workers are ordinarily employed in connection with construction work on any day during the period during which the contract work is in progress.

3. FIRST-AID FACILITIES

- (i) At every work place there shall be provided and maintained, so as to be easily accessible during working hours, first-aid boxes at the rate of not less than one box for 150 contract labour or part thereof ordinarily employed. (ii) The first-aid box shall be distinctly marked with a red cross on white background and shall contain the following equipment, a) For work places in which the number of contract labour employed does not exceed 50 - Each first-aid box shall contain the following equipments :- 1. 6 small sterilised dressings. 2. 3 medium size sterilised dressings. 3. Large size sterilised dressings. 4. 3 large sterilised bum dressings. 5
- (ii) . 1 (30 ml.) bottle containing a two per cent alcoholic solution iodine. 6. 1 (30 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label. 7. 1 snakebite lancet. 8. 1 (30 gms.) bottle of potassium permanganate crystals. 9. 1 pair scissors. 10. 1 copy of the first-aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India. 11. 1 bottle containing 100 tablets (each of 5 gms.) of aspirin. 12. Ointment for bums. 13. A bottle of suitable surgical antiseptic solution. b) For Work places in which the number of contract labour exceeds 50 - Each first-aid box shall contain the following equipments. 12 small sterilised dressings..1 6 medium size sterilised dressings..2 6 large size sterilised dressings..3 6 large size sterilised bum dressings..4 6 (15gms.) packets sterilised cotton wool..5 1 (60 ml) bottle containing two percent alcoholic solution iodine..6 1 (60 ml) bottle containing salvolatile having the dose and mode of administration indicated on the label. 1 roll of adhesive plaster..8 1 snake bite lancet..9 1(30 gms.) bottle of potassium permanganate crystals..10 1 pair scissors..11 1 copy of the first-aid leaflet Issued by the Director General Factory..21 Advice Service and Labour Institutes / Government India. A bottle containing 100 tablets (each of 5 gms.) of aspirin..31 Ointment for bums..41 157 A bottle of suitable surgical antiseptic solution..51 (iii) Adequate arrangements shall be made for immediate recoupment of the equipment, when necessary. (iv) Nothing except the prescribed contents shall be kept in the First-aid box. (v) The first-aid box shall be kept in charge of a responsible person who shall always be readily available during the working hours of the work place. (vi) A person in charge of the First-aid box shall be a person trained in First-aid treatment, in the work places where the number of contract labour employed is 150 or more. (vii) In work places where the number of contract labour employed is 500 or more and hospital facilities are not available within easy distance from the works. First-aid posts shall be established and run by a trained. The compounder shall be on duty and shall be available at all hours when the workers are at work. (viii) Where work places are situated in places which are not towns or cities, a suitable motor transport shall be kept readily available to carry injured person or person suddenly taken ill to the nearest hospital.

4.DRINKING WATER

(i) In every work place, there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking. (ii) Where drinking water is obtained from an intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored. (iii) Every water supply or storage shall be at a distance of not less than 50 feet from any latrine drain or other source of pollution. Where water has to be drawn from an existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed and be provided with a trap door which shall be dust and waterproof. (iv) A reliable pump shall be fitted to each covered well, the trap door shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

5. WASHING FACILITIES

(i) In every work place adequate and suitable facilities for washing shall be provided and maintained for the use of contract labour employed therein. (ii) Separate and adequate cleaning facilities shall be provided for the use of male and female workers. (iii) Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition.

6. LATRINES AND URINALS

(i) Latrines shall be provided in every work place on the following scale namely: a) Where female are employed there shall be at least one latrine for every 25 females. b) Where males are employed, there shall be at least one latrine for every 25 males. Provided that where the number of males or females exceeds 100, it shall be sufficient if there is one latrine for 25 males or females as the case may be upto the first 100, and one for every 50 thereafter. (ii) Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings. (iii) Construction of latrines: The inside walls shall be constructed of masonry or some suitable heat-resisting nonabsorbent materials and shall be cement washed inside and outside/at least once a year. Latrines shall not be of a standard lower than borehole system. 158 (iv) a) Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal, a notice in the language understood by the majority of the workers "For Men only" or "For Women Only" as the case may be. b) The notice shall also bear the figure of a man or of a woman, as the case may be. (v) There shall be at least one urinal for male workers upto 50 and one for female workers upto fifty employed at a time, provided that where the number of male or female workmen, as the case may be exceeds 500, it shall be sufficient if there is one urinal for every 50 males or females upto the first 500 and one for every 100 or part thereafter. (vi) a) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times. b) Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the Public Health Authorities. (vii) Water shall be provided by means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals. (viii) Disposal of excreta :- Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator. Alternately excreta may be disposed of by putting a layer of night soil at the bottom of a pucca tank prepared for the purpose and covering it with a 15 cm. layer of waste or refuse and then covering it with a layer of earth for a fortnight (when it will turn to manure). (ix) The contractor shall at his own expense, carry out all instructions issued to him by the Engineer-in-Charge to effect disposal of night soil and other conservancy work in respect of the contractor's workmen or employees on the site. The contractor shall be responsible for payment of any charges which may be levied by Municipal or Cantonment Authority for execution of such on his behalf.

7. PROVISION OF SHELTER DURING REST

at every place there shall be provided, free of cost, four suitable sheds, two for meals and the other two for rest separately for the use of men and women labour. The height of each shelter shall not be less than 3 metres (10 ft.) from the floor level to the lowest part of the roof. These shaft be kept clean and the space provided shall be on the basis of 0.6 sq.m. (6sft) per head. Provided that the Engineer-in-Charge may permit subject to his satisfaction, a portion of the building under construction .or other alternative accommodation to be used for the purpose.

8. CRECHES

(i) At every work place, at which 20 or more women worker are ordinarily employed, there shall be provided two rooms of reasonable dimensions for the use of their children under at the age of six years. One room shall be used as a play room for the children and the other as their bedroom. The rooms shall be constructed with specifications as per clause 19H (ii) a, b & c. (ii) The rooms shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean. (iii) The contractor shall supply adequate number of toys and games in the play room and sufficient number of cots and beddings in the bed room. (iv) The contractor shall provide one ayaa to look after the children in the creche when the number of women workers does not exceed 50 and two when the number of women workers exceeds 50. 159 (v) The use of the rooms earmarked as crèches shall be restricted to children, their attendants and mothers of the children.

9. CANTEENS (i) In every work place where the work regarding the employment of contract labour is likely to continue for six months and where in contract labour numbering one hundred or more are ordinarily employed an adequate canteen shall be provided by the contractor for the use of such contract labour. (ii) The canteen shall be maintained by the contractor in an efficient manner. (iii) The canteen shall consist of at least a dining hall, kitchen, storeroom, pantry and washing places separately for workers and utensils. (iv) The canteen shall be sufficiently lighted at all times when any person has access to it. (v) The floor shall be made of smooth and impervious materials and inside walls shall be lime-washed or colour washed at least once in each year. Provided that the inside walls of tile kitchen shall be Semi-washed every four months. (vi) The premises of the canteen shall be maintained in a clean and solitary condition. (vii) Waste water shall be carried away in suitable covered drains and shall not be allowed to accumulate so as to cause a nuisance. (viii) Suitable arrangements shall be made for the collection and disposal of garbage. (ix) The dining hall shall accommodate at a time 30 per cent of the contract labour working at a time. (x) The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chairs shall not be less than one square meter (10 sft) per diner to be accommodated as prescribed in sub-Rule 9. (xi) a) A portion of the dining hall and service counter shall be partitioned off and reserved for women workers in proportion to their number. b) Washing places for women shall be separate and screened to secure privacy (xii) Sufficient tables stools, chair or benches shall be available for the number of diners to be accommodated as prescribed in sub-Rule 9. (xiii) a) There shall be provided and maintained sufficient utensils crockery, furniture and any other equipment necessary for the efficient running of the canteen. 1. The furniture utensils and other equipment shall be maintained in a clean and hygienic condition. b) Suitable clean clothes for the employees serving in the canteen shall be provided and maintained. 1. A service counter, if provided, shall have top of smooth and impervious material. 2. Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipments. (xiv) The food stuffs and other items to be served in the canteen shall be in conformity with the normal habits of the contract labour. (xv) The charges for food stuffs, beverages and any other items served in the canteen shall be based on 'No Profit, No Loss' and shall be conspicuously displayed in the canteen. (xvi) In arriving at the price of foodstuffs, and other article served in the canteen, the following items shall not be

taken into consideration as expenditure namely :- a) The rent of land and building. 160 b) The depreciation and maintenance charges for the building and equipments provided for the canteen. c) The cost of purchase, repairs and maintenance of equipments including furniture, crockery, cutlery and utensils. d) The water charges and other charges incurred for lighting and ventilation. e) The interest and amounts spent on the provision and maintenance of equipments provided for the canteen. (xvii) The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors.

10.ANTI-MALARIAL PRECAUTIONS

The contractor shall at his own expense, conform to all anti-malarial instructions given to him by the Engineer-in-Charge including the Ming up of any borrow pits which may have been dug by him.

11. The above rules shall be incorporated in the contracts and in notices inviting tenders and shall form an integral part of the contracts.

12. AMENDMENTS Government may, from time to time, add to or amend these rules and issue directions- it may consider necessary for the purpose of removing any difficulty which may arise in the administration thereof.

C.P.W.D. CONTRACTOR'S LABOUR REGULATIONS

1. SHORT TITLE

These regulations may be called the C.P.W.D./PWD (DA) / Delhi Jal Boards Contractors Labour Regulations.

2. DEFINITIONS

(i) Workman means any person employed by/C.P.W.D/PWD (DA) / Delhi Jal Boards or its contractor directly or indirectly through a subcontractor with or without the knowledge of the Central Public Works Department/PWD (DA) / Delhi Jal Boards to do any skilled, semiskilled or unskilled manual, supervisory, technical or clerical work for hire or reward, whether the terms of employment are expressed or implied but does not include any person :- a) Who is employed mainly in a managerial or administrative capacity: or b) Who, being employed in a supervisory capacity draws wages exceeding five hundred rupees per mensem or exercises either by the nature of the duties attached to the office or by reason of power's vested in him, functions mainly of managerial nature : or c) Who is an out worker, that is to say, person to whom any article or materials are given out by or on behalf of the principal employers to be made up cleaned, washed, altered, ornamental finished, repaired adopted or otherwise processed for sale for the purpose of the trade or business of the principal employers and the process is to be carried out either in the home of the out worker or in some other premises, not being premises under the control and management of the principal employer. No person below the age of 14 years shall be employed to act as a workman. (ii) Fair Wages means wages whether for time or piece work fixed and notified under the provisions of the Minimum Wages Act from time to time. (iii) Contractors shall include every person who undertakes to produce a given result other than a mere supply of goods or articles of manufacture through contract labour or who supplies contract labour for any work and includes a subcontractor. (iv) Wages shall have the same meaning as defined in the Payment of Wages Act. 161 0.3 (i) Normally working hours of an adult employee should not exceed 9 hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 hours on any day. (ii) When an adult worker is made to work for more than 9 hours\on any day or for more than 48 hours in any week he shall be paid overtime for the extra hours put in by him at double the ordinary rate of wages. (iii) a) Every worker shall be given a weekly holiday normally on a Sunday, in accordance with the provisions of the Minimum Wages (Central) Rules 1960 as amended from time to time irrespective of whether such worker is governed by the Minimum Wages Act or not. b) Where the minimum wages prescribed by the Government under the Minimum Wages Act are not inclusive of the wages for the weekly day of rest. The worker shall be entitled to rest day wages at the rate applicable to the next preceding day, provided he has worked under the same contractor for a continuous period of not less than 6 days. c) Where a contractor is permitted by the Engineer-in-Charge to allow a worker to work on a normal weekly holiday, he shall grant a substituted holiday to him for the whole day on one of the five days immediately before or after the normal weekly holiday and pay wages to such worker for the work performed on the normal weekly holiday at overtime rate.

3. DISPLAY OF NOTICE REGARDING WAGES ETC.

The contractor shall before he commences his work on contract, display and correctly maintain and continue to display and correctly maintain in a clear and legible condition in conspicuous places on the work, notices in English and in the local Indian languages spoken by the majority of the workers giving the minimum rates of wages fixed under Minimum Wages Act, the actual wages being paid, the hours of work for which such wage are earned, wages periods, dates of payments of wages and other relevant information as per Appendix III'

4. PAYMENT OF WAGES

The contractor shall fix wage periods in respect of which wages shall be payable. (ii) No wage period shall exceed one month. (iii) The wages of every person employed as contract labour in an establishment or by a contractor where less than one thousand such persons are employed shall be paid before the expiry of seventh day and in other cases before the expiry of tenth day after the last day of the wage period in respect of which the wages are payable. (iv) Where the employment of any worker is terminated by or on behalf of the contractor the wages earned by him shall be paid before the expiry of the second working day from the date on which his employment is terminated. (v) All payment of wages shall be made on a working day at the work premises and during the working time and on a date notified in advance and in case the work is completed before the expiry of the wage period, final payment shall be made within 48 hours of the last working day. (vi) Wages due to every worker shall be paid to him direct or to other person authorized by him in this behalf. (vii) All wages shall be paid in current coin or currency or in both. (viii) Wages shall be paid without any deductions of any kind except those specified by the Central Government by general or special order in this behalf or permissible under the Payment of Wages Act 1956. (ix) A notice showing the wages period and the place and time of disbursement of wages shall be displayed at the place of work and a copy sent by the contractor to the Engineer-in-Charge under acknowledgment. 162 (x) It shall be the duty of the contractor to ensure the disbursement of wages in the presence of the Junior Engineer or any other authorised representative to the Engineer-in-Charge who will be required to be present at the place and time to disbursement of wages by the contractor to workmen. (xi) The contractor shall obtain from the Junior Engineer or any other authorised representative of the Engineer-in-Charge as the case may be, a certificate under his signature at the end of the entries in the 'Register of Wages' or the "Wage-cum-Muster Roll" as the case may be in the following form :- 'Certified that the amount shown in column No..... has been paid to the workman concerned in my presence on at " FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES

0.6 (i) The wages of a worker shall be paid to him without any deduction of any kind except the following :- (a) Fines (b) Deductions for absence from duty i.e. from the place or the places where by the terms of his employment he is required to work. The amount of deduction shall be in proportion to the period for which he was absent. (c) Deduction for damage to or loss of goods expressly entrusted to the employed person for custody, or for loss of money or any other deduction which he is required to account, where such damage or loss is directly attributable to his neglect or default. (d) Deduction for recovery of advances or for adjustment of overpayment of wages, advances granted shall be entered in a register. (e) Any other deduction which the Central Government may from time to time allow. (ii) No fines should be imposed on any worker save in respect of such acts and omissions on his part as have been approved of by the Chief Labour Commissioner. Note : An approved list of Acts and Omissions for which fines can be imposed is enclosed at Appendix-1 (iii) No fine shall be imposed on a worker and no deduction for damage or loss shall be made from his wages until the worker has been given an opportunity of showing cause against such fines or deductions. (iv) The total amount of fine which may be imposed in any one wage period on a worker shall not exceed an amount equal to three paise in a rupee of the total wages, payable to him in respect of that wage period. (v) No fine imposed on any worker shall be recovered from him by installment, or after the expiry of sixty days from the date on which it was imposed. (vi) Every fine shall be deemed to have been imposed on the day of the act or omission in respect of which it was imposed.

7. LABOUR RECORDS

(i) The contractor shall maintain a Register of persons employed on work on contract in Form XIII of the CL (R&A) Central Rules 1971 (Appendix IV) (ii) The contractor shall maintain a Muster Roll register in respect of all workmen employed by him on the work under Contract in Form XVI of the CL (R&A) Rules 1971 (Appendix V). (iii) The contractor shall maintain a Wage

Register in respect of all workmen employed by him on the work under contract in Form XVII of the CL (R&A) Rules 1971 (Appendix VI) (iv) Register of accident - The contractor shall maintain a register of accidents in such form as may be convenient at the work place but the same shall include the following particulars : Pull particulars of the labourers who met with accident.)α 163 Rate of Wages.)β Sex)χ Age)δ Nature of accident and cause of accident.)ε Time and date of accident.)φ Date and time when admitted in Hospital.)γ Date of discharge from the Hospital.)η Period of treatment and result of treatment.)ι Percentage of loss of earning capacity and disability as assessed by)φ Medical Officer. . Claim required to be paid under Workmen's Compensation Act.)κ Date of payment of compensation.)λ Amount paid with details of the person to whom the same was paid.)μ Authority by whom the compensation was assessed.)ν Remarks)ο (v) The contractor shall maintain a Register of Fines the Form XII of the CL (R&A) Rules 1971 (Appendix-XI) The contractor shall display in a good condition and in a conspicuous place of work the approved list of acts and omissions for which fines can be imposed (Appendix-X) (vi) The contractor shall maintain a Register of deductions for damage or loss in Form XX of the CL (R&A) Rules 1971 (Appendix-XII) (vii) The contractor shall maintain a Register of Advance in Form XXIU of the CL (R&A) Rules 1971 (Appendix-XIII) (viii) The Contractor shall maintain a Register of Overtime in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIV).

8. ATTENDANCE CARD-CUM-WAGE SLIP

(i) The contractor shall issue an Attendance card-cum-wage slip to each workman employed by him in the specimen form at (Appendix-VII) (ii) The card shall be valid for each wage period. (iii) The contractor shall mark the attendance of each workman on the card twice each day, once at the commencement of the day and again after the rest interval, before he actually starts work. (iv) The card shall remain in possession of the worker during the wage period under reference. (v) The contractor complete the wage slip portion on the reverse of the card at least a day prior the disbursement of wages in respect of the wage period under reference. (vi) The contractor shall obtain the stature or thumb impression of the worker on the wage slip at the time of disbursement of wages and retain the card with himself.

9. EMPLOYMENT CARD

The contractor shall issue an Employment Card in Form XIV of the CL (R&A) Central Rules 1971 to each worker within three days of the employment of the worker (Appendix-VIII).

10. SERVICE CERTIFICATE

On termination of employment for any reason whatsoever the contractor shall issue to the workman whose services have been terminated, a Service certificate in Form XV of the CL (R&A) Central Rules 1971 (Appendix-IX).

11. PRESERVATION OF LABOUR RECORDS

All records required to be maintained under Regulations Nos. 6&7 shall be preserved in original for a period of three years from the date of last entries made in them and shall be made available for inspection by the Engineer-in-Charge or Labour Officer or any other officers authorized by the Ministry of Urban Development t) Ms behalf.

12. POWER OF LABOUR OFFICER TO MAKE INVESTIGATIONS OR ENQUIRY The Labor Officer or any person authorized by Central Government on their behalf shall have power to make enquires with a view to ascertaining and enforcing due and proper observance of Fair Wage Clauses and the Provisions of there Regulations. He shall investigate into any complaint regarding the default made by the contractor or subcontractor in regard to such provision.

13.REPORT OF LABOUR OFFICER

The Labor Officer or other persons authorized as aforesaid shall submit a report of result of his Investigation or enquiry to the Executive Engineer concerned indicating the extent, if any, to which the default has been committed with a note that necessary deductions from the contractor's bill be made and the wages and other dues be paid to the labourers concerned. In case an appeal is made by the contractor under Clause 13 of these regulations, actual payment to labourers will be made by the Executive Engineer after the Superintending Engineer has given his decision on such appeal. (i) The Executive Engineer shall arrange payments to the labor concerned within 45 days from the receipt of the report from the Labor Officer or the Superintending Engineer as the case may be.

14. APPEAL AGAINST THE DECISION OF LABOUR OFFICER

Any person aggrieved by the decision and recommendations of the Labor Officer or other person so authorized may appeal against such decision to the Superintending Engineer concerned within 30 days from the date of decision, forwarding simultaneously a copy of his appeal to the Executive Engineer concerned but subject to such appeal, the decision of the officer shall be final and binding upon the contractor.

15. PROHIBITION REGARDING REPRESENTATION THROUGH LAWYER

(i) A workman shall be entitled to be represented in any investigation or enquiry under these regulations by :- a) An officer of a registered trade union of which he is a member. b) An officer of a federation of trade unions to which the trade union referred to in clause (a) is affiliated. c) Where the employer is not a member of any registered trade union, by an officer of a registered trade union, connected with the industry in which the worker is employed or by any other workman employed in the industry in which the worker is employed. (ii) An employer shall be entitled to be represented in any investigation or enquiry under these regulations by :- a) An officer of an association of employers of which he is a member. b) An officer of a federation of associations of employers to which association referred to in clause (a) is affiliated. c) Where the employers is not a member of any association of employers, by an officer of association of employer connected with the industry in which the employer is engaged or by any other employer, engaged in the industry in which the employer is engaged. (iii) No party shall be entitled to be represented by a legal practitioner in any investigation or enquiry under these regulations.

16. INSPECTION OF BOOKS AND SLIPS

The contractor shall allow inspection of alt the preserved labour records to any of his workers or to his agent at a convenient time and place after due notice is received or to the Labour Officer or any other person, authorized by the Central Government on his behalf.

17. SUBMISSIONS OF RETURNS

The contractor shall submit periodical returns as may be specified from time to time.

18. AMENDMENTS

The Central Government may from time to time add to or amend the regulations and on any question as to the application / interpretation or effect of those regulations the decision of the Superintending Engineer concerned shall be final.

Specifications and Special Terms & conditions for Sewer lines related works.

NOTE: Special condition & Specifications of contract shall prevail without any prejudice to the General Conditions of contract.

1. The work shall be carried out as per safety code related to sewer works as contained in DJB contract.
2. The contractor will provide all necessary safety equipments as per DJB safety code to the workers at his own cost. **The contractor shall provide, as soon as possible, modern protective equipments to all the sewer workers in consultation with the Engineer in charge.**
3. The contractor shall be responsible for proper supervision and safety of workers. No compensation shall be entertained by DJB in case, any injury /casualty takes place. **Contractor shall be responsible for pay compensation of Ten lakh for each person in case of any fatal accident.**
4. The contractor will provide T & P to the workers required for de-silting work & nothing shall be paid extra.
5. No underage / overage person shall be engaged against the work. The latest guidelines related to sewer works shall be strictly adhered to.
6. Contractor shall issue oil/soap as required by engaged workers on his own & no extra payment shall be made to him on this account. **The Contractor shall provide soap and oil to all the workmen according to the present quota but on monthly basis and not at the end of the year.**
7. In case of any dispute between workers engaged & the contractor or any third party, the decision of engineer-in-charge shall be final.
8. All instructions issued by the Engineer-in-charge shall be followed strictly. In case of any disobedience, misbehaviour by the staff of contractor, Engineer-in-charge may also order for removal of such person(s) from site of work for which the agency shall have to comply strictly & promptly. The decision of Engineer-in-charge in such events shall be final and binding to the contractor.
9. The contractor shall be responsible for engaging the staff after due verification of their character & past antecedents.
10. He will ensure that their medical examination should also be got done on regular basis. The medical examination and medical treatment will be given free of charge to Sewer workers and the treatment will continue for all such workers found to be suffering from an occupational disease, ailment or accident until the workman is cured or until death.
11. **Labour insurance should be of more than Ten lakh for each person working in sewer work by the contractor.** Copy of the insurance of all engaged workers shall be submitted before start of work.
12. Copy of wages slip of workers engaged shall be submitted to Engineer-in-charge at the time of submission of bills.
13. All such record should be maintained by contractor & has to be produced as & when required by the Authority/Officer of Delhi Jal Board.
14. The firm shall be responsible for engaging appropriately, qualified/trained staff for the respective job.
15. Contractor shall quote rates including all expenses and taxes.
16. **Permission from Relevant Authorities**

- i. The contractor shall pursue road cutting /Traffic Police permission with the concerned Govt. agency. The required R R Charges shall be deposited by the department. However, contractor is also allowed to deposit the same after justifying the implication of bills by department. The deposited charges will be reimbursed to the contractor as per actual.
- ii. The commencement of work shall not be withheld in want of receipt of formal permission from land owning agency. No hindrance shall be accounted in execution of the work unless otherwise it is practically stopped at site by land owning agency.

17. The quoted rates are deemed to be include cost of all labour, equipments etc required for cutting of C C Road irrespective of hardness of surface i/c RMC road. Payment for cost of all materials and work involved will be made as per relevant items in the bill of quantities/ contract. No extra item what so ever in reference to cutting of RMC, if any, apart from the items existing in BOQ will be considered for payment.

18. Inspection / Checking of works:

1. The work is liable to be inspected and checked by a 3rd party fixed by DJB/vigilance wing of DJB or by any other statutory authority of the Govt. The work can be checked by the agencies as mentioned above simultaneously, subsequently, jointly or independently and the contractor shall be responsible for removing of all defects / deficiencies pointed out at his own cost.
 2. The inspection of one agency / authority / team shall not absolve the contractor of his own responsibility on to the defects pointed out by the other agencies and rectification thereto. Recoveries, if any, proposed by any of the inspection agency on account of short comings in respect of quality / quantity, if it is within acceptable limit but not reducing soundness and strength of the work, shall be recovered from the contractor's payments.
 3. If the defects noticed are beyond the acceptable limit, the contractor shall have to demolish / dismantle and rectify the same as per instructions of Engineer-in-Charge.
 4. The Contractor shall inform the Engineer-in-charge in advance for the production of material and fabrication for the factory inspection.
19. Co-bidder will not be allowed to work as the sub contractor to the main contractor for any component of the awarded scope of work.
 20. The contractor shall survey the proposed alignment to ensure the requirement of material like pipes, specials etc for obtaining Excise exemption certificate.
 21. All the surplus mulba/ excavated earth shall be disposed off by the contractor at his own. In lieu of the same neither any cartage shall be paid nor shall any royalty be recovered.
 22. The man entry in the manhole/pipeline is strictly prohibited. In case of any emergency or any other suitable alternate manual entry may be permitted with written permission of the Engineer-in-charge by using all safety equipments i/c full body suit as prescribed in the guidelines issued by NHRC.
 23. The successful bidder shall ensure that the safety measures mentioned in the contract conditions and PEMS Act and their Rehabilitation Rule 2013 are followed strictly. In case of any

accident /death ,the contractor shall be liable to pay minimum compensation of Rs. 10 lacs in accordance with the Hon'ble Supreme Court verdict dated 27.03.2014 in Writ Petition No. 583 of 2003 (Safai Karamchari Andolan and Other Vs UOI &Ors) and as provided in the PEMS Act.2013. In case of failure, DJB shall have the right to make the compensation and recover the amount from the contractor .Further DJB reserve the right to debar the firm from tendering/black listing if the above condition is not adhered to by the firm/contractor.

24. The minimum wages to the labour shall be paid strictly as per the latest orders of the Govt. of NCT Delhi with time to time amendments in this regard.
25. No claim on account of working in foul conditions and confined space shall be entertained.
26. No escalation what so ever shall be paid on the quoted rates during and after completion of works. This supersedes all other conditions related to the escalation clause.
27. In case of condition or specifications mentioned at different places in the bid document, the most stringent shall be applicable.
28. There should be no over flow/surcharged condition while carrying out the above desilting.
29. If required only pneumatic plug will be used for short duration.
30. Tracing of buried manholes and replacement of manhole frame and cover if required will be done by the contractor at his own cost.
31. Alignment of sewer lines and installations of barricades shall be the responsibility of the contractor and nothing extra will be paid on this account.
32. All the safety precautions during progress of work will be adopted as per the NHRC guidelines/ safety code and DJB SOP regarding work in the deep sewer line.

OFFICE OF THE MEMBER (DRAINAGE)
DELHI JAL BOARD: GOVT. OF NCT OF DELHI
VARUNALAYA PH-II: KAROL BAGH: NEW DELHI-05

No: DJB/Member (Dr.)/2023/196

Dated: 03.10.2023

INSTRUCTIONAL ORDER

It is a subject of grave concern that reports of accidents and deaths in sewer-related works continue to emerge from different areas intermittently, underscoring the imperative of robust preventive measures to eliminate the scourge from the National Capital. It is a fact that most accidents/deaths occur due to non-compliance with mandatory safeguards and protective measures, either due to ignorance or design. Hence, comprehensive awareness and educational campaigns are needed to comply with the provision of Prohibition of Employment as Manual Scavengers & their Rehabilitation Act-2013 (PEMS Act-2013) and to ensure that all necessary precautions are followed while carrying out de-silting/cleaning/removing/blockage of the sewers\drain\septic tanks, etc.

It is noted that various instructional orders have already been issued regarding the safety of workers and implementation of the PEMS Act and their Rehabilitation Rules, 2013. In the instructional order, dated 30.08.2017 issued by Member (Dr.), Rule 3 to 8 of the PEMS Act and their Rehabilitation Rules, 2013 has been spelt out in detail for implementation.

The Instructional Order issued by Member (Admin) vide No. DJB/M(Admin)/2008/758 dated 18.03.2008 regarding issuance of work permit system be strictly followed.

Therefore, it is hereby directed, the following conditions/ guidelines shall be added as a clause of safety and precaution in the contract conditions of bid to ensure all necessary precautions are followed while execution of the work of all sewer cleaning/ sewer rehabilitation/ other sewer works.

1. The successful bidder shall ensure that the safety measures mentioned PEMS Act-2013, and as per the Hon'ble Supreme Court verdict dated 27.03.2014 in

- Writ Petition No. 583 of 2003 (Safai Karamchari Andolan and Others Vs UOI & Ors.) & advisory issued by NHRC on 24 September- 2021 are followed strictly.
2. In case of any accident/ death, the contractor shall be liable to pay minimum compensation of Rupees 10 Lakh in accordance with the Hon'ble Supreme Court verdict dated 27.03.2014 in Writ Petition No. 583 of 2003 (Safai Karamchari Andolan and Others Vs UOI & Ors.) as well as mentioned in the PEMS Act, 2013, the employer shall ensure that the labour has a life insurance policy of at least Rupees 10 Lakh and the premium for which shall be paid by the contractor.
 3. In addition to above, the advisory on protection of Human Rights of the Person Engaged in Manual Scavenging on Hazardous Cleaning, issued by National Human Rights commission vide dated 24.09.2021 may be strictly followed.
 4. Further, DJB reserves the right to debar/black list the firm to participate any type of work, if the above condition is not adhered to by the firm/ contractor." For compliance with the above, Instructional Order No. F-1(3)/M(Dr)/2018/40-54 dated 09.01.2018 has also been issued from Member (Dr), Delhi Jal Board.

It is reiterated that the conditions/guidelines laid down as above should be followed strictly for the Departmental staff as well as the contractor, and are also be made part of the tender documents for sewer /drain-related works so that the successful bidder is contractually obligated to ensure the compliance of all safety measure as per PEMS Act-2013.

Pr. CE (Dr.) PRjo.- I/II
CE (Dr.) Proj.- III/ CE (SDW)
All ACEs (M)


(Ajay Gupta)
Member (Drainage)

Copy for kind information to: -

1. CEO
2. Member (A)


Member (Drainage)

help sub m.
 CE
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OFFICE OF THE MEMBER (ADMN.)
DELHI JAL BOARD, GOVT. OF NCT OF DELHI,
VARUNALAYA PHASE-II, JHANDEWALAN
KAROL BAGH, NEW DELHI-110005.

No. DJB/M (Admn.)/2008/ 758

Dated:- 18-03-08

INSTRUCTIONAL ORDER

Ensuring the Safety of workers during execution of work either through departmental labourer or by the contractors is the utmost responsibility of DJB. Instructions for ensuring safety have been issued time to time from various offices of DJB. The following guidelines/ codes must be followed by all to ensure the safety of the workers.

1. NHRC GUIDELINES AND NORMS
Issued vide letter No. DJB/member (Dr.)/2002/2293 dated 29.11.2002 and reiterated by Director (S&DM) vide No. F(1)/DJB/Dir.(S&DM)/2006/869 to 919 dated 29.5.2006.

These guidelines cover all important aspects related to the operation and maintenance of the sewers and manholes like sewer cleaning equipments and procedures, potential hazards and precautions, safety equipments and simple tests for detection of gases and oxygen deficiency, selection of sewer workers & safety guidelines for men working in the sewers to ensure the safety of the workers.

These guidelines are to be followed by all during sewerage maintenance works & must be included in the tender conditions.

2. DJB SAFETY CODE
Available on the DJB web site.
DJB Safety Code details out the procedures to be followed for ensuring safety during various construction activities and while working in sewers and man holes.
DJB Safety Code should form a part of the conditions of the contract.

Dr (S & DM)

3. REGARDING COMPENSATION TO BE PAID TO THE WORKERS.
Issued vide DJB/Member (Dr.) 2008/9308 dated 20.2.2008 is an obligatory condition on the part of the contractor and must be included in the tender specifications for all kinds of sewer works

"The successful bidder shall ensure that the safety measures mentioned in the contract conditions are followed strictly. In case of any accident/death, the contractor shall be liable to pay minimum compensation as provided under Workmen Compensation Act-1923. In case of failure, DJB shall have the right to make the compensation & recover the amount from the contractor. Further DJB reserves the right to debar the firm from tendering/black listing if the above condition is not adhered to be the firm/contractor."

4. CONSTITUTION OF SAFETY COMMITTEES

A Safety Committee at each JE (Sewer Store) comprising of JE (Sewer)/SI and a mate for ensuring availability of safety equipments in working conditions & their regular usage, adoption of proper work permit system & reporting to concerned Executive Engineer regarding any safety related issues/accidents must be constituted. Monthly reports of the implementation of above must be given by the Safety Committee to the concerned ZE/EE. Regular monitoring to be undertaken at the level of SE & CE on monthly and quarterly basis.

It is reiterated that the above guidelines must be followed in true letter & spirit for ensuring the safety of workers. The above guidelines, if not available with any division, may be collected from the office of Director (S&DM).

(X. K. Mahto)
Member (Administration)

All Chief Engineers

Copy to:-

1. ✓ CEO, for kind information.
2. M(W)/M(Dr.)
3. All SE's for ensuring compliance. S.E.
4. Director (S&DM)


Member (Administration)

(15)

Draft

OFFICE OF THE MEMBER (DRAINAGE)
DELHI JAL BOARD: GOVT. OF NCT OF DELHI
VARUNALAYA PHASE-II: KAROL BAGH
NEW DELHI-110005

No F-1(3)/M(Dr)/2018/ 40 - 54

Dated: 09.01.2018

INSTRUCTIONAL ORDER

During the review meeting of Hon'ble Chief Minister, Delhi on 6th & 7th January, 2018, the issue of additional labours for sewer cleaning was raised by few divisions. In this regard, it is informed that 10 Nos. SG Beldars for each Assembly Constituencies as per requirement projected earlier is already being provided for maintenance work of sewer for over ground work, like replacement of broken/ misplaced manhole cover, reporting of chocking, blockage and overflow of sewer in the area and minor repairing works. In addition to above, one Jetting-cum-suction machine has already been provided to the division for each Assembly constituency and one Recycler has also been provided at Circle level. Apart from above, for major sewer lines, super sucker is also being deployed with the specific permission from concerned Chief Engineer's.

However, in the specific problematic areas as per requirement of each division, management contract for the maintenance and upkeep of sewerage system may be awarded by the divisions for limited period with specific permission from concerned Chief Engineer.

It may be noted that a detailed instructional order vide No.F.1(3)/DJB/M(Admn)/2017/488-504 dated 30.08.2017 have already been issued regarding safety of workers and implementation of PEMS Act and their Rehabilitation Rules, 2013. In the instructional order, Rule 3 to 8 of the PEMS Act and their Rehabilitation Rules has been spelt out in detail for implementation.

The Instructional Order issued by Member (Admn) vide No.DJB/M(Admn)/2008/758 dated 18.03.2008 regarding issuance of work permit system be strictly followed.

A clause shall be added in the contract conditions of all sewer cleaning works that "The successful bidder shall ensure that the safety measures mentioned in the contract conditions and PEMS Act and their Rehabilitation Rule, 2013 are followed strictly. In case of any accident/ death, the contractor shall be liable to pay minimum compensation of Rs.10 lacs in accordance with the Hon'ble Supreme Court verdict dated 27.03.2014 in Writ

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Petition No.583 of 2003 (Safai Karamchari Andolan and Others Vs UOI & Ors.) and as provided in the PEMS Act, 2013. In case of failure, DJB shall have the right to make the compensation and recover the amount from the contractor. Further, DJB reserves the right to debar the firm from tendering/ black listing if the above condition is not adhered to be the firm/ contractor."

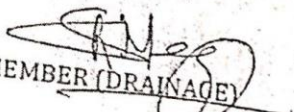
It is reiterated that the instructions laid down in the above said instructional order should be followed strictly for the departmental staff as well the management contract.

All CEs

Copy for information to:-

1. CEO
2. Member(A)/(F)/CNO(W)/CVO


(R.S. NEGI)
MEMBER (DRAINAGE)


MEMBER (DRAINAGE)

**OFFICE OF THE DEPUTY DIRECTOR (LAW)
DELHI JAL BOARD, VARUNALAYA PHASE-II,
KAROL BAGH NEW DELHI-110005**

Reference: - E-File no. 244823 *37687*

OFFICE ORDER NO. *55*

DATED: 23.07.2025

INSTRUCTIONAL ORDER

It has been learnt that an Instructional Order vide dated 11.07.2002 was issued from the office of Member (DR) with regard to deletion of Arbitration Clause in the tenders of DJB and the same is not strictly being complied with by the Engineering and other offices, while executing the contract agreements.

However, the matter of arbitration clause in DJB tenders is examined afresh and has now been decided that henceforth, all the officers concerned (either of engineering / revenue or of any other division/branch) are hereby instructed that in all the tenders/contract agreements of DJB, which are to be executed in future, there shall be no provision / clause of arbitration proceedings as a dispute resolution mechanism and a clause in this regard must specifically and invariably be mentioned stating that the disputes arising out of the contract agreements shall be adjudicated by the Courts of competent jurisdiction, at Delhi only.

This order shall come into effect immediately from the date of its issuance and it must be followed scrupulously by all concerned.

This is issued with approval of the CEO (DJB).

[Signature]
Dy. Director (Law)

Copy for information to:-

1. CEO
2. Member (A) / Member (F) / CVO/Addl.CEO

For information & compliance to:-

3. Director (A&P) / (Finance) / Revenue / Vigilance
4. CEN (DR) / CEN (WS)
5. All Chief Engineers

Copy for uploading on DJB Website:-

6. DD (IT)

7. Office Order Register

Dy. Director (IT)
Delhi Jal Board, GNDCTD

Dy. No. 1162 dt 24-7-25

Prp I
24/07/25

[Signature]
Dy. Director (Law)

DELHI JAL BOARD: GOVT OF NCT OF DELHI
OFFICE OF THE CHIEF EXECUTIVE OFFICER
VARUNALAYA PH-II, KAROL BAGH, NEW DELHI

No. DJB/CEO/2025/ D-607

Date : 19.07.2025

Time and again instructions are issued to ensure proper safety equipments/measures for the labours/workers working in Water and Drainage sectors under DJB.

It is reiterated that it shall be the responsibility of the executing agency/contractor to ensure that all safety measures/norms as instructed by different Commissions /Forums are strictly followed. It is necessary that DJB must be seen implementing all safety norms in letter and spirit to build up its professionalism.

During a surprise visit of the undersigned last week, one labour was found cleaning the sewer line without safety equipments which is a safety hazard and clear violation of safety measures/norms on the part of work-in-charge and the contractor concerned. Non-compliance of proper safety norms endangers the life of a worker/labour engaged particularly in sewer sector.

It is, hereby, directed that surprise checking be carried out in next one month vigorously in guidance of all the CEs concerned by officers subordinate to them to ensure that all safety norms are followed scrupulously by the contractors and work executing agencies in DJB internally. Any violation, in this regard, if noticed, the same should be tackled strictly to avoid any untoward incident.


(Kaushal Raj Sharma)
Chief Executive Officer, DJB

1. CEN(Dr)/CEN(W)
2. All CEs (Pr)
3. All SEs/EEs

Copy to :

1. Member (A)
2. Addl. CEO

Employer's Requirements (Technical Specifications)

: Technical Specifications for Rehabilitation Works

Part 1 – General Requirements

Part 2 – Technology and General Description

Part 3 – Site Establishment and Preliminary Works

Part 4 – Safe Entry and Working in Sewers Guidelines

Part 5 – General Works for Sewer Rehabilitation

Part 6 – Contractor's Submittals

Part 7 – Flow Diversion

Part 8 – Cleaning of Sewer and Desilting

Part 9 – Internal Condition Survey and CCTV/ Video Inspection of Sewer

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11 - Structural Lining

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TECHNICAL SPECIFICATION FOR REHABILITATION WORKS PART 1 -

GENERAL REQUIREMENTS

1.1. Specification

These specifications are intended for general description of site conditions, scope of work and requirements, products, execution, quality of workmanship and finished work. They are not intended to cover minute details. The work shall be executed in accordance with best modern practices and using special techniques.

The Contractor shall read this Technical Specification in conjunction with the standard specification of the Delhi Jal Board for Sewerage Works and other documents and technical manual, papers, guidelines, standards and specification etc. referred to the specification.

1.2 Contractor's Obligations

The clauses in this section are meant to provide general guidelines and compliance requirements to the Contractor. It does not however relieve the Contractor from taking all precautions as deemed necessary to complete the rehabilitation of sewers successfully within the specified contract period and the bided amount.

The consideration that structural lining method as a suitable method for rehabilitating the sewers in the Specification shall not relieve the Contractor in any way from his prima facie obligation and responsibility under the contract to successfully rehabilitate the sewer lines without causing interruptions to road and pedestrian traffic. It is deemed that the Contractor's rates in the Bill of Quantities are for successfully rehabilitating the sewers included in the scope of works, regardless of the methods considered as suitable in this specification.

1.2.1 Geology and Soil: To be updated based on Geotechnical Exploration Report

A brief description of surface geological cross section of the area, Kondli drainage zone of Delhi, covering package namely: Package – K2 (1) Refurbishment of Sewers of sizes varying from 1600 mm to 2100 mm Dia. in Kondli Zone is given below.

The Contractor shall obtain further geological and geotechnical information of the area, if required, from appropriate authorities and organisations or carryout geotechnical investigation, if he deems necessary, at his own cost.

The KONDLI Drainage Zone generally consists of sub-soil strata consists of layers of filled up, Fine Sand and Silty Sand. The sub-soil strata are loose to medium dense. The subsoil stratum from 0.0 to

1.50 m depth consists of Filled up, from 1.50 m to 4.50 m depth consists of Silty Sand classified as SM, and from 2.50 m to 10 m depth consists of Fine Sand classified as SP-SM.

The Chemical analysis of Soil sample for Sulphate contents, Chloride content and pH values but found below permissible limits and will not affect the structures adversely. The basement or hard rock occurs at greater depth around 300 m below GL. The ground water table is present from 4.80 m to 10.00 m below GL; it rises up to GL during Monsoon period some times. Contractor shall make reference to detailed geological survey maps for NCT areas from the relevant authorities for further details on the ground conditions.

The successful bidder shall carry out geotechnical investigations at every 500 m and submit its report at the time of liner design after award of the contract.

1.2.2 Ground Water

The ground water during monsoon period is expected to be high and some time it is up to the ground level. For the purpose of designing liners, the Contractor shall consider that the ground water level is up to the ground level.

1.2.3 Manholes

The manholes constructed on the sewerage system in Delhi are usually conical tapering manhole. Most of the manhole structures are made of brick masonry. The manhole is provided with the clear opening of 560 mm at the top. The shafts of the manholes are about 6.50 m to 9.80 m depth. The bottom of the manholes is generally of 1.50 m to 1.80 m diameter.

For easy access to the sewer body, the manholes are generally provided at a distance of 25 m-50 m for different sizes of Sewer. For lining method, the bidder has to design the liner system in such a way that their installation can be carried out using the opening of manholes only. The cost of any excavation or modifications required by the bidder for access through the manhole and subsequent reinstatement of the manhole at least to its original condition shall be borne by the Contractor and he is deemed to have made provisions in his price for the work.

1.2.4 Confined Space Safety Procedure for Working in Live Sewers

“Confined space”, in relation to a place of work, means a space of any volume which a person may at any time enter or be allowed to be enter in which the atmosphere is liable at any time to be oxygen deficient. This includes but not limited to pipes, sewers, manholes, tunnels, shafts, ducts, other similar sewerage installations and etc.

The Contractor shall implement a well prepared Confined Space Entry Safety Procedure to work in the sewers. Such procedures shall incorporate all aspects of staff work activities, internationally adopted best practice, site staff and workmen training, hazard awareness, first aid procedures, particularly applicable to workmen working in live sewers and confined areas, appropriate equipment to monitor gas levels, personal hygiene, safety/emergency procedure, method of easy evacuation of workers working in sewers, register of known hazardous sites and etc. Confined space entry safety procedure guidelines and requirements are incorporated in Part 4 of this specification to enable the Contractor to develop and implement his own

confined space entry procedure for working in live sewers. No extra payment shall be made except as provided in BOQ.

1.3 Special Traffic Precaution

Attention is specially drawn to the requirements by the traffic police and road authorities and specifications regarding Traffic Control, Access and the Reinstatement of road surfaces etc.

Agency is obliged to obtain separate permission for each section of works from the Traffic Police. Department will extend its help in writing letters. Nothing extra shall be paid other than what Contractor is deemed to have allowed for in his rates.

The progress/programme and road opening schedule must be arranged in details for discussion with the Engineer and the Traffic Police. The lining of sewers shall be broken into suitable sub sections wherever necessary so that special traffic diversions can be arranged by the firm in consultation with Traffic Police and Department.

Whenever carriage ways are affected, it is the responsibility of the Contractor to contain the works within the narrowest possible area and as allowed by the traffic authorities. The Contractor is deemed to have done his own investigation and made adequate provisions in his method of work and rates quoted for the work to carry out and complete the work successfully within the prevailing constraints existing on sites.

It is necessary to carry out the work in such a manner as to cause minimum interference with the public use of roads, footpaths and other through fares.

1.4 Location of the Works

The locations of the sewers nominated for rehabilitation in this project are in Kondli Drainage Zone..

1.5 Scope of Work

The scope of work also include rehabilitation of all the manholes by plastering the walls, filling of holes/voids with appropriate materials, and epoxy mortar plaster of areas prone to hydrogen sulphide attack, replacement of manhole frame and covers, step footers etc. as specified in the Contract.

1.6 Operational Facility

The Contractor is advised that there may be other Contractors (i.e. from PWD or MCD or Metro or other authorities) working within the site area. The Contractor may therefore be given joint possession, in some sections of the sites, with the other Contractors for the purpose of carrying out his contractual obligation and he shall in no way interfere with, impede or otherwise prevent these other Contractors, from carrying out their contractual obligations. The Contractor shall allow in his prices, when bidding, for affording reasonable facilities to the other Contractors and for any interference with his work from these other contract operations.

PART 2 - TERMINOLOGY AND GENERAL DESCRIPTIONS

2.1 Intent

For the purpose of this project, some of the technical terms pertaining to the rehabilitation works and their functional details are defined below. The definitions herein are meant only as a guide and some of them are reproduced from Trenchless Technology Guidelines, definitions or technical terms are used by the Contractor in his submittals, they shall be clearly defined by him in the submittals.

2.2 Rehabilitation of Sewers

For the purpose of this specification, Rehabilitation of Sewers is defined as a process of improving or restoring the structural and hydraulic performance capacity of the sewers by permanently incorporating a fabric of lining materials to the inner sewer body of the sewers by trenchless or other methods.

2.3 Trenchless Technology

A technological process that requires less or no digging of ground surfaces to line, install, replace, renovate or repair underground utility pipes, ducts, cables and other conduits. This also includes other associated processes such as underground inspection and mapping of utilities and, their structural conditions, cavities, geotechnical and geological features etc., without opening up or digging of ground surfaces.

2.4 Confined Space

“Confined space”, in relation to a place of work, means a space of any volume which a person may at any time enter or be allowed to be enter in which the atmosphere is liable at any time to be oxygen deficient. This includes but not limited to pipes, sewers, manholes, tunnels, shafts, ducts, other similar sewerage installations and etc.

2.5 Trenching or Open Excavation

It is a process of temporarily opening up of ground surfaces for the purpose of installation, replacement, renovation and inspection of underground utility pipes, ducts, cables and other conduits.

2.6 CCTV Inspection

Close Circuit Television Inspection is a process of carrying out internal inspection and surveys of pipelines using a self-propelled and remote controlled television camera system.

2.7 Host Pipe

The original pipe to which the liner is installed.

2.8 Man Entry

Description applied to any trenchless process, which requires an operator to enter a pipeline, duct or bore. The minimum size for which this is permissible may be defined by local legislation. For the purpose of this specification the man entry size is specified as the internal pipe diameter is greater or equal to 1000 mm.

2.9 Fully Deteriorated

For the purpose of this specification, the fully deteriorated sewer is considered as one that has lost its load carrying capacity and collapsed at certain sections and shows signs of total collapse if no attempt is made to restore its structural capacity to bear the full load from ground, traffic and ground water.

2.10 Partially Deteriorated

Similarly, the partially deteriorated sewer is considered as one that shows signs of deterioration of structural capacity and is likely to collapse in the foreseeable future, if no attempt is made to stop further deterioration and restoration of its structural capacity to bear the full load from ground, traffic ground water.

2.11 Intact Pipe

The existing sewer body is in good condition and is capable of carrying the externally imposed earth pressure and traffic loading but has lost its water tightness and ability to withstand the hydrostatic pressure.

2.12 Preconditioning Work

That part of a project, usually before renovation work, which includes Preparatory Cleaning and Internal inspection.

2.13 Ovality

The difference between the mean inside diameter and minimum inside diameter divided by the mean inside diameter at any cross section of a pipeline, generally expressed as a percentage.

2.14 Patch Repair

A type of Localised Repair in which a short sleeve of resin impregnated material is positioned within the defective carrier pipe and cured.

2.15 Live Insertion

Installation of a liner into a pipeline, whilst it remains in service also referred to as On-Line Renovation.

2.16 Localised Repair

Repair work on a pipeline, particularly a sewer, for lengths less than the distance between two access points.

2.17 Grouting

Filling of the annular space between the host pipe and the new product pipe / Liner, Grouting is also used to fill the space around the laterals and between the new pipe and manholes. Other uses of grouting are for Localised Repairs of defective pipes and ground improvement prior to excavation during new installations.

2.18 Close Fit Lining

A lining system in which the new pipe makes close contact with the defective carrier pipe. Typical techniques are those in which the liner is temporarily reduced in size by swaging or folding, and is reverted to its original size after insertion into the defective pipe (host pipe).

2.19 Cured-In-Place-Lining

A system in which a flexible, fabric tube is impregnated with resin and forced into position against the inner wall of a defective pipeline or other conduit before curing the resin to harden the materials. The uncured lining may be installed by winch or inversion by water or air pressure. Linings may be structural or supplementary to the existing pipeline.

2.20 Segmental Lining

The use of prefabricated segments in Man-Entry work to form a new lining within a defective carrier pipe. The segments are discrete pipes sealed at the joints and the annulus grout-filled to bond with the host pipe.

2.21 GRP Liner

Structural Lining with discrete pipe segments comprised of glass reinforced plastic (GRP) for man-entry sized sewers (diameter of 1000 mm and above). The use of prefabricated segments in Man-Entry work to form a new lining within a defective carrier pipe. The segments are discrete pipes sealed at the joints and the annulus grout-filled to bond with the host pipe.

2.22 Spiral Lining (SWL)

A technique in which a ribbed plastic strip is spirally (or helically) wound by a winding machine to form a liner which travels up the host pipe as further turns of the helix are added. The annular space may be grouted or the spiral liner expanded to reduce the annulus and form a Close-Fit Liner. In larger diameters the liner may be produced from within the host pipe by manually forming the plastic strip into a helix.

2.23 Slip Lining

Insertion of a new pipe by pulling or pushing it into the existing pipe, usually followed by grouting the annular space. The pipe used may be continuous or a string of discrete pipes. This latter is also referred to as segmental slip lining.

2.24 Soft Lining

An alternative term for Cured-in-Place Lining.

2.25 Spray Lining

A technique for applying a lining of cement mortar or resin by rotating a spray head which is winched through the defective host pipe.

2.3 Abbreviations and Acronyms

Some of the abbreviations and acronyms referred to in the bid documents are given below for easy reference.

BOQ Bill Of Quantities

GCC General Conditions Of Contract

COPA Conditions Of Particular Application SBD

Standard Bidding Document

QED Qualification Eligibility Documents

GITA General Instructions to Applicants, in the SPD ICB

International Competitive Bidding

ITB Instructions To Bidders

JV Joint Venture

JVA Joint Venture Agreement NCB

National Competitive Bidding

QEC Qualification Eligibility Criterion PITA

Particular Instructions to Applicants DJB

Delhi Jal Board

COC Clauses of Contract

PART 3 - SITE ESTABLISHMENT AND PRELIMINARY WORKS

3.1 Transport of materials

It shall be noted by the Contractor that transport of the materials of construction overland will be subject to co-ordination of transport during peak hour traffic in the city/suburbs. The Contractor's rates/prices shall include for all costs arising from the imposition of traffic hour's restriction by the Traffic Police.

3.2 Use of Employer's land

The Contractor shall not be permitted to enter on (other than for inspection purposes) or take possession of Site until instructed to do so by the Engineer in writing. The portion of the site for construction if indicated on the Site plan the Contractor shall on no account be allowed to extend his operations beyond these areas. The contractor may be allowed to use such land, free of charge, for the purpose of sheds, offices thereon for himself, and the Engineer and his site staff shall remove the same from the ground at the completion of the Works, or when required to do so, by the Engineer after receiving 7 days' notice. The Contractor will not be required to pay any taxes or any license fee to the Employer in respect of the ground, shed or offices used as above. He shall restore to good condition after the period of construction.

He shall not use or allow to be used any such ground, sheds or offices or any portion of the site or the works, for any other purposes other than carrying out of Works under this Contract. In the event of insufficiency of ground belonging to the Delhi Jal Board, the Contractor shall provide such other ground at his own cost.

3.3 (a) Electrical Power

The Contractor shall at his own cost, arrange for electrical power required by him for the execution and completion of the Works.

3.3 (b) Water Supply

The Contractor shall make his own arrangement at his cost to supply water for his use and as per clause 4.19(a) & (b) of Conditions of Contract.

Water to be used for drinking/construction purposes shall strictly confirm to IS: 456-2000. Water samples have to be got-tested from DJB Laboratory before the start of the work and every three months interval till completion of work. The cost of testing shall be borne by the Contractor.

3.4 Engineer's cum Contractor's Offices etc.

For the use of Engineer's cum Contractor's his own staff and work force, the Contractor shall provide, erect, construct, maintain and subsequently remove all temporary offices, sanitary arrangements, stores, workshops, compounds parking areas and the like necessary Works. The sitting and layout of these shall be to the general approval of the Engineer.

Provide for Engineer's cum Contractor's site office of minimum 50 sqm. with toilet and pantry (As per site plan approved by Engineer In charge) with furniture, fixtures, office equipment all as required and specified. including supply of all required consumable related to office stationeries, potable drinking water, incurring of all operation and maintenance costs on electricity, water supply, providing adequate Office Peons, Messenger, night watchman and other required office support staff throughout the duration of the contract, maintenance and removal of site office on completion of works and as directed by the Engineer. After completion of work all related belongings (property) shall be of Contractor.

After the completion of the works the Contractor shall remove the temporary office building and all related belongings, which shall be the property of the Contractor.

3.5 Contract Drawings

List of Bid drawings is given in the Contract document. These drawings are meant for Bidder's guidance only and not meant for construction purposes unless otherwise the information in the drawings are validated on site by the Contractor. However, the Contractor shall prepare Drawings for Construction purpose as per prevailing site conditions and obtain the approval from Engineer before proceeding with the Construction work. "Released for Construction" drawings will be furnished to the Contractor during the progress of the work. "Released for Construction" drawings may be revised and revised copies issued to the Contractor from time to time by the Engineer.

The information contained in the drawings is for indicative only. Neither DJB nor the Consultant assumes any responsibility of accuracy, errors, inadequacies etc. contained in the drawings though efforts were made to provide best available information.

The Contractor shall carefully scrutinise the drawings and shall verify at site about dimensions and draw to the attention of the Engineer before execution of the work any discrepancies or ambiguities between one drawing and another in sufficient time to allow the Engineer to make necessary adjustments in accordance with the provisions in the Conditions of Contract without delaying the Works.

The use of any information, data, and survey details etc. containing in the drawings, without validating and ascertaining their accuracy on site by the Contractor shall be at the full risk and responsibility of the Contractor and he is deemed to have understood that he is not entitled for any claims what so ever by using the information without validation by himself on site or getting written confirmation from the Engineer or for wanting of more information etc.

3.6 Issue and Return of Contract Documents.

The two certified true copies of the Contract Document (including drawings) will be supplied to the Contractor upon the Letter of Acceptance. Two further copies and the drawings may be also issued to the Contractor.

The Contractor shall note that the contract documents contain copy righted materials. The Contractor shall ensure that the documents are kept under lock and key and shall not be copied or electronically transferred, Volume 2 in particular, to a third party for use without the exclusive written permission from the Engineer. If any additional copies are required, the Contractor shall copy the documents after obtaining a written permission from the Engineer and obtain his endorsements on all the additional copies. Failure to comply with this requirement can result in serious consequences and the Contractor will be held fully responsible for such noncompliance.

3.7 Standards and Manuals

The Contractor shall include in his rates for providing one hard copy of the latest edition of each of the following reference material for Engineer's use. Sewerage Rehabilitation Manual WRC/AWAA M 45, Latest Edition Manual of Sewer Condition Classification, published by WRC

All relevant Water Industry Specification (including WIS 4-34-02, WIS 4-34-04, ASTM D 3262, ASTM D 2990, ASTM 3571, ASTM 1741 & ASTM 2412), published by WRC. All other standards relevant concerned to the Contract and as required by the Engineer for use in the Contract. No extra shall be paid except as provided in BOQ.

3.8 Assistance for the Engineer's Staff

The Contractor shall provide all necessary assistance to the DJB/Engineer's Representative and his staff in carrying out their duties of checking the setting-out, inspecting and measuring the works. The Contractor shall provide chainmen, staff-men and labourers as may be needed from time to time by the Engineer's Representative.

The Contractor shall provide for the Engineer's Representative and his staff such protective clothing, safety helmets and rubber boots of suitable sizes, hand lamps and the like as may be reasonably required by them. These articles shall remain the property of the Contractor. Contractor is deemed to have allowed for the above in his rates

3.9 Payment of Items

All items shall be paid in accordance with the Payment Schedule in the Bill of Quantities (BOQ).

3.10 Access and Site Roads

The contractor shall construct, maintain and afterwards remove and reinstate site roads and accesses required for the execution of the works. Unless the Contract otherwise provides, the cost of such works shall be borne by the Contractor.

3.11 Use of I.S. Specifications

In case no particular specification is given for any work to be done under the contract, the relevant specifications, where exists, of the Indian Standard Institutions shall apply.

3.12 Provisional Items

Provisional Items means an item included in the Contract and so designated in the Bill of Quantities for the execution of certain works or supply of goods, materials or services or for contingencies, which may be used, in whole or part, or not at all, at the direction and discretion of the Engineer. The Contract price shall include only such amounts in respect of the work, supply or service to which such provisional item relate as the Engineer shall approve or determine in accordance with this Clause.

In respect of every provisional item, the Engineer shall have the power to order to execute the work, including goods, materials or services to be supplied by the Contractor. The Contract price shall include the value of such goods, materials supplied, or value of such work executed as may be determined by the Engineer, inclusive of Contractor's overheads and profits over and above to the value of the materials, labour, operation of the construction equipment etc. required to execute the said work.

3.13 Use of Provisional Sums

All sums set out in the bill of quantities which shall be stated to be provisional or for contingencies shall be used only at the direction of Engineer and if not used, either wholly or in part shall, as to the amount not used, be deducted from the Contract Price.

The Contractor shall when required by the Engineer produce all quotations, invoices, vouchers and accounts or receipts in connection with expenditure in respect of provisional sums.

3.14 Works to be Kept Clear of Water

The Contractor shall keep the Works, well drained until the Engineer certifies that the whole of the Works is substantially complete and shall ensure that so far as is practicable all work is carried out in the dry. Excavated areas shall be kept drained and free from standing water except where this is impracticable having regard to methods of Temporary Works properly adopted by the Contractor.

The Contractor shall construct, operate and maintain all temporary dams' watercourses and other works of all kinds including pumping and well-point dewatering plant that maybe necessary to exclude water from the Works while construction (including plant installation work by other contractors) is in progress. Such temporary works and plant shall not be removed without the approval of the Engineer's Representative.

Notwithstanding any approval by the Engineer's Representative of the Contractor's arrangements for the exclusion of water the Contractor shall be responsible for the sufficiency thereof and for keeping the Works safe at all times particularly during any floods and for making good at his own expense any damage to the Works including any that may be attributable to floods or tides. Any loss of production or additional costs of any kind that may result from floods, tidal inundation or waves shall be at the Contractor's own risk. Floods, tidal inundation or waves shall not be an "Employer's risk".

All costs for works to be kept clear of water shall be deemed to be included in the rates/prices quoted for such items of work requiring dewatering.

3.15 Claims for Damage to Persons or Property (Procedure)

Any claim received by the employer in respect of matters in which the Contractor is required under the Contract to indemnify the employer will be passed to the Contractor who shall likewise inform the Employer of any such claim which is submitted directly to him by a claimant.

The Contractor shall do everything necessary, including notifying the insurers of claims received, to ensure that all claims are settled properly and expeditiously and shall keep the Employer informed as to the progress made towards settlement, failing which the Employer shall be entitled to make direct payment to claimants of all outstanding amounts due to them in the Employer's opinion and without prejudice to any other method of recovery to deduct by way of set-off the amounts so paid from sums due or which become due from the Employer to the Contractor.

3.16 Existing Service

The Contractor shall take all due care and necessary precautionary measures to ensure that no damage occurs to any existing sewer, sewer connections, existing sewerage system, water or gas mains, electricity or telephone cables culverts and any other existing services. Any damage arising out of the Contractor's work in such respect will be met with entirely by the Contractor and no claim to the contrary will be entertained by the Delhi Jal Board.

3.17 Traffic Control.

The Contractor will be required to arrange the work sites and order of working in or alongside carriageways to minimise the interference with the free flow of traffic and shall take all measures and precautions required by the Traffic Police, Road Authorities and the Engineer for the safety and convenience of traffic

The work sites must be arranged in length to be consistent with good progress in laying the sewers and sufficient distance between work sites must be maintained to ensure the free flow of road traffic.

The Contractor must provide and maintain at each work site proper and efficient automatic traffic lights operating day and night for the full duration of the Works. The use of stop and go boards will not be accepted as an alternative to traffic lights at the main work sites.

3.18 Working Space

Where reserves for the location of the sewers have been established these are generally two metre (2.0 m) wide. The Contractor shall note that within reserve or immediately adjoining the outside of the sewer reserves, other services may have already been laid and his attention is particularly drawn to his responsibility for the maintenance of other services. The Contractor will be allowed working space outside reserves, where approval for its use is obtainable by him from the owners/authorities, but the Contractor will be required to limit his working space where obstruction to traffic is likely or access to adjoining sites or services is affected.

Any additional working space required by the Contractor will be entirely the Contractor's responsibility and he will be required to obtain all necessary consents, pay all the costs arising out of compensation, etc. and reinstate the land affected to the satisfaction of the owner and the Engineer.

3.19 Bench Mark.

The Contractor shall establish substantial bench marks and fixed points on the site to the Engineer's direction and shall ensure that these are not damaged or disturbed. All such bench marks and fixed points must be referred to a Master Bench Mark and follow National Datum as maintained by the relevant government authority. All survey information shall be in UTM co-ordinates and compatible with the National GPS system for uploading into the GIS system maintained by DJB.

3.20 Contractor's Plant

All mechanical plants used by the Contractor in the execution of the Works must be of such type, size and of such method of working as the Engineer shall approve.

The Engineer's approval to the use of mechanical plants will not be unreasonably withheld, but if in the Engineer's opinion, circumstances arise which make it desirable that the use of plants should be suspended either temporarily or permanently, the Contractor shall change the method of performing the work affected at his own cost and he will be deemed to have no cause for claim against the Delhi Jal Board on account of having to carry on the work by another method nor will he be deemed to have cause for claim if any order issued by the Engineer results in the mechanical plant having either to stand idle for a period of any duration whatsoever or to be removed.

This clause shall apply also to plants which, in the opinion of the Engineer, are not as quiet in operation as the circumstances seem to the Engineer to warrant.

The Contractor shall use every possible means to prevent noise and annoyance to the residents of the neighbourhood in which the works and the Contractor's depots are situated and all machinery must be of such design and so arranged to be reasonably free of noise in working.

In the event of air compressors or pneumatic tools being used on the Works, the Contractor shall, if and when required by the Engineer, arrange for such compressors or tools to be fitted with silencers of approved design or adopt other means approved by the Engineer for the purpose of reducing noise as far as possible.

The Contractor will not be allowed to make any extra charge for work or expense incurred in complying with the requirements of this clause.

3.21 Continuous Working.

If, in the opinion of the Engineer, it is deemed necessary, by reason of the safety of the works, or for the restoration of interrupted services, or for any other reason whatever, the Contractor shall, when so ordered, carry out the Works or any portion thereof continuously by day and by night without any extra charge to Employer.

3.22 Drain and Water-Course

The Contractor shall level and clear undergrowth and also provide for the temporary diversion of such existing drains, water courses or land springs as are interfered with during the progress of the works. Any drains or water courses so diverted must be reconstructed in their original positions on completion of the works. Where drains or open ditches occur, the Contractor will be responsible for keeping these free of excavated material and ensuring the free flow of water. The dewatering Pumps must be deployed of such capacity, no inundation occurs in upstream side due to blockage.

3.23 Anti-pollution and Mosquito Control.

The site and working areas shall be maintained at the Contractor expense in accordance with current existing regulations governing anti-pollution and mosquito control.

3.24 Safeguarding Properties Adjacent to Site

Where work is undertaken near or adjacent to buildings and in the opinion of the Engineer, the stability of such buildings is liable to be affected as a result of the work, he shall arrange to have such buildings inspected and to have record any cracks or any other defects which may be affected by the work. Every precaution should be taken by the Contractor to safeguard such building or structure and they should be to the complete satisfaction of the Engineer. The Contractor may be directed by the Engineer to excavate in such lengths of excavation as will permit the least amount to be opened at one time in order to minimise to danger of such open excavation affecting the stability of buildings or their supports.

The Contractor will be held responsible for damage to public, private or other buildings and properties adjacent to the site of the works which is caused as a direct or indirect result of the Contractor's work. Should the Contractor fail to take the necessary precautions the Engineer may, after giving the Contractor twenty-four (24) hours' notice in writing, carry out such work as may be necessary using Delhi Jal Board labour, material, plant, implements and transport. The cost of such work will be charged to the Contractor.

The Contractor must take due care to safeguard all existing services, such as water, sewer or gas mains, electricity telephone cables, required to excavate trial pits in advance of the Works and determine accurately the position of mains, pipes etc. The Contractor shall notify the Engineer of any mains, pipes or conduits met with in trial pits or excavation and shall take

steps to support and protect these to the satisfaction of the Engineer. The Contractor will be responsible for any damage done to mains, cables, culverts and other services, inside or outside the excavation as a result of earth movement, faulty timbering, excessive weight of excavated material being deposited too close to open trench, leaving the excavation open for an unduly long period or to any form of settlement following backfilling.

No work done by the Engineer or his workmen nor the fact that the timbering has complied with this Specification or neither requirements of the Engineer nor the approval of proposed or completed timbering etc. by the Engineer. Shall absolve the Contractor from his responsibilities and he will be required to make good any damage caused as a result of the timbering failing to give proper support to the sides of the excavation.

Furthermore, the Contractor is required to conform to any other safety and fire regulations that may be introduced from time to time.

3.25 Method of Working

The Contractor is required to carry out the Works in the manner detailed herein, shown on the drawings and normally adopted. He is at liberty to supply with his Bid such modification as he proposes for consideration and shall seek approval from the Engineer before he is allowed to apply new or changed methods of construction. Notwithstanding any Specification, approval of decision given by the Engineer as to the carrying out of the Works, the Contractor will be wholly liable for the safety of the works, both temporary and permanent and for the completion of the Contract to the satisfaction of the Engineer.

3.26 Protection of Work.

The Contractor shall, at his own expense, protect all work liable to damage either by the weather or by the method adopted for the execution of the Works, cover up, water and protect all work requiring the use of cement. The Contractor's attention is drawn to the risk of damage to structures due to temperature expansion and contraction and he will be required to protect all materials subject to damage from the direct rays of the sun.

3.27 Demolition and Making Good

The Contractor shall take care when demolishing or cutting away existing work that no adjacent work is unnecessarily damaged in any way. Any work so damaged will be made good entirely at the expense of the Contractor.

Old materials may not be re-used in the new work, except where so specified or as directed by the Engineer.

Exposed raw faces of existing concrete or brickwork which will not have new work built on them will be made good with cement rendering or new brickwork and finished to a neat, straight, vertical or plane surface in harmony with the adjoining surface.

3.28 Prevention of Flotation.

The Contractor's warned that the structures may not be heavy enough to resist the possible uplift due to water pressure until the structure, soil cover and backfilling have been completed. The Contractor shall make adequate arrangements to keep the excavation dry until the structure and filling are complete or shall adopt other approved means of ensuring the stability of the temporary or permanent works. His proposed method must be submitted to the Engineer for approval before work is commenced and he shall provide for adequate standby plant and attendance throughout 24 hours each day.

For pipelines laid in wet, waterlogged or ground subject to flooding all necessary precautions must be taken to prevent the flotation or movement of pipelines whether laying, laid or under test.

3.29 Inspection and Replacement of Defective Work

At any time during or after the execution of the Works the Contractor shall, at the request of the Engineer and within such time as the Engineer shall name, open for inspection any work covered up and if the Contractor refuse or neglect to comply with such request, then employer shall employ other workmen to open up same at contractor's cost.

If the said work has been covered up in contravention of the Engineer's instructions, or if on being opened up it be found not in accordance with the Drawings, Specification and Bills of Quantities or the instructions of the Engineer, the expenses of such opening and covering it up again, whether done by the Contractor or such other workmen, will be borne by and is recoverable from the Contractor.

If the work has not been covered up in contravention of such instruction or is found to be in accordance with the said Drawings, Specification and Bills of Quantities or instruction, the expenses aforesaid will be borne by the Delhi Jal Board and be added to the Contract Sum.

Wherever in the opinion of the Engineer the work done is inadequate or of poor workmanship or inferior materials or in any way sub-standard such works will be demolished, cut out and removed from the Works immediately and replaced with new materials of the required standard and quality.

3.30 Reinstatement of Surface

The Contractor's work shall include the reinstatement of the foundation and surfaces of roads, kerbs, cycle tracks footways and grass areas disturbed by the excavation work both within and without the actual trench area.

The Contractor shall also allow for the complete reinstatement of all surfaces damaged, and all Private or Government's or Delhi Jal Board's Lands to approval of the Engineer and generally to a condition at least equal to the original ground surface before the Works commenced.

3.31 Reinstatement of Foundation and Road Surface

The Contractor will be required to maintain in a clean, safe and tidy state the temporary reinstatement of trench and other damage surfaces in roads as specified previously until such time as the permanent reinstatement is carried out.

Permanent reinstatement must only be carried out on receipt of an instruction from the Engineer and the reinstatement will then be commenced within 7 days and completed as soon as possible. The Engineer may instruct the Contractor to reinstate the roads intersections as the work proceeds.

The reinstatement must comply with all the requirements of the Roads Authority. Any work not conforming in standard or extend to the requirements of the Engineer or the Road Authority must be immediately removed and replaced or extended

If the Contractor fails to carry out all the required reinstatement works within a reasonable time of being instructed to do so, the Engineer may arrange for the execution of the work at the expense of the Contractor.

On completion of the reinstatement the Contractor will be required to maintain all the road surfaces etc., affected for the full period of the Contract and Maintenance Period. All faults, settlement etc., developing within this period must be made good immediately upon receipt of an instruction from the Engineer

The Contractor's attention is also drawn to the fact that he will be liable for all claims for injury or damage arising from any defect in the reinstated road surface during the Contract and Maintenance Periods.

3.32 Measurement and Progress Payment

Payment will be made for Complying with all requirements as described in Part 3 of the Technical Specification.

The amounts for the insurances to be effected under the Contract shall be the actual cost of the premiums that the Contractor expects to pay for taking out the various insurances and keeping them in force during the whole of the Contract Period, The “Engineer” will certify and the Employer will reimburse to the Contractor the amounts of premiums actually paid and supported by valid receipts for the amounts paid, up to but not exceeding the amounts entered against the appropriate items in the Bill of Quantities. The payment will be made on pro-rata basis throughout the contract period.

The Contractor shall allow for each and every expense for fully complying with the general requirements and conditions in the Specification and drawings as no claim for extra will be entertained.

An item is included for site preparation, setting up of site office, road safety diversion signs and everything else required to carry out and completes the rehabilitation work at the section. The Contractor shall also include in this item the expenses for complying and observing all the contractual/ statutory/ regulatory safety requirements relating to work in confined spaces and to supply and maintain all necessary trained safety personnel for Cardio-Pulmonary Resuscitation (CPR) and safety equipment such as first aid, CPR facilities, gas detectors, breathing apparatus, fire protection and practical emergency response facility inclusive of suitable trolleys or carts to pull injured men from sewers, lighting, ventilation, etc. and everything else required to carry out and complete the work in a safe manner. A vehicle for emergency use shall also be provided on site at all times. The item shall also include the expenses to provide and maintain the road cautionary boards and barricades, duly painted with illuminating paint, around the place of work and red light night blinkers and other safety measures to avoid any mishap /accident as per the direction of Engineer-in-charge.

PART 4 - SAFE ENTRY AND WORKING IN SEWERS GUIDELINES

4.1 Safe Work Practice Principles

4.1.1 Introduction

These general guidelines are intended to assist the Contractor in the development of safe work practices. Where the risk assessment indicates that a particular hazard cannot be present, the precautions to control that hazard do not apply. Remember that a favourable history does not guarantee absence of hazard on this occasion.

4.1.2 Confined Space

“Confined space”, in relation to a place of work, means a space of any volume which a person may at any time enter or be allowed to be enter in which the atmosphere is laible at any time to be oxygen deficient. This includes but not limited to pipes, sewers, manholes, tunnels, shafts, ducts, other similar sewerage installations and etc.

The Contractor shall develop acceptable work practices and safe entry procedures based on the guidelines provided hereunder and the other guidelines including DJB/Metro on safety precautions to be observed during sewer desilting / lining work included in this specification and implemented on site.

4.1.3 Notification to Work in Confined Space

The Contractor shall obtain an entry permit from the Engineer for each occupancy of any confined space. The Contractor shall furnish all required details in an approved format to the Engineer for permission to work in confined space at least 24 hours prior to the entry. Where prolonged work is involved, the permit must be renewed for each shift. An incident which substantially alters the condition of a confined space entry requires immediate evacuation and reassessment of the condition.

4.1.4 Air Quality and Ventilation

Contaminant control and effective ventilation are major factors influencing air quality in a confined space. The ventilation must be adequate to clear pre-existing contaminated air and maintain a respirable atmosphere during planned work. This ventilation may be permanently installed or portable equipment used for this task. For general ventilation, fresh air should be supplied to the workplace. Within the sewer system this creates an environment which displaces contaminated air in the immediate vicinity.

Where a task generates atmospheric contaminants in a specific area e.g. use of chemical such as polyester resin, adequate local exhaust ventilation should be used to remove the contaminants. Where failure of the mechanical ventilation system would result in deterioration of air quality, the controls must be clearly tagged to prevent accidental interference and the ventilation system monitored while the confined space is occupied. Self-Rescuers must be carried whenever failure of the ventilation system or changes in the working environment can create a contaminated atmosphere. The self-rescuer can be a self-contained breathing apparatus, oxygen self-rescuer, or short duration self-contained breathing apparatus, depending on the time taken to reach open air.

Note: Obtain occupational hygiene advice on the- selection or performance of ventilation system where this is not specified in the work practice or plant design.

4.1.5 Lighting

Any regularly accessed confined space should be illuminated with electrical installation to appropriate Indian Standard or equivalent. Portable lighting may be used to supplement permanent lighting in the workplace. Temporary mains powered lighting installed for a task must comply with the requirements of appropriate Indian Standard. Miners lamps, mounted on a safety helmet may be used as an alternative to a hand held torch for personal illumination.

The possibility of a flammable atmosphere must be eliminated by isolation, cleaning, ventilation purging etc.

Where the confined space has been proclaimed as a flammable gas hazard area, all fixed and temporary electrical installation must comply with appropriate Indian standard. Torches and portable lights must comply with appropriate Indian standard.

Illumination standards are:-

General Lighting: - 40 lux minimum, equivalent to a poorly lit room

Stairway lighting: - 80 lux minimum

Task Lighting: - 240 lux minimum (normal workshop requirements)

4.1.6 Equipment usage, Standards and Maintenance

All confined space safety equipment must meet established standards and be of appropriate design for the proposed usage. The equipment must be checked for visible damage and correct operation before each use. Preventative maintenance must be performed by trained, and where necessary, authorised persons at the intervals recommended by the equipment manufacturers. The Contractor shall submit to the Engineer evidence of such periodic check and maintenance of the equipment used for confined space entry at every month during the first week of the month.

4.1.7 Room to work

When the constricted volume of a worksite prevents normal work postures and tool movement, the need for special tools or frequent work rotation should be considered.

4.1.8 Control of Flooding

When a confined space is normally liquid filled, accidental return to service must be prevented by double isolation e.g. insertion of suitable blanking piece, plugging with

inflatable plugs, temporary coffer dams as a second isolation in a manhole or other effective means.

4.1.9 Flow Control

Where a sewer is entered while flowing rapid increase in flow must be prevented by use of stop logs. Isolation of pumping stations, weather watch and other means appropriate to the sewer catchments. Adequate communication with the person responsible for flow diversion must be maintained for the duration of the entry.

4.1.10 Drowning

Where deep or flowing water is present use personal flotation devices. Safety harness and lifeline, safety nets etc. as appropriate to prevent drowning.

4.1.11 Fire and Explosion

Adequate precautions must be taken to minimise the risk of fire or explosion when entering a confined space for any purpose.

4.1.12 Presence of Flammable Gas

The presence of flammable gas, flammable dust or the possibility of the presence of airborne substances in flammable quantities may create a hazardous Area. Care shall be taken by the authorised person to determine the presence of any such flammable situation in the confined space before entry. Smoking or lighting any cigarette or box matches in confined space shall be strictly prohibited. The flammable gases of concern are methane, digester gas, vapours from flammable liquid, and vapours and gases from trade waste discharges.

4.1.13 Manual Handling of Tools etc.

Safe system of work should be followed to protect against falls of persons or objects and crush by moving or falling objects. Extra care is needed if normal manual handling gear is not available or confined space safety gear (Harness, Respirator) is worn.

4.1.14 Noise

Reverberation within a confined space can increase noise levels, especially if more than one person is working. Heavy duty hearing protection may be required.

4.1.15 Vermin

All persons working in confined spaces should be aware of the health hazards presented by the presence of vermin. The presence of cockroaches etc. does NOT indicate that the atmosphere is free of danger to health.

4.1.16 Standby and communication

A member of the confined space work team is allocated the task of maintaining communication with the members inside the confined spaces. This task may be rotated among the members of the team. The Standby person must be trained and be physically capable of providing the

assistance and life support in an emergency and must have sufficient proficiency in Marathi, Hindi and English languages to promptly communicate information by radio or telephone when required.

While acting as stand-by, this person must not enter the confined space or leave the vicinity unless relieved from this duty. A standby person is needed for all confined space entries. The Safe System of Work must indicate the process for communication from the confined space to the standby, e.g. 2 way radios. 'Man down' alarm, line of sight etc.

4.1.17 Fitness Assessment

An assessment of fitness, including cardiovascular and respiratory health, is required to ensure that all persons entering confined spaces, or acting as the stand-by person, can comply with the physical demands of the job, without risk to their health.

The contractor shall ensure conducting the medical tests i.e. chest X-Ray, TLC/DLC/Urine and Sputum at regular intervals for the sewer workers engaged on the rehabilitation works and submit its records to DJB.

4.1.18 Emergency Rescue and First Aid

No person shall enter any confined space, even in an emergency, without first ensuring all safety requirements have been met. A safety emergency plan may assist in a safe, speedy response in the event of an emergency.

All confined space work teams must be trained and equipped to sustain life and be able to summon emergency help. Provide first aid and assist emergency service personnel, if requested.

Rescue of persons apparently overcome by toxic gases in a sewer or other confined space must only be attempted by trained persons using supplied air breathing apparatus. Stabilisation of other injuries must be prioritised against the availability of breathable air.

4.1.19 Gas Detector

The Contractor shall engage an authorised person for gas monitoring and detection. This person shall be trained to operate and response test gas testing equipment and is authorised by management to perform the necessary tests to decide whether a category 2 or 3 confined space is fit to enter.

Gas testing can only be performed by persons trained in gas testing, using equipment appropriate for the anticipated contaminants. This person can perform other duties provided these do not conflict with the gas testing task.

4.1.20 Specialist Gas Detector

This person has technical qualifications and acceptable training to operate and response test gas testing equipment, including hydrocarbon detectors and detector tubes and assesses portable ventilation systems. He is authorised by management to carry out atmospheric testing to establish entry conditions for all confined space categories, and to establish whether a Category 1 confined space can be re-classified to a Category 2. He also performs tests to verify whether hot work is permitted in gas hazard areas.

4.1.21 Cleaning

Where possible, cleaning should be performed without entry to the confined space, even if only preliminary cleaning is possible.

Particular attention should be given to the probability of releasing hydrogen sulphide when disturbing microbiologically active sludge and sediments which have accumulated in a confined space. Supplied air respiratory protection shall be worn where such residues exist and effective ventilation cannot be guaranteed. Continuous gas monitoring is required even when supplied air respirator protection is used.

Hose couplings should be designed to resist accidental dislodging or loosening. Both the operators and the standby person should be able to stop the flow of cleaning material into the confined space.

Hydro jetting must be performed according to the relevant regulations. Where chemical compound is used in within the confined space, the chemical compound should be classed in the Material Safety Data Sheets as non-irritant to respiratory system, eyes and skin. If this is not possible then appropriate respirator skin and eye protection must be worn. Substance specific air monitoring may be required.

4.1.22 Visitors

A visitor to a confined space is a person other than a contractor, who is not a member of the Confined Space Work team. Visitors must be escorted and trained or inducted in the necessary skills for that entry and shall sign an indemnity form before entry into a confined space.

4.1.23 Hazard Control

Hazards to be identified and controlled include but are not limited to: access. Mechanical and electrical isolation, flow isolation and control, drowning and engulfment, last known contents, atmospheric contaminants, temperature extremes, security and public access.

4.1.24 Air Quality Standard for Entry

The acceptable limits of some gases in confined spaces are:

	Gas/Vapour Present	Acceptable Limits
a	Oxygen Content (O)	19.5% to 23.5% by volume.
b	Flammable Gas/Vapour :	5% of Lower Explosive Level (LEL)
c	Hydrogen Sulphide (H ₂ S)	10 Parts Per Million (ppm) Maximum
d	Carbon Monoxide (CO)	30 Parts Per Million (ppm) Maximum,

4.1.25 Carbon Monoxide (CO)

Carbon monoxide is colourless, odourless, flammable and toxic. Its common sources are Fire, motor vehicle exhausts and cigarette smoke.

This gas is a chemical asphyxiate and is readily absorbed by the haemoglobin in the blood. Then haemoglobin is unable to transport oxygen to the body tissues and the body becomes oxygen starved. These effects are more pronounced with hard work or for heavy smokers. Symptoms include headache (50-200 ppm), nausea (400 ppm), and irregular heartbeat (1200 ppm), collapse and death (2000 ppm).

The entry permit limit is 30 Parts per Million (ppm), Maximum with an IDLH value of 1500 ppm. (IDLH –Immediately Dangerous to Life and Health)

Note: Some gas detecting machine sensors are cross sensitive, H₂S being detected by the CO cell and vice versa. Alarm by either sensor requires evacuation and re-evaluation of the safe system of work.

4.1.26 Flammable Gas/Vapour

A gas or vapour which will burn when mixed with air in certain proportions and ignited.

The mixture which contains the least amount of flammable gases which will explode is called the Lower Explosive Limit (LEL) The mixture, which contains just enough Oxygen to let the flammable gas explode is called the Upper Explosive Limit (UEL). The flammable range varies for gases and vapours

Many of these have toxic effects when inhaled and a Workplace Exposure Standard has been issued to protect workers from this Gas/Vapour. The Contractor shall obtain relevant Workplace Exposure Standard (WES) for use in the site.

Gas/Vapour	Flammable range in %	5% LEL	WES
Butane	1.9- 8.5	950 ppm	800 ppm
n-Hexane	1.2 -6.9	600 ppm	50 ppm
Methane	5-15	2500 ppm	Asphyxiate
Petrol	1.3 - 6	650 ppm	900 mg/cum
Trichloroethylene	12.5 - 90	6259 ppm	50 ppm

4.1.27 Hydrogen Sulphide (H₂S)

Hydrogen sulphide is a colourless, toxic and flammable gas which usually has the odour of rotten eggs in sewerage systems it is usually derived from the action of bacteria on the sulphur compounds in anaerobic or old sewage. A small amount of sludge or slime in wet wells or sewers will release a lot of H₂S when disturbed.

After a few minutes exposure, the ability to smell hydrogen sulphide by a person is lost and then hydrogen sulphide becomes more dangerous as its presence is no longer obvious and the person could become an innocent victim.

It can sometimes be detected by odour at less than. 0.1 ppm but can be readily detected by odour at 4ppm. More serious health effects include eye irritation (10 ppm), respiratory irritation (50 ppm), headache, nausea, dizziness (200 ppm), Collapse and death (700 ppm).

The entry permit limit is 10 Parts per Million (ppm), Maximum with an IDLH value of 300 ppm.

Note: Some gas detecting machine sensors are cross sensitive, H₂S being detected by the CO cell and vice versa. Alarm by either sensor requires evacuation and re-evaluation of the safe system of work.

4.1.28 Methane (CH₄)

The most common flammable gas found in sewers is methane. This mainly comes from gas pipe leaks in the city's gas distribution systems. It can also be derived from the action of anaerobic bacteria on rotting material. However a range of other flammable gases and vapours may be encountered. These include LPG, petrol vapour and other solvents.

Digester gas, found in anaerobic sludge digesters on sewage treatment plants is a flammable mixture of methane nitrogen and carbon dioxide.

Methane is a colourless, odourless gas, although pure methane is slightly lighter than air. The relative density of methane/ air mixtures is similar to air in the entry permit range. Methane is hazardous because

of its flammability, i.e. between concentrations of 5% to 15% in air, may explode if an ignition source is present.

High concentrations of methane may result in oxygen deficiency. Injury or death results from lack of oxygen not methane toxicity classifying methane as a simple asphyxiate.

Note: That the entry permits level is 5% of LEL, NOT 5% flammable gas.

4.1.29 Oxygen Content (O₂)

Fresh air contains 20.9% oxygen.

In a confined space, oxygen can be used up by bacteria in sewage or sludge, rusting of iron fittings. Burning (or welding) or displaced (pushed out) by other gases.

Breathing of air which contains reduced oxygen results in increasingly serious health effects. These range from impaired coordination and faulty judgement (12-16% O₂) to collapse and rapid death (less 6% O₂)

Increased oxygen readings can only come from instrument error or by leakage from oxygen cylinders, liquid oxygen tank, etc. High oxygen levels greatly increase fire hazards, fires burn fiercely; oily clothing and hair can catch fire without an ignition source.

The entry permit levels are 19.5% to 23.5% by volume.

4.1.30 Definition

Parts per million (ppm)

Parts of gas or vapour per million parts of contaminated air by volume at 20°C and 1 bar pressure. 1 ppm = 0.0001%

Percentage

Parts of substance per 100 parts of air, water

etc. 1% = 10,000 P

4.1.31 Other Atmospheric Contaminants

Entry, unless wearing air supplied breathing apparatus, is not permitted unless atmosphere contaminants are below the relevant 8 hour time weighted average (TWA) Workplace

Exposure Standard. This limit applies for all entries including brief exposures. Entry wearing breathing apparatus is only permitted where the concentration of the contaminant is within the protection factor of the breathing apparatus and below the IDLH (Immediately Dangerous to Life & Health) value.

4.1.32 Sewer Gases

Air in contact with live sewage contains gases released from the sewer. For safe entry, contaminated air must be replaced with clean air by ventilation of the confined space. The resulting atmosphere must be confirmed by gas testing.

Discharge of untreated wastes, e.g. hypo chlorites, electroplating effluent, acids may result in generation of chlorine, hydrogen cyanide and other harmful gases some distance from the original discharge.

4.1.33 Confined Space Categorisation

The confined space category is a guide to developing a safe system of work. The confined space category may change to a more stringent level as a result of adverse environmental factors or work produced contaminants. Alternatively it may change to a less restrictive category if appropriate engineering upgrades, whether temporary or permanent, are implemented.

4.1.34 Category 1 - Confined Space

Entry allowed only if flammable gas is below 5% of L.E.L. and other gases are within the protection factor of the respiratory protective equipment used.

Visibility must be adequate

Personal Safety

- Wear specified protective clothing for the hazards
- Wear safety harness
- Use lifeline where appropriate

Respiratory Protection

- Test air quality prior to entry. by a Specialist Gas Detector
- Ventilate to reduce contamination
- Monitor air quality as directed by the Specialist Gas Detector

Wear airline breathing apparatus with backup air supply OR wear self-contained breathing apparatus

Note: Oxygen self-rescuer is not a backup for an airline used in contaminated atmospheres.

If the Category 1 confined space is a chemical storage tank, it can be reclassified to a Category 2 or 3 confined space when the Specialist Gas Detector confirms that the chemical has been cleared from the interior.

Sewer, wet wells etc. can be reclassified by a Specialist Gas Detector to a lesser confined space only when an approved safe system of work is employed.

This safe system of work must provide for demonstrated control of airborne contaminants and other hazards in the workplace, to provide conditions equivalent to a category 2

Hot work requires control of fire and explosion hazards and may require air supplied breathing apparatus to control fumes irrespective of the confined space category. A Hot work permit is required in addition to the normal entry permit.

4.1.35 Category 2 - Confined Space

Entry allowed only if all gases are within entry permit limits

Personal Safety

- Wear specified protective clothing for the hazards
- Wear safety harness
- Use lifeline where appropriate

Respiratory Protection

- Test air quality prior to entry
- If air quality test fails refuse entry until reason found and rectified, or revert to Category 1 entry conditions.
- Ensure adequate ventilation
- Monitor air quality during entry
- Carry oxygen self-rescuer

Note: Standby person must have SCBA (Self-contained Breathing Apparatus) readily available.

Hot work requires control of fire and explosion. Hazards and may require air supplied breathing apparatus to control fumes irrespective of the confined space category. A Hot work permit is required in addition to the normal entry permit. A hydrocarbon check by a 'specialist gas detector' is required unless the environment can be upgraded to Category 3 conditions.

4.1.36 Category 3 - Confined Space

Entry permit required (unless using a posted entry procedure for routine operation of the facility) for each shift that the structure be occupied.

Personal Safety

- Wear protective clothing specified for the hazards

Respiratory Protection

- Test air quality prior to entry
- If the proposed work can generate airborne contaminants, arrange ventilation. Respiratory protection and/or air quality monitoring as appropriate.

Hot work requires hot work permit and control of fumes.

- If air quality test fails, revert to Category 1 entry conditions or refuse entry until reasons found and rectified.

4.1.37 Category 4 - Confined Space

Follow facility safety procedures. **Personal**

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Safety

- Wear protective clothing specified for the hazards

Respiratory Protection

- Evacuate when alarms advise Hot

work requires control of fumes.

Separate Permit(s) required for chemical cleaning and/ or Hot Work. If evacuation alarm sounds, evacuate following site emergency procedure. Reoccupy as a Category 2 confined space.

Generic Entry Summary

	Category1	Category 2	Category 3	Category 4
Entry Permit	yes	yes	yes	Yes
Standby Person	yes	yes	yes*	*
Communication to remote standby			yes*	
Protective Clothing	yes*	yes*	yes*	yes*
Safety Harness	yes	yes		
Lifeline/Fall arrester	yes	yes		
SCBA	yes*	#		
Airline and backup	yes*			
OSR	yes*	yes*		
Specialist gas tester	yes			
Gas tester		yes	yes	Yes
Gas monitoring	yes	yes		
Ventilation	yes*	yes*	yes	Yes
*Appropriate choice given in Safe Work practice for the task				
# Required by Standby Person				

4.1.38 Entry Permit Format

A general entry permit for working in sewerage works is given below as an example on page 132-133. The Contractor shall develop his own format of the entry permit form and submit it for the approval of Engineer.

4.1.39 Maintenance of Equipment

This equipment must be maintained as per manufacturer's recommendation and records kept of this maintenance.

Compressed air bottles must be refilled by a source which warrants that the air meets quality standards

Air from air compressors must be treated to meet quality standards and tested periodically to demonstrate compliance.

All respiratory protection systems must be used in accordance with relevant standards.

4.1.40 Gas Detecting Machines

The Instrument must be operated according to the manufacturer's instructions.

The instrument must be checked for correct functioning using a test gas ('Response Check') every day when the instrument is used to check possibly contaminated atmospheres.

If the instrument is used less frequently, it can be response checked each time it is used.

4.1.41 Standards

The following equipment must meet the relevant standard.

- a. Self-contained breathing apparatus
- b. Oxygen Set (Rescuer)
- c. Airline compressed air breathing apparatus

All workmen should use all the same-model of this equipment for interchange ability.

Obtain professional advice for selection of airline breathing apparatus and compressed air self-rescuers. Portable gas detection instruments must meet the following requirements.

Manual of Practice

	Gas Monitored	Range Required	Resolution Required
1	Oxygen	1% - 30%	Resolution 1 %
2	Flammable Gas	1% - 100% of LEL	Resolution 1% of LEL
3	Hydrogen Sulphide	1 - 50 ppm	Resolution 1 ppm
4	Carbon. Monoxide	1 - 400 ppm	Resolution 1 ppm

Safety Equipment

Contractor to provide all Safety Equipment as required for the Works.

This includes but is not limited to the following:

Waterproof overalls/suits E and TASK Information	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Waterproof boots (Non-static)	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Waterproof gloves	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites

Ropes, safety trapeze, Safety Cones, harnesses, winches, rope ladders, structural frame support for winch/pulley system, Aluminium ladder	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Hardhats, Safety helmets	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Communication device for underground to surface communication	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Gas monitors, gas testing machines	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Gas masks	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Portable Oxygen breathing apparatus	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Air blowers, generators, ventilation equipment, Metal detectors	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Airline compressed air breathing apparatus	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Adjustable structural supports and shoring equipment, timbers, steel plates	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Compressed air tanks	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Lighting/torches	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Portable helmet mounted lamps with battery pack	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Battery chargers	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
First aid kit	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Rescue equipment	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Antiseptic washing facilities	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Ear muffs, safety goggles	Sufficient For all workers, Engineer staff, Consultant staff and visitors at all sites
Emergency Standby Vehicle	Sufficient for transportation of injured worker

ENTRY PERMIT FOR CONFINED SPACES

(Required for an confined space entries)

	CONFINED -SPACES CATEGORY []
	Is a hot work permit also required? Y/N
	If yes. Permit No:

1. SITE AND TASK INFORMATION	
Location of work.....	
Work Team:	Standby Person:
Contractor's Name:	Visitor's Name:
Description of work to be undertaken:	Requested by:
.....	Date:
.....	
2 ISOLATION OF CONFINED SPACE	5. PERSONNEL PROTECTIVE EQUIPMENT
() Water/.Sewer Flow isolation/Control	() Supplied air respirator
() Harmful substance present	() Oxygen self-rescuer
() Warning notices, locks or tags in place	() Safety harness
() Other (specify)	() Safety line
	() Other protective clothing/equipment
3 AIR QUALITY	
Oxygen (19.5%-23.5%)	6. OTHER PRECAUTIONS
Hydrogen Sulphide(<10ppm)	() Warning notices/barricades in position
Flammable gas (<5%LEL)	() Smoking prohibited
Carbon monoxide (<30ppm)	() Rescue system in place
Others (Specify)	() Emergency rescue trolley available
Limit () Result.....	() Other precaution (Specify)
Ventilation Operating/provide.....	
	
Time and Date of Test:	7. CONFINED SPACE ENTRY PERMIT
Response test date for gas testing machine:	This confines space in my opinion safe for entry and work under the listed indications.
Monitor while occupied: Yes/No	() The work team is trained and equipped for this entry.
Additional Category 1	Safe Entry Valid on:
Substance checked (identify and limits)	From am/pm
.....	to: am/pm
.....	Responsible person:
.....	
.....	
Monitoring delegated to Gas Tester (Y/N)	8. SIGNING OUT
Conditions:	() All persons have left the confined space and no further entry is permitted on this permit
Specialist Gas Tester:	
Time: am/pm Date:	
4. CHEMICALS (to be used in the confined space).....	9. OBSERVED FAULTS / INCIDENTS

PART 5 - GENERAL WORKS FOR SEWER REHABILITATION

5.1 Information for the execution of works

Where specified in the Drawings and Bills of Quantities, sections of the sewer shall be rehabilitated by lining method as approved by the Engineer.

The contractor shall be responsible for inspecting the sites and familiarizing himself with the conditions under which the work will be performed and with all necessary details as to orderly execution of the work. The omission of any details shall not relieve the Contractor of full responsibility for the satisfactory installation of the work in its entirety. No monetary or other claims made by the Contractor on the grounds of want of knowledge will be entertained by the Delhi Jal Board.

The contractor is advised that it shall be deemed to be his sole responsibility to ascertain for himself the extent of work that is required to be done in site and to generally obtain his own information on all matters affecting the execution of the whole of the works involved in this contract to the entire satisfaction of the Engineer. No claim of extras in consequence of any alleged ignorance in any aspect will be entertained by the Engineer. It must be clearly and definitely understood that the contractor shall be held solely responsible for making all necessary arrangements and co-ordinating with all relevant Authorities, Specialists, Sub Contractors, etc. to ensure satisfactory completion of this contract.

5.2 Site investigation

The Contractors site investigation for lining work shall be critical and the most important engineering work to be carried out before commencement of lining work. The contractor shall clearly understand the importance of establishing the predominant subsurface ground conditions and their range of variability along the sewer route well before embarking on the actual lining works.

This shall include:

- Determination of water table and groundwater
- Determination of soil type and condition in sewer location.

The contractor shall carry out Geo Technical Investigation at every 1000 m interval of alignment of existing sewer, for determination of soil type, density, modulus of soil , water table and groundwater etc. for designing Type II standalone structural Liner.

The Contractor is deemed to have visited the sites and familiarised himself of the conditions, restrictions and constraints under which the work will be executed. The omission of any details shall not relieve the Contractor of his prima facie obligation and responsibility under the Contract to carry out and successfully complete the rehabilitation works. No monetary or other claims, made by the Contractor on the grounds of want of knowledge will be entertained by the Employer.

The Contractor is advised that it is his sole responsibility to ascertain for himself the extent of work that is required to be done on site and to generally obtain his own information on all matters affecting directly or indirectly the execution of the whole works involved in the contract to the complete satisfaction of the Engineer. No claim of extras in consequence of any alleged ignorance in any aspect will be entertained by the Engineer. It must be clearly and definitely understood that the contractor shall be held solely responsible for making all necessary arrangement and co-ordinating with relevant authorities, competent agencies and specialist contractors etc., to ensure satisfactory completion of the Contract.

This includes but not limited to: All negotiations for land use, relocation of any structures, approvals to work in residential areas, Identification and Relocation of utilities i.e. water mains, as necessary Traffic diversions as required Sewage flow diversions and management of flows. Site office location and construction accesses

5.3 Safe Entry and Working in Sewers

The Contractor shall ensure that all the necessary safety requirements for persons working in sewers, manholes, chambers, and all other sewerage installations are fully complied with all statutory safety requirements and provisions in the DJB's general safety precautions and the clauses in the specification. The requirements and precautions to be taken when working in confined space and in live sewers are specified in the specification.

5.4 Ventilation

The Contractor shall provide adequate ventilation and efficient apparatus to keep all excavations, tunnels and sewers free from all dangerous gases, and he shall take precaution to ascertain that they are in a safe condition before allowing his workmen to descend. Refer Technical specifications Parts 4.

While working in existing sewer or manhole, the Contractor shall provide air blowers to ventilate the place as sewage gas usually contains a high proportion of hydrogen sulphide, methane and other toxic gases which in combination with oxygen is explosive. Approved gas monitors/detectors and oxygen meters shall be used to ensure that the place is free from all dangerous gases.

The Contractor is required to appoint a supervisor to ascertain that the sewer or manhole is in a safe condition before allowing his workmen to descend and work. No smoking or naked flame shall be allowed in the sewer or manhole. Monitoring of the air quality shall also be carried out regularly by the Contractor's supervisor while work is in progress and work shall be immediately suspended should unsafe condition develop.

The Contractor is warned that besides performing any work in existing sewer or manhole, connecting to or breaking into existing sewer or manholes also poses potentially hazardous conditions. The existing sewer or manhole in which the work has to be carried out should therefore be thoroughly ventilated and certified as safe by the supervisor before workmen are allowed to execute the connection. During the work all the safety precautions shall be followed as mentioned in the technical specification.

5.5 Continuous Working

If, in the opinion of the Engineer it is necessary, by reason of the safety of the works, or the restoration of interrupted services or for any other reason whatever, the Contractor shall, when so ordered by the employer to carry out the works or any portion thereof continuously by day and by night in a safe manner at no additional cost to the DJB.

If he requires working continuously in three shifts to makeup his progress, he will seek the permission from the employer.

It shall be clearly and definitely understood by the Contractor that no claims in respect of any of the above shall be allowed in the settlement of the Final Account, unless approved by DJB.

5.6 Programme and Progress Chart

Within two weeks of the Date of Acceptance of the Bid, the Contractor shall submit a Rehabilitation Bench Mark Programme showing the time within which the various significant activities of the work

will be executed and completed. External dependencies if any shall be identified in the programme. The programme shall make due allowance for public holidays etc.

The Rehabilitation Programmes shall be in the form of a critical path network set out to a time scale of working days and critical path of the Works as well as the interdependencies of the activities and available float shall be clearly indicated. Any departure from the works procedure as programmed shall first be discussed with and agreed to by the Engineer before implementation.

When required by the Engineer and/or deemed necessary by the Contractor, an updated Rehabilitation Programme shall be prepared by the Contractor to incorporate any changes in the methods, times or sequence of activities, and to show the Contractor's planned progress towards the Date of practical Completion. The level of details required for the updated programme shall be as specified for the original Rehabilitation Programme.

If the Contractor fails to comply with the provisions of this clause, the Engineer may withhold the issue of payment certificate next due and any subsequent payment certificates, until such time as the Contractor complies with the provisions of this clause.

5.7 Working Along Roads

5.7.1 Special Traffic Precautions

The Contractor's attention is specially drawn to the requirements by the traffic police and road authorities and Specifications regarding Traffic Control, Access and the Reinstatement of road surfaces etc.

The Contractor shall obtain separate permission for each Works Package from the respective Senior Inspector of Police (traffic).

The Contractor's progress/programme and road opening schedule must be arranged in details for discussion with the Engineer and the Traffic Police. The lining sewers must be broken into suitable sections and sewers to be lined wherever necessary, special traffic diversions shall be arranged.

Whenever carriage ways are affected, the Contractor must arrange to contain the works within the narrowest possible area. The Contractor shall carry out the work in such a manner as to cause minimum interference with the public use of roads, footpaths and other thoroughfares. All workmen working on roads are required to wear approved retro-reflective vests at all times. The Contractor shall, include in his rates for compliance; with all the conditions stipulated above.

5.7.2 Road Opening

In case, if opening of upper portion of the manhole (not wider than 1.5 meter) is necessary, the Contractor shall submit a detailed road opening schedule to the Engineer for approval. The Contractor shall contain the works within the narrowest possible area when opening the road for access to sewer line.

Traffic flow must be maintained at all times along the roads affected by the work. Sufficient lighting road signs, barricades and traffic diversion signs must be established along the sites of the works in accordance with the Traffic Police requirements and to the entire satisfaction of the Engineer.

The Contractor shall also comply with the conditions imposed by Traffic Police and Roads Opening Conditions and Requirements stipulated by DJB.

Upon completion of the work, the Contractor shall backfill and makes good all disturbances to the road, side table, road kerb and drains to the satisfaction of the Road authorities and the Engineer.

The work shall be carried out at night time as far as possible to minimize the disturbance. If required, the Pits shall be covered with decking plates with appropriate support so that all traffic shall be allowed to run over the decking during day time. If directed by the authorities or the Engineer, the Contractor shall construct temporary diversions on the roads at his own cost to allow the traffic to flow through during the construction.

5.7.3 Road Reinstatement to Road Authority's Requirements

The Contractor shall carry out the reinstatement of road foundation and road surface in accordance with the specifications and requirements of the Roads authorities. This shall include machine-paving as and when directed by the Engineer.

Where road markings are affected, the Contractor shall reinstate it with thermoplastic (instead of paint) to the satisfaction of Roads authorities. The Contractor shall include in his rates for compliance with all the conditions stipulated above.

5.7.4 Partial Covering up of Road in Busy Areas

Where it is necessary to open the road for access to sewer line, in busy roads, the top of the openings shall be covered by decking, if required by traffic authorities, leaving only the minimum required area open at the top to carry out work within the shaft. Vehicles shall be permitted to travel over such covers provided. The Contractor shall submit to the Engineer, details of the partial covering. He shall allow for compliance of this requirement in his rates.

5.7.5 Reinstatement of Surface

The contractor shall be responsible for the reinstatement and maintenance of foundation and surface of roads, kerbs, footways and turfed areas, whether public or private, disturbed or damaged by the work, and the prices offered shall include such works.

The contractor shall allow for carrying out this reinstatement work in one or more stages, the maintenance of the reinstatement shall be to the satisfaction of the Engineer. This shall include the provision of temporary surfacing, its maintenance and subsequent breaking out and removal of temporary surfacing required for the reinstatement of final carriageways.

The contractor shall also make provision for any additional width in short lengths or in stages as considered required by the Engineer due to the Contractor's operations or to subsidence or traffic. The contractor shall carry out the reinstatement of road foundation and road surface in accordance with the specifications and requirements of the Roads Authorities.

This shall include machine-paving as and when directed by the Engineer. Where road markings are affected, the contractor shall reinstate it with thermoplastic to the satisfaction of Road Authorities. The contractor shall include in his rates for compliance with all the conditions stipulated above. In the event of the contractor failing to carry out maintenance work, the Engineer may get this work done as set out in the specification through any other

contractor, in which case, the cost so incurred shall be borne by the contractor and deducted from money due or to become due to the contractor.

The contractor shall also allow for matching paving in all reinstatement of road surfaces. The contractor must follow the safety rules as required. The contractor shall allow for all the above in his rates.

5.8 Rehabilitation of Sewers in Well Established Residential Areas

The Contractor shall note that certain sections of the sewer will be rehabilitated in close proximity to existing premises. He shall take all necessary precautions, including the provision of steel sheet piling cut off walls where necessary, to prevent any damage to the existing premises and shall be responsible for the complete repairs of all damage that occurs.

The Contractor shall be responsible for restricting his workmen to the site of the work while working.

No equipment and material shall be stored at places other than those areas allocated to him by the Engineer. Temporary fencing shall be erected as directed by the Engineer to separate the worksite from the rest of the premises at the Contractor's own expense for all execution. Turf, walls, slopes, fencing, shed or any other structures whether directly or otherwise disturbed or damaged by the work shall be reinstated to the original conditions by the Contractor at his own expense.

The Contractor shall allow in his rates for complying with the above Clauses as no claim to the contrary will be entertained by the Engineer.

5.9 Sewer Rehabilitation Works-Procedure

5.9.1 Preparation Work

Sewer rehabilitation shall include all aspects of restoring the structural capacity and hydraulic performance of an existing sewer. The method employed in rehabilitation shall be by approved lining and local in-situ temporary repair of sewer and rehabilitation of manholes.

The Contractor shall be responsible for locating and accessing all the required manholes along the sewer lines to be rehabilitated. This also includes locating and reinstating of all property /house service connections and lateral connections to the sewer section being lined. Should a manhole be buried, the Contractor shall notify the Engineer and he shall arrange for the manhole to be exposed

In all cases the Contractor shall endeavour to utilise existing manholes for access, insertion and installation of rehabilitation systems. Working shafts may be sunk with the approval of the Engineer but will not be paid for. Alteration to existing manholes for access, insertion and installation of rehabilitation systems may be allowed by the Engineer but no additional payment will be made for access arrangements made to or reinstatement of the manhole.

Where services are encountered in the sinking of working shafts or trial trenches the Contractor will allow-in his rates for all temporary support or diversion in accordance with the utility service authority's requirements.

The Contractor shall allow for any difficulty and inconvenience to be encountered during the construction works. He is deemed to have visited the site pursuant to the relevant clauses in the Conditions of Contract to ascertain existing conditions and constraints of whatever nature, including the amount of sewage flows; the depth, size of sewers, material of sewer, length and condition of sewers and manholes, and the nature of the ground conditions etc. relevant to the rehabilitation of the sewer lines included in the contract.

5.9.2 Preparation Prior to Sewer Rehabilitation

The Contractor shall be responsible for liaising with owners and/or occupiers of all properties affected by the works and for such means as are necessary to maintain sewerage services during the works. The

Contractor shall submit details of the means to maintain sewerage facility to the Engineer for approval prior to commencement of work.

If required by the Engineer the sewer shall be checked for collapses immediately before rehabilitation by man entry inspection of sewers if a collapse is detected, its position shall be determined and the debris removed. The collapse shall be brought to the attention of the Engineer, and repair of the collapse shall be undertaken by the Contractor as per details to be approved by the Engineer. The Contractor shall then commence work on the next available sewer within two working days.

5.10 Proposed Sequence of Rehabilitation Work

Manhole cleaning and Stanching

Installation of sufficient capacity Pumping Arrangement and flow

diversion Desilting of sewer

Sewer cleaning and colour CCTV inspection

Structural assessment and make recommendations on the appropriate local repair, measurement of internal dia., replacement work etc. if required, to be carried out before proceeding with lining work.

Upon completion of the above, the following shall be carried prior to lining:

- Submission of detailed liner design calculations and method statement and temporary structural enhancement work carried out.
- Carry out sewer lining works including QC (quality control) tests and appropriate safety measures.
- Reinstatement of laterals to re-lined sewers and re-lined sewers to existing manholes.
- Final sewer cleaning and CCTV inspection
- Manhole rehabilitation

It is deemed that the Contractor has allowed for in his prices in the Contract to carry out all the pre and post rehabilitation works, including the above generically described work, and also for everything else required to fulfil his prime obligation and responsibility to rehabilitate all the sewers included in the scope of work in accordance with the approved design, specifications and requirements as outlined in the Contract.

5.11 Sewer Inspection

The Contractor shall inspect each sewer for which re-lining is proposed to confirm or determine the following:

- That adequate access to the sewer is available at manholes or chambers.
- The location of existing services whether shown on the drawings or not.

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- The length of sewer to be relined.

- The number of lateral connections to the sewer and their locations and access to the lateral via inspection chambers.
- (a) The lining shall be a close fit against the original pipe / annular space between host pipe and liner shall be well grouted along the whole of its length and lateral connections shall be clean with no projections.
- (b) The lining shall be free from visible defects including foreign inclusions, dry spots, air bubbles, pinholes and pimples.

In the event that the lining is unacceptable due to partial collapse or due to an unacceptable degree of all type of defects etc., the Contractor shall remove and replace with a lining of the same thickness as the failed lining at his own cost. The Contractor shall submit to the Engineer for approval a complete method statement of these or any other remedial processes he proposes to use. All such remedial works of renovation, repair or replacement shall be carried out at no cost to DJB.

5.12 Measurement and Payment

Payment will be made for Complying with all requirements as described in the Technical Specification.

After rehabilitation of the sewer, the Contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the Engineer-in-charge.

The Payment Item shall be made as per relevant BOQ items.

PART: 6 - CONTRACTOR'S SUBMITTALS

6.1. General information on submittals

To ensure compliance with the requirements specified in the Contract, the contractor shall make a number of submittals as described in the following clauses to the Engineer for approval by the specified time. The contractor shall ensure that the submittals prepared are of good professional standard, comply with all the requirements specified in the contract and complete with all details and information to enable the Engineer to evaluate and approve the submission. It shall be clearly understood by the contractor that he shall not commence any work without the approval of the submittals by the Engineer.

Submittals by the contractor shall, inter alia, include: Contractor's method of construction, details on the construction equipment, description of the rehabilitation system and technical literature, safety plan, CCTV Survey procedure, cleaning of sewers, dimensional measurements of sewer cross sections, structural assessment and proposed temporary structural enhancement, site office layout details, Engineer's office layout, detailed. Design calculations and engineering properties of the lining materials, construction program, quality control, site layout etc.

All the above submittals shall be made to the Engineer within 14 days of commencement of Contract.

6.2 Construction Method submittals

The construction method submittals shall explain in details the various steps involved in the rehabilitation process and it shall include the equipment details, techniques, materials and other permanent and temporary features such as treatment of manholes and service laterals etc. The submittal should explain the process of traffic control, flow management and by pass arrangement, cleaning and disposal of silt, inspection including verification of lateral and structural defect locations, pipe preparation, lateral reinstatement, post inspection and commission and surface restoration. Any other details specific to the proposed lining system shall be also included.

Submittal should also include details of repair procedures if the lining is damaged during installation, site testing procedure, etc.

6.3 Sequence of Operation

The Contractor shall submit an overall bench mark programme as per the specification. The programme shall form the basis of monitoring the Contractor's performance. Any deviations to the programme shall be reported to the Engineer and adequate reasons shall be given for the deviation. The programme will form a yard stick to measure the Contractors' performance.

6.4 Detailed Construction Programme.

The Contractor shall prepare a detailed construction program incorporating all the section of work included in the package. The program shall be based on Microsoft project or any other suitable work scheduling programs. The activities shall be clearly identified and suitably linked into the programme. The milestone dates shall be indicated in the programme.

6.5 Site Layout Operations

Contractor's attention is drawn to various clauses in the document with regard to the site constraints and space availability in all the sites. The contractor shall carefully examine the site and prepare site layout plans showing the arrangement of various ancillary equipment required for the rehabilitation

works. The removal, storage and disposal of silt and other debris from the sewer shall be clearly indicated in the submittal. This submittal shall be submitted progressively to Engineer for approval.

6.6 Submittals for obtaining approval from authorities

The Contractor shall submit plans showing the proposed locations of the work area start and end shafts and detailed design drawings of the proposed modifications to the existing manholes to the Engineer progressively and in accordance with contractor's construction schedule, for approval. The contractor shall plan ahead make a submission to the relevant authorities (roads, railway, traffic police etc.) through the Engineer with ample lead time and obtain their permission or approval to excavate the shafts at the locations approved by the Engineer.

6.7 Submittal on Safety

The contractor shall implement a comprehensive safety plan for his workers. He shall comply with all relevant acts governing safety procedures and guidelines to work in live sewers. A detailed safety procedure and the Employer's compliance requirements are given in the specification. He shall submit to the Engineer the details of the safety arrangement he made with the local health authorities and the availability of medical staff, first aid equipment ambulance, sick bay etc. He shall give the names and contact telephone numbers (24 hours) of the occupational health and safety personnel. Beside he shall submit a list of safety equipment that he would provide to all the workers on site.

6.8 Submittal of Traffic Management Plan

The contract shall implement a comprehensive traffic management plan.

The Contractor will be required to arrange the work sites and order of working in or along carriageways to minimise the interference with the free flow of traffic and shall take all measures and precautions required by the traffic police and road authorities and the Engineer for the safety and convenience of traffic.

The worksite must be arranged in length to be consistent with good progress in laying the sewers and sufficient distance between work sites must be maintained to ensure the free flow of road traffic. The contractor must provide and maintain at each work site proper and efficient automatic lights operating day and night for the full duration of his occupancy of the roads.

The contractor shall submit a comprehensive traffic management plan for all his sites at least 14 days prior to commencing work for Engineer's approval.

6.9 Submittal on Flow Diversion & Management Plan

The contractor shall develop a comprehensive flow diversion and management plan whenever section of the sewer is to be isolated for rehabilitation works. The contractor shall carefully work out the best flow diversion option and plan his work accordingly. The flow diversion plan shall be such that all incoming flows from the upstream sewers are by passed through the

section either over pumping or other acceptable means in such a manner there shall be no overflows or surcharge in the upstream areas. The contractor shall possess all resources and necessary pumping equipment to carry out flow diversion safely and not to cause nuisance to the residents served by the sewers.

The contractor shall submit a well detailed Flow Diversion Plan with drawing showing the proposed by flow pass routes and other details to the Engineer at least 14 days prior to commencing any flow diversion works.

6.10 Submittal on Quality Assurance/Control Plan

The Contractor shall implement a Quality Assurance Program complying with ISO 9002 or approved equivalent for the manufacture of the lining and for installation of the lining. The Contractor's Quality Assurance Manual for the Works shall be submitted to the Engineer for his endorsement within fourteen (14) days of the Date of Acceptance of the Bid. The Quality Assurance Programme shall be maintained in accordance with the provision of the manual. No works shall commence until the Quality Assurance Manual has been endorsed by the Engineer.

The Contractor's Quality Assurance System shall incorporate but not be limited to the following:

- (i) The Quality Assurance and Quality Control procedures covering all material design. Manufacture, supply and installation carried out by the Contractor and any of his sub-contractors.
- (ii) Such tests necessary to demonstrate that materials comply with the requirements of this specification and the requirements of the relevant Standards and Codes as described in the specification.

6.11 Submittal on Contractor's personnel

The Contractor shall submit a list of his key site staff including their curriculum vitae to the Engineer with 7 days from the commencement of the contract. He shall submit the diagram showing the communication link within the site and from the site to Contractor's headquarters. He shall indicate in the line of communication the names, designation and the telephone numbers of the key staff for the Engineer's record.

6.12 Submittal for Replacement of Settled Sewers

The Contractor shall submit a proposed method statement for the replacement of settled sewers by narrow trench excavation techniques or trenchless method with his Bid.).

This shall also include the method of replacement/repair of the sewers adjacent drain.

This shall also include the method of new sewer construction along a new alignment for the sewer section.

All permissions and approvals for carrying out of the excavation will be the Contractor's responsibility.

6.13 Submittal for Maintenance of Sewer after Completion of Rehabilitation

The Contractor shall submit a proposed Maintenance programme for the maintenance of the rehabilitated sewers.

6.14 Effect of Approval and Acceptance of Proposals

Approval or acceptance by the Engineer of any proposal for executing the Works, including drawings, specifications or resources employed under the Contract shall not relieve the

Contractor of his responsibility for any errors thereon and shall not be regarded as an assumption of risk or liability by the Delhi Jal Board.

The Contractor shall have no claim under the Contract on account of the failure or partial failure or inefficiency of any plan, method of work or equipment approved or accepted by the Engineer. Such approval or acceptance shall be considered to mean only that the Engineer had no objection to these proposals.

Notwithstanding any approval or acceptance by the Engineer, the Contractor shall remain fully responsible for completing the Works correct in every detail.

6.15 Measurement and Payment

Payment will be made for Complying with all requirements as described in the Technical Specification

This item is for the preparation and Submittal of Construction Plans, Method Statements, Flow Diversion Plans, Traffic Management Plans, Safety Plan, drawings, design calculations etc. for the approval of the Engineer in-charge. The cost of submittal to relevant Authorities for their approval prior to work commencement shall also be included in their relevant BOQ items.

PART 7 - FLOW DIVERSION

7.1 Diversion of Flows

7.1.1 Bypass Pumping/Diversion of Flow

A separate system of sewers and storm water conduits exist on the site of the works. Sewerage services shall be maintained at all times during the works. Sewers to be inspected shall be kept at specified maximum depth of flow unless otherwise allowed by the Engineer.

The Contractor shall supply details to the Engineer, from whom prior approval should be sought; outlining his methodology for maintaining sewerage services through bypass pumping of upstream sewer in to the downstream sewer of the stretches which is under rehabilitation.

The contractor shall submit flow diversion proposal to the Engineer for approval. The proposal shall include details of plugging/ blocking of sewers and diversion arrangement either by pass pumping of upstream flows.

The Contractor is deemed to have inspected the site and ascertain himself the availability of such bypassing opportunities in the vicinity of the sewer lines to be rehabilitated before pricing the Contract. He shall include all the expenses for controlling the flow during the rehabilitation works.

The Contractor is deemed to have included in his prices for plugging, deployment of requisite pumps, gen sets etc. for proper diversions/ bypass pumping of sewer.

The sewers are generally flowing full in the peak hours. The by-pass system shall be of sufficient capacity to handle the estimated flows and the wet weather flows during and after a rainstorm.

The Contractor shall note that it is entirely his responsibility to devise appropriate flow diversion strategies and to allow for their costs in the Contract. The above information on diversion possibilities is provided to assist the Contractor to devise appropriate flow diversion strategies and the Engineer does not take responsibility for its availability or applicability.

The Contractor must allow in his flow diversion strategy for possible backflow from pumping stations and inflow from storm water drains. Infiltration flow must also be allowed for sewers situated adjacent to drain.

7.1.2 Contractor to have Adequate Pumping Facilities

The Contractor shall satisfy himself that the pumping equipment he proposes to use is sufficient and adequate for all flows actually encountered in the sewers.

The Contractor shall retain on site sufficient standby pumping equipment to replace defective units in the event of a breakdown. A competent person approved by the Engineer shall attend to the pumping equipment at all times.

Approval of the Contractors proposals by the Engineer shall not relieve the Contractor of his responsibility to ensure that sufficient and adequate pumping arrangements are provided at all time and for all flows.

The Contractor shall in addition to all the foregoing requirements of this Clause also allow in his rates for the provision (including establishment and removal), operation, maintenance and noise suppression of all over pumping plant; for the provision (including establishment and removal), operation and

maintenance of all delivery hose installed and for the period during which by pass pumping work is required; sinking hoses in trenches; backfilling and reinstating those trenches as required; placing horizontal and/or ramped metal plating over temporary diversion of the delivery hose either in trench or at the road surface and for routing delivery hoses through other conduits; standing and plugging lateral connections as well as other relevant requirements of the Engineer.

7.2 Measurement and Payment

Payment will be made for Complying with all requirements as described in Part 7 of the Technical Specification

The item for temporary plugging and blocking of sewer line & flow diversion shall include, but not limited to investigations of sewer networks & inter connections of storm water drains with sewerage system, all the cost of supplying and installation of all the pneumatic and mechanical plugs, metal plates, brick works, machinery and other materials etc. and for restraining them from dislodging etc. Contractor shall plug the storm water connections to sewer line and if necessary divert/pump that flow as per site requirement to complete the works. All preparatory costs, including any modifications and additional work related to diversion of flows and by pass pumping are deemed to have included in this item. Also plugging and flow diversion of branch connections, storm water connections etc. and everything else required to make the sewer stretch completely free of flow to enable the rehabilitation work to be carried out are also shall be included in the item. There are chances of sudden shut down of sewer treatment plant during construction period which may result in sewer backflow; so contractor shall be responsible for plugging of sewer stretch, upstream as well as downstream side and should design plug for the required water head while plugging the sewer line.

The item for flow diversion shall include but not limited to supply, installation & maintaining in running conditions of required capacity of generators, submersible pumps for diversion of sewage flow, pumps, hoses, pipes, clamps and accessories, machinery for deployment of set up & pumps and other materials etc. and for restraining them from dislodging etc. Currently trunk sewers systems are running in surcharge conditions. Contractor should visit the site and make sure that drains are available for flow diversion and he shall be responsible for getting the permissions for diverting the flow into the drain from the concern authority. If necessary Contractor has to lay a new rising main of required capacity parallel to the trunk sewer and maintain it for entire period for the purpose of flow diversion as per site conditions. Contractor shall pursue and obtain necessary permissions from the concern authorities for laying of rising main, diversion of flow etc. Contractor shall make the sewer stretch completely free of flow to enable the rehabilitation work to be carried out.

This item shall also include any groundwater control, which may be necessary to prevent groundwater infiltration, ingress of water from drain into sewer and any soil subsidence during the works. To reduce groundwater infiltration, dewatering techniques to lower the groundwater level may be required in some locations.

The Payment Item shall be made as per relevant BOQ items.

PART 8 - CLEANING OF SEWER AND DESILTING

8.1 Cleaning of Sewer Prior to Inspection

Sewers to be inspected shall be suitably cleaned by high pressure water jetting (the minimum pressure to be used shall be proposed by the Contractor and approved by the Engineer) to remove all silt, grease and loose material, to the satisfaction of the Engineer.

Where necessary mechanical cleaning tools may be used to scrape off grease and encrustations in the sewer prior to the final inspection.

Where necessary mechanical tools shall be used for the removal of boulders, tyres, steel, concrete and any other items found in the sewers.

Due to limited access and the type of debris encountered, manual methods may be permitted by The Engineer. The Contractor shall include his intention for manual methods in His Work Method Statements.

All mass roots, intruding laterals and concrete shall be neatly cut off as required for proper structural lining work. Items have been allowed in the Bills of Quantities for this Work.

Cleaning shall be carried out from the upstream access manhole or chamber to the downstream access manhole or chamber and shall include all operations necessary to remove all silt, grease, loose material, boulders, concrete, steel, tyres and any other debris from the sewer bore and manhole or chamber. All loosened and inherent silt and grease material in the pipeline shall be prevented from passing downstream.

The methodology for trapping all silt, grease, loose material, boulders, concrete steel tyres and any other debris from passing downstream shall be submitted to the Engineer for prior approval. Notwithstanding the approval of the Engineer, the Contractor shall ensure that the method or methods adopted shall be effective in the prevention of silt migration downstream.

All silt, grease, loose material, boulders, concrete, steel tyres and any other debris removed from the sewers and manholes shall be disposed of in an environmentally acceptable manner at the approved disposal grounds.

The Contractor is required to provide equipment of the appropriate calibre to deal with the demanding service conditions, including heavy grease, deposits of silt, cement grout, concrete, tyres, other debris and high levels of infiltration that he can expect to encounter in the sewerage network without causing any structural disturbance to the body of the sewer. A combination of mechanical equipment and suction/ jetter unit or similar is recommended. Details of the proposed combination unit or units and including ancillary features (including root cutter) shall be provided to the Engineer for approval prior to commencement of clearing work. Notwithstanding the approval of the Engineer, the Contractor shall ensure that the equipment adopted shall be effective in cleaning sewers as specified.

8.2 Sewer- Cleaning Immediately Prior to Rehabilitation.

Cleaning immediately prior to sewer rehabilitation shall include all operations necessary to remove all grease, slime and loose material from the sewer and manholes and disposed of in an environmentally acceptable manner at approved disposal grounds. All loosened and inherent silt and grease material in the sewer to be rehabilitated shall be prevented from passing downstream.

The methodology for trapping all silt, grease, concrete, boulders, timber, steel, tyres and loose material from passing downstream shall be submitted to the Engineer for prior approval. Notwithstanding the approval of the Engineer the Contractor shall ensure that the method or methods adopted shall be effective in the prevention of silt migration downstream.

Sewers shall be suitably cleaned by mechanical means and high pressure water jetting, at a minimum pressure and flow rate (to be proposed by the Contractor and approved by the Engineer) to remove all silt, grease, concrete, boulders, timber, steel, tyres and loose material to the satisfaction of the Engineer.

Where necessary mechanical cleaning tools may be used to scrape off heavy grease deposits and encrustations in the sewer with the prior approval of and as directed by the Engineer. The Contractor shall ensure that the removal of all silt and other undesirable materials on the surface of the sewer shall be such that the surface is conducive enough to make effective bonding in accordance with the design assumptions assumed by the Contractor in the structural design of the liner.

The adequacy of the cleaning work shall be monitored with CCTV/Video pan, tilt (and zoom) equipment and the Video tape shall be jointly viewed by the Contractor and the Engineer's staff to determine that the cleaning and any temporary repairs carried out are satisfactory.

The Contractor is required to provide equipment of the appropriate calibre to deal with the demanding service conditions, including heavy grease, silt, grease, concrete, boulders, timber, steel, tyres and other debris and high levels of infiltration that he can expect to encounter in the sewerage network. Details of the proposed methodology and equipment used shall be provided to the Engineer for approval prior to commencement of cleaning work.

Notwithstanding the approval of the Engineer the Contractor shall ensure that the equipment adopted shall be effective in cleaning sewers as specified without causing or precipitating (further) structural damage including collapse. The Contractor shall note those locations where the initial colour CCTV survey indicates the sewers to be in poor structural condition and shall ensure that cleaning operations cause no damage to the sewers at these locations.

Sewer rehabilitation shall not proceed without full compliance of above requirements and the approval of the Engineer after viewing the CCTV tape or inspection of the sewer as per the clause above.

Sewer rehabilitation shall be carried out within three (3) days of cleaning. If rehabilitation works are delayed for a period in excess of three (3) days after cleaning, the sewer shall be re-inspected and re-cleaned in accordance with the above clause, unless instructed otherwise by the Engineer. All costs associated with re-inspection and re-cleaning shall be borne by the Contractor.

The Contractor shall include in his rates for complying with the foregoing requirements of this clause for which there are measured items in the Bills of Quantities.

8.3 Mass Roots, Intruding Laterals, Concrete Grout and Other Obstructions

- (a) All mass roots, intruding laterals, concrete grout and other obstructions shall be neatly removed and the surface grinded to an acceptable finish. Other obstructions typically consist of, but are not

restricted to, intrusion of steel bars, cables or timber etc. that are the result of construction or other activities, which result in the intrusion of such material through the sewer pipe. Care is to be taken to ensure that damage to the existing sewer body is minimised. All cutting/grinding activities are to be carried out under supervision.

- (b) The scope of works for the removal of mass roots, intruding laterals and other obstructions shall include firstly the grinding down of the root, lateral intrusion or other obstructions until the

surface of the sewer pipe at the point of entry of the root, intruding lateral or other obstructions is fully exposed. The exposed surface shall then be ground to a depth of two thirds the thickness of the pipe wall. The. Recessed surface and any cracks or openings shall then be prepared by steam cleaning or by high Pressure water jetting. All prepared surfaces shall then be filled by the injection of an epoxy repair material. The final surface shall be smoothened to provide a hydraulically smooth finish.

- (c) The scope of works for the removal of concrete grout shall include the grinding down of the concrete grout until the surface of the sewer pipe is fully exposed. The exposed surface shall then be filled with an epoxy repair material and the final surface shall be smoothened to provide a hydraulically smooth finish. All surfaces shall be prepared by steam cleaning or by high pressure water jetting before the application of the epoxy filling material.

The length of repair for each removal of mass roots, intruding laterals, concrete grout or other obstructions shall extend a minimum additional length of 100 mm around the defect to enable the provision of a smooth transition between the repaired surface and the host pipe.

8.4 Removal of Heavy Grease Deposit, Encrustations/Crystallised Deposits in Sewers

All heavy / thick grease deposits and encrustations that cannot otherwise be removed by high pressure water jetting, either during sewer pre-conditioning or sewer cleaning immediately prior to rehabilitation or at such times as directed by the Engineer, shall be removed by an approved mechanical means. The proposed method(s) shall include the removal of hardened heavy/thick grease deposits and encrustations and/or crystallised deposits found on the inner surface of sewers.

The contractor is deemed to have allowed for in his price for the Contract for all the above work.

8.5 Measurement and Payment

Payment will be made for Complying with all requirements as described in the Technical Specification.

An item is provided for de-silting and disposal of silt after solidification. Most existing Trunk sewer is heavily silted up & sewers are running in surcharged conditions. The silt shall comprises materials, but not limited to, sand, organic & inorganic compounds, sludge, liquid, debris, malba, house hold spent items, stones bricks, tyres, dead animal bodies, vegetation, timber, roots, glass items, plastic items, metal items etc. The contractor shall separate the liquid components from the silt and solidify the silt as required on site or elsewhere at his own cost before disposing off in the approved dumping area. The Contractor shall include all transportation and dumping cost at the approved disposal site in his rates.

In case the sewer internal diameter is different to that specified in the Contract document, the payment for this item will be adjusted on a pro rata basis, based on the internal perimeter of the sewer.

The Payment shall be made as per BOQ item.

PART 9 - INTERNAL CONDITION SURVEY AND CCTV/ VIDEO INSPECTION OF SEWER

9.1 Sequence and Extent of Survey/Inspection

The Contractor shall carry out an initial survey of the complete length of sewers/manholes indicated for rehabilitation to ascertain their conditions prior to proceeding with the sewer rehabilitation works.

Inspection of manhole conditions is to be carried out concurrently with the initial survey of the sewers. Manhole inspection shall be carried out manually with data logging of defects and general conditions.

The Contractor shall survey the pipelines by means of CCTV imagery. Sewers of size up to 450mm shall require CCTV camera with pan and tilt facilities. For sewers more than 450mm diameter, CCTV/Video camera with pan, tilt and zoom facilities shall be used.

Inspection results for each sewer length shall be reported in accordance with the sample format submitted by the Contractor and approved by the Engineer. Defects classification shall be in accordance with Examiner software or the WRc/WAA (Water Research Centre/Water Authorities Associations of UK) "Manual of Sewer Condition Classification" 4th Edition 2001 or more.

9.2 Sewer Inspection Work

9.2.1 Inspection of Sewers

The sewers /manholes shall be sufficiently cleaned to enable existing cracks and corrosion to be clearly recorded on photographs. Engineer's approval shall be obtained prior to proceeding with the inspection work.

The Contractor shall survey the sewers by means of CCTV/Video imagery using a camera with pan, tilt and zoom facilities. The Contractor may also carry out the inspection manually. The CCTV/video camera is to be mounted on skids for such purposes. The bidder is to highlight his intended method of inspecting the man- entry sewers in his bid.

9.2.2 Inspection of Manholes

Inspection of manhole conditions is to be carried out concurrently with the inspection of sewers. Manhole inspection shall be carried out manually with data logging of defects and general conditions. Video tape evidence of manhole conditions is not required but provision shall be made in the rates to provide photographic evidence of defects, if required by the Engineer.

Condition of manhole shall be logged in accordance with the format to be approved by the Engineer. Manhole inspection report shall be included with the submission of the fortnightly CCTV Inspection Report as mentioned in clause 9.4.2

9.2.3 Depth of Flow for Inspection

The Contractor is to note that the bulk of sewer inspection is anticipated to be carried out during the low flow periods of between mid-night and 05:00 hours. The Contractor is to allow in his rates for all overtime cost expected to complete the inspection work. No extra claims shall be entertained in respect of this.

The pre cleaning CCTV survey shall cover the overt body of sewer at least from 8 o' clock to 4 o'clock points.

9.2.4 Night-work

For work in residential areas, permission must be obtained from the Engineer, if night work is to be carried out. All equipment used shall comply with the acceptable noise emission levels.

9.3 Contractor to Give Notice

The Contractor shall give notice to the Engineer the date of commencement and anticipated completion of work in each pipeline or manhole to be inspected at least three days before work begins. The Contractor shall also notify residents in the area and give notice to service utility departments if the process requires temporary disconnection of laterals.

9.4 CCTV/Video Inspection

9.4.1 Record of Defects and Proposed Temporary Improvement Works

The Contractor shall carry out inspection of the sewers and record its existing structural condition. The purpose of the inspection is to enable the contractor to record the defects and to carry out temporary structural enhancement measures as required before the chosen liner is installed.

Computer-based software pre-approved by the Engineer shall be used to capture and synthesise the data arising from the sewer inspection carried out and to grade the coded data. The structural condition of the sewers shall be graded into one of five internal condition grades using the system described in 'Sewer Rehabilitation Manual' published by Water Research Centre/Water Authorities Association of UK. The structural assessment shall be carried out on the advice of a Rehabilitation Engineer or other Qualified Persons with relevant experience to be engaged by the Contractor. Any improvement work desired by the Contractor shall be made known in the inspection report for the approval of the Engineer.

9.4.2 Condition Assessment and CCTV Survey Reports

Two copies of the Condition Assessment and CCTV Inspection Report must be submitted progressively at fortnightly intervals. One copy shall be a hard copy containing original coloured photographs extracted from the CCTV and laser imagery and actual photographs taken during manual inspection of the sewer. The other copy shall be a soft copy written in Microsoft Word for Windows 7 format supplied in an appropriate data storage media. The soft copy version shall include all coloured photographs. The graphic images shall be stored in compressed JPEG format in order to minimise demand on computer memory space. The Contractor shall include in his rates to provide a copy of the sewer inspection and condition evaluation reporting software to the Engineer to enable his staff to view the report.

The CCTV Inspection Report shall also contain an overall plan of all pipelines and manholes inspected structural assessment of the sewers and manholes and a summary of the findings.

9.4.3 Survey/Inspection Units

The Contractor shall provide sufficient survey/inspection units, including standby units in the event of breakdown, in order to complete CCTV surveys and/or inspections as specified.

9.4.4 Survey/Inspection Vehicle

The survey/inspection vehicle shall comprise two totally separate areas. One of these, designated as the viewing area, shall be insulated against noise and extremes in temperature, include the provision of air-conditioning, and shall be provided with means of controlling external and internal sources of light in a

manner capable of ensuring that the monitor screen display is in accordance with the specification. Proper seating accommodation shall be provided by the Contractor to enable two people, in addition to the operator, to view clearly the on-site monitor which shall display the Survey as it proceeds.

The working area shall be reserved for equipment both operational and stored, and no equipment utilised within the sewer shall be allowed to be stored in the viewing area.

9.4.5 CCTV/Laser Profile/Survey/Inspection and Operational

Equipment CCTV Television Camera

The television camera used for the inspection shall be specifically designed and constructed for such inspection. Lighting for the camera shall allow a clear picture of the entire periphery of the pipe above the existing flow. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall produce a picture quality to the satisfaction of the Engineer, and if the picture quality is not satisfactory, TV inspection equipment shall be removed. Standard pipe inspection software pre-approved by the Engineer shall be used. No payment will be made for an unsatisfactory inspection or use of any unapproved poor quality CCTV camera system.

9.4.5.1 Laser Profiler

The television camera shall be capable of accommodating a stand-alone laser profiling Snap-On tool capable of projecting a ring of laser light onto the interior of the pumping main wall in a plane perpendicular to the television camera's line of sight. As the television camera and laser ring moves through the pipe, the television image is recorded. The camera shall be equipped with ac software capable of digitally processing the image and develop vast amounts of information such as deflection, ovality, corrugation depth and pipe cross sectional area. The software which has ability to create a full interactive 3 D model of the pipe is desirable.

9.4.5.2 Communication Equipment

When manually operated winches are used to pull the television camera through the main, two-way radio or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communications between members of the crew.

9.4.5.3 CCTV Survey/Inspection equipment to be good Working Condition

The surveying/ inspecting equipment shall be capable of surveying / inspecting a length of non-man entry sewer up to 350 m where entry onto the sewer may be obtained at each end and up to 30 m by rod-ding or up to 150 m where a self-propelled unit is used, where entry is at one end only.

Contractor shall maintain this plant in full working order and shall satisfy Engineer at the commencement of each working shift that all items of plant have been provided and are in full working order.

Each survey/ inspection unit shall contain a means of transporting the CCTV/Video camera in a stable condition through the sewer under survey and/ or inspection. Such equipment shall ensure that the position of the CCTV /Video camera is always in prime location to capture images of the sewer body on or near to the central axis of the sewer when required.

9.4.5.4 CCTV/Video Camera Prime Position

Wherever prevailing conditions allow, the CCTV /Video camera/Laser profiler shall be positioned to reduce the risk of picture distortion, and as all sewers are ovoid or circular or rectangular shaped in this Contract, the CCTV/Video camera lens/Laser beam emitter shall be positioned centrally (i.e. in prime position) within the sewer. In all instances the camera lens and laser beam emitter shall be positioned looking along the axis of the sewer when in the prime position. When photograph is taken to illustrate a lateral or a specific defect, it shall occupy the central part of the photograph and be clearly in focus and accurately reflect the lateral or defect. If necessary a second photograph shall be taken at the location to put the lateral or defect depicted in the specific photographs into perspective in the overall context of the sewer.

9.4.5.5 CCTV/Video Camera Speed

The speed of the CCTV/Video camera in the sewer shall be limited to 0.20 m/s or such other speed as agreed by the Engineer to enable all details to be extracted from the video recording.

9.4.5.6 Variable Scan Camera

The Contractor shall provide colour pan and tilt camera(s) with zoom lens for larger diameter sewers to facilitate the survey and inspection of all laterals before and after rehabilitation as well as other features, including defects such as hydrogen sulphide corrosion, missing or dislodged bricks, etc. in the overt of sewers and benching or walls of manholes. These will be carried out as part of the normal CCTV assessment as the survey or inspection proceeds when approved by the Engineer. A 360 ° rotational scan indicating general condition must be implemented at every 10 metre interval (min.) along sewers and at any salient defect features. The tilt arc shall not be less than 225° unless otherwise agreed.

The variable scan camera and colour monitor shall include screen graphics clearly indicating the directional location of the field of view of the sewer at any selected position relative to the cameras rotational and tilting arc. Zoom images shall similarly include reference to 'zoom' lens usage.

9.4.5.7 Linear Measurement

The CCTV monitor display shall incorporate an automatically updated record in metres and tenths of a metre of the chain age of the camera or centre point of the Transducer, whichever unit is being metered, from the cable calibration point. The relative positions of the two centre points should also be noted.

The Contractor shall use a suitable metering device which enables the cable length or camera's position to be accurately measured; this shall be accurate to 1% or 0.3m whichever is the greater.

The Contractor shall demonstrate that the tolerance in the above Sub-clause is being complied with using one or both of the following methods in conjunction with a linear measurement audit form which shall be completed each day during the Survey:

- Use of a cable calibration device;
- Tape measurement of the surface between manholes.

If the Contractor fails to meet the required standard of accuracy the Engineer shall instruct the Contractor to provide a new device to measure the chainage. The S.O. may at his discretion instruct the Contractor in writing, to re-survey those lengths of sewer first inspected with the original measuring device using the new measuring device.

9.4.5.8 Data Display, Video Recording and Start of Survey/Inspection

At the start of each sewer length being surveyed /Inspected, the length of pipeline from zero chainage up to the cable calibration point shall be recorded and reported in order to obtain a full record of the sewer length.

The meter reading entered on to the data display at the cable calibration point must allow for the distance from the start of the survey/ Inspection to the cable calibration point such that the chainage at the start of the survey is zero.

In the case of surveying through a manhole where a new header sheet is required, the chainage shall be set at zero with the camera focused on the outgoing pipe entrance.

At the start of each manhole length a data generator shall electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following minimum information:

- Automatic update of the camera's chainage position in the sewer line from adjusted zero
- Sewer dimensions
- Manhole/ pipe length reference numbers
- Date of survey
- Road name/location
- Direction of Survey
- Time of start of Survey
- Sewer use

The size and position of the data display shall be such as not to interfere with the main subject of the picture.

Once the survey of the pipeline is under way, the following information shall be continually displayed: Automatic update of the camera's chainage position in the sewer line from adjusted zero.

- Sewer dimensions
- Manhole/pipe length reference number
- Direction of Survey

Correct adjustment of the recording apparatus and monitor shall be demonstrated by use of the test tape or other device approved by the Engineer. Satisfactory performance of the camera shall then be demonstrated by the recording of the appropriate test device at the commencement of each day for a minimum period of 30 seconds.

9.5 Survey Data Specification

9.5.1 CCTV Inspection Report

Inspection results of the Initial Colour CCTV /Video Survey for each sewer length between manholes shall be reported in accordance with the sample format to be submitted by the Contractor and approved by the Engineer. All description of defects shall be in full. Defects classification shall be in accordance with the WRc /WAA "Manual of Sewer Condition Classification" 4th Edition 2001 or more or equivalent.

Photographic evidence of each defect must be taken and included in the CCTV Inspection Report.

Following the completion of a sewer line survey and no later than three days following the survey, a copy of the video tape and original photographs must be submitted to the Engineer for approval. Any errors in recording, CCTV imagery and/or unclear photographs (as compared to the standard of sample photographs to be approved by the Engineer) shall be rejected and the Contractor would be required to correct the errors at his own cost. The original report and photographs shall be returned to the Contractor, once they are accepted by the Engineer for compilation of the final CCTV Inspection Report.

Condition of manholes shall be logged in accordance with the sample format to be submitted by the Contractor and approved by the Engineer. Manhole inspection reports shall be submitted together with the progressive CCTV Inspection Report.

The structural condition of the sewers inspected shall be graded into one of 5 internal condition grades using the system described in the WRc/WAA Sewerage Rehabilitation Manual or other approved system. The structural **assessment** shall be carried out using approved computer-based software and on the advice of a Qualified Person with relevant experience engaged by the contractor.

The contractor shall submit on a fortnightly basis, two copies of the CCTV Inspection Report in accordance with Clause 9.4.2 inclusive of progressive technical reports on the structural condition of the sewers inspected.

All photographs and video recordings taken under the Contract shall remain the property of the Sewerage Operations of the DJB.

9.5.2 Site Coding Sheets

Each sewer length i.e. the length of sewer between two consecutive manholes shall be entered on a separate coding sheet. Thus where a Contractor elects to "pull through" a manhole during a CCTV/Video survey or "walk through" during a Man Entry survey he shall start a new coding sheet at the manhole "pulled or walked through" and shall re-set the chainage to zero on the coding sheet. Where a length of sewer between consecutive manholes is surveyed from each end (due to an obstruction) two coding sheets should be used.

Where a length of sewer between two consecutive manholes cannot be surveyed or attempted for practical reasons a (completed header) coded sheet shall be made out defining the reason for abandonment. At uncharted manholes it is not necessary to start a coding sheet or to re-set the chainage

to zero. The Contractor shall complete site coding sheets at the time of the survey and these shall be made available for the Engineer's inspection at all times.

9.5.3 Units of Measurement

All dimensions shall be in SI units. For the purpose of metrication, Imperial sized sewers shall be converted on the basis of 1 inch = 25.4 mm. Measurement shall be on nominal diameter dimensions quoted to the nearest mm.

9.5.4 CCTV and Man Entry Photographs

Photographs shall be taken of all laterals and pipeline defects, as defined in the WRc/WAA "Manual of Sewer Condition Classification" 4th Edition 2001. Where a defect is continuous or repeated the photographs shall be taken at the beginning of the defect and at not less than 5m intervals thereafter. Where photographs are not otherwise required a general condition photograph shall be taken not more than 10 m after the previous photograph.

CCTV/Video Photographs must clearly and accurately show what is displayed on the monitor which shall be in-proper adjustment.

Photographs, which shall be durable, shall be of 4R size.

Photographs shall be clearly identified in relation to the street location, sewer dimensions and shape, material of the sewer (e.g. Brick, concrete), manhole start and finish numbers, survey direction, chainage and date when the photograph was taken.

The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than 5mm, and be type printed.

The annotation shall be positioned so as not to interfere with the subject of the photograph.

9.5.5 Colour CCTV/Video production

All CCTV/Video work shall use colour CCTV/Video reproduction

9.5.6 CCTV/Video Picture Quality

An approved test device shall be provided and be available on site throughout the Contract, enabling the tests specified in this clause to be checked.

The test card shall be the Marconi Regulation Chart No. 1 or its derivatives with a colour bar, clearly differentiating between colours with no tinting to show the following:

White, Yellow, Cyan, Green, Magenta, Red, Blue, Black

9.5.7 Resolution

The live picture must be clearly visible with no interference and capable of registering a minimum number of TV lines/pictures height lines. The resolution shall be checked with the

monitor colour turned down. In the case of tube cameras this shall be 400 lines (BW) or 250 lines (Colour) and in the case CCD type cameras 300 lines.

9.5.8 Colour Consistency

To ensure the camera shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. In order to ensure colour consistency, generally no variation in illumination shall take place during the survey.

The Contractor shall note that the Engineer may periodically check both the live and video picture colour consistency against the colour bar. Any differences will necessitate re-survey of these new length affected at the Contractor's expense.

9.5.9 Video Playback

Video playback shall be capable of a resolution of a minimum of 250 lines recorded at standard speed.

9.5.10 Contractor's Quality Control Procedure

The Contractor shall operate a quality control system, to be approved by the Engineer which will effectively gauge the accuracy of all survey reports produced by the operator. The system shall be such that the accuracy of reporting should be a function particularly of:

- The number of faults not recorded (omissions);
- The correctness of the coding and classification of each fault recorded.

The minimum levels of accuracy to be attained under the various survey headings are given below:

Standard for this Contract

Header Accuracy	95%
Detail Accuracy	85%
Lowest Acceptable Tolerance	75%

9.5.11 Quality Control and Audit

The Engineer shall be entitled to audit periodically the control system and be present when assessments are being computed. When requested by the Engineer in writing the Contractor shall forward to the Engineer sufficient details and information for this audit assessment.

Should any report fail to achieve the specified percentages for a particular sewer length, the Engineer shall require the Contractor to re-code and re-submit the report. If the accuracy check fails, the Contractor shall repeat the full quality control check on 5 surveys either side of the survey which has failed. If any further failures are found to be outside the tolerances laid down in the above sub-clause within these additional checks, the process will be repeated

until an acceptable standard is reached. Any reports that have failed will be re-coded by another qualified person and submitted to the Engineer to replace those in his possession.

9.6 Measurement and Payment

Payment will be made for Complying with all requirements as described in the Technical Specification

This item includes all survey work and pre rehabilitation CCTV/Video survey work. The Contractor is deemed to have made provision for all types of CCTV/Video survey inclusive of photographic and manual video survey work in large size sewers where conventional CCTV is not practical to use and for carrying out any additional CCTV survey as necessary to capture and document essential pre rehabilitation works. Preparation of reports, CDs and area/location for viewing of the CCTV videos shall also be included.

Also allow for laser profiling of the sewer at every 10m interval and submit drawings with 4 diameter measurements (vertical, horizontal and cross measurements)

The Payment shall be made as per relevant BOQ .

PART 10 - REPAIR WORKS PRIOR TO LINING & SEWR REHABILITATION WORKS

10.1 Structural Defects in Sewer System

Based on the recent experience in rehabilitating the trunk sewers it is evident that most of the trunk sewers and peripheral sewers in the network are suffering from a multitude of problems due to:

- Poorly made joints,
- Structurally weak pipes
- Lack of appropriate pipe bedding (cause the sewer to sink)
- Hydrogen sulphide related corrosion in sewer crown which causes the sewer pipe to collapse.
- Siltation caused by poor gradients (including reverse gradients, elevated sewer sections) & sunken sections of sewer,
- Lack of self-cleansing velocity to prevent siltation.
- Indiscriminate discharge of solid waste and rubbish into the sewer through manholes causing the sewers to choke
- Ground water inflow through cracks and opened up joints which cause the surrounding soil to erode.
- Connections to storm water drains allowing silt and debris to flow into sewer during rain periods.
- Pump station breakdowns and malfunction.

In concrete sewers, the commonly found defects include broken/ cracked pipes, fractures, displaced/ broken joints, deformation, etc., and they appear to increase with depth. The incidence of infiltration guster (possibility of a void behind the guster) is predominant in some of the sewers.

Accumulation of debris, grease and silt and also calcium based deposits seem to be most common in all types of sewers. A thorough cleaning and removal of these materials is required before applying any lining systems to rehabilitate the sewers.

It shall not be construed that the above information describes adequately and accurately the actual conditions found in the sewers but provided herein only as a guide to the Contractor. DJB does not assume any responsibility for its accuracy or adequacy.

10.2 Sewer Corrosion

The sewers in Delhi are susceptible to hydrogen sulphide related corrosion and there is evidence of extensive hydrogen sulphide induced corrosion of the sewer fabric throughout Delhi. The Contractor shall note that the lining system proposed shall have excellent and proven ability to withstand the extensive corrosive atmosphere found in the sewers.

10.3 Defects Abbreviation

The abbreviations to be used in the Contract for classifying various types of defects shall be in accordance with the approved abbreviations by the Engineer. The abbreviations which have been used by DJB in the Sewer Condition Reports are based on Manual of Sewer Condition Classification (MSCC) by UK Water Industry Engineering and Operation Committee. The defects abbreviations are given in the table 1.3 below for reference.

Table 1.3

Defects Abbreviations

Structural Defects		Service Defects	
Code	Definition	Code	Definition
B(J)	Broken pipe (at Joint)	DE(J)	Debris (at Joint)
CC(J)	Crack Circumferential(at Joint)	DEG	Debris Grease
CL(J)	Crack Longitudinal (at Joint)	DES	Debris Silt
CM(J)	Crack Multiple (at Joint)	EL(J)	Encrustation Light(at Joint)
D(H/V)	Deformation (Horiz. /Vert.)	EM(J)	Encrustation Medium(at Joint)
DB	Displaced Bricks	EH(J)	Encrustation Heavy(at Joint)
FC(J)	Fracture Circumferential (Joint)	ESL	Scale Light
FL(J)	Fracture Longitudinal(Joint)	ESM	Scale Medium
FM(J)	Fracture Multiple (at Joint)	ESH	Scale Heavy
H	Hole in sewer	ID(J)	Infiltration Dripper (at Joint)
JDS	Joint Displaced Slight	IG(J)	Infiltration Guster (at Joint)
JDM	Joint Displaced Medium	IR(J)	Infiltration Runner (at Joint)
JDL	Joint Displaced Large	IS(J)	Infiltration Seepage (at joint)
MB	Missing Bricks	OB(J)	Obstruction (at Joint)
MM	Mortar Missing Medium	RF(J)	Roots Fine(at Joint)
MS	Mortar Missing Surface	RM(J)	Roots Mass (at Joint)
MT	Mortar Missing Total	RT(J)	Roots Tap (at Joint)
OJM	Open Joint Medium	V	Vermin
OJL	Open Joint Large		
SSS	Surface Damage, palling Slight		
SSM	Surface Damage palling Med.		
SSL	Surface Damage, palling Large		
SWS	Surface Damage, Wear Slight		
SWM	Surface Damage, Wear Medium		
SWL	Surface Damage, Wear Large		
X	Sewer Collapsed		

10.4 Site Measurement

The Contractor shall be responsible for measuring the dimensions of the existing sewer prior to fabrication, to ensure that proper fit is achieved.

For structural linings, survey shall include the measurement of changes in horizontal and vertical alignment at changes in direction and bends where they occur between bends. As a minimum this shall include measurement of the internal width and height at each access chamber, and at 10 m maximum intervals between chambers.

Prior to the fabrication of any structural lining segments, details shall be provided to the Engineer showing the results of the internal measurements and the chosen resultant selection of dimensions of the lining. Additional information shall be provided to demonstrate the fit of the structural lining segments at bends.

10.5 Cleaning And Surface Preparation

The selection of equipment and methods used for the cleaning and surface preparation shall be the Contractor's responsibility.

All silt, debris and materials removed during cleaning shall be collected and extracted from the sewer at the next downstream access chamber.

Preliminary cleaning of the existing concrete surface shall be carried out by high pressure water washing to remove surface contaminants and concrete and mortar softened by acid attack.

For the brick sewer where significant mortar loss has occurred in the joints between bricks, precautionary measures shall be included in working procedures to account for the possibility that bricks may dislodge or come loose during cleaning and surface preparation.

10.5.1 Surface Preparation for TYPE II Linings

The Contractor shall thoroughly clean the inside of the existing sewer conduits to prepare them for installation of the lining.

All dislocated joints, stepped joints or other surface irregularities of the existing sewer pipes shall be made as smooth as possible by grinding and cement mortar/epoxy mortar as required.

This is required to ensure the maximum possible cross sectional area of the existing sewer is maintained at the joint.

It is also required so that the proposed liner shall fit the actual pipe cross section at either side of the joint without any damage caused by the dislocated joint or surface irregularity. It is also to ensure that there are no voids/gaps formed between the liner and the existing sewer pipe.

10.6 Inspection of Pipeline

All conduits shall be inspected to confirm they are cleaned and ready for installation of the lining. Visual inspection shall be carried out for all man-entry conduits.

10.7 Treatment of Exposed Reinforcement

Following cleaning of the pipe and prior to lining, any exposed reinforcement shall be inspected to determine if any action is required prior to lining.

For sewer pipe 1000mm diameter and less, if inspection indicates there is a risk of damage to the lining then a robotic cutter shall be used to remove the protruding sections of reinforcement.

For larger diameter conduits man access shall be used to wire brush clean and coat exposed reinforcement with a zinc rich epoxy primer.

Additionally for CIPP inverted lining systems, reinforcement shall be coated with a minimum thickness of 3 mm of epoxy mortar or cement render to avoid potential damage to the containment tube during installation.

10.8 Infiltration Control

Measures shall be instigated to limit or/control infiltration during lining to ensure that the completed lining is installed in accordance with the requirements of this specification.

For Type II standalone structural linings, infiltration shall be controlled during lining to prevent contamination of the grout, and to ensure complete filling of the annular space between the liner and the existing sewer.

The arrangement of reducing groundwater infiltration or any sullage from drains, dewatering techniques to lower the groundwater level may be required in some locations.

10.9 Sewer Rehabilitation Works

10.9.1 Preparation Work

Sewer rehabilitation shall include all aspects of restoring the structural capacity and hydraulic performance of an existing sewer. The method employed in rehabilitation shall be by approved lining and local in-situ temporary repair of sewer and rehabilitation of manholes.

The Contractor shall be responsible for locating and accessing all the required manholes along the sewer lines to be rehabilitated. This also includes locating and reinstating of all property /house service connections and lateral connections to the sewer section being lined. Should a manhole be buried, the Contractor shall notify the Engineer and he shall arrange for the manhole to be exposed.

In all cases the Contractor shall endeavour to utilise existing manholes for access, insertion and installation of rehabilitation systems. Working shafts may be sunk with the approval of the Engineer but will not be paid for. Alteration to existing manholes for access, insertion and installation of rehabilitation systems may be allowed by the Engineer but no additional payment will be made for access arrangements made to or reinstatement of the manhole.

Where services are encountered in the sinking of working shafts or trial trenches the Contractor will allow-in his rates for all temporary support or diversion in accordance with the utility service authority's requirements.

The Contractor shall allow for any difficulty and inconvenience to be encountered during the construction works. He is deemed to have visited the site pursuant to the relevant clauses in the Conditions of Contract to ascertain existing conditions and constraints of whatever nature,

including the amount of sewage flows; the depth, size of sewers, material of sewer, length and condition of sewers and manholes, and the nature of the ground conditions etc. relevant to the rehabilitation of the sewer lines included in the contract.

10.9.2 Preparation Prior to Sewer Rehabilitation

The Contractor shall be responsible for liaising with owners and/or occupiers of all properties affected by the works and for such means as are necessary to maintain sewerage services during the works. The Contractor shall submit details of the means to maintain sewerage facility to the Engineer for approval prior to commencement of work.

If required by the Engineer the sewer shall be checked for collapses immediately before rehabilitation by man entry inspection of sewers if a collapse is detected, its position shall be determined and the debris removed. The collapse shall be brought to the attention of the Engineer, and repair of the collapse shall be undertaken by the Contractor as per details to be approved by the Engineer. The Contractor shall then commence work on the next available sewer within two working days.

10.9.3 Sewer- Cleaning Immediately Prior to Rehabilitation

Cleaning immediately prior to sewer rehabilitation shall include all operations necessary to remove all grease, slime and loose material from the sewer and manholes and disposed of in an environmentally acceptable manner at approved disposal grounds. All loosened and inherent silt and grease material in the sewer to be rehabilitated shall be prevented from passing downstream.

Notwithstanding the approval of the Engineer the Contractor shall ensure that the equipment adopted shall be effective in cleaning sewers as specified without causing or precipitating (further) structural damage including collapse. The Contractor shall note those locations where the initial colour CCTV survey indicates the sewers to be in poor structural condition and shall ensure that cleaning operations cause no damage to the sewers at these locations.

Sewer rehabilitation shall not proceed without full compliance of above requirements and the approval of the Engineer.

Sewer rehabilitation shall be carried out within three (3) days of cleaning. If rehabilitation works are delayed for a period in excess of three (3) days after cleaning, the sewer shall be re-inspected and re-cleaned in accordance with the above clause, unless instructed otherwise by the Engineer. All costs associated with re-inspection and re-cleaning shall be borne by the Contractor.

The Contractor shall include in his rates for complying with the foregoing requirements of this clause for which there are measured items in the Bills of Quantities.

10.10 Cavity Grouting

The Contractor shall be fully responsible for ensuring that the existing soil conditions are as per design assumptions. Any cavities discovered behind the host pipe will have to be grouted unless the liner is redesigned for the new conditions.

The Contractor shall discuss the sequence of grouting, location of grouting holes etc. with the Engineer and incorporate the agreed details in his submission for Engineer's approval.

Systems of standard pipe, fittings, hose, and special grouting outlets embedded in the pipe walls shall be provided by the Contractor. Care shall be taken to ensure that all parts of the system are maintained free from dirt. Grout composed of cement, fly-ash and other approved compound and water shall be forced under pressure into the grouting connections as specified.

Apparatus for mixing and placing grout shall be of a type approved by the Engineer and shall be capable of mixing effectively and stirring the grout and then forcing it into the grout connections in a continuous uninterrupted flow.

After grouting is completed, pressure shall be maintained by means of stop cocks, or other suitable devices until the grout has set sufficiently.

10.11 Measurement and Payment

Payment will be made for Complying with all requirements as described in the Technical Specification.

An item is allowed for all pre-rehabilitation repairs to the sewers. The Contractor is deemed to have allowed for everything else required to carry out and complete the repairs to enhance the existing structural capacity of the sewer walls so that the sewer walls and the surrounding areas provide structural action consistent with the assumptions made for the structural design of the liner/composite sewer walls. If deemed necessary, the Contractor shall fill the voids around the sewer, using appropriate grouting techniques approved by the Engineer. Contractor is deemed to have allowed for such grouting work in the item.

This item shall also for all necessary pre-rehabilitation work for control of infiltration and any repairs to exposed steel work, grinding of protruding laterals or obstructions and any other works to ensure the satisfactory installation of the liner.

In case of any brick sewers, this may also include some trimming of mortar or brick work at some locations to ensure uniformity of sewer cross section.

This item shall also include local rectification of dislocated joints, stepped joints or other surface irregularities to ensure that liners can be installed correctly. The rate quoted for this item should be inclusive of supply of all grinding, excavation, shoring, materials, removing all debris & materials, construction etc. complete in all respect. All methods of repair shall be submitted for approval of The Engineer prior to commencement.

An item is allowed for making measurements of cross sectional dimensions of the sewer. The Contractor shall use laser profiler/ custom made templates of same internal size and shape as that of the liner (or that of the rehabilitated sewer) or any other acceptable technique to make the measurements of cross sectional dimensions.

Where the use of a template is not practical in larger size sewers, the Contractor shall propose an alternative method of measuring the cross sectional dimensions for Engineer's approval.

The Contractor shall also allow in the item for producing AutoCAD based cross sectional geometry and area of the sewer at 10 m intervals as specified. The Contractor shall also make provision for measurement of invert level using laser beam based equipment at every manhole and at 10m of interval inside the sewer.

The Payment shall be made as per relevant BOQ items.

PART 11 - STRUCTURAL LINING

11.1 Scope

This specification is an engineering product and execution specification for the internal rehabilitation of existing sewers owned and operated by the within Delhi Jal Board.

The specification assumes all circular sewers equal or greater than 1000 mm in diameter may be lined using man entry techniques. All circular sewers smaller than this are to be lined using non- man entry techniques.

11.2 Intent

The intent of rehabilitating the existing conduits by lining is, among other things, to

- Restore or increase the structural capacity of the sewer
- Protect the internal surface of the sewer from chemical and biological attack from a sewage environment in a tropical climate.
- Provide adequate abrasion resistance to the internal surface of the sewer to prevent structural degradation due to migration of silt, sand and debris and movement of cleansing equipment.
- Improve hydraulic performance and capacity of the sewer by using materials that offer least flow resistance.
- Seal all opened up and leaking joints and Provide complete water tightness to the sewer
- Prevent infiltration of groundwater and ex-filtration of sewage.

11.3 Types of Lining Systems

This specification is applicable for Type II standalone structural line for the following lining systems and material types:

- Structural Lining with cured in place pipes (CIPP) formed using resin impregnated tubes for all sizes of pipes.
- GRP segmental liner
- Structural lining using Machine spiral wound technology.

Lining systems not capable of meeting CIPP equivalent standalone Type II structural liner shall be considered non-conforming in terms of this specification and shall be rejected without reason.

Use of the systems mentioned above does not necessarily imply that they will satisfy the requirements of this specification. Type II Structural linings may for instance require strengthening by inclusion of

special reinforcing layers and corrosion protection layers to satisfy design requirements of the specification.

11.4 Definition of Lining Types

11.4.1 Lining Type

For the purpose of this specification linings will be broadly classified into two categories. The classification is in accordance with the Water Research Centre's Sewer Rehabilitation Manual and is as follows:

Type I Lining: Linings that form a bond to the grout and/or the sewer wall, so that the renovated sewer acts as a rigid composite body.

Type II Lining: Lining is designed as a flexible pipe that does not rely on bond with the sewer wall. Structural capacity results from the self-strength of the lining and grout as a standalone liner and no long term strength is assigned to the existing sewer body.

11.5 General Design Requirements

- (a) The liner must have sufficient strength to support all loadings.
- (b) The liner must seal the sewer to prevent the infiltration of ground water into the sewer and the ex-filtration of sewage into the surrounding ground.
- (c) The lining system must be proven technology for sewers of comparable size and shape and materials.
- (d) The liner shall be designed to withstand all construction loads including handling, lifting, installation and grouting stresses without overstressing the liner or cracking
- (e) The liner shall have protective layers on the interior or exterior surfaces to meet technical requirements in the specification.
- (f) The internal surface of the install liner shall be smooth with Colebrook White roughness of not more than 1.5mm throughout its life span.
- (g) The relining of the sewer shall be wrinkle free and retain the grade and level of the existing sewer.
- (h) The internal surface of the liner at the joints shall be flush with a tolerance step of not more than 1mm between adjoining pipes.
- (i) The joints shall be leak free and watertight and able to resist opening due to external or internal forces & structurally sound.
- (j) Details shall be provided for the cutting and making good of the laterals and branches. Also to provide details of sealing grout holes for Engineer's approval.
- (k) The design, manufacturing and delivery of the liner shall comply with ISO 9002 for production and delivery.
- (l) All design calculations required as per the specification shall be supplied with the bid .

- (m) Grouting holes (at least 2 Nos. per panel/section for GRP liner) shall be provided in the liner at appropriate locations, as approved by the Engineer.
- (n) The minimum thicknesses of grout for design purposes (refer Section 4.3.2 of WRc Manual, 4th Edition for thickness of grout) shall be 15mm.

Hydraulic Requirements

11.6 Reduction in the Cross Sectional Area

The liners are to be circular structural liners and must retain the largest possible internal dimensions (diameters). The reduction in the physical cross sectional area of the existing sewer lines after the rehabilitation shall be allowed up to a maximum of twelve and a half per cent (12.5%) of the actual cross-sectional area of the sewer.

The reduction in cross sectional area of existing sewer lines after rehabilitation shall be exclusively in terms of physical dimensions. The Contractor shall support the quoted percentage reduction in cross sectional area by submitting detailed calculations with the bid. The improvement in hydraulic capacity shall not be taken into account for calculating cross sectional area reduction.

The physical dimensions of the sewer will be measured after desilting works and the actual diameter and cross-sectional area will be agreed prior to submission of detailed liner design by The Contractor. For Tender purposes, the Nominal diameter of sewer shall be used.

The reduction in hydraulic capacity of the sewer system as a result of rehabilitation has significant implications on the long term serviceability of the sewer system. If the reduction in the physical cross sectional area of the renovated sewers can be kept to a minimum then this will enhance the long term serviceability of the sewer network.

Any lining system resulting in the reduction of the physical cross sectional area exceeding the above limit may be considered as non-conforming in terms of this specification and may be rejected without reason.

11.7 Design Responsibility

The Contractor shall be responsible for the suitability and correctness of design calculations necessary to substantiate that the lining system will be suitable in the long term for loads and all conditions experienced by the lining.

Notwithstanding the Tender design calculations submitted with the Tender, the Contractor shall submit final design calculations based on the actual site parameters for each length and size of sewer to The Engineer for approval prior to commencement of liner fabrication. However, the Contractor shall note that the final thickness shall not be less than the tendered thicknesses of the liner

The design requirements set down in this clause shall be considered as minimum requirements. The Contractor may adopt more conservative assumptions or design methods should they consider it necessary to accept full design responsibility.

Review of the Contractor's design calculations shall not be construed as acceptance of the calculations. Responsibility of the design shall remain with the Contractor.

The Contractor shall note that the acceptance of his bid and award of the Contract by the Employer will not in any way be considered as acceptance of the thicknesses proposed in the bid for construction. The Contractor shall clearly understand that if the design thicknesses found to be inadequate during the detailed checking of design during the construction, or he failed to check the design as per procedure set out in Part 11 of this specification, he shall be held solely and fully responsible to rectify and adjust the thickness without any variation to the Contract price or to the compliance requirements of the contract conditions.

11.8 Design Life

The service life of the installed lining system shall be not less than **fifty (50) years** under live sewer conditions. The Contractor shall produce documentary evidence to substantiate that the system he offered shall have minimum fifty years of service life.

11.9 Structural Design of Liners

11.9.1 CIPP Liner

The lining system offered shall be better than or equivalent to the lining systems suitable for Type 2 structural liners addressed in WRc, SRM manual, (2001) 4th Edition or more and ASTM F1216-03.

The structural design technique shall follow the design guidelines given in Sewerage Rehabilitation Manual, (WRc, SRM Manual (2001), 4th edition) or ASTM F 1216-03 (for CIPP) or other structural design methods of International Standard. (Refer engineering product and execution specification in Part 11 of this document). All designs shall be checked for critical buckling pressure based for both hydraulic loading and soil and traffic loading.

The Contractors shall use the Technical Schedule included in Item 17 of this document to provide the required engineering details of the liner materials and design calculations. The Contractor shall submit with the bid adequate data, test results, proven track record, technical publications, comments and recommendations, if any, made on the use of the lining system by water authorities, professional bodies or WRc or any similar association to substantiate that the system offered.

The Contractor's attention is drawn to the phenomenon that most of the polymeric liner materials do creep with time, resulting in substantial change in their engineering properties. The Contractor shall use only the proven long term engineering properties of materials in the structural design of the liner. However, for any short term temporary loadings, such as from handling and transporting the liner, grouting pressure etc. the Contractor may use the short term engineering properties in the design.

The Contractor shall state the short term and long term engineering properties including the stiffness values assumed for the materials in the design and submit documentary evidence to support the values of short term and long term stiffness assumed.

The Contractor shall make provision in his prices to conduct tests on site to prove that the materials actually used on site have achieved the short term values assumed in the design.

11.9.1.1 CIPP Lining Systems

This specification is applicable for the following lining systems and material types:

- Structural Lining with cured in place pipes (CIPP) formed using resin impregnated tubes for all sizes of pipes.

Use of the systems mentioned above does not necessarily imply that they will satisfy the requirements of this specification. Structural linings may for instance require strengthening by inclusion of special reinforcing layers and corrosion protection layers to satisfy design requirements of the specification.

11.9.1.2 Reference Documents and Standards

AS/ANZ 2566.1	Buried Flexible Pipes - Part 1: Structural Design
ASTM D-638	Test for Tensile Properties of Plastics.
ASTM D-790	Test Methods for Flexural Properties of Reinforced Plastics and Electrical Insulating Material.
ASTM D-2412	Test for Apparent Tensile Strength of Reinforced Thermosetting Plastic Pipe and Tube.
ASTM D-2587	Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impresser.
ASTM F-1216-03	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube.
ASTM F-1743	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
ASTM D-5813	Standard specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems.
ASTM D-2990	Standard Test Methods for Tensile, Compressive ,and Flexural Creep and Creep-Rupture of Plastics
ASTM F-2090	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP) (steam or UV cure)
BS 1881	Testing Concrete Part 102 Method of Determination of Slump Part 116 Method for the Determination of Compressive Strength of Concrete Cubes.
BS 2782	Methods of Testing Plastics Method 335a Determination of Flexural Properties of Rigid Plastics - Method 1003 Determination of Tensile Properties.

ISO11296-1 & 11296-4	Specification for Renovation of Gravity Sewers by Lining with Cured-In-Place Pipes.

WIS 4-34-02	Specification for Glass Fibre Reinforced Plastic (GRP) Sewer Linings.
WRC, SRM	Water Research Centre, Sewerage Rehabilitation Manual.
EN1120	Plastic Pipe Systems – Determination of Resistance to Chemical Attack from the Inside of a Deflected Section.
EN13566-4	Plastic Pipe Systems for Renovation of Underground Non Pressure Drainage and Sewerage Networks. - Part 1 General.
EN13566-4	Plastic Pipe Systems for Renovation of Underground Non Pressure Drainage and Sewerage Networks. - Part 4 :Lining with Cured in Place Pipes
AUST ROADS	Bridge Design Code.
IRC-AA CLASS	Indian Road Congress, Design Load Standard
ASTMI 1697	Wound Lining
ASTM D 256-1997	Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics”.
ASTMD 2240 - 1997	For Rubber Property – Durometer Hardness”.
WIS 4-31-05	Specification For Solid Wall Concentric External Rib-Reinforced Pvc Sewer Pipe.
Or any equivalent/ similar standard acceptable to the engineer	
In case of conflicting requirements between this specification and the ASTM standards, this specification will govern.	

11.9.1.3 Notation

The following notation shall apply to this specification:

Symbol	Definition	Units of Measurement
C	Ovality correction factor (Refer Clause 2.2.3.2)	-
C _b	Crown bending moment coefficient	-
D	Diameter at neutral axis of lining.	M
d _{av}	Mean internal diameter of the existing pipe	M
d _{min}	Minimum internal diameter of the existing pipe	M
D _e	External diameter of barrel of existing pipe.	M
D _f	Deflection factor	-
E _b	Ring bending modulus of elasticity of lining material	MPa
E _{bL}	Long term ring bending modulus of elasticity of lining material	MPa
E'	Effective soil modulus	MPa
FS	Factor of Safety	-
H	Depth of cover; vertical distance between the top of the pipe and the existing surface level	M
h	Overall height of lining	Mm
I	Moment of Inertia of lining wall for ring bending	m ⁴ /m
K _b	Ratio of horizontal to vertical earth pressure	-
K	Buckling resistance enhancement factor	-
q _{all}	Critical buckling pressure for lining	KN/m ²
S _D	Ring bending stiffness of lining (per metre length)	N/m/m
S _{DL}	Long term ring bending stiffness of lining (per metre length)	N/m/m
t	Lining material thickness	Mm
t ₁	Minimum grouted annulus thickness	Mm
t ₂	Wall thickness of existing sewer	Mm
w	Unit weight of soil	KN/m ³
W _g	External dead loading	KN/m
W _q	External live loading	KN/m
Δ _y	Predicted long term vertical deflection of lining	M
Δ _y / D	Limiting long term vertical deflection of lining	%
ε _b	Long term strain	-
ν	Poisson's ratio	-

11.9.1.4 Materials

The minimum required service life of the installed lining material is fifty [50] years.

The lining system shall be comprised materials that are chemically and biologically resistant to internal exposure to sewage, sewage related gases and mild concentrations of industrial effluent for the service life of the lining. In particular the system shall be chemically resistant to prolonged high concentrations of sulphuric acid (up to 10% concentration) resulting from the bacterial conversion of hydrogen sulphide. Linings shall not be susceptible to strain corrosion under deflection (Refer test method in EN1120).

The lining material shall have satisfactory abrasion resistance to the migration of silt, sand and debris along the sewer. It shall be sufficiently robust not to be damaged by sewer cleaning equipment that may be required to remove silt or any future blockage following installation of the lining.

CIPP linings shall satisfy the minimum material requirements given in ASTM F-1216 -03 & ISO11296-1 & 11296-4

Test data shall be provided prior to manufacture of any linings to confirm minimum material properties.

11.9.1.5 Materials for CIPP Lining

11.9.1.5.1 The Tube

The sewn Tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216, Section 11.1 or ASTM F1743, Section 11.2.1 The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.

The wet out Tube shall have a relatively uniform thickness that when compressed at installation pressures will equal or exceed the calculated minimum design thicknesses.

The Tube shall be manufactured to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion. Overlapped layers of felt in longitudinal seams that cause lumps in the final product shall not be utilized.

The outside layer of the Tube shall be coated with an impermeable, flexible membrane that will contain the resin and all the resin impregnation (wet out) procedure to be monitored.

The Tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated electrometric layers. No material shall be included in the Tube that may cause de-lamination in the cured CIPP. No dry or unsaturated layers shall be evident.

The wall colour of the interior pipe surface of CIPP after installation shall be a relatively light reflective colour so that a clear detailed examination with closed circuit television inspection equipment may be made.

Seams in the Tube shall be stronger than the non-seamed felt material.

The Contractor must have performed long-term testing for flexural creep of the CIPP pipe material installed by his Company. Such testing results are to be used to determine the long-term, time dependent

flexural modulus to be utilized in the product design. This is a performance test of the materials (Tube and Resin) and general workmanship of the installation and curing.

A percentage of the instantaneous flexural modulus value (as measured by ASTM D790 testing) will be used in design calculations for external buckling. Retention values exceeding 50% of the short-term test results shall not be applied unless substantiated by qualified third party test data to the Engineer's satisfaction. The materials utilized for the project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in the CIPP design.

The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If the layers separate during field sample testing, new samples will be required to be obtained from the installed pipe. Any reoccurrence may cause rejection of the work

11.9.1.5.2 Resin

The resin system shall be a corrosion resistant unsaturated polyester meeting the requirements of BS3532: 1990, or epoxy resin conforming to the requirements of ASTM D1763-88, including all required catalysts, initiators or hardeners that when cured within the tube create a composite that satisfies the requirements of ASTM F1216 and ASTM F1743, the physical properties herein, and those which are to be utilized in the design of the CIPP for this project.

The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this specification and shall be capable of producing the necessary design strengths and modulus assumed in the designing of the liner where high flexural modulus used in the design or required to meet the thickness requirements to keep the cross sectional area reduction of the sewer to be minimum.

All resins used for rehabilitation in the bid must have a proven track record for CIPP lining in proposed sewer rehabilitation work for at least 10 years. Manufacturer details of resins to be used and history of use in sewer.

The Contractors shall use the Technical Schedule included in Item 17 of this document to provide the required engineering details of the liner materials and design calculations. The Contractor shall submit with the bid adequate data, test results, proven track record, technical publications, comments and recommendations, if any, made on the use of the lining system by water authorities, professional bodies or WRC or any similar association to substantiate that the system offered.

The Contractor's attention is drawn to the phenomenon that most of the polymeric liner materials do creep with time, resulting in substantial change in their engineering properties. The Contractor shall use only the proven long term engineering properties of materials in the structural design of the liner. However, for any short term temporary loadings, such as from handling and transporting the liner, grouting pressure etc. the Contractor may use the short term engineering properties in the design.

The Contractor shall state the short term and long term engineering properties including the stiffness values assumed for the materials in the design and submit documentary evidence to support the values of short term and long term stiffness assumed.

The Contractor shall make provision in his prices to conduct tests on site to prove that the materials actually used on site have achieved the short term values assumed in the design.

The stiffness consistency of the as-installed liners shall be checked on site to ensure uniformity along the length of the rehabilitated sewer. Contractor shall make provision in his prices to determine the

actual thickness of the as-installed liner and the engineering properties of the liner materials (especially the soft liners with considerable thickness). The procedure for cutting and testing the liners shall be proposed by the Contractor for Engineer's approval.

The Contractor shall clearly understand the difficulties of some of the liners (both soft and flexible liners) achieving a good fit to the invert of smaller size circular sewers due to difficulties in bending the liners, especially the thicker liners. The Contractor shall study the situation and design the liner thickness to ensure that proposed liner shall achieve the required bending radius.

Strain related corrosion in polymeric materials in aqueous environment has been a source of structural capacity degradation. The Contractor shall address the issue of strain related corrosion for the materials he proposes to use and shall submit his recommended design practice and the standard for Engineer's perusal and acceptance. The Contractor shall consider restricting the strain to minimum recommended values in the design codes or British Standards or in any standards/codes as accepted by the Engineer for materials known to be more prone to strain related corrosion in aqueous environment. A more stringent strain limitation would be about 0.5%

The contractor shall ensure that deflections are within the acceptable limits and show in his design that deflection issues have been adequately taken into consideration in determination of the liner thicknesses.

11.9.1.5.3 Material Properties for Design

Where material properties under load vary with time, material properties of the lining at the end of the fifty (50) year service life shall be used in design calculations. The exception to this is design of the lining for loads applied only during installation, which may be based on short term material properties.

The material properties used in the design shall be consistent with the composition of the lining material. Values for material properties may be nominated by the Contractor but must be capable of being substantiated by test data based on representative samples of the installed lining material. The Contractor shall make provision in the Contract for such tests to be conducted during installation.

11.9.1.6 Design Loads

Design loads shall comprise the maximum load produced from the combination of earth pressures, hydrostatic loads and traffic surcharge loads for each particular lining. Vertical earth pressures shall comprise the nominated effective overburden height of soil above the pipe without reductions for trench effects.

Maximum hydrostatic pressures from groundwater shall be determined assuming the water table is located at surface level.

Traffic surcharge loads shall be calculated in accordance with Indian Road Congress AA Class Loading standard. Loads shall vary depending on the road usage as follows:

TYPE A:	Main Road Multiple adjacent lanes

TYPE B:	Light Road Single lane
TYPE C:	Field Load
Traffic live and soils loads given in WRc SRM (2001) 4 th Edition is also acceptable.	

11.9.1.6.1 Installation Design Checks

Linings shall be checked to ensure they are stable and will not be overstressed for any intermediate states during the installation and/or curing of the particular system. These checks may be based on short term properties of the lining material.

11.9.1.7 Design Calculations

Calculations shall be provided to substantiate that linings have been proportioned to suit the design requirements of this specification. Unless noted otherwise, all calculations shall assume a minimum factor of safety of 2. For Buckling Check use factor of Safety 2.5.

The Contractor shall supply full details of their design calculations, including proof checking and review of the calculations, by a qualified professional who is familiar with design procedure adopted in the WRc manual and ASTM F-1216-03 and with the bid documents.

If requested, the Contractor shall also provide a copy of the calculations for short term design checks.

11.9.1.8 Definitions for Pipe Condition

For the purpose of this specification and for design purposes, the condition of the existing sewer body has been classified as the following:

11.9.1.8.1 Fully Deteriorated

The sewer body has lost a sufficient degree of its original structural capacity that it cannot be relied upon to support applied loads for the next 50 years. The lining is expected to act as a structural replacement for the original sewer to bear the full load from the ground, traffic and ground water.

11.9.1.9 Design for Circular Pipes

11.9.1.9.1 Design of Liners

All liners must be capable of resisting a combination of maximum load arising from soil, water and traffic loading imposed on the lining.

All liners shall be designed in accordance with WRc /ASTM design procedures.

All liners shall also satisfy the requirements of this Specification for Type II standalone liners.

11.9.1.9.2 TYPE II Linings – Hydraulic

The design shall be based on the buckling strength of the lining with account taken of the enhancement provided against a buckling mode of failure by the existing pipe.

Design thickness shall be sufficient to withstand the hydrostatic pressure due to groundwater without collapsing.

The following equation shall be used to determine the required stiffness of the lining:

$$q_{all} = \frac{24 \times K \times S_{DL} \times 10^{-3}}{(1-v^2)} \times \frac{C}{FS}$$

where

$$FS = 2.0$$

$$K = \begin{cases} 7.0 & \text{when lining and pipe are in intimate contact or the annular gap is grouted.} \\ 4.0 & \text{when the gap between the lining and inside of the pipe exceeds a mean value of 1 mm.} \end{cases}$$

$$C = \frac{\left(\left(1 - \frac{d_{av} - d_{min}}{d_{av}} \right)^3 \right)}{\left(\left(1 + \frac{d_{av} - d_{min}}{d_{av}} \right)^2 \right)}$$

$$S_{DL} = \frac{(E_{bL} \times I)}{D^3} \times 10^6$$

The ovality shall be calculated as per ASTM F1216-03.

Minimum value for ovality of the existing sewer will be

2%.

11.9.1.9.3 Type II Lining Standalone

The lining shall ignore any contribution from the original conduit and be designed to support all imposed loads in its own right.

The lining shall be designed to satisfy the critical performance criteria of vertical deflection, strength, and buckling under maximum combined loads. Contractor must validate Soil Modulus from existing soil data available along sewer routes when submitting final design.

The lining must also satisfy the design for hydrostatic loads

(1) DEFLECTION

The predicted long term vertical deflection shall be less than six percent (6 %) of the diameter of the lining when calculated in accordance with the following equation,

$$\frac{\Delta_v}{D} \times 100 = \frac{0.1 \times 10^{-3} \times \left(\frac{(W_g + W_q)}{D} \right)}{8 \times 10^{-6} \times S_{DL} + 0.061 E'} \times 100 \leq 6 \%$$

Where

$$W_g = w H D$$

$$w = 18 \text{ kN/m}^3$$

$$E' \leq 6.0 \text{ Mpa (is the maximum allowable Soil Modulus if no voids are present around the sewer and the body of the sewer is stable)}$$

(2) FLEXURAL STRAIN

The long term flexural strain developed in the wall of the lining for any load or load combination shall not exceed the permissible value appropriate for the lining material. The predicted long term strain shall be calculated as follows:

$$\varepsilon_b = D_f \times (\Delta_y / D) \times (t / D)$$

$$D_f = \frac{3.33 \times 10^{-6} \frac{S_{DL}}{E'} + 0.00136}{1.11 \times 10^{-6} \frac{S_{DL}}{E'} + 0.000151}$$

(3) BUCKLING RESISTANCE

The lining shall be designed so that its buckling resistance is sufficient to support the imposed loads when calculated in accordance with the following equation:

$$q_{all} > w \left(\frac{D_e}{2} + H \right) + \frac{W_q}{D}$$

where

$$q_{all} = \frac{(S_{DL} \times 10^{-6})^{\frac{3}{2}} (E')^{\frac{2}{3}} \times 10^3}{FS}$$

The Factor of Safety (FS) shall be 2.5.

If requested calculations shall also be provided to demonstrate that the existing structure will not be overstressed by any combination of applied loading or reactions from the installation or performance of the lining

11.9.1.10 Retention of Existing Integrity Of Sewer

11.9.1.10.1 Rehabilitation Activities Affecting the Integrity of the Sewer.

No activity of the Contractor during preparation of the conduit and installation of the lining shall adversely affect existing structural integrity of the sewer No reaming or grinding of inner surface of the sewer body may be permitted for CIPP linings in man-entry pipes subject to the Contractor complying relevant clause.

No reaming shall be permitted to be carried out on RCC Pipe sewers.

11.9.1.11 Method Involving Internal Loading

The structural capacity of the existing sewer is unknown. Any method involving internal loading on to the sewer body during the construction operation will be viewed cautiously.

11.9.1.12 Working shafts (Starting and Ending Pits).

The Contractor shall note that no open excavation will be permitted under normal circumstances along the road or the sewer line and he shall thus select the renovation system that requires minimum or no excavation. However, widening of existing manhole up to a limit of 1.5m may be allowed subject to the Contractor obtaining necessary traffic permission from the authorities. It may be necessary to provide decking, especially in busy streets, and in which case the Contractor shall make provision in his rates for providing decking as required. The decking details shall be submitted to Engineer for approval.

Generally, the Contractor shall be allowed to work in night in streets where the traffic is heavy. However, the works can be continued during busy hours during the day provided the Contractor shall obtain necessary permission to work in such hours from the traffic authorities and such permission shall be submitted to the Engineer for him to authorise such work. Contractor is deemed to have included in his rates the cost of construction of all starting and ending pits

11.9.1.13 General

The manufacture of the lining shall be carried out in accordance with a specification purpose written for the particular system. This specification shall detail all labour, materials and equipment required to combine the various constituents to produce the lining ready for delivery to site. The specification shall include reference to appropriate standards for the manufacture.

The purpose written specification shall include testing and inspection work to be carried to verify the dimensions and quality of the manufactured lining.

A project specific Quality Control System, shall be also developed during the execution of works for site verification, manufacturing and installation of the liner.

11.9.1.14 Additional Requirement for Manufacture of CIPP Linings

The lining tube should be manufactured in an ISO certified facility.

The specification shall include reference to appropriate standards for the manufacture such as the following:

ASTM F1216 -03 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube. EN 13566.4 Plastic Pipe systems for renovation of underground non-pressure drainage and sewerage networks. Part 4: Lining with cured in place pipes WIS 4-34-04 Specification for renovation of Gravity Sewers by Lining with Cured-In-Place Pipes

The perimeter of the CIPP lining tube shall be dimensioned such that when installed it forms a close fit with the inside wall of the sewer. The manufactured length and thickness of the CIPP lining tube shall include allowances for any longitudinal or circumferential stretch during installation.

The lining tube after impregnation shall be provided in lengths such that no jointing is required between points of access to the sewer.

11.9.1.15 Appearance and Surface Condition

The Cured-In-Place Pipe lining system shall be a composite tube, consisting of one or more layers of polyester felt or similar approved. It shall have an integral impermeable membrane, impregnated with unsaturated synthetic resin (Polyester, Epoxy or Vinyl ester) or similar approved which, after inversion or winching into the pipe, will be in continuously firm contact with the host pipe wall, with the coating on the inside.

The lining shall comply with the relevant provisions of ASTM, WRc & WIS 4-34-04 or equivalent accreditation.

The lining shall be fabricated in such a length that when installed, it will occupy exactly the length of the pipeline between the launch and reception manholes and, in addition, the flow through channels of the launch, intermediate and reception manholes. The lining shall be of the correct diameter so that on inversion or winching in-situ it does not wrinkle by more than 1% for linings in sewers equal to or greater than 600mm bore.

The dimensions of the lining shall take account of longitudinal and circumferential expansion and any variation in existing pipe internal diameter (i.e. existing sewer bore), including loss of pipe wall thickness due to hydrogen sulphide corrosion and deformation of pipe.

Where several layers of felt are required, the inner layer shall be stitched or spot welded to form a tube. Each successive layer shall be individually wrapped around the previous one and spot welded or stitched together. The outer layer of felt shall have an installation tube pre-bonded to it, or a sheet of this material shall be wrapped around the completed felt tube, lapped over and bonded to the felt to form an airtight seal. Where pre-bonded material is used a covering strip shall be bonded over the seam to form an airtight joint.

11.9.1. 16 Pre - Liner

Pre-liner to be used only in case of pull in pipe. A pre - liner composed of a polymeric membrane or similar approved material which may be integral with the lining shall be used to prevent the resin from being washed out of the Cured-In-Place liner by infiltration as well as contain all odour, and assist in the curing process (temp insulation from omniscient water/sewage).

The pre-liner shall be non-porous, completely free from pin holes and bubbles, air tight and impervious to resins even when inflated to 20% over its normal size.

11.9.1.17 Trial section

The contractor and the testing standards shall carry out a successful demonstration trial and procedure shall be agreed with the Engineer before commencing the trial. One sewer line as selected by the Engineer shall be lined as a trial section and Quality Control tests performed as detailed herein for approval of the methodology proposed by the Contractor.

The Contractor shall allow for any further requirement of the Engineer to modify his Method or material subsequent to the trial, to complete the work satisfactorily. The Contractor shall include in his rates for complying with all the foregoing requirements of this Clause.

11.9.1.18 Standard of Finish

- (a) The lining shall be close fit with annular space grouted against the original pipe along the whole of its length and lateral connections shall be clean with no projections;
- (b) The lining shall be free from visible defects including foreign inclusions, dry spots, air bubbles, pinholes and pimples.

In the event that the lining is unacceptable due to partial collapse or due to an unacceptable any degree of defects such as protruding fibers, air voids, crazes cracks, blisters or foreign matter that might impair the performance in service. The internal surface of the lining shall be smooth. The Contractor shall remove and replace with a lining of the same thickness as the failed lining at his own cost. The Contractor shall submit to the Engineer for approval a complete method statement of these or any other remedial processes he proposes to use. All such remedial works of renovation, repair or replacement shall be carried out at no cost to DJB.

11.9.1.19 Reinstatement of Connections

All laterals shall be cut open and reinstated in consultation with the Engineer-In-Charge/ Consultant.

11.9.1.20 Finish (Hydraulic Acceptability)

The installed lining shall be continuous over its length and shall be free of any defect which is likely to affect the satisfactory hydraulic performance of the lined conduit or cause accumulation of solids.

11.9.1.21 Quality Control

Type of tests and quality control tests shall be carried out as per Quality Control/Assurance Procedure to be submitted by the Contractor and approved by the Engineer.

The Engineer shall inspect testing equipment, witness tests and review documentation as he so wishes.

11.9.1.22 Process Control Sheet

The Contractor shall complete a Process Control Sheet for each sewer undergoing rehabilitation and submit a copy to the Engineer once rehabilitation has been completed.

The Process Control Sheet shall include the following information unless otherwise modified by the Engineer:

Location details, including upstream, downstream and all internal dimensions of the sewer, manhole reference numbers, and street location;

Material(s) used in the liner,

Condition (cleanliness, infiltration etc.) of sewer and manholes (intermediate, immediately upstream and downstream) prior to re lining;

Time of despatch of liner and arrival at site

Weather conditions immediately prior to lining and during the lining process; Time of commencement and completion of re-lining works;

Material properties and Resin (as may be required) details:

Quantity, weight of components, batch number of resin / hardener used

Temperature and Time

The Engineer so instruct, the process control sheet and other relevant database should be supplied by the Contractor in electronic format.

The Contractor shall allow in his rates for complying with the above quality control requirements.

11.9.1.23 Measurement and Payment

Payment will be made for Complying with all requirements as described in Part 11 of the Technical Specification.

This item includes the Geo Technical Investigation, design, approval, fabrication, transport and installation of the structural CIPP liner inclusive of all materials, labour and equipment required for the rehabilitation of the sewer by the approved Lining method. The liner shall be installed through the channel of the manhole, or shafts constructed by the Contractor, and the contractor shall carry out all cutting, final finishing including sealing of the edges and cutting for any laterals by an Engineer approved method. After rehabilitation of the sewer, the Contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the Engineer-in-charge.

In case the sewer internal diameter is different to that specified in the Contract document, the payment for this item will be adjusted on a pro rata basis, based on the internal perimeter of the sewer. The Contractor shall be aware that the final thickness of liner shall not be less than the tendered thicknesses of the liner. If the proposed thickness of the liner submitted in this Bid is found to be inadequate during the detailed design stages, the thickness will be adjusted without any variation of bid price.

Lining shall be measured by linear metre of liner installed. For CIPP, the lining will continue through the manholes for each inversion. However the paying length will be measured from wall to wall (inner face) between two successive manholes. The Contractor shall make allowance for the portion of the liner within the channel in his pricing for Manhole Rehabilitation.

The Payment shall be made as per relevant BOQ .

11.9.2 Structural Lining Glass Reinforced Plastic (GRP)

11.9.2.1 **Scope**

This specification is an engineering product and execution specification for the internal rehabilitation of existing sewers owned and operated by the within Delhi Jal Board.

This specification does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this specification to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

The specification assumes all circular sewers equal or greater than 1000 mm in diameter may be lined using man entry techniques. All circular sewers smaller than this are to be lined using non- man entry techniques.

11.9.2.2 Types of Lining Systems

This specification is applicable for the following lining systems and material types:

Structural Lining with discrete pipe segments comprised of glass reinforced plastic (GRP) for man-entry sized sewers (diameter of 1000 mm and above)

GRP linings shall be used for all man entry sized circular

sewers. GRP structural lining shall be used for rehabilitating

Trunk Sewers.

All other lining systems are considered non- conforming in terms of this specification and shall be rejected without reason.

Use of the systems mentioned above does not necessarily imply that they will satisfy the requirements of this specification. Structural linings may for instance require strengthening by inclusion of special reinforcing layers and corrosion protection layers to satisfy design requirements of the specification.

Design of full segment GRP structural Type II Liner as standalone has been done in accordance with WIS 4- 34-02, ASTM D3262, AWWA M45, ASTM 2412 , and AS 3571 as a gravity pipe in a fully deteriorated pipe condition.

A close-fit to the host pipe with annulus space for the grouting allowable for installation of GRP pipe Liner as permitted in WIS 4-34-02. Grout composed of cement, fly-ash and other approved compound and water shall be forced under pressure into the grouting connections as specified.

A design check to confirm the full flow hydraulic capacity of the GRP will be equal to or greater than the existing sewer. “Manning’s” formula with assumed ‘n’ value of 0.011 for the GRP and “n” value for the existing section 0.016

Live Load, External Loads have been considered as per SRM WRC.

Assume ground water table as the existing ground surface for sewers with deep sewers (cover greater than 3 m).

Ovality of the existing Sewer for rehabilitation by GRP liner shall be taken as 0%.

Long-term value for flexural modulus of elasticity has been considered to be the projected value at 50 years of a continuous application of the design load based on the specific resin and E-Glass roving & Sand in layers composite as established by WIS 4-34-02 ASTM D2990

Maximum Modulus of soil reaction ($E's$) has been assumed to be 6.0MPa for deep sewers.

Minimum factor of safety (N) of 2.0

A design value for Short Term Flexural modulus is equal to or greater than the minimum value of 10000 MPa.

The liner thickness shall be such that the cross sectional area reduction is within the allowable limit of 12.5%.

The inner surface of the liner shall be free from all defects meeting the requirement as per WIS 4-34-02 Appendix G. The lining system needs to be capable of being installed within the geometry of the sewer

The GRP process results in a discrete length of circumferentially continuous sewer lining which is a single pipe lining unit. No longitudinally jointed GRP pipe shall be accepted. “Pipe-within-a-pipe” with a smooth continuous inner surface which usually increases flow capacity.

Accordance with WIS 4- 34-02, ASTM D3262, AWWA M45, ASTM D 2412, and AS 3571 as a

gravity pipe in a fully deteriorated pipe condition

11.9.2.3 Reference Documents and Standards

AS/ANZ 2566.1	Buried Flexible Pipes - Part 1: Structural Design
AS 3572	Plastic- Glass Filament Reinforced Plastics (GRP) Method of Test.
ASTM D-638	Test for Tensile Properties of Plastics.
ASTM D-790	Test Methods for Flexural Properties of Reinforced Plastics and Electrical Insulating Material.
ASTM D-2412	Test for Apparent Tensile Strength of Reinforced Thermosetting Plastic Pipe and Tube.
ASTM D-2587	Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impresser.
ASTM D 3262	Specification for manufacturing of GRP Pipe liner for gravity Sewers.
BS 5480	Specification for manufacturing of GRP Pipe liner for gravity Sewers.
BS 1881	Testing Concrete Part 102 Method of determination of slump Part 116 Method for the determination of compressive strength of concrete cubes.

BS 2782	Methods of Testing Plastics Method 335A Determination of flexural properties of rigid plastics - Method 1003 Determination of tensile properties.
WIS 4-34-02	Specification for Glass Fibre Reinforced Plastic (GRP) Sewer Linings.

AS 3571	Glass Filament Reinforced Thermosetting Plastic (GRP) Pipes Polyester Based- Water Supply, Sewerage and Drainage Applications.
WRC, SRM	Water Research Centre, Sewerage Rehabilitation Manual.
EN1120	Plastic Pipe systems – Determination of resistance to chemical attack from the inside of a deflected section.
EN13566-4	Plastic Pipe systems for renovation of underground non-pressure drainage and sewerage networks. - Part 1 General
AUSTROADS	Bridge Design Code.
IRC-AA CLASS	Indian Road Congress, Design Load Standard
Or any equivalent/ similar standard acceptable to the Engineer.	

11.9.2.4 Notation

The following notation shall apply to this specification:

Symbol	Definition	Units of Measurement
	Ovality correction factor (Refer Clause 2.2.3.2)	-
	Crown bending moment coefficient	-
	Diameter at neutral axis of lining.	M
	Mean internal diameter of the existing pipe	M
	Minimum internal diameter of the existing pipe	M
	External diameter of barrel of existing pipe.	M
	Deflection factor	-
	Ring bending modulus of elasticity of lining material	MPa
	Long term ring bending modulus of elasticity of lining material	MPa
	Effective soil modulus	MPa
	Factor of Safety	-

	Depth of cover; vertical distance between the top of the pipe and the existing surface level	M

	Overall height of lining	Mm
	Moment of Inertia of lining wall for ring bending	m ⁴ /m
	Ratio of horizontal to vertical earth pressure	-
	Buckling resistance enhancement factor	-
	Critical buckling pressure for lining	KN/m ²
	Ring bending stiffness of lining (per metre length)	N/m/m
	Long term ring bending stiffness of lining (per metre length)	N/m/m
	Lining material thickness	Mm
	Minimum grouted annulus thickness	Mm
	Wall thickness of existing sewer	Mm
	Unit weight of soil	KN/m ³
	External dead loading	KN/m
	External live loading	KN/m
	Predicted long term vertical deflection of lining	M
	Limiting long term vertical deflection of lining	%
	Long term strain	-
	Poisson's ratio	-

11.9.2.5 Materials

The minimum required service life of the installed lining material is fifty [50] years.

The lining system shall be comprised materials that are chemically and biologically resistant to internal exposure to sewage, sewage related gases and mild concentrations of industrial effluent for the service life of the lining. In particular the system shall be chemically resistant to prolonged high concentrations of sulphuric acid (up to 10% concentration) resulting from the bacterial conversion of hydrogen sulphide. Linings shall not be susceptible to strain corrosion under deflection (Refer test method in EN1120).

The lining material shall have satisfactory abrasion resistance to the migration of silt, sand and debris along the sewer. It shall be sufficiently robust not to be damaged by sewer cleaning equipment that may be required to remove silt or any future blockage following installation of the lining.

GRP linings shall satisfy the minimum material requirements given in AS 3571 or WIS 4-34-02.

Test data shall be provided prior to manufacture of any linings to confirm minimum material properties.

11.9.2.6 Resin

Only isophthalic or biphenyl A fumarate resins meeting the requirements of Type B or Type C of BS3532: 1062 or vinyl-ester resins shall be used. The resin shall also meet all the requirements in 3.1 of WS 4-34-02.

All resins must have a proven track record for GRP lining in sewer rehabilitation work for at least 10 years. Manufacturer details of resins to be used and history of use in sewer rehabilitation work must be submitted by the contractor.

11.9.2.7 Glass Fibre

C Glass: Glass reinforced fibres formed from a low-soda borosilicate glass, regarded as chemical resistant, primarily used for overlay or surfacing mats.

E Glass: Corrosion resistant E type glass with reduced Boron content and superior acid resistance shall be used.

11.9.2.8 Lining section

A discrete length of circumferentially continuous sewer lining, which is a single pipe lining unit. No longitudinally jointed GRP pipes will be accepted.

11.9.2.9 Non-slip invert

If a non-slip invert coating is applied to the resin rich liner it shall be bonded to the cured lining unit using a suitable compatible resin.

NOTE: Non slip inserts should be specified with care as they might compromise the durability or performance of the lining unit.

11.9.2.10 Edges and ends

At the edges and ends of all lining segments and sections the structural wall shall be sealed with a suitable compatible epoxy resin (with suitable hardening system). The resin shall be pigmented to ensure that a visual check can be used to determine full resin coverage.

11.9.2.11 Material for grouting

Material requirements for grouting for GRP lining shall be in accordance with Section 6 of this Specification and Section 8 of W Rc Sewer Rehabilitation Manual, 4th Edition, 2001.

The minimum thicknesses of grout for design purposes (refer Section 4.3.2 of WRc Manual, 4th Edition for thickness of structural grout) shall be:

TYPE I GRP liner: 25mm (Structural Grout)

TYPE II GRP Liner: 10mm

11.9.2.12 Quality Assurance

In strict accord with the requirements of WIS 4-34-02 all GRP materials shall be manufactured under a suitable 3rd Party ISO 9001:2000 Accredited quality assurance scheme acceptable to The Engineer.

As part of the quality assurance procedures the manufacturer shall keep records of the following against the individual serial numbers of output product:

Raw material batch details, including source, acceptance test records, purchase dates and shelf-life at time of use; computerised mixing records; negative mould pressure at commencement of infusion; maximum pressure during the manufacturing process; and, confirmation of resin draw for each injection.

The necessary design strengths and modulus assumed in the designing of the liner where high flexural modulus used in the design or required to meet the thickness requirements to keep the cross sectional area reduction of the sewer to be minimum.

All resins must have a proven track record for GRP lining in sewer rehabilitation work for at least 10 years. Manufacturer details of resins to be used and history of use in sewer rehabilitation work must be submitted by the contractor.

11.9.2.13 Hydraulic Requirements

11.9.2.14 Reduction in the Cross Sectional Area

The liners are to be circular structural liners and must retain the largest possible internal dimensions (diameters). The reduction in the physical cross sectional area of the existing sewer lines after the rehabilitation shall be allowed up to a maximum of twelve and a half per cent (12.5%) of the actual cross-sectional area of the sewer.

The reduction in cross sectional area of existing sewer lines after rehabilitation shall be exclusively in terms of physical dimensions. The Contractor shall support the quoted percentage reduction in cross sectional area by submitting detailed calculations with the bid (Technical Schedule 17.5). The improvement in hydraulic capacity shall not be taken into account for calculating cross sectional area reduction.

The physical dimensions of the sewer will be measured after desilting works and the actual diameter and cross-sectional area will be agreed prior to submission of detailed liner design by The Contractor. For Tender purposes, the Nominal diameter of sewer shall be used.

The reduction in hydraulic capacity of the sewer system as a result of rehabilitation has significant implications on the long term serviceability of the sewer system. If the reduction in the physical cross sectional area of the renovated sewers can be kept to a minimum then this will enhance the long term serviceability of the sewer network.

Any lining system resulting in the reduction of the physical cross sectional area exceeding the above limit may be considered as non-conforming in terms of this specification and may be rejected without reason.

11.9.2.15 General Design Requirements (Check from 4-34-02)

- (a) The liner must have sufficient strength to support all loadings.
- (b) The liner must seal the sewer to prevent the infiltration of ground water into the sewer and the ex-filtration of sewage into the surrounding ground.

- (c) The lining system must be proven technology for sewers of comparable size and shape and materials.

- (d) The liner shall be designed to withstand all construction loads including handling, lifting, installation and grouting stresses without overstressing the liner or cracking
- (e) The liner shall have protective layers on the interior or exterior surfaces to meet technical requirements in the specification.
- (f) The internal surface of the install liner shall be smooth with Colebrook White roughness of not more than 1.5mm throughout its life span.
- (g) The relining of the sewer shall be free from all defects and retain the grade and level of the existing sewer.
- (h) The internal surface of the liner at the joints shall be flush with a tolerance step of not more than 1mm between adjoining pipes.
- (i) The joints shall be leak free and watertight and able to resist opening due to external or internal forces.
- (j) Details shall be provided for the cutting and making good of the laterals and branches. Also to provide details of sealing grout holes for Engineer's approval.
- (k) The design, manufacturing and delivery of the liner shall comply with ISO 9002 for production and delivery.
- (l) All design calculations required as per the specification shall be supplied with the bid (Technical Schedule 17.4)
- (m) Grouting holes (at least 2 Nos. per panel/section for GRP liner) shall be provided in the liner at appropriate locations, as approved by the Engineer.
- (n) The minimum thicknesses of grout for design purposes (refer Section 4.3.2 of WRc Manual, 4th Edition for thickness of structural grout) shall be:
- (o) **Grout thickness TYPE I GRP liner: 25mm (Structural grout)**
- (p) **Grout thickness TYPE II GRP Liner : 10mm**

11.9.2.16 Design Life

The service live of the installed lining system shall be not less than **fifty (50) years** under live sewer conditions. The Contractor shall produce documentary evidence to substantiate that the system he offered shall have minimum fifty years of service life.

11.9.2.17 Structural Design of Liners

The lining system offered shall be better than or equivalent to the lining systems suitable for Type 2 structural liners addressed in WRc, SRM manual, (2001) 4th Edition, WIS 4-32-02, BS 5480, ASTM D3262, ASTM 2412, AS 3571 and AWWA M45.

The structural design technique shall follow the design guidelines given in Sewerage Rehabilitation Manual, (WRc, SRM Manual (2001), 4th edition) WIS 4-34-02 (for GRP) or other structural design methods of International Standard. (Refer engineering product and execution specification in Part 11 of this document).

All designs shall be checked for critical buckling pressure based for both hydraulic loading and soil and traffic loading.

A professionally qualified Chartered Engineer or an Engineer duly licensed by an Engineering Institution recognised and approved by the Engineer and practising as a rehabilitation engineer for at least ten years with particular experience in liner design and structural assessment of sewers of similar nature and complexity to the project shall carry out the design of liner for the Contractor and the design calculations shall be duly certified by him.

The Contractors shall use the Technical Schedule included in Item 17 of this document to provide the required engineering details of the liner materials and design calculations. The Contractor shall submit with the bid adequate data, test results, proven track record, technical publications, comments and recommendations, if any, made on the use of the lining system by water authorities, professional bodies or WRc or any similar association to substantiate that the system offered.

The Contractor's attention is drawn to the phenomenon that most of the polymeric liner materials do creep with time, resulting in substantial change in their engineering properties. The Contractor shall use only the proven long term engineering properties of materials in the structural design of the liner. However, for any short term temporary loadings, such as from handling and transporting the liner, grouting pressure etc. the Contractor may use the short term engineering properties in the design.

The Contractor shall state the short term and long term engineering properties including the stiffness values assumed for the materials in the design and submit documentary evidence (in Technical Schedule 17.3) to support the values of short term and long term stiffness assumed.

The Contractor shall make provision in his prices to conduct tests on site to prove that the materials actually used on site have achieved the short term values assumed in the design.

The stiffness consistency of the as-installed liners shall be checked on site to ensure uniformity along the length of the rehabilitated sewer. Contractor shall make provision in his prices to determine the actual thickness of the as-installed liner and the engineering properties of the liner materials (especially the soft liners with considerable thickness). The procedure for cutting and testing the liners shall be proposed by the Contractor for Engineer's approval.

Strain related corrosion in polymeric materials in aqueous environment has been a source of structural capacity degradation. The Contractor shall address the issue of strain related corrosion for the materials he proposes to use and shall submit his recommended design practice and the standard for Engineer's perusal and acceptance. The Contractor shall consider restricting the strain to minimum recommended values in the design codes or British Standards or in any standards/codes as accepted by the Engineer for materials known to be more prone to strain related corrosion in aqueous environment. A more stringent strain limitation would be about 0.5%.

For GRP, the thermo-set materials in contact with corrosive environment shall incorporate a corrosive barrier of minimum 2.5mm thick inclusive of “c” glass tissue with a resin rich surface layer of thickness not less than 0.50mm.

The contractor shall ensure that deflections are within the acceptable limits and show in his design that deflection issues have been adequately taken into consideration in determination of the liner thicknesses.

11.9.2.18 Material Properties for Design

Where material properties under load vary with time, material properties of the lining at the end of the fifty (50) year service life shall be used in design calculations. The exception to this is design of the lining for loads applied only during installation, which may be based on short term material properties.

The material properties used in the design shall be consistent with the composition of the lining material. Values for material properties may be nominated by the Contractor but must be capable of being substantiated by test data based on representative samples of the installed lining material. The Contractor shall make provision in the Contract for such tests to be conducted during installation.

11.9.2.19 Design Loads

Design loads shall comprise the maximum load produced from the combination of earth pressures, hydrostatic loads and traffic surcharge loads for each particular lining.

Vertical earth pressures shall comprise the nominated effective overburden height of soil above the pipe without reductions for trench effects.

Maximum hydrostatic pressures from groundwater shall be determined assuming the water table is located at surface level.

Traffic surcharge loads shall be calculated in accordance with Indian Road Congress AA Class Loading standard. Loads shall vary depending on the road usage as follows:

TYPE A:	Main Road Multiple adjacent lanes
TYPE B:	Light Road Single lane
TYPE C:	Field Load

Traffic live and soils loads given in WRC SRM (2001) 4th Edition is also acceptable.

11.9.2.20 Installation Design Checks

Linings shall be checked to ensure they are stable and will not be overstressed for any intermediate states during the installation of the particular system. These checks may be based on short term properties of the lining material.

11.9.2.21 Design Calculations

Calculations shall be provided to substantiate that linings have been proportioned to suit the design requirements of this specification. Unless noted otherwise, all calculations shall assume a minimum factor of safety of 2.

The Contractor shall supply full details of their design calculations, including proof checking and review of the calculations, by a qualified professional who is familiar with design procedure adopted in the WRc manual, AS 3571 and WIS 4- 34-02 and with the bid documents.

Design of full segment GRP structural Liner as standalone has been done in accordance with AS 3571 and WIS 4- 34-02 as a gravity pipe in a fully deteriorated pipe condition.

- Maximum Modulus of soil reaction ($E's$) has been assumed to be 6.0MPa for deep sewers.
- Minimum factor of safety (N) of 2.
- The liner thickness shall be such that the cross sectional area reduction is within the allowable limit of 12.5%
- The inner surface of the liner shall be free of defects (wrinkling bulges and retain the grade and level of the existing sewer).
- The lining system needs to be capable of being installed within the geometry of the sewer (i.e. bends and access restrictions).
- The GRP process results in a discrete length of circumferentially continuous sewer lining which is a single pipe lining unit. No longitudinally jointed GRP pipe. "Pipe-within-a-pipe" with a smooth, continuous inner surface which usually increases flow capacity.
- Minimum value for ovality of the existing sewer, in case of rehabilitation of Sewer by GRP Lining will be taken as 0%.
- A close-fit to the host pipe with annulus space for the grouting allowable for installation of GRP pipe Liner as permitted in WIS 4-34-02. Grout composed of cement, fly-ash and other approved compound and water shall be forced under pressure into the grouting connections as specified.

If requested, the Contractor shall also provide a copy of the calculations for short term design checks.

11.9.2.22 Definitions for Pipe Condition

For the purpose of this specification and for design purposes, the condition of the existing sewer body has been classified as the following:

11.9.2.23 Fully Deteriorated:

The sewer body has lost a sufficient degree of its original structural capacity that it cannot be relied upon to support applied loads for the next 50 years. The lining is expected to act as a structural replacement for the original sewer to bear the full load from the ground, traffic and ground water.

11.9.2.24 Design for Circular Pipes

11.9.2.25 Design of Liners

All liners must be capable of resisting a combination of maximum load arising from soil, water and traffic loading imposed on the lining.

All liners shall be designed in accordance with WRC/ AS 3571 and WIS 4- 34-02 design procedures. All liners shall also satisfy the requirements of this Specification for Type II standalone liners.

11.9.2.26 TYPE II Linings – Hydraulic

11.9.2.26.1 Type II Lining

The design shall be based on the buckling strength of the lining with account taken of the enhancement provided against a buckling mode of failure by the existing pipe.

Design thickness shall be sufficient to withstand the hydrostatic pressure due to groundwater without collapsing.

11.9.2.26.2 Equations

The following equation shall be used to determine the required stiffness of the lining:

$$q_{all} = \frac{24 \times K \times S_{DL} \times 10^{-3}}{(1 - \nu^2)} \times \frac{C}{FS}$$

Where

$$FS = 2.0$$

$$K = 7.0 \quad \text{when lining and pipe are in intimate contact or the annular gap is grouted.}$$

$$= 4.0 \quad \text{when the gap between the lining and inside of the pipe exceeds a mean value of 1 mm.}$$

$$C = \frac{\left(\left(1 - \frac{d_{av} d_{min}}{d_{av}^2} \right) \right)^3}{\left(\left(1 + \frac{d_{av} d_{min}}{d_{av}^2} \right) \right)^2}$$

$$S = (E_{bl} \times I) \times 10^6$$

$$DL \left(\frac{1}{D^3} \right)$$

- In case of rehabilitation of Sewer by GRP liner will be taken as 0%.

11.9.2.26.3 TYPE II Linings - Standalone

The lining shall ignore any contribution from the original conduit and be designed to support all imposed loads in its own right.

The lining shall be designed to satisfy the critical performance criteria of vertical deflection, strength, and buckling under maximum combined loads. Contractor must validate Soil Modulus from existing soil data available along sewer routes when submitting final design.

The lining must also satisfy the design for hydrostatic loads in accordance with Clause 11.9.2.26.2

(1) Deflection

The predicted long term vertical deflection shall be less than six per cent (6 %) of the diameter of the lining when calculated in accordance with the following equation,

$$\frac{\Delta_v}{D} \times 100 = \frac{0.1 \times 10^{-3} \times \left(\frac{(W_g + W_q)}{D} \right)}{8 \times 10^{-6} \times S_{DL} + 0.061 E'} \times 100 \leq 6 \%$$

Where

$$W_g = w H D$$

$$w = 18 \text{ kN/m}^3$$

$$E' \leq 6.0 \text{ Mpa (is the maximum allowable Soil Modulus if no voids are present around the sewer and the body of the sewer is stable)}$$

(2) Flexural strain

The predicted long term flexural strain shall be less than Two per cent (2 %) of the diameter of the lining

Or

The long term flexural strain developed in the wall of the lining for any load or load combination shall not exceed the permissible value appropriate for the lining material. The predicted long term strain shall be calculated as follows:

$$\epsilon_b = D_f \times (\Delta_y / D) \times (t / D)$$

$$D_f = \frac{3.33 \times 10^{-6} S_{DL} + 0.00136}{E'}$$

$$\frac{1.11 \times 10^{-6} \frac{S_{DL}}{E'} + 0.000151}{E'}$$

(3) Buckling resistance

The lining shall be designed so that its buckling resistance is sufficient to support the imposed loads when calculated in accordance with the following equation:

$$q_{all} > w \left(\frac{D_e}{2} + H \right) + \frac{W_q}{D}$$

where

$$q_{all} = \frac{(S_{DL} \times 10^{-6})^{\frac{1}{3}} (E')^{\frac{2}{3}} \times 10^3}{FS}$$

The Factor of Safety (FS) shall be 2.5.

If requested calculations shall also be provided to demonstrate that the existing structure will not be overstressed by any combination of applied loading or reactions from the installation or performance of the lining

11.9.2.27 Minimum Lining Dimensions

GRP linings shall be sufficiently robust to be delivered, handled and installed without damage. They shall have sufficient stiffness to prevent excessive distortion during installation and grouting.

11.9.2.28 Retention of Existing Integrity of Sewer

11.9.2.28.1 Rehabilitation Activities Affecting the Integrity of the Sewer.

No activity of the Contractor during preparation of the conduit and installation of the lining shall adversely affect existing structural integrity of the sewer. No reaming or grinding of inner surface of the sewer body may be permitted for GRP linings in man-entry pipes subject to the Contractor complying the relevant clause.

No reaming shall be permitted to be carried out on RCC Pipe sewers.

11.9.2.29 Method Involving Internal Loading

The structural capacity of the existing sewer is unknown. Any method involving internal loading on to the sewer body during the construction operation will be viewed cautiously.

11.9.2.30 Method involving Reaming or Grinding

If reaming or grinding or mechanical scrapping of the internal surface of the sewer body is proposed by the Contractor to upsize, or minimise the loss of cross sectional area, or regularise (and standardise) the shape and size of the sewer during the construction operation , the Contractor shall carryout a structural assessment of the existing sewer and necessary temporary structural enhancement to the sewer body, such as grouting the voids, if present behind the sewer body, replacing any missing bricks etc. and filling up of any missing mortar and make the sewer body temporarily fit to sustain such temporary loadings arising from the proposed construction process. The contractor shall submit the details of the structural enhancement measures he proposes to carryout for the Engineer's approval, submit

calculations, and test result to prove that the proposed construction process involving grinding or reaming operation is safe and the integrity of the existing sewer body is intact.

The approval to such works will be given only after the Contractor has produced evidence of structural assessment and structural enhancement work and a certification from a reputable rehabilitation engineer (a professionally qualified chartered engineer practising as a rehabilitation engineer for at least five years with particular experience in structural assessment of sewers of similar

complexity to the project) stating that the sewer is capable of sustaining temporarily loads arising from the proposed construction process.

All the cost associated with structural assessment and certification by the rehabilitation engineer shall be borne by the Contractor.

The liner shall be designed as a stand-alone liner to carry all loadings.

It is deemed that the rates offered by the Contractor have included everything required to comply with all the required provisions as above and any additional requirements as necessary to carry out the construction safely. The Contractor is also deemed to have allowed for any method related contingencies in his rates.

Innovation in relation to the best specified product and the best practice is encouraged and the Employer will consider all the options to get the best installed product at competitive price. Hence, sufficient documentation must be submitted with the Technical Schedules of the bid to enable the Employer to carry out an initial investigation and appraisal of the product and the method offered and to ascertain the benefit and the advantage of the product to the Employer.

11.9.2.31 Working shafts (Starting and Ending Pits)

The Contractor shall note that no open excavation will be permitted under normal circumstances along the road or the sewer line and he shall thus select the renovation system that requires minimum or no excavation. However, widening of existing manhole up to a limit of 1.5m may be allowed subject to the Contractor obtaining necessary traffic permission from the authorities. It may be necessary to provide decking, especially in busy streets, and in which case the Contractor shall make provision in his rates for providing decking as required. The decking details shall be submitted to Engineer for approval.

Generally, the Contractor shall be allowed to work in night in streets where the traffic is heavy. However, the works can be continued during busy hours during the day provided the Contractor shall obtain necessary permission to work in such hours from the traffic authorities and such permission shall be submitted to the Engineer for him to authorise such work. Contractor is deemed to have included in his rates the cost of construction of all starting and ending pits

11.9.2.32 Manufacture of Lining

11.9.2.32.1 General

The manufacture of the lining shall be carried out in accordance with a specification purpose written for the particular system. This specification shall detail all labour, materials and equipment required to combine the various constituents to produce the lining ready for delivery to site. The specification shall include reference to appropriate standards for the manufacture.

The purpose written specification shall include testing and inspection work to be carried to verify the dimensions and quality of the manufactured lining.

A project specific Quality Control System, shall be also developed during the execution of works for site verification, manufacturing and installation of the liner.

11.9.2.33 Requirement for Manufacture of GRP Linings

The specification shall include reference to appropriate standards for the manufacture such as the following:

The lining tube should be manufactured in an ISO certified facility.

AS 3571- Glass Filament Reinforced Thermosetting Plastic (GRP) Pipes Polyester Based - Water Supply, Sewerage and Drainage Applications.

WIS 4-34-02 Specification for Glass Fibre Reinforced Plastic (GRP) Sewer Linings. 222

GRP lining segments shall be constructed using a fixed geometry form for each particular internal conduit geometry.

Joints between units shall be formed or cast to a uniform geometry that will ensure adjacent segments fit without gaps or distortion. The joints are to be sufficiently robust to avoid damage during handling, transport and installation.

Trial fit of adjacent GRP units shall also be used in circular pipes where special segments are made to traverse a bend or change in alignment within a lining length between access points.

Materials and temperatures in the working environment shall not be less than 15°C. All laminating work shall be discontinued if the air temperature falls below 15°C or if the dew point is reached (condensation occurs), whichever is the higher.

11.9.2.34 Appearance and Surface Condition

The surface of the lining material shall be free from tackiness and defects such as protruding fibres, air voids, crazes, cracks, blisters or foreign matter that might impair the performance in service. The internal surface of the lining shall be smooth.

Some rectification or repair is permitted. Refer to WIS 4-34-02, Table Appendix G).

11.9.2.35 Section length

Lining sections shall be manufactured to within a tolerance of ± 10 mm of the nominal overall or effective lengths specified by or agreed with the Engineer.

11.9.2.36 Cross Section

The tolerance on internal diameter shall be ± 2 mm, for circular linings. (Provided cross sectional area reduction does not exceed 12.5%).

11.9.2.37 Wall thickness

The wall thickness of the lining, excluding the rough backing if applied, but including the resin rich liner shall be at least the minimum specified. The maximum overall wall thickness shall be not greater than the minimum specified thickness by more than 2mm.

11.9.2.38 Pipe lining units

The out-of-squareness at each end shall be compatible with the jointing system employed and shall be not more than $2\text{mm} + 0.005\phi$ or 10 mm, whichever is the lesser, where ϕ is the average of the maximum and minimum internal diameters measured in mm.

11.9.2.39 Out-of-straightness

The out-of-straightness of a unit shall be no more than 5mm

11.9.2.40 Joints

Longitudinal joints

No longitudinal joints for the structural liner will be accepted.

Circumferential joints

Circumferential joints between lining sections may be flexible or rigid. All joints shall be capable of taking up an angular displacement of 1° in the vertical plane, 2° in the horizontal plane up to 1000mm size, 1° above that, and mismatch of the lining sections due to manufacturing tolerances. The joint detail shall be fit for the purpose intended such that grout infiltration during installation is minimised.

11.9.2.41 Joint Sealing materials: Rings and strips

Elastomeric sealing rings and strips shall be provided as jointed O-rings and shall not be jointed at site. Rings shall then be placed on the outside of the spigot section and greased with a suitable compound to allow pipe jointing. Care must be taken to protect the sealing rings prior to joining and all rings should be thoroughly cleaned prior to joining. All jointing rings shall be manufactured from a bio-deterioration resistant elastomer deemed fit for purpose under ASTM F4777 or BS EN 681:2000. Where the lining is to be used to convey the deleterious trade effluents a bio-deterioration resistant elastomer suitable for use under those conditions shall be used. See also Information and Guidance Note No. 4-40-01.

Joint Sealing materials: Compounds

Rigid setting or flexible compounds used to caulk or seal the gap between lining units shall be resistant to the sewer environment for which they are intended, and shall be suitable for installation within a confined space taking safety aspects into consideration.

Cement Grouting

11.9.2.42 Grout Mix

The grout shall be a mixture of sulphate resistant cement and water. The water/solid ratio shall be in the range of 0.35-0.45 as appropriate to the circumstances. All grout to be used shall be of non-shrink type. The Engineer may allow the use of plasticizers or non-shrink

agent in the grout mix or the use of other additives except those containing calcium chloride. For further details, the Contractor shall refer to WRC manual Volume II.

The constituent materials in the cement grout shall follow the grouting materials specifications given in the British Standard tabulated below or equivalent Indian Standards. The cement grout plays a major structural role in bonding the lining materials to the existing sewer body in Type 1 structural design. The Contractor shall submit the details of the grout constituents, grout design and grouting procedure etc for

Engineer's approval. The Contractor shall allow for in the Contract price for carrying out all engineering tests to establish that the proposed grout mix achieve the design strength assumed in his structural design of liners.

Material **British Standard or Equivalent**

Cement: - BS12 Specification for ordinary and Rapid Hardening Cement
BS 4027 Sulphate Resisting Cement

Sand: - BS882 Specification for aggregate from Natural Sources for concrete
BS1200 Building Sands from natural sources.

Admixtures: - BS5075: Part 1 Specification for accelerating, retarding and water and water reducing admixtures.

BS 5075 Part 2 Specification for air entraining admixtures

Water: The water used shall be of potable quality

11.9.2.43 **Cavity Grouting**

The Contractor shall be fully responsible for preventing the occurrence of voids during grouting. Grouting shall be from the interior of the pipe through grouting holes as specified.

The Contractor shall discuss the sequence of grouting, location of grouting holes etc. with the Engineer and incorporate the agreed details in his submission for Engineer's approval.

Systems of standard pipe, fittings, hose, and special grouting outlets embedded in the pipe walls shall be provided by the Contractor. Care shall be taken to ensure that all parts of the system are maintained free from dirt. Grout composed of cement, fly-ash and other approved compound and water shall be forced under pressure into the grouting connections as specified.

Apparatus for mixing and placing grout shall be of a type approved by the Engineer and shall be capable of mixing effectively and stirring the grout and then forcing it into the grout connections in a continuous uninterrupted flow.

After grouting is completed, pressure shall be maintained by means of stop cocks, or other suitable devices until the grout has set sufficiently. After the grout is set, grout holes shall be completely filled as specified. Multiple grout lift installations may be required to avoid buckling of the liner type.

11.9.2.44 Delivery and Installation of

Lining General

Cleaning of the conduit shall be carried out immediately prior to lining. Flow in the conduit shall be isolated during the lining operation to prevent debris being trapped between the lining and the original conduit.

Visual or a closed circuit television (CCTV) inspection shall be carried out after installation to establish that the lining has been installed in the desired manner and that all connections have been properly reinstated.

The Contractor is solely responsible for the details of execution and suitability of methods and procedures used to satisfy the peculiar conditions of each lining length.

Delivery and installation of the lining shall be carried out in accordance with a specification purpose written for the particular lining system.

The purpose written specification shall detail all labour, materials, equipment and procedures necessary to deliver and install the lining. The specification shall also include testing and inspection work carried out to verify the quality of the installed lining. A copy of this specification shall be provided by the Contractor prior to commencement of fabrication of the liner.

11.9.2.44.1 TYPE II Linings

The specification shall include reference to appropriate standards for the installation of linings such as the following:

ASTM F1216	Glass Filament Reinforced Thermosetting Plastic (GRP) Pipes Polyester Based - Water Supply, Sewerage and Drainage Applications.
AS 3571	Glass Filament Reinforced Thermosetting Plastic (GRP) Pipes Polyester Based - Water Supply, Sewerage and Drainage Applications.
AS 3572	Plastics - Glass Filament Reinforced Plastics (GRP) Methods of Test
WIS 4-34-02	Specification for Glass Fibre Reinforced Plastic (GRP) Sewer Linings. Lining shall be installed in a continuous operation.

During installation, infiltration into the annular space between the existing pipe and the lining shall be prevented.

Abrupt irregularities including excessively rough surfaces, stepped joints, holes, etc. shall be removed prior to lining by filling with a cement render or epoxy mortar. Where the maximum aggregate projection from a cleaned concrete surface exceeds 5mm, the surface shall be rendered to remove the projections.

The lining shall be sealed at its ends to prevent infiltration/exfiltration using an epoxy mortar that is compatible with the lining and has a service life under similar conditions that is comparable with the lining material.

11.9.2.45 Lining in Manholes

For GRP pipes, the lining will continue through the manholes. Half pipes can be fabricated and placed at manhole locations.

Lining shall be measured by linear metre of liner installed.

Lining shall be measured by linear metre of liner installed and its paying length will be measured from wall to wall (inner face between two successive manholes)

The lining shall be sealed at its ends to prevent infiltration/exfiltration using an epoxy mortar that is compatible with the lining and has a service life under similar conditions that is comparable with the lining material.

11.9.2.46 Transportation of Lining

The lining shall be transported to site under controlled conditions. The Contractor shall decide when to transport the lining to the site and when to commence insertion with regard to weather conditions and traffic situation.

11.9.2.47 Trial section

The contractor and the testing standards shall carry out a successful demonstration trial and procedure shall be agreed with the Engineer before commencing the trial. One sewer line as selected by the Engineer shall be lined as a trial section and Quality Control tests performed as detailed herein for approval of the methodology proposed by the Contractor.

The Contractor shall allow for any further requirement of the Engineer to modify his Method or material subsequent to the trial, to complete the work satisfactorily. The Contractor shall include in his rates for complying with all the foregoing requirements of this Clause.

11.9.2.48 Installation of Lining

Existing manholes shall be utilised as launch and reception pits. Due to the constriction at manhole openings it may be necessary, especially if the diameter of the sewer to be lined is large, for the manhole openings to be made larger. This entails the removal of the manhole frame and cover, engineering brickwork and road pavement materials. In addition, it may also be necessary for the channel benching and walls of the manholes to be altered to receive the lining products.

Details of proposed alterations shall be submitted to the Engineer for approval before such alterations are made. No alterations shall be carried out until the proposals have been approved by the Engineer. All manhole alterations shall be made good following the completion of the lining. The cost of all manhole alterations and reinstatement necessary to facilitate all lining work is deemed to be included in the Contractor's rates and no extra claim shall be entertained by the Delhi Jal Board.

The lining shall be inserted preferably from upstream to downstream into the prepared sewer.

11.9.2.49 Standard of Finish

- (a) The lining shall be close fit with annular space grouted against the original pipe along the whole of its length and lateral connections shall be clean with no projections;
- (b) The lining shall be free from visible defects including foreign inclusions, dry spots, air bubbles, pinholes and pimples.

In the event that the lining is unacceptable due to partial collapse or due to an unacceptable any degree of defects such as protruding fibers, air voids, crazes cracks, blisters or foreign

matter that might impair the performance in service. The internal surface of the lining shall be smooth. The Contractor shall remove and replace with a lining of the same thickness as the failed lining at his own cost. The Contractor shall submit to the Engineer for approval a complete method statement of these or any other remedial processes he proposes to use. All such remedial works of renovation, repair or replacement shall be carried out at no cost to DJB.

11.9.2.50 Reinstatement of Connections

All laterals shall be cut open and reinstated in consultation with the Engineer-In-Charge/ Consultant.

11.9.2.51 Finish (Hydraulic Acceptability)

The installed lining shall be continuous over its length and shall be free of any defect which is likely to affect the satisfactory hydraulic performance of the lined conduit or cause accumulation of solids.

11.9.2.52 Quality Control

Type of tests and quality control tests shall be carried out as per Quality Control/Assurance Procedure to be submitted by the Contractor and approved by the Engineer.

The Engineer shall inspect testing equipment, witness tests and review documentation as he so wishes.

11.9.2.53 Process Control Sheet

The Contractor shall complete a Process Control Sheet for each sewer undergoing rehabilitation and shall submit a copy to the Engineer once rehabilitation has been completed.

The Process Control Sheet shall include the following information unless otherwise modified by the Engineer:

Location details, including upstream, downstream and all internal dimensions of the sewer, manhole reference numbers, and street location;

Material(s) used in the liner,

Condition (cleanliness, infiltration etc.) of sewer and manholes (intermediate, immediately upstream and downstream) prior to re lining;

Time of despatch of liner and arrival at site

Weather conditions immediately prior to lining and during the lining

process; Time of commencement and completion of re-lining works;

Material properties and Resin (as may be required) details: Quantity, weight of components, batch number of resin / hardener used temperature and time.

Start and completion of GRP installation

The engineer so instruct, the process control sheet and other relevant database should be supplied by the Contractor in electronic format.

The Contractor shall allow in his rates for complying with the above quality control requirements.

11.9.2.54 Measurement and Payment

Payment will be made for Complying with all requirements as described in Part 11 of the Technical Specification.

This item includes the Geo Technical Investigation, design, approval, fabrication, transport and installation of the structural GRP liner inclusive of all materials, labour and equipment required for the rehabilitation of the sewer by the approved Lining method. The liner shall be installed through the channel of the manhole, or shafts constructed by the Contractor, and the contractor shall carry out all

cutting, final finishing including sealing of the edges and cutting for any laterals by an Engineer approved method. After rehabilitation of the sewer, the Contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the Engineer-in-charge

In case the sewer internal diameter is different to that specified in the Contract document, the payment for this item will be adjusted on a pro rata basis, based on the internal perimeter of the sewer. The Contractor shall be aware that the final thickness of liner shall not be less than the tendered thicknesses of the liner. If the proposed thickness of the liner submitted in this Bid is found to be inadequate during the detailed design stages, the thickness will be adjusted without any variation of bid price.

The Contractor shall be aware that the final thickness of liner shall not be less than the tendered thicknesses of the liner. If the proposed thickness of the liner submitted in this Bid is found to be inadequate during the detailed design stages, the thickness will be adjusted without any variation of bid price.

Lining shall be measured by linear metre of liner installed. For GRP, the lining will continue through the manholes. However the paying length will be measured form wall to wall (inner face) between two successive manholes. The Contractor shall make allowance for the portion of the liner within the channel in his pricing for Manhole Rehabilitation.

The Payment shall be made as per relevant BOQ .

11.9.3 Structural Lining by Spiral Wound Technology

11.9.3.1 Scope

This specification is an engineering product and execution specification for the rehabilitation of existing sewers with standalone structural lining by spiral wound technology.

11.9.3.2 Type of Lining System

This specification is applicable for the following lining systems and material types:

i) Structural Lining using Spiral Wound technology (Fixed diameter)

The spiral wound technologies for gravity sewers are based on the principle of winding a continuous plastic strip of the liner directly into the deteriorated pipe. The plastic strip is spirally wound via a winding machine positioned in the base of an existing manhole or access chamber. The edges of the strip are interlocked as it is spirally wound to form continuous water tight liner of fixed diameter inside the host pipe and leaving an annular space between the pipes and the existing (host) sewer. This annular space shall be completely filled under pressure with a cementations grout. The joints between the pipes must be completely sealed with a gasket and with an approved sealant, if required. The pipes shall provide a rehabilitated sewer that has sufficient structural capacity to handle all the loads and pressures to which the existing pipe is presently subject to.

ii) Structural Lining using Expanded Spiral Wound technology (Close fit)

This system has a double locking system. The secondary lock is formed using hot melt adhesive which holds the PVC liner at a constant diameter as it is wound in the winding machine stationed at the benching of the manhole. The diameter of the wound liner is set to slightly lower than the host pipe. The winding machine also insert a high strength steel “cutting wire” between the primary and secondary locks as the edges of the profile are locked together.

After the liner is wound from one manhole to the next, the end of the liner is held in position and the secondary lock progressively severed by pulling the cutting wire. The edges of the primary are then free to slide relative to one another, along the primary lock as the winding machine continues to wind more profile. It is this mechanical process that causes the liner is in contact with the liner wall of the host pipe and forms a close fit inner to match the liner surface of the host pipe. The primary lock continues a slow setting lubricating sealant that, until it sets, aids the expansion process by acting as a lubricant.

Thus the process provides a maximum internal diameter with a circular cross section and constant wall thickness irrespective of the size and shape of the deteriorated host pipe. The annulus and the voids around the tees are filled with grout to provide a complete seal and to prevent transmigration of ground water through the profile. The profile has height ranging from 7mm to 30mm and thus the liner is capable of meeting the cross sectional area reduction requirement for sewers from 450mm to 1050mm

The pipes shall provide a rehabilitated sewer that has sufficient structural capacity to handle all the loads and pressures to which the existing pipe is presently subject to.

11.9.3.3 Definition of Lining

Types Lining Types

For the purpose of this specification linings will be broadly classified into two categories. The

classification is in accordance with the Water Research Centre's Sewer Rehabilitation Manual (WRC SRM) and is as follows:

Type I Lining: Linings that form a bond to the grout and/or the sewer wall, so that the renovated sewer acts as a rigid composite body.

Type II Lining: Lining is designed as a flexible pipe that does not rely on bond with the sewer wall. Structural capacity results from the self-strength of the lining and grout as a standalone liner and no long term strength is assigned to the existing sewer body.

All spiral wound linings are considered to be Type II standalone structural lining.

11.9.3.4 Design Loadings

For this peripheral Sewer line only Type-II Linings shall be designed to withstand the hydrostatic head assuming ground water from invert level to ground level, where additional loads, traffic and soil are included in design standards for these linings are ASTM F 1741, AS/NZS 2566, ATV-DVWK-M 127 E shall be adopted.

11.9.3.5 Related Reference Documents and Standards for the Spiral Wound Liners

WRc	Water Research Centre (WRc) Sewerage Rehabilitation Manual (SRM).
WIS 4-31-05	Specification for Solid Wall Concentric External Rib-reinforced PVC Sewer Pip
AS/ANZ 2566.1	Buried Flexible Pipes – Part 1 : Structural Design
ASTM D-638	Test for Tensile Properties of Plastics
ASTM D-790	Test Methods for Flexural Properties of Reinforced Plastics and Electrical Insulating Material.

ASTM D-2412	Test for Apparent Tensile Strength of Reinforced Thermosetting Plastic Pipe and Tube.
ASTMI 1697	Wound Lining
ASTM D 256-1997	“Standard Test Methods for Determining the Izod pendulum Impact Resistance of plastics”.
ASTM D 2240 - 1997	“Standard Test Method for Rubber property – Durometer Hardness”.
ASTM D-2587	Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impresser.
BS 2782	Methods of Testing Plastics Method 335A Determination of Flexural Properties of Rigid Plastics Method 1003 Determination of tensile properties.
EN 13566-1	Plastic piping systems for Renovation of underground non pressure drainage and sewerage networks – Part 1: General
IRC-AA CLASS	Indian Road Congress, Design Load Standard.

11.9.3.6 Notation Applied

The following notation shall apply to this specification pertaining to design calculation :

Symbol	Definition	Units of Measurement
C	Ovality correction factor (where applicable)	-
C _b	Crown bending moment coefficient	-
D	Diameter at neutral axis of lining proposed	M
d _{av}	Mean internal diameter of the existing pipe	M
d _{min}	Minimum internal diameter of the existing of the existing pipe	M
D _e	External diameter of barrel of existing pipe	M
D _f	Deflection factor	-
E _b	Ring bending modulus of elasticity of lining material	MPa
E'	Effective soil modulus	MPa
FS	Factor of Safety	-

H	Depth of cover; vertical distance between the top of the pipe and the existing surface level	M

Symbol	Definition	Units of Measurement
h	Overall depth of lining	Mm
I	Moment of Inertia of lining wall for ring bending	m ⁴ /m
K _b	Ratio of horizontal to vertical earth pressure	-
K	Buckling resistance enhancement factor	-
q _{all}	Critical buckling pressure for lining	KN /m ²
S _D	Ring bending stiffness of lining (per metre length)	N/m/m
S _{DL}	Long term ring bending stiffness of lining (per mete length)	N/m/m
t	Lining material thickness	Mm
t ₁	Minimum grouted annulus thickness	Mm
t ₂	Wall thickness of existing sewer	inch/mm
w	Unit weight of soil	KN/m ³
W _g	External dead loading	KN/m
W _q	External live loading	KN/m
Δ _v /D	Limiting long term vertical deflection of lining	%
ε _b	Long term strain	—
u	Poisson's ratio	—

11.9.3.7 Lining Materials

The minimum required design life of proposed/installed lining material shall be at least **fifty (50) years**.

The lining system shall be comprised of materials that are chemically and biologically resistant to internal exposure to sewage, sewage related gases and mild concentrations of industrial effluent for the service life of the lining. In particular the system shall be chemically resistant to prolonged high concentrations of sulphuric acid (up to 10% concentration) resulting from the bacterial conversion of hydrogen sulphide.

The lining material shall have satisfactory abrasion resistance to the migration of silt, sand and debris along the sewer as measured by approved method of testing by means of gravity

chute vide DIN 1230, Part-2. It shall be sufficiently robust not to be damaged by sewer cleaning equipment that may be required to remove silt or any future blockage following installation of the lining.

Materials meeting the Japan Industrial Standards or other National and Internationally accepted standards which ensure quality equivalent to or higher than the standards specified will also be accepted.

Test data shall be provided prior to manufacture of linings to confirm minimum material properties

11.9.3.8 Hydraulics Requirements

11.9.3.9 Reduction in the Cross Sectional Area

The changes in the hydraulic capacity of the sewer system as a result of rehabilitation have significant implications on the long term serviceability of the sewer system. If significant reduction in the physical cross sectional area of the renovated sewers is kept to a minimum, then the long term serviceability including carrying capacity of the sewer network is not seriously compromised with.

Thus a specified limit on the maximum permissible net reduction in the internal cross sectional area of the proposed liner is assessed and set at 12.5% of the related existing sewer cross sectional area.

The proposed lining system shall not reduce the inside cross sectional area of the existing sewer by more than 12.5%. Any implemented renovation system resulting in the reduction of the cross sectional area exceeding the specified limit due to buckling (bulging), ovality or by other defective means and bulging exceeding the permissible limit in accordance with EN 13566; the same will be rejected outright and will not be further considered by the Employer; except for its replacement to the level of acceptance by the Engineer/Employer.

11.9.3.10 Surface Roughness Values

The improved surface roughness associated with the polymeric and plastic materials of the liners has a considerable impact on the hydraulic capacity of the renovated sewer when it is new. However with reduction in gradients due to site conditions and ageing of the renovated sewer, the roughness values tend to be higher due to slime formation and accumulation of silt/sludge at the invert.

From the point of view of slime formation and localized accumulation of slit/sludge in the renovated sewer, the Manning average “n” value at 0.013 for segmental lining and 0.011 for non-segmental smooth lining (for host sewer “n” taken at 0.017) and alternatively Colebrook White with equivalent roughness Ks values (using the formula $n = 0.012 K_s^{1/6}$) shall be adopted for computing the hydraulic flow capacity of sewers lined with all types of polymeric and plastic materials. Continuous liner shall be substantially free from surface irregularity.

The hydraulic flow capacity of sewer lines thus arrived are for assessment and comparison only and no “loading on tender prices” shall be considered.

11.9.3.11 General Design Requirements of Liner

11.9.3.12 Design Responsibility

The Contractor shall be responsible for the suitability and correctness of the chosen liner design calculations necessary to substantiate that the lining system will be suitable in the long term for loads and conditions experienced by the lining.

The design requirements set down in this clause shall be considered as minimum requirements. The Contractor may adopt more conservative assumptions or design methods should they consider it necessary to accept full design responsibility.

Review of the Contractor's design calculations shall not be construed as acceptance of the calculations. Responsibility of the design even approved by the Engineer based on the field parameters submitted by the Contractor; the same shall remain with the Contractor only.

11.9.3.13 Material Properties

- Ib Where material properties under load which vary with time, long term material properties of the lining based on a (50) years design life shall be used in design calculations. The exception to this is design of the lining for load applied only during installation, which may be based on short term material properties

The material properties used in the design shall be consistent with the composition of the lining material. Values for material properties may be nominated by the Contractor but must be capable of being substantiated by test data based on representative samples of the installed lining material. The Contractor shall make provisions in the Contract for such tests to be conducted before installation.

Stainless Steel reinforcement/SS plate/ Rib steel of SS grade 316 shall be used in the profile

11.9.3.14 Design Loads

Design loads shall comprise the maximum load produced from the combination of earth pressures, hydrostatic loads (taken at G.L.) and heavy traffic surcharge loads for each particular lining / liner

Vertical earth pressures shall comprise the full height of soil above the pipe without reductions for trench effects.

For sewer Rehabilitation project, the maximum hydrostatic pressures from groundwater shall be determined assuming the water table is located at surface level irrespective of the depth of ground water table.

Heavy traffic surcharge loads shall be calculated in accordance with Indian Road Congress-AA Class Loading standard or similar approved code.

Design depths from surface level to invert level and the type of traffic load used for design of the lining shall be considered as per variable site conditions and approved by the Engineer. However, the critical design by complying with uniform TYPE-A (as applicable for the Main Road) wheel loads shall be considered as safer due to the usages of heavy equipment during Operation and Maintenance period.

11.9.3.15 Installation Design Checks

Linings shall be checked to ensure that they are stable and will not be overstressed for any intermediate nature of works during the installation and/or curing of the particular system. These checks may be based on short term properties of the lining material.

11.9.3.16 Liner Design Calculations

Design Calculations shall be provided to substantiate that linings have been proportioned to suit the design requirements of this specification unless noted otherwise; all calculations shall assume a minimum factor of safety of 2 except for buckling resistance which shall be 2.5.

The Contractor shall also provide a copy of the calculations for critical design parameters taken for short term design checks.

11.9.3.17 Minimum Lining Dimensions

The Liner units shall be sufficiently robust to be delivered, handled and installed without any damage. They shall have sufficiently proposed stiffness to prevent excessive distortion (during installation) and annulus / cavity grouting where applicable on completion. The liner unit shall also comply with the minimum thickness as stipulated in the referenced documents and in accordance with the manufacturers

/ fabricator's safe handling standards.

11.9.3.18 Retention of Existing Integrity of Sewer

11.9.3.19 Rehabilitation Activities affecting the Integrity of sewer

No activity of the Contractor during preparation of the conduit / host sewer and installation of the lining shall adversely affect the existing structural integrity of the sewer and also safety of the labourers. However, Reaming or cutting and grinding of inner surface of the sewer body by safe means to arrive required shape may be permitted subject to the Contractor complying the following.

11.9.3.20 Reaming or Grinding of Inner Surface of Sewer

If reaming or cutting / grinding of the inner surface of the sewer body is proposed to be carried out to upsize and thereby minimize the Cross Sectional area of the sewer body, the Contractor shall:

Carry out an inspection of the existing condition of the sewer and propose temporary measures to enhance the existing integrity of the sewer body and establish that reaming or cutting/grinding operation is safe and that the sewer body will remain intact. The contractor shall submit the details of the temporary measures he proposes to carryout for the Engineer's approval and submit calculations, test result to prove that such operation is safe and the integrity of the sewer body is intact.

Alternatively, the Contractor if ordered by the Engineer shall propose temporary support system (such as that used in soft ground tunnelling machines in which the entire excavated bore is temporarily and very safely supported) until the permanent lining is installed. Sometime a roof hood is provided as safer means to temporarily support the overt of the bore, all as approved by the Engineer.

It may also include the removal of any rusted / loose inner face of the host sewer including reinforcement and obstruction that may come in the way of enlargement.

In such situation as above, the structural liner shall be as a critical Type-II liner to carry all loadings.

11.9.3.21 Cleaning and Surface Preparation

The selection of equipment and methods used for cleaning and surface preparation shall be the Contractor's responsibility consistent with all labour safety standards and regulation in force.

All silt, debris and materials removed during cleaning by safer means shall be collected and extracted from the sewer at the next downstream access manhole / chamber.

Preliminary cleaning of the existing concrete surface shall be carried out by high pressure water washing to remove surface contaminants and concrete and mortar softened by acid attack.

For brick sewers where significant mortar loss has occurred in the joints between bricks, precautionary measures shall be included in working procedures to account for the possibility that bricks may dislodge or crown loose during cleaning and surface preparation.

11.9.3.22 Surface Preparation for TYPE-II Linings

The Contractor shall thoroughly clean the existing surfaces of concrete, mortar joints and bricks to prepare them for installation of the lining.

11.9.3.23 Inspection of Host Pipeline

All host conduits shall be inspected to confirm that they are cleaned and ready for installation of the lining. Visual inspection followed by CCTV / Video surveys shall be carried out for all sewers prior to installation of liners.

11.9.3.24 Treatment of Exposed Reinforcement

Following cleaning of the pipe and prior to lining, any protruding reinforcement and projections shall be cut off flush with the pipe bore and any exposed reinforcement shall be wire brushed, cleaned and coated with a zinc rich epoxy primer.

11.9.3.25 Infiltration Control

Measures shall be taken to limit or control infiltration during lining to ensure that the complete lining is installed in accordance with the requirements of these specifications.

Infiltration shall be controlled during lining to prevent contamination of the grout, and loss of grout strength and reduction in bond between the grout and inside wall of the existing sewer.

11.9.3.26 Site Measurement

The Contractor shall be responsible for measuring the dimensions of the existing sewer prior to fabrication to ensure that proper fit is achieved. Horizontal and vertical alignment shall also be measured at changes in direction and bends. As a minimum, this shall include measurement of the internal dia. at each access chamber and at 10m maximum intervals between manhole chambers.

11.9.3.27 Manufacture of Lining

The manufacture of the lining as approved by the Engineer shall be carried out in accordance with the bid submission. Their submission shall detail all labour, material and equipment required to combine the various constituents and the process employed to produce the lining ready for delivery to site. The related specifications shall include reference to appropriate standards for the manufacture

The specification shall also include testing and inspection work carried out to verify the dimensions and quality of the manufactured lining. A copy of the proposed manufacturing specification shall also be included in the Tender submission.

11.9.3.28 Installation of

Lining Linings

Linings shall be installed in a continuous operation.

During installation, infiltration shall be prevented into the annular space between the existing host sewer and the lining.

Abrupt irregularities including excessive rough surfaces, stepped joints and holes shall be rectified prior to lining by filling with a cement or epoxy mortar. Where the maximum aggregate or other projection from a cleaned concrete / masonry surface exceeds 5 mm, such surface projections shall be removed.

On installation, the lining shall be sealed at its ends to prevent infiltration / infiltration using an epoxy resin, grout or other material that is compatible with the lining and has a service life, which is comparable with the lining material.

11.9.3.29 Reinstatement of Connections

Live connections into the existing sewer line shall be reinstated. Cutting equipment shall leave a smooth, bevelled edge free of any protrusions so as not to inhibit the flow of sewage in the conduit. The cut out shall be finished flush with the inside surface of the conduit.

At each connection, a polyurethane grout or equal shall be used to seal the connection at the junction to the sewer line. The polyurethane grout of minimum 10% solids shall be used for grouting.

11.9.3.30 Finish (Hydraulic Acceptability)

The installed lining shall be continuous over its length and shall be free of any defect which is likely to affect the satisfactory hydraulic performance of the lined conduit or cause accumulation of solids / silts / grits / sludge.

11.9.3.31 Defects

The finished lining shall be free of all defects that affect hydraulic performance or structural adequacy. This shall include defects arising from substandard materials, faulty or inaccurate manufacture, inadequate preparation, faulty installation or workmanship, or inadequate curing as per requirement of EN, ASTM or as per other applicable standards.

11.9.3.32 Confirmation of Internal Dimension

Measurements shall be undertaken on installed liners to confirm finished internal dia. of the lining. As a minimum, this shall include measurements of the internal dia. at each access manhole / chamber, at 10m maximum intervals between manholes / chambers, and at any intermediate point where buckling causes a reduction in dimensions. Access to the sewer shall be via existing access manholes / a chamber at Contractor's cost unless approval has been given for the excavation of additional or enlarged access shafts.

11.9.3.33 Failure during Post Installation Testing

A test result shall be deemed to have failed if the value obtained by testing fails to achieve the minimum values nominated for the design and quality control of the lining.

11.9.3.34 Design and Materials Specifications

11.9.3.35 Liner

The rehabilitation method shall employ a suitable Liner system pre-fabricated to meet the requirements of ASTM F 1741(Type-II Lining) and live load from WRC graph in Figure 4.10, SRM manual (2001) 4th edition. The pre-fabricated liner, if chosen for lining, the same shall be custom designed and manufactured to interlock together in the sewer.

Thus the process provides a maximum internal diameter with a circular cross section and constant wall thickness irrespective of the size and shape of the deteriorated host pipe. The annulus and the voids around the tees are filled with grout to provide a complete seal and to prevent transmigration of ground water through the profile. The profile has height ranging from 7mm to 30mm and thus the liner is capable of meeting the cross sectional area reduction requirement of rehabilitated sewers.

The pipes shall provide a rehabilitated sewer that has sufficient structural capacity to handle all the loads and pressures to which the existing pipe is presently subject to.

11.9.3.36 Liner System Specification

Any liner system proposed to suit existing site conditions, shall conform strictly to the requirements of ASTM F 1741 (Type-II Lining) and live load from WRC graph in Figure 4.10, SRM manual (2001) 4th edition.

11.9.3.37 Design

The Liner shall be designed to meet the following requirements.

11.9.3.38 External Hydrostatic Load:

For design purpose, wherever possible / applicable the water table shall be considered at ground level.

11.9.3.39 External Ground Cover and Traffic Load:

The actual depth of cover of sewer varies from 1m to 10m. The Contractor shall confirm these covers prior to undertake the design calculations. The dead load shall be calculated based on assumption of prism loading on host pipe. The WRC SRM shall be applied to derive the traffic live and soil loads. The actual depth of cover over the top of the sewer shall be used for soil loads imposed on the sewer.

Type – ‘A’ Traffic loading (Heavy) shall be complying with Indian Road Congress – AA Class loading standards.

11.9.3.40 Design Condition

The design with not less than 50 years estimated life shall be taken into account the condition of the existing sewer. In critical site conditions the design shall be for a structurally deteriorated sewer whereby the entire external load shall be carried by the rehabilitated liner.

11.9.3.41 Design Safety and Enhancement Factor

The above factors shall comply in accordance with the applicable manufacturing standards/ codes.

11.9.3.42 Design Method :

The design shall be based on ASTM F 1741 Type-II Lining) and live load from WRC graph in Figure 4.10, SRM manual (2001) 4th edition. Any alternate design method proposed on the chosen material must be based on acceptable sound engineering principles. The design method shall be clearly identified and the design calculations with proposed thickness for each sewer size presented in a manner consistent with good engineering practice and whereby all assumptions and design parameters are clearly identified. Each liner design shall be signed and sealed by a professional engineer duly licensed by an Engineering Institution recognized and approved by the Engineer.

The materials chosen for rehabilitation shall meet the Japan Industrial Standard or other Internationally accepted standards which ensure quality equivalent to or higher than the standards specified in the technical specifications.

Where applicable, materials shall be manufactured under an ISO Quality Management System assessed and certified by an independent authorized and accredited third party.

The material engineering properties used in the design shall have the appropriate long-term values determined from third party independent testing by an accredited laboratory experienced in the testing of lining long-term values shall not exceed 50% of short-term values.

11.9.3.43 Short-Term Design Requirements:

Short-term checks are prescribed in the WRC, SRM, and 4th Edition for Type-II (2001) linings for larger dia. pipes. Spiral liner shall be checked;

The Tenderer shall provide a method statement for the safest systems to be employed during installation to prevent buckling due to grouting pressures.

11.9.3.44 Design Approval:

The design of the liner shall be submitted for approval to the Engineer.

11.9.3.45 Cross Sectional Area:

The cross sectional area after rehabilitation must be at least '100-12.5' % i.e. 87.5% of the nominal cross sectional area before rehabilitation.

11.9.3.46 Slope and Grade:

The design of the liner shall result in a continuous downward slope (in correlation with the allow ability at sites) in direction of flow throughout the entire rehabilitation including across manholes. There shall be no reverse slope or stepwise transitions in the flow path. Loss of grade and remedial proposals shall be reported to the Engineer without delay. Exception to this design requirement will only be permitted and authorized by the Engineer, if the configuration of the existing sewer makes rectification impossible to achieve.

11.9.3.47 Materials

The Contractor shall obtain and make available at all times the Materials Safety Data Sheets (MSDS) information pertaining to any materials used in the works.

11.9.3.48 Liner

The lining materials and construction shall be fully resistant to any contact with municipal sewage and storm water. All liner pipes shall meet the physical properties and other testing requirements shall conform to relevant internationally accepted codes and manufactured under an ISO 9001 quality management system and subject to performance assessments by an independent third party such as WRC or similar approved by the Engineer. The proposed liner shall have a design life of at least 50 years.

11.9.4 Testing

11.9.4.1 General

Testing shall be undertaken on the lining material and its constituents.

All the tests shall be in accordance with the relevant standards for the specific material or in accordance with recognized tests developed and proven for the lining system.

(a) Relevant Standards and tests for Spirally Wound Linings

1. The most commonly applicable design standards for these linings are ASTM F 1741, AS/NZS 2566, and ATV-DVWK-M 127 E.
2. Lining with Spirally Wound Pipes shall comply with WRC Sewer Rehabilitation Manual, 4th Edition.
3. The two part Rib steel liner; which is normally used for Rehabilitation project of this nature, consists of both steel (grade 316 SS) and plastic with high stiffness up to 10,000 N/m/m (80 psi).
4. Standard specification for Poly Vinyl Chloride (PVC) Profile strip for machine spiral wound liner pipe rehabilitation of existing sewers and conduits including the required testing shall fully comply with ASTM F 1697-96 and also ASTM D 1784 – 99a with technically equivalent to ISO 1163-1 : 1985 and ISO 1163-2 : 1980.
5.
 - (a) Tensile Testing in accordance with ASTM D 638 - 1997 – “Standard Test Methods for Tensile properties of plastic”.
 - (b) Impact Testing in accordance with ASTM D 256 - 1997 – “Standard Test Methods for Determining the Izod pendulum Impact Resistance of plastics”.
 - (c) Hardness Shore D Testing in accordance with ASTM D 2240 - 1997 – “Standard Test Method for Rubber property – Durometer Hardness”.
 - (d) Abrasion Resistance by means of gravity chute in accordance with DIN 1230, Part-2.

11.9.4.2 Payment to Testing Institutions

All costs for preparation of testing samples, transportation to testing facility, wastage and any other associated works inclusive of any overhead and supervision will be deemed to have been included by the Contractor in his Bid.

Testing charges will be paid by The Contractor to the testing facility nominated by DJB. Upon satisfactory completion of testing and submission of Test Reports, receipts for cost of testing will be submitted to the engineer for reimbursement by DJB. Test Reports from the

Testing Institution must also be accepted by the Consultant/Engineer prior to Payment approval. Testing charges shall be reimbursed as per provisions in the conditions of contract.

For reference purpose only, reputed testing institutions for calibration and testing of building materials are Indian Institute of Technology Delhi, Shriram Institute for Industrial Research (Delhi), the National Council for Cement and Building Materials and Central Institute of Plastics Engineering & Technology. Test Reports from the Testing Institution must be accepted by the Consultant prior to Payment approval.

The Contractor will prepare all samples for delivery to the testing institution as directed by The Consultant. This cost and administrative costs for co-ordinating all testing is deemed to be covered in the Contractor's rates for the liner.

11.9.4.3 Measurement and Payment

Payment will be made for complying with all requirements as described in the technical specification

This item includes the design, approval, fabrication, transport and installation of the structural spiral wound liner or expended spiral wound linear inclusive of all materials, labour and equipment required for the rehabilitation of the sewer by the approved lining method. The liner shall be installed through the channel of the manhole, or shafts constructed by the contractor, and the contractor shall carry out all cutting, final finishing including sealing of the edges and cutting for any laterals by an engineer approved method. After rehabilitation of the sewer, the contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the engineer-in-charge

In case the sewer internal diameter is different by more than plus or minus 2% to that specified in the contract document, the payment for this item will be adjusted on a pro rata basis, based on the internal perimeter of the sewer. The contractor shall be aware that the final thickness of liner shall not be less than the tendered thicknesses of the liner. If the proposed thickness of the liner submitted in this bid is found to be inadequate during the detailed design stages, the thickness will be adjusted without any variation of bid price.

Lining shall be measured by linear metre of liner

installed. The payment shall be made as per relevant

BOQ .

PART 12 - TESTING OF LINER

12.1 Defects

The finished lining shall be free of all defects that affect hydraulic performance or structural adequacy. This shall include defects arising from substandard materials, faulty or inaccurate manufacture, inadequate preparation, faulty installation or workmanship, or inadequate curing.

Defects which are considered unacceptable for CIPP linings include, but are not be limited to the following:

- ☐ Unsatisfactory hydraulic performance
- ☐ Insufficient structural adequacy
- ☐ Foreign inclusions
- ☐ Irregularity in lining caused by inadequate surface preparation
- ☐ Leakage through the lining
- ☐ Inadequate material curing
- ☐ Inadequate resin impregnation
- ☐ Excessive resin loss during installation
- ☐ Dry spots, bubbles, cracks or delamination's
- ☐ Pinholes

12.2 Testing

12.2.1 General

Testing shall be undertaken on the lining material and its constituents.

The testing program shall include pre installation testing of pre formed materials, testing of constituents before and after their combination and post installation testing of the lining as appropriate for the lining system.

All tests shall be in accordance with the relevant standard for the specific material or in accordance with recognised tests developed and proven for the lining system.

12.2.2 Pre Installation Testing

For CIPP linings the pre installation testing program shall include the testing of three prepared samples for the same series of tests to those required for the installed lining. The frequency of testing shall be as specified in this document.

Pre Installation testing will be required in this contract.

Tests for CIPP Linings

Samples for testing may be prepared using the procedure given in Appendix C of WIS

4-34-04. Type testing shall be carried out prior to the commencement of the works.

The following tests shall be carried out by the Contractor at a testing laboratory or tertiary institutions as approved by the Engineer to demonstrate that the liner installed indeed achieved the design values that are used in the design calculations.

If, during the course of the contract, there is a change in manufacturer and/or change in source of materials used, another type test will be required unless otherwise directed by the Engineer.

All the above tests shall be carried out at $35^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (ambient sewer).

Laboratory testing required for this contract is summarised in Table 12.2. Quality control tests and Field tests will also be conducted to ensure that the installed product achieves the required standard

Testing in the Contract is described below. All test samples shall be made and delivered by the Contractor to the testing institutions in the presence of Engineer's representative. The contractor shall be deemed to have included in his bid price for the cost of any transportation, preparation of samples, unused test samples, waste materials, unusable liner sections of the test piece and disposal of waste materials, & etc.

- (a) Tensile strength/ Tensile modulus of elasticity
- (b) Flexural strength/ Flexural modulus of elasticity
- (c) Compressive strength
- (d) Hardness (Barcol)
- (e) 100 day acid test
- (f) Gravity Pipe Leakage Test

Corresponding test reports and results duly endorsed by the testing institutions shall be provided to the Engineer. Details of standard test procedures are given in WIS 4-34-04 (1995) and the documents referred to therein.

(a) Tensile Strength Testing

Tensile testing shall be carried out in accordance with BS 2782: Part 3: Method 320E or ASTM D638. Samples shall be without end pieces. The rate of grip separation shall be 1 mm/minute. The tensile modulus of elasticity shall be measured over the linear portion of the load extension curve. If the load extension curve contains no straight portion the modulus shall be taken as the slope of the tangent to the curve over the first 0.2% strain ignoring the initial strain required to straighten the sample. Samples of single layer felt/resin composite and multilayer (2 or more layers of felt) composite shall be tested.

The test report shall contain all particulars referred to in Section 12 of BS 2782: Part 3: Method 320E, and shall also include load extension curves for each sample.

Testing frequency: Conduct testing for each inversion

(b) Flexural Testing

Flexural testing shall be carried out in accordance with or ASTM D790 or BS 2782: Method 335A (3 samples for each lining length). Samples of single layer felt/resin composite and multilayer (2 or more layers of felt) composite shall be tested. The modulus of elasticity shall be measured in accordance with Tensile Strength Testing as explained above. The test report shall contain all particulars referred to in Section 8 of the BS2782: Part 3: Method 335A.

Testing frequency: Conduct testing for each inversion

(c) Compressive Strength

(d) Hardness (Barcol)

Tests shall also be carried out in accordance with BS 2782: Part 10: Method 1001 or ASTM D2584 to determine the hardness of single layer and multi-layer samples of cured resin/felt composite.

Testing frequency: Conduct testing for every inversion

12.2.3 100 Day Acid Test

The values of the tensile and flexural strengths obtained from these tests shall not be less than 75% of the minimum values specified by the standard tests (above).

Trial mixes of the grout type proposed shall be undertaken to establish the properties of the grout. The following properties shall be determined and the results shall form the control values for quality control purposes.

12.2.4 Payments to Testing Institutions

All costs for preparation of testing samples, transportation to testing facility, wastage and any other associated works inclusive of any overhead and supervision will be deemed to have been included by the Contractor in his Bid.

Testing charges will be paid by The Contractor to the testing facility nominated by DJB. Upon satisfactory completion of testing and submission of Test Reports, receipts for cost of testing will be submitted to The Engineer for reimbursement by DJB. Test Reports from the Testing Institution must also be accepted by the Consultant/Engineer prior to Payment approval. Testing charges shall be reimbursed as per provisions in the conditions of contract.

For reference purpose only, reputed testing institutions for calibration and testing of building materials are Indian Institute of Technology Delhi, Shriram Institute for Industrial Research (Delhi), the National Council for Cement and Building Materials and Central Institute of Plastics Engineering & Technology. Test Reports from the Testing Institution must be accepted by the Consultant prior to Payment approval.

The Contractor will prepare all samples for delivery to the testing institution as directed by The Consultant. This cost and administrative costs for co-ordinating all testing is deemed to be covered in the Contractor's rates for the liner.

12.2.5 Confirmation of Internal Dimension

For CIPP linings and measurements shall be undertaken to confirm finished internal dimensions of the lining.

For non-man entry conduits and measurements shall be made using a digital project laser beam ("Light line" system) or side scan CCTV or equivalent system. Alternatively, the dimensions can be measured at each end of the pipe section at the manholes.

For man entry sewers measurements shall include the internal width and height at each access chamber, at 10m maximum intervals between chambers, and at any intermediate point where bulges or wrinkling causes a reduction in dimensions. A test template of the external liner diameter can then be pulled through the pipe to ensure that the design diameter is adequate.

12.2.6 Failure during Post Installation Testing

A test result shall be deemed to have failed if the value obtained by testing fails to achieve the minimum values nominated by the Contractor for the design and quality control of the lining.

12.2.7 Measurement and Payment

The Contractor shall include in his rates for complying with all requirements as described in Part 12 of the Technical Specification except testing charges. Payment will be made after submission of Payment receipts to approved Test Laboratories on acceptance of Test Report.

All costs for preparation of testing samples, transportation to testing facility, wastage and any other associated works inclusive of any overhead and supervision will be deemed to have been included by The Contractor in his Bid.

Testing charges will be paid by The Contractor to the testing facility nominated by DJB. Upon satisfactory completion of testing and submission of Test Reports, receipts for cost of testing will be submitted to The Engineer for reimbursement by DJB. Test Reports from the Testing Institution must also be accepted by the Consultant/Engineer prior to Payment approval.

The Payment shall be made as per relevant BOQ Items.

STRUCTURAL CONDITION OF EXISTING SEWERS

TABLE 12.1

Package No.	Sewer	Length (m)	Existing sewer	Size (mm)	Sewer Description
1	Package K2: REHABILITATION OF TRUNK SEWER NO. 5 AND JHILMIL SEWERS OF SIZES VARYING FROM 1600 MM TO 2100MM DIA. KONDLI ZONE BY STANDALONE STRUCTURAL LINING METHOD UNDER YAP(III)	7715 m	RCC pipes	DN 1600 to 2100, RCC pipes	The Sewer Lines have deteriorated significantly due to settlements, leakage in the barrel and displaced joints, ground water infiltration, siltation and structural failures, hence it is therefore proposed to.

Table 12.2 TESTING PROCEDURES FOR CIPP LINING: MATERIALS / FABRICATION

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHED	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
Resin	Type of Resin	BS3532 ASTM D2690		Isophthalic polyester, vinyl ester, Epoxy resins Approved resin with over 10 years history in sewer environment	Test results of each batch supplied for fabrication. Quality Audits carried out by Engineer/ consultant	Supplier to by Quality assured to ISO9001. Batch testing results to be provided for Acceptance	(a) Independent 3rd party testing (as part of the ISO9001 QMS of the Supplier). Supplier's ITP and Test Certificates shall be supplied. (b) Random test 1 per dia. or per km whichever is less by engineer approved institution. All these tests can be conducted at Shri Ram Test House, Delhi/ CIPET
	Hardness	ASTM D2584		Barcol>35	As above	As above	The test is also included in the material test fabrication
	Gel time	IS 6746		Required for	As above	As above	To be done on

				fabrication > MSDS			site during installing of each inversion.
	Elongation	B2782:320C IS 6746		> 2.5%	As above	As above	3 rd Party test result from ISO

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHED	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
		ASTM D638M					certified supplier as per item (1).
	Acid value	B2782:432B IS 6746		<20	As above	As above	3 rd Party test result from ISO certified supplier as per item (1).
	Hydroxyl	B2782:432C IS 6746		<30	As above	As above	As above
Resin Additives				Inconformity with MSDS	Test results of each batch supplied for fabrication. Quality Audits carried out by Engineer/ consultant	Supplier to be Quality assured to ISO9001	Independent 3rd party Testing Facility (as part of the ISO9001 QMS) (Delete)
Felt	Elongation			Must be greater than 100% before breaking	As above	As above	Engineer Approved Testing Institution
	Thickness of liner			Must be > design liner thickness	As above	As above	
Soil/ Geotechnical Testing	Soil parameters for design	AS2566	As required	Inconformity with C.A	After every 500 meters or change of diameter	Determination of design parameters	To be provided by the Contractor. A geotechnical investigation report based on bore log as per professional geotechnical

							engineer's investigation

Table 12.3 TESTING PROCEDURES FOR CIPP LINING: SAMPLE FROM PIPE COMPOSITE PRIOR TO LINING

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
CIPP LINER	Type of Resin	Gel time test IS6746 BS3532 ASTM D2690	Cut from liner for isophthalic resin test Gel time test on resin sample	Isophthalic resin ,vinyl ester epoxy resin	1 samples per inversion Gel time	Batch number correlation. Shelf life to be checked	Gel test on site
	Tensile strength	BS2782: Part 3: Method 320E or ASTM D638M	Sample in accordance with WIS 4-34-04 Appendix B	Must be greater than specified in design submission	2 inversions per km At least 2 samples per inversion	Structural capacity	Engineer approved Testing Institution
	Flexural testing/flexural modulus	BS2782: Part 3: Method 335A or ASTM D790M	Sample in accordance with WIS 4-34-04 Appendix B	Must be greater than specified in design submission	2 inversions per km At least 2 samples per inversion	Structural capacity	Engineer approved Testing Institution
	Compressive strength	BS2782: Part 3: Method 345A or ASTM D695M	Sample in accordance with WIS 4-34-04 Appendix B Or Cut sample from installed liner	> 90	2 inversions per km At least 2 samples per inversion	Durability	Engineer approved Testing Institution
	Hardness	BS2782: Part 10: Method 1001 or ASTM D2584	Sample in accordance with WIS 4-34-04 Appendix B Or Cut sample from installed liner	Barcol>35	2 inversions per km At least 2 samples per inversion	Durability	Engineer approved Testing Institution

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
	Corrosion Resistance	ASTM D543 or 100 Day Acid Test as described in specification clause 11.24.4 (ASTM 1216- 03 Appendix X2	Sample in accordance with WIS 4-34-04 Appendix B Or Cut sample from installed liner	Tensile and Flexural Strength must be greater than 75% of the tested value	Three samples selected at commencement of installation.	Durability	Engineer approved Testing Institution
	Gravity Pipe Leakage Test	ASTM F1216- 03	After Inversion after Curing	Leakage from CIPP Inversion	one Test per three Inversions	Correct Installation	At Site
Dimensions	Internal diameter Thickness of liner	measure	Manual inspection	Achieve approved design within tolerance	10 m intervals for man entry sewers	Correct dimension for hydraulic capacity	Consultant/ Engineer
	Wrinkles surface irregularities	measure	Manual inspection	For man entry sewers circumferential wrinkles larger than 1% of sewer dia shall be rectified	All inversions	hydraulic capacity	Consultant/ Engineer
Installation	Curing	WIS 4-34-04 Clause 10		Inspection and records of inversion and curing process	All inversions	Structural capacity and durability	Consultant/ Engineer/ Contractor

	Liner defects by high temperatures			Temp. within range + pressure	All inversions	Structural capacity and durability	Consultant/ Engineer/ Contractor

12.3 TESTING OF LINER GLASS REINFORCED PLASTIC (GRP)

12.3.1 Defects

The finished lining shall be free of all defects that affect hydraulic performance or structural adequacy. This shall include defects arising from substandard materials, faulty or inaccurate manufacture, inadequate preparation, faulty installation or workmanship.

Defects which are considered unacceptable for GRP linings include, but are not be limited to the following:

- ☐ Damage to units such as chips, cracking and scratching of resin coats.
- ☐ Leakage through joints.
- ☐ Excessive step or distortion at joints.
- ☐ Incomplete grouting behind lining.
- ☐ Bulging or distortion caused by grouting.

12.3.2 Testing

12.3.2.1 General

Testing shall be undertaken on the lining material and its constituents.

The testing program shall include pre installation testing of pre formed materials, testing of constituents before and after their combination and post installation testing of the lining as appropriate for the lining system.

All tests shall be in accordance with the relevant standard for the specific material or in accordance with recognised tests developed and proven for the lining system.

Laboratory testing required for this contract is summarised in Table 12.2 (B) Quality control tests and Field tests will also be conducted to ensure that the installed product achieves the required standards.

12.3.2.2 Pre Installation Testing

For GRP linings unit test shall be carried out to verify the quality and physical properties of the units. As a minimum these tests shall include determination of the short term tensile flexural strength and the short term flexural modulus. These tests and other type tests normally carried out on the lining material shall be performed in accordance with the relevant standard for the lining material.

12.3.2.3 Tests for GRP Linings

Samples for testing may be prepared using the procedure given in Appendix C of WIS

4-34-02. Type testing shall be carried out prior to the commencement of the works.

The following tests shall be carried out by the Contractor at a testing laboratory or tertiary institutions as approved by the Engineer to demonstrate that the liner installed indeed achieved the design values that are used in the design calculations.

If, during the course of the contract, there is a change in manufacturer and/or change in source of materials used, another type test will be required unless otherwise directed by the Engineer.

All the above tests shall be carried out at $35^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (ambient sewer).

Laboratory testing required for this contract is summarised in Table 12.2 (B) Quality control tests and Field tests will also be conducted to ensure that the installed product achieves the required standard

Testing in the Contract is described below. All test samples shall be made and delivered by the Contractor to the testing institutions in the presence of Engineer's representative. The contractor shall be deemed to have included in his bid price for the cost of any transportation, preparation of samples, unused test samples, waste materials, unusable liner sections of the test piece and disposal of waste materials, & etc.

- (a) Flexural (Bending) Testing
- (b) Ring Stiffness Test
- (c) Chemical Corrosion
- (d) Beam Strength
- (e) Grout Strength
- (f) Analysis of GRP pipe wall
- (g) Hardness (Barcol)
- (h) Gravity Pipe Leakage Test
- (i) Grout Testing

Corresponding test reports and results duly endorsed by the testing institutions shall be provided to the Engineer. Details of standard test procedures are given in WIS 4-34-02 the documents referred to therein.

(a) Flexural (Bending) Testing

The short term Flexural modulus testing shall be carried out in accordance with the procedures described in ASTM D790 or BS 2782: Method 1005: 1977, EN 63: 1977 from coupons cut from the hoop (bending) direction and using a testing speed of 10mm/min.

Straight sections fabricated in the identical GRP design can also be tested.

Frequency: Conduct testing for every 200 m length

(b) Ring Stiffness Test

A full scale ring stiffness test shall be carried out on a 300 mm wide section of the GRP Pipe in accordance with AS3572. Pipes shall be selected at random by The Engineer and a 300 mm

wide section shall be cut from the pipe for testing. A Universal Testing machine capable of testing GRP pipe section to a diameter of 1800 mm will have to be purchased or located in an independent testing facility to carry out this testing.

Calibration Certificates for the UTM machine will be required on a two monthly basis Testing frequency: Conduct one full scale test for each diameter and thickness.

Testing will be carried out prior to full scale production to ensure that GRP pipe meets the design requirements. Tests will be carried out on each pipe of varying diameters and thickness. Tests will be carried out from time to time to ensure conformance with design.

Any changes to design including resins, filler, and different suppliers will require additional testing.

(c) Chemical Corrosion

The lining system shall have demonstrated chemical corrosion resistance, tested in accordance with these procedures or ASTM D3681.

Testing frequency: Conduct testing for every 500 m of lining or as directed by the Engineers

(d) Beam Strength

The lining materials shall achieve the minimum beam strength requirements of ASTM D3262-04. Straight sections fabricated in the identical GRP design can be tested.

Testing frequency: Conduct testing for every 200 m of lining or as directed by the Engineers.

(e) Grout strength

Grout Cube Strength in accordance with BS 1881: Part 116. (Three for each batch or grout with a maximum of six for any one length of lining).

Grout Slump Test in accordance with BS 1881: Part 102. (One for each batch of grout)

(f) Analysis of GRP pipe wall: -

A minimum of five samples from the full design wall thickness of each lining test unit (excluding any rough backing or non-slip coating) shall be fully analysed in accordance with Appendix E of WIS 4-34-02 and the results declared. The values shall form the control values for quality control purposes.

Wall thickness and resin rich liner thickness shall be determined at a minimum of five locations in each test sample using a method of measurement accurate to the nearest 0.1 mm, by measuring cut surfaces through the lining wall. The cut surfaces shall be smoothed sufficiently for the different layers to be delineated. The resin rich liner thickness shall be measured using a suitable optical (magnifying) technique.

Generally the locations of cores shall include

- i. a point of minimum internal surface curvature,

- ii. a point towards the centre of the test sample,
- iii. Points near each end of the test sample, but not at a joint. The internal and external surfaces of each lining unit shall be examined visually for freedom from defects. Where practicable this shall occur prior to application of any rough backing or non-slip surface coating. Types of defect and final allowable limits are given in WIS 4-34-02, Table 2, and Appendix G.

All raw materials shall be tested at a frequency sufficient to ensure consistency and compliance with this specification. The manufacturer shall adequately supervise all stages of production and keep records of the raw material batches used and products made each work shift or day. Manufacture shall be under environmental conditions compatible with producing satisfactory linings and raw materials shall be stored and used in compliance with the recommendations of their manufacturers.

Reinforcement materials shall be stored in dry conditions.

(g) Hardness (Barcol)

Tests shall also be carried out in accordance with BS 2782: Part 10: Method 1001 or ASTM D2584 to determine the hardness of single layer and multi-layer samples of cured resin/felt composite.

Testing frequency: Conduct testing for every inversion

(h) Gravity pipe Leakage Test

As the diameters are greater than 36" (0.9 m), a physical inspection of completed pipes will take place with Consultant's representative to ensure all joints are sound and no leakages occur.

Inspection on all completed pipe sections

(i) Grout Testing

Trial mixes of the grout type proposed shall be undertaken to establish the properties of the grout. The following properties shall be determined and the results shall form the control values for quality control purposes.

Density using the Baroid mud balance or similar approved equipment and density shall be 1100 ± 50 Kg per cum. The contractor shall supply wind proof shelter for the equipment.

Workability using the Marsh cone with 10 mm. orifice shall be in the range of 8 to 25 sec.

Compressive Strength - The grout cube shall be prepared and tested as below. Cube moulds shall be of size 100 mm. or 70.7 mm and all joints shall be sealed to prevent leakage. Mould shall be overfilled and air bubbles be removed by tapping.

After leaving for 30 to 60 minutes the cast grout shall be taken off and the mould covered with plastic sheet.

Moulds shall be stored generally at 25°C for 24 hours or until the grout has attained sufficient strength to allow the cube to be stripped from the mould whichever is greater.

The cube shall be removed from the moulds, marked and stored in water at room temperature. The contractor shall test the grout cubes at 28 days after casting at an approved testing laboratory.

The grout cubes shall have minimum compressive strength of 12 N/mm² at 28 days for annulus filling to be designed for type 1 lining and tested in accordance with BS 4551 or equivalent whereas the exterior filling grout shall have strength of 3 N/mm².

The contractor shall supply all necessary moulds and storage tanks of sufficient size for curing cubes.

12.3.2.4 Payments to Testing Institutions

All costs for preparation of testing samples, transportation to testing facility, wastage and any other associated works inclusive of any overhead and supervision will be deemed to have been included by the Contractor in his Bid.

Testing charges will be paid by The Contractor to the testing facility nominated by DJB. Upon satisfactory completion of testing and submission of Test Reports, receipts for cost of testing will be submitted to The Engineer for reimbursement by DJB. Test Reports from the Testing Institution must also be accepted by the Consultant/Engineer prior to Payment approval. Testing charges shall be reimbursed as per provisions in the conditions of contract.

For reference purpose only, reputed testing institutions for calibration and testing of building materials are Indian Institute of Technology Delhi, Shriram Institute for Industrial Research (Delhi), the National Council for Cement and Building Materials and Central Institute of Plastics Engineering & Technology. Test Reports from the

Testing Institution must be accepted by the Consultant prior to Payment approval.

The Contractor will prepare all samples for delivery to the testing institution as directed by The Consultant. This cost and administrative costs for co-ordinating all testing is deemed to be covered in the Contractor's rates for the liner.

12.3.2.5 Confirmation of Internal Dimension

For GRP linings and measurements shall be undertaken to confirm finished internal dimensions of the lining.

For non-man entry conduits and measurements shall be made using a digital project laser beam ("Light line" system) or side scan CCTV or equivalent system. Alternatively, the dimensions can be measured at each end of the pipe section at the manholes.

For man entry sewers measurements shall include the internal width and height at each access chamber, at 10m maximum intervals between chambers, and at any intermediate point where bulges or wrinkling causes a reduction in dimensions. A test template of the external liner diameter can then be pulled through the pipe to ensure that the design diameter is adequate.

12.3.2.6 Failure during Post Installation Testing

A test result shall be deemed to have failed if the value obtained by testing fails to achieve the minimum values nominated by the Contractor for the design and quality control of the lining.

12.3.2.7 Measurement and Payment

The Contractor shall include in his rates for complying with all requirements as described in Part 12 of the Technical Specification except testing charges. Payment will be made after submission of Payment receipts to approved Test Laboratories on acceptance of Test Report.

All costs for preparation of testing samples, transportation to testing facility, wastage and any other associated works inclusive of any overhead and supervision will be deemed to have been included by The Contractor in his Bid.

Testing charges will be paid by The Contractor to the testing facility nominated by DJB. Upon satisfactory completion of testing and submission of Test Reports, receipts for cost of testing will be submitted to The Engineer for reimbursement by DJB. Test Reports from the Testing Institution must also be accepted by the Consultant/Engineer prior to Payment approval.

The Payment shall be made as per relevant BOQ Items.

Table 12.4 TESTING PROCEDURES FOR GRP LINING: MATERIALS / FABRICATION

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
Resin	Type of Resin	BS3532 ASTM D2690		Isophthalic polyester or vinyl ester, Approved resin with over 10 years history in sewer environment	Test results of each batch supplied for fabrication. Quality Audits carried out by Engineer/ consultant	Supplier to be Quality assured to ISO9001. Batch testing results to be provided for Acceptance	Independent 3 rd party Testing Facility (as part of the ISO9001 QMS)
	Hardness	ASTM D2584		Barcol>35	As above	As above	As above
	Gel time	IS 6746:1994		Required for fabrication purposes	As above	As above	As above
	Elongation	B2782:320C ASTM D638M		> 2.5%	As above	As above	As above
	Acid value	B2782:432B IS 6746:1994		<20	As above	As above	As above
	Hydroxyl	B2782:432C IS6746		<30	As above	As above	As above
Pipe section	Corrosion Resistance	ASTM D3681 Strain corrosion test	As per ASTM3681	50 year corrosion resistance	1 Pipe sample tested under the Manufacturer's QMS	Corrosion resistance	Independent 3 rd party Testing Facility (as part of the ISO9001 QMS)
Glass	Corrosion Resistance		C glass surface tissue E type glass CSM or woven mat/fibres	Must be Boron free/reduced	Test results of each batch supplied for fabrication. Quality Audits carried out by	Supplier to be Quality assured to ISO9001	Independent 3 rd party Testing Facility (as part of the ISO9001 QMS)

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
					Engineer/ consultant		
	Elongation				Test results of each batch supplied for fabrication. Quality Audits carried out by Engineer/ consultant		As above
Filler/ Aggregate	Grading			High grade silica sand 0.05mm to 5mm	1 per 50 m3	Fabrication quality control	Independent 3 rd party Testing Facility
	purity			No contaminants Na Cl Ca Cl K Cl	1 per 50 m3		As above
	moisture	BS812		<0.2% moisture	1 per 50m3		
Joints	Joint seal	Full scale hydraulic load testing	Joint section prepared		External hydraulic loading to 1.5 x max groundwater pressure Internal load to 50 Kpa	Joint water tightness	Independent 3 rd party Testing Facility
	Joint break strength				As above	As above	As above
Soil/ Geotech Testing	Soil parameters for design	AS2566	As required	At every 500m interval or change of sewer diameter	Once	Determination of design parameters	Engineer approved Testing Agency

Table 12.5 TESTING PROCEDURES FOR GRP LINING: SAMPLE FROM PIPE COMPOSITE PRIOR TO LINING

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
GRP LINER	Type of Resin	ASTM D2690 BS3532		Isophthalic polyester or vinyl ester	Test results of each batch supplied for GRP Installation. Quality Audits carried out by Engineer/ consultant	Batch number correlation. Shelf life to be checked	Engineer approved Testing Institution
	Tensile strength	BS2782: Part 3: Method 320E or ASTM D638M		Must be greater than specified in design submission	1 test per 200m	Structural capacity	Engineer approved Testing Institution
	Flexural testing/flexural modulus	BS2782:10 or ASTM D790M	Prepared sample of identical GRP composite	Must be greater than specified in design submission	1 test per 200m	Structural capacity	Engineer approved Testing Institution
	Ring stiffness test	AS3572 IS 14402 ASTM D2412	300mm pipe section cut from selected GRP pipe	Must be greater than specified in design submission	2 tests per diameter and thickness	Structural capacity	Engineer approved Testing Institution

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
	Compressive strength	BS2782: Part 3: Method 345A or ASTM D695	Sample in accordance with WIS 4-34-02 Or Cut sample from installed liner	> 90	1 test per 200m	Durability	Engineer approved Testing Institution
	Hardness	BS2782: Part 10: Method 1001 or ASTM D2584	Cut sample from liner	Barcol>35	Every 200 metres of liner	Durability	Engineer approved Testing Institution
	Corrosion Resistance	ASTM D543 Or 100 day acid test As described in Specification clause 11.24.4	Sample in accordance with WIS 4-34-02 Appendix B Or Cut sample from installed liner	tensile and flexural strength values Must be greater than 75% of tested value(above)	2 samples per 1km	Durability	Engineer approved Testing Institution
	Long term Flexural creep test	WIS 4-32-02 Appendix C BS4618:SUBS 1.1.2	Sample in accordance with WIS 4-34-02 Appendix B Or Cut sample from installed liner	Long term Flexural modulus to be greater than design value	3 samples selected at commencement of installation	Structural capacity and Durability	Engineer approved Testing Institution
	Gravity Pipe Leakage test	ASTM F1216	After installation	Visual inspection in man entry sized sewers	Every completed section	Correct Installation	Consultant/ Engineer

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
GRP LINER Analysis	Dimensions: Inner diameter	ASTM D3567	Measured prior to installation	Must be as approved design	Every completed section	Hydraulic capacity	Consultant/ Engineer
	Thickness(excl. rough backing)		Calipers	Must be greater or equal to approved design	Every completed section	Structural capacity	Consultant/ Engineer
	Composition	WIS 4-32-02 Appendix C	Cut sample from liner	Resin rich layer>0.5mm Barrier layer> 2mm	5 samples per diameter and thickness	Durability	Engineer approved Testing Institution
	Visual defects	WIS 4-32-02 Appendix G	Inspection prior to installation		At random		
Grout	Compressive strength	BS 1881	6 per each lining length	Must be > 3 Mpa	Each batch or completed section	Correct Installation	Consultant/ Engineer

12.4 TESTING OF LINER (MACHINE WOUND SPIRAL LINING (MWSL))

12.4.1 Defects

The finished lining shall be free of all defects that affect hydraulic performance or structural adequacy. This shall include defects arising from substandard materials, faulty or inaccurate manufacture, inadequate preparation, faulty installation or workmanship.

Defects which are considered unacceptable for MWSL linings include, but are not be limited to the following:

- ☐ Unsatisfactory hydraulic performance
- ☐ Insufficient structural adequacy
- ☐ Foreign inclusions
- ☐ Irregularity in lining caused by inadequate surface preparation
- ☐ Leakage through the lining
- ☐ Cracks or delamination's
- ☐ Excessive step or distortion at joints.
- ☐ Incomplete grouting behind lining.
- ☐ Bulging or distortion caused by grouting.

12.4.2 Reference:

- A. ASTM D 256: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
- B. ASTM D 638: Standard Test Method for Tensile Properties of Plastics
- C. ASTM D 790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D. ASTM D 2412: Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- E. ASTM D 2444: Test for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- F. ASTM D 3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- G. ASTM F 2136: Standard Test Method for Notched Constant Ligament Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE

12.4.3 Testing

12.4.3.1 General

Testing shall be undertaken on the lining material and its constituents.

The testing program shall include pre installation testing of pre formed materials, testing of constituents before and after their combination and post installation testing of the lining as appropriate for the lining system.

All tests shall be in accordance with the relevant standard for the specific material or in accordance with recognised tests developed and proven for the lining system.

Laboratory testing required for this contract is summarised in Table 12.2 (C). Quality control tests and Field tests will also be conducted to ensure that the installed product achieves the required standards.

12.4.3.2 Pre Installation Testing

Material Testing

A. Before installation of the liner has commenced, a sample of profile from each production run shall be

tested to confirm that the value of initial stiffness factor shall be exceeds specified minimum values.

For MSWL linings unit test shall be carried out to verify the quality and physical properties of the units. As a minimum these tests shall include determination of the short term tensile flexural strength and the short term flexural modulus. These tests and other type tests normally carried out on the lining material shall be performed in accordance with the relevant standard for the lining

Marking

A. Each PVC/HDPE profile strip shall be distinctly marked on its inside surface at intervals not to exceed 1.5m (60 inches) with a code number identifying the manufacturer, plant, date of manufacture and shift, and profile type. This information shall also appear on each reel.

Materials

- A. The extruded profile strip shall be made from un-plasticised PVC compounds meeting the minimum requirements for cell classification 12344 or 13354 or higher, as defined in ASTM D1784.
- B. The extruded profile strip shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The extruded profile strip shall be as uniform as commercially practical in color, opacity, density, and other physical properties.
- C. At the time of manufacture, each lot of extruded profile strips shall be inspected for defects and tested for physical properties as specified. A "lot" is defined as a continuous extrusion run of a given profile designation on a spool.
- D. PVC/HDPE profile strip minimum dimensions and initial stiffness factors shall be in accordance with designed values and manufacture's data sheet.
- E. The nominal gauge, nominal height, minimum strip thickness and minimum moment of inertia of the individual steel reinforcing profiles shall conform to the designed values and manufacture's data sheet (profiles) contain Nos. strips of steel reinforcement.
- F. Design stiffness values for a specific combination of PVC/ HDPE profile strip and steel reinforcing profile are available from the manufacturer.
- G. Interlocking of the edges of PVC/HDPE strip is achieved with a site applied PVC/HDPE weld, suitable for use in a sewer environment.

12.4.3.3 Post Installation Testing

12.4.3.4 Inspection and Acceptance:

The installation should be inspected either by closed circuit television or by direct visual inspection. The spiral wound liner pipe should be continuous over the entire length of the insertion. Variations from true line and grade may be inherent because of the conditions of the existing pipeline. No infiltration of

ground water through the spiral wound liner pipe should be observed. All service entrances should be accounted for and be unobstructed.

- A. A closed circuit television (CCTV) inspection shall be carried out after installation to establish that the lining has been installed as specified and all live junctions have been reinstated.
- B. The finished lining shall be free of defects that would affect long term strength or hydraulic performance.

12.4.3.5 Tests for MSWL

Linings Spirally Wound Linings

1. The most commonly applicable design standards for linings are ASTM F 1741, AS NZS 2566, ATV-DVWK-M 127 E.
2. Lining with Spirally Wound Pipes shall comply with WRC Sewer Rehabilitation Manual, 4th Edition.
3. The two part Ribsteel liner; which is normally used for Rehabilitation project of this nature consists of both steel (grade 316 SS) and plastic with high stiffness up to 10,000 N/m/m (80 psi).
4. Standard specification for Poly Vinyl Chloride (PVC) Profile strip for machine spiral wound liner pipe rehabilitation of existing sewers and conduits including the required testing shall fully comply with ASTM F 1697-96 and also ASTM D 1784 – 99a with technically equivalent to ISO 1163-1 : 1985 and ISO 1163-2 : 1980.
5.
 - a) Tensile Testing in accordance with ASTM D 638 – 1997 – “Standard Test Methods for Tensile properties of plastic”.
 - b) Impact Testing in accordance with ASTM D 256 – 1997 – “Standard Test Methods for determining the Izod pendulum Impact Resistance of plastics.
 - c) Hardness Shore D Testing in accordance with ASTM D 2240 -1997 – “Standard Test Method Rubber property – Durometer Hardness”.
 - d) Abrasion Resistance by means of gravity chute in accordance with DIN 1230. Part-2.

All the essential tests as prescribed under ASTM D 1874 like Impact strength. Tensile Strength Modulus of Elasticity. Deflection Temperature including flammability will be conducted under minimum load of 1.82 MPa (240 psi).

Base Resin and other required tests including the essential field tests: all to be clearly listed in the tender documents.

Material Testing shall be done in accordance with above Standards and any other latest international standards.

Testing in the Contract is described below. All test samples shall be made and delivered by the Contractor to the testing institutions in the presence of Engineer's representative. The contractor shall be deemed to have included in his bid price for the cost of any transportation, preparation of samples,

unused test samples, waste materials, unusable liner sections of the test piece and disposal of waste materials, & etc.

- (a) Flexural (Bending) Testing
- (b) Abrasion Resistance Test
- (c) Chemical Corrosion
- (d) Grout Strength
- (e) Thickness of MSWL pipe wall
- (f) Gravity Pipe Leakage Test
- (g) Grout Testing
- (h) Grout Compressive Strength Testing
- (i) Leakage Testing
- (j) An ex-filtration testing

Corresponding test reports and results duly endorsed by the testing institutions shall be provided to the Engineer. Details of standard test procedures are given in WIS 4-34-02 the documents referred to therein.

(a) Flexural (Bending) Testing

The short term Flexural modulus testing shall be carried out in accordance with the procedures described in ASTM D790 or BS 2782: Method 1005: 1977, EN 63: 1977 from coupons cut from the hoop (bending) direction and using a testing speed of 10mm/min.

Straight sections fabricated in the identical MSWL design can also be tested.

Frequency: Conduct testing for every 200 m length

The lining system shall have demonstrated chemical corrosion resistance, tested in accordance with these procedures or ASTM D3681.

Testing frequency: Conduct testing for every 500 m of lining or as directed by the Engineers.

(b) Abrasion Test

Abrasion Resistance by means of gravity chute in accordance with DIN 1230. Part-2.

All the essential tests as prescribed under ASTM D 1874 like Impact strength. Tensile Strength Modulus of Elasticity. Deflection Temperature including flammability will be conducted under minimum load of

1.82 MPa (240 psi).

(c) Chemical Corrosion

The lining system shall have demonstrated chemical corrosion resistance, tested in accordance with these procedures or ASTM D3681.

Testing frequency: Conduct testing for every 500 m of lining or as directed by the Engineer

(d) Grout strength

Grout Cube Strength in accordance with BS 1881: Part 116 (Three for each batch or grout with a maximum of six for any one length of lining).

Grout Slump Test in accordance with BS 1881: Part 102 (One for each batch of grout).

(e) Thickness of MSWL pipe wall:

A minimum of five samples from the full design wall thickness of each lining test unit (excluding any rough backing or non-slip coating) shall be fully analysed in accordance with Appendix E of WIS 4-34-02 and the results declared. The values shall form the control values for quality control purposes.

Wall thickness and resin rich liner thickness shall be determined at a minimum of five locations in each test sample using a method of measurement accurate to the nearest 0.1 mm, by measuring cut surfaces through the lining wall. The cut surfaces shall be smoothed sufficiently for the different layers to be delineated. The resin rich liner thickness shall be measured using a suitable optical (magnifying) technique.

Generally the locations of cores shall include

- i. a point of minimum internal surface curvature,
- ii. a point towards the centre of the test sample,

All raw materials shall be tested at a frequency sufficient to ensure consistency and compliance with this specification. The manufacturer shall adequately supervise all stages of production and keep records of the raw material batches used and products made each work shift or day. Manufacture shall be under environmental conditions compatible with producing satisfactory linings and raw materials shall be stored and used in compliance with the recommendations of their manufacturers.

Reinforcement materials shall be stored in dry conditions.

(f) Gravity pipe Leakage Test

As the diameters are greater than 36" (0.9 m), a physical inspection of completed pipes will take place with Consultant's representative to ensure all joints are sound and no leakages occur.

Inspection on all completed pipe sections

(g) Grout Testing

Trial mixes of the grout type proposed shall be undertaken to establish the properties of the grout. The following properties shall be determined and the results shall form the control values for quality control purposes.

Density using the Baroid mud balance or similar approved equipment and density shall be 1100 ± 50 Kg per cum. The contractor shall supply wind proof shelter for the equipment.

Workability using the Marsh cone with 10 mm. orifice shall be in the range of 8 to 25 sec.

Compressive Strength - The grout cube shall be prepared and tested as below. Cube moulds shall be of size 100 mm. or 70.7 mm and all joints shall be sealed to prevent leakage. Mould shall be overfilled and air bubbles be removed by tapping.

After leaving for 30 to 60 minutes the cast grout shall be taken off and the mould covered with plastic sheet.

Moulds shall be stored generally at 25°C for 24 hours or until the grout has attained sufficient strength to allow the cube to be stripped from the mould whichever is greater.

The cube shall be removed from the moulds, marked and stored in water at room temperature. The contractor shall test the grout cubes at 28 days after casting at an approved testing laboratory.

The grout cubes shall have minimum compressive strength of 12 N/mm² at 28 days for annulus filling to be designed for type 1 lining and tested in accordance with BS 4551 or equivalent whereas the exterior filling grout shall have strength of 3 N/mm².

The contractor shall supply all necessary moulds and storage tanks of sufficient size for curing cubes.

(h) Grout Compressive Strength Testing

If required by the owner or designated in the contract documents or purchase order, or both, samples from the mixed grout being pumped/ poured into the annular space should be collected and tested for compressive strength in accordance with Test Method C 39. Samples should be taken and tested for each manhole to manhole pipe section where the annular space is grouted. Measured values of compressive strength should meet the job requirements.

(i) Leakage Testing:

If required by the owner or designated in the contract documents or purchase order, or both, gravity pipes should be tested for leakage. This test is limited to pipe lengths with no service laterals, or lines with service laterals which have not yet been reinstated. One of the following two test method:

- An exfiltration test method involves plugging the spiral wound liner pipe at both ends and filling it with water. The allowable water exfiltration for any length of pipe between termination points should not exceed 50 gal per inch of internal spiral wound line pipe diameter per mile per day, providing that all air has been bled from the line. The leakage quantity should be gaged by the water level in a temporary standpipe placed in the upstream plug. During exfiltration testing, the maximum internal pipe pressure at the lowest end should not exceed 10 ft. (3.0 m) of water or 4.3 psi (29.7 kPa), and the water level inside of the standpipe should be 2 ft. (0.6 m) higher than the top of the pipe or 2 ft (0.6 m) higher than the ground water level, whichever is greater. The test should be conducted for a minimum of 1 h.

- An air test conducted in accordance with Test Method F 1417.

NOTE 3:—the leakage test is intended to evaluate the water tightness of pipe lengths, with no service laterals or lines with service laterals which have not yet been reinstated.

NOTE 4:—it is impractical to test pipes above 36-in (900mm) diameter for leakage, due to the technology available in the pipe rehabilitation industry. Post inspection of larger pipes will detect major leaks or blockages.

12.4.3.6 Payments to Testing Institutions

All costs for preparation of testing samples, transportation to testing facility, wastage and any other associated works inclusive of any overhead and supervision will be deemed to have been included by the Contractor in his Bid.

Testing charges will be paid by The Contractor to the testing facility nominated by DJB. Upon satisfactory completion of testing and submission of Test Reports, receipts for cost of testing will be submitted to The Engineer for reimbursement by DJB. Test Reports from the Testing Institution must also be accepted by the Consultant/Engineer prior to Payment approval. Testing charges shall be reimbursed as per provisions in the conditions of contract.

For reference purpose only, reputed testing institutions for calibration and testing of building materials are Indian Institute of Technology Delhi, Shriram Institute for Industrial Research (Delhi), the National Council for Cement and Building Materials and Central Institute of Plastics Engineering & Technology. Test Reports from the Testing Institution must be accepted by the Consultant prior to Payment approval.

The Contractor will prepare all samples for delivery to the testing institution as directed by The Consultant. This cost and administrative costs for co-ordinating all testing is deemed to be covered in the Contractor's rates for the liner.

12.4.3.7 Confirmation of Internal Dimension

For MSWL linings and measurements shall be undertaken to confirm finished internal dimensions of the lining.

For non-man entry conduits and measurements shall be made using a digital project laser beam ("Light line" system) or side scan CCTV or equivalent system. Alternatively, the dimensions can be measured at each end of the pipe section at the manholes.

For man entry sewers measurements shall include the internal width and height at each access chamber, at 10m maximum intervals between chambers, and at any intermediate point where bulges or wrinkling causes a reduction in dimensions. A test template of the external liner diameter can then be pulled through the pipe to ensure that the design diameter is adequate.

12.4.3.8 Failure during Post Installation Testing

A test result shall be deemed to have failed if the value obtained by testing fails to achieve the minimum values nominated by the Contractor for the design and quality control of the lining.

12.4.3.9 Measurement and Payment

The Contractor shall include in his rates for complying with all requirements as described in Part 12 of the Technical Specification except testing charges. Payment will be made after submission of Payment receipts to approved Test Laboratories on acceptance of Test Report.

All costs for preparation of testing samples, transportation to testing facility, wastage and any other associated works inclusive of any overhead and supervision will be deemed to have been included by The Contractor in his Bid.

Testing charges will be paid by The Contractor to the testing facility nominated by DJB. Upon satisfactory completion of testing and submission of Test Reports, receipts for cost of testing will be submitted to The Engineer for reimbursement by DJB. Test Reports from the Testing Institution must also be accepted by the Consultant/Engineer prior to Payment approval.

The Payment shall be made as per relevant BOQ Items.

Table 12.5 TESTING PROCEDURES FOR SPIRAL WOUND LINING: MATERIALS / FABRICATION

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
Soil/ Geotech Testing	Soil parameters for design	AS2566	As required	At every 1000m interval or change of sewer diameter	Once	Supplier to be Quality assured to ISO9001. Batch testing results to be provided for Acceptance	Independent 3 rd party Testing Facility (as part of the ISO9001 QMS)

Table 12.6 TESTING PROCEDURES FOR MSWL LINING: SAMPLE FROM PIPE COMPOSITE PRIOR TO LINING

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATION	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
A. Extruded uPVC Profile of SW LINER	Dimension	ASTM F1697-02	As required	1. Manufacturer Test Certificate 2. At nominated Testing Institution by Engineer	1. Every Spool 2. Lot	Table I ASTM F1697-02	Engineer approved Testing Institution
	Acetone Immersion Testing	ASTM F1697-02	As required	1. Manufacturer Test Certificate 2. At nominated Testing Institution by Engineer	1. Every Spool 2. Lot	Table I ASTM F1697-02	Engineer approved Testing Institution
	Virgin u PVC material/Cell classification by carrying out test for strength, tensile strength and modulus of elasticity, deflection temperature, chemical resistance flammability and base resin	ASTM D1784-99a	As required	1. Manufacturer Test Certificate 2. At nominated Testing Institution by Engineer	1. Every Spool 2. Lot	Table I ASTM D1784-99a	Engineer approved Testing Institution

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATIO N	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
	Stiffness Factor	ASTM F1697-02	As required	1.Manufacturer Test Certificate 2.At nominated Testing Institution by Engineer	1. Every Spool 2. Lot	Table I ASTM F1697-02	Engineer approved Testing Institution
	Resistance to Reagents	ASTM D 543	As required	1.Manufacturer Test Certificate 2.At nominated Testing Institution by Engineer	Lot	ASTM D 543	Engineer approved Testing Institution
B. O-Ring used in construction of liner	Dimension	ASTM D 543	As required	1.Manufacturer Test Certificate 2. At nominated Testing Institution by Engineer	Lot	ASTM D 543	Engineer approved Testing Institution
C. Two hot melt glues used in construction of liner	Resistance to Reagents	ASTM D 543	As required	1. Manufacturer Test Certificate 2. At nominated Testing Institution by Engineer	Lot	ASTM D 543	Engineer approved Testing Institution

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATIO N	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
D. Stainless Steel Gr 316 used in liner profile	Chemical test: Carbon, silicon, manganese, nickel, chromium, molybdenum, sulphur and phosphorus Mechanical Test: Tensile, Yield strength, hardness test and elongation	IS: 6911 IS:1693,1608,1500 &1501	As required	1. Manufacturer Test Certificate 2. At nominated Testing Institution by Engineer	One test per work if no change in manufacture	As per requirement of SS Gr.316	Engineer approved Testing Institution
E. Liner Pipe	Pressure and Vacuum testing	ASTM F 1697	As required	At nominated Testing Institution by Engineer	One test for every profile and diameter of sewer	ASTM F 1697	Engineer approved Testing Institution
	Tensile Testing	ASTM D 638	As required	At nominated Testing Institution by Engineer	One test for every profile and diameter of sewer	ASTM D 638	Engineer approved Testing Institution
	Abrasion Resistance	DIN: 1230 (Part 2)	As required	At nominated Testing Institution by Engineer	One test for every profile and diameter of sewer	DIN: 1230 (Part 2)	Engineer approved Testing Institution
	Impact Testing	ASTM D 265	As required	At nominated Testing Institution by Engineer	One test for every profile and diameter of sewer	ASTM D 265	Engineer approved Testing Institution
	Hardness Shore D Testing	ASTM D 2240	As required	At nominated Testing Institution by Engineer	One test for every profile and diameter of	ASTM D 2240	Engineer approved Testing Institution

					sewer		

TEST ITEM	PARAMETER/ CHARACTERISTIC	TEST METHOD	SAMPLE PREPARATIO N	REQUIREMENT	TEST FREQUENCY	QUALITY CONTROL	TEST BY
	Ex-filtration Test	EN:1610-1997	As required	Field test	As per direction of Engineer-in charge	EN: 1610- 1997 As per Clause 12.4.3.5 (i)	Engineer's approval at site
F. Grout	Cement	IS: 4031	As required	1. Manufacturer Test Certificate 2. At nominated Testing Institution by Engineer	Every 50 Tonnes or part	IS: 4031	Engineer approved Testing Institution
	Water	IS: 3025/456	As required	DJB Testing Lab.	Every Three months	IS: 3025/456	DJB Testing Lab.
	Compressive Strength	BS 4551	As required	1. Field Lab. Testing 2. At nominated Testing Institution by Engineer	1. One test for every day grouting 2. One test for every reach from one manhole to other manhole.	28 days strength not less than 3 MPa	Engineer approved Testing Institution

PART 13 - MANHOLE REHABILITATION

13.1 Scope

The Contractor shall note that all the manholes require some form of repair including plastering/epoxy coating of the walls. The Contractor is deemed to have studied the existing conditions of the manholes and included for everything else required to rehabilitate the manholes including stopping any existing infiltration flows into the manhole by chemical grouting of approved materials.

The Contractor's pricing shall include, but not limited, to cleaning, removal of debris, scrapping of weakened cement plaster and removal of dislodged bricks etc. and disposing off, the replacement of all missing bricks with new bricks, chemical grouting to stop all leaks, and etc. The bedding and benching shall be repaired and made good and finish with epoxy mortar coating up to one m above the benching.

The walls shall be plastered with 20 mm thick sulphate resistant mortar and coated with epoxy painting. Where ever the manholes tops are exposed and/ or raised the Contractor shall make provision in his pricing of this item to plaster all exposed surfaces of the manholes. When raising the manhole, the vertical access shaft shall be limited to 400 mm height only. Where the access shaft height exceeds 400 mm height, the raising of the manhole shall be achieved by raising the tapered section of the manhole as per standard DJB's drawing. Contractor shall deem to have taken this requirement into consideration in his rates.

All CI steps and any missing CI steps shall be replaced with new orange colour safety foot rest. Orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS:10910 on 12 mm dia. steel bar conforming to IS:1786 having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs.

The Manhole covers if not properly seated shall be removed and the seating is made good for the cover to sit properly. The Contractor shall be deemed to have included everything else necessary in the rates to complete the work described in the item and to prevent any storm water entry through the covers.

The Contractor shall, replace all the Manhole Cover & Frame with new SFRC Manhole cover & frame, extra heavy duty (EHD 35 grade designation), conforming to IS 12592 and return all the old CI/Covers removed from the manholes to DJB. The rates shall include for handing over such items to the appropriate stores of DJB.

13.2 Technical Requirements.

This technical specification includes, but not limited to, the requirements for internal rehabilitation of the DJB Sewerage System manholes.

The manholes typically consist of a cement rendered brick masonry circular or square shaft with a concrete neck holding a cast iron frame and lid/SFRC frame and cover. The shaft is usually narrower at the surface but some manholes continue to the surface without any

narrowing and are covered by a concrete slab. The bottom of the manhole is a mass concrete half pipe.

The scope of works at existing manholes shall include the following:

- Cleaning and preparation of the internal surfaces of the shaft
- Reinstatement of bricks where necessary
- Protective coating of lower internal brick and concrete surfaces with epoxy mortar

- Reinstatement of the remainder of the upper surfaces of the shaft including repointing of eroded mortar joints and reinstatement of cement render.
- Replacement of existing safety foot rest, frame and covers of the manholes

13.2.1 Chemical Grouting

The intent of this section is to define the properties that a sealing material must have to perform effectively in the intended application and under expected field conditions. The materials described herein also have application in the manual access sealing of sewer pipes and manholes.

It should be understood that all of the generically classified chemical sealing materials could achieve desired long-lasting results when used in the proper application and if applied properly. The knowledge and skill of the applicator has a greater effect on achieving the desired results than the specific sealing material applied.

The Contractor shall propose his method of sealing infiltration leaks in manhole for Engineer's approval.

In every case, mixing and handling of chemical sealing materials shall be in strict accordance with the manufacturer's recommendations. All chemical sealing materials used in the performance of the work specified must have the following properties and characteristics:

While being injected, the chemical sealant must be able to react/perform even in the presence of water (groundwater).

The cured material must withstand submergence in water without degradation.

The resultant sealant (grout) formation must prevent the passage of water (infiltration) through the sewer pipe joint. The sealant material, after curing, must be flexible. In place, the sealant formation should be able to withstand wet/dry cycles without adversely affecting the seal. The sealant formation must not be biodegradable. The cured sealant should be chemically stable and resistant to the concentrations of acids, alkalis, and organics found in normal sewage in Delhi (INDIA). Packaging of component material must be compatible with field storage and handling requirements. Packaging must provide for worker safety and minimize spillage during handling.

Mixing of the component materials must be compatible with field operations and should not require precise measurements of the ingredients by field personnel. Clean-up must be done without inordinate use of flammable or hazardous chemicals. Residual sealing materials must be easily removable from the sewer line to prevent reduction or blockage of the sewage flow.

13.3 Internal Inspection

General details of the typical works at manholes is shown on the Contract Drawings and described in this technical specification.

Internal dimensions shown on the drawings have been obtained from original design drawings and/or limited survey work carried out by DJB. The dimensions, geometry and details, including concrete member thicknesses, brick wall thicknesses and pipe entry and exit into the manhole have not been verified by DJB. The Contractor shall make allowances for possible discrepancies in dimensions and details arising from construction tolerances.

Allowance shall also be made for the changes to internal dimensions of the sewer from loss of concrete from gas attack. The Contractor shall be responsible for independently verifying any information provided on the drawings for the internal dimensions. Any dimensions taken from the drawings which are not independently verified shall be used at the Contractor's own risk.

Prior to commencing any rehabilitation work on each manhole the Contractor shall undertake a survey to confirm the internal dimensions and construction details at the manhole. A sketch is to be provided for each manhole which shall as a minimum show the following:

- Depth to invert
- Variation in cross section geometry with height
- Details of benching
- Location and type of safety foot rest
- Size and type of surface cover
- Size of inlet and outlet pipes
- Alignment of inlet and outlet pipes
- Materials used for construction of shaft and base

A copy of the sketch shall be forwarded to the Engineer prior to the commencement of any work on the manhole.

Following initial pressure washing of the internal surfaces of the shaft the Contractor shall undertake an internal condition assessment survey of the shaft. This shall be in the form of a schedule or by annotating the survey sketch previously provided. The condition assessment shall as a minimum indicate the following

- Condition of cover and surround
- Extent of softening or loss of render coat on internal brickwork
- Depth of mortar loss in brick joints
- Areas where surface preparation could lead to dislodgement of bricks
- Extent of gas attack on concrete surfaces.
- Condition of safety foot rest
- Location and extent of any infiltration
- Location and extent of any root ingress

The inspection and condition assessment shall be sufficiently detailed so that the Contractor is able to produce a drawing containing a developed plan of the internal surface of the manhole showing the current state of of the internal surfaces and the area over which different repair techniques will be adopted. Areas of infiltration are also to be identified in elevation. It shall also include areas where brick

mortar loss has reached a stage where there is a risk that bricks may be dislodged as part of the cleaning process. Photographs shall be taken of the major findings of the condition assessment.

The drawings shall contain a legend which denotes the various type of defects for which different repair strategies will be required. The Contractor shall forward copies of the preliminary drawings to the Engineers for review. The review shall include a joint internal inspection arranged by the Contractor with the Engineer to confirm the accuracy of the Contractor's survey.

From the condition assessment the Contractor shall produce a schedule of repairs. The schedule of repairs shall be based on the repair methods and details provided in the drawings and specification

13.4 Internal Rehabilitation Methods

13.4.1 Rehabilitation Requirements

Internal rehabilitation of the manhole consists of the following types of repairs:

1. Manhole Concrete Repairs.
2. Manhole Brick Repairs.
3. Replacement of existing metalwork items or provision of new metalwork items such as manhole frame and covers and safety foot rest.
4. Miscellaneous items such as sealing infiltration and removal of roots.

The types shall be verified by the Contractor by a detailed internal inspection and preparation of a repair schedule.

In some cases more than one repair type may apply to an area. Also cleaning and preparation of some areas may loosen bricks or cause distortion and further repairs will be required to rectify these before mortar joints can be repaired.

13.4.2 Rehabilitation Methods

The types of repairs listed in Clause 13.4.1 shall be repaired using the following

methods: Type A Manhole Concrete Repairs (Refer Clauses 13.5 & 13.8)

- Cement Render Internal Protective Coating

Type B Manhole Brick Repairs (Refer Clauses 13.5, 13.6, & 13.7)

- Epoxy Internal Protective Coating

Type C Manhole Brick Repairs (Refer Clauses 13.5, 13.7 & 13.8)

- Cement Render Internal Protective Coating

Type D Manhole Step Iron & Cover Repairs (Refer Clauses 13.6 & 13.9)

- Step iron, frame and covers and grills replacement

Type E Seal Manholes (Refer Clauses 13.10)

13.4.3 Modifications for Sewer Rehabilitation

The upper section of manhole shafts may be demolished and rebuilt to accommodate rehabilitation of the sewer by lining. The replacement shaft shall be constructed in reinforced concrete.

All work on the demolition of the shaft, excavation, and construction of the new shaft including approval, design and temporary works shall be the responsibility of the Contractor (Refer elsewhere in Technical Specification). Work associated with the demolition and reconstruction of a shaft shall not be taken as being part of the Manhole rehabilitation instead being considered as part of the lining works.

The only exception to this shall be the case where the existing manhole or cover is cracked or broken and requires replacement. In this case the new manhole cover in the rebuilt manhole will be included as a manhole repair component.

13.5 Surface Preparation

13.5.1 General

All internal concrete and brick surfaces of the manhole shall be cleaned and prepared to ensure they are suitable for the application of either epoxy mortar protective coating or cement based render.

13.5.2 Detailed Inspection

Prior to the commencement of any internal repairs, the Contractor shall be responsible for undertaking a detailed internal inspection of the manhole in accordance with Clause 13.3.

13.5.3 Preliminary Cleaning of Concrete Surfaces

Preliminary cleaning of the existing concrete and brick surfaces shall be carried out by high pressure water washing to remove surface contaminants, loose or softened cement render, mortar in softened joints and concrete softened by acid attack.

Precautionary measures shall be adopted by the Contractor at locations where bricks are loose or may be dislodged by the cleaning process or joint preparation process. This shall include, where necessary, the temporary removal and storage of bricks for later reinstatement.

All deposits of oil or grease shall be removed by a solvent or alkaline cleaner. Hand tools or light percussive tools shall be used where necessary to remove deposits which have accumulated at points of infiltration.

13.5.4 Surface Preparation

The Contractor shall thoroughly clean the existing concrete, mortared brick and corroded steel surfaces to prepare them for application of the protective coating system or cement render. The selection of the cleaning method shall be the Contractor's responsibility.

Cleaning of the concrete shall be sufficient to remove all loose or softened material to ensure the prepared surface comprises of exposed aggregate and un attacked concrete. This shall where necessary include the use of hand held percussive tools such as "needle guns". If directed by the Engineer, the Contractor shall spray on phenolphthalein to confirm the prepared surface has an alkalinity consistent with sound concrete. This should be applied immediately after cleaning. Fresh surfaces may need to be exposed if there is any delay between cleaning and application of the phenolphthalein. Correctly prepared surfaces should turn pink.

Brick surfaces shall be cleaned to remove all loose and softened render. In areas where an epoxy mortar is to be applied all cement render shall be removed during surface preparation irrespective of its condition. In areas where render is to be reapplied existing render that has not softened or experienced any significant degradation may be retained. Edges of retained rendered shall be saw cut for the full depth of the render coating to define the repair edges and avoid feathering.

In areas where epoxy is to be applied following initial cleaning, the brick joints shall be routed to remove all softened and attacked mortar in the brick joints. High pressure jetting shall only be used where sufficient control can be provided so as to remove all contaminated mortar without unnecessary removal of sound mortar or causing bricks to loosen. The depth of mortar removed shall be sufficient to ensure minimum protective coating thicknesses are able to be applied in the joints (10 mm deep for epoxy mortars).

In areas where render is to be applied cleaning only needs to be sufficient to remove any loose or deteriorated mortar. Joints do not require routing.

Details of methods and equipment to be used for the cleaning and preparation of brick joints and the intended precautionary procedures for potential dislodgement of bricks shall be forwarded to the Engineer prior to the commencement of work. If requested by the Engineer trials shall be undertaken to demonstrate the suitability and effectiveness of the Contractor's methods and equipment.

Steelwork and ends of reinforcement which are to be retained shall be cleaned to bright metal.

One core sample 100 mm long shall be taken of the prepared concrete surface. These shall be forwarded to the Engineer for inspection and independent testing.

13.5.5 Abrasive Blast Cleaning

Abrasive blast cleaning may be used to assist in surface preparation of concrete surfaces. The Contractor shall give the Engineer notice of the intention to use abrasive blast cleaning not less than seven (7) days prior to commencement.

The Contractor shall furnish to the Engineer a sample of the abrasive which is to be used for the works. The use of silica sand in dry abrasive blast cleaning is prohibited. The grit shall be dust free, dried, screened and graded. Abrasives shall be such so as not to contaminate the surface which is being blast cleaned. The abrasives shall be salt free. Sands containing limonite shall not be used. Abrasive grit shall not be reused.

Used grit shall be collected and disposed of by the Contractor.

All compressed air used in blast cleaning, and blowing down after cleaning, shall be free from oil and moisture. Suitable air and moisture traps shall be installed in the compressed air system as required.

Unless precautions are taken to the satisfaction of the Engineer, no blast cleaning shall be carried out during the application of the protective system or when the surface of the protective system has not hardened sufficiently not to be damaged or contaminated as a result of blast cleaning.

13.5.6 Local Breakout Work

The Contractor shall locally breakout existing concrete as required on drawing to both define the extent and form transitions for the internal repairs. This shall include the removal of sound concrete at corners as necessary to form the required minimum radii nominated on the drawings.

Local breakout shall also be carried out where required around embedded steel items so they can be cut off, and coated with an epoxy primer. The extent of the breakout shall be sufficient to form a recess around the bar so it can be removed in accordance with Clauses 13.5.9 and 13.9.1.

Break out work shall be undertaken using light percussive equipment.

Horizontal limits of transitions at the bottom of the protective coating shall first be established using a saw cut with a minimum depth of 10 mm. Breakout of concrete is then to proceed using light percussive equipment to trim the concrete to the required dimensions indicated on the drawings.

13.5.7 Deep Holes

Any localised holes where the total depth of epoxy mortar layers will exceed 50 mm may be filled following surface cleaning with an approved cementitious or epoxy mortar based filler. The material used shall be compatible with the later applied protective coating system.

Surfaces of the hole shall be primed to ensure bond to the existing concrete and the filler in accordance with the manufacturer's recommendations. The filler material shall be a dry pack material and shall be rammed into place to eliminate any voids within the filling material. The surface of the filler is to be struck flush with the cleaned concrete surface adjacent to the hole. The finished surface texture shall be suitable to ensure bond with the later applied protective coating system.

13.5.8 New and Saw Cut Surfaces

Any smooth surfaces formed by concrete sawing and any new internal concrete surfaces shall be roughened by scrubbing, early age water blasting or similar techniques. The surface shall be roughened to obtain a minimum average surface projection of 3 mm.

13.5.9 Treatment of Steel Work including Reinforcement

On completion of cleaning of the internal surfaces, all exposed reinforcement and steelwork shall be treated prior to covering with the protective coating system.

Any reinforcement left protruding from the surface shall be cut off at the surface. A recess shall then be locally broken out around the stub of the bar so that the end of the bar can be burnt off or cut off at least 25 mm below the cleaned concrete surface.

The exposed surfaces of the bar shall then be coated with a suitable corrosion resistant primer and the recess remaining filled with an epoxy mortar. The primer shall be compatible with the epoxy mortar and epoxy resin used for the protective coating.

The primer and epoxy mortar which are used shall be one of those given, or shall be an approved equivalent product, in accordance with Clause 13.7.

The primer shall be applied within four (4) hours of cleaning to avoid surface contamination and flash rusting.

13.5.10 Control of Infiltration

Major sources of infiltration through the walls of the manhole shall be sealed as required. It is not expected that the Contractor will be able to eliminate infiltration altogether and some brick joints and concrete interfaces may still be subject to constant wetting from seepage. The Contractor shall be

responsible in such cases to concentrate or locally reduce flows so joint repairs and the protective coating system may be successfully completed.

The Contractor shall be responsible for the choice and development of the method used to control infiltration for the given purpose. Methods may include procedures such as chemical grouting, localised plugging with rapid setting mortar or the installation of weep pipes to concentrate inflow.

The Contractor's procedures shall:

- Take account of the likely increase in infiltration during and after wet weather.
- Minimise damage to the internal brick surface
- Be compatible with repair methods and materials proposed for the filling of the mortar joints
- Use non-corrodible materials which are suitable for continuous exposure in a live sewer environment for fixtures left in place on completion of repairs (e.g. weep pipes)
- Be suitable for work site conditions

Details of the methods used by the Contractor to control infiltration forwarded to the Engineer for review prior to commencement of any work on surface preparation.

13.5.11 Root Removal

Any roots found on the inside of the manhole shall be cut out and removed. The cut ends of the roots are to be coated with a root inhibitor or root foaming agent to reduce root regrowth.

13.6 Epoxy Mortar Internal Protective Coating

13.6.1 General

The protective coating system shall consist of a high build epoxy resin mortar which may comprise one or more of the following:

- (i) Bonding bridge or surface primer
- (ii) Epoxy mortar layer
- (iii) Multi-layered epoxy coating

13.6.2 Extent

The epoxy mortar coating shall be applied to all internal surfaces of the lower part of the manholes up to 1m height above the benching and epoxy painting on cement plastered surface up to the top of manholes as shown on the Contract drawings and described in detail elsewhere in this Technical Specification.

Protective coating is applied to the required internal surfaces of the concrete and brickwork with a minimum depth of the protective coating of 10mm. The thickness of the coating is to

be thickened at corners, terminations and junctions with the end of the lining to form smooth transitions to the dimensions shown on the Contract Drawings.

Where the epoxy mortar is applied over joints where the depth of mortar loss following cleaning exceeds the minimum required to anchor the coating the difference may be made up by either increasing the epoxy mortar filling in the joint or alternatively partially filling the joint with a cement based mortar to 10mm below the internal face of the brickwork.

13.6.3 Thickness of Epoxy Mortar Layer

Unless otherwise indicated in the Contract documents or on the drawings, the minimum thickness of the epoxy mortar protective coating shall be 10 mm generally. The protective coating is to be anchored a minimum of 10mm into the brick joints.

The thickness of the epoxy mortar coating shall be increased where necessary to suit the geometry requirements shown on the drawings, to maintain minimum covers to retained steelwork, or to satisfy surface tolerance requirements in Clause 13.6.11.

13.6.4 Alternatives

The following is a range of products which are acceptable for use for the internal protection system subject to the supplier's willingness to provide a warranty in accordance with Clause 13.6.13.

	A	B	C	D
Company Name	MC Bauchemie	BASF	SIKA	FOSROC
Main Coating	Ombran MHP	BASF MASTER PROTECT1890	Sikadur 41	Nitomortar S
Bonding Coat	Ombran HB	BASF MASTER EMACO 102	Sikadur 32	Nitobond EP
Epoxy Paint	MC Dur 1700/1500	BASF MASTER PROTECT1812	Inertol Poxitar	Nitocote EP140

Methods which require longer construction time should be avoided.

Methods/Products which have shorter application time should be preferred.

All above mentioned products/systems shall satisfy the following minimum requirements:

- All products must be supplied by the one supplier and must be compatible with each other.
- The products must have previously been installed in a live sewer environment in tropical climate countries which is regularly exposed to H₂S levels exceeding 20 ppm in acid environment of pH level up to 1.

- Suitable for application in the work site conditions described in this specification.
- High Abrasion, Impact & Highly Sulphate Resistance.
- Suitable for application within a confined space (i.e. solvent less).
- Chemical resistance in a sewer environment (Refer Clause 5.5)

- Impermeable to water.
- Ability to be applied without pinholes or other defects.

Guaranteed long term durability (Refer Clause 13.6.13)

13.6.5 Chemical Resistance

Chemical resistance shall include the satisfactory performance of the coating in the presence of traces of vegetable oil, gasoline, kerosene, detergent, soap, ferrous chloride and dilute concentrations of nitric, hydrochloric and phosphoric acid. The coating system shall also be resistance to gases in the sewer atmosphere including any possible condensate solutions from these gases.

In particular the system shall be chemically resistant to high concentrations of sulphuric acid resulting from bacterial conversion of H_2S .

13.6.6 Approved Applicators

Application of the protective coating system shall only be carried out by applicators that are approved and endorsed by the supplier of the protective coating system.

At least seven (7) days prior to the commencement of any application work, the Contractor shall provide written advice to the Engineer nominating the subcontractor who will be applying the protective coating system. This written advice shall include a history of the subcontractor's experience both in working under similar conditions and with the same coating products. A copy of written correspondence from the supplier shall be attached to the Contractor's advice, confirming the subcontractor is approved by the supplier for the application of the supplier's system.

13.6.7 Specification

Prior to the commencement of any application work the Contractor shall provide a copy of a purpose written specification from the supplier which details the requirements for the supply, storage, mixing, equipment, application, curing, inspection, testing and repair of defects for the protective coating system.

The specification must include details of requirements which are peculiar to these works including, but not necessarily limited to, the following:

- minimum and maximum curing times between layers and between different coating components
- action to be taken in the event of delays between layers or different components
- surface cleaning between layers or components
- protective measures between layers or components

- Procedures to be followed after submergence during diurnal or wet weather flows.
- minimum and maximum application temperatures
- Minimum and maximum levels of surface dampness or wetness.
- Inspection and testing requirements.

13.6.8 Control, Handling and Storage

All protective coating materials shall be standard commercial materials and shall be brought to the site in their original unopened containers bearing the manufacturer's label, batch number, instructions for application and date of expiry where applicable.

All coating materials shall be stored under conditions which would not lead to deterioration of the material.

The Contractor shall keep a record of the batch numbers of the coating materials on the works.

13.6.9 Application

Work on the application of the coating shall be carried out by the approved subcontractor strictly in accordance with the supplier's purpose written specification.

Prior to the application of the protective coating system on the internal surfaces, the system shall be trailed on two test areas prepared in accordance with technical specifications to confirm the viability of the proposed system and the intended construction method. If the test area applications are considered unsatisfactory by the Engineer, further areas shall be prepared and the protective system applied until the Engineer gives approval to the Contractor for the Contractor's procedures. Unsatisfactory test areas shall be removed by the Contractor. Amendments shall be made to the supplier's specification where necessary to match the materials and procedures for the approved test areas.

13.6.10 Supplier Supervision

A representative from the Contractor's protective coating supplier shall be on site full-time during the application of the various components of the system on the test areas. The Contractor shall also ensure that this representative is also on site for a sufficient time or times during the internal repair work to witness and supervise the applicator's work. On completion of the protective coating system, the Contractor shall forward a letter from the supplier certifying that the supplier has witnessed the application of the system and is satisfied the work has been completed in accordance with the specification. Failure to provide a letter from the supplier shall be considered as grounds for withholding Progress Payments.

13.6.11 Surface Finish

The outside surface of the epoxy mortar shall have a surface finish with abrupt irregularities not exceeding 1 mm abrupt irregularities exceeding this value shall be removed prior to the application of the epoxy coating. The Contractor shall be responsible for developing a method to remove abrupt irregularities. This may include physical means such as rubbing or mechanical grinding. Alternatively additional epoxy mortar could be placed to level the area. Trials shall be carried out to verify the viability of the Contractor's proposed method to the satisfaction of the Engineer prior to its use.

The finished surface for the epoxy mortar does not have to be exactly vertical or horizontal and may match, to a limited extent, the geometry of the cleaned deteriorated face of the original concrete below. The general limit to which this applies to most surfaces is that

gradual irregularities in the surface shall not exceed 10 mm when measured against a 1 m straight edge.

The surface finish of the epoxy coating shall be smooth to touch by hand. Any area of the coating with mechanical damage, abrupt irregularities, or showing imperfections such as blisters, runs or sags shall be repaired by the Contractor by rubbing down the defect and/or recoating or other repair methods approved by the Engineer.

The quality of the surface finish of the epoxy coating on the test areas shall form the basis for the acceptance or rejection of the completed works.

13.6.12 Inspection and Testing

The Contractor shall be responsible for ensuring that inspection and testing of the protective coating system is carried out in accordance with the supplier's written specification as approved by the Engineer.

The Contractor's quality control system shall include inspection and testing of the protective coating system.

Inspection and testing shall include, but not be limited to, the following:

- Visual inspection of surface preparations before application of each layer.
- Measurement of ambient and substrate temperature and relative humidity immediately prior to, and at regular intervals during, coating application.
- Collection of cube samples for each batch of two or more part component layer following mixing and measurement of set times and Barcol hardness
- Measurement of layer thicknesses of epoxy mortar.
- Measurement of wet film thicknesses of the epoxy coating by a wheel gauge.
- Core samples 50 mm in diameter through epoxy mortar at rate of two for every manhole (one for brick wall and one for concrete base).

The completeness of the epoxy coating shall be monitored by use of different colours for each coat.

The location for the core samples will be nominated by the Engineer upon request by the Contractor. Core holes shall be filled with epoxy mortar prior to the application of the epoxy coating.

13.6.13 Warranty

The Contractor shall be responsible for arranging the provision of a written warranty from the protective coating system supplier stating that the period over which the material, workmanship and installation specifically provided or performed under this Contract shall be free from defects for a period of 15 years. The warranty period shall commence from the projected Date of Practical Completion of the Works at the time of completion of the internal repairs.

Such written warranty shall provide for the prompt, total and complete repair and/or replacement of the defect or defective area of the coating system to the satisfaction of the Principal, upon the written notification by the Principal of the specific non-conformance of the protective coating system or application with the Contract Documents. Such defects or non-conformance shall be repaired or replaced immediately upon notification from the Principal, and at no cost to the Principal.

The written warranty shall be forwarded to the Engineer within fourteen days (14) days of the completion of the internal repairs. Failure to provide a written warranty shall be considered grounds for both delaying the award of Practical Completion and withholding of Progress Payments and/or Security Deposit.

13.6.14 Trial Applications

The Contractor shall prepare two areas and carry out trials using the proposed coating system. These trials shall be completed to the satisfaction of the Engineer prior to the commencement of any work on the internal repairs proper.

The first trial shall be undertaken on a 1 m x 1 m area of an access chamber brick wall in a location of significant mortar loss between bricks where infiltration is present. The second shall be carried out over a 1 m vertical strip of the concrete benching from the base of the manhole wall to the bottom horizontal termination. Further trials shall be undertaken and witnessed where separate crews are set up to work multiple shifts on multiple locations.

The trials shall be carried out strictly in accordance with the Contract Documents and the purpose written specification from the supplier. Should it become apparent during the trials that adjustments are required to the materials, equipment or work methods the Contractor shall provide written advice to the Engineer detailing the adjustment and giving reasons as to why it is necessary?

The trials shall be carried out by the same persons from the applicator, Contractor and/or Subcontractor who will be undertaking the internal repairs. A list of the names of the persons who took part in the repairs shall be forwarded to the Engineer on completion of the trials. Any other persons not on the list shall first carry out a trial application in accordance with this clause prior to undertaking any work on the internal repairs proper.

The Contractor is responsible for ensuring that a representative from the supplier of the protective coating system inspects the substrate surface prior to commencement of work on the coating system. The Contractor shall also arrange that a representative from the supplier is on site full time during any application work on the trial areas.

Tests in accordance with the requirements for a final repair shall be carried out on the trial repaired areas. These tests could include up to two core samples for each area.

The Contractor's Quality System for the internal repairs shall be implemented in full for the trials unless otherwise requested in writing by the Contractor and agreed by the Engineer.

Approval of the trial applications shall not relieve the Contractor of the responsibility for ensuring that the proposed materials, equipment and procedures will be satisfactory to complete the work on the internal repairs in accordance with the requirements of the Contract.

Providing the trials are satisfactory the test areas may be incorporated as part of the total repair work. Any trial area deemed to be unsatisfactory shall be removed by the Contractor.

13.7 Brickwork Repairs

13.7.1 Scope of Brickwork Repairs

The scope of the work for the repair to the brickwork joints shall include the following: Detailed inspection and preparation of schedule of brickwork repair work (Clause 13.3).

- Removal of soft and deteriorated mortar in joints.
- Removal of loose or softened cement renders.

- Cleaning and priming of brick surfaces and mortar joint interfaces
- Measures to reduce or control infiltration and sand ingress in addition to the control of major infiltration as given in Clause 13.1
- Replacement of any bricks dislodged during cleaning
- Filling of deep joints with a cement based repair materials
- Saw cutting of edges of existing intact cement render to avoid feathered edges and transitions.

The supply and application of the cement render shall be carried out in accordance with Clause 13.13.

13.7.2 Joint Repair Methods

The Contractor shall be responsible for the choice of equipment and methods used to deliver and place repair mortars in the cleaned and prepared brick joints. Prior to the commencement of repair work inside the manholes the Contractor shall develop a repair procedure which provides details of the following:

- Procedures, equipment and materials used for the control of minor infiltration (Refer Clause 13.5.10)
- Equipment and procedures used for joint preparation.
- Equipment used to mix and deliver joint repair materials to site of repair.
- Control, handling and storage requirements for pre-batched materials.
- Purpose written specification for mixing and placement of joint repair materials.

Quality control procedures (eg testing methods and sampling frequency)

Placement methods may include hand pointing, pressure pointing or other methods developed by the Contractor. Whichever method is intended to be used by the Contractor, it must ensure that the joint repair material is placed without voids to the full depth of the prepared joints. The repair materials shall bond to the bricks on either side of the joint and the existing mortar at the end of the prepared joint with or without the addition of a primer.

13.7.3 Brick Replacement or Reinstatement

The Contractor shall reinstate any bricks which are missing or come loose during cleaning and joint preparation.

Any bricks which are removed because they are loose, or which come loose during cleaning shall, be collected and stored by the Contractor and used for the reinstatement work. If replacement bricks are required they shall be clay fired bricks which are suitable for salt spray areas. Bricks shall be selected to match the colour and texture of the bricks used to construct the sewer.

The surface onto which the bricks are to be reinstated shall be thoroughly cleaned to remove the existing mortar. The surface shall then be primed and bedded with a high build epoxy mortar. The rear brick surface shall be primed with a bonding bridge compatible with the epoxy mortar and the brick tamped into position so that the inside face of the brick matches the adjacent internal profile of the sewer

maintaining even joint widths between the bricks. Joints between bricks shall then be filled using the same procedures and materials as the brick joints elsewhere.

The actual location of missing or loose bricks shall be mapped by the Contractor in terms of location and number during the detailed internal inspection to determine the schedule of repair work.

13.8 Cement Render

A cement render coating shall be applied over all brick and concrete surfaces of the manhole above the benching not covered with an epoxy mortar coating.

The cement render coating shall be applied following surface preparation in accordance with Clause 13.4, and brick work repairs and reinstatement of mortar joints. Where mortar joint loss extends to less than 10mm below the internal face of the bricks the joint filling may be included as part of the rendering process.

Where required action shall be taken to control infiltration to ensure an adequate bond between the brick wall and render.

Prior to the application of the render action shall be taken to ensure an adequate bond is obtained between the brickwork and render. This may include one or more of the following:

- Action to control infiltration and seepage
- Moisten dry areas of the wall 48 hours ahead of rendering
- Application of a scratch or bond coat

Application of a bonding agent

The render shall be comprised of sand and cement with a ratio of no more than 3 parts sand to 1 part cement with water and plasticiser added to obtain the correct consistency for render application. Hydrated lime shall not be added to the mix. The cement render shall be covered by a cement floating coat in accordance with the Standard Drawings.

The render shall be applied to a nominal thickness of 20 mm. The render is to be applied by hand. Spray techniques may be considered acceptable providing the Contractor can demonstrate a uniform thickness can be obtained and problems will not be encountered such as overspray at the join with the epoxy mortar or original intact mortar nor where there are changes in geometry of the wall.

The surface finish of the render shall be free from defects and shall be smooth and even matching the geometry of the walls below. The render shall be moist cured for 7 days.

13.9 Replacement of Safety Foot Rest

All CI steps and any missing CI steps shall be replaced with new orange colour safety foot rest. Orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per

IS:10910 on 12 mm dia. steel bar conforming to IS:1786 having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs.

Safety foot rest shall be removed before the application of the epoxy mortar protective coating or rendering. New safety foot rest shall be installed following completion of the protection system. The

safety foot rest shall be embedded with an epoxy with care taken to ensure no voids are left around the insert through the protective coating.

Details of size, embedment and spacing of safety foot rest shall be in accordance with standards.

13.10 Control of Infiltration

The Contractor shall be responsible for adopting measures to reduce and control infiltration. All major sources of infiltration are to be eliminated however minor seepage through the walls and joints may be allowed providing these sources can be adequately controlled in the short term during application of the epoxy protective coating or cement render.

The Contractor shall be responsible to developing methods to seal all major points of infiltration. Methods may include drilling and chemical injection of polyurethane grouts, chemical sealing materials forced into joints and cracks or packaged non-shrink hydraulic cements used to plug holes or cracks or mortar joints. Materials used shall be suitable for wastewater applications and designed specifically for repair work of brick masonry and concrete subject to both internal and external hydrostatic pressure. A sand cement grout will not be allowed.

Jetting or driving pipes for external grouting shall not be used unless specifically applicable to a fault and approved by the Engineer.

Details of methods to be used are to be submitted to the Engineer for review prior to use. The first application of any specific product shall be considered as a trial and shall be witnessed by the Engineer.

13.11 Restoration

All surfaces, services and/or improvements which are disturbed, destroyed or damaged by work under the Contract shall be replaced, repaired, reinstated or otherwise restored, as near as practicable to their pre-existing condition. Improvements include trees, shrubs, gardens, retaining walls, fences and all other structures.

When the backfilling of an excavation in pavement has been completed, the pavement shall be immediately restored to a trafficable and safe condition.

The Contractor shall arrange for final restoration of the road and footpath pavement and sub-base to be performed to the standard required by the relevant authority at the expense of the Contractor.

13.12 Measurement and Payment

Payment will be made for Complying with all requirements as described in Part 13 of the Technical Specification.

The Contractor shall note that all the manholes require some form of repair including plastering/epoxy coating of the walls. The Contractor is deemed to have studied the existing

conditions of the manholes and included for everything else required to rehabilitate the manholes including stopping any existing infiltration flows into the manhole by chemical grouting of approved materials. The Contractor's pricing shall include, but not limited, to cleaning, removal of debris, scraping and removal of cement plaster and removal of dislodged bricks etc. and disposing off, the replacement of all missing bricks with new bricks, chemical grouting to stop all leaks, and etc. From benching to height of 1m towards MH top shall be repaired and made good and finish with epoxy coating. The walls shall be plastered with 20 mm thick sulphate resistant mortar (1:3). Where ever the manholes tops are exposed and/ or raised the Contractor shall make provision in his pricing of this item to plaster all exposed surfaces of the manholes. When

raising the manhole, the vertical access shaft shall be limited to 400 mm height only. Where the access shaft height exceeds 400mm height, the raising of the manhole shall be achieved by raising the tapered section of the manhole as per standard DJB's drawing. Contractor shall deem to have taken this requirement into consideration in his rates.

All foot rest shall be replaced with new orange colour safety foot rest. Orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS:10910 on 12 mm dia. steel bar conforming to IS:1786 having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs. The foot rest shall be as per item 19.16 of CPWD/DSR2014. All manholes frame and cover shall be removed and return all the old frames and covers removed from the manholes to DJB for reuse. The rates shall include for handing over such items to the appropriate stores of DJB. The Contractor shall, provide and replace all the manhole cover & frame with new SFRC Manhole cover & frame, extra heavy duty (EHD 35 grade designation), conforming to IS 12592. The Contractor shall be deemed to have included everything else necessary including redoing the seating for the frames and covers in the rates to complete the work described in the item and to prevent any storm water entry through the covers.

The Payment shall be made as per relevant BOQ Items

PART 14 - NEW MANHOLE CONSTRUCTION AND OTHER CONSTRUCTION WORK

14.1 General Requirement

14.1.1 Material

The term "materials" shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and plant of every kind to be supplied by the Contractor for in Delhi Jal Board in the Works.

Except as may be otherwise specified for particular parts of the Works the provisions of clauses in "Materials and Workmanship" shall apply to materials and workmanship for any part of the Works.

All materials shall be new and of the kinds and qualities described in the Contract and shall be at least equal to approved samples.

As soon as the practicable after receiving the order to commence the Works the Contractor shall inform the Engineer of the names of the suppliers from whom he proposes to obtain any materials but he shall not place any order without the approval submitted and satisfactorily tested. The Contractor shall thereafter keep the Engineer informed of orders for and delivery dates of all materials.

Materials shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination.

14.1.2 Samples and Tests of Materials

The Contractor shall submit samples of such materials as may be required by the Engineer and shall carry out the specified tests directed by the Engineer at the Site, at the supplier's premises or at a laboratory approved by the Engineer. Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Engineer.

The Contractor shall give the Engineer at least 3 days' notice in writing of date on which any of the materials will be ready for testing or inspection at the supplier's premises or preparation of samples on site (such as inversions or cutting of samples). The Engineer shall attend the preparation of samples and testing of samples at the approved Laboratory.

Approval by the Engineer as to the placing of orders for materials or as to samples or tests shall not prejudice and of the Engineer's powers under the contract.

The provisions of this clause shall also apply to materials supplied under any nominated sub-contract.

14.1.3 Standards

Materials and workmanship shall comply with the relevant Indian Standards (with up to date amendments) current at the thirty-first day of December of the year preceding the Bid Date, unless a more recent amendment is specified hereinafter, or with the requirements of any other authoritative standard approved by the Engineer which shall be no less exacting in the opinion of the Engineer than the corresponding standard quoted herein.

Where the relevant standard provided for the furnishing of a certificate to the purchaser, at his request, stating that the materials supplied comply in all respects with the standard, the Contractor shall obtain the certificate and forward it to the Engineer.

If no standard is indicated, the relevant Indian Standard, if any, shall apply. Indian Standards are published by:-

Bureau of Indian Standards
Manak Bhavan
9, Bahadur Shah Zafar Marg
New Delhi - 110 002

14.2 Earth Works

14.2.1 Applicable Codes

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to:

IS – 783 - Code of practice for laying concrete pipes.

IS - 1200 - Method of Measurement of Building works
(Part I to Part XXV)

IS – 3764 - Safety Code for Excavation

work IS – 2720 Part-II - Determination of Water

Content

Part-VII - Determination of Water Content - Dry Density Relation Using
Light Compaction.

Part-XXVIII - Determination of Dry Density of Soils, in place, by the Sand
Replacement Method

Part-XXIX - Determination of Dry Density of Soils, in place by the Core Cutter

Method Part-XXXI - Field Determination of California Bearing Ratio

14.2.2 Earthwork general

Earth work shall be carried out as per CPWD specifications.

14.3. Concrete and Allied Works

14.3.1 Scope

This specification covers the general requirements for concrete to be used on jobs on-site production facilities including requirements in regard to the quality, handling storage o

ingredients, proportioning, batching, mixing and testing of concrete and also requirements in regard to the quality, storage, bending and fixing of reinforcement. This also covers the transportation of concrete from the mixer to the place of the final deposit and the placing, curing, protecting, repairing and furnishing of concrete.

14.3.2 Applicable Codes and Specifications

The following specifications, 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.

14.3.3 Material

I.S. 269	Specification for ordinary and low heat Portland cement
I.S. 455	Specification for Portland slag cement.
I.S.12330-1988	Specification for Sulphate resisting Portland cements
I.S. 1489	Specification for Portland- pozzolana cement
I.S. 4031	Methods of physical tests for hydraulic cement
I.S. 650	Specification for standard sand used for testing of cement.
I.S.488	Modular extruded burnt fly ash clay Sewer bricks.
I.S. 4860	Acid resistance bricks for Industrial effluent (SEWAGE)
I.S. 383	Specifications for coarse and fine aggregates from natural sources for concrete.
I.S. 2386	(Part I to VIII) Methods of test for aggregates for concrete.
I.S. 516	Method of test for strength of concrete
I.S. 226	Specification for structural steel (standard Quality)
I.S. 1199	Method sampling and analysis of concrete
I.S. 3025	Methods of sampling and test (physical and chemical) for water used in industry
I.S. 432	Specification for mild steel and medium tensile steel (Parts I & II) bars and hard drawn steel wire for concrete reinforcement
I.S. 1566 reinforcement	Specification for hard drawn steel wire fabric for concrete
I.S. 4990	Specification for plywood for concrete shuttering work
I.S. 2645	Specification for integral cement waterproofing compounds
B.S. 4461	Cold worked steel bars for the reinforcement of concrete.
I.S. 10262	Recommended guidelines for concrete mix design
S.P. 23	Handbooks on Concrete Mix

I.S. 458

Specification for concrete pipes

I.S. 1786

Cold worked steel high strength deformed bars for concrete reinforcement.

14.3.4 Equipment

I.S. 1791	Specification for batch type concrete mixers
I.S. 2438	Specification for roller pan mixer
I.S. 2505	Specification for general requirements for concrete vibrators, immersion type
I.S. 2506	Specification for screed board concrete vibrators
I.S. 2514	Specification for concrete vibrating tables
I.S. 3366	Specification for pan vibrators
I.S. 4656	Specification for form vibrators concrete
I.S. 2722	Specifications for portable swing weigh batchers for concrete (single and double bucket type).
I.S. 2750	Specification for steel scaffoldings

14.3.5 Codes of Practice

I.S. 456	Code of practice for plain and reinforced concrete.
I.S. 1343	Code of practice for pre-stressed concrete.
I.S. 457	Code of practice for general construction.
I.S. 3370	Code of practice for concrete structures (Parts I to IV) for storage of liquids
I.S. 3935	Code of practice for composite construction.
I.S. 3201	Criteria for design and construction of precast concrete trusses
I.S. 2751	Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
I.S. 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
I.S. 3558	Code of practice for use of immersion vibrators or consolidating concrete.
I.S. 3414	Code of practice for design and installation of joints in buildings. (Parts I & II)
IS4014	Code of practice for steel tubular scaffolding (Parts I to II)

I.S. 2751

Code of practice for laying insitu cements concrete flooring.

14.3.6 Construction Safety

S. 3696 Safety code for scaffolds and ladders. (Parts I & II)

14.3.7 Measurement

I.S. 1020 (Parts I to XXV) Method of measurement of building works

In the event that state, city or other government bodies as well as IBRD have requirements more stringent than those set forth in this specification, such requirements shall be considered part of this specification and shall supersede this specification where applicable.

14.4 General

The quality of materials and method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise, shall conform to the applicable portions of this specification.

Engineer shall have the right to inspect the source/s of material/s, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Engineer's approval obtained, prior to starting of concrete work.

14.5 Materials for concrete

The ingredients to be used in the manufacture of concrete shall consist solely of Portland cement, clean sand, natural coarse aggregate, clean water, and admixtures, if specifically called for on drawings or specifications, or conditions at site warranting the use of it.

14.6 Cement

The cement for concrete work in sub-structures and structures below high tide level of creek directly exposed to join contact with saline water or soil containing high sulphate & chlorides, shall be Sulphate Resisting Portland Cement conforming to IS: 12330.

In all other cases, unless otherwise specified in the Bill of quantities or called for by Engineer, ordinary Portland cement in 50 kg. Bags shall be used. The use of bulk cement will be permitted only with the approval of Engineer. Changing of brands or type of cement within the same structure shall be avoided as far as possible.

A certified report attesting to the conformance of the cement to I.S. specifications by the cement manufacturer's chemist shall be furnished to Engineer, at least seven days prior to use in the works.

Contractor will have to make his own arrangements for the procurement and storage of adequate quantity of cement. If supplies are arranged by Corporate cement will be issued in quantities to cover work requirements of one month or more, as deemed fit by the Engineer and it will be the responsibility of the contractor to ensure adequate and proper storage. Cement in bulk may be stored in bins or silos which will provide complete protection from dampness, contamination and minimise caking and false set. Cement bags shall be stored in a

dry enclosed shed (storage under tarpaulins will not be permitted), well away from the outer wall and insulated from the floor to avoid contact with moisture from ground and so arranged as to provide ready access.

Damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site. The storage bins and storage. Not more than 12 bags shall be stacked in any tier. The storage

arrangement shall be approved by the Engineer. Consignments of cement shall be stored as received and shall be consumed in the order of their delivery.

Cement held in storage for a period of ninety (90) days or longer shall be tested. Should at any time Engineer have reasons to consider that any cement is defective, then irrespective of its origin, date of manufacture and/or manufacturer's test certificate, such cement shall be tested immediately at Contractor's cost at any approved test laboratory and until the results of such tests are found satisfactory, it shall not be used in any work? The contractor shall not be entitled to any claim of any nature on this account.

14.7 Aggregates

Aggregate" in general designates both fine and coarse inert materials used in the manufacture of concrete.

Fine Aggregate" is aggregate most of which passes through 4.75 mm IS

sieve. Coarse Aggregate" is aggregate most of which is retained on 4.75

mm IS sieve.

All fine and coarse aggregates proposed for use in the work shall be subject to the Engineer's approval and after specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of the Engineer.

All fine and coarse aggregates where concrete is subject to temperatures higher than 176°C shall be limestone aggregates and calcareous sands or slag. Such requirements, if any, will be specified in the Bill of Quantity.

Aggregates shall, except as noted above, consist of natural sands, crushed stone and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, durable against weathering, of limited porosity and free from deleterious materials that may cause corrosion of the reinforcement or may impair the strength and/or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the "mix design" and preliminary tests on concrete specified later.

14.8 Sampling and Testing

Samples of the aggregates for mix design and determination of suitability shall be taken under the supervision of the Engineer and delivery to the laboratory, well in advance of the Scheduled placing of concrete. Records of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to the Engineer in advance of the work for use in determining aggregate suitability. These tests shall also be done periodically on samples of material actually being used in concreting during course of concreting operations, as directed by the Engineer. The costs of all such tests, sampling, etc., shall be borne by Contractor.

14.9 Storage of Aggregates

All coarse and fine aggregates shall be stacked separately in stock piles in the material yard near the work site in bins properly constructed to avoid inter mixing of different aggregates, contamination with foreign material and earth during storage and while heaping the materials shall be avoided. The aggregate must be of specified quality not only at the time of receiving at site but more so at the time of loading into mixer. Rakers shall be used for lifting the coarse aggregates from bins or stock piles. Coarse aggregate shall be piled in layers not exceeding 1.20 metres in height to prevent coning or segregation.

Each layer shall cover the entire area of the stock pile before succeeding layers are started. Aggregates that have become segregated shall be rejected. Rejected material after remixing may be accepted, if subsequent tests demonstrate conformance with required gradation.

14.10 Specific Gravity

Aggregates having a specific gravity below 2.6 (saturated surface dry basis) shall not be used without special permission of the Engineer.

14.11 Fine Aggregate

Fine aggregate except as noted above, and for other than light weight concrete shall consist of natural or crushed sand conforming to I.S. 383. Sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, alkali, organic matter, mica, salt or other deleterious substances, which can be injurious to the setting qualities/strength/durability of concrete.

14.12 Machine-made Sand

Machine-made sand will be acceptable, provided the constituent rock-gravel composition shall be sound, hard, dense, non-organic, uncoated and durable against weathering.

14.13 Screening and Washing

Sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions.

14.14 Foreign Material Limitations

The percentages of deleterious substances in sand delivered to the mixer shall not exceed the following:

Per cent by weight

		Uncrushed	Crushed
(i)	Material finer than 75 micron I.S. sieve	3.00	15.00
(ii)	Shale	1.00	-
(iii)	Coal and Lignite	1.00	1.00
(iv)	Clay lumps	1.00	1.00
(v)	Total of all above substances including items (i) to (iv) for uncrushed sand and items (iii) and (iv) for crushed sand	5.00	2.00

14.15 Gradation

Unless otherwise directed or approved, the grading of sand shall be within the limits indicated hereunder

Percentage (%) Passing For

I.S. Sieve Designation	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60- 95	60- 95	85-100	95-100
1.18 mm	30- 70	30- 70	75-100	90-100
600 micron	15- 34	15- 34	60- 79	80-100
300 micron	5- 20	5- 20	12- 40	15- 50
150 micron	0-10	0- 10	0- 10	0- 15

Where the grading fails outside the limits of any particular grading zone of sieves, other than 600 micron

I.S. sieve, by total amount not exceeding 5 per cent, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron I.S. Sieve or to percentage passing any other sieve size on the coarser limit of Grading Zone I or the finer limit of Grading Zone IV. Fine aggregates conforming to Grading Zone IV shall be used unless mix designs and preliminary tests have shown its suitability for producing concrete of specified strength and workability.

14.16 Fineness Modulus

The sand shall have a fineness modulus of not less than 2.2 or more than 4.2. The fineness modulus is determined by adding the cumulative percentages retained on the following I.S. sieve sizes (4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron) and dividing the sum by 100.

14.17 Coarse Aggregates

Coarse aggregate for concrete, except as noted above and for other than light weight concrete shall conform to I. S. 383. This shall consist of natural or crushed stone and gravel and shall be clean, and free from elongated, flaky or laminated pieces, adhering coatings, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter.

14.18 Screening and Washing

Natural gravel and crushed rock shall be screened and/or washed for the removal of dirt or dust coating, if so demanded by Engineer.

14.19 Grading

Coarse aggregate shall be either in single size or graded in both cases, the grading shall be within the following limits.

I.S. Sieve Designation	Percentage passing for single -sized aggregate of nominal size					Percentage passing for Graded aggregate of nominal size			
	40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
63 mm	100	-	-	-	-	100	-	-	-
40 mm	85-100	100	-	-	-	95-100	100	-	-
20 mm	0-20	85-100	100	-	-	30-70	95-100	100	-

I.S. Sieve	Percentage passing for single -sized aggregate of nominal size					Percentage passing for Graded aggregate of nominal size			
16 mm	-	-	85-100	100	-	-	-	90-100	-
12.5 mm	-	-	-	85-100	100	-	-	-	90-100
10 mm	0-5	0-20	0-30	0-45	85-100	10-35	25-35	30-70	40-85
4.75 mm	-	0-5	0-5	0-10	0-20	0-5	0-10	1-10	0-10
2.36 mm	-	-	-	-	0-5	-	-	-	-

The pieces shall be angular in shape and shall have granular or crystalline surfaces. Friable, flaky and laminated pieces, mica and shale, if present, shall be only in such quantities that will not, in the opinion of Engineer, affect adversely the strength and /or durability of concrete. The maximum size of coarse aggregate shall be 40 mm for M-15 to M-30 concrete and 20 mm for M-35 to M-40 concrete, or as directed by the engineer or specified otherwise.

The maximum size of coarse aggregate shall be the maximum size specified above, but in no case greater than 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. Plums above 160 mm and up to any reasonable size can be used in plain mass concrete work of large dimension up to a maximum limit of 20% by volume of concrete when specifically approved by Engineer.

For heavily reinforced concrete members, the normal maximum size of the aggregate shall be 5 mm less than the minimum clear distance between the reinforcing main bars or 5 mm less than the minimum cover to the reinforcement whichever is smaller. The amount of fine particles occurring in the Free State or as loose adherent shall not exceed 1% when determined by laboratory sedimentation tests as per I.S. 2386. After 24 hours' immersion in water, a previously dried sample shall not have gained more than 10% of its oven dry weight in air, as determined by I.S. 2386.

14.20 Foreign Material Limitations

The percentage of deleterious substances in the aggregate delivered to the mixer shall not exceed the following:

Foreign Material	Per cent by weight	
	Uncrushed	Crushed
(i) Material finer than 75 micron I.S. sieve	3.00	3.00
(ii) Coal and lignite	1.00	1.00
(iii) Clay lumps	1.00	1.00
(iv) Soft fragments	3.00	-
(v) Total of all the above substances	5.00	5.00

14.21 Water

Water used for washing, mixing and curing shall be free from injurious amounts of deleterious materials. Portable waters are generally satisfactory for mixing and curing concrete.

Water to be used for drinking/construction purposes shall strictly confirm to IS: 456-2000. Water samples have to be got-tested from DJB Laboratory before the start of the work and every three months interval till completion of work. The cost of testing shall be borne by the Contractor.

In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in I.S. 456. The sample of water taken for testing shall be typical of water proposed to be used for concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

Average 28 day compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water. The cubes shall be prepared, cured and tested in accordance with the requirements of I.S. 516.

The initial setting time of test block made up with the appropriate test cement and the water proposed to be used shall not be less than 30 minutes and shall not differ by more than 30 minutes from the initial setting time control test block prepared with appropriate test cement and distilled water.

The test blocks shall be prepared and tested in accordance with the requirements of I.S. 4031.

Where water can be shown to contain an excess of acid, alkali, sugar or salt, Engineer may refuse to permit its use. As a guide, the following concentrations represent the maximum permissible values:

- (a) To neutralise 200 ml. Sample of water, using Phenolphthalein as indicator, it should not require more than 2 ml. of 0.1 Normal NaOH. The details of test shall be given in I.S. 3025.
- (b) To neutralise 200 ml. Sample of water, using methyl orange as an indicator, it should not require more than 10 ml. Of 0.1 Normal HCl. The details of test shall be as given in I.S. 3025.
- (c) Percentage of solids, when tested in accordance with the method indicated below, shall not exceed the following:

Solids	Percentage	Method of test (ref Is 3025)
Organic solids	0.02	10 and 11 (organic solids total minus ignited residue)
Inorganic	0.30	11 (Ignited residue)
Sulphates (as SO ₄)	0.05	20
Alkali Chlorides(as Cl)	0.20	24

Suspended matter	0.20	

- (d) The pH value of water shall not generally be less than 6.

14.22 Steel Shapes Encased in Concrete

Structural steel columns, beams, girders and bracings to be encased in concrete shall be unpainted, if so indicated on the drawings. The encasing shall be done in concrete with 10mm maximum size aggregate and works cube strength not less than the prescribed value.

14.23 Reinforcement

14.23.1 Supply

Reinforcement bars, shall either plain round mild steel bars Grade I as per I.S. 432 (Part I) or medium tensile steel bars as per I.S.432 (Part I) cold twisted steel bars and per I.S. 1786 as shown and specified on the Specified on the Specification Drawings. Wire mesh or fabric shall be in accordance with I.S.1566. Substitution of reinforcement will not be permitted except upon written approval from the Engineer.

Plain round mild steel bars Grade II as per I.S. 432 (Part I) may be used with prior approval of the Engineer in writing and with 10% increase in the reinforcement area but its use shall not be permitted in structures located in earthquake zones subjected to severe damage (as per I.S. 1893) and for structures subject to dynamic loading (other than wind loading), such as railway and highway bridges, crane girders, frames supporting rotary or reciprocating machinery, etc.

14.23.2 Storage

The reinforcement shall not be kept in direct contact with the ground but stacked on top of an arrangement of timber sleepers or the like.

If the reinforcing rods have to be stored for a long duration, they shall be coated with cement wash before stacking and/or kept under cover or stored as directed by the Engineer.

Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.

14.23.3 Quality

All steel shall be of Grade I quality unless specifically permitted by the Engineer. No rerolled material will be accepted. The Contractor shall submit to the Engineer the Manufacturer's test Certificates for steel reinforcement at least seven days prior to use in the works. The Engineer may order such physical and/or chemical tests for confirmation on such steel reinforcement when he considers necessary. If such confirmatory tests are found to be unsatisfactory, the reinforcement shall not be used in any work. Random tests on steel supplied by the Contractor may be performed by Corporate as per relevant Indian Standards. All costs incidental to such tests shall be at the Contractor's expense. Steel not conforming to specifications shall be rejected.

All reinforcement shall be clean, free from grease, oil, paint, dirt, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used.

14.23.4 Laps

Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be staggered and the locations of all splices, except those specified on the Drawings, shall be approved by the Engineer. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

14.23.5 Bending

Reinforcing bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This considered as a part of reinforcement bending fabrication work.

All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawings/bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and re-bent in a manner that will injure the material; bars containing cracks or splits shall be rejected.

They shall be bent cold, except bars over 25 mm in diameter which may be bent hot if specifically approved by the Engineer. Bars which depend for their strength on cold working shall not be bent hot. Bars bent hot shall not be treated beyond cherry red colour (not exceeding 845°C) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and re-bending is such as shall not, in the opinion of the Engineer, injure the material.

No reinforcement shall be bent when in position in the work hardened concrete. Bars having kinks or bends other than those required by design shall be used.

14.23.6 Fixing

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the Drawings by the use of blocks, spacers and chairs, as per I.S. 2502. to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be securely bound together at all such points with number 16 gauge annealed soft iron wire. The vertical distances required between successive layers of bars in beams or similar members shall be maintained by the provision of mild steel spacer bars at such intervals that the min bars do not perceptibly sag between adjacent spacer bars.

14.23.7 Cover

Unless indicated otherwise on the Drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as follows:

- (a) At each end of reinforcing bar, not less than 25 mm nor less than 25 mm nor less than twice the diameter of the bar.
- (b) For a longitudinal reinforcing bar in a column, not less than 40 mm, nor less than the diameter of the bar. In case of columns of minimum dimension of 20 cm or under, with reinforcing bars of 12 mm and less in diameter, a cover of 25 mm may be used.
- (c) For longitudinal reinforcing bars in a beam, not less than 25 mm nor less than the diameter of the bar.
- (d) For tensile, compressive, shear or other reinforcement in a slab or wall not less than 15 mm, nor less

than the diameter of such reinforcement.

- (e) For any other reinforcement not less than 15 mm, nor less than the diameter of such reinforcement.

- (f) For footings and other principal structural members in which the concrete is deposited directly against the ground, cover to the bottom reinforcement shall be 75 mm. If concrete is poured on a layer of lean concrete the bottom cover may be reduced to 50 mm.
- (g) For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, grade beams, footing sides and top, etc. not less than 50 mm for bars larger than 16 mm diameter and not less than 40 mm for bars 16 mm diameter or smaller.
- (h) Increased cover thickness shall be provided, as indicated on the Drawings, for surfaces exposed to the action of harmful chemicals (or exposed to earth contaminated by such chemicals), acid, alkali, saline atmosphere, sulphurous smoke, etc.
- (i) For reinforced concrete members, totally or periodically immersed in sea water or subject to sea water spray, the cover of concrete shall be 50 mm more than those specified in (a) to (e) above.
- (j) For liquid retaining structure, the minimum cover to all steel shall be 40 mm or the diameter of the main bar, whichever is greater. In the presence of sea water and soils and waters of a corrosive character the cover shall be increased by 10 mm.
- (k) Protection to reinforcement on case of concrete exposed to harmful surroundings may also be given by providing a dense impermeable concrete with approved protective coatings, as specified on the drawings. In such a case, the extra cover mentioned in (h) and (i) above may be reduced by the Engineer to those shown on the drawings.
- (l) The correct cover shall be maintained by cement mortar cubes or other approved means. Reinforcement for footings, grade beams and slabs on subgrade shall be supported on precast concrete blocks as approved by the Engineer. The use of pebbles or stones shall not be permitted.
- (m) The 28 day crushing strength of cement mortar cubes/precast concrete cover blocks shall be at least equal to the specified strength of concrete in which these cubes/blocks are embedded.

The minimum clear distance between reinforcing bars shall be in accordance with I.S. 456 or as shown in the drawings.

14.23.8 Inspection

Erected and secured reinforcement shall be inspected and approved by the Engineer prior to placement of concrete.

14.24 Welding of Reinforcement

Reinforcement which is specified to weld shall be welded by any process which conforms to the requirements of I.S. 2751 and which the contractor can demonstrate by bend and tensile tests will ensure that the strength of the parent metal is not reduced and that the weld possesses strength not less than that of the parent metal. The welding procedure established by successful test welds shall be maintained and no departure from this procedure shall be permitted.

Weld in positions other than those shown on the Drawings shall not be permitted. Tack Welding to lightly secure reinforcements in place will be permitted subject to approval of the Engineer's Representative.

14.25 Supply of Reinforcing Bars

All the steel reinforcements, M.S. Bars/High Yield strength deformed bars, etc. required for the Works will be supplied by the Contractor.

All steel brought on site shall be stored in a proper manner as approved by the Engineer so as to avoid distortion, deterioration and corrosion.

14.26 Building Work

14.26.1 Applicable Codes and Specifications

The following codes, standards and specifications are made a part of this specification. All standards, tentative specifications, specifications, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

IS: 1077 Common burnt clay building bricks

IS: 3102 Classification of burnt clay solid

bricks IS: 2180 Heavy duty burnt clay

building bricks IS: 3495 Method of burnt clay

building bricks IS: 2691 Burnt clay facing

bricks

IS: 4885 Modular extruded burnt fly ash clay Sewer bricks

IS: 4860 Acid resistance Sewer bricks for Industrial effluent

(SEWAGE) IS: 2212 Code of practice for brick work

IS: 427 Distemper, dry, colour as required

IS: 428 Distemper, oil emulsion, colour as

required IS: 2395 Code of practice for painting

concrete, (Parts I & II) masonry and plaster surfaces

14.26.2 Brickwork

Mortar

Mortar for brickwork, block work and stonework shall be in accordance with IS: 2250. Cement mortar shall consist of 1 part of Portland cement to 4 parts of sand.

Mortar shall be mixed on clean, hard dry platforms protected from sun and rain. The constituents shall be measured before water is added. Any mortar not used 30 minutes after the water is added shall be discarded.

Portland cement for mortar shall comply with Clause 2.3.4 (a) of the specification. Sand for mortar shall comply with I.S. 2116 and shall be of the following grading:-

I.S. Sieve	Percentage passing by weight
4.75 mm	98-100
2.36 mm	80-100
1.18 mm	60-80
600 microns	40-65
300 microns	10-40
150 microns	0-10

Sand for mortar shall be from an approved source and shall consist of hard, coarse siliceous grains free from deleterious matter. It shall be stored separately from other sand or fine aggregate and shall be kept covered. The Contractor shall submit samples of sand for mortar for the Engineer's approval if ordered.

Water for mortar shall comply with Clause 2.3.7 of the specification.

14.26.3 Bricks

Sewer Bricks conforming to relevant IS: 4885/4860 shall be sound, well burnt clay bricks free from cracks best locally available. Samples of bricks to be supplied shall be submitted to the Engineer for his approval prior to procurement. Bricks shall not be tipped on the Site but shall be carefully stacked by hand keeping the different grades. Broken or damaged bricks shall not be used in brickwork.

14.26.4 Brickwork

Brickwork shall be built in accordance with the requirements of I.S. 2212. Every brick shall be wetted and laid one operation, joints being fully flushed up as the work proceeds. The previous course shall be wetted if it has dried and the walls shall be brought up evenly with no portion racked up (and not toothed) more than one metre higher than another. All brickwork shall be properly bonded together. Joints shall not exceed 10 mm in thickness and shall be raked out to a depth of 7.5 mm as a key for rendering or plastering. All courses shall be truly horizontal and all face faces shall be strictly plumb and square.

In cavity walls the two leaves of brickwork shall be bonded with galvanised wall ties 150 to 250 mm long as required. The ties shall be built into the horizontal joints as the work proceeds and the space between successive ties shall not exceed 750 mm horizontally nor 250 mm vertically. Ties shall be staggered and shall be laid sloping down towards the outer leaf of the cavity. Cavities shall be kept free from mortar droppings by the use of suspended battens and temporary openings at the bottom of the wall. Every fourth vertical joint in the external

face in the course immediately above the horizontal damp proof courses shall be raked out and left open to form a weep hole. Completed masonry shall be kept wet for a minimum period of 14 days.

The walls shall be plastered with 20 mm thick sulphate resistant mortar (1:30). Where ever the manholes tops are exposed and/ or raised the Contractor shall make provision in his pricing of this item to plaster all exposed surfaces of the manholes.

After the construction of new manhole, the internal epoxy mortar/paint protective coating system shall meet the compliance of Clauses mentioned in Part !3 of this specification.

14.27 Restoration

All surfaces, services and/or improvements which are disturbed, destroyed or damaged by work under the Contract shall be replaced, repaired, reinstated or otherwise restored, as near as practicable to their pre-existing condition. Improvements include trees, shrubs, gardens, retaining walls, fences and all other structures.

When the backfilling of an excavation in pavement has been completed, the pavement shall be immediately restored to a trafficable and safe condition.

The Contractor shall arrange for final restoration of the road and footpath pavement and sub-base to be performed to the standard required by the relevant authority at the expense of the Contractor.

14.28 Measurement and Payment

Payment will be made for Complying with all requirements as described in Part 14 of the Technical Specification.

An item is allowed for construction of new manholes as per DJB/ contract drawings. The details of the manholes are included in the Contract drawings. The Contractor shall construct the manholes at locations to be nominated by the Engineer. The contractor shall be deemed to have included for everything required for construction of the manhole including epoxy coating of the lower portion of the manhole.

The Quantity shown in the Bill of Quantities is Provisional. The Contractor will be paid for the actual number of manholes constructed at the contract rate and no deviation limit applies to this item. Manholes constructed as part of a new sewer line constructed under Payment shall not be paid under this item.

All foot rest shall be replaced with new orange colour safety foot rest. Orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS:10910 on 12 mm dia. steel bar conforming to IS:1786 having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs. The foot rest shall be as per item as per CPWD/DSR and covers removed from the manholes to DJB for reuse. The rates shall include for handing over such items to the per appropriate stores of DJB. The Contractor shall, provide and replace all the manhole cover & frame with new SFRC Manhole cover & frame, extra heavy duty (EHD 35 grade designation), conforming to IS 12592. The Contractor shall be deemed to have included everything else necessary including redoing the seating for the frames and covers in the rates to complete the work described in the item and to prevent any storm water entry through the covers.

The Payment shall be made as per BOQ Items.

PART 15 – SETTLED / SUNKEN SEWERS

15.1 Geotechnical Investigation for the area

Based on the preliminary geotechnical data available for the area and the extensive settlements that had occurred in the past in the areas, the contractor is alerted that he shall take extreme measures during rectification of sunken sewer stretches or construction of replacement sewers to prevent ground settlement. Any methods that require dewatering or pumping of ground water flows and thereby lowering of water table will not be permitted in these areas.

The areas generally the sub-soil strata consist of layers of filled up, Fine Sand and Silty Sand. The sub-soil strata are loose to medium dense. The sub-soil stratum comprise layers of filled up from 0.0 to 1.50m depth, from 1.5 to 4.5m depth consists of Silty sand classified as SM, from 2.5 to 10m and 4.5 to 10 consists of Fine Sand classified as SP-SM. The chemical analysis of soil for Sulphate, chloride and pH content, the above contents are found below permissible limits and henceforth will not affect the structures adversely. The water table below EGL 4.8 to 10 m. and during the period of Monsoon water table is high. This information is tentative, if bidders are using this information on entirely at his own risk, cost and responsibility, neither DJB nor the Consultant shall be responsible.

Thus the contractor shall carryout a comprehensive geotechnical investigation at his own cost for geotechnical investigation) for these settled stretches and submit a comprehensive geotechnical report including the soil profile of different soil strata to the Engineer before commencing any work.

After survey of sewer and if sections of the existing sewer are found to have settled (reverse gradients) these sections will be informed to the Engineer. If so instructed by the Engineers, the settled sewer shall be replaced using narrow trench excavation techniques or trenchless methods.

The lining for the new sewer sections shall be designed as Type II Structural Lining (Hydraulic) to ensure that new sewer is water tight and capable of withstanding hydraulic buckling from groundwater pressure and to enhance the corrosion resistance of the sewer to a life span of least 50 years.

All location of existing services/utilities and permission of relevant Authorities is the responsibility of The Contractor. If the Contractor proposes a new alignment for the replacement of the settled sewer pipe sewer, he shall be responsible for ensuring all New Manholes at least every 50 metres will be required.

Rectify settled / sunken sewers by methods that require no dewatering such as micro-tunnelling & pipe jacking method by installing stainless steel collared 3mm thick HDPE lined RCC NP4 jacking IS-438-2003 in all soil/conditions at suitable depths including entry & exist shafts and construction of new manholes as required so as to make the sewer functional

without any reverse gradient as per approval of the Engineer including supply, transport, delivery & construction & jet grouting to stabilize ground and or fill voids etc. as required to prevent ground movement and disturbance to nearby structure & amenities including filling of pits & malba etc. and making the connections with the existing sewers complete. After rectification of the Sewer, the Contractor shall restore the ground, footpath road surface to its original condition as per CPWD specifications & as directed by the Engineer In charge.

The rates quoted for Rectify sunken sewers should be inclusive of all trenching excavation, shoring, sheet piling, new S&S RCC NP3 class pipes confirming to IS 458 , cement concrete bedding, materials, transport, delivery, removing all debris & materials, construction, excluding the cost of construction of new manholes and installation of CIPP Type II structural Liner (Hydraulic), complete in all respect. All methods of construction shall be submitted for approval of The Engineer prior to commencement. After rehabilitation of the sewer, the Contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the Engineer-in-charge After rehabilitation of the sewer,

the Contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the Engineer-in-charge.

15.2 Replacement of Settled Sewers

After survey of sewers and if sections of the existing sewer are found to have settled (reverse gradients) these sections will be informed to The Engineer. If so instructed by The Engineer, the settled sewer shall be replaced using narrow trench excavation techniques or trenchless methods.

The lining for the new sewer sections shall be designed as Type II Structural Lining (Hydraulic) to ensure that new sewer is water tight and capable of withstanding hydraulic buckling from groundwater pressure and to enhance the corrosion resistance of the sewer to a life span of at least 50 years.

All location of existing services/utilities and permission of relevant Authorities is the responsibility of The Contractor. If the Contractor proposes a new alignment for the replacement of the settled sewer pipe sewer, he shall be responsible for ensuring all existing services/utilities are identified for the new alignment.

New Manholes at least every 50 metres will be required.

The Contractor shall submit his Construction Method for Replacement of Settled Sewer with his Bid.

The bidders shall submit a work method statement for replacement of settled sewers by narrow trench method or trenchless methods.

Full details including sheet piling as well as a construction sequence is to be submitted.

15.2.1 Replacement of Settled Sewers by New Pipes

Based on the above geotechnical data available for the area and the extensive settlements that had occurred in the past in the areas, the contractor is alerted that he shall take extreme measures during rectification of sunken sewer stretches or construction of replacement sewers to prevent ground settlement. Any methods that require dewatering or pumping of ground water flows and thereby lowering of water table will not be permitted in these areas.

A provisional item is allowed for the contractor to price for rectifying the sunken stretches of the sewer. The exact quantity of sunken sewer is unknown but the contractor would be required to rectify the sunken stretches before carrying out the liner installation. New Manholes at least every 50 metres will be required.

The rates quoted for this item should be inclusive of supply of all trenching excavation, shoring, sheet piling, new pipes, materials, transport, delivery, removing all debris & materials, construction, and construction of new manholes, restoration of sewer connections, existing sewerage system, other public services as required so as making the sewer functional, without any reverse gradient as per approval of the Engineer In-charge and installation of CIPP Type II structural Liner (Hydraulic), complete in all respect. All methods of construction shall be submitted for approval of The Engineer prior to commencement. After rehabilitation of the sewer, the Contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the Engineer-in-charge.

If no settled pipe areas are found after survey of the invert levels, no replacement of the sewer pipe will be carried out and no payment shall be made to the Contractor for this item.

Any stretches that are found sunken by more than 10% of the diameter of the sewer and/or as per instruction of Engineer in-charge shall be rectified or replaced including construction of new manholes.

Manholes should be constructed at least every 50 metres or as per approval of the Engineer In-charge. The rectification or replacement of the sewers that are sunken by more than 10% of the dia. shall be done.

15.3 Construction of Replacement Sewer along new alignment -by Micro Tunnelling

A Provisional Item has been included for the replacement of sewer sections. If the Contractor wishes or is so directed by The Engineer, the Contractor shall construct a new sewer line along a new alignment. Permission for constructing the new sewer along a new alignment will be required from relevant Authorities and obtaining such permission and approvals will be the responsibility of the Contractor.

The Contractor shall submit to The Engineer ACAD drawings showing Ground Levels, new invert levels and locations of Manholes. The Contractor shall submit to the Engineer for approval.

15.3.1 Selection of Micro-Tunnelling Equipment

The contractors shall be responsible for the selection of a suitable micro tunnel boring machine capable of excavating the materials including rocks that may be encountered at the sites.

The contractor shall ensure that geological and geotechnical information he possesses for the sites is adequate to accurately determine the types of soil and rock that may be encountered during execution of the project. The contractor is deemed to have carried out additional geological and geotechnical investigation of the sites and testing of the soil and rock (to determine compressive strength, mineral makeup of the rock, boulders etc.) as necessary at his own cost before the selection of the micro-tunnelling system. The contractor shall also ensure that the micro-tunnelling system he selects for the project shall successfully excavate in the wide ranging ground conditions from clayey strata with boulders and loose rocks that may be encountered at the sites.

Contractors shall pay particular attention, when selecting the tunnelling equipment for the project, to ground water level fluctuation and the wide ranging subsurface soil strata from gravels, soft soils with boulders and loose rocks that may be present at the sites. The tunnelling equipment selected for the project shall have appropriate cutter head equipped with suitable cutter bits to excavate soils and boulders below the water table.

The tunnelling equipment shall be capable of balancing the ground water pressure supporting the excavated tunnel face at all times. The equipment shall be articulated to enable remotely controlled steering, in both the horizontal and vertical directions. It shall be capable of preventing rotation and rolling movement of shield's body during the drive. The tunnelling equipment shall, inter-alia, have the following features.

Shall have been manufactured by a reputable micro-tunnelling machine manufacturer whose machines have been successfully used by contractors to install sewers in projects of similar nature and complexity.

- Equipped with lasers and suitable steering guide system that ensures easy steering control.
- Instrumentation to measure deviation from the designed level and grade, rolling and pitching of the equipment, cutter torque and its percentage to the maximum torque, rpm, jacking speed, tunnel face pressure etc.

The micro-tunnelling equipment proposed for the project shall meet all the above mentioned criteria or otherwise it will not be permitted to use in the project.

15.3.1.1 Details of the Jacking Pipes

The pipes shall be of stain less steel collared, 3mm thick HDPE lined RCC NP4 jacking pipes as manufactured confirming to IS: 458 -2003 . The concrete jacking pipes shall be manufactured by a centrifugal or other equivalent process to be approved by the Engineer. Design, manufacture and factory testing of the pipes and specials shall be to A.S. 1342 or S.S 183 or JSWAS A-6-1989/A-2-1973 or other acceptable standard and shall also meet the basic requirement specified in I.S 458 & I.S 3597 of 1966 or its equivalent standard as amended up to-date . The clear cover of concrete over steel reinforcement on the wet side shall not be less than 50mm.

The outside and inside diameters of the pipe shall be such that they match the dimensions of the tunnelling equipment or vice versa. The standard length of the pipe shall be 3.05m or 2.43m or equivalent length. However the length of the pipe shall be shorten if desired by the contractor to suit the site conditions but the Engineer's approval would be required.

The precast reinforced concrete pipes shall be sufficiently reinforced with steel to withstand all stresses induced by handling, jacking, earth and water pressures and all working loads at the depths at which they are to be used without cracking, spalling or distortion. A load factor (for the maximum jacking force) of not less than 2.5 shall be used in the calculations to determine the strength of the pipes required. The strength of the pipes shall be tested by the three edge bearing test. When subjected to the design load in such a test, the load required to produce the crack width of 0.25mm on the pipe shall be in accordance with IS Code 458. All such tests shall be carried out at the expense of the Contractor.

When designing the jacking pipes, the contractor shall take into consideration the following: jacking load, pipe stiffness, corrosive resistance, flexibility, durability etc.

The Contractor shall submit full details of his proposals for the pipes, giving detailed drawings showing sizes, reinforcement and type of joints, calculations, together with the name of the proposed manufacturer, the place of manufacture and the manufacturing process to the Engineer for approval along with a consent letter for manufacture of the pipes. All workmanship and materials used in the manufacture shall be subject to the approval of the Engineer who shall from time to time be permitted to inspect materials at source and the manufacturing processes in the factory.

Contractors shall allow for eccentric loading in the pipe, rather than an axial loading, during the installation of the pipe. To minimise the resultant pipe stresses in a jacking pipe and to achieve a trouble free jacking operation, attention shall be paid to the following:

- a) Pipe shall be straight and uniform with square ends. The joints shall be well formed to allow efficient transfer of jacking load from pipe to pipe.
- b) Pipe joint shall be fitted with compressible packer for better distribution of jacking load.
- c) The jacking frame, jacks and steering head shall be properly aligned along the designed alignment and grade and the whole assembly shall be square and true to the thrust wall
- d) Steering corrections shall be made gradually to minimise abrupt misalignment angles between the pipes

The pipes shall be sufficiently cured before they are used in the construction of the Works. They shall be handled with extreme care to prevent the edges of the pipes from chipping. Repaired pipes shall not be allowed for use in the Contract. The Engineer may reject any pipes he considers not suitable for the Works and these rejected pipes shall be removed from the site immediately. After factory testing and before despatch, every pipe and special shall be marked in accordance with the Standard used. In addition, each pipe shall be marked with a number corresponding with the order of manufacture. Test certificates from the manufacturers or other relevant authority shall be submitted to the Engineer.

Some of the sites may have limited or restricted storage space for stacking of jacking pipes. The Contractor shall therefore schedule the supply of pipes to the sites in such a way that only absolute minimum numbers of pipes are brought to the site at a time.

15.3.1.2 Jacking Pipe Joints

The jointing arrangement for the jacking pipes is crucial in terms water-tightness, flexibility and smooth transmission of jacking force. Spigot ended jacking pipe with recess to receive rubber rings and stainless steel couplings (collars) or other acceptable joints shall be used in pipe jacking application. The contractor shall submit joint details to the Engineer for approval.

A provisional item is allowed for the contractor to price for rectifying the sunken stretches of the sewer. The exact quantity of sunken sewer is unknown but the contractor would be required to rectify the sunken stretches before carrying out the liner installation.

Any stretches that are sunken by more than 10% of the diameter of the sewer and/or as per instruction of Engineer in-charge shall be rectified including construction of new manholes. Manholes should be constructed at least every 50 metres.

The rates quoted for this item should be inclusive of cost/hire charges of all micro - tunnelling equipment's, machinery, & material etc. including trenching excavation, shoring, sheet piling, new pipes, transport, delivery, removing all debris & materials construction excluding cost of construction of new manholes which shall be paid in respective BOQ item, complete in all respect. All methods of construction shall be submitted for approval of The Engineer prior to commencement. After rehabilitation of the sewer, the Contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the Engineer-in-charge. After rehabilitation of the sewer, the Contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the Engineer-in-charge.

The contractor shall allow for each and every other expense in relevant BOQ item 214 in addition to that included elsewhere for successfully completing the rehabilitation of sewer passing along and across of Drains including its flow diversion, embankment protection for proper completion of work.

The Quantity shown in the Bill of Quantities is Provisional. The Contractor will be paid for the actual length of sunken sewer replaced inclusive of manhole construction at the contract rate and no deviation limit applies to this item.

If no settled pipe areas are found after survey of the invert levels, no replacement of the sewer pipe will be carried out and no payment shall be made to the Contractor for this item.

15.3.1.3 Rubber Ring Joints

The joint rubber rings supplied and installed shall be of the Cornelius rubber ring type or similar approved and shall be capable of accommodating 2 degree deflection at each joint. Joint rings shall meet with the current I.S 5328 of 1969 and B.S 2494 part 2 of 1967 or be of approved quality by the Engineer. The properties of the joint ring shall be between those specified in BS 2494:1967 for grade D and grade B.

The testing of rubber ring shall confirm to IS. 3400 of 1965 and also IS. 5382 of 1969.

The Contractor shall indicate the grade of rubber rings he intends to use and submit samples for approval and test prior to in DJB in the Works. The grade, type or source of supply of rubber rings may not be changed without the written approval of the Engineer.

15.3.1.4 Jacking Pipe Couplings (Collars)

Where pipe couplings (collars) are used for pipe joints, it shall be made of weldable structural stainless steel to BS 4360 Grade 43 or equivalent I.S. The stainless steel coupling shall be of such dimension and thickness so that when inserted into the pipe, it fits exactly into the recesses in the pipe. The joint so formed shall be watertight. The joint details shall be approved by the Engineer.

15.3.1.5 Compressible Packers

Suitable compressible packers shall be used at the joints for distributing the jacking force evenly through the wall of the jacking pipes. Uneven transfer of jacking force from a pipe to another shall result in concentrated and excessive stresses in the pipe which can cause the pipe to crack. Contractor shall submit details of the compressible packers for Engineers approval.

15.3.1.6 Identification of Pipes, Rubber Rings etc.

Every pipe made shall be clearly and indelibly marked upon it an identification number, class, diameter and date of manufacture. Full records are to be maintained of each pipe test and for each individual pipe the date manufactured, cleared after testing and supplied.

Pipe manufacture shall be arranged to permit the full completion of batching of pipe before testing. After the satisfactory completion of testing and approval of the pipes by the Engineer the pipes shall be stored at factory premises during the period awaiting delivery.

15.3.1.7 Site Investigation

The Contractor's site investigation for micro-tunnelling work shall be critical and the most important engineering work to be carried out before commencement of micro-tunnelling work. The contractor shall clearly understand the importance of establishing the predominant subsurface ground conditions and their range of variability along the sewer route well before embarking on the actual micro-tunnelling works. There should not be any room for unforeseen ground conditions and is absolutely necessary for the Contractor to know what is to be encountered during the tunnelling operation. The contractor shall be deemed to have accurately established the types of soil and rock strata along the tunnel bore and their range to enable him to select the tunnelling system/ machines and to set-up and operated correctly.

15.3.1.8 Construction of Jacking and Receiving Shaft

The excavations for manholes may be used as Jacking or Receiving shafts. Where a Jacking shaft is used for the construction of a manhole, the Contractor shall allow for this in his rates for construction of the manhole. Additional Jacking or Receiving shafts may be sunk with the approval of the Engineer but will not be paid for.

The Contractor shall submit to the Engineer for approval dimensioned drawings and calculations of the timbering or trench sheeting details for the Jacking shafts. Each jacking shaft shall have a separate ladder bay for access which shall be isolated from the part of the shaft used for hoisting materials. The shaft trenching shall be watertight and shall prevent any pressurised slurry from the tunnel face reaching the shaft

The shaft shall be kept dry at all times and shall have a drainage sump to pump out the ingress water. The Contractor is deemed to be fully aware of the serious consequences to the tunnelling equipment and other accessories if the shaft is flooded. He shall take every precaution to avoid flooding in the shaft. The shaft shall be well protected against surface runoff getting into the shaft. The contractor shall be solely responsible for any consequential delays and expenditure arising as a result flooding the shaft.

The shaft floor shall be designed to withstand the tunnel machine and other accessories.

15.3.1.9 Entrance and Exit Arrangement

One of the most critical micro-tunnelling operations is the launching and the retrieval (entry and exit) of the micro-tunnelling machine. Often this process takes place well below the water table. In such cases, it is critical that the contractor implement adequate engineering measures including the stabilisation of any unstable soil by grouting or other means so as to prevent soil and water inflows into the shaft.

It is common practice to install a rubber seal at the entry and exit. The purpose of the seal is to prevent the flow of ground water or lubricant (used for reducing the frictional resistance) through the shield/pipe entry opening on the shaft wall.

The contractor shall plan this work well in advance and fabricate the fittings and the rubber seal, as per approved drawings.

15.3.1.10 Jet Grouting to Stabilise Soil/Prevent Flow of Ground Water

If required, the contractor shall use jet grouting methodology to stabilise soil and to create soil plug around excavation to prevent ingress of ground water. In the event contractor proposes to use jet grouting methodology for soil stabilisation etc, he shall submit full details on the jet grouting methodology and the applicator's particulars to the Engineer for approval.

15.3.1.11 Soil Stabilisation at the Tunnel Entry and Exit

In addition to the seal, it may be necessary to stabilise the soil behind the entrance wall. This is to prevent any free flow of unstable soils into the pit when opening is made for the shield to enter into the ground. Chemical grouting, cement grouting, jet

Grouting piles, ground freezing or temporary shoring is some methods commonly used by the contractors to prevent the soil flow into the shaft.

15.3.1.12 Cement Grouting of Annulus Void around Jacking Pipe

The Contractor shall be fully responsible for preventing the occurrence of voids outside the pipe and if they occur he shall fill them with cement grout.

Immediately following the jacking operation the Contractor shall pressure grout the jacked section to fill all voids existing outside of the pipe. Grouting shall be from the interior of the pipe through grouting holes as specified. The grout mix shall be at least 1:3

Systems of standard pipe, fittings, hose, and special grouting outlets embedded in the pipe walls shall be provided by the Contractor. Care shall be taken to ensure that all parts of the system are maintained free from dirt. Grout composed of cement, sand and other approved compound and water shall be forced under pressure into the grouting connections at the invert and shall proceed until grout begins to flow from upper connections. Connections shall then be made to these holes and the operation continued to completion.

Apparatus for mixing and placing grout shall be of a type approved by the Engineer and shall be capable of mixing effectively and stirring the grout and then forcing it into the grout connections in a continuous uninterrupted flow.

After grouting is completed, pressure shall be maintained by means of stop cocks, or other suitable devices until the grout has set sufficiently. After the grout is set, grout holes shall be completely filled with dense concrete and finished neatly without evidence of voids or projections.

15.4 General Information on Submittals for Micro-Tunnelling Works

To ensure compliance with the requirements specified in the Contract, the contractor shall make a number of submittals as described in the following clauses to the Engineer for approval by the specified time. The contractor shall ensure that the submittals prepared are of good professional standard, comply with all the requirements specified in the contract and complete with all details and information to enable the Engineer to evaluate and approve the submission. It shall be clearly understood by the contractor that he shall not commence any work without the approval of the submittals by the Engineer.

Submittals by the contractor shall, inter-alia, include: Contractor's method of construction, Micro-tunnelling equipment description and literature, Jacking system and maximum jacking loads, Pipe shop drawings and calculation demonstrating the ability to sustain maximum jacking loads, Intermediate jacking stations details, Lubrication system, Bentonite injection system details, Ground water control details, Entry and exit details, Jacking and receiving shaft design details, Thrust block detail, Muck removal and disposal etc.

15.5 Submittals on Contractor's Method of Construction

The Contractor shall submit his proposed method of construction of sewers and manholes to the Engineer for approval within fourteen (14) days of commencement of the Contract. The submittal shall contain a detailed explanation of various steps involved in the construction process. They shall include details on the micro-tunnelling equipment, specific manufacturer's instructions and guidelines pertaining to the project, a methodology statement outlining the operation of the equipment and, details on materials including pipe materials, rubber ring, compressible packers and collars for jointing of pipes.

The submittal shall also include construction details on other permanent and temporary structures such as jacking and receiving shafts, cast in-situ and precast manholes, thrust walls, and entry and exit of the shaft. The details on other equipment such as intermediate jacking stations spoil removal system including slurry and feed pumps, control systems, slurry tanks and associated machinery, jacking frames, spacers, thrust ring etc shall be also included in the submittal.

15.6 Submittal on Geotechnical Profile along the Sewer Route

The Contractor shall establish the predominant subsurface ground conditions and their range of variability along the sewer before embarking on the micro tunnelling works. He shall clearly identify the types of soil or rock that is likely to be encountered at the tunnel face along the

entire sewer route. If found necessary he shall carryout simple probing techniques at closer interval and determine accurately the types of ground to be expected at the tunnel face.

He shall prepare a comprehensive geotechnical profile along the sewer route with detailed descriptions of the types of soil or rock to be expected at the tunnel face. A well prepared geotechnical drawing would enable the operator to navigate the tunnelling machine carefully and confidently. The Contractor shall submit the drawing to the Engineer within twenty eight (28) days from the commencement date of the Contract.

The Contractor shall make no reference to the data contained in the preliminary geotechnical bore logs investigation carried out by the DJB in the above submittals unless the Contractor had independently verified and satisfied himself during prequalification and Biding periods that such data accurately and sufficiently describe the expected ground conditions along the sewer routes.

The Contractor shall note that any risks he takes by solely depending on the above preliminary geotechnical bore logs information to establish the predominant ground/soil conditions and their range of variability shall be entirely his own and shall be wholly and fully responsible for any consequential expenses arising as a result of the risk he assumed

15.7 Submittals on Jacking Pipe Design

The contractor shall furnish design and manufacturing details of the jacking pipe to the Engineer for approval within fourteen (14) days of the commencement of contract. The contractor's attention is drawn to the requirement pertaining to the design, manufacture and handling of the jacking pipes.

The contractor shall, with the approval of the Engineer, engage a reputable pipe manufacturer to design and manufacture the jacking pipes. In which case, the submittal shall include the manufacturer's name, address, contact telephone and facsimile numbers and the manufacturer's quality assurance /control and testing plan for the jacking pipe. The manufacturer's representative name shall be also included in the submittal. A dimensioned drawing of the jacking pipe with design calculations from the manufacturer shall be also submitted to the Engineer for approval.

15.8 Submittal on Micro Tunnelling System

The contractor shall furnish name of the micro-tunnelling system, model, and manufacturer's technical literature for the equipment and all other data to the Engineer for approval with fourteen (14) weeks of the commencement of contract. The submittal shall include information to ensure that the micro tunnelling equipment proposed for the project meet with the general requirements specified in clauses

2.15 & 5.2.

15.9 Submittal on Site Layout

Contractor's attention is drawn to various clauses in the document with regard to the site constraints and space availability in all the sites. The contractor shall carefully examine the site and prepare site layout plans showing the arrangement of various ancillary equipment required for micro tunnelling works, such as spoil removal equipment and slurry tanks, generators, control cabin. Crane, storage of pipes etc for each tunnel drive and submit them progressively to Engineer for approval.

15.10 Submittal on Existing Sewer Levels, Locations of Shafts and New Sewer Alignment

The contractor shall survey and verify the as-built invert levels of the upstream and downstream sewers and manholes shown on the contract drawings for all the sites. The contractor shall confirm or insert the correct as-built levels in the contract drawings and

submit them to the Engineer for necessary amendments and re issue of the contract drawings for construction. The contractor shall submit the corrected drawings to the Engineer at least twenty eight (28) days before commencement of work in any of the Sites. Under no circumstances the contractor shall commence works without verifying the as - built levels and obtaining the approval of the Engineer.

The Contractor will be required to set out and plan the actual route for the sewer lying well in advance of actual excavations. Trial holes and other preliminary surveys must be carried out and the resulting information carefully plotted. A copy of all preliminary surveys and the results of exploratory excavations must be supplied to the Engineer as soon as possible.

For convenience of construction, if the Contractor prefers changes to the sewer alignment or diameter or the location of manholes shown on the contract drawings, he shall incorporate such changes in his submittals to the Engineer for approval. The Engineer would evaluate and approve if the proposed changes are found to be economically and technically acceptable. It shall be clearly understood by the

Contractor that any construction risks and additional costs arising as a result of Contractor's changes made to the original sewer design shall be entirely borne by the Contractor.

15.11 Submittal on Jacking and Receiving Shaft Design

The Contractor shall submit the design and construction details of the jacking and receiving shaft and their proposed locations along the sewer route to the Engineer for approval within fourteen (14) days of the commencement of the construction of shafts. The Contractor's design shall ensure that the shaft dimensions are absolute minimum required and method of construction shall be such that the shafts are constructed without causing unacceptable obstruction to the existing traffic flow in the vicinity of the construction. The Contractors shall also submit design and construction details of decking, if required, for the shaft. The Contractor shall be deemed to have allowed for in his Bid for such decking work necessary to maintain the traffic flow.

The submittal shall also include details on entry and exit arrangement, thrust wall layout and design details, general layout of guide rail and jacking table arrangement etc.

15.12 For Obtaining Approval from Authorities

The Contractor shall submit plans showing the proposed locations of the jacking and receiving shaft and detailed design drawings of the shaft to the Engineer progressively and in accordance with contractor's construction schedule, for approval. The contractor shall plan ahead make a submission to the relevant authorities (roads, traffic police etc.) through the Engineer with ample lead time and obtain their permission or approval to excavate the shafts at the locations approved by the Engineer.

15.13 Submittal on Buried Services and Obstructions

The contractors shall investigate and determine the actual location of the services and physical obstructions, if any, along the sewer route and at his chosen locations of the jacking and receiving shafts, and submit service location drawings to the authorities responsible for electricity, telecom, water, sewer, gas etc. and obtain their approval or permission to excavate in their vicinity.

The Contractor shall not interfere with the operation of any existing or proposed service. He shall carefully plan the sewer route and the locations of the shafts and manholes and shall identify the services that require diversion well ahead so as to give ample time to the authorities to divert the services or give approval to carry out the diversion by others. Where applicable, the Engineer would assist the contractors in getting the approval as expeditiously as possible from authorities.

If in the opinion of the Engineer any services that are within the manhole proper or across the micro tunnel bore (other than those identified in the drawings or otherwise) and require permanent diversion, they shall be diverted at the expenses of the DJB. Expenses for all other

diversions and temporary protection of services shall be borne by the Contractor and allowed for in his rates.

Any consequential delays or expenditure arising from Contractors' carelessness or lack of foresight on this matter shall be entirely borne by the Contractor. The Contractor shall prepare separate schedule for this work and submit it to the Engineer for approval within fourteen (14) days of commencement of work.

The Contractor shall fully co-operate with the Engineer and the authorities and shall have no claim for delay due to such relocation.

15.14 Submittal on Monitoring of Ground Settlement and Upheaval

15.14.1 Submittal on Safety

The contractor shall implement a comprehensive safety plan for his work people. He shall comply with all relevant acts governing safety on construction site and all corresponding clauses specified in Volume 1 of the contract documents. He shall submit to the Engineer the details of the arrangements he made with the local health authorities and the availability of medical staff, first aid equipment ambulance, sick bay etc. He shall give the names and contact telephone numbers (24 hours) of the occupational health and safety personnel. Beside he shall submit a list of safety equipment that he would provide to all the workers on site.

15.14.2 Submittal on Quality Assurance /Control Plan

The Contractor shall implement a Quality Assurance Program complying with ISO 9002 or approved equivalent for the manufacture of the reinforced concrete jacking pipe or other types of jacking pipe and for installation of the pipes by micro tunnelling and pipe jacking method.

The Contractor's Quality Assurance Manual for the Works shall be submitted to the Engineer for his endorsement within fourteen (14) days of the Date of Acceptance of the Bid. The Quality Assurance Programme shall be maintained in accordance with the provision of the manual. No works shall commence until the Quality Assurance Manual has been endorsed by the Engineer.

The Contractor's Quality Assurance System shall incorporate but not be limited to the following:

- (i) The Quality Assurance and Quality Control procedures covering all material design. Manufacture, supply and installation carried out by the Contractor and any of his sub-contractors.
- (ii) Such tests necessary to demonstrate that materials comply with the requirements of this specification and the requirements of the relevant Standards and Codes as described under clause 5.1

15.14.3 Submittal on Contractor's Personnel

The Contractor shall submit a list of his key site staff including their curriculum vitae to the Engineer with 7 days from the commencement of the contract. He shall submit the diagram showing the communication link within the site and from the site to Contractor's head quarters. He shall indicate in the line of communication the names, designation and the telephone numbers of the key staff for the Engineer's record.

The Contractor shall submit a list of his key site staff including their curriculum vitae to the Engineer with 7 days from the commencement of the contract. He shall submit the diagram showing the communication link within the site and from the site to Contractor's head quarters. He shall indicate in the line of communication the names, designation and the telephone numbers of the key staff for the Engineer's record.

The Contractor shall take each and every precaution to ensure that the shield machine will successfully excavate the tunnel along the chosen sewer route before he commences the tunnel excavation. Once the tunnel excavation is commenced in a drive, the Contractor will be held fully and wholly responsible for the successful completion of the tunnel excavation and retrieval of the shield from the receiving shaft. In the event the tunnelling shield is unable to complete the tunnel drive, due to break down or any other reasons, the Contractor shall be fully responsible to recover the shield from the ground by a method approved by the Engineer.

It shall be clearly understood by the Contractor that the occurrence of such an event is preventable as the occurrence of such an event is generally due to Contractor's negligence in the "preventive maintenance" of the shield or driving of it to true level and gradient or his failure to determine accurately the expected ground conditions before commencement of the tunnel excavation.

The proposed remedial measures to retrieve the machine in the event of an occurrence of such an event as explained above shall be submitted to the Engineer for approval within 28 days from the commencement of the Contract.

The Contractor shall in his submittal clearly state the measures that he would implement to retrieve the shield without causing interruptions to traffic etc. The cost for such retrieval measures or any consequential expenditure or delays arising from thereof shall be entirely borne by the Contractor.

15.15 Measurement and Payment

Payment will be made for Complying with all requirements as described in Part 15 of the Technical Specification.

A provisional item is allowed for the contractor to price for rectifying the sunken stretches of the sewer. The exact quantity of sunken sewer is unknown but the contractor would be required to rectify the sunken stretches before carrying out the liner installation.

Any stretches that are sunken by more than 10% of the diameter of the sewer and/or as per instruction of Engineer in-charge shall be rectified including construction of new manholes. Manholes should be constructed at least every 50 metres.

The Quantity shown in the Bill of Quantities is Provisional. The Contractor will be paid for the actual length of sunken sewer replaced inclusive of manhole construction at the contract rate and no deviation limit applies to this item.

If no settled pipe areas are found after survey of the invert levels, no replacement of the sewer pipe will be carried out and no payment shall be made to the Contractor for this item.

After rehabilitation of the sewer, the Contractor shall restore the road/footpath surface to its original condition as per CPWD specifications and as directed by the Engineer-in-charge.

Payment will be made for the respective item under BOQ item for Complying with all requirements as described in Part 15 of the Technical Specification.

PART 16 - POST REHABILITATION WORKS

16.1 Post-Rehabilitation Cleaning and Inspection

Following completion of sewer rehabilitation works, the sewer shall be re- cleaned to remove all loose extraneous material including material and/or cut pipe segment, which shall be prevented from passing downstream.

The Contractor shall use suitable equipment for removing such material and disposed of the removed materials etc. at approved disposal grounds.

The sewer shall then be finally inspected by CCTV/Video to confirm that the sewer rehabilitation work is complete and the sewer is ready for commissioning.

The final Colour CCTV videos together with colour photographs of the rehabilitated sewer shall be submitted in accordance with the clauses in Item of the specification to the Engineer for final approval.

The Contractor shall include in his rates for complying with all the foregoing requirements in this Clause for which there are measured items in the Bills of Quantities.

16.2 Reinstatement of Laterals

The Contractor shall incorporate full details in the design and method statement of his detailed proposals for reintroducing lateral connections by remote cutter and/or manually.

16.3 Re-commissioning

- The sewer shall be re-commissioned by removing all stanks, stoppers, diversions, temporary pumping arrangements, etc. and informing all owners/occupiers affected by the works that normal sewerage services have been restored.
- The sewer shall not be re-commissioned until the Engineer has granted permission

The Engineer will retain the colour CCTV video disks and photographs of the approved renovation works.

16.4 Measurement and Payment

Payment will be made for Complying with all requirements as described in Part 16. of the Technical Specification. This item is for the Post Rehabilitation CCTV survey to be submitted in 2 sets. The Contractor is deemed to have made provision for all types of CCTV/Video survey inclusive of photographic and manual video survey work in large size sewers where conventional CCTV is not practical to use and for carrying out any additional CCTV survey as necessary to capture and document essential post rehabilitation works. Preparation of reports, CDs and area/location for viewing of the CCTV videos shall also be included.

The Payment shall be made as per BOQ Item.

PART 17 - CONTRACTOR'S SUBMITTALS (TO BE SUBMITTED WITH BID)

17.1 Construction programme and methodology

The bidder shall submit details of the equipment, materials and method of construction including method statements describing the sequence of works etc. and bench mark construction programme showing the time within which various significant activities of the work will be executed and completed. The expected date of start and completion of the works in various sections of the sewers shall be clearly indicated in the programme. The Bidder shall also submit with the bid an anticipated cash flow/ progress claim chart for the Contract. (All the above are to be submitted as Technical Schedule 17.1).

17.2 Durability Performance Data and Design Life

The bidder shall submit documentary evidence with the bid to substantiate that the proposed standalone structural lining system he offers shall have the specified life expectancy of not less than **50 years**. The fundamental factors which influence the durability of materials are:-

- Abrasion resistance
- Chemical and corrosion resistance
- Integrity of jointing
- Long term engineering properties such as tensile strength flexural modulus, stiffness, creep modulus and creep factor.

For the established lining materials sufficient durability data pertaining to the above factors are available to justify design life predictions up to 50 to 100 years. The bidder shall submit such data with his bid and establish the liner he proposes for the project shall have a life expectancy of not less than 50 years. In addition to this, the bidder shall also furnish the information and available laboratory and field test data and performance appraisal by independent third party testing institutions/authorities, municipal authorities and professional establishment to justify that the lining system proposed shall have a life expectancy of not less than 50 years. The bidder shall use the Durability Data form in Technical Schedule 17.2 to furnish the requested data along with the bid.

17.3 Bidder's Track Record on the Application of the proposed standalone structural lining System

Bidder's track record on the application of the proposed standalone structural lining system proposed for the project shall be submitted along with the bid. The bidder shall use the Technical Schedule 17.3 to provide the necessary information and data.

Innovation in relation to the best product and the best practice is encouraged and the Employer will consider all the options to get the best installed standalone structural product at competitive price. Hence sufficient documentation must be submitted with the bid (along with the Technical Schedule 17.3) to enable the Employer to carry out an initial investigation and appraisal of the standalone structural product and the method offered and to ascertain the benefit and the advantage of the product to the Employer.

The bidder shall use separate sheets to provide additional information, if necessary.

17.4 Design Procedure and Design Calculation for the Proposed Standalone Structural Liner

All structural design technique shall follow the guidelines given in the International Standards and design guidelines given in Part 11 of this Specification.

Bidder shall provide the detailed Design calculations and a summary of the design as Technical Schedule 17.4.

Suggested thicknesses of CIPP/GRP/SWL liners are tabulated in Table 17.7(a), 17.7 (b) & 17.7 (c) for bidders guidance. These thicknesses are based on certain design parameters as listed in Tables.

The bidder shall supply full details of their design calculations, including checking and review of the calculations duly signed and stamped by a qualified professional/ institution who is familiar with design procedure adopted in relevant ASTM's and WRc manual or any other International Standards/ Guidelines. **Any deviation in the design thicknesses submitted by the bidder's qualified professional and the suggested thicknesses as shown in Table 17.7 shall be fully explained.**

The design submission shall contain detailed design sheets. Only the standalone structural liner design based on the above referred procedure in the bid documents (Chapter 11) will be considered for evaluation purposes.

17.4.1 Design Procedure for Lining Thickness / Lining

Profile Materials

All material/ profile/ and proposed Resins (name and series) must have at least been used for ten (10) years in standalone structural liner for sewer rehabilitation works. Any materials not satisfying these criteria will be considered as non-conforming and the design will not be accepted.

Short term and Long Term Elastic Bending modulus to be provided by the manufacturer with Test results in accordance with ASTM, EN or AS standard.

Type II Standalone Liner thickness design for combination of soil and traffic loading.

Detailed Design Submission with Method Statement

The detailed structural design proposal and method statement submitted for each rehabilitation system shall cover each reach of sewer either in separate designs for each reach if liner thickness is variable or a single size wise design that covers all reaches of the project by considering the critical reach of maximum liner thickness. The design shall incorporate the requirements detailed in the Technical Specifications and shall be in accordance with Sewer Rehabilitation Manual 4th Edition WRc plc (2001) or other related internationally accepted standards which will ensure quality equivalent or higher. The design method shall be clearly identified and the design calculations presented in a manner consistent with good engineering practice and whereby all assumptions and design parameters are clearly identified. All linings shall be designed as Type-II STANDALONE structural liners and to withstand all external loadings including ground water with design parameters as specified in this specification. Each Liner design shall be vetted, and signed with seal by any Professional Engineer of IIT and registered Chartered Engineer. The design submission shall also indicate the reduction of cross section implicit in the design proposed by the Tenderer and the effect on hydraulic flow (for comparisons only) before and after lining assuming Manning average "n" value at 0.013 for

segmental lined sewer and $n=0.011$ for continuous lined sewer with smooth inner surface (for host sewer “n” taken at 0.017 and alternatively equivalent Colebrook White (Ks) formula by using $n= 0.012 Ks^{1/6}$). The Tenderer shall also submit technical data to demonstrate the performance of their proposed lining material including chemical resistance, abrasion resistance and long term properties of the Liner including third party independent test data and technical evaluations.

Notwithstanding the pre-tender design calculations submitted by the Tenderer along with his tender, the successful Tenderer shall also submit final design calculations based on actual site parameters and also vetted by any one of the above Professional Engineer for each length and size of sewer together with his installation method statement including lining manufacturing schedule for each sewer line to the

Engineer for approval prior to the commencement of any liner fabrications. Approval of the calculations will not relieve the Contractor of any of his obligations under the Contract.

Materials Submission

The Materials submission shall briefly describe the materials used including the type of resins at various layers in manufacturing process of liner and also replacing in settled/dislocated reaches pipes, their construction jointing and assembly method and any design standards or specifications to which they conform by complying with the following critical and worst design parameters.

- Soil density at 18 KN/m³
- Soil Modulus Value, E at 7 MPa
- Ovality to consider at 3% (MSWL), 0% (GRP) and 2% Minimum (CIPP)
- Water table at ground surface.
- Traffic Loading at Type –A (Heavy Traffic vide Road Department.)
- Invert depths by selecting the appropriate I.L. maximum of each sewer dia., which ranges from 5 m to 8.30 m.
- Also to adopt the worst design field parameters, wherever applicable for the liner design

The submission shall identify the following physical properties for the Liner in each direction and the independent test procedures to determine these properties (such as BS EN, ASTM, etc.) which shall be used as the Type testing requirement for the liner product:

Property	Value	Direction	Test Method
Short term flexural (bending) modulus	Specify MPa	Longitudinal Circumferential	Identify test method
Long term flexural (bending) modulus	Specify MPa	Longitudinal Circumferential	Identify test method
Short term flexural (bending) strength	Specify MPa	Longitudinal Circumferential	Identify test method
Long term flexural (bending) strength	Specify MPa	Longitudinal Circumferential	Identify test method
Short term tensile strength	Specify MPa	Longitudinal Circumferential	Identify test method
Long term tensile strength	Specify MPa	Longitudinal Circumferential	Identify test method

Long term permissible flexural (bending) strain	Specify %	Longitudinal Circumferential	Identify test method

The submission should clearly indicate in the materials specifications and design procedures if the product has uni-directional or bi-directional properties. The material properties in the longitudinal direction versus the circumferential direction should also be clearly identified.

The materials submission shall also describe the circumferential pipe jointing system. Seal materials and its performance characteristics.

The materials submission shall provide information on the liner manufacturer, experience approvals and third party certification.

The materials submission shall include the accreditation certification of the testing laboratory where type testing of the liner has been undertaken.

The materials submittal shall include type of testing of liner and replacement pipe critical joints.

For grout, the submission shall identify the type and method of grout (including admixtures) and the relevant physical properties (including compressive strength) and the independent test procedures used to verify these properties (such as BS EN, ASTM procedure)

17.4.1.1 CIPP Liner:

The liner thickness shall be determined in accordance with ASTM F1216-03. The water table level for design purposes is at ground level. CIPP liner thickness shall also satisfy the hydraulic buckling resistance in accordance with Specification 11.9.1 for Type II hydraulic design.

17.4.2 GRP Liner:

GRP liner thickness must satisfy the requirements of Specification clause 11.9.2 for Type II standalone liner.

WRc Manual Volume II is used to calculate the Liner Thickness.

The Factor of Safety against Buckling under full soil and Traffic loading in accordance with equation

11.9.2 shall be greater than 2.5

GRP liner thickness shall also satisfy hydrostatic loading in accordance with Specification clause 11.9.2

In accordance with the Specification, the water table level for design purposes is at ground level. The design Head of water therefore is equal to the depth of pipe invert level below ground level.

Maximum deflection to be checked to ensure it does not exceed 6%

Maximum permissible flexural strain to be checked to ensure it does not exceed 0.5%.

17.4.3 SWL Lining:

The most commonly applicable design standards are ASTM F 1741, AS/NZS 2566, and ATV-DVWK-M 127 E Design of liner shall be done as per clause 11.9.3.

17.5 Bidder's Proposed Liner Thickness and Reduction in Cross Sectional Area.

The bidders shall submit calculations to show the cross sectional area of the sewers before and after rehabilitation. The cross sectional area calculations for circular sewers shall be based on the geometry of

the sewers and the formula given in the Technical Schedule 17.5. The cross sectional areas shall be expressed in square meters and are rounded off to two decimal places. A table is provided in Technical Schedule 17.5 to enable the bidders to provide the liner thickness, grout thickness and reduction in the cross sectional area of the sewer etc. with his bid.

Note to Bidders: All the Technical Schedules and the requested information shall be furnished with the bid. The information shall be accurate and correct. Any attempt by the bidder's to provide inaccurate or false information or incomplete data will result in his bid being not considered for evaluation.

The bids submitted without the Technical Schedules will also result in his bid being not considered for evaluation

17.6 Replacement of Settled Sewers.

The bidders shall submit a work method statement for replacement of settled sewers by narrow trench method or trenchless methods.

Full details including sheet piling as well as a construction sequence shall be submitted as per specification Part 15 of vol. II.

17.7 Bidder's Declaration

The bidders shall sign and acknowledge the Bidder's Declaration in Technical Schedule No.17.6.

TECHNICAL SCHEDULE 17.2

Durability Performance Data and Design Life

Durability assessment of the product in sewer environment in tropical climate, (expected loss of thickness in mm and Engineering properties with age/time)

S. N o.	Requirements	Bidder' s Comment				Page No. (from - to)
		Abrasion resistance	Chemical &Corrosion Resistance	Integrity of jointing	Long Engineerin g properties	
1	Name & series of Resin to be used					
2	History of use of above Resin for at least 10 years in sewer conditions (submit projects and dates separately)	Yes/No	Yes/No	Yes/No/NA	Yes/No	
3 (a)	Availability of test data by independent testing Institutions/authorities (Neat Resin & Composite material Separately)	Yes/No	Yes/No	Yes/No/NA	Yes/No	
3 (b)	Availability of test data by independent testing Institutions/authorities for other structural liner.	Yes/No	Yes/No	Yes/No/NA	Yes/No	
4	If yes describe the data submitted with the bid.					
5 (a)	Availability of in house test data by the supplier (Neat Resin & Composite material Separately)	Yes/No	Yes/No	Yes/No/NA	Yes/No	
5 (b)	Availability of in house test data by the supplier for other structural liner					
6	If yes, describe the data submitted with the bid.					
7	Expected thickness loss in mm.(Based on track Records)					

	In 5 years period			NA	NA	
	In 10 year period					
	In 50 year period					

S. N o.	Requirements	Bidder' s Comment				Page No. (from - to)
		Abrasion resistance	Chemical &Corrosion Resistance	Integrity of jointing	Long Engineerin g properties	
8	How long (as of January, 2016) the liner is in use in Sewer Environment.					
9	To submit details of liners in use (Location, sizes, length and name of Client)					
10	Manufacturing and Joints defects known/reported by Clients since the installation of the liner.					
8	Change in Engineering properties (Neat Resin & Composite material/ for other structural liner Separately)				Values	
8a	Tensile Strength (MPa)					
	In 5 years					
	In 10 years					
	In 50 years					
8b	Flexural modulus (MPa)					
	In 5 years					
	In 10 years					
	In 50 years					
8c	Creep Modulus (MPa)					
	In 5 years					
	In 10 years					
	In 50 years					
8d	Creep Factor					
	In 25 years					
	In 50 years					

The above data shall be substantiated with documents, Independent test reports, client appraisal report, In house tests and technical report.

Bidder's Track Record on the application of Proposed Structural Lining
System (Data to be provided for 3 or more projects in separate
sheets)

S. No.	Requirements	Tick if submitted	Page No. (from - to)
1.	Product name and description of the proposed lining system used in the Contracts CIPP/ GRP/MSWL/Other (if any)		
2.	Type of materials used in the liner/lining in the Contracts		
3.	Whether the liner has been used for Standalone structural Liner for Fully Deteriorated Sewer Pipe Rehabilitation Works of similar nature and complexity		
4.	Give previous history of lining installations for similar sized conduits. (Use separate sheet for each project.)		
5.	Project Name } Size of sewers } Length of sewers } Value of work } Contract name } Name of the Contractor} Contact Address of Client}		
6.	Contact Numbers Telephone: Facsimile:	Email:	
7.	To what design guidelines the structural liners have been designed.		
8.	Engineering properties:	Values	
	Short Term Tensile Strength (Mpa)		
	Short term Flexural Strength (Mpa)		
	Short term Flexural Modulus (Mpa)		
	Long Term (50Year) Flexural modulus (Mpa)		
	Long Term Tensile Strength (Mpa)		
	Long Term Flexural Strength (Mpa)		
	Maximum allowable long term strain (Percentage)		
	Poisson Ratio		
	Hardness		
	Coefficient of thermal expansion		
	Curing time, if applicable		
	Any other key tests with results.		
9.	Test method and relevant standard used to obtain each material property values as above. (Submit copy of the English version of the relevant standards. (provide in a separate sheet)		

10.	Any Technical publication on the product, if so included copies of the publication.		

Data on the Proposed lining System and Design Calculations

Sl. No.	Requirements	Tick if submitted	Page No. (from - to)
1.	Name and Description of the lining system (s)		
2.	Method of installation, plant and equipment to be used for each lining system.		
3	Design Calculations for maximum loading case for each different lining sizes duly vetted by a qualified professional who is familiar with design procedure.		
4	Ability to meet the bending radius requirements for the sewers.		
5	Internal dimensions of each sewer after rehabilitation.		
6	Details of the impact of any irregularities of the internal geometry of lining (e.g. bends, localised reduction in diameter and ovalisation of pipe non standard pipe dia.)		
7	Details of any changes to existing access openings including details of the size and location of any required additional openings.		
8	Methods used for preparation of the surface of the existing conduit prior to lining.		

TECHNICALSCHEDULE 17.5

Table of Bidder's Proposed Liner Thickness /Profile Dimension and Reduction in Cross Sectional Area PROPOSED LONG

TERM FLEXURAL MODULUS

S. No.	PACKA GE NO.	SEWER	Pre Rehabilitated sewer						Loadings kN/sqm			Post Rehabilitated Sewer					Area Reductio n in (%)
			Dia. 1 (mm)	Dia. 2 (mm)	Shape	Area (sqm)	Depth To invert (m)	Cover depth (m)	Soi l	Traffic	Hydrosta tic	Liner Thickne ss (mm) / Profile dimensio n	Grout Thickne ss (mm)	Dia. 1 (m m)	Dia. 2 (mm)	Area (sqm)	
1	2	3	4	5	6	7	9	10	11	12	13	14	15	16	17	18	19

Notes:

Columns 4 &16: Dia.1= Vertical Diameter: Columns 5 &17: Dia.2= Horizontal Diameter.

Columns 7 &18: Cross sectional area of sewer.

Liner thickness will vary for different pipe depths. Bidder shall state liner thickness for each range of invert depths.

(Extra Lines can be added to itemise structural liner thicknesses for each pipe diameter and each range of depths.)

The Area of the existing pipe is calculated on Nominal Diameter (Column 7).

TECHNICAL SCHEDULE 17.6:
BIDDER'S DECLARATION
UNDERTAKING BY THE BIDDER

We,

1. Confirm that if the proposed thickness of the liner as submitted in this Bid is found to be inadequate during the detailed design stages, the thickness will be adjusted without any variation of bid price or substance of the Bid. If found to be adequate, the thickness will remain as that proposed in our bid.
2. Confirm that all construction and physical difficulties for installing the sewer liner have been understood and adequate provision in this Bid Price has been made to overcome such difficulties without any variation to the Bid Price or substance of the Bid.
3. Confirm that any conflict or ambiguity in the Bid Documents has been satisfactorily clarified by DJB and that the documents have been understood and all works have been identified and included in the Bid Price. No claim or variation of The Bid Price will be sought based on any conflicting clauses or ambiguity in these documents.
4. Confirm that we will commit sufficient resources to complete the works in the stipulated Time for Completion.

SIGNED:

.....Name of Authorised Signatory

.....Title

.....Company Name and Company Seal

.....Date

SUGGESTED LINER THICKNESS FOR STRUCTURAL LINERS

The suggested liner thickness for structural liners in Table 17.7 is for bidder's guidance only and is based on certain assumed design parameters as indicated in the table. The bidder's use of the information in the table is entirely at his own risk and cost and neither DJB nor the Consultant assume any responsibility for the design or the suggested thickness and the bidder's shall make his own design by a professional engineer who is familiar with structural liner design as per WRc manual or any similar design manual for standalone liner designs. The final acceptance of the bidder's thickness will be based on the site conditions and subject to checking by DJB and its Consultant.

Table 17.7 TABLE OF SUGGESTED THICKNESS FOR CIPP STRUCTURAL LINER

S No.		DIMENSIONS			LIVE LOADS	CIPP Standalone Type II Structural Liners
	SEWER	Diameter (mm)	Shape	Depth To Invert (m)	Traffic Condition	Suggested Liner thickness (mm) Long Term flexural modulus 1700mpa soil modulus
1	Rehabilitation of 1600/1200 mm dia trunk sewer line from Amichand chowk to Old kalyanpuri SPS by open technology Method (Structurally Stand Alone Pipe) under EE(C)Dr-VIII	1600	Circular	7.00 to 7.5	IRC AA	37
			Circular	7.50 to 8.0	IRC AA	37.5
			Circular	8.0 to 8.4	IRC AA	38.2
			Circular	8.5 to 8.7	IRC AA	39
2						

NOTE: - The depth of Sewer was calculated at Manhole cover level to invert level.

SUGGESTED LINER THICKNESS FOR STRUCTURAL LINERS

The suggested liner thickness for structural liners in Table 17.7 is for bidder's guidance only and is based on certain assumed design parameters as indicated in the table. The bidder's use of the information in the table is entirely at his own risk and cost and neither DJB nor the Consultant assume any responsibility for the design or the suggested thickness and the bidder's shall make his own design by a professional engineer who is familiar with structural liner design as per WRc manual or any similar design manual for standalone liner designs. The final acceptance of the bidder's thickness will be based on the site conditions and subject to checking by DJB and its Consultant.

Table 17.7 TABLE OF SUGGESTED THICKNESS FOR GRP STRUCTURAL LINER

S No.	SEWER	DIMENSIONS			LIVE LOADS	GRP Standalone Type II Structural Liners
		Diameter mm	Shape	Depth To Invert m	Traffic Condition	Suggested Liner thickness (mm) Long Term flexural modulus
1	Rehabilitation of 1600/1200 mm dia trunk sewer line from Amichand chowk to Old kalyanpuri SPS by open technology Method (Structurally Stand Alone Pipe) under EE(C)Dr-VIII	1600	Circular	7.00 to 7.5	IRC AA	21.50
			Circular	7.50 to 8.0	IRC AA	22.50
			Circular	8.0 to 8.4	IRC AA	23.40
			Circular	8.5 to 8.7	IRC AA	24.20
2						

NOTE: - The depth of Sewer was calculated at Manhole cover level to invert level.

SUGGESTED LINER THICKNESS FOR STRUCTURAL LINERS

The suggested liner thickness for structural liners in Table 17.7 is for bidder's guidance only and is based on certain assumed design parameters as indicated in the table. The bidder's use of the information in the table is entirely at his own risk and cost and neither DJB nor the Consultant assume any responsibility for the design or the suggested thickness and the bidder's shall make his own design by a professional engineer who is familiar with structural liner design as per WRC manual or any similar design manual for standalone liner designs. The final acceptance of the bidder's thickness will be based on the site conditions and subject to checking by DJB and its Consultant.

Table 17.7 TABLE OF SUGGESTED THICKNESS FOR MSWL STRUCTURAL LINER

S No.	SEWER	DIMENSIONS			LIVE LOADS	MSWL Standalone
		Dia met er mm	Shape	Depth To Invert m	Traffic Condition	Suggested Liner thickness (mm) Long Term flexural modulus
1	Rehabilitation of 1600/1200 mm dia trunk sewer line from	1600	Circular	7.00 to 7.5	IRC AA	19-25RS PROFILE, Steel Reinforcement 1.20 mm, profile height 25 mm and Long Term Ring stiffness 2504 N/m/m
			Circular	7.50 to 8.0	IRC AA	
			Circular	8.0 to 8.4	IRC AA	
			Circular	8.5 to 8.7	IRC AA	
2	Amichand chowk to Old kalyanpuri SPS by open technology Method (Structurally Stand Alone Pipe) under EE(C)Dr-VIII					

NOTE: - The depth of Sewer was calculated at Manhole cover level to invert level.

Bill of Quantities

Sr.No	DESCRIPTION	UOM	BOQ		
			QTY.		AMOUNT
1	Corridor survey to determine sewer alignment including locating MH/Chamber, tracing, uncovering of buried manholes, proximity of structure, measurement of exact length centre to centre MH/Chamber, taking Ground Levels, invert levels(after de-silting) & Geotechnical Investigation in the vicinity of sewer route. Submission of A0 size indicating GIS Coordinates of all manholes in total 7 sets.	Meter	2800		
2	Providing and fixing 2 m high MS sheet barricading with frame of angle iron 40x40x6mm every post to be welded with MS Channel ISLC100X50X6.4mm horizontal i/c making of hole in the channel for providing embedding of 16mm dia round torquw bars in the road as per drawings(For trunk sewer work only).	meter	2044		
3	Temporary / permanent plugging and blocking of sewer line, branch connections for diversion of flows and removals of all plugs etc. on completion of work.				

A	450mm dia sewer line	Each	5		
B	500mm dia sewer line	Each	5		
C	600mm dia sewer line	Each	5		
D	700mm dia sewer line	Each	5		
E	800mm dia sewer line	Each	5		
F	900mm dia sewer line	Each	5		
G	1000mm dia sewer line	Each	5		
H	1100mm dia sewer line	Each	5		
I	1200mm dia sewer line	Each	10		

J	1400mm dia sewer line	Each	5		
4	Providing everything else required for diversion of flow by pumping and / or by passing and to maintain the sewerage system functioning normal and managing the flow without any surcharging overflows etc. during the de-silting works of the sewer line to the satisfaction of the Engineer-in-charge. (Pumping sewage inliding cost of material, equipment, pumps, generators, hose pipes, flow meters, labour, T&P diesel/ lubricating oils and maintenance etc all compltete during de-silting of sewer line). (c) 1200 mm Dia Sewer line	Meter	300		
5	Providing everything else required for diversion of flow by pumping and / or by passing and to maintain the sewerage system functioning normal and managing the flow without any surcharging overflows etc. during the rehabilitation works of the sewer line to the satisfaction of the Engineer-in-charge. 1600 mm Dia Sewer line	Meter	2500		

6	Loosen desilt and thoroughly clean and remove debris and objects such as boulders, bricks etc, bacteriological slimes, roots, encrustations, grease, carbonated deposits, etc from the sewer line by super sucker machine including disposal of silt / debris / malba / objects etc, to the dumping sites as per the direction of the engineer-in-charge, within the Delhi NCT area. 1200 mm Dia Sewer for :-				
A	Slab-I Above 80%	meter	10		
B	Slab-II 70%-80% Silt	meter	250		
C	Slab-III 60%-70% Silt	meter	10		
D	Slab-IV 50%-60% Silt	meter	10		
E	Slab-V 40%-50% Silt	meter	10		
F	Slab-VI Upto 40%	meter	10		
7	Loosen desilt and thoroughly clean and remove debris and objects such as boulders, bricks etc, bacteriological slimes, roots, encrustations, grease, carbonated deposits, etc from the sewer line by super sucker machine including disposal of silt / debris / malba / objects etc, to the dumping sites as per the direction of the engineer-in-charge, within the Delhi NCT area. 1600 mm Dia Sewer for				
A	Slab-I Above 80%	meter	10		

B	Slab-II 70%-80% Silt	meter	2450		
C	Slab-III 60%-70% Silt	meter	10		
D	Slab-IV 50%-60% Silt	meter	10		
E	Slab-V 40%-50% Silt	meter	10		
F	Slab-VI Upto 40 Silt	meter	10		
8	Pre-rehabilitation colour CCTV/ Photographic survey including pan and zoom inspection of laterals and defects and submission of video tapes or CD inclusive of colour photographs at every 10m interval printed off video printer to the Engineer in total 2 sets.	Meter	2800		
	Also allow for laser profiling of the sewer at every 10m interval and submit drawings with 4 diameter measurements (vertical, horizontal and cross measurements)				

9	Design, manufacture, supply, deliver on site and install any one of these structural lining system (UV cured CIPP or Hot water cured CIPP or GRP or MWSL) including preparatory site work such as making good the sewer etc, grouting (wherever applicable)/ sealing of cracks and joints suitable as per site and local repairs to provide structural action consistent with the assumptions made in the structural design and construction of working shaft(wherever applicable) and reinstatement and making good of rehabilitated sewer and lateral connections etc and end sealing of the migration gap between the liner wall to wall (inner face between two successive manholes. This item is payable subject to completion of manholes/Chambers rehabilitation within the stretch of the completed liner for 1200mm				
		Meter	350		

10	Design, manufacture, supply, deliver on site and install any one of these structural lining system (UV cured CIPP or Hot water cured CIPP or GRP or MWSL) including preparatory site work such as making good the sewer etc, grouting (wherever applicable)/ sealing of cracks and joints suitable as per site and local repairs to provide structural action consistent with the assumptions made in the structural design and construction of working shaft(wherever applicable) and reinstatement and making good of rehabilitated sewer and lateral connections etc and end sealing of the migration gap between the liner wall to wall (inner face between two successive manholes. This item is payable subject to completion of manholes/Chambers rehabilitation within the stretch of the completed liner for 1600 mm				
		Meter	2600		
11	Rehabilitation of manholes/chamber, including removal of old plaster, sealing of leaks, preparing surface after thorough cleaning, washing including.	each	12		

I)Application of 12 mm thick plaster with High strength, abrasion- resistance epoxy reinstatement mortar over a coat of Epoxy Resin concrete/ mortar bond coat of approved brand and manufacture . The plaster shall be applied on a well prepared surface after thorough cleaning and washing upto 1 meter high from top of benching and channel.				
II) 12 mm cement plaster of mix 1:4 (1 cement : 2 Coarse sand) on remaining portion of manhole including cost of necessary scaffolding, curing and finishing etc ,providing& applying Epoxy Resin coating for Steel/ Concrete chemical and acid resistant resin based protective coating with hardener in two or more coats of approved brand and manufacture to give a minimum thickness of 400 microns including preparation of surface etc over the plastered surface.				
III) Installation of new SFRC EXTRA HEAVY duty (EHD35) FRAME & COVER marked with DJB, SEWER, EHD35 year of manufacture trade name to required level as specified including installation of PVC encapsulated footrests as per requirement, and directed by the Engineer in charge. Manhole of dia 1520mm upto I.L =4 m				

12	Add or Deduct per meter depth for rehabilitation of manholes/chambers including removal of old plaster, sealing of leaks, preparing surface after thorough cleaning, washing, application of 12 mm thick plaster 1:4 (1 SR cement: 4 Coarse sand),including cost of necessary scaffolding, curing and finishing etc., providing& applying Epoxy Resin coating for Steel/ Concrete chemical and acid resistant resin based protective coating with hardener in two or more coats of approved brand and manufacture to give a minimum thickness of 400 microns including preparation of surface etc, installation of P.V.C encapsulated footsteps as per requirement and directed by the Engineer in charge. Manhole of dia 1520mm	meter	24		
13	Rehabilitation of manholes/chamber, including removal of old plaster, sealing of leaks, preparing surface after thorough cleaning, washing including. I)Application of 12 mm thick plaster with High strength, abrasion- resistance epoxy reinstatement mortar over a coat of Epoxy Resin concrete/ mortar bond coat of approved brand and manufacture . The plaster shall be applied on a well prepared surface after thorough cleaning and washing upto 1 meter high from top of benching and channel.	Each	100		

	II) 12 mm cement plaster of mix 1:4 (1 cement : 2 Coarse sand) on remaining portion of manhole including cost of necessary scaffolding, curing and finishing etc ,providing& applying Epoxy Resin coating for Steel/ Concrete chemical and acid resistant resin based protective coating with hardener in two or more coats of approved brand and manufacture to give a minimum thickness of 400 microns including preparation of surface etc over the plastered surface. III) Installation of new SFRC EXTRA HEAVY duty (EHD35) FRAME & COVER marked with DJB, SEWER, EHD35 year of manufacture trade name to required level as specified including installation of PVC encapsulated footrests as per requirement, and directed by the Engineer in charge. Manhole of dia 1830mm upto I.L =5 m				
14	Add or Deduct per meter depth for rehabilitation of manholes/chambers including removal of old plaster, sealing of leaks, preparing surface after thorough cleaning, washing, application of 12 mm thick plaster 1:4 (1 SR cement: 4 Coarse sand),including cost of necessary scaffolding, curing and finishing etc., providing& applying Epoxy Resin coating for Steel/ Concrete chemical and acid resistant resin based protective coating with hardener in two or more coats of approved brand and manufacture to give a minimum thickness of 400 microns including preparation of	meter	200		

	surface etc, installation of P.V.C encapsulated footsteps as per requirement and directed by the Engineer in charge. Manhole of dia 1830mm				
15	Raising of manholes to required level by demolishing/reconstruction to taper portion and restoration of road/reconstruction of road/ ground surface to its original condition as directed by engineer in charge.				
	Manhole of dia 1520mm	each	20		

16	Constructing brick masonry circular manhole 3'-0" or 0.91 m dia at bottom and 1'-10" or 0.56 m dia at top built in brick work with extruded burnt sewer bricks confirming to IS 4885-1988 in curved in cement mortar 1 : 4 (1 cement : 4 coarse sand) excluding excavation and soling but including 9" or 0.23 m thick foundation cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 graded stone 40mm nominal size) including centering and shuttering and fixing of SRFC manhole cover and frame (heavy duty) 560 mm dia internal fixed in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) and 12mm thick plaster both in side and out side with cement mortar 1:4 (1 cement : 4 coarse sand) and inside plaster to be finished with a floating coat of neat cement making necessary channel in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) all complete as per departmental drawing and as directed by engineer-in-charge. Note: Cement required 2.68 Qtls. each)	Each	2		
17	Extra per meter depth of 3'-0" or 0.91 m internal dia circular manhole beyond 3'-0" or 0.91 m and upto 5'-6" or 1.67 m depth built in brick work with extruded burnt sewer bricks confirming to IS 4885-1988 in curved in cement mortar 1:4 (1 cement : 4 coarse sand) 12 mm thick plaster both inside and outside with cement mortar 1:4 (1 cement : 4 coarse sand) and inside plaster to be with a floating coat of neat cement as per departmental drawings and as directed by the engineer-in-charge. (Cement reqd=1.35 qtl each)	meter	1		

18	Constructing brick masonry circular manhole 4'-00" dia or 1.22 m internal dia at bottom and 1'-10" (0.56m) dia at top depth up to 1.L 5'-6" or 1.67 m built in brick work with extruded burnet sewer bricks (In FPS size) conforming to IS-4885 - 1988 in curved in cement mortar 1:4 (1 cement :4 coarse sand) excluding excavation, but including 12" or (0.30 m) thick foundatin concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 40mm nominal size) including fixing of SFRC manhole cover and frame (heavy duty) 560 mm internal dia fixed in 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) and 12 mm thick plaster both in side and out side with cement mortar 1:4 (1cement : 4 coarse sand) and inside plaster to be finished with a floating coat of neat cement. Making necessary channel in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) all complete as per departmental drawings and as per directed by Engineer-in-Charge. 1. Cement required 5.46 Qtl / Each 2. Cost of manhole cover and frame shall be be paid seperatly. 3. Cost of providing and fixing of plastic encapsulated foot rest will be paid seperately.	each	2		

19	Extra per meter dpth of 4'-00" dia or 1.22 m dia internal circular manhole beyond 5'-6" or 1.67 m up to 1.L 7'-6" or 2.28 m depth in brickwork extruded burnt sewer bricks (In FPS size) with conforming to IS-4885 - 1988 in curved in cement mortar 1:4 (1 cement :4 coarse sand) 12 mm thick plaster both in side and out side with cement mortar 1:4 (1cement : 4 coarse sand) and inside plaster to be finished with a floating coat of neat cement and all complete as per departmental drawings and as per directed by Engineer-in-Charge. 1. Cement required 1.62 Qtl/meter depth 2. Cost of providing and fixing of plastic encapsulated foot rest will be paid seperately.	meter	1		
20	Constructing brick masonry circular manhole 5'-00" dia or 1.52 m internal dia at bottom and 1'-10" (0.56m) dia at top depth up to 1.L 7'-6" or 2.28 m built in brick work with extruded burnet sewer bricks (In FPS size) conforming to IS-4885 - 1988 in curved on plain in cement mortar 1:4 (1 cement :4 coarse sand) excluding excavation and soling, but including 12" or (0.30m) thick foundatin concrete 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 40mm nominal size) including fixing of SFRC manhole cover and frame (heavy duty) 560 mm internal dia fixed in 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) and 12 mm thick plaster both in side and out side with cement mortar 1:4 (1cement : 4 coarse sand) and inside plaster to be finished with a floating coat of neat cement. Making necessary channel in cement concrete 1:2:4 (1 cement : 2 coarse	Each	4		

	sand : 4 graded stone aggregate 20mm nominal size) all complete as per departmental drawings and as per directed by Engineer-in-Charge. 1. Cement required 13.71 Qtl / Each 2. Cost of manhole cover and frame shall be be paid seperatly. 3. Cost of providing and fixing of plastic encapsulated foot rest will be paid seperately.				
21	Extra per meter depth of 5'-00" dia or 1.52 m dia internal circular manhole built with brickwork with extruted burnt sewer bricks conforming to IS-4885 - 1988 in curved in cement mortar 1:4 (1 cement :4 coarse sand) 12 mm thick plaster both in side and out side with cement mortar 1:4 (1cement : 4 coarse sand) and inside plaster to be finished with a floating coat of neat cement and all complete as per departmental drawings and as per directed by Engineer-in-Charge (Cost of providing and fixing of plastic encapsulated foot rest will be paid seperately). (A) Beyond 7'-6" or 2.28 m and up to 1.L 13'-8" or 4.16 m (Cement required 3.50 Qtl/meter depth)	meter	7.52		

22	(b) Extra per meter depth of 5'-00" dia or 1.52 m dia internal circular manhole built with brickwork with extruded burnt sewer bricks conforming to IS-4885 - 1988 in curved in cement mortar 1:4 (1 cement :4 coarse sand) 12 mm thick plaster both in side and out side with cement mortar 1:4 (1cement : 4 coarse sand) and inside plaster to be finished with a floating coat of neat cement and all complete as per departmental drawings and as per directed by Engineer-in-Charge (Cost of providing and fixing of plastic encapsulated foot rest will be paid seperately). Beyond 13'-8" or 4.16 m and up to 1.L 20'-00" or 6.09 m (Cement required 5.08 Qtl/meter depth)	meter	7.72		
23	(c)Extra per meter depth of 5'-00" dia or 1.52 m dia internal circular manhole built with brickwork with extruded burnt sewer bricks conforming to IS-4885 - 1988 in curved in cement mortar 1:4 (1 cement :4 coarse sand) 12 mm thick plaster both in side and out side with cement mortar 1:4 (1cement : 4 coarse sand) and inside plaster to be finished with a floating coat of neat cement and all complete as per departmental drawings and as per directed by Engineer-in-Charge (Cost of providing and fixing of plastic encapsulated foot rest will be paid seperately). Beyond 20'-0" or 6.09 m and up to IL 37"-00" OR 11.27 m (Cement required 5.62 Qtl/meter depth)	meter	20.72		
24	Post Linning/ Rehabilitation CCTV video survey/Photographic survey of the rehabilitated sewer (prior to commissioning) and submit video/photographic records in CD and still photographs taken at	meter	2950		

	10m interval in 2 sets.				
25	Rectify settled sewers with new S & S RCC NP3 class pipes Conforming to IS:458 by narrow trench excavation method or trenchless method as required so as to make the sewer functional without any reverse gradient as per approval of the Engineer induding supply, transport, delivery & construction. After rehabilitation of the sewer, the contractor shall restore the ground/footpath surface to its original condition as per CPWD specifications and as directed by The Engineer-in- charge. (The cost of construction of new Man holes shall be paid under relevant item of BOQ.) (i) 1200 mm dia sewer depth upto 7.50 m	meter	34		
26	Add or deduct per meter depth for rectification of sunken sewer by narrow trench excavation method	M	85		

27	Rectify settled sewers with new S & S RCC NP3 class pipes conforming to IS:458 by narrow trench excavation method or trenchless method as required so as to make the sewer functional without any reverse gradient as per approval of the Engineer including supply, transport, delivery & construction. After rehabilitation of the sewer, the contractor shall restore the ground/footpath surface to its original condition as per CPWD specifications and as directed by The Engineer-in-charge. (The cost of construction of new Man holes shall be paid under relevant item of BOQ.) (i) 1600 mm dia sewer upto desired depth as per engineer incharge	meters	220		
28	Rectify settled/sunken sewers by methods that require no dewatering such as micro-tunneling & including cost of Pipe jacking method by installing stainless steel collared, 3mm thick HDPE lined RCC NP4 jacking pipes as manufactured conforming to IS:438-2003 in all soil/conditions at suitable 17 depths including entry & exit shafts and construction of new manholes as required so as to make the sewer functional without any reverse gradient as per approval of the Engineer including supply, transport, delivery & construction & jet grouting to stabilise ground and or fill voids etc, as required to prevent ground movement and disturbance to nearby structure & amenities including filling of pits & disposal of Surplus earth &	meter	136		

	malba etc and making the connections with the existing sewers complete. After rectification of the sewer, the contractor shall restore the ground/footpath surface to its by The Engineer-in-charge (g) 1200 mm dia sewer line.				

29	Rectify settled/sunken sewers by methods that require no dewatering such as micro-tunneling & including cost of Pipe jacking method by installing stainless steel collared, 3mm thick HDPE lined RCC NP4 jacking pipes as manufactured conforming to IS:438-2003 in all soil/conditions at suitable 17 depths including entry & exit shafts and construction of new manholes as required so as to make the sewer functional without any reverse gradient as per approval of the Engineer including supply, transport, delivery & construction & jet grouting to stabilise ground and or fill voids etc, as required to prevent ground movement and disturbance to nearby structure & amenities including filling of pits & disposal of Surplus earth & malba etc and making the connections with the existing sewers complete. After rectification of the sewer, the contractor shall restore the ground/footpath surface to its by The Engineer-in-charge (g) 1600 mm dia sewer line .	meter	880		

33(a)	Constructing brick masonry circular manhole 6'-0" or 1.83 m internal dia at bottom and 1'-10" or 0.56 m dia at top, up to IL 12'-6" or 3.81 m built in brickwork with extruded burnt sewer brick (in FPS Size) conforming to IS-4885-1988 in curved on plan in cement mortar 1:4 (1 cement : 4 coarse sand) excluding excavation & soling, but including 12" or (0.30 m) thick foundation cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 40 mm nominal size) including centring and shuttering and fixing SFRC manhole cover and frame (Heavy Duty) 560 mm internal dia in cement conc. 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) and 12 mm thick cement plaster both inside and outside with cement mortar 1:4 (1 cement : 4 coarse sand) and inside plaster to be finished with a floating coat of neat cement. Making necessary channel in cement conc. 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) all complete as per departmental drawings and as directed by Engineer-in-Charge. Note: 1. Cement required 13.71 Quintals/Each 2. Cost of Manhole frame and cover shall be paid separately. 3. Cost of providing and fixing plastic encapsulated foot rest shall be paid separately.	each	8		

33	Extra per meter depth of 6'-0" dia Or 1.829 m dia internal circular manhole built with brickwork with extruded burnt sewer brick (in FPS size) conforming to IS 4885-1988 in curved in cement mortar 1:4 (1 cement : 4 coarse sand) 12 mm thick cement plaster both inside and outside with cement mortar 1:4 (1 cement : 4 coarse sand) and inside plaster to be finished with a floating coat of neat cement and all complete as per departmental drawings and as directed by the Engineer-in-Charge. (cost of providing and fixing of plastic encapsulated foot rest shall be paid separately).				
(b)	Beyond Detail for 3.81 meter and upto IL 6.096 meter depth (12'-6" to 20'-0") cement required 5.06 Qtl./ meter depth	meter	18.37		
(c)	Beyond Detail for 6.096 meter to 10.668 m depth (20'-0" to 35'-0") (cement required 6.10 Qtl./ meter depth)	meter	36.57		
31	Supplying and stacking at site SFRC manhole frame and cover with steel fibre of ISI marked conforming to IS 12592 part I of EHD -35 with matching frame of EHD-35 IS: 12592 part II with 875 mm external dia and clear 560 mm internal dia	each	10		
32	Fixing of SFRC manhole cover and frame, 560 mm dia HD EHD 35.	each	10		
34	12 mm cement plaster 1:4 (1 cement : 4 coarse sand)	Sqm	10		

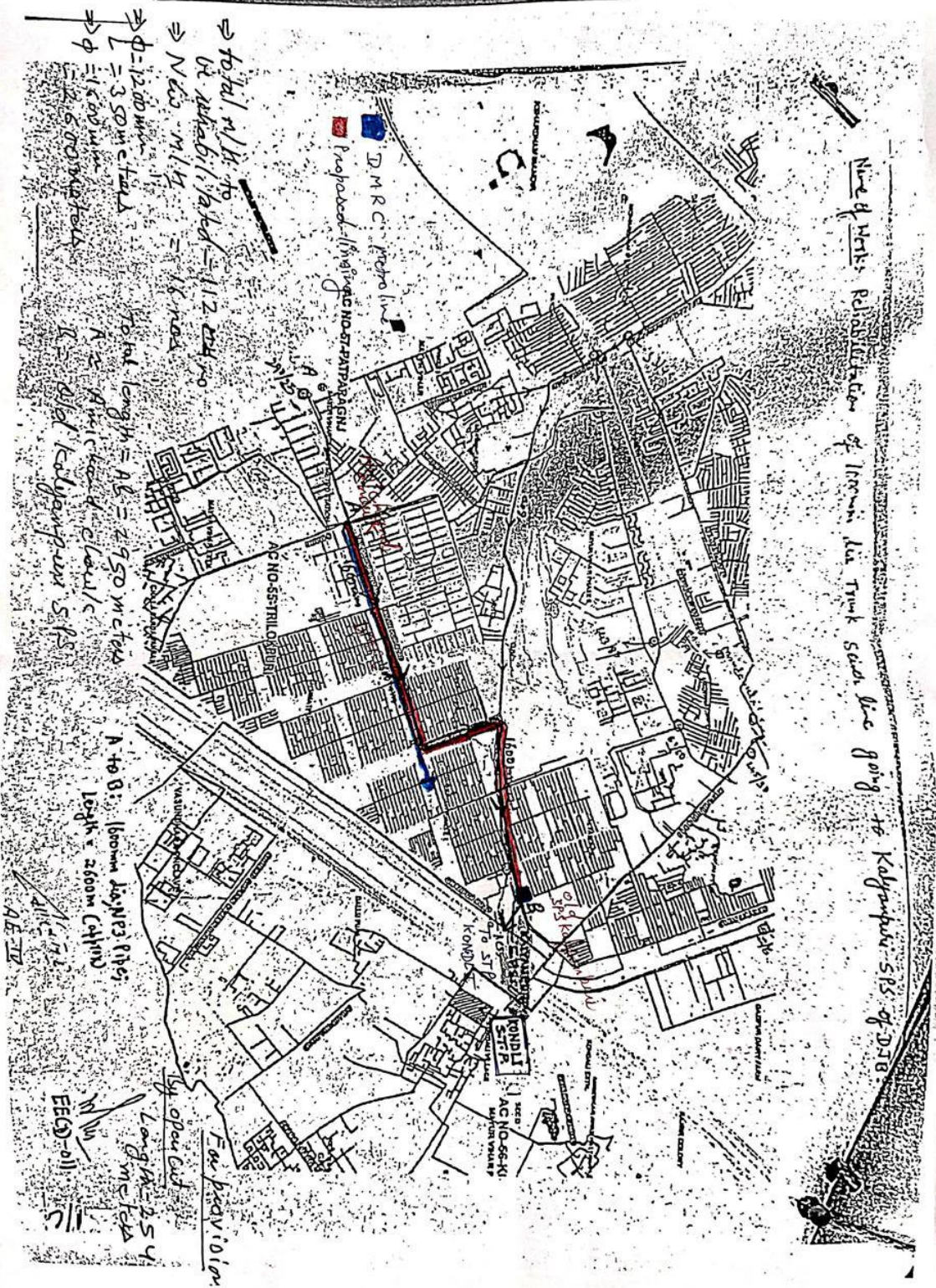
35	Demolishing cement concrete manually/ by mechanical means including disposal of material within 50 metres lead as per direction of Engineer - in - charge. 1:3:6 or richer mix	cum	10		
36	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas (exceeding 30cm in depth. 1.5m in width as well as 10 sqm on plan) including disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposed earth to be levelled and neatly dressed.All kinds of soil	cum	10		
37	Demolishing brick work manually/ by mechanical means including stacking or serviceable material and disposal of unserviceable material within 50 meters lead as per direction of engineer-in-charge.	cum	10		
38	Providing and laying 75 mm thick compacted bed of dry brick aggregate of 40 mm thick nominal size including spreading,well ramming, consolidating and grouting with jamuna sand, including finishing smooth etc. complete as per direction of Engineer-in-charge.	Sqm	10		

39	Providing and laying C.C. pavement of mix M-25 with ready mixed concrete from batching plant. The ready mixed concrete shall be laid and finished with screed board vibrator , vacuum dewatering process and finally finished by floating, brooming with wire brush etc. complete as per specifications and directions of Engineer-in-charge. (The panel shuttering work shall be paid for separately). (Note:- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable/ recoverable separately).	Cum	10		
40	Carriage of materials by mechanical transport including loading, unloading and stacking Lime, moorum, building ,rubbish,5 km	Cum	10		
41	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 and for all lift.	cum	10		

42	Brick work with modular extruded burnt fly ash clay sewer bricks (Conforming to IS: 4885) in cement mortar 1:4 (1 cement : 4 coarse sand) in foundation and plinth : Cement Mortar 1:4 (1 cement : 4 coarse sand)	cum	10		

Total=

Drawing



Signature Not Verified

Digitally signed by SANJAY SHARMA
 Date: 2026.06.03 15:10:01 IST 441
 Location: NCD of Delhi-DL