Government of Nepal

Ministry of Water Supply

Department of Water Supply and Sewerage Management

Urban Water Supply and Sanitation (Sector) Project

Project Management Office

Urban Water Supply and Sanitation (Sector) Project (UWSSP)
(ADB Loan No.: 3711-NEP and Project No: 35173-015)

Quality Assurance and Quality Control Manual

Submitted by

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Foreword

The Quality Assurance Quality Control Guidelines of the Urban Water Supply and Sanitation (Sector) Project, under Department of Water Supply and Sewerage Management (DWSSM), is a document specified in the Project Administration Manual of the Project. The Guidelines is intended to be used as guide line for supervision of construction activities, primarily by the field staff of the Contractor and the Design Supervision and Management Consultants. This Guidelines could also be replicated to other large projects under DWSSM.

Quality is conformity to standards and requirements to achieve excellence. This Guidelinesis based on Various Quality Assurance practices, specifications, requirement of the tender document for test of materials, field/laboratory testing and relevant codes. This Guidelines providesthe basis for outlining policy, procedure, responsibilities, compliance acceptance criteria and documentation for carrying out tasks related to inspection, testing and reporting on various materials, items involved for the satisfactory completion of the work.

This Guidelines would need improvement based on the experiences gained under the Urban Water Supply and Sanitation (Sector) Project and other similar projects in the DWSSM. Any suggestion for the improvement of the Guidelines is welcome

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Acknowledgment

This Quality Assurance Quality Control Manual is prepared by the Urban Water Supply and Sanitation (Sector) Project (UWSSP), supported by GoN, Users, Municipalities and ADB to ensure the quality of construction of the sub-projects under UWSSP. As the projects are expanding into more urban areas identified for future investment, there is a need for uniformity and consistency in maintaining quality of the construction.

This manual will not only contribute to mainstreaming quality assessment and quality controlling through monitoring and enforcing the quality of inputs, processes, and outputs during all activities of construction to ensure the quality of works conforms with the specifications and drawings, but also enhance the cost efficiency and sustainability of WASH investments.

Quality Assurance Quality Control (QA/QC) Manual provides a guideline for supervision of construction project. A QA/QC Manual establishes a standard guideline for enabling supervisory staff to check different activities of construction in respect of technical specifications. Quality assurance plan serve as a road map to supervisory staff to ensure quality of project works.

This manual will be useful for Projects Management Office, Regional project Management Offices under the Department of Water Supply and Sewerage Management (DWSSM), Design Supervision and Management Consultants (DSMC) under UWSSP, staff of DWSSM, Water Supply and Sanitation Users' Committee, Construction Supervision Engineers, Contractors, technical professionals and private sector engaged in the quality, construction and implementation of Water Supply and Sanitation projects in urban areas of Nepal.

I would like to thank entire professionals and experts of the DWSSM, PMO, RPMO, PMQAC and DSMC making this manual a reality. I would like to appreciate and acknowledge the efforts of the Project Management and Quality Assurance Consultants (PMQAC) under PMO in reviewing earlier document and finalizing this manual.

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ABBREVIATION

Sl. No.	Abbreviation	Description
1.	AC	Asbestos Cement
2.	BOQ	Bill of Quantities
3.	BIS	Bureau of Indian Standard
4.	°C	Degree Celsius Temperature
5.	CI	Cast Iron
6.	Cm	Centimeter
7.	Cum/ M^3	Cubic Meter
8.	CQC	Construction Quality Control
9.	CSE	Construction Supervision Engineer
10.	CWR	Clear Water Reservoir
11.	RDSMCM	Department of Water Supply and Sanitation Management
12.	DPD	Deputy Project Director
13.	Dia	Diameter
14.	EMPs Monitor	Environmental Mitigation Plan Monitor
15.	FC	Fully Covered
16.	Fig	Figure
17.	GC	Galvanized Corrugated
18.	GI	Galvanized Iron
19.	Gm	Gram
20.	Govt.	Government
21.	HDPE	High Density Poly Ethylene
22.	HRD	Human Resources Development
23.	HSE	Health Safety Environment
24.	ISI	Indian Standard Institution
25.	ITP	Inspection Test Plan
26.	JE	Junior Engineer
27.	Kg	Kilogram
28.	Kl	Kilo Litre
29.	Km	Kilo Meter
30.	M	Meter
31.	MC	Manufacturer Certificate
32.	MH	Manhole
33.	Ml	Milliliter
34.	Mm	Millimeter
35.	M^3	Cubic Meter
36.	M&E	Monitoring and Evaluation
37.	NC	Not Covered
38.	No.	Number
39.	OHT	Overhead Tank
40.	OHSR	Overhead Storage Reservoir

41.	O&M	Operation and Maintenance.
42.	PC	Partially Covered
43.	PHE	Public Health Engineering.
44.	PMO	Project Management Office
45.	PD	Project Director
46.	PVC	Poly Vinyl Chloride
47.	PMQAC	Project Management Quality Assurance Consultant
48.	P.W.D.	Public Works Department
49.	PPE	Personnel Protective Equipment
50.	QAC	Quality Surveillance and Control
51.	QA/QC	Quality Assurance/Quality Control
52.	QAP	Quality Assurance Plan
53.	QCF	Quality Control Format
54.	QC-M	Quality Control of Material
55.	QC-P	Quality Control Process
56.	QMSW	Quality Management and Surveillance Wing
57.	QS	Quality System
58.	QAS	Quality Assurance Specialist
59.	RPMO	Regional Project Management Office
60.	RPM	Regional Project Manager
61.	RCC	Reinforced Cement Concrete
62.	RDSMC	Regional Design Supervision Management Consultant
63.	STP	Sewage Treatment Plant
64.	T	Tone
65.	TOR	Terms of Reference
66.	TMT	Thermo Mechanically Treated
67.	TP	Third Party
68.	TL	Team Leader
69.	UWSSP	Urban Water Supply and Sanitation Project
70.	UGSR	Under Ground Storage Reservoir
71.	WUA	Water User's Associations
72.	WUSC	Water User's and Sanitation Committee
73.	WQM&S	Water Quality Monitoring & Surveillance
74.	WS &SM	Water Supply & Sanitation Monitoring
75.	WTP	Water Treatment Plant

1. INTRODUCTION

This Quality Assurance Quality Control Manual is prepared for the use of Urban Water Supply and Sanitation Project. It is based on Various Quality Assurance practices, specifications, requirement of the tender document for test of materials, Field/laboratory testing and relevant IS: codes. This will provide a base document outlining policy, procedure, responsibilities, compliance acceptance criteria and documentation for carrying out tasks related to inspection, testing and reporting on various materials, items involved for the satisfactory completion of the work. In all cases however, it is important to understand that the contract documents including the technical specifications are the basis for execution of the construction. Quality Assurance Quality Control (QA/QC) Manual provides a guide lines for supervision of construction project. A QA/QC Manual establishes a standard guideline for enabling supervisory staff to check different activities of construction in respect of technical specifications. Quality assurance plan serve as a road map to supervisory staff to ensure quality of project works.

As per studies the Project Management Quality Assurance Consultant (PMQAC) has to prepare a Construction Quality Control / Quality Assurance Manual for the type of construction generally carried out for urban water supply and sanitation, and also to describe the responsibility and accountability of the supervisory staff. Reporting system shall also be covered in the Manual.

1.1 QUALITY DEFINITION

Quality is the totality of features and characteristics of a product for service that bears on its ability to satisfy the projects functional requirements. The quality of output is always agreed upon between the supplier and the client (In project works, Contractor and the employer, respectively), and the quality objective is to achieve zero defects with best quality of the project works. This is possible only by ensuring quality control at every stage during progress of construction.

Quality is conformity to standards and requirements to achieve excellence. The following are some definitions pertaining to quality and how to achieve it:

Quality control (QC): The operational techniques or a system of maintaining standards by reviewing, checking, inspecting and testing.

Quality Assurance (QA): The planned and systematic actions and implementations necessary to provide adequate confidence that the work will satisfy quality requirements.

Quality System (QS): A set of documented processes, which seek to provide satisfaction that the project outputs will fulfill all the requirements for which it is being planned. The Quality System should fully incorporate the organization, human resources, materials, equipments, processes, inspections, testing and other parameters of the project. A key element of QS is the QA/QC Manual.

Quality Surveillance: This normally covers two aspects.

- At the project level, a review is required to ensure that the quality practices are implemented and documented to ensure in relation to the quality system.
- At the contract package level, inspection and testing is required to ensure that the works executed meet the required quality standards.

1.2 QA/QC MANUAL

This QA/QC Manual focuses on the implementation activities of the project following contract award, primarily on supervision and quality control of construction works. The QA/QC Manual is intended to be used as guide line for supervision of construction activities, primarily by the field staff of the Contractor and the Design Supervision and Management Consultants.

It will provide a base outline towards, procedure, responsibilities, compliance acceptance criteria and documentation for carrying out inspection, testing and reporting on various materials, items involved for the satisfactory execution of the project work. In all cases, somehow, it is most important to understand that the technical specifications as specified in the contract document / agreement are the guidelines for any construction activity.

The QA/QC Manual for the Construction activity does not attempt to suggest technical specifications, since these are stated in the contract documents. Its aim is to ensure that the works are executed as per specifications to achieve best results. Test results shall be interpreted as applicable for individual package, in accordance with the technical specifications as specified in the conditions of contract.

1.2.1 Key Parameters of Quality Assurance

Quality system involves the various key tools which are generally practiced in the field for Quality Assurance System. The well designed quality assurance system will provide confidence that the project outputs will fulfill all the requirements for which it is being planned. The quality assurance system should have the following basic parameters.

- Site documents
- Mandatory and optional testing
- Availability of field and departmental laboratories
- Manufacturing test certificates
- Departmental team inspections
- Checklist guide for works
- Site inspections
- Post quality testing of finished works
- Quality certification
- Monthly reporting and review meetings

1.3 HEALTH SAFETY & ENVIRONMENT

The Health and Safety of any project site also plays an important role and is also a part of the quality control of any project work. The HSE audits have to be conducted at the Project Sites for the various work areas generally encountered in the projects being executed. The following activities are to be maintained under HSE.

- Display of Notices
- Warning tape, lighting arrangement at location of any excavated trench, electrical installation or mechanical erection.
- Fire Prevention and Protection
- Environment & Health
- House Keeping
- Lighting
- Monsoon Precaution
- Noise and Vibration
- Personnel protective equipment (PPE) for field staff.

2. ORGANISATION, RESPONSIBILITIES AND AUTHORITIES

This section of the QA/QC Manual describes the organizational arrangements for project implementation and outlines the responsibilities of each organization.

2.1 PROJECT IMPLEMENTATION ARRANGEMENTS

The Department of Water Supply and Sewerage Management (DWSSM) is the implementing agency whereas the Ministry of Water Supply (MOWS) is the executing agency.

Project Management Office (PMO) and Regional Project Management Office (RPMO) have been created for overall programme planning, fund flow management, capacity building, Quality Control, monitoring of physical and financial progress and reporting.

Project Management Quality Assurance Consultant has been created for technical audit of different activities of construction at various stages during progress of project work.

Regional Design Supervision Management Consultants have been appointed in three (Central, Eastern and Western) region for design, supervision and management. They have Team Leader, Contract Management Specialist, Design Engineer, Environmental Safeguard Specialist, Social Sage Guard Specialist, Construction Supervision Engineer, Junior Engineer, EMPs, Monitor, and Social Mobilizer etc. for project planning, supervision of projects in the state and O&M of MV schemes.

2.2 RESPONSIBILITIES OF KEY ORGANIZATIONS

Table 2.1 identifies the responsibilities of each organization's to avoid any misunderstanding.

Table 2.1: Responsibilities of Key Organizations

SI.No.	Task	Activities	Unit
1.	TECHNICAL APPROVAL OF DESIGN DRAWING AND COST ESTIMATES.	Approval	PMO
2.	TENDER, ALLOTMENT AND UPKEEP OF CONTRACT DOCUMENTS.	Invitation, Receive tenders, evaluation	PMO
3.	REGIONAL MONITORING AND PAYMENT OF CONSULTANT AND CONTRACTOR.	Monitoring, Evaluation and Payment	RPMO
4.	**CONTRACT ADMINISTRATION AND OVERALL SUPERVISION**.		
4.1	Administration and management of contracts including interpretations of technical specifications.	Management	PMQAC and RDSMC
4.2	Construction Drawing	Submission	Contractor
4.3	Construction Drawing	Approval	RDSMC
4.4	Revised drawings and designs	Submission	Contractor
4.5	Revised drawings and designs	Review and approvals	RDSMC
4.6	Provide layouts/levels for works. Checking of levels and layouts.	Primary Secondary	Contractor RDSMC
4.7	Adequacy of the input such as material, labour, equipment with reference to technical requirement.	Primary Secondary	Contractor RDSMC
4.8	Material register	Documentation Review	Contractor RDSMC
4.9	Maintain work site in neat, orderly and safe manner.	Primary Secondary	Contractor RDSMC
4.10	Minimize inconveniences to the public.	Primary Secondary	Contractor RDSMC
4.11	Inter departmental coordination.		PMO/RPMO
4.12	Continuous on sites supervision during construction and ensuring safety.	Primary Secondary	Contractor RDSMC
4.13	Monitoring of progress, find cause of delay,remedial measures and issue instructions to contractor.	Primary Secondary	Contractor RDSMC

4.14	The contractor fulfills all contractual obligation, proper storage of materials, regulations, contract conditions, specifications and instructions.	Primary Secondary	Contractor RDSMC
4.15	Ensuring that site order book are properly maintained.	Primary Secondary	Contractor RDSMC
4.16	Test records and results are available for review and assessment.	Primary Secondary	Contractor RDSMC
4.17	Contractor prepares and submit monthly progress report in time.	Primary Secondary	Contractor RDSMC
4.18	Quarterly Progress Report	Submission	RDSMC
4.19	Completion Certificate of Stage 1	Issue	RDSMC
4.20	Operation and Maintenance Period (2nd stage)	O & M Monitoring Cash Collection	Contractor RDSMC WUSC
4.21	Defect Liability Period (DLP)	O & M Maintenance Monitoring	WUSC Contractor RDSMC
5	**QUALITY ASSURANCE AND INSPECTIONS**		
5.1	Training on using manual to contractor staff.	Training	RDSMC
5.2	Provide effective supervision of the works in order to ensure the quality and conformity with the standards and specifications prescribed in the contract.	Primary Secondary	Contractor RDSMC
5.3	Inspect all work sites regularly to ensure that the work is being implemented in accordance with the approved standards and that the quality control procedures set forth under the contract are followed.	Primary Secondary	Contractor RDSMC
5.4	Take samples and test independently testing Wherever considered necessary. Insure that proper records of the tests conducted are maintained.	Primary Secondary	Contractor RDSMC
5.5	Inspect interim work as required to accept or reject completion stages before permitting the contractor to proceed with further works. Enter all approvals in the site order book and have it signed by all parties.	Primary Secondary	Contractor RDSMC
5.6	Inspect the completed works insuring that any defects in materials or workmanship are Properly identified in a timely manner.	Primary Secondary	Contractor RDSMC
5.7	Conduct monthly inspections and site Coordination meetings for all works to review the overall progress and quality of the works.	Management Meeting	Contractor/ RDSMC/ WUSC
5.8	If any work item or construction material is Substandard or unacceptable, deduct such work or supply of material from the progress payment or defer payment until the contractor rectifies the deficiencies.	Primary Secondary	Contractor RDSMC
6	**MEASUREMENT AND PREPARING BILLS AND PAYMENTS**		
6.1	Conduct joint measurements of the works with the contractor and record them in the stipulated format for payment.	Primary Secondary	Contractor RDSMC

6.2	Monthly Statement	Submission Check and Certify Payment Make	Contractor RDSMC RPMO
6.3	Final Account	Submission Check and Certify Payment Make	Contractor RDSMC RPMO
6.4	Prepare necessary release order of security and payment after completion of the defect liability period as per the contract.	Prepare and verified Hand receipt	RDSMC
7	**REPORTING**		
7.1	Prepare and submit Monthly Progress Reports in the approved format that includes Quality Control Status, physical and financial progress.	Submission	Contractor to RDSMC RDSMC to PMO/ RPMO/PMQAC PMQAC to PMO/ ADB
7.2	Submit a quarterly progress report.	Submission	Contractor to RDSMC RDSMC to PMO/ RPMO/ PMQAC to PMO/ADB
7.3	Environmental and Social Safeguard Semiannual Report	Submission	RDSMC to PMO/ RPMO/PMQAC PMQAC to PMO/ ADB
7.4	Annual Progress Report	Submission	RDSMC
7.5	Drawing of completed works (As-built).	Submission Approval	Contractor RDSMC
7.6	Checklist during entering into 2nd Stage	Prepare Verify Approval	Contractor RDSMC Representatives of PMO, RPMO, TDF, RDSMC and WUSC
7.7	Submission of Operation and Maintenance Manual	Submission Approval	Contractor RDSMC
7.8	Water Safety Plan	Submission Approval	Contractor RDSMC
8	**INTER DEPARTMENTAL AFFAIRS**		
8.1	Identify power connection, road crossings, pipe line inter connections with existing system, permission for use of land, etc.	Primary Secondary	Contractor RDSMC
8.2	Obtain permissions from other departments and organizing the works as required through them.	Primary Secondary	Contractor RDSMC
9	**OTHER RESPONSIBILITIES**		
9.1	QA/QC Training module for PMO/RPMO/ RDSMC engineers	Training	PMQAC
9.2	QA/QC Training module for contractors	Training	RDSMC

These procedures are prepared with a view of ensuring stream lime action in various activities that might have over lapping responsibilities. These are only clarifications on the responsibilities as prescribed in the department. In case of variance, the contract documents will prevail over the stipulations above.

2.3 QA/QC DUTIES

The contractor's QA/QC duties are summarized in Table: 2.2. Apart from these other duties shall be performed as per the contract documents or directed by the Engineer. It is essential to keep certain documents at site for making a permanent record of each and every item related to the project. Such items may include tests conducted at site, test certificates, instructions issued to contractor, record of drawings issued to the contractor, inventory of the material at site. All such site documents play an important role not only in assuring the quality of the work, but also in making the project management comparatively easier. All these documents with a definite identification number have been listed in Chapter 3.

Table 2.2: List Of Contractor's QA/QC Duties

Activity/Item	Contractor's QA/QC Duties
Designs/Drawings for contract	• Maintain design / drawing register at site • Use only approved drawings for construction
Test laboratory and equipment	• Intimate RDSMC/WUSC the details, date of completion with requisite manufacturers' and calibration certificates of equipments. • Maintain the equipments in good condition and calibrate as necessary
Material receipts Materials testing	• Enter receipts in material register • Materials to be tested only in approved laboratories • Prepare concrete mix proportions as per volume as required by contract and submit test results to RDSMC and take the approval. • Take test samples in presence of RDSMC/WUSC when requested • Perform material tests • Submit test reports to RDSMC/WUSC with monthly reports • Maintain test log
Rejected materials	• Entries to be made in material register at site • Tag and record all rejected materials • Intimate RDSMC/WUSC in writing the proposed date of removal of material from site and confirm after removal.
Material consumption	• Enter daily consumption of materials in material register and indicate balance quantity.
Construction equipment	• Intimate RDSMC/WUSC the details, date of mobilization along with requisite insurance certificate • Maintain equipments in good working condition • Intimate breakdown of construction equipments
Construction	• Intimate WUSC/RDSMC in writing when construction is going to commence and what activities are proposed to be undertaken. • Intimate WUSC/RDSMC in advance when critical works, such as concreting, embankment, paving, pipeline laying and jointing, testing, etc., would be undertaken, along with the test certificates of the materials proposed to be used in these works. No critical activity shall start unless the material is tested. Certificates are verified and approved by the RDSMC. • Concreting to take place only after pour card is signed. • To provide any other necessary QA/QC requirement. • To provide Traceability plans in the case of concrete and pipes). Similarly provide the communication Plan and Equipment maintenance plan with disposal measures regarding oil, grease, fuel, filters, etc.
Daily work progress	• To maintain in daily log/daily site diary.
Testing of works in progress	• Perform tests as per contract requirements. • Submit test reports to RDSMC/WUSC. • Maintain test log during the execution of works.

Activity/Item	Contractor's QA/QC Duties
Rejected work items	• Intimate WUSC/RDSMC in writing the proposed date of removal from site and confirm after removal. • Rectify defective work and invite WUSC/RDSMC for re-inspection.
Instructions from Engineer	• Enter change orders, site instructions, letter and minutes of meetings issued by the Engineer and Consultants in the Instruction Log.
Inspection of Engineer	• Take instructions in Site Order Book. • Intimate RDSMC of compliance.
Progress scheduling and control	• Prepare and maintain project schedules and undertake work in accordance with approved schedule.
Reporting	• Prepare and submit Monthly Progress Reports and other reports as per contractual requirements.
Records	• Maintain the following records on Site/Contractor's Office/Laboratory as given in Annexure C. • Site Order book • Material Register • Daily Progress Report. • Concrete pour Register • Test Record • Design & Drawing Record • Non-conforming item record • Cube test record
Workmanship	• All the work executed against the contract shall be of good workmanship.
Disposal Of Debris	• All the Debris should be disposed in landfill. If no landfill is available, measures and approval process should be defined.

2.4 QUALITY ASSURANCE BY RIGIONAL DESIGN SUPERVISION MANAGEMENT CONSULTANT (RDSMC) DURING INSPECTION

The tenders are on turnkey basis and all the material is procured by the contractor, hence to have a proper quality control and to improve the quality of work, the departmental engineers at various level will ensure the key parameters of quality assurance during inspections as per Table 2.3. Such tools are not covered up in the Manual of orders. These inspections shall not impinge the existing responsibilities of the officers/ engineers as laid down in the Manual of orders.

Table 2.3: Quality Assurance During Inspection

Sl.No.	Key parameters of Quality Assurance	ICG Engineer	TL/CSE Cont	Contractor
1	**SITE DOCUMENTS**			
1.1	Site Order book	√	√	√
1.2	Material Register	√	√	√
1.3	Daily Progress Report.	-	√	√
1.4	Concrete pour Record	-	√	√
1.5	Test Record	√	√	√
1.6	Design and Drawing Record	√	√	√
1.7	Non-Conforming Item Record	√	√	-
1.8	Cube test record	√	√	√
2	**MANDATORY TESTING**			
2.1	Cement	√	√	√
2.2	Fine aggregate	√	√	√
2.3	Coarse aggregate	√	√	√
2.4	Concrete (Slump, Cube test)	-	√	√

Sl.No.	Key parameters of Quality Assurance	ICG Engineer	TL/CSE Cont	Contractor
2.5	Steel bars	-	√	√
2.6	Bricks	-	√	√
2.7	Timber	-	√	√
2.9	Hydro testing of pipeline	-	√	√
2.10	Water for construction	-	-	√
3	**AVAILABILITY OF FIELD AND LAB EQUIPMENTS**	√	√	√
4	**MANUFACTURING CERTIFICATES**			
4.1	Cement	-	√	√
4.2	Steel for Reinforcement and structural steel	-	√	√
4.3	HDPE PE Pipe/ DI Pipe/GI Pipe / HDPE Fitting/ DI Fitting/GI Fittings/ PVC /MS /SW /RCC Pipes	√	√	√
4.4	Manhole covers and Footrest	-	√	√
4.5	AC/GI/Fiber glass sheets	-	√	√
4.6	Electrical cables/fans and fixtures	-	√	√
4.7	Switches/sockets and boards	-	√	√
4.8	Flow measuring devices	-	√	√
4.9	Control Panel	-	√	√
4.10	Lightening arrestor	-	√	√
4.11	Level indicator and controllers.	-	√	√
4.12	Silver ionization plant	√	√	√
4.13	Any other item as per agreement	-	√	√
5	**DEPARTMENTAL TEAM INSPECTION**			
5.1	DI, CI,PVC, MS,GI,HDPE	√	√	√
5.2	Pumps , Motors & D.G. Sets	√	√	√
5.3	Manhole Frames and covers	√	√	√
5.4	R.C.C. Pipes	√	√	√
6	**CHECK LIST GUIDE FOR WORKS**			
6.1	Tube well	-	√	√
6.2	Laying and jointing of pipeline, Back filling, Hydro testing	-	√	√
6.3	Pump & machinery of Tubewell	-	√	√
6.4	Disinfecting plant		√	√
6.5	Pump chamber	-	√	√
6.6	Development of water works	-	√	√
6.7	Water treatment plant (canal based)	-	√	√
6.8	Sewer laying & treatment plant	-	√	√
6.9	Control panel for 3 phase pump & motor	-	√	√
6.10	Centrifugal pump and motor	-	√	√
7	**PERIODICAL SITE INSPECTIONS**	√	√	√
8	**POST QUALITY INSPECTION OF FINISHED WORKS**	√	√	√
9	**QUALITY CERTIFICATION**	-	√	√
10	**MONTHLY REPORTING AND REVIEW MEETINGS**	√	√	√

2.5 ACCOUNTABILITY MATRICES FOR VARIOUS CONSTRUCTION ACTIVITIES

The responsibilities for different construction activities at various levels are not fixed in the existing system. The responsibilities are therefore recommended to be fixed as per Table: 2.4 to ensure a good quality of works.

Table 2.4: Accountability Matrices

Sl.No.	Item of Work	Responsibility	
		Primary	Secondary
1	Excavation, shoring and dewatering	JE	CSE
2	Damp Proof coarse	JE	CSE
3	Curing	JE	CSE
4	Shuttering and scaffolding	JE	CSE
5	Reinforcement	JE	CSE
6	Plain Concreting	JE	CSE
7	Reinforced concreting	JE	CSE
8	Masonry work	JE	CSE
9	Plastering and Pointing	JE	CSE
10	Laying and jointing of pipe line	JE	CSE
11	Backfilling	JE	CSE
12	Flooring	JE	CSE
13	Door and windows	JE	CSE
14	Painting and finishing	JE	CSE
15	Hydro testing	JE	CSE
16	Water proofing	JE	CSE
17	Tube well and pump	JE	CSE
18	Water treatment plant	JE	CSE
19	Sewage treatment plant	JE	CSE
20	Development of compound	JE	CSE

Quality assurance is a process control and not the inspection of final construction. The Consultant and Contractor have to ensure that the Quality must be consistent throughout.

2.6 RESPONSIBILITIES OF WUSC

The WUSC will represent the community and will have the following functions.

- Planning and Technology Selection
- Procurement of qualitative Materials for Sub-project
- Construction Supervision of Construction works
- Full involvement in OJT during the O & M Phase
- Management & full operations of sub-project after O&M Phase

WUSC should be involved from the initial planning stage of the sub-project and in the correct & viable technology selection. The involvement of WUSC as the owner of the sub-project must be more precise in procurement of the material and the visual quality check of work being done by the contractor.

The members of WUSC should involve themselves into the day to day progress of work such as laying of PE/HDPE/DI/GI pipes, refilling of the trenches and restoring the pavement, concreting of OHT and curing etc. The WUSC is fully responsible for all the assets created under the various sub-projects/contracts for their Management & financing of O&M, including levying & collecting sufficient user charges.

3. DOCUMENT CONTROL PROCEDURES

It is essential to keep certain documents at site for making a permanent record of each and every item related to the project. Such items may include tests conducted at site, test certificates, instruction issued to contractor, record of drawings issued to the contractor, inventory of the material at site. All such site documents play an important role not only in assuring the quality of the work, but also in

making the total management of the project comparatively easier. All these documents with a unique identification number have been listed in the end of Chapters as **Appendix C**.

Document control is an art for transmittal, receipt, recording, processing filing and retrieval of documents, and to ensure common format. The most important documents for QA/QC are final design documents, test reports, Approved Quality Assurance Plan (QAP), Approved work schedule, Minute of Meetings and instructions. Document control procedures, including guidelines for correspondence control, are outlined below.

An important part of the junior engineer's work as regards to QA/QC procedures is to keep adequate records. These records enable an appraisal to be made at any time of the progress of work, they form the basis of fixing an accurate assessment in monitoring the contractor's work, they enable all material to be ordered in proper time, they enable the designers to be assured that the assumptions made for design purposes are valid, they assist in the solving of new design problems that they may arise during construction, and they form a source of information on the subsequent behavior of the completed works.

3.1 SITE ORDER BOOK

The contractor shall be responsible for a site order book, in triplicate, at the site of work at all time, and this shall be open for inspection by authorized representative of RDSMC. The site order book has two primary purposes to record day today instruction to the contractor and the contractor's compliance with these instructions, and to record the inspections and expectations of work completion stages along with issuing approvals to the contractor to proceed with the next stage of constructions.

As noted above the status of the contractor's compliance with instructions issued is to be Summarized in the site order book, Format No. C/QRF-1 of **Appendix C**, and reviewed monthly by the WUSC, RDSMC and Contractor during the management meeting or periodic squad checks. In cases where the contractor has failed to comply with the instructions the reasons therefore shall be determined and necessary remedial action required to be taken.

The RDSMC will maintain a file of site orders issued to contractor for record and compliance.

3.2 MATERIAL CONTROL

All the materials procured for the construction activities of the scheme as required in the contract agreement shall be entered in the material register by the contractor and shall be open for inspection by all the engineer of RDSMC, PMQAC, RPMO and PMO.

The report of input materials will be recorded in the Material Register in the form of ledger, using Format No. C/QRF-2 of Appendix C. This document shall provide overall information of materials requirement, consumed and balances on that date.

3.3 DAILY PROGRESS REPORT

Daily Progress Report is an essential Document for complete monitoring of the progress of work. It concentrates on extracting the information for the work completed during the day, how many men were engaged on each part of the project, details of the delays, and other related and pertinent issues. Report shall be maintained as per format No. C/QRF -3 of **Appendix C**.

3.4 CONCRETE POUR RECORD

It is desirable to follow concrete pour card method. This is a method of giving written instructions to the contractor in a card form about the concreting to be done in accordance with the contractual provisions giving salient features of concrete mix proportion, water cement ratio, test to be carried out such as slump test, casting of cube for strength test. It shall be maintained by the contractor as per format No. C/QRF - 4 of **Appendix C**.

3.5 TEST REPORT CONTROL

All the tests and field checks are to be carried out as per the applicable quality control requirements. If tests are to be carried out by the contractor at site lab, he will designate an experienced Laboratory-in-charge who attains proper knowledge about testing of materials (he should preferably be a civil engineer) authorized to sign test reports for him. The witnessing officer will sign the reports and put his name and designation. The test record shall be maintained by the contractor using the format No. C/QRF -5 **of Appendix C**. The contractor shall maintain all test records properly.

The test reports shall be submitted by the contractor to the CSE.

3.6 DESIGN & DRAWING CONTROL

All the designs and drawings approved by PMO and provided to the contractor will be recorded in the Design/Drawing register using Format No. C/QRF -6 of **Appendix C**. Any change in design or drawing from time to time shall also be recorded in it. The change design and drawing shall be provided by the RDSMC with their stamp and signature with provided date and kept by the Contractor.

3.7 NON CONFORMING ITEM RECORD

Any material found non-conforming (Material deviating from the approved standards) by RDSMC, the Non- Conformance Report (NCR) about the work will be issued by the CSE, suggesting the preventive measures to apply in the future to avoid the repetition of the non-conformity, using Format No. C/QRF -7 of **Appendix C.** Rejected materials should be placed on a dedicated site area and non-conforming record should be issued. In case of the defects of works for which notice has been given to the contractor and if he failed to correct the defects in a specified time, the Engineer- in- charge will assess the cost of having the defect corrected and the contractor will pay this amount. Where in certain cases the technical specifications provide for acceptance of works with in specified tolerance limits at reduced rates, engineer will certify payments to contractor accordingly.

3.8 OTHER RECORDS

Other records as per item 3.8.1 to 3.8.4 are also required as per site requirement and direction of CSE, which shall be maintained by Contractor. This will provide healthy information about the project as and when required.

3.8.1 Engineer's Diary

The Engineer's Diary will aim to record all major decisions made and instructions given. Every effort should be made to keep a system and it is well to make a list beforehand in the front of the diary of special points to be noted.

Of course, the Engineer's own diary will be a personal record of events, and therefore in some cases confidential. His main purpose will be to note down points about which there might be some argument. Examples are:

- The visits of all the representatives to the site;
- Any dispute which have arisen during the day, and particularly any verbal instructions he gave as a result;
- Any particular points regarding the work which he does not necessarily raise with the
- Contractor at present; and
- Any notes regarding particular stages of work or carried out.

It is useful, where plant or proprietary equipment has included in the works, to make up a data file which lists the maker of such plant and equipment, the original order reference and data, and any descriptive

details that be of future use. If the plant requires attention later on the employer will find it useful to have particulars the original order. Instruction manuals and plant test data, such as performance curves of pumps, turbines and motors should all be collected and two sets of each, together with a set of the manufacturer's drawings in each case, should be handed over to the employer.

3.8.2 Pipe Laying Record

Where long pipeline are laid it is usual to produce a pipe-laying record book which itemizes in sequence the laying of every pipe and fitting which has been laid.

Water pipe line should have a detail of type of pipe, size of pipe, type of joint, bedding condition, offset from the permanent nearby permanent objects specials, depth of cover, results of pressure testing should be recorded.

In Case of Sewer Lines the invert levels of pipes are given in meters and O.D. at every point of change of gradient. Notes as to bedding, hunching, or surrounding in concrete are given and each fitting or cut pipe is described. From time to offset distances from near-by building or other landmarks to particular fittings, such as bends where a change of direction occurs, are noted in the record book, so that their position can be found afterwards if required. The cumulative change from the starting-point is given as measured on the ground. Large sewers and drains crossed by the trench are similarly logged in a record book.

3.8.3 Sample Register

Whenever more than a few samples of natural materials are likely to be taken for examination (and since the Junior Engineer will never know at the beginning of any job how many samples will be taken, he had best assume it will be a large number) it is important to open a sample register, in which every sample is booked down, no matter for what purpose. The numbering of the samples can be straight forward, just as they come to hand, care being taken to label the sample itself with the same number.

Once this is done, the sample can always be referred to later by its number in correspondence and reporting, and all the details of how it was obtained, etc., can be traced back to the sample register.

The register can consist of a ruled book which has columns ruled vertically, headed in sequence from the left to right across both pages as follows:

Col.

1. Sample number
2. Source
3. Location
4. Description (brief only)
5. Depth
6. Date taken
7. Where tested
8. Remarks/references

Each sample need take up not more than two or three down the page, and perhaps not all the columns need have an entry for each sample. It is important to keep the system simple and brief, so that no one has any trouble keeping it going.

3.8.4 Completion Records and Drawings

As built records are very important and consist of pictorial records (the Record Drawings, etc.) of all the work as completed, showing the where about regarding dimensions of all parts as they exist at completion, together with factual descriptions of their origin, operation and their performance

under test. Little need to be said on the topic of record drawings. Every engineer has come across cases where record drawings of previously built structures have never been made, or have been inadequately made and has known the great difficulties that arise as a result, often causing a costly amount of work to be undertaken to expose foundations or to locate buried pipes.

The work on record drawings should continue throughout the contract, a special set of contract drawings being provided on which the Junior Engineer marks out all deviations from the original design from time to time, where extensive alteration are encountered, or where preliminary surveys are made, completely new record drawings will have to be made.

On numbers of occasions clarification of the existing contract drawings upon points of detail may be asked for by the contractor, such as a quick detail sketch of footing work for the bricklayer. If these freehand sketches are always drawn in a carbon-copy book the carbon copies will form an exceedingly valuable record in the Supervising engineer's office for record- drawing alterations, extra works, and so on.

Where pipes are laid underground special care must be taken to chart the course of these pipes accurately, marking valve and stopcock positions and hydrants. The only way to get a really permanent record of the positions of such valves, etc., is to measure the distance from buildings and 'tie-in' by two or more measurements. Measuring from frontages, or from kerb lines or road centre's, gives only transitory information, as these reference lines may later be altered in position.

4 CONSTRUCTION QUALITY CONTROL

This section provides an overview of construction quality control activities, including testing and site inspection. Materials control requirements are presented in detail here while specific testing and inspection requirements for each category of works are presented in Sections 6 to 10 of this Manual.

4.1 INTRODUCTION

Construction Quality Control (CQC) is intended to provide a comprehensive, common and consistent framework for quality control across various contract packages. CQC comprises two main elements of quality control:

- Testing
- Inspections

Testing control covers the type of tests to be carried out, frequency of testing and stage of testing. Inspection control covers the timing of inspections, what to be inspected and the inspection procedures. CQC should be affected at five stages:

- Input Materials and Equipment Components
- In-process Activities
- Stage Completion
- Interfacing (of special importance in water and sewerage contract packages)
- Final completion

The contractor is responsible for informing CSE giving sufficient notice time so that they can witness the tests.

4.2 TESTING

Various field tests on materials and works are required to be carried out by the contractor during construction. A well-equipped and properly operating field test laboratory is an important feature of quality assurance plan. A list showing typical testing equipment to be provided in the contractor's site laboratory is presented in **Table 4.1**. It should be made mandatory as per provision in the technical/ contract bid.

Table 4.1: List of Equipment Required for Field Testing

Sl.No.	Equipments	Purposes
1	Compression testing machine	Cube and brick
2	Sieve set complete	Aggregates
3	Measuring jars	Silt
4	Screw gauge	Thickness of pipes
5	Vernier caliper	Dia. of pipes
6	Balance	Mass of pipe/steel etc
7	Slump cone	Workability
8	Cube mould 2 sets.	Testing of C.C.
9	Hydraulic testing machine	Testing of pipe

The contractor shall set-up the site laboratory within 15 days after getting letter to proceed and inform the CSE for conducting inspections. Laboratory equipment shall be properly calibrated, and certificates and its updating as and when required should be kept at the laboratory for review by CSE and WUSC as necessary. Specialized tests at outside laboratories shall only be undertaken with the prior approval of the RDSMC.

Regional laboratories one in each region shall also be established for quality testing of materials used by the contractor. The tests to be conducted in the regional laboratory are given in **Table 4.2**.

Table 4.2: Tests to be Conducted in the Regional Laboratory

Sl.No.	Material	Test to be Conducted	Equipments
1	Cement	• Consistency • Soundness • Setting time • Fineness of Cement	• Vicat apparatus • Le chatelier apparatus • Vicat apparatus • Sieving method
2	Aggregate	• Bulk density • Flakiness/ Elongation • Crushing value • Total Deleterious Material • Ten Percent Fineness Value • Wash Test • Sieve Analysis	• Bulk density apparatus • Thickness and length gauge. • Crushing value apparatus • Material finer than 0.075mm Sieve
3	Sand	• Sieve Analysis • Total Deleterious Material • Wash Test • Bulk density	• 0.075mm Sieve • Bulk density apparatus
4	Concrete (fresh)	• Cube test	• Compression testing machine
	Post concrete	• Compressive strength of post concrete	• Rebound hammer
5	Bricks	• Compressive strength • Water absorption Test	• Compression testing machine
6	Pipes	• Hydraulic testing of pipes	• Hydraulic pump
7	Steel	• Bend Test • Re-bend Test • Elongation • Ultimate Tensile Strength • Yield Strength (Proof stress)	
8	Water Quality Test**		

*** Water quality test shall be performed as per National Drinking Water Quality Standard 2062.*

Tests should be performed in accordance with the contract documents. The control of test reports shall be done as stipulated in Section 10 of this Manual. All test samples should be preserved in a sealed container, with proper identification numbers, test log reference, test date, and other applicable information. These samples must be stored at contractor's office/laboratory by the contractor.

In addition to tests performed on site, the contractor is responsible for external tests which are performed at approved laboratories as per the contract document.

4.3 INSPECTIONS OF SITES

Inspections of sites must be carried out to ensure that the construction activities and Construction materials conform to the relevant standards. Site inspections can be divided into everyday supervision and periodical quality inspection. The suggestions in respect of these two have been elaborated herein.

4.3.1 Everyday Supervision

Everyday site supervision of all construction activities shall be carried out by the CSE. This includes checking of lines, layouts and levels and other relevant checks. Daily Progress monitoring shall also be carried out by the CSC. The Supervising team of the RDSMC shall ensure that materials that have been rejected or for which a non- conformance report has not yet been issued are not used in works.

Equipments to be used in construction are point of concern in quality assurance system. The equipment requirements have been laid out in the Contract documents. It is necessary that the CSE check the adequacy of the equipment used by the contractor for construction as per the prescribed standards and specifications.

WUSC involvement in the procurement will be limited to the extent that the materials being used by the contractor should be checked visually from time to time for its quality and to be associated during sampling and its testing.

4.3.2 Periodical Inspection for Quality

Officers/ Engineer of PMQAC & WUSC shall carry out periodic quality inspections during in-process, stage completion, interfacing and final completion, and during all critical activities component wise as per the following examples in **Table 4.3**.

Table 4.3: List of Critical Activities Component Wise

Sl.No.	Component	Critical Activities
1	Pipe line	• Excavation • Completion of excavation Trenches for Pipe laying • Laying and jointing of pipes in correct alignment. • Pressure/leakage Testing of pipeline • Backfilling in layers and watering
2	OHSR/UGSR	• Centering and shuttering for R.C.C. works • Placing of reinforcing steel • Concrete mixing, vibrating and pouring • Testing for water tightness • Curing
3	Electro Mechanical	• Installation of electrical and mechanical equipments such as Pump & Machinery and Disinfecting units etc. • Testing, trial runs and commissioning of electro- mechanical equipment and plants

Sl.No.	Component	Critical Activities
4	Tube Well	• Drilling • Lowering of Assembly • Verticality Test • Water Quality Test
5	Pump Chamber	• Mortar proportion in Brick masonry • Centering and shuttering for R.C.C. works • Placing of reinforcing steel • Concrete mixing, vibrating and pouring • Curing
6	Canal Based Water Treatment Plant with units as; i) Intake works and inlet channel ii) Storage cum Sedimentation tank iii) Suction cum scour well iv) High Level Tank v) Filter beds vi)Clear water tank	• Mortar proportion • Centering and shuttering for R.C.C. works • Placing of reinforcing steel • Concrete mixing, pouring and vibrating • Curing • Grading of filter media • LDPE sheets • Water tightness • Hydraulic losses • Efficiency of plant
7	Sewage Treatment Plant with units as; i) Collecting tank ii) Facultative pond / Maturation pond iii) Sludge Drying Beds iv) Sludge Curing Platform v) Composting Pits etc.	• Mortar proportion • Centering and shuttering for R.C.C. works • Placing of reinforcing steel • Concrete mixing, pouring and vibrating • Curing • LDPE sheets and Thickness of lining • Water tightness • Hydraulic losses • Efficiency of plant

The RDSMC and WUSC shall also inspect the materials certified by manufacturers, materials and equipment components upon delivery to the site. The contractor shall give advance notice to the RDSMC and WUSC when critical activities are proposed or major equipment items are to be delivered. On completion of one stage of the construction and before proceeding to the next stage the engineer in charge of RDSMC shall inspect and certify the quality of the works completed before granting approval for the next stage of the works to start. The final inspection shall encompass tests on completion and trial runs. The certification of quality will be based on the documents and the periodic site visits. The RDSMC representative and the WUSC representative should witness all the tests conducted by the contractor.

4.3.3 Random Checks

The concept of Random Checks has been adopted to have an external review of quality of works executed. The checks should be conducted jointly by the RDSMC and WUSC. A fixed time table is not suggested for this. The tentative agenda for the random checks is described as follows:

- Physical inspection of the works under execution and inspection of quality of workmanship:
- Review of site documentation and contractor compliance:
- Sample verification of test reports and quality certificates:
- Review of issues, constraints and lacunae in quality system implementation:
- Preparing of action plans for improving the quality: and
- Performance appraisal of the contractors.

If any non-conformance is observed, the details will be recorded in Performa C/QRF-7 as mentioned in clause 3.7.

4.4 CHECKLIST GUIDE FOR WORKS

All the works has to be executed as per specifications given in the agreement. For checking of these works check list are designed and the relevant formats are given in **Appendix B**.

4.5 QUALITY CERTIFICATION

The RDSMCs shall responsible to certify that the items included in the contractor's Interim Payment Certificate satisfy the required quality of works and are acceptable with regard to the specifications and standards prescribed under the contract before the running bill is passed for payment. A format for this quality certification is included in **Appendix B**, as format B/CL-12.

5 CONTROL OF MATERIALS AND EQUIPMENT

This section on control of materials and equipment gives an overview of control requirements for construction materials and equipment including field testing, manufacturer's certification, departmental team inspection for materials, efficiency of equipment and calibration of equipment.

5.1 GENERAL

General Control and approval of construction materials and equipments to be incorporated in the works shall be based on the following;

Test reports for materials tested at site, such as cement, sand, water, and aggregate; the contractor will perform all tests. The designated RDSMC representative and WUSC representative shall witness as per Section 1. They shall sign the report in token of witnessing.

Manufacturer's certificates and IS/ISO mark for manufactured items indicated in **Table 5.6** or as stipulated in the contract;

5.2 MANDATORY TESTS PERFORMED AT SITE

For mandatory tests the list of materials if to be performed at site is given in **Table 5.1**. Types of tests are presented in **Table 5.2** to **5.5** under the referenced procedure number. Test report formats are included in Appendix A. The reports are to be maintained in a bound register, where in 3 copies of report will be prepared, two copies to be submitted with monthly report to RDSMC & WUSC and third copy to be retained by contractor.

Table 5.1: List of Materials Tested on Site

Sl.No.	Material	Identification Number
1	Cement	QC-M -01
2	Fine aggregate (Sand)	QC-M -02
3	Bricks	QC-M -03
4	Coarse aggregate for concrete works	QC-M -04
5	Pipe line works	QC-M -05

Table 5.2: Type of Test for Cement

CEMENT				QC-M-01
Sl.No.	**Type of Test**	**Procedures**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Fineness	Clause 11.1	One for each source of 10 T or part thereof and when called for by the Engineer. Sampling should comply with IS :3535 - 1986	On receipt of material at site and before using as directed by the Engineer. Test certificate to be produced to the Engineer before use.
2	Compressive strength – 72 hrs, 168 hrs, 672 hrs.			
OPC 43 shall conform to IS 8112:1989 OPC 53 shall conform to IS: 12269-1987 PPC to conform IS :1489-1991				

Table 5.3: Type of Test for Sand

FINE Aggregate (SAND)				QC-M-02
Sl.No.	**Type of Test**	**Procedures**	**Frequency of Test**	**Timing of Test/Inspection**
1	Particle Size and shape IS :2386-Part-(I)-1963	Clause 11.2	One test for 20 m^3 or part thereof.	On receipt at site and test certificate to be produced to the Engineer before use.
2	Fineness modulus		One test for 20 m^3	
3	Bulking test		One test per 20 m^3 or part thereof	
4	Silt content IS 2386: Part(II)-1963		One test for 20 m^3	

Table 5.4: Type of Test for Bricks and Brick Tiles

BRICKS & BRICK TILES				QC-M-03
Sl. No.	**Type of Test**	**Procedures**	**Frequency of Test**	**Timing of Test/Inspection**
1	Compressive strength	Clause 11.3	One test for each source.	On receipt at site
2	Physical properties			
3	Water absorption test			
4	Efflorescence			

Table 5.5: Type of Test for Coarse Aggregate for Concrete

COARSE AGGREGATE FOR CONCRETE				QC-M-04
Sl. No.	**Type of Test**	**Procedures**	**Frequency of Test**	**Timing of Test/Inspection**
1	Particle size distribution IS 2386(I)-1963	Clause 11.4	One for each source of 40 cum. Or part thereof and when called for by the EIC.	On receipt of material at site
2	10% Fine value as per IS 2386- Part (IV)-1963	Lab		

5.3 MATERIALS AND EQUIPMENTS CERTIFIED BY MANUFACTURER

Acceptance of certain manufactured materials and equipment components, as stipulated in the contract, shall be based on test certificates from the manufacturer conforming to IS/ISO and on visual inspection. These items shall bear the IS/ISO mark. RDSMC shall review the manufacturers' certificates for conformance to contract requirements before these items are delivered to the site. Upon their delivery and before their installation or otherwise incorporation in the works RDSMC and WUSC shall inspect the condition of these items. Inspection criteria shall be decided jointly by RDSMC and WUSC. They may decide to have the material additionally tested in Laboratory. The cost of such tests will be borne by the contractor.

The reference numbers are allocated for different materials/equipments as given in **Table 5.6** which are meant for references only to be used while listing the manufacturer's certificates.

Table 5.6: List of Material and Equipment Certified by the Manufacturer

Sl.No.	Description	Reference Number
1	Cement	MC-1
2	Steel for Reinforcement and structural steel	MC-2
3	Pipe such as HDPE/PE, GI, PVC, MS,CI, DI, SW, RCC etc.	MC-3
4	Manhole covers and Footrest	MC-4
5	AC/GI/Fiber glass sheets	MC-5
6	Electrical cables/fans and fixtures	MC-6
7	Switches/sockets and boards	MC-7
8	Flow measuring devices	MC-8
9	Control Panel	MC-9
10	Lightening arrestor	MC-10
11	Water Level indicator and controllers.	MC-11
12	Disinfection Units	MC-12
13	Pump and Motor	MC-13
14	All type of specials such as PVC, GI, CI etc.	MC-14
15	All types of valves such as sluice valve, Air valve etc.	MC-15
16	Any other item as per agreement	MC-16

5.4 MATERIAL AND EQUIPMENTS MAY INSPECTED BY DEPARTMENTAL, RDSMC, PMQAC TEAM AT THE FACTORY

Materials and equipment to be inspected by Departmental, RDSMC, PMQAC Team vary from package to package, as stipulated in the contract documents. Inspection would normally take place at the factory during or upon completion of manufacture. Upon delivery and before installation or incorporation in the works, RDSMC and WUSC shall inspect the physical condition of these items and, if necessary, test them on site. Inspection criteria should be stipulated in the contract document. Refer to **Table 5.7** for a list of materials and equipment suggested for inspection by team inspections.

Table 5.7: Material and Equipments Inspected by Team at the Factory

Sl.No.	Description
1	Pipes such as DI, CI,PVC, MS,SW,HDPE/MDPE
2	Pumps , Motors & D.G. Sets
3	Manhole Frames and covers
4	R.C.C. Pipes

6 CONTROL OF CIVIL STRUCTURAL WORKS AND WATER RETAINING STRUCTURES

This section of the Quality assurance and Quality control Manual covers the testing of works and working procedures and sequences for general civil and structural works. The key elements to be inspected in these works are concreting brickwork and finishes. The requirements for testing and control of materials for these works are already described in previous section.

6.1 FLOW CHARTS

Flow charts indicating the sequence and control points for cement concrete and mortar works are shown in **Figure 6 (i)** and **Figure 6 (ii)** respectively.

6.1.1 Proportions of Cement Concrete

As per IS 456 : 2000 Nominal mix concrete may be used for concrete of M20 or lower. The proportions of materials for nominal mix concrete shall be in accordance with provision of Technical Specification or BIS as given in **Table 6.1** ;

Table 6.1: Proportions of Nominal Mix Concrete

Grade of Concrete	Total Quantity of dry Aggregate by Mass per 50 kg of cement, to be taken as the sum of the individual masses of Fine and Coarse Aggregate, Kg, Max.	Proportion of Fine Aggregate to Coarse Aggregate(By mass)	Quantity of water per 50 kg of cement, Max. in liter.
1	2	3	4
M5	8000	Generally 1:2 but subject to upper limit of 1: 1.5 and a lower limit of 1:2.5	60
M 7.5	625		45
M 10	480		34
M 15	330		32
M 20	250		30
NOTE- The proportions of the fine to coarse aggregate should be adjusted from upper limit to lower limit progressively as the grading of the aggregates becomes finer and the maximum size of the coarse aggregate becomes larger. Graded coarse aggregate shall be used. For an average grading of the fine aggregate (that is, Zone II of Table 4 of IS 383), proportions shall be 1:1.5, 1:2 and 1:2.5 for maximum size of aggregates 10 mm, 20mm and 40mm respectively.			

The cement content of the mix specified in above Table for any Nominal mix shall be proportionately increased if the quantity of water in a mix has to be increased to overcome the difficulties of placement and compaction, so that the water – cement ratio as specified is not exceeded.

The Civil engineering Hand Book provides strength expected to be attained by concrete of different proportions and the permissible stresses are laid down as given in **Table 6.2**;

Table 6.2: Strength of Concrete of Different Proportions

Grade of Concrete	Characteristic Compressive Strength (In Kg/cm2)	
	At 7 days	At 28 days
M10-1:3:6	70	100
M15- 1:2:4	100	150
M20-1:1.5:3	135	200
M25-1:1:2	170	250

6.1.2 Proportions of Cement Mortar

IS 2250 : 1981 provides different grade of mortar for use in masonry work as given in **Table 6.3**;

Table 6.3: Grades of Masonry Mortar

Grade	Compressive strength at 28 days in N/mm2	Cement: Sand
MM – 0.7	0.7-1.5	1:8
MM – 1.5	1.5-2.0	1:7
MM – 3	3-5	1:6
MM – 5	5-7.5	1:5
MM – 7.5	7.5 and above	1:4
MM – 7.5	7.5 and above	1:3

The selection of mortar will be governed by the strength required by the masonry and reference may be made in IS : 1905- 1987 for knowing the suitability of combination of various types of mortars and grade of bricks for the different strength required for the masonry.

6.2 CONSTRUCTION OF WATER RETAINING STRUCTURES

In the case of Reinforced Cement Concrete (RCC) retaining structures, only concrete mix proportions by volume shall be used. The associated quarry and source of sand and aggregate shall be approved by Engineer after satisfactory tests of aggregates. Mechanical mixing with mixtures is mandatory. Mechanical vibrators in sufficient number should be used for compaction of concrete. Hand compaction cum manual compaction is not permitted under any circumstances. Adequate mixtures and vibrators, including standby should be available at site well before the start of concrete work. Shuttering quality should be of good standard, as approved by the Engineer well before the fixing of any shuttering. Shuttering should be fixed in such a manner that no slurry or water seeps through the jointing or box outs. For this plastic tape, Plaster of Paris (POP), putty or other suitable sealants should be used at joints of shuttering. The concrete should be kept moist throughout 24 hours a day for the specified number of days for adequate curing by flooding with water, or by putting moist gunny bags. Adequate separate labour and supervisor should be deployed for curing work, in ensuring that this important component of the work is satisfactorily conducted.

Table 6.4: List of Tests for Civil Works and Liquid Retaining Structures

Sl.No.	Activity	Name	Material Type of test	Test & Sampling Procedure
1	**Pump chamber**			
1.1	Earth Bedding	Earth/Soil	QC-P-01	Lab
1.2	Concrete Bedding	Coarse Aggregate	QC-M-04	Clause 11.2
		Cement	QC-M-01	Clause 11.1
		Fine Aggregate	QC-M-02	Clause 11.2
1.3	Masonry	Cement	QC-M-01	Clause 11.1
		Fine Aggregate	QC-M-02	Clause 11.2
		Water		Lab
		Stone	QC-M-03	Clause 11.3
		Bricks		
1.4	Horizontal DPC	Cement	QC-M-01	Clause 11.1
		Coarse Aggregate	QC-M-04	Clause 11.2
		Fine Aggregate	QC-M-02	Clause 11.2
		Bitumen		Lab
1.5	RCC Slab	Cement	QC-M-01	Clause 11.1
		Coarse Aggregate	QC-M-04	Clause 11.2
		Fine Aggregate	QC-M-02	Clause 11.2
		Water		Lab
		Steel	MC -2	Lab
1.6	Mortar	Cement	QC-M-01	Clause 11.1
		Fine Aggregate	QC-M-02	Clause 11.2
		Water		Lab
2	**Water retaining structures**			
2.1	RCC works	Cement	QC-M-01	Clause 11.1
		Coarse Aggregate	QC-M-04	Clause 11.2
		Fine Aggregate	QC-M-02	Clause 11.2
		Water		Lab
		Steel	MC -2	Lab

3	Completion of Liquid Retaining Structures (wet wells, storage reservoirs, UGSR/ OHSR, pretreatment units, RCC open channels, etc.)	Stage Completion Test	Field	

The QC-P-01 to QC-P-06 are Reference Numbers given to various quality control process of works to be executed as mentioned in **Table 6.5**.

Table 6.5: Identification Numbers Given to Various Quality Control Process

Sl.No.	Type of Work	Reference Number
1	Bedding	QC-P-01
2	Concreting	QC-P-02
3	Cement sand mortar	QC-P-03
4	Liquid retaining structure	QC-P-04
5	Completion of pipe line and jointing	QC-P-05
6	Manholes and valve chambers	QC-P-06

The format provides type of test, frequency of test, time of test etc.

Table 6.6: Type of Test for Earth Bedding

Earth Bedding				QC-P-01
Sl.No.	**Type of Test**	**Test Performed at**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Moisture content as per IS :2720-1983	Lab	One test for each 250 m^3 of soil	During execution of work
2	Field density test as per IS :2720-1983	Lab	One test for each 100 m^2 of compacted area	

Table 6.7: Type of Test for Concreting

Concreting				QC-P-02
S.No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/Inspection**
1	Compressive strength as per IS : 516 -1959	A/TR-5 Clause 11.4	One test for 1-5 m^3 of concrete. Two tests for 6-15 m^3 of concrete. Three tests for 16-30 m^3 of concrete. Four tests for 31-50 m^3 of concrete +one set every 50 m^3 of additional concrete work.	Type of Test for Concreting. Test samples to be taken while pouring. 4 cube mold sets to perform tests at 7 and 28 days after concrete manufacturing. Two would be tested at 7 days and a third at 28 days. The remaining cube would be used to double-check any result or if any test was not properly executed.
2	Slump test per IS : 1199-1959	A/TR-6 Clause 11.4	Random checks throughout concreting period as directed by the Engineer	Before pouring concrete
3	Steel reinforcement placement and bending	Daily Report	Before pouring concrete	Before pouring concrete
4	Concrete Pour Report	C/QRF-4	When pouring is done	Immediately after pouring

Table 6.8: Type of Test for Cement Sand Mortar

Mortar				QC-P-03
Sl. No.	**Type of Test**	**Test Performed at**	**Frequency of Test**	**Timing of Test/Inspection**
1	Compressive strength as per IS :2250-1981	Site /Lab	One sample for every 2 m^3 of mortar subject to a minimum of three samples for a day's work	Test samples to be taken while placing. Tests to be done as specified in the contract.
2	Consistency as per IS :2250-1981	Lab	**----- do -----**	**------ do -----**

Table 6.9: Type of Test for Liquid Retaining Structures

Testing of Liquid Retaining Structures				QC-P-04
Sl.No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Water tightness for underground structures	A/TR-9	One test per structure	On completion of stage
2	Water tightness for elevated structures	A/TR-10	One test per structure	

6.3 SOURCE OF WATER AND TREATMENT UNITS OF SURFACE WATER SUPPLY SCHEMES

Urban water supply schemes are based on surface source or ground water source. Surface water is drawn from rive. Depending upon the availability of potable water in the region the source of water supply is selected as surface or ground water.

6.3.1 Tube well

Tube well is drilled by reverse rotary, percussion rig or by hand boring as per IS: 2800 (part-1) 1991, and developed in accordance with IS : 11189- 1985 and tested in accordance with IS : 2800 (part-II)-1991. General requirement of Tube well shall be as given in **Table 6.10**.

Table 6.10: General Requirement of Tube Well

Sl.No.	Description	Purpose
1	Size of Tube well	M.S housing pipe conforming to IS: 4270-2001 0f nominal dia. 200 mm (8mm thick), 250mm (8mm thick) shall be generally provided.
2	Strainer	Steel Strainer, screens and slotted pipe shall be as per IS : 8110-2000 of nominal bore dia. of 200 mm shall generally be provided. Slot size of the strainer shall be arrived at from grain size analysis of aquifer to be tapped.
3	Depth	Depth of Tube well shall depend upon the availability of aquifer and discharge requirement.

6.3.2 Water Works Structures

The water works structures required for further utilization of tube well water is given in **Table 6.11**

Table 6.11: Water Works Structures

Sl.No.	Description	Purpose
1	Pump chamber	To house machinery and other equipment and shall be constructed as per standard design.
2	WUSC Office building	To be constructed for operation of WUSC office
3	Guard house/Staff quarter	For the residence of maintenance staff employed at water works
4	Over Head Storage Tank	Elevated R.C.C. Storage Tank to supply water to consumer at minimum residual pressure of 5m head. The staging of tank will be as Guided by IS: 11682-1985 foundation design shall depend on bearing capacity of soil.
5	Pumping Machinery	Submersible pump conforming to IS: 8034-2002 and motor Conforming to IS 9283-1995 shall be provided for lifting water form bore well.
6	Distribution system	To convey wholesome water to consumer at adequate residual pressure in sufficient quantity at convenient points.

6.3.3 Disinfection Plant

Disinfection of water shall be carried out by Mechanical chlorinator using chlorine salutation or silver ionization based plant.

6.3.3.1 Silver Ionization Process

The silver is a cold sterilization process using special silver electrodes which discharge silver ions into the water by means of low power direct electric current. As the water passes through the sealed chamber, metallic ions are generated to purify the water. The microscopic actions of the ions with bacteria are twofold. First, the bacteria are destroyed through a change in their enzyme process. The ions maintain a stable sanitizer residual in the water until they are used up by this process.

6.3.3.2 Chlorination Process

Chlorination is the most common type of drinking water disinfection. It is designed to kill harmful organisms, and generally does not result in sterile water (free of all microorganism) Two types of processes are generally used; hypo chlorination, employing a chemical feed pump to inject a calcium or sodium hypochlorite solution, and gas chlorination, using compressed chlorine gas.

6.4 CONVENTIONAL UNITS OF SURFACE WATER SUPPLY SCHEMES

The various units of surface water supply scheme with their purpose is tabulated in **Table 6.12** below;

Table 6.12: Units of Surface Water Supply Scheme

Sl.No.	Description	Purpose
1	Intake works	For with drawl of water from surface source and to ensure entrance velocity of 0.60-0.90cm/sec.
2	Inlet and Outlet	For conveyance of raw water to sedimentation and storage tank and it should be laid at correct gradient/ alignment.
3	Storage cum Sedimentation tank	It should be made water tight to reduce losses
4	Underground suction cum scour well	Collection chamber for pumping water should be tested for water tightness.

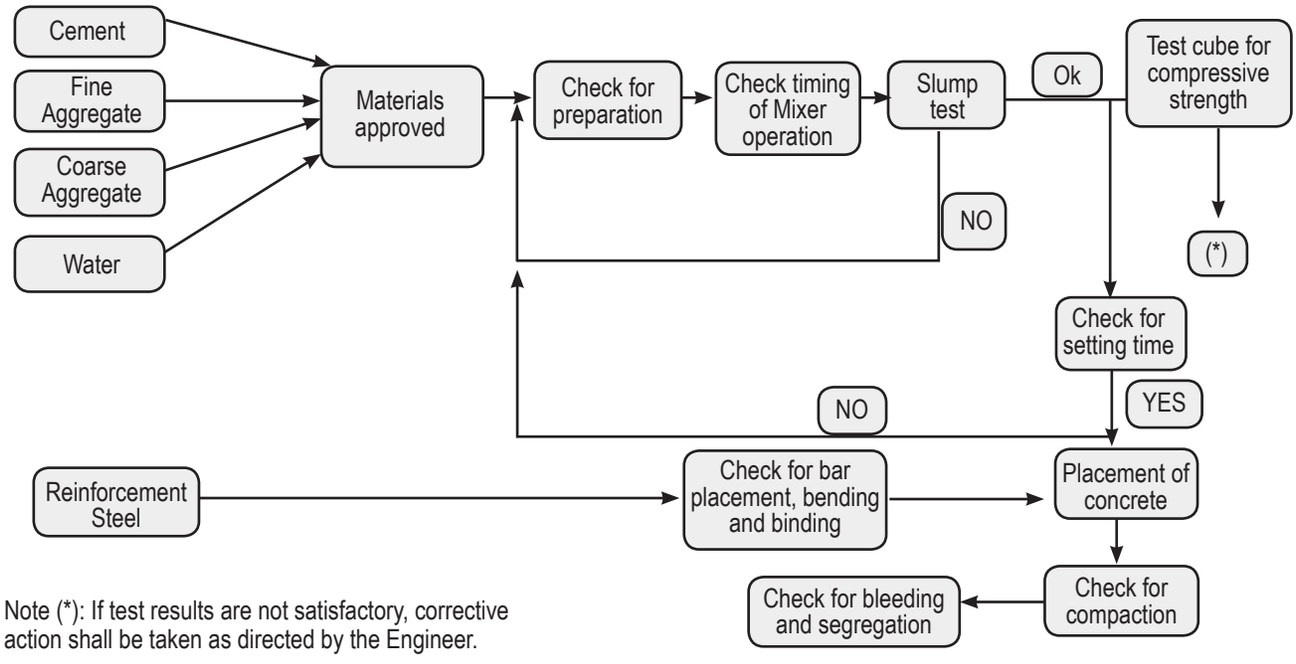
Sl.No.	Description	Purpose
5	Pump chamber	To house machinery and other equipment and shall be constructed as per standard departmental design.
6	Pumping plants	Centrifugal pumps as per IS:9542-1980 are installed for pumping raw water to high level Tank and clear water to O H S R.
7	High Level Tank	For distribution of raw water to filter units and should have scour and overflow arrangement. The structure should be tested for water tightness.
8	Slow sand filter/ Rapid sand filter	Provided for filtration of water. The structure is provided with under drainage, filter media, inlet outlet channels as per specifications. The structure should be tested for water tightness.
9	Clear water reservoir	For storage of clear water, and is provided with scour/over flow pipes . Structure should be tested for water tightness.
10	O H S R	Elevated R.C.C. Storage Tank to supply water to consumer at minimum residual pressure of 12m head. The staging of tank will be as Guided by IS: 11682-1985 foundation design shall depend on bearing capacity of soil.
11	Disinfection	Disinfection of water shall be carried out by Mechanical chlorinator using chlorine Solution or silver ionization based plant.

6.5 TESTING OF MATERIALS

All the materials proposed to be used in the works must have been tested by the contractor and approved by the RDSMC well before the start of work at site. The contractor shall submit the concrete pouring report to the RDSMC and WUSC as and when concreting is done and shall obtain the approval of the RDSMC when a particular stage is completed and before proceeding to the next stage.

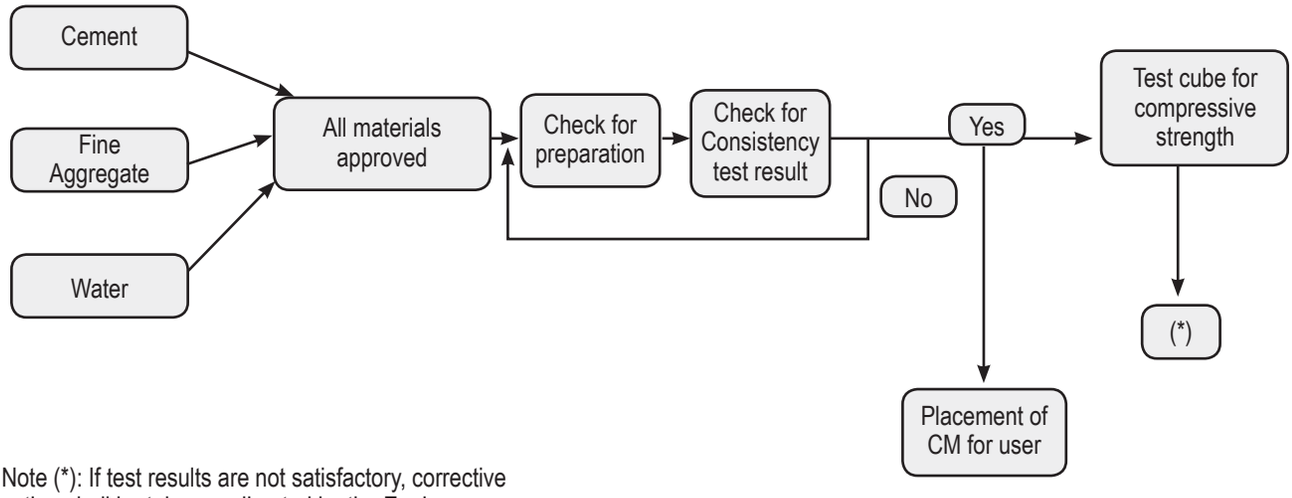
Tests for general civil and structural works are listed in **Table 6.4**. Test processes are presented in **Table 6.6, 6.7, 6.8** under the referenced test numbers. Required materials tests are also indicated (materials testing process are presented in Section 5). Test report formats are included in **Appendix A.** Testing of liquid retaining structures is given in **Table 6.9**. The contractor shall be responsible for conducting tests as stipulated.

FIGURE 6(I): PROCESS CHART FOR CONCRETE WITH STAGES OF INSPECTION



Note (*): If test results are not satisfactory, corrective action shall be taken as directed by the Engineer.

FIGURE 6(II): PROCESS CHART FOR CEMENT MORTAR WITH STAGES OF INSPECTION



Note (*): If test results are not satisfactory, corrective action shall be taken as directed by the Engineer.

7 CONTROL OF PIPELINE WORKS

This section of the QA/QC Manual covers the testing and inspection of workmanship for pipeline works (i.e. Water and sewer lines). The requirements for testing and control of input materials are outlined in **Table 7.1**. An inspection checklist for pipeline works is included in **Appendix B**.

7.1 GENERAL

The pipe-laying appears simple, but it requires too much care while laying, along with close watch to ensure the levels required for quality assurance to attain a satisfactory job. In pipe laying process, generally the whole of the work takes place below the ground surface and the jointing and bedding of pipes must be carried out with precision. Pipes should be laid according to specified grade in straight lengths with least number horizontal and vertical bends.

It should be taken care of that pipes are not to be bedded directly on large stones. Too much precision is necessary for ensuring quality of work , joints and jointing materials should be kept perfectly clean. If the quality of work is not ensured it will prove more costing in terms of future repairs, since the cost of locating and repairing of leaks is very high. All specials and fittings etc. should be installed at the same time of main pipe installation work, without leaving gaps for later insertion.

7.2 EXCAVATION AND BACKFILLING

The excavation should give enough room at the sides of a pipe for a man to stand down in the trench and move along sideways. Joint holes should be excavated before the pipe is lowered in to position, and must give enough room for the man to reach round to the underside face of the joint. For large-diameter the joint hole must be large enough for the worker to crouch down beside the pipe and reach the lower face of the joint.

Backfilling must be completed in layers and laid according to specified requirements. Mechanical compaction should be conducted to achieve the required level of compacted density as per the contract document and specification. All large stones liable to damage the coating of the pipe must be removed from contact with the pipe.

Additional excavation is to be completed at localized positions, in accommodating the joints and so ensuring that the full length of the pipe barrel rests directly on the trench bedding.

To ensure firm bedding conditions, the final excavation and dressing of the last 15 cm to trench bed formation level, should be completed manually and not by mechanical excavator

7.2.1 Laying and Jointing of HDPE/PE Pipes and Specials

While there is no hard-and-fast rule about which direction pipes should be laid if coupler joints are to be provided. Lying of pipeline should be straight and in correct alignment and laid on leveled bed. At the end of each day's work the last pipe laid shall have its open ends securely closed with a gunny bag or a wooden plug or end cap to prevent entry of rain water, soil, rats and any other foreign matter into the pipe. The cutting of the pipes shall be cleanly cut and reasonably square to the axis of the pipe or may be chamfered.

7.2.2 Trench Preparation

The trench must be prepared and be in good condition before the pipe is lowered into it. This means its bottom must be in level and made free of all sharp stones, the trench must be dry, and its sides must be made safe against slips or collapse. Preparation of pipe trenches is a very important activity. All the precautions regarding safety must be followed while the trench preparation, the excavated earth should be placed away from the both sides of trenches Wooden planks should be placed across the trenches in front of entry gate of houses.

If the Junior Engineer thinks the Contractor not taking enough precautions to support the trench he should point out the dangers and offer advice to remedy the matter. Usually, the Junior Engineer should find no difficulty in convincing the contractor's representative, but if unreasonable risks persist, the Junior Engineer should discuss the problem with his superiors (CSE).

All heavy pipes must be handled with care to prevent damage to them and their sheathing. Slings or ropes should be used to lift heavy pipes. Chains and wire ropes should be forbidden. Even ropes must be used with care to prevent damage to the sheathing. It is a good precaution for the Junior Engineer to insist that proper slings in sufficient numbers are brought on the job at the very start.

7.2.3 Cover to Pipes

All pipes are normally laid below ground and the standard amount of cover is 900 mm above the top of the pipe. However, cover of less than 1000 mm is not to be permitted below a public road, or traffic loading would cause damage to pipes. Use of HDPE/PE/GI/CI/DI/MS pipe is an option for road crossings to mitigate the heavy vehicular traffic.

7.2.4 Pipeline Log Book

It is essential to maintain a pipe log book in which are entered full details of the laying of the pipeline covering each and every pipe, giving frequent levels, details of fittings and connections, and a running total of the chainage laid, together with sketch plans showing other services encountered and dimensions to locate the position of the pipe from time to time.

7.2.5 Thrust Block Considerations

At every change of direction in the pipeline, at every change of size, at connection and valves, thrust blocks are necessary. Complete or partial failure of a pipe at a bend is almost always due to soil movement behind the block.

Thrust blocks for vertical bends are essential, and those on bends down may have to be reinforced. Other thrust blocks, such as those adjacent to river banks, ditches, or depressions in the ground, must be carefully placed, as there is a possibility of collapse of earth at these points.

7.2.6 Flanged Pipes

Two practical points need to be noted when setting up flanged piping; Care must be taken not to tighten up the flange bolts until it is certain that the exact alignment required has been achieved. If there is lack of alignment between flanges the tightening of the bolts can break the flange. The stipulations of the appropriate IS code must be strictly adhered which are generally followed by the manufacturers/suppliers.

7.3 FLOW CHARTS

Flow charts indicating the sequence and control points for materials used in pipeline work and for its laying with stages of inspection are shown in **Figures 7 (i) , 7 (ii) & 7 (iii).**

7.4 TESTING OF WORKS

The works to be tested on site include bedding for pipelines, pipeline laying and jointing, and hydrostatic leakage and water tightness tested after completion. All the materials proposed to be used in these works must have been tested by the Contractor and approved by the RDSMC well in advance of commencing works. The contractor shall obtain the approval of the RDSMC when a particular stage is completed and before proceeding to the next stage.

Tests for laying of pipeline works and their process are presented in **Table 7.1**, **Table 7.2** and **Table 7.3** under the referenced test numbers. Required materials tests are also indicated (Materials testing procedures are presented in **Section 11**). Test report formats are included in **Appendix A.**

The full requirement, for the testing of pipelines, is given within the provisions of the contractor's contract and specifications. Every section of pipeline laid must be tested before it can be accepted by the supervising engineer. The personal observation of this test is one of his most important duties. The extent of pipeline to be tested at one time is usually at the discretion of the contractor.

It is always preferable to test small sections at a time. In some instances the contractor is not allowed to fill back over the joints until a satisfactory test has been taken. Though it is obviously of great benefit to be able to inspect the exterior of joints under pressure, there are definite disadvantages in not backfilling around the joints. In the first place, if the main is being laid in a road it is almost certain that the necessity of restoring the road fully open to traffic will be of overriding importance.

An experienced contractor will try to test the pipeline in as short lengths as possible, with as many joints left exposed to view as is practicable, even if such testing can only be undertaken in the first instance at somewhat less pressure than the final acceptance test. To do this, the contractor will need some easily fixed stop ends for temporary closure of the end of the pipeline. He must remember, however, to give time for all thrust blocks on the line to be properly completed and made secure before the test is started.

The test should be carried out at specified pressure and any resulting losses should be within the stipulated permissible levels, as given in the contract document. The pipeline should only be accepted after ensuring losses within the permissible levels, under the full terms of testing.

Table 7.1: List of Tests for Pipeline Works

Sl.No.	Activity	Material		QC-M-05
		Name	Type of Test	Q C Process
1	**Bedding for Pipeline**			
1.1	Earth Bedding	Earth/Soil	Lab	QC-P-01
1.2	Concrete Bedding	Cement	QC-M-01	QC-P-02

Sl.No.	Activity	Material		QC-M-05
		Name	Type of Test	Q C Process
		Sand	QC-M-02	
		Water	Lab	
		Coarse Aggregate	QC-M-04	
		Steel	MC	
2	Pipeline Laying and Jointing			
2.1	GSW Pipe	Cement	QC-M-01	QC-P-03
		Fine Aggregate	QC-M-02	
		Water	Lab	
		Pipes	MC	
2.2	HDPE/PE,GI,CI,DI,MS Pipes	Pipes	DTI	
		Coupler, Gaskets	DTI	
2.3	RCC Pipes	Pipes	DTI	QC-P-03
3	Manhole/Valve Chamber Construction	Cement	QC-M-01	
		Fine Aggregate	QC-M-02	QC-P-03
		Water	Lab	
		Bricks	QC-M-03	
		Coarse Aggregate	QC-M-04	
		Cover & Frame	DTI/MC	
		Steel	MC(2)	

Table 7.2: Type of Test for Completion of Pipeline and Jointing

Completion of Pipeline Laying and Jointing				QC-P-05
S. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Hydrostatic test for NP pipes	A/TR-7	On completion of M.H.	On completion of M.H.
2	Hydrostatic test for pressure pipes	A/TR-8	One test for defined stretch for each type/size of pipeline	On completion of stage

Table 7.3: Type of Test for Manhole/ Valve Chambers

Completion of Manhole/Valve Chamber				QC-P-05
Sl.No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/Inspection
1	Leakage Test	A/TR-9	On completion of M.H./ Chamber	On completion of M.H./ Chamber

Figure 7(i): Checks for Material Used in Pipeline Works

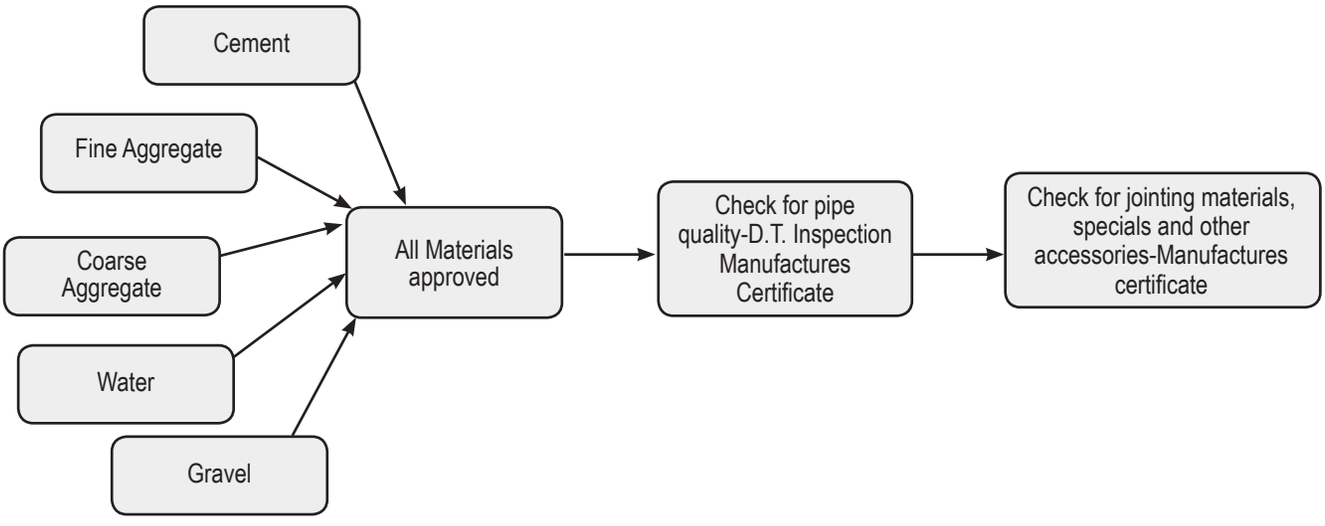


Figure 7(ii): Checks of Preparatory Works Before Laying Water Supply/ Sewerage Pipe Lines

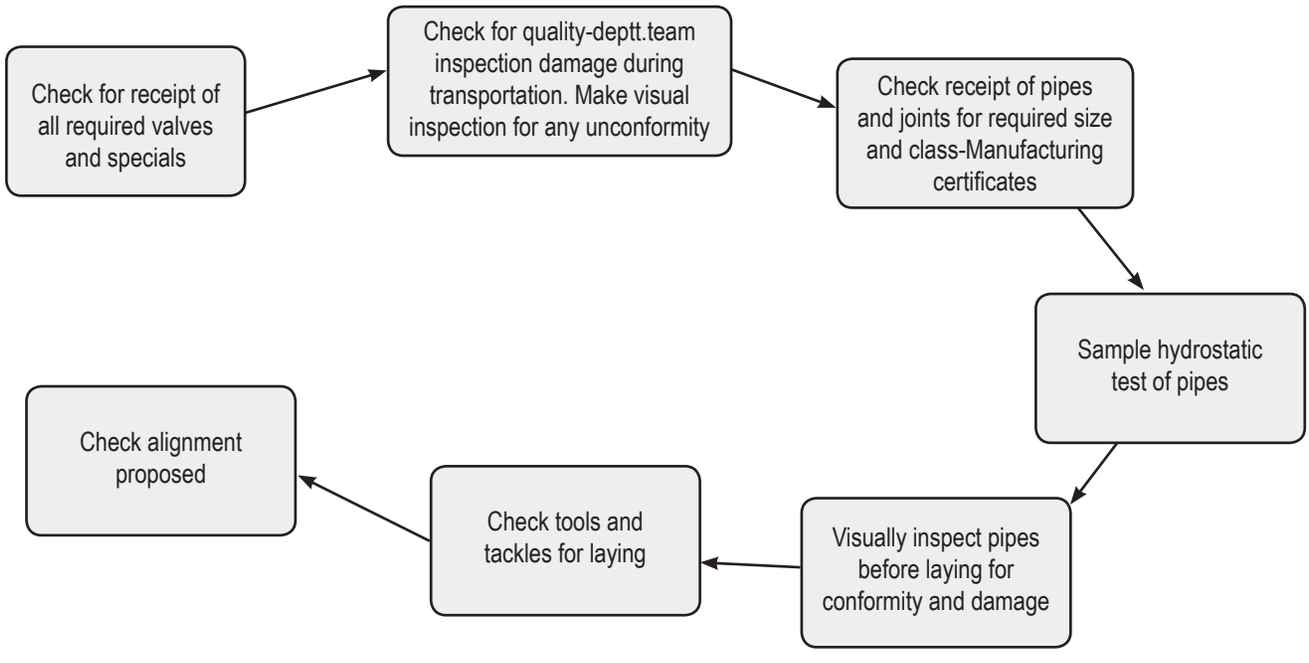
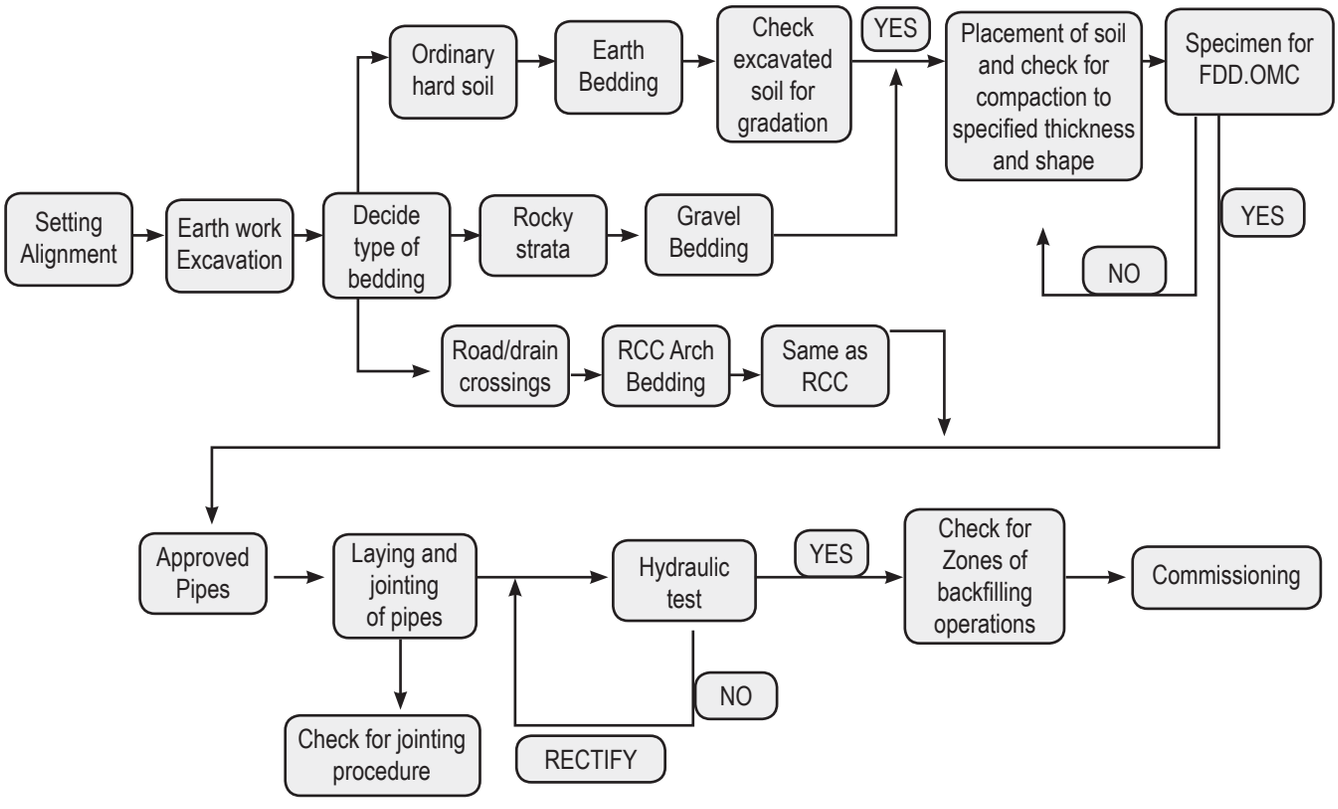


Figure 7(iii): Process Chart for Pipeline Works with Stages of Inspection



8 CONTROL OF MECHANICAL & ELECTRICAL WORKS

This section of the QA/QC Manual gives an overview of the quality control requirements for electromechanical works, such as water treatment and supply systems, sewage treatment plants, compost plants, pumping systems, and power supply and distribution systems. The requirements for testing and control of input materials and components, including manufacturers' certification, and departmental party inspections, are outlined in Section 5. Materials and components to be incorporated into electromechanical works shall be inspected by RDSMC and WUSC as soon as they are delivered, to ensure that they meet the specifications and design requirements, are in agreement with shipping documentation, and are accompanied by manufacturer's certification, third party or departmental inspection certificates, as applicable. Accepted materials and equipment shall be properly stored by the contractor until needed. If manufacturer's installation instructions conflict with design or contract requirements, the RDSMC WUSC shall be notified immediately. Installation shall proceed only after the materials and components are approved by RDSMC.

A series of inspections and tests during installation and completion of electromechanically works shall be performed by the contractor or the equipment manufacturer and witnessed by RDSMC and WUSC as follows:

Preparatory Inspections: Prior to installation, the civil and structural works where electromechanical equipment is to be installed shall be inspected to ensure conformance with designs and equipment installation requirements.

Installation inspections and Tests: A system of inspections and tests, as specified in the contract or recommended by the equipment manufacturer, shall be employed throughout movement to position and installation of equipment and systems. Inspections shall be performed by RDSMC at critical points during installation. The critical points are indicated below in **Table 8.1**;

Table 8.1: Critical Points for Inspection

Sl.No.	Critical Points	Items
1	Installation of Mechanical Equipments	• Lowering of submersible pump to proper depth • Size of cables • ISI markings as per contract requirement • Efficiency of pump sets
2	Installation of Electrical Equipments	• Proper capacitor in control panel to improve the power factor • Power connection are not loose and properly insulated with use of lugs • Double earthing
3	Disinfection Unit	• Unit of specified capacity. • Unit connected & working properly.

Surveillance shall be provided by RDSMC/WUSC throughout the progress of work to ensure that installation is performed in accordance with the contract requirements, approved drawings, acceptable workmanship standards and configuration control requirements.

All field modifications and retrofit work shall be performed under the surveillance of the RDSMC and WUSC installation inspector.

Installation Verification Inspections: Prior to all mechanical and electrical testing, verification inspection shall be performed to ensure that equipment has been satisfactorily installed.

System Tests: These tests shall be conducted as appropriate to demonstrate that the installed systems are free from damage due to shipment and installation, and that equipment performs in accordance with specifications.

Integrated Tests: After completion of system tests, integrated tests shall be performed to demonstrate that the system performs satisfactorily when connected to its interfacing systems or sub-systems. These tests will be followed up by commissioning tests.

Commissioning Tests: These consist of a tests performed under service operating procedures to demonstrate compatibility of the physical plant with operating procedures.

Final Inspections: Final inspections shall be performed to ensure that the completed work is in accordance with the contract and that all previously identified discrepancies have been resolved satisfactorily.

8.1 PARAMETERS TO BE DECLARED BY THE MANUFACTURER

The pumps supplied by the manufacturer shall be marked with the following parameters and shall be declared by the manufacturer.

- Model, size and serial number of the pump;
- Rated speed, total head and discharge at the guaranteed duty point; (iii) Range of Head;
- Motor range (kW) Prime mover rating; (v) Rated volume;
- Rated frequency;
- Number of phases; (viii) Winding connection;
- Maximum current in amperes; (x) Class of insulation of motor;
- Manufacture's name / trade mark;
- Power input in kW; (xiii) Classification;
- Number of stages in case of multistage; and
- Self priming time at 1.5 m or 3 m static suction lift.

8.2 PUMP TEST RECORD

The Pump test record shall be maintained as per sheet given here;

Name of Manufacturer: **PUMP TEST RECORD**

F U L L L O A D

Pump Type ……..Pump No ……. Motor Make ……
Current ……Amps Voltage …… Volts

Suction…….. mm Delivery ……. Motor Rating ……..kW

Speed …….Rpm Phase …….

Imp. Dia. ……mm Material …… Motor Frame …….

Motor Efficiency……% Frequency ……Hz

Capacity Measured By Motor Sl. No. ……..

Suction lift measured by : Delivery head measured by :

Motor Eff. Reference : Performance curve at Full load, rpm Nature of test -- Performance test

Sl. No.	Speed of Pump rev/min	Suction Gauge Reading, m	Delivery Gauge Reading, m	Gauge Distance, Z m	Velocity Head Correction, m	Total Head, m	Discharge Measurement	Discharge in l/s	Current, A	Voltage	Watt Meter Reading		Watt Meter Reading (IP) kw	Pump Input (BP) kw	Pump Output (LP) kw	Performance of Rated speed H/Q/BP
											W1	W2				

Pump Certified for

(i) Head range …….. .m (i) Total Head in m Date ……

Remarks ……. (ii) Max. Self Priming time ……s (ii) Discharge in l/s ……rev/min……

Tested by …… ……. (iii) Max. self priming Static

Pump input kW Set started at ……. …….

Suction Head ……..m

General Requirements ---- Satisfactory / Unsatisfactory

8.3 QUALITY CONTROL METHODS

The quality of Electro-Mechanical works shall be ensured through the following control methods:

- Joint Team Inspection.
- Check list for pump and machinery works (B/CL-3)
- Check list for Tube well (B/CL-2)
- Check list for control panel for 3 phase Pump and Motor (B/CL-10)
- Check list for centrifugal pump & motor(B/CL-11)
- Obtaining Manufacturing Certificates.

9 CONTROL OF SANITATION WORKS

9.1 EXCAVATION IN TRENCHES FOR LAYING OF SEWERS

Excavation for sewer trenches for laying sewers shall be in straight lines and to the correct depths and gradients required for the pipes as specified in the drawings. The material excavated from the trench shall not be deposited very close to the trench to prevent the weight of the materials from causing the sides of the trench to slip or fall. The sides of the trench shall, however, be supported by shoring where necessary to ensure proper and speedy excavation. In case, the width of the road or lane where the work of excavation is to be carried out is so narrow as to warrant the stacking of materials near the trench, the same shall be taken away to a place to be decided by Engineer-in-Charge. This excavated material shall be brought back to the site of work for filling the trench.

9.2 LAYING OF SEWERS

In laying sewers, the Centre of each manhole shall be marked by a peg. Two wooden posts 100mm x 100mm x 1800mm high shall be fixed on either side at nearly equal distance from the peg and sufficiently clear of all intended excavation. The sight rail when fixed on these posts shall cross the centre of manhole. The sight rails made from 250mm wide x 40 mm thick wooden planks and screwed with the top edge against the level marks shall be fixed at distances more than30m apart along the sewer alignment. The centre line of the sewer shall be marked on the sight rail. These vertical posts and the sight rails shall be perfectly square and planed smooth on all sides and edges. The sight rails shall be painted half white and half black alternately on both the sides and the tee heads and cross pieces of the boning rods shall be painted black. When the sewers converging to a manhole come in at various levels there shall be a rail fixed for every different level.

The boning rods with cross section 75mm x 50mm of various lengths shall be prepared from wood. Each length shall be a certain number of meters' and shall have a fixed tee head and fixed intermediate cross pieces, each about 300mm long. The top edge of the cross pieces shall be fixed at a distance below the top edge equal to, the outside dia, of the pipe, the thickness of the concrete bedding or the bottom of excavation, as the case may be. The boning staff shall be marked on both sides to indicate its full length. The posts and the sight rails shall in no case be removed until the trench is excavated, the pipes are laid, jointed and the filling is started.

The pipes shall be laid with sockets facing up the gradient, on desired bedding. Special bedding, hunching or encasing may be provided where conditions so demand All the pipes shall be laid perfectly true, both to line and gradient. (IS: 4127-1983). At the close of each day's work or at such other times when pipe is not being laid, the end of the pipe should be protected by a close fitting stopper.

9.3 HYDRAULIC TESTING OF SEWERS

Each section of sewer shall be tested for water tightness preferably between manholes. To prevent change in alignment and disturbance after the pipes have been laid, it is desirable to backfill the pipes up to the top keeping at least 90cm length of the pipe open at the joints. However, this may not be feasible in the case of pipes of shorter length.

In case of concrete and stoneware pipes with cement mortar joints, pipes shall be tested three days after the cement mortar joints have been made. It is necessary that the pipelines are filled with water for about a week before commencing the application of pressure to allow for the absorption by pipe wall. The sewers are tested by plugging the upper end with a provision for an air outlet pipe with stop cock. The water is filled through a funnel connected at the end provided with a plug. After the air has been expelled through the air outlet, the stop cock is closed and water level in the funnel is raised to 2.5 m above the invert at the upper end. Water level in the funnel is noted after 30 minutes and the

quantity of water required to restore the original water level in the funnel is determined. The pipe line under pressure is then inspected while the funnel is still in position. There shall not be any leaks in the pipe or the joints (small sweating on the pipe surface is permitted). Any sewer or part there of that does not meet the test shall be emptied and repaired or re-laid as required and tested again. The leakage or quantity of water to be supplied to maintain the test pressure during the period of 10 minutes shall not exceed 0.2 liters/mm dia. of pipes per kilometer length per day.

9.4 BACKFILLING OF THE TRENCHES

Backfilling of the sewer trench is a very important consideration in sewer construction. The method of backfilling to be used varies with the width of the trench, the character of the material excavated, the method of excavation and the degree of compaction required. In developed streets, a high degree of compaction is required to minimize the load while in less important streets, a more moderate specification for back fill may be justified. In open country it may be sufficient to mound the trench and after natural settlement return to regard the areas.

No trench shall be filled in unless the sewer stretches have tested and approved for water tightness of joints. However, partial filling may be done keeping the joints open to avoid disturbance. The refilling shall proceed around and above the pipes. Soft material screened free from stones or hard substances shall first be used and hand pressed under and around the pipes to half their height. Similar soft material shall then be put up to a height of 30cm above the top of the pipe and this will be moistened with water and well rammed. The remainder of the trench can be filled with hard material, in stages, each not exceeding 60cm. At each stage the filling shall be well rammed, consolidated and completely saturated with water and then only further filling shall be continued. Before and during the backfilling of a trench, precautions shall be taken against the floatation of the pipe line due to the entry of large quantities of water into the trench causing an uplift of the empty or the party filled pipe line. Upon completion of the backfill, the surface shall be restored fully to the level that existed prior to the construction of the sewer.

9.5 CORROSION PREVENTION AND CONTROL

9.5.1 General

Corrosion is phenomenon of the interaction of a material with the environment (water, soil or air) resulting in its deterioration. There are many types of corrosion, major types being galvanic, concentration cell, stray current, stress and bacterial. Wastewater collection and treatment systems are more prone to corrosion in view of the nature of the wastewater. Since wastewater contains solids which are more likely to cause abrasion in sewers, pumps and their components thus removing the protective coating and accelerating the corrosion process, corrosion control becomes all the more important in wastewater systems. It is particularly acute in areas where sewage strength is high, sulphate content of water is substantial and average temperature is above 20o C.

9.5.2 Sewer-Protection

Protection of sewer structures by coating against H2S attack can also be considered if other methods of control are impracticable.

9.5.3 Liners

A plastic polyvinyl chloride sheet, having T-shaped protections on the back which key into the pipe wall at the time of manufacture is one of the successful lining materials. Vitrified clay of low porosity has also been used as a liner. In regions where high sulphides and high production of H2SO4 can be expected, problems still remain. Cement mortar joints are subject to attack. Bituminous are emulsified and dissolved by soaps, oil and grease. Acid cement joints offer the best protection but they are costly.

Some type of plastic coatings and/or linings for sewers and other structures have proved moderately successful, given continued inspection and maintenance. The function or these linings is to isolate the concrete from the corrosive atmosphere. To be effective, the lining including joints must be sealed completely to protect the sewer system throughout its expected life.

The interior of cast iron and ductile iron pipe usually is lined with cement mortar. Steel pipe sometimes is lined similarly. Smooth walled steel pipe also may be protected by cementing plasticizes polyvinyl chloride sheets to the pipe and sealing the joints.

Corrugated metal pipe may be coated inside and out with bituminous material. For added protection, asbestos fibers' may be embedded in the molten zinc before it is bituminous coated (asbestos bonded). Such coatings should be of impermeable material of sufficient thickness and free of flaws such as pin holes.

9.5.4 Protective Coatings

Any protective coating used should possess the following qualities:

- It should be resistant to acid attack,
- It should bond securely to the concrete,
- It should be economical,
- It should be resistant to abrasive action by flow of sewage, and when applied, it should be thin enough to fill all pores and irregularities in the surface.
- The coating should be continuous with no pin holes or other breaks.

The effectiveness of a coating thus depends on its inherent resistance to acid attack and also on its ability to form impervious membrane. In practice, coating can applied without discontinuity. Inspection and maintenance must be periodical. Plastic-base paints and coal tar epoxy coatings have proved to be good.

9.5.5 Sewage Pumps

For pumps and pumping equipment, proper materials selection is of paramount importance. The pump casing is normally of close grained cast iron capable of resisting erosion on account of abrasive material in the waste. For handling sewage and other corrosive wastes, the impeller is generally made of high grade phosphor bronze or equivalent materials. The wearing rings for impeller should be of good corrosion resistant materials such as bronze. The shafts are normally made of high tensile steel and replaceable shaft sleeves are recommended.

For pump and pumping equipment, painting is the usual protective measure. Both the interior and exterior surfaces of pumps should be painted after rust scale and deposits are removed by sand blasting, wire brushing or rubbing with sand paper.

10 QUALITY OF DESIGN, DRAWING AND COST ESTIMATE

This section of the QA/QC Manual covers the quality of design, drawing, cost estimate and tender documents during the feasibility and detailed design and tendering process.

10.1 PREPARATION OF FEASIBILITY STUDIES REPORT

For the preparation of feasibility studies report, the design consultant shall collect existing baseline information pertaining to water supply and environmental sanitation for the project municipalities and analyze the existing situation. In liaison with the branch office of DWSS, RPMO staffs, WUA/ municipality, identify and priorities deficiencies in these sectors and finalize the area to be covered

by the system. Study existing and alternative sources of row water taking into consideration factors such as water quality, safe yields, financial viability, sustainability, other uses, environmental impact, climate change, and suggest best possible options. Prepare and compare alternative solutions for improving water supply and sanitation and present them to primary stakeholders (mainly WUSC, municipality and DWSS) and assist them in selecting the best possible alternatives. Carry out the topographic survey and a socio-economic survey for the system. Both surveys should be adequate to allow the completion of detailed design. The socio-economic survey will include women's time spent on water and sanitation activities and cover a representative sample of minimum 10% of the service area to generate a gender, caste, ethnic-disaggregated socio-economic profile. Assess and recommend appropriate connection costs, fees and tariff structure, in line with tariff guidelines adopted by DWSS for small towns, taking into consideration issues such as affordability and willingness to pay, WUSC's and municipalities cash flows and ensuring assess of all the poor in the service area to the subprojects benefits. Conduct economic and financial analyses for each subproject in conformance with ADB guidelines. Liaise with TDF and ADB, through PMO and incorporate their comments on the financial and economic analysis. The design shall be presented to the WUSC/municipality for agreement, the feasibility findings, particularly financial aspects, in an easy understandable manner. Revise the feasibility report to accommodate comments agreed by DWSS, the municipality and WUA and obtain their written agreement before proceeding to detailed design.

10.2 DETAILED ENGINEERING SURVEY

Before start the detailed engineering survey, the design consultants must be established, at the suitable location, suitable benchmarks and survey points. Bench marks shall be constructed in class 20/20 concrete, with minimum dimensions of 0.30m x 0.30m, the upper surface being approximately 50mm above ground level. A 20mm diameter mild steel rod, not less than 300mm in length, shall be cast into the concrete so that projects about 10mm above the centre of the surface of the concrete. The consultant shall also prepare the detailed card of benchmarks and survey points. The co-ordinate and level of each benchmark shall be determined in meter to 3 decimal places. The detailed engineering survey shall be carried out on the supervision of design engineer. During the survey, the existing ground levels shall be taken at intervals not exceeding 10m. Information related to all existing structures, obstructions and services should be located in the survey drawing. Nearby source of the construction materials shall be identified by the Consultant during the detailed survey. During the identification of source of the construction material, the necessary laboratory tests shall be carried out by the design Consultant as mentioned in Appendix-A. The geotechnical surveys as necessary for structural design of subprojects, particularly intakes, water containing structures, water treatment plants and wastewater treatment components shall be carried out by the design Consultants.

10.3 PREPARATION OF DETAILED DESIGN AND TENDER DOCUMENTS

The preparation of detailed design and tender documents shall be carried out in sufficient detail and with adequate QA/QC to ensure clarity and understanding by the WUA, municipality, and other relevant stakeholders. All the designs should conform to DWSS's design guidelines and other national engineering standards, including climate and disaster risk considerations. The tender documents shall be prepared using ADB cleared master bidding documents including all necessary information including: detailed technical specification; BoQ; drawing; specific condition of contract; and evaluation criteria.

10.4 PREPARATION OF DRAWING

The plan of the alignment showing the location of the proposed water main, the width of right of way of roads in relation to the water main, existing services and obstructions to proposed pipeline and edges of asphalt carriageway shall all be presented in the drawing. The drawing shall also be made for pipe laying details, electrical, mechanical, piping drawings, reinforcement details such as

bar-bending schedules for all structures including valve chambers, setting out details, layouts, utility relocation and protection if any required. All drawings shall be computerized and shall be submitted both in hard copies as well as digital by the design Consultant. All dimensions shall be in metric units and each drawing shall be properly identified by a drawing head and a numbering code. Drawing shall be scaled at A1 size, and plotted at A1 size and A3 size.

10.5 PREPARATION OF COST ESTIMATE

The detailed cost estimates, using the latest rates from the sub-project district will be developed from an accurate bill of qualities (BoQ) derived from detailed technical design, drawing that show all design aspects and to be approved by the PMO/RPMO. Estimate the operation and maintenance needs for the first year of operation of the water supply & wastewater management system including staff, material and power costs, and prepare performance standards within the framework of Departmental Operational Guidelines for this operation to be included in the tender documents.

11 PROCEDURE OF SAMPLING AND TESTING OF MATERIALS

Sampling procedures, sample collection, test to be conducted and acceptable test results of widely used materials in the projects are covered as under;

11.1 CEMENT

11.1.1 Sampling Procedures and Sample Collections

The sample collected represents the typical of average properties of material to be tested. Such sample is said to be the representative sample. Much care and systematic sampling procedure is required to be followed, which are now standardized by the relevant BIS.

- Sampling instrument should be clean and dry when used.
- Precautions should be taken to protect the sample from contamination.
- Sample containers should be of such a size that they are almost completely filled by the sample.
- Sample container shall be sealed airtight after filling and marked with full particular of the material and the date of sampling.

Quantity of cement offered at one time is called a lot.

This lot is normally divided in to sublots depending upon its total weight. Quantity of cement taken by a single operation is called increment. Aggregates of all these increments from the same sublot is called gross sample. When these gross samples of each sublot are reduced by suitable procedures for laboratory testing, they are called laboratory samples. Equal quantities of cement from each laboratory sample representing sublots, are mixed to form composite samples.

The method of sampling from bags is described below;

Divide the entire lot in to sub lots. Sub lots should consist of equal No. of bags.

From each sample at least 2% bags should be sampled.

These bags are to be chosen at random. To ensure randomness following procedure should be followed. For example, if a lot consists of 600 bags that is 30 tonnes, divide this lot into 3 sub lots i.e. 200 bags each. Thus N=200. Since at least, 2% bags are to be sampled, then n=4 bags. Therefore, r=200/4=50. Thus starting from any one point, every 50th bag is to be removed.

Increments are to be taken by inserting a tube sampler as per IS: 3535. The material so collected from each bag is 0.75 kg.

Material so collected should be placed in to air tight containers. Cans, plastic bags may be used. These containers shall be sealed immediately. Gross- samples thus obtained have to be reduced to laboratory samples by quartering. Reduction should be continued till about 7-10 kg material required for laboratory sample are obtained.

Equal quantities of material shall be taken from each laboratory sample representing the sublot and mixed together to constitute composite sample representing the lot as a whole. The weight of the composite sample shall be about 7 kg to 10 kg.

All laboratory samples and composite samples should be sealed in an air tight moisture proof container.

11.1.2 Test for Cement

The cement is the important ingredient of mortar and concrete used for construction purposes. The various physical and chemical test should be conducted as per prescribed frequency. Following are the tests to be conducted to judge the quality of cement.

- Consistency
- Fineness
- Soundness
- Initial and Final Setting Time Of Cement
- Compressive strength

11.1.2.1 Test For Compressive Strength

METHOD

Gauge a mixture of cement and regarded identified Indian Standard sand in the proportion of 1:3 by weight using (P/4+3.0) percent of water where P is the percentage of water required to produce a paste of standard consistency.

Fill the cube moulds (70.6mmx70.6mm) by compacting it for 2 minutes on a vibrating machine at a speed of 12,000±) 400 vibrations per minute.

Smoothen the top surface of the cubes with flat side of a trowel.

Immediately upon completion of moulding, place the cube moulds in an atmosphere of 270c±20c and relative humidity over 90%. After, 24 hours, remove the specimens from the moulds and keep them in water till testing.

Test the cubes at 3 days and 7 days age in the compression testing machine at such a rate that maximum load is reached in 80-100 seconds.

Report the average compressive strength in N/mm2 (kg/cm2). /Mpa. The reporting is to be made on format A/TR-1.

STANDARD

CEMENT (PPC) IS : 1489 (1)-1991 FLY ASH BASED

Test	Frequency	Ref. Codes	Acceptance/Standard
1. Chemical Tests (i) Loss on ignition, percent by mass (ii) Magnesia (Mgo), percent by mass (iii) Sulphuric anhydride (So3) Percent by mass (iv) Insoluble material, percent by mass	Once for every source approval Once for every lot Once for every 3 months	As per IS: 4032-1985	i)5.0 % max ii)6.0 max iii)3.0 % max iv)x + 4.0(100-x)/100 where x is the declared % of flyash in the given Portland pozzolona cement
2. Physical Tests (a) Setting Time (i) Initial (ii) Final (b) Soundness (Le-Chatelier Expansion)	Once for every source approval Once for every lot		i) Min.30 min. ii) Max.600 min. 10mm (max.) 0.8% (max) by Autoclave method
(c) Compressive Strength (i) At 72±1 hr (ii) At 168±2 hrs (iii) At 672±4 hr (d)Fineness (e) Drying shrinkage	Once for every 3 months		Not less than 16 MPa strength Not less than 22 MPa strength Not less than 33 MPa strength Specific surface shall not be less than 300 M^2/kg Not be more than 0.15%

CEMENT (OPC-43 GRADE) IS : 8112-1989

Test	Frequency	Ref Codes	Acceptance/Standard
1.Chemical Tests Chlorides (as Cl) Ratio of Alumina to that of Iron Oxide Magnesium (MgO) Total Sulphur content (SO3) Loss on Ignition Insoluble residue Lime saturation factor 2. Physical Tests (a) Setting Time (i) Initial (ii) Final (b)Soundness (Le-Chatelier Expansion) (c) Compressive Strength (i) At 72±1 hr (ii) At 168±2 hrs (iii)At 672±4 hr	Once for every source approval Once for every lot Once for every 3 months Once for every source approval Once for every lot Once for every 3 months	As per IS: 4032:1985 As per IS : 4031-1988	0.05 % max 0.66 % min 6.0 % max 3.0 % max 5.0 % max 2.0 % max 0.66- 1.02 Not less than 30 min. Not less than 600 min 10mm (max.) and 0.8% (max)by Auto clave method Not less than 23 MPa strength Not less than 33 MPa strength Not less than 43 MPa strength
(d) Fineness (Blain's air permeability method) By sieving on 90µ Sieve			225 M^2/kg Minimum Residue not to exceed 10%

11.2 AGGREGATE

11.2.1 Sampling Procedures and Sample Collections

The method of sampling from stacks on site is described below; Divide the lot in sublots.

Minimum weight of gross samples are the minimum No. of increments.

Increments should be drawn with the help of scoop.

Sampling of aggregate from the stacks should be carried out, as for as possible, during making of the stack.

Number of increments should be equally distributed over the sub-lot.

When it becomes necessary to sample a stationary stack, trench sampling method may be used.

Each gross sample should be reduced separately. Reduction may be done by quartering method.

Each laboratory sample so obtained is carefully packed, great care being taken to prevent the loss of any fine material. Each container should have card giving the following information:

- Name of the quarry pit, river bed etc. and address.
- Proposed use of material.
- Geographic location and shipping facilities.

11.2.2 Test for Fine Aggregate (Sand)

Sand is extensively used for masonry and concrete works. Therefore mandatory test of sand is needed for quality control. The various test required are given below.

11.2.2.1 Sieve Analysis & Fineness Modulus

METHOD

6 nos. of I.S. sieves as specified in the standards given below are used for determination of percentage of weight of sand retained on each sieve. A sample of about 1000 gms of sand is weighted and then it is passed successively through the set of sieves specified below. The weight of sand retained on each sieve is weighted and tabulated and Fineness Modulus is calculated.

The sample shall be brought to an air-dry condition before weighing and sieving. This may be achieved either by drying at room temperature or by heating at a temperature of 100 degree to 110 centigrade. The air dry sample shall be weighed and sieved successively on the appropriate sieves starting with the largest. Care shall be taken to ensure that the sieves are clean before use. Each sieve shall be shaken separately over a clean tray until not more than a trace passes but in any case for a period of not less than two minutes. The shaking shall be done with a varied motion backwards and forwards, left to right, circular clockwise and anti- clockwise and with frequent jarring, so that the material is kept moving over the sieve surface in frequently changing directions. Materials shall not be forced through the sieve by hand pressure but on sieves coarser than 20 mm. Placing of particles is permitted. Lumps of fine material, if present may be broken by gentle pressure with fingers against the side of the sieve. Light brushing of underside of the sieve with a soft brush may be used to clear the sieve openings.

Light brushing with a fine camel hair may be used on the 150 micron IS sieve to prevent segregation of powder and blinding of apertures. Still or worn out brushes shall not be used for this purpose and pressure shall not be applied to the surface of the sieve to force particles through the mesh. On completion of sieving the material retained on each sieve together with any material cleaned from the

mesh shall be weighed. The cumulative percentage by weight of the total sample passing each of the sieves, to the whole number is reported on Format A/TR-2.

STANDARDS

Test	Frequency	Ref. of Codes	Acceptation/Standard				
1. Particle Sizes (a) Sieve Analysis	Once for every source approval Once in a month	IS:383-1970 IS: 2386 (Part I) – 1963 IS : 1542-1992 IS : 2116-1980	Fine aggregates should be grading for as given below				
			IS Sieve Designation	**Percent by weight passing for**			
				Zone-I (High strength Conc.)	**ZoneII (Stand. Conc.)**	**Plaster IS:1542**	**Masonry IS: 2116**
			10 mm	100	100	100	
			4.75 mm	90-100	90-100	95-100	100
			2.36 mm	60-95	75-100	95-100	90-100
			1.18 mm	30-70	55-90	90-100	70-100
			600 µ	15-34	35-59	80-100	40-100
			300 µ	5-20	5-20	20-65	5-70
			150 µ	0-10	0-10	0-15	0-15

For crushed stone sands, crushed gravel sand the permissible limit on 150 micron I S sieve is increased to 20 %. Tolerance of ± 5 % is allowed except on 600 µ for sand used in concrete.

11.2.2.2 Silt Test

METHOD

A sample of sand to be tested shall be placed without drying in a 200 ml measuring cylinder. The size of the sample shall be such that it fills the cylinder up to 100 ml mark. Water shall be added to 150 ml mark. The mixture shall then be shaken vigorously and allowed to settle for 3 hours. The height of silt visible as settled layer above the sand shall be expressed as percentage the height of sand settled below the jar.

The reporting is to be made on format No. A/TR-12 of **Appendix A**.

STANDARDS

Not more than 8% by weight in natural sand.

Not more than 10% by weight in case of crushed stone sand.

11.2.2.3 Organic Impurities

METHOD

Fill a 350 ml clear glass medicine bottle up to 70 ml mark with a 3% solution of caustic soda or sodium hydroxide. The sand is next added gradually until the volume measured by the sandy layer is 125 ml. The volume is then made up to 200 ml by addition of more of solution. The bottle is then Stoppard and shaken vigorously and allowed to stand for 24 hours. At the end of this period, the color of the liquid will indicate whether the sand contains a dangerous amount of matter.

STANDARDS

A colorless liquid indicates a clean sand free from organic matter.

A straw colored solution indicates some organic matter but not enough to be seriously objectionable. Darker color means that the sand contains injurious amounts and should not be used unless it is washed, and a retest shows that it is satisfactory.

11.2.2.4 Bulkage Of Sand

METHOD

Take a measuring cylinder and fill it with damp sand (consolidated by shaking) to its four fifth capacity. Let the volume of damp sand in the cylinder be X, then pour water in the cylinder and stir the sand well. The water shall be sufficient to submerge the sand completely. Let the volume of consolidated sand be Y. The percentage of bulk age of damp sand shall be calculated from the formula:

$$\text{Percentage Bulk age} = \frac{(X - Y)}{Y} \times 100$$

STANDARD

<table>
<tr><th>Test</th><th>Frequency</th><th>Ref. of Codes</th><th>Acceptance/Standard</th></tr>
<tr><td>1. Deleterious Materials</td><td>Once for every source approval
Once in a month</td><td>IS: 383-1970
IS: 2386 (Part II) – 1963</td><td>
<table>
<tr><th>Deleterious Material</th><th>Percentage by weight (Max.)</th></tr>
<tr><td>Coal and Lignite</td><td>1</td></tr>
<tr><td>Clay and Lumps</td><td>1</td></tr>
<tr><td>Material finer that 75 micron IS Sieve</td><td>3</td></tr>
<tr><td>Soft Fragment</td><td>-</td></tr>
<tr><td>Shale</td><td>1</td></tr>
<tr><td>Total % of all.</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>2. Silt Content</td><td>Once for every source approval once daily</td><td></td><td>Maximum 8% or as specified in Agreement</td></tr>
<tr><td>3. Specific Gravity and Density</td><td>Once for every source approval
Once every 3 months</td><td>IS: 383-1970
IS: 2386 (Part III) – 1963</td><td>Test is required for maintaining uniformity of material brought from the source</td></tr>
<tr><td>4. Water Absorption</td><td>Once for every source approval
Once Daily</td><td>IS: 383-1970
IS: 2386 (Part III) – 1963</td><td>Test required for adjusting the water content in the mix design before starting any concrete mixing</td></tr>
<tr><td>5. Soundness</td><td>Once for every source approval
Once every 3 months</td><td>IS: 383-1970
IS: 2386 (Part V) – 1963</td><td>Maximum average loss of weight after 5 cycles (i) Tested with Sodium Sulphate - 10%
(ii) Tested with Magnesium Sulphate - 15%</td></tr>
</table>

11.2.3 Test for Coarse Aggregate (Stone Grit)

Coarse aggregate is most important constituent in concrete, which mainly imparts strength to concrete structure. The various test required are given below to judge the hardness of coarse aggregate.

- Impact Test
- Crushing Test
- Abrasion Test
- 10% fine Value

11.2.3.1 Sieve Analysis & Fineness Modulus Test

METHOD

The stone ballast for use in all types of cement concretes work shall meet the grading requirements specified below. I.S. sieve of sizes as given below are used and weight retained on each sieve is found out with the help of balance. The reporting is to be made on format No.A/TR-2 of **Appendix A**.

STANDARDS

<table>
<tr><th>Test</th><th>Frequency</th><th>Ref. of Codes</th><th colspan="4">Acceptance/Standard</th></tr>
<tr><td rowspan="13">1. Particle Size
(a) Sieve Analysis</td><td rowspan="13">Once for every source approval
Once in a week</td><td rowspan="13">IS: 383-1970
IS: 2386 (Part I) –1963</td><td></td><td>Grading</td><td>IS Sieve Designation</td><td>Percentage passing (by weight)</td></tr>
<tr><td></td><td>20 mm Nominal size</td><td>40 mm</td><td>100</td></tr>
<tr><td></td><td></td><td>20 mm</td><td>85 – 100</td></tr>
<tr><td></td><td></td><td>10 mm</td><td>0 – 20</td></tr>
<tr><td></td><td></td><td>4.75 mm</td><td>0 – 5</td></tr>
<tr><td></td><td>12.5 mm Nominal size</td><td>16 mm</td><td>100</td></tr>
<tr><td></td><td></td><td>12.5 mm</td><td>85 – 100</td></tr>
<tr><td></td><td></td><td>10 mm</td><td>0 – 45</td></tr>
<tr><td></td><td></td><td>4.75 mm</td><td>0 – 10</td></tr>
<tr><td></td><td>10.0 mm Nominal</td><td>12.5 mm</td><td>100</td></tr>
<tr><td></td><td></td><td>10 mm</td><td>85 – 100</td></tr>
<tr><td></td><td></td><td>4.75 mm</td><td>0 – 20</td></tr>
<tr><td></td><td></td><td>2.36</td><td>0 -- 5</td></tr>
<tr><td>(b) Flakiness Index and Elongation Index</td><td></td><td>IS: 2386(I) – 1963</td><td colspan="4">35% Maximum value of combined Elongation and Flakiness Index</td></tr>
<tr><td>2. Deleterious Materials (crushed aggregate)</td><td>Once for every source approval
At every change of source</td><td>IS: 383-1970
IS:2386(II) – 1963</td><td colspan="4"><table><tr><th>Deleterious Material</th><th>Percentage by weight (Maximum)</th></tr><tr><td>(i) Coal and Lignite</td><td>1</td></tr><tr><td>(ii) Clay and Lumps</td><td>1</td></tr><tr><td>(iii) Material finer that 75 micron IS Sieve</td><td>3</td></tr><tr><td>(iv) Soft Fragment</td><td>--</td></tr><tr><td>(v) Shale</td><td>--</td></tr><tr><td>Total % of all.</td><td>5</td></tr></table></td></tr>
<tr><td>3. Specific Gravity and Density</td><td>Once for every source approval
Once in a fortnight</td><td>IS: 383-1970
IS: 2386 (Part III) –1963</td><td colspan="4">Test is required for maintaining uniformity of material brought from the source</td></tr>
</table>

Test	Frequency	Ref. of Codes	Acceptance/Standard
4. Mechanical properties (a) Aggregate Crushing Value (b) Impact Value (c) 10 percent Fines (d) Abrasion Value	Once for every source approval Once for every source approval	IS: 383-1970 IS: 2386 (Part IV) – 1963	45% maximum by Weight 45% maximum by Weight Not less than 5 tonnes 50% maximum by Weight
5. Soundness	Once for every source approval	IS: 383-1970 IS: 2386 (Part V) –1963	Maximum Average Loss of weight after 5 cycles (i) Tested with Sodium Sulphate - 12% (ii) Tested with Magnesium Sulphate - 18%
6. Surface Moisture Content	Once for every source approval At every change of mix design	IS: 383-1970 IS: 2386 (Part III) –1963	Test required adjusting the water content in the mix design before starting any concrete mixing.
7. Alkali Reactivity	Once for every source approval	IS: 383-1970 IS: 2386 (Part VII) –1963	Innocuous Aggregate

11.3 BRICKS

11.3.1 Sampling Procedures and Sample Collections

The sample may be drawn by random sampling.

The stack shall be divided into a number of real or imaginary sections and the required number of bricks are drawn from each sections. For this purpose bricks in the upper layers of the stack shall be removed to enable units to be sampled from places with in the stack.

The bricks shall be selected and inspected for each lot separately for ascertaining their conformity to the requirement of the relevant specification.

11.3.2 Test for Bricks IS : 1077-1992

Following test are required for bricks;

- Visual,
- Dimension,
- Absorption,
- Efflorescence,
- Compressive strength.

11.3.2.1 Visual

METHOD:

20 bricks shall be selected at random out of 50,000 bricks of each class, then color and shape is observed. Two bricks are struck back to back with each other and sound observed is recorded.

STANDARDS:

All Class for Masonry	Over Burnt for road
Shall have a uniform deep cherry red color, and shall be thoroughly burnt and not over burnt. The bricks must give a clear ringing sound on being struck. They may be free from cracks, chips, flaws and stones lumps of any kind.	Shall have a deep copper color, and shall be over-burnt and regular in shape. The bricks should emit a clear ringing sound when struck. The bricks must be free from cracks, chips, flaws and stones or lumps and spongy matter.

11.3.2.2 Dimensions

METHOD:

20 whole bricks shall be selected at random and their dimensions shall be measured by spreading the bricks in contact with one another, length, breadth and height wise on a level surface. These dimensions should be within the tolerance limits specified below:

All Classes Non Modular Brick (In mm)		
Length	4600 ± 80	Standard size of one brick Length : 230 mm Width : 110 mm Height : 70 mm or 30 mm
Width	2200 ± 40	
Height	1400 ± 40 for 70 mm high 600 ± 40 for 30 mm high	
Straight Over Burnt Bricks		
Length	177.5'' to 182.5''	Standard size of one brick Length : 8 7/8'' Width : 4 1/4'' Height : 2 5/8''
Width	85'' to 87.5''	
Height	52.5 to 55.0''	
Modular Bricks		
Length	3800 ± 80 mm	Standard size of one brick Length : 190 mm Width : 90 mm Height : 90 mm or 40 mm
Width	1800 ± 40 mm	
Height	1800 ± 40 cm for 90 mm high ± 40 for 40 mm high	

11.3.2.3 Water Absorption

METHOD:

5 whole dry bricks shall be selected at random from the sample obtained. The test specimen shall be weighted and shall then be completely immersed in clean water at room temperature and allowed to remain in this state for a period of 24 hours. The specimen shall then be taken out, wiped with damp cloth and then weighed immediately.

Absorption percentage by weight = $\frac{(B - A)}{A} \times 100$

A : Weight of dry specimen

B : Weight of the specimen after 24 hours immersion in cold water.

The reporting is to be made on format A/TR 11 of **Appendix A**.

STANDARD

Sl. No.	Class	Ref. Codes	Limit
1	For Masonry	IS : 3495(II)-1992	Not more than 20% by weight
2	Straight over burnt for road work		Not more than 10% by weight

11.3.2.4 Efflorescence

METHOD:

Five dry bricks shall be selected at random from the sample of bricks obtained. Each brick shall be placed on end in a flat bottom dish containing distill water. The depth of emersion of the brick being not less than 2.5 cm. The whole arrangement shall be allowed to stand in a warm (i.e. 18 to 30oC) and well ventilated room until all the water in the dish evaporate. When the water is absorbed and the bricks appear to be dry, a similar quantity of distilled water shall again be placed in the dishes and the same allowed to evaporate as before. At the end of this period the bricks shall be examined for efflorescence.

STANDARDS:

The liability to efflorescence shall be reported as per following definitions:

Sl.No.	Standard	Definition	Ref. Codes
1	Nil	When there is no perceptible deposit of efflorescence	IS : 3495(II)-1992
2	Slight	When not more than 10% of area of the brick is covered with a thin deposit of salt.	
3	Moderate	When there is a heavier deposit than under slight and covering up to 50% of the brick surface but unaccompanied by powdering of flaking of the surface.	
4	Heavy	When there is a heavy deposit of salts covering up to 50% or more of the brick surface but unaccompanied by powdering of flaking of the surface.	
5	Serious	When there is a heavy deposit of salts accompanied by powdering and for flaking of the surface and tending to increase with repeated weathering of the specimens.	

11.3.2.5 Compressive Strength

METHOD:

The bricks when used in masonry are subjected to compressive stresses due to load transferred. So in order to enable them to sustain the load coming on them, they should be tested for their compressive strength.

5 whole bricks shall be selected at random from the sample of bricks. The bricks shall be immersed in water at 25 to 29 0C for 24 hours. They shall then be removed and allowed to dry at room temperature for about 5 minutes and wiped free from surplus moisture. Their frogs shall be filled with mortar composed of one part Portland cement and three parts clean sand graded to 3 mm and down. The bricks shall then be stored under damp sacks for 24 hours. After the expiry of this period, they shall be immersed in water for 3 days.

At the end of 3 days the sample of bricks shall be taken out, wiped dry and placed with the flat surface horizontal and the mortar filled face facing upwards between 2 or 3 plywood sheets approximately 3 mm thick and carefully centered between the plates of the compression testing machine. The compression plate of the testing machine shall have a ball seating in the form of a portion of a sphere, the centre of which coincides with the centre of the face of the plate. The load shall be applied axially at a uniform rate of approximately 140 kg/cm2 per minute until failure occurs. The compressive strength of bricks shall be expressed in kg/cm2or N/mm2 . During testing of bricks if any brick is found to have strength more than 20% of the group, it shall be limited to +20%only for calculating the average strength.

STANDARD

Class Designation	Average Compressive Strength not less than		Ref. IS Codes
	N/mm2	Kg/cm2	
35	35	350	IS : 3495 (I) – 1992
30	30	300	
25	25	250	
20	20	200	
17.5	17.5	175	
15	15	150	
12.5	12.5	125	
10	10	100	
7.5	7.5	75	
5	5	50	
3.5	3.5	35	

The first class bricks as per technical specifications should have strength of 10.5 N / mm2

11.4 CONCRETE

11.4.1 Sampling Procedures and Sample Collections

From mixer : At least three approximately equal sample increments totaling 0.02m3 (20 liters) shall be taken from a batch during its discharge. Each sample increments is to be collected by passing clean dry receptacle across a stream of concrete. Receptacle should be such as to avoid segregation. Buckets of 7to 10 liters capacity of G. I. will serve the purpose.

From batch : Sample shall be taken while a batch of concrete is being prepared or immediately after it has been discharged on site. Sample shall be collected at not less than five well distributed position, avoiding edge of the mass where segregation may have occurred.

The composite sample obtained by either of the methods mentioned above shall be mixed on a non-absorbent base either with a shovel or trowel to ensure uniformity. These samples can then be used for conducting:

- Slump test,
- Preparation of cube for strength test.

11.4.2 Test of Cement Concrete

11.4.2.1 Slump Test:

METHOD:

This test is carried out in the field during the course of concreting. The slump test apparatus as per IS : 7320- 1974is used for determination of slump of fresh concrete. The cone (30x20x10cm) is placed on a flat non-absorbent surface and then filled with concrete mix in four different layers of equal thickness. Each layer is template 25 times by the 16 mm dia bullet pointed 60 cm length iron pinning rod. The stroke are applied uniformly over the entire area with a force that the rod just penetrates the full depth of the layer compacted. After the filling is completed the conical vessel or mould is removed by raising vertically and the molded concrete is allowed to subside. The subsidence height of the specimen is measured in mm and recorded in terms of slump. The reporting is to be made on format A/TR-6 of **Appendix A**.

STANDARDS

Sl. No.	Placing Conditions	Ref. Codes	Degree of Workability	Slump in mm
1	Blinding concrete; Shallow sections; Pavement using pavers	IS: 456 – 2000 IS :1199 – 1959	Very low	< 25
2	Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns; Floors; Hand placed pavements; Canal lining; Strp footings		Low	25 - 75
3	Heavily reinforced sections in slabs, beams, walls, columns; Slip form work; Pumped concrete		Medium	50 – 100 75 – 100
4	Trench fill;		High	100 – 150
5	In-situ piling Tremie concrete		Very high	> 150

11.4.2.2 Compressive Test

METHOD:

The 150 mm cube moulds as per IS : 10086 -1982 are used for this purpose. Six test specimens shall be taken for each sample to be tested for 7 and 28 days. The mould is filled with concrete mix in 3 layers of equal thickness. Each layer is template 25 times by the 16 mm dia bullet pointed 60 cm length iron pinning rod.

The test shall be made at the edge of concrete corresponding that to for which the strength specified, Compression tests shall be made immediately upon removal of the concrete test specimens from the curing room i.e. the test specimens shall be loaded in damp condition. The dimensions of the test specimens shall be measured in millimetres accurate to 0.5 The metal bearings plates of the testing machine shall be place in contact with sides of the test specimens.

Cushioning material shall not be used in the machine. In the case of cube, the test specimen shall be placed in the machine in such a manner that the load is applied to the sides of the specimen. An adjustable bearing block shall be the used to transmit the load to the test specimen. The size or lower section of the bearing block shall be kept in machine as the head of the testing machine is brought to a bearing on test specimen.

The load shall be applied axially without shock at the rate of approximately 140 kg/ cm2 per minute. The total load indicated by the testing machine at failure of the test specimen shall be recorded and the unit compressive strength calculated from the measured dimensions of the test specimen. The type of failure and appearance of the concrete shall be noted. The reporting is to be made on format A/TR-5 of **Appendix A**.

STANDARDS OF CHRACTERISTIC STRENGTH

Group	Grade Designation	Compressive Strength on 15 cm cubes for work test in N/mm2	
		Min at 7 days	Min at 28 days
Ordinary Concrete	M 10	7.0	10
	M 15	10.0	15
	M 20	13.5	20

Standard Concrete	M 25	17.0	25
	M 30	20.0	30
	M 35	23.5	35
	M 40	27.0	40
	M 50		50
	M 55		55
High strength Concrete	M 60		60
	M 65		65
	M 70		70
	M 75		75
	M 80		80

11.5 STEEL

11.5.1 Sampling Procedures and Sample Collections

Take sufficient rods, at random, from each lot to obtain desired number of samples. If more than one rod is needed, they must be taken from different bundles.

Using a hacksaw, cut off as many one-metre long pieces as are needed for the test from the sampled rod or rods.

Tie the cut-off pieces from each lot together with wire and mark properly.

Every bundle of steel samples must be identified with a proper label and be sent to the laboratory under cover of a sample data from giving:

- Type of steel
- Nominal size
- Cross-section
- Grade and mould number
- Test to be done on the samples.

11.5.2 Test of Steel For Reinforcement IS : 1786-2008

METHOD:

The steel should be got tested in authorized laboratories before it is used for work at site. Following tests should be conducted for reinforcement steel,

- Mass per meter/dia
- Yield stress (0.2% Proof stress)
- Ultimate tensile strength
- Elongation
- Cold bend rebend test
- Chemical composition

Three pieces of 100 cms. length in each size should be drawn out of 10 ton lot. After measuring the diameter in mm and weight in kg the strength test and elongation is carried out in Universal testing machine.

Chemical test could be done on one sample only for each manufacturer.

STANDARDS

The steel shall be clean and free from loose mill scale, loose rust, mud, oil, grease or any other coating which may reduce or destroy the bond between the concrete and steel. A slight film of rust may not be regarded as harmful but steel shall not be visibly pitted by rust.

Test	Frequency	Ref Codes	Acceptance/Standard
1. Chemical Tests	Once for every source approval Once for every lot	IS : 228 (1-24)-1987	0.30 Max.
Carbon			0.06 Max.
Sulphur			0.06 Max.
Phosphorus (Sulphur+ Phosphorus)		IS: 1786: -1985	0.11 Max.
2. Physical Test			10% more than the actual 0.2% proof stress but not less 485 MPa
Ultimate tensile strength			Min. - 415 MPa
	Once every 3 months		Min.- 14.5 %
0.2% proof stress	Once for every source approval		To be satisfactory
			To be satisfactory
% Elongation	Once for every lot	IS : 1608-2005	6.31 ±3% for 32 mm Dia,
			4.830 ±3% for 28 mm dia.,
Bend Test			3.85 ± 3% for 25 mm dia.,
			2.470 ±3% for 20 mm Dia,
Re-bend Test			1.580 ±5% for 16 mm Dia,
			0.888 ±5% for 12 mm Dia,
			0.617 ±7% for 10mm dia,
Mass per meter run (kg)		IS :1599-1985	0.395 ±7% for 8mm dia,
	Once every 3 months	IS :1786-2008	0.222 ±7% for 6 mm dia.

MILD STEEL (STRUCTURAL)

STANDARDS

<table>
<tr><th>Test</th><th>Frequency</th><th>Ref Codes</th><th>Acceptance/Standard</th></tr>
<tr><td>1. Chemi cal Composit ions</td><td>Once for every source approval Once in a project for each source</td><td>IS:2062 -2006</td><td>
<table>
<tr><th>Grade</th><th>Desig nation</th><th>C</th><th>Mn</th><th>S</th><th>P</th><th>Si</th><th>Carbon equal value max.</th></tr>
<tr><td>A</td><td>Fe410 WA</td><td>0.23</td><td>1.5</td><td>0.05</td><td>0.05</td><td>0.04</td><td>0.42</td></tr>
<tr><td>B</td><td>Fe410 WB</td><td>0.22</td><td>1.5</td><td>0.046</td><td>0.045</td><td>0.04</td><td>0.41</td></tr>
<tr><td>C</td><td>Fe410 WC</td><td>0.20</td><td>1.5</td><td>0.040</td><td>0.04</td><td>0.04</td><td>0.39</td></tr>
</table>
Nitrogen Content 0.02 %
Nb, V and Ti content (all or any) 0.2 %
</td></tr>
</table>

Tensile strength of structural steel

Sl. No.	Test	Standards
1	Yield strength	250 MPa
2	Ultimate strength	400 MPa
3	Density	7.8 g/cm^2

11.6 PIPES

11.6.1 Sampling Procedures and Sample Collections

All pipes in a single assignment of the same class, same size and manufactured under essentially similar conditions shall constitute a lot.

For ascertaining conformity of the lot to the requirements of the standards, sample shall be tested from each lot separately.

These pipes shall be selected at random from the lot and in order to ensure the randomness of the selection, a random number tables IS: 4905 may be referred to.

In the absence of random number table, the following procedure may be adopted; Starting from any pipe in the lot, count 1, 2, 3 ….and so on up to r, where r is the integral part of N/n , N being the number of pipes in lot, and n the number of pipes in the sample. Every rth pipe so counted shall be withdrawn so as to constitute the required sample size.

11.6.1.1 Test of Pipe For Potable Water Supply IS 4985-2000

METHOD AND STANDARD:

The dimension test should be carried out in the field and other types should be carried out in the laboratory before use.

Pipes of 1.0 m length each size should be sampled out for test.

Field Test	Ref. Codes	Standards
Length of pipe	IS: 4985-2000	As per Table-1
		,,
Mean outside dia.(Min/Max) Diameter at any point.(Min/Max)		,,
		,,
Wall Thickness .Average (Min/Max) Visual appearance		Smooth, clean, both end square cut
		Ls = 0.5dn + 6mm
		Ls = minimum socket length
Dimensions of sockets		dn = nominal outside dia of pipe

LAB TEST	REF. CODES	STANDARDS
Reversion test	IS : 12235(5)-2004	Shrinkage not more than 5%
Short term hydro static pressure test 4.19xPN(MPa) at 27^{O}C for one hour	IS : 12235 (8)-2004	Pipe shall not fail during the prescribed test duration.
Resistant to external blows at 0^{O}C Vicat softening temperature	IS : 12235 (9)-2004	TIR not more than 10 %
Density	IS : 6307-1985	VST of specimen shall not be less than 80^{0} C
Sulphated ash content	IS : 13360 (3) –sec-I – 1995	Density of pipe shall be between 1.40 and 1.46 gm /cc 11.0 % (Max.)

11.6.1.2 Test of U P V C Pipes For Drainage/Sewerage Work

METHOD AND STANDARD:

The dimension test should be done in field on receipt of pipes using ball ended screw gauge/and caliper for other test sample as above should be sent to approved laboratory and it should be used only after the result are found satisfactory as per relevant standards

Field Test	Ref. Codes	Standards
Dimention (i)Mean outside dia. (ii) Outside dia. at any point (iii) Wall thickness 2 Visual appearance 3 Color	IS:15328- 2003	IS 15328- 2003 Table-1 ---- do ---- IS 15328- 2003 Table-3 2)The internal & external surface of the pipe shall be smooth clean and free from any other ducts 3)The color shall be dark (any shade of brown) uniformly colored throughout the entire wall, slight variations in the appearance of the color are permitted.
4. Vicat softening temp. 5 Longitudinal Reversion test 6 Resistant to external blows at 0°C 7 Resistance to Internal hydrostatic pressure.	 IS :12235(V)-2004 IS :12235(IX)-2004 IS :12235(VIII)-2004	4)Not less than 79°C 5)Maximum ± 5% 6)TIR not more than 10% 7) Pipe shall not fail (seep, crack, bulge or burst) during the prescribed test duration and shall meet the requirement of IS : 15328 Table-6

Minimum one Pipe of 1.0 m length each size should be Sampled out for test.

11.6.1.3 Test of R.C.C Pipes

METHOD AND STANDARDS:

It shall be as per IS: 458-2003 and should also conform the test requirement as per IS: 3597-1998.

Test	Frequency	Ref. Code	Acceptance/Standard
1. Tolerances in Dimensions Wall Thickness	At the start of work for source approval Once for every Lot for each size	IS:458-2003	Up to and including 30 mm + 2mm, -1mm Over 30 mm and up to and including 50mm + 3mm, - 1.5 mm Over 50 mm and up to and including 65mm + 4mm,- 2.0 mm Over 65 mm and up to and including 80mm + 5mm, - 2.5 mm Over 80 mm and up to and including 95mm + 6mm, - 3.0 mm Over 95 mm + 7mm, - 3.5 mm
Internal Dia. Of pipe or socket		IS:458-2003	Up to and including 300 mm ± 3mm Over 300 mm and up to and including 600 mm ± 5mm Over 600 mm ± 10 mm
Overall Length		IS: 458-2003	±1% of standard Length
2. Three Edge Bearing		IS: 458-2003	Shall withstand the design Load
3. Water absorption		IS:3597-1998	After 10 minutes, 2.5 % of dry Mass Max, and total absorption at the end of 24 Hours shall not exceed 6.5% of dry mass

4. Hydrostatic Test			No leakage under the design pressur
5. Straightness			The deviation from straightness when tested by means of rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed 3 mm for every m length
6. Reinforcement		IS: 458-2003	On breaking the Pipe and extracting the reinforcement, it shall be as per the provision

11.6.1.4 Test of HDPE/PE Pipes

METHOD AND STANDARDS:

The pipe shall conform to IS: 4984-1995 and Contract Documents.

Test	Frequency	Ref. Code	Acceptance/Standard
1.Dimensions (i) Outside Dia. (ii) Wall thickness 1. Hydraulic Characteristics 2. Reversion Test			As per Table No localized swelling, leakage, weeping, or bursting during subjecting to internal pressure creep test. Longitudinal reversion shall not be more than 3%
3. Density 4. Melt Flow Rate (MFR) 5. Carbon Black Content and Dispersion			940.5 to 946.4Kg/m^3 at 27^0C and shall not differ from the nominal value by more than 3kg/ m^3 0.41 to 1.10 at 190^0C with nominal load of 5kg and shall be within 20% of the value declared by the manufacturer. 2.5+ 0.5% with uniform dispersion.

Note: Record the equipment used, name of welder, day/hour, section, location, temperature of the weld when connecting pipes, etc., cooling period, according to manufacturer instructions.

11.6.1.5 Test of G.I. PIPES

METHOD AND STANDARDS:

It shall conform to IS : 1239 (I) -2004 with respect to dimension, weight per meter and Hydraulic test pressure. The Galvanizing of pipes shall also conform to relevant IS : Codes as given below;

Test	Frequency	Ref. Code	Acceptance/Standard
1. Mass of Zinc Coating	One test per lot	IS: 6745-1972	400 g/m^2 minimum total mass of Zinc (inside and outside) per surface area (inside and outside) of the coated surface.
2. Visual Test	One test per lot	IS: 2629-1985	The Zinc coating shall be free from imperfection like flux, ash and dross inclusions, bare patches, black spots, pimples, lumpiness, rums, rust, blister, white deposit etc.

Minimum 1m pipe length for each size should be sent for lab test.

11.7 WATER FOR CONSTRUCTION PURPOSES

Water used for mixing and curing shall be clean and free from injurious amounts of oil, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete orsteel. Potable water is generally considered satisfactory for mixing concrete.

11.7.1 Sampling of Water

The containers of glass or other inert material like polythene must be carefully cleaned before use. Minimum one liter sample should be collected for lab test.

11.7.1.1 METHOD AND STANDARDS

Water should be tested as per relevant IS Codes as shown below, and shall conform to IS : 456 -2000 and IS : 10500-1991. The reporting is to be made on format A/TR-4.

Test	Frequency	Ref. Codes	Acceptance/Standard
1. Chemical Analysis (a) PH value (b) Chlorides (as Cl)	Once for every source approval Every Quarterly Chemical tests daily in the site Laboratory with testing kits	IRC: 21-2000 IS: 3025 (Part 32) - 1987	a) Minimum 6 b) 2000mg/L for concrete not containing embedded steel and 500mg/L for RCC and PSC
(c) Sulphates (as SO_3) (d) Neutralization with NaoH (with phenolphthalein as indicator)		IS: 3025 (Part 28) -1987 IS: 3025 (Part 22) -1987	c) 400mg/L d) Max. 5 ml of 0.2 normal NaOH to neutralize 100 ml. sample of water
2. Physical Analysis (a) Suspended Matter (b) Organic Matter (c) Inorganic Matter	Once for every source approval Every Quarterly	IS: 3025 (Part 23) - 1987 IS: 3025 (Part 17) IS: 3025 (Part 18) IS: 3025 (Part 19) - 1987	a) 2000 mg/ l max. b) 200 mg/ l max. c) 3000mg/l max.

11.8 TIMBER

All the mechanical properties of seasoned timber vary with moisture content, and therefore, it is necessary that the moisture content of timber be determined. It can be measured by moisture meter using electrode. When moisture content of timber is checked by oven drying method, the result of electrical moisture meter shall be ignored.

METHOD

SURFACE ELECTRODE:

For surface measurement of moisture content of veneers, plywood and finished wood ware item as there are no needles or knives to be driven into the timber, it does not spoil the fabricated articles, just press lightly on the surface of the wood and you get an instantaneous reading of the moisture content.

KNIFE ELECTRODE:

For measuring the moisture content of planks and boards, the knives are en-headed in a plastic material, which can stand light hammers for driving the knives up to about 8mm into the timber. This will give the average moisture content of a plank from 25 to 40 mm thick.

STANDARD

Sl.No.	Description	Ref. Codes	Limit as per Zone I
1	Allowable moisture content for doors and windows (i) Thickness 50 mm and above (ii) Thickness below 50 mm	IS : 287-1993 IS : 1708(1)-1986	10% Max. 8 % Max.

11.9 BRICK BALLAST IS: 3068-1986 AND IS : 3182-1986

METHOD

GAUGE TEST

The ballast should be from 1st Class or over burnt bricks without jhama, the gauge for foundation concrete should be 40mm and for terrace gauge will be 25mm.

The test at site will be done in the following manner and results entered in the site register of tests. Sample of 50 kg. is required for test.

STANDARD

Not more than 20% shall pass through a square mesh screen of 25 mm in case of 40 mm gauge and square mesh of 20 mm in case of 25 mm gauge brick ballast.

The whole shall pass through a screen having square mesh 12.5 mm greater than specified gauge.

After immersion in cold water for 24 hrs absorption by weight shall not exceed 12%

11.10 TERRACING

METHOD

When terracing is completed and curing is done for a period of 7 days, the roof shall be tested by filling of 10 cm deep water for 72 hours. The seepage shall be watched and results entered in site register of checks. Standard required is as mentioned here under:

STANDARD

The roof surface as completed shall be even and true to slope of 1 in 48 or as specified and should be leak proof.

11.11 PRECAST CONCRETE MANHOLE COVER AND FRAMES

Precast Manhole covers and Frames and cover shall conform to IS :12592- part (I-II)- 1988. Manufactures certificate with test report should be taken before it is used for the work. 16 mm bars may be used in heavy duty and 12 mm dia bars in light duty with minimum embedment of 20 cm on both sides of the hook duly welded with the main reinforcement of the cover. Manhole covers shall be of the following four grades and types;

Grades	Grade designation	Ref. codes	Load in tones	Type/shape of cover frame
Light Duty	L D-2.5	IS :	2.5	Circular, Square, Rectangular
Medium Duty	M D-10	12592-	10	Circular, Rectangular
Heavy Duty Extra	H D -20	1988	20	Circular, Square, Rectangular
heavy Duty	E H D -35		35	Circular, Square, Rectangular

Concrete weaker than M-30 shall not be used. Compaction of concrete shall be done by machine vibrations.

11.12 TEST FOR TUBE WELL

11.12.1 Verticality Test

A simple method of measuring eccentricity in a bore is by use of heavy plumb-ring, 6 mm smaller in diameter than the inside diameter of the well casing. The plumb-ring is suspended by means of a thin strong wire of steel or copper running over a pulley, rigidly fixed to the apex of a tripod. The tripod pulley is at least 3 m above the top of the casing. The tripod is so adjusted that the wire passes through the centre of the top of the well casing. The plumb-ring is lowered in steps of 3 m and the deviations of line from the centre of the casing are observed. The drift at any depth is given by the deviation multiplied by the depth of the line and divided by the height of the pulley above the top of the well casing.

For verticality and alignment, the requirement as laid down in clause 4 of IS : 2800-1979 part–II will be ensured. The reporting will be made in format No. A/TR-13 of **Appendix A**.

11.12.2 Water Sampling

Physical, chemical and bacteriological analyses are necessary for drinking water. All samples of water should be properly labeled and should be accompanied by complete and accurate identifying and descriptive data. Data should include date and time of collection, type of source of the sample and temperature of water at the time of collection.

11.12.2.1 SAMPLING FOR PHYSICAL AND CHEMICAL ANALYSIS

The containers of glass or other inert material like polythene must be carefully cleaned before use. It can be rinsed with alkaline permanganate solution followed by oxalic acid solution. After having been cleaned, should be rinsed thoroughly with tap water and then with distilled water. About 2.5 liters of the sample is required for analysis. Prior to filling, the sample bottle should be rinsed out two or three times with water to be collected. Care should be taken to obtain a sample that is truly representative of existing conditions and to handle it in such a way that it does not deteriorate or become contaminated before it reaches the laboratory. The sample should reach the place of analysis as quickly as possible within 72 hours of collection. The sample should only be collected after the well has been pumped for a sufficient time to ensure that the sample will be representative of the ground water.

11.12.2.2 SAMPLING FOR BACTERIOLOGICAL ANALYSIS

Sterilized glass bottles provided with round glass stopper having an overlapping rim should be used. The stopper and the neck of the bottle should be protected by brown paper. The sterilization is carried out in an autoclave at 1 kg/cm2 pressure for 15 minutes or by dry heat at 1600 C for 1 hour. The sample should be representative of the water to be tested and they should be collected with utmost care to ensure that no contamination occurs at the time of collection or prior to examination. The sample bottle should not be opened till the time of filling. The stopper with the cap should be removed with care to eliminate soiling. During sampling, the stopper and the neck of the bottle should not be touched by hand and they should be protected from contamination. The bottle should be held near the base, filled without rinsing and the stopper replaced immediately. The bottle should not be filled completely but sufficient air space left for shaking before analysis. Then the brown paper warping should be tied to protect the sample from contamination. The volume of the sample should be sufficient for carrying out all the tests required and in no case, it should be less than 250 ml.

11.12.2.2 STANDARD

Recommended Guidelines for Physical, Chemical and Microbiological Parameters as per Government of Nepal, National Drinking Water Quality Standard 2062:

SN	Category	Parameter	Unit	Concentration Limit	Remarks
1	Physical	Turbidity	NTU	5 (10)	
2		PH		6.5 - 8.5*	
3		Color	TCU	5 (15)	
4		Taste and Odor		Non-objectionable	
5		TDS	Mg/L	1000	
6		Electrical conductivity (EC)	µs/cm	1500	
7	Chemical	Iron	Mg/L	0.3 (3)	
8		Manganese	Mg/L	0.2	
9		Arsenic	Mg/L	0.05	
10		Cadmium	Mg/L	0.003	
11		Chromium	Mg/L	0.05	
12		Cyanide	Mg/L	0.07	
13		Fluoride	Mg/L	0.5 - 1.5*	
14		Lead	Mg/L	0.01	
15		Ammonia	Mg/L	1.5	
16		Chloride	Mg/L	250	
17		Sulphate	Mg/L	250	
18		Nitrate	Mg/L	50	
19		Copper	Mg/L	1	
20		Total Hardness	Mg/L as $CaCo_3$	500	
21		Calcium	Mg/L	200	
22		Zinc	Mg/L	3	
23		Mercury	Mg/L	0.001	
24		Aluminum	Mg/L	0.2	
25		Residual Chlorine	Mg/L	0.1 - 0.2*	In systems using chlorination
26	Microbio-logical	E Coli	MPN/100 ml	0	
27		Total Coliform	MPN/100 ml	0 in 95% samples	

Notes:

** These values Show lower and upper limits*

( ) Values in parenthesis refers the acceptable values only when alternative is not available.

*** Figures in excess of those mentioned under "Concentration Limit "render the water not acceptable.*

11.13 CHECKS AND TESTS OF FINISHED WORKS

1. DAMP PROOF COURSE

The thickness has to be checked at every 10 M length. It should be ensured that there are no joints in DPC. Results of thickness checked be recorded in the register of checks. DPC shall be cured for at least for 7 days, after which it shall be allowed to dry.

2. BRICK MASONARY

Every 10th layer of brick masonry be checked to see that joints and frogs of bricks are filled with mortar. These should be at every 10 m length in long wall and 3 m in cross wall. Mortar from joints be scraped out and sent to lab for test of mix. Results of check and result of test of mix be entered in register of checks and test to be maintained at site.1 kg of sample is required for chemical tests.

3. R.C.C.

The surface of every structure member laid in R.C.C. should be checked to see whether it is porous. Where porosity is suspected a portion be chipped off to see its extent the results be recorded in site register of checks. It should be checked to see that no reinforcement bars are visible. For testing of post concrete 1 kg of sample is required for chemical tests.

4. PLASTER

The finished plaster surface be cut out 10x10 cms in size and thickness be checked and recorded in site register of checks. Such cut outs should be in each wall of every room. 1 kg of sample is required for chemical tests.

5. THICKNESS OF FLOORS

Cut out of size 5x5 cms will be made in the corner of each room and thickness of floor will be measured and recorded in the site check register.

6. CHUKHATS

The section of the chaukhats be checked and dimensions recorded in the site register of checks. Each chaukhat be checked by J.E. in token of having been checked. The dimensions of sections should be within the prescribed tolerances.

7. STEEL WINDOWS

The steel iron sections thickness of all windows will be measured and recorded in the site register of checks.

8. PAINT, DISTEMPER PLASTIC EMULSION (One test for each brand of paint)

Approved paint will be obtained in container and each container will be opened in the presence of J.E. who will sign the container in token thereof. Such container when empty will be kept in his custody and counted when all painting work is completed to ascertain that the spreading capacity has been maintained as laid down by the manufacturers. The results be noted in the site register for checks.

9. FITTINGS

The fittings for doors and windows shutters will be checked to see that they are in according to specifications, designs and results are entered in the register of checks. It should also be ensured that the fittings are fixed with the specified number and quality of screws.

10. DISTEMPERED SURFACE

Where oil bound distemper of plastic emulsion has been used an area of 1 m x 1 m on each wall be washed with water and checked to see if the paint washes off. Results should be entered in the site register of checks.

11. GLASS PANES

The thickness of 5% of the glass panes to be fixed will be checked with calipers and recorded in the site register of checks. It should also be seen that the panes are fixed with specified number and quality of screws.

12. SAL WOOD FOR CHAUKHATS

No individual hard and sound knot shall be more than 2.5 cm diameter and the aggregate area of all knots shall not exceed 1% area of the piece. There shall not be less than 5 growth rings per 2 cm width. Air dry wood shall weight at an average of about 0.8 to 0.9 gms / Cm3.

13. TIMBER FOR SHUTTERS

No individual hard and sound knot shall be more than 2.5 cm diameter and the aggregate area of all knots shall not exceed 1% area of the piece. Air dry wood shall weight at an average of about 0.56 gms /Cm3.

14. THICKNESS OF SHUTTERS

The thickness of all the shutters shall be measured with caliper and recorded in the site register of checks. The thickness of shutters shall be within the prescribed tolerances.

11.14 MANDATORY TESTS

Quality Control is defined as conformity to the specification, no more, no less. The most practical method of effective Quality Control is to check what is done in totality to conform to the specification. The Quality Control is a corporate, dynamic program to assure that all the aspects of materials, equipments and workmanship are well looked after. Quality control requires carrying out testing of material at regular interval during the execution of works. The list of mandatory tests required for different items are given in Table 11.1.

The detail of each Column is as under;

Column 1: It lists the serial No. of material.

Column 2: it lists name of material to be tested.

Column 3: It lists the name of test that a material is essentially to undergo before accepting it as fit for use in the work.

Column 4: This refer to Bureau of Indian Standards/ international Codes/ Specifications.

Column 5: it provides the frequency of testing to ensure the uniformity in its quality.

Column 6: it provides the minimum sample size required to carry out tests.

Column 7: It provides the check level of the test, which is to be performed on the material.

Column 8: it provides the quality standards.

Level 1 indicates the test performed by the contractor before requesting the RDSMC for accepting the material. This test may be in the shape of Manufacturers Test Certificate on the basic tests at random conducted by the manufacturer or it may be the tests got conducted by the contractor at his own level before requesting the RDSMC for its approval.

Level 2 indicates the tests to be conducted by the department in order to ensure satisfaction regarding the suitability of the material in view of the test certificates submitted by the contractor. These testing may be at the site laboratory if the facilities could be created or got done by an outside laboratory if the facilities are not possible to create in the site laboratory. Level 2 is classified in two categories i.e. Level 2 A and Level 2 B. Level 2 A is for the tests conducted at site laboratory and level 2B is for test conducted outside the site laboratory as necessary, if facilities could not be made available at site.

Level 3 is for the material such as cement and steel which are more sensitive than other materials and in order to have more confidence, it is always desired that materials are got tested from an independent reputed laboratory equipped with proper controls like temperature, humidity, etc. essential for the specific material testing and also equipped with well qualified staff, from whom an expert opinion can be obtained.

The flow chart for testing of raw materials is given in Figure 11(i). The flow chart for testing of manufactured items is given in Figure 11(ii). The flow chart for testing of assembled items is given in Figure 11(iii).

Figure 11(i): Testing of Raw Materials

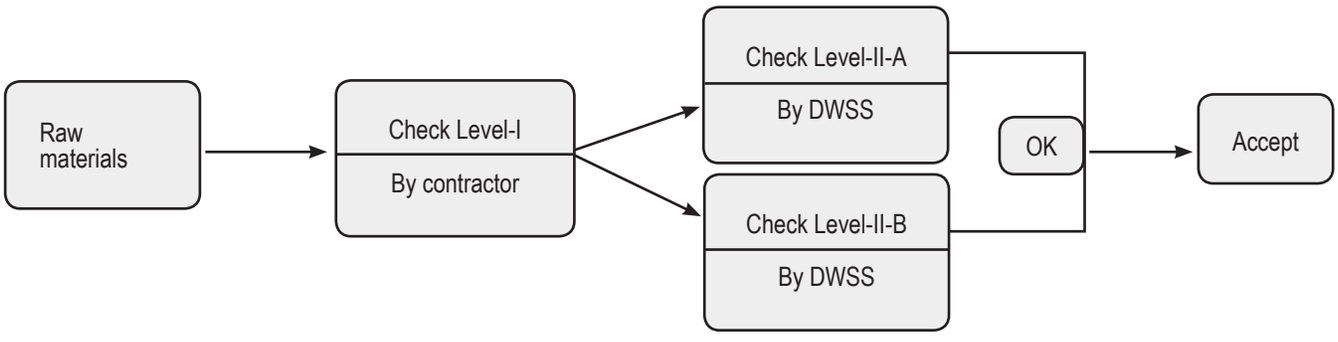


Figure 11(ii): Testing of Manufactured Items

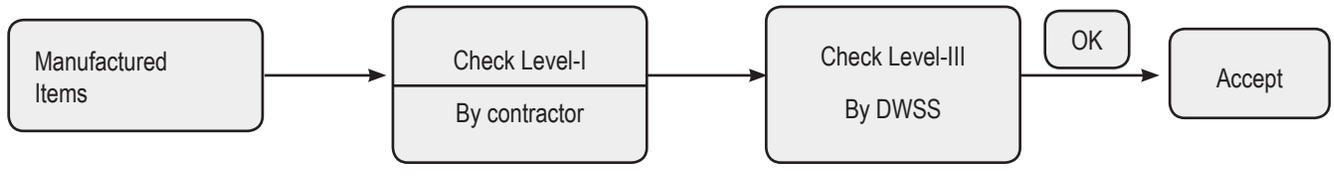


Figure 11(iii): Testing of Assembled Items

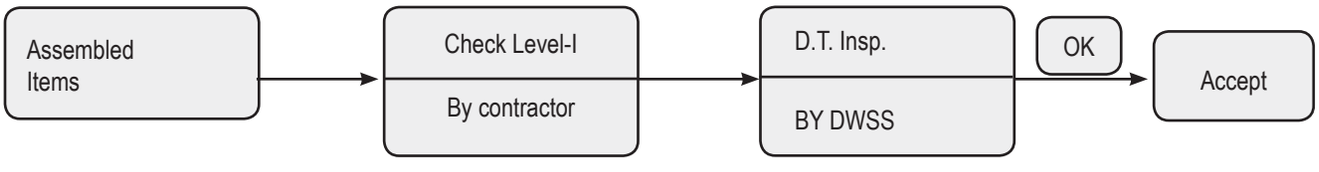


Table: 11.1 Mandatory tests

Sl.No.	Name of material	Test	Reference Codes	Frequency	Mini Samp. Size	Check level	Standards
1	2	3	4	5	6	7	8
1	MORTAR						
1.1	Water	(i) PH value (ii) Limits of Acidity (iii) Limits of Alkality (iv) Percentage of solids (a) Chlorides (b) Suspended matter (c) Sulphates (d) Inorganic solids (e) Organic solids	IS : 3025-1987	Water from each source shall be got tested before the commencement of work and thereafter once in every 3 months till the completion of work. Water from municipal source need be tested once in 6 months. Number of tests for each source shall be 3	One liter	I&IIA	> 6 Max.5 ml of 0.02 NaoH in 100 ml water. Max. 25 ml of 0.02 H_2SO_4 in 100 ml water a)2000 mg/l PCC 500 mg/l RCC b)2000 mg/l Max. c)400 mg/l d)3000 mg/l Max. e)200 mg/l
1.2	Cement	(a)Physical requirement (i) Fineness (ii) Soundness (iii) Setting time (Initial & Final) (iv) Compressive strength (v) Consistency of standard cement paste	IS : 4031-1988	Every 10 tonnes or part thereof. Each brand of cement brought to site shall be tested as per this frequency.	10 Kg	I&III	i)Not > 10% ii)10mm Max. iii) Initial 30 mint. minimum Final 600 mint.Max. iv) > 43 Mpa
1	2	3	4	5	6	7	8
1.3	Sand	(a) Organic impurities (b) Silt content (c) Particle size distribution (d) Bulking of sand	IS : 2386-1963	Every 20 cum or part thereof or more frequently as decided by EIC	2 Kg	I&IIA	As per IS : 383-1970 Max. 8% As per IS : 383-1970

Sl.No.	Name of material	Test	Reference Codes	Frequency	Mini Samp. Size	Check level	Standards
2	**CONCRETE WORK**						
2.1	Stone aggregate	(a) Percentage of soft or deleterious material (b) Particle size (c) Organic impurities (d) Surface moisture (e) Determination of 10% fine value (f) Specific gravity (g) Bulk density (h) Crushing strength (i) Impact value	Is :2386-1963	Every 40 cum or part thereof or more frequently as decided by EIC	6.5 Kg	I,IIA&II B	a)Max .5% As per IS: 383 -1970 e)Not less than 5T h,i) 45% Max. 30% for wearing surface
2.2	Concrete	Slump test	IS :516-1959	15 cum or part thereof	As directed by CSE	I&IIA	As per grade
3	**R.C.C. WORK**						
3.1	Concrete	(a) Cube test (b) Slump test	IS :516-1959	1-5 m^3 - 1 sample 6-15 m^3 - 2 sampl 16-30 m^3 - 3 sampl 31-50 m^{3-} 4 sampl As and when reqd.	As directed by CSE	I&IIA	As per Grade.
3.2	Steel	(a) Physical (i) Ultimate tensile strength (ii) 0.2% proof stress (iii) % Elongation (iv) Bend Test (v) Re-bend Test (vi) Mass per metre run (kg) (b) Chemical	IS: 1608-2005 IS: 1599-1985 IS: 1786-2008 IS: 1786-2008 IS: 228- (1-14) 1987	Under 10mm: 1 sample for each 25 T 10mm to 16mm: 1 sample for each 35 T Over 16mm dia.: 1 sample for each 45 T	3 pieces of 100 cms. for each size.	I&III	i) 485 Mpa min. ii)410 Mpa min. iii) Minim. 14.5% C = 0.3 P = .06 S = .06 P&S = 0.11 Max
4	**BRICK WORK**						
4.1	Bricks and Tiles	(i) Dimension (ii) Compressive strength (iii) Water absorption (iv) Efflorescence	IS: 1077-1992 IS:3495-1992	1 Test for each source Lot size / Sample: 2001-10000: 5 10001-35000: 10 35001-50000: 15	20 Bricks 5 Bricks	I&II A	As per class Not > 20% by Wt. Nil

Sl.No.	Name of material	Test	Reference Codes	Frequency	Mini Samp. Size	Check level	Standards
5	**WOOD WORK**						
5.1	Timber	Moisture Content	IS: 287-1993	Every one cum or part there of	3 Pieces of 2 x 2 x 2 . 5 cms	I&IIA	8% Max. below 50 mm 10% Max. above 50 mm
6	**STRUCTURAL STEEL IS : 8910-2010**						
6.1	Structural steel	(a) Tensile strength (b) Bend Test	IS:1599-1985	Every 20 T or part there of	1 No. 0.5 mt length	I&III	
6.2	Tubular pipes	(a) Tensile Test (b) Bend Test (C) Flattening Test	IS:1608-2005 IS: 2329-2005 IS:2328-2005	Every 8 T or part there of	1 Piece of 1m length for each size	I&III	
7	**HYDRO TESTING OF SEWERS**						
7.1	Testing of M.H. chambers	Leakage	As per manual	On completion of M.H.	-	I&IIA	
7.2	Pipe sewer laid	Leakage	As per manual	Between every 2 M.H.	-	I&IIA	
8	**HYDRO TESTING OF PIPELINE**						
8.1	Pipe line laid	Pressure Testing	As per manual	At each running bill	-	I&IIA	

11.15 HYDROSTATIC TESTS OF PIPELINES

After a new pipe has been laid, jointed and back filled (or any valved section thereof), it shall be subjected to the following two tests:

Pressure test at a pressure of at least double the maximum working pressure-pipe and joints shall be absolutely water tight under the test.

Leakage test (to be conducted after the satisfactory completion of the pressure test) at a pressure to be specified by the authority for duration of two hours.

The portions of the line shall be tested by subjecting to pressure test as the laying progresses before the entire line is completed. In this way any error of workmanship will be found immediately and can be corrected at a minimum cost. Usually the length of the section to be tested shall not exceed 500m.

Where any section of a main is provided with concrete thrust blocks or anchorages, the pressure test shall not be made until at least five days have elapsed after the concrete is cast. If rapid hardening cement has been used in these blocks or anchorages, test shall not be made until at least two days have elapsed.

Prior to testing, enough back fill shall be placed over the pipe line to resist upward thrust. All thrust blocks forming part of the finished line shall have been sufficiently cured and no temporary bracing shall be used.

The open end of the section shall be sealed temporarily with an end cap having an outlet which can

serve as an air relief vent or for filling the line, as may be required. The blind face of the end cap shall be properly braced during testing by screw jacks and wooden planks or steel plate. The section of the line to be tested shall be filled with water manually or by a low pressure pump. Air shall be vented from all high spots in the pipe line before making the pressure strength test because entrapped air gets compressed and causes difficulty in raising the required pressure for the pressure strength test.

The test pressure shall be gradually raised at the rate of approximately one Kg,/sq. cm. /min. the duration of the test period if not specified shall be sufficient to make a careful check on the pipe line section.

The pipe shall be judged to have passed the test satisfactorily if the quantity of water required to restore the test pressure does not exceed 1.5 liters per 10 mm of nominal bore for a length of 1 km.

11.16 FILTER MEDIA TESTS OF SAND AND GRAVEL

Filter Sand

A. Grain Shape and Shape Variation

1. Shape of filter grains is important from the hydraulic and turbidity removal points of view. Rounded grains are preferable to angular ones.
2. Filter sand shall meet the requirements of effective size and uniformity coefficient as specified by the designer.

   The composite sand for filter is expressed with its effective size (D_{10}) and uniformity coefficient (UC). Effective size of the composite sand is defined as the sieve opening in mm that permits passage of 10% by weight of the sand. The uniformity coefficient of sand is defined by the ratio between the sieve size that permits passage of 60% of sand (by weight) and effective size D_{10} of the composite sand i.e. UC = D_{60} / D_{10}. Effective size and the uniformity coefficient can be determined by sieve analysis and as indicated below:

   A mixture of four or five samples is taken as a representative sample of the sand in a staked area. The sample is washed thoroughly to remove impurities and allowed to dry.

- Some 500g of dried sand is then sieved for 15 minutes, using a mechanical sieving shaker through a series of standard sieves with the coarsest sieve at the top and the finest at the bottom.
- The sand retained in the coarsest sieve is weighed. Sand retained in each of the subsequent sieves is added to the previous one, and the total amount of sand retained weighed.

B. Filter sand quality requirement

1. Filter sand shall consist of hard, durable grains of silica and shall have a specific gravity of not less than 2.5. All grains of sand shall preferably be water worn. The minimum silica content in sand as determined by method given in **7** of IS: 2000-1962† shall be 90 percent.
2. Any sample of filter sand shall not contain more than 5 percent by volume of impurities, such as clay, loam, silt, etc, in one hour settlement after shaking in water in accordance with procedure described below.

   Fill a 1000 ml calibrated measuring cylinder with filter sand to be tested to half its volume and add water until the cylinder is three-fourths full. Shake up the mixture vigorously and allow it to settle for one hour.

   Report the volume of impurities standing over the sand as percentage of volume of sand.

3. The sand shall not contain more than 5 percent of acid soluble matter as determined by solubility test described below.

Rinse a minimum of 10 g of sample with distilled water to remove all dust and fine material, dry at 103°C in hot air-oven for one hour, cool and weigh. Immerse in 40 percent (*v/v*) hydrochloric acid for a period of 24 hours at room temperature. After 24 hours of immersion, wash the sample thoroughly with distilled water, dry at 103°C in hot air for one hour, cool and weigh.

The percentage of solubility is given by the formula:

$$Solubility\ \% = \frac{Loss\ in\ weight}{Original\ weight}\ X\ 100$$

4. The loss on ignition, which is a measure of the organic matter present in sand, and determined by the procedure given below shall not be more than 0.7 percent.

   Rinse a minimum of 10 g of the sample with distilled water to remove dust and fine material, dry at-103°C in hot air-oven for one hour, cool and weigh. Ignite the sample at 550°C in an electric muffle furnace for one hour, cool and weigh.

   Calculate percent loss on ignition using the following formula:

$$Loss\ on\ ignition = \frac{Loss\ in\ weight}{Original\ weight\ of\ sample}\ X\ 100$$

C. Sampling

Sampling and criteria for conformity for filter sand may be as following.

a) *Lot*—The quantity of sand received in a consignment from a single source shall be divided into a convenient number of lots of approximately equal size not exceeding 10 m^3.

b) From each lot, 10 increments each weighing about 2 kg shall be collected. The increment shall be taken at regular intervals during loading or unloading. From a stationary lot, 2 increments shall be taken from the top and 2 each from the four sides. The increment in all cases shall be taken from a depth of at least 150 mm.

c) All the increments taken from the same lot shall be mixed thoroughly and reduced by the process of coning and quartering to yield a laboratory sample of required mass (about 2 kg).

d) *criteria for Conformity*—The laboratory sample as obtained in **c)** shall be tested for all the requirements and if it passes in respect of them the lot shall be considered as conforming to this standard.

†Methods of chemical analysis of bauxite.

Gravel

A. Quality requirements for gravel

Filter gravel shall consist of hard, preferably rounded stones with an average specific gravity of not less than 2.5 and shall be free from clay, sand, loam and organic impurities of any kind.

The gravel shall contain no more than 2 percent by mass of thin, flat or elongated pieces (in which the largest dimension exceeds three times the smallest dimension) determined by hand picking.

Gravel should be free from excessive amount of limestone or shells and acid solubility determined in accordance with procedure given in *Acid Solubility Test* should not exceed the following limits:

a) For gravel sizes 10 mm or larger 10% solubility

b) For sizes smaller than 10 mm 5% solubility

B. Sampling

Sampling and criteria for conformity for gravel shall be as following.

a) *Lot* — The quantity of gravel received in a consignment from a single source shall be divided into a convenient number of lots of approximately equal size not exceeding 25 m^3.

b) From each lot 25 increments each weighing about 5 kg shall be collected. The increments shall be taken at regular intervals during loading or unloading. From a stationary lot the increment shall be taken by a suitable method so as to represent the material in various locations of the lot.

c) All the increments taken from the same lot shall be mixed thoroughly and then reduced by the process of coning and quartering to yield a laboratory sample of about 5 kg.

d) *Criteria for Conformity* — The laboratory sample as obtained in **c)** shall be tested for all the requirements. If it passes in respect of all of them, the lot shall be considered as conforming to this standard.

11.17 TEST REPORT FORMATS

All the essential test report formats for implementation of QA/QC procedures are given in Appendix-A. and are listed below;

- Test Certificate for Cement
- Test Certificate for Coarse Aggregate
- Test Certificate for fine Aggregate
- Test Certificate for water (where water is brackish)
- Compressive Strength of Concrete
- Concrete Slump Test
- Hydrostatic Test for NP Pipes
- Hydrostatic Test for pressure Pipes
- Leak Test for Under Ground RCC Structures
- Leak Test for Elevated RCC Structures
- Water absorption of bricks
- Silt content of fine aggregates
- Verticality test report

11.18 SAMPLING OF MATERIAL FOR LAB TEST

During the site inspection of schemes by consulting agency if any construction material found to be sub standard, it will be sampled out in the presence of CSE, Chairman WUSC and Contractor and sealed in their presence. The sample will be sent to the laboratory with the consent of Consulting agency. The test results will be conveyed to DWSS and consulting agency.

APPENDICIES

APPENDIX- A

TEST REPORT FORMATS

APPENDIX- B

CHECKLIST GUIDE FOR WORKS

APPENDIX- C

SITE DOCUMENTS

APPENDIX D

QUALITY FIELD INSPECTION REPORT FORMAT

APPENDIX - A

TEST REPORT FORMATS

Sl. No.	Test Report Title	Reference IS Code	Form No.	Remarks
1	Test Certificate for Cement	1489 - 1991 8112 -1989	A/TR -1	Mandatory
2	Test Certificate for Coarse Aggregate	383- 1970 2386 - 1963	A/TR -2	Mandatory
3	Test Certificate for fine Aggregate	383 - 1970 2386- 1963	A/TR -3	Mandatory
4	Test Certificate for water	3205 - 1987	A/TR -4	For saline zone only
5	Compressive Strength of Concrete	456 - 2000 516 - 1959	A/TR -5	Mandatory
6	Concrete Slump Test	1199 -1959	A/TR -6	Mandatory
7	Hydrostatic Test for NP Pipes	Manual	A/TR -7	Mandatory
8	Hydrostatic Test for pressure Pipes	Manual	A/TR -8	Mandatory
9	Leak Test for Under Ground RCC Structures	3370 - 2009	A/TR -9	Mandatory
10	Leak Test for Elevated RCC Structures	3370 -2009	A/TR -10	Mandatory
11	Water absorption of bricks	3495 – 1992	A/TR -11	Mandatory
12	Silt content of fine aggregate	383(III) – 1963	A/TR -12	Mandatory
13	Verticality test report	2800(II) -1979	A/TR -13	Mandatory

Ref No. ……..Dated ……. Form No A/TR-1

TEST CERTIFICATE FOR CEMENT

Name of work : Contract No : Name of contractor :

Source of supply ; Date of sampling & Quantity :

Material description :

CONSISTENCY

Trial No.	Weight of cement	Weight of water	Percentage of water	Reading of indicator	Consistency (P)	Remarks

SETTING TIME

Setting Time	Time recorded when water added	Time recorded at set	Setting time	Remarks
Initial				
Final				

FINENESS

Weight of cement used	Retained on o.o75 Sieve	Percentage retained	Remarks

COMPRESSIVE STRENGTH

Room temperature	Date of casting	Date of testing	Age of specimen	Crushing load (T)	Crushing strength kg/cm2	Remarks

Signature : Signature : Name : Name : Date : Date :

For Contractor For Consultant

Ref No. ……..Dated …… Form No A/ TR-2

TEST CERTIFICATE FOR COURSE AGGREGATE

Name of work :

Contract No. :

Name of contractor :

Source of supply :

Date of sampling & Quantity :

Material description :

A - 20 mm Nominal size

Sieve size in mm	Weight retained (g)	Cumulative weight retained	Cumulative % retained	Cumulative % passing	Remarks/Standards % Passing
40 mm					100
20 mm					85-100
10 mm					0-20
4.75 mm					0-5
Pan					
TOTAL					

B - 10 mm Nominal size

Sieve size in mm	Weight retained (g)	Cumulative weight retained	Cumulative % retained	Cumulative % passing	Remarks/ Standards % Passing
12.5 mm					100
10 mm					85-100
4.75 mm					0-20
2.36 mm					0-5
Pan					
TOTAL					
Fineness modulus of coarse aggregate = C is cumulative % retained Signature : Signature : Name : Name : Date : Date : For Contractor For Consultant					

Ref No. ……..Dated …… Form No A/TR-3

TEST CERTIFICATE FOR FINE AGGREGATE

Name of work :

Contract No :

Name of contractor :

Source of supply :

Date of sampling & Quantity :

Material description :

Sieve size in mm	Weight retained (g)	Cumulative weight retained	Cumulative % retained	Cumulative % weight passing	Standards Zone II passing limits
10mm					100-100
4.75mm					90-100
2.36 mm					75-100
1.18 mm					55-90
600 µ					35-59
300 µ					8-30
150 µ					0-10
Pan					
TOTAL					
Fineness modulus of fine aggregate = Signature : Signature : Name : Name : Date : Date : For Contractor For Consultant					

Ref No. ……..Dated ……. Form No. A/TR-4

TEST CERTIFICATE FOR WATER (For saline zone only)

Name of work : Contract No. : Name of contractor :

Source of supply : Date of sampling & Quantity : Material description :

Sl. No.	Color	PH value	Organic Solids (mg/l)	Inorganic Solids (mg/l)	Sulphates (mg/l)	Chlorides (mh/l)	Suspended matter (mg/l)
Limits		> 6	< 2000	< 3000	< 500	PCC <2000 RCC < 1000	< 2000
1							
2							
3							

Remarks / Recommendations……..

Signature : Signature :

Name : Name :

Date : Date :

For Contractor For Consultant

Ref No. ……..Dated ……. Form No. A / TR-5

COMPRESSIVE STRENGTH OF CONCRETE

Name of work :

Contract No. :

Name of contractor :

Sampling done By :

Date of sampling & Quantity :

Description of structural member :

Sl. No.	Particulars	Unit	Test No.		
			1	2	3
1	Identification Mark				
2	Weight	Kg			
3	Length	Cm			
4	Breadth	Cm			
5	Height	Cm			
6	Area	Cm2			
7	Crushing Load	Kg			
8	Compressive strength	Kg/cm2			

Average compressive strength of concrete = …… kg/ cm2

Remark / Recommendation. ……..

Signature : Name :

Date : For Contractor

Name of RDSMC and WUSC representative

Present at the time of testing. : …….

Ref No. ……..Dated ……. FORM No. A/TR – 6

CONCRETE SLUMP TEST

Name of work : Contract No. : Name of contractor :

Source of supply : : Date of sampling & Quantity : Material description :

Sl. No.	Particulars	Unit	Test No.		
			1	2	3
1	Weight of cement	Kg			
2	Weight of Coarse aggregate	Kg			
3	Weight of fine aggregate	Kg			
4	Water / cement ratio				
5	Weight of water	Kg			
6	Slump	Mm			

Average slump of concrete …….. mm

Remark/Recommendation. ……..

Signature : Signature :

Name : Name :

Date : Date :

For Contractor For Consultant

Ref No. ……..Dated ……. Form No. A/ TR – 7

HYDROSTATIC TEST FOR NP PIPES

Name of work : Contract No. : Name of contractor :

Source of supply : Material description :

Sl. No.	Internal diameter (mm)	Time in hours	Stretch	Length (m)	Water level drop (mm)		Volume of water to restore to original level (liters)	
					10 min	30 min	10 min	30 min

Remark / Recommendation. ……..

Signature : Signature :

Name : Name :

Date : Date :

For Contractor For Consultant

Ref No. ……..Dated ……. Form No. A/TR – 8

HYDROSTATIC TEST FOR PRESSURE PIPES

Name of work : Contract No. : Name of contractor :

Source of supply : : Material description :

Sl. No.	Material of pipe	Internal diameter (mm)	Stretch	Length (m)	Applied test pressure (kg/cm2)	Time (hours)			Observations
						1	2	3	

Remark / Recommendation. ……..

Signature : Signature :

Name : Name :

Date : Date :

For Contractor For Consultant

Ref No. ……..Dated …… Form No. A/TR – 9

LEAK TEST FOR UNDER GROUND RCC STRUCTURES

Name of work : Contract No. :

Name of contractor : Material description :

Date of Filling		**Initial Water level**		**Remarks**
Observation No.	**Date of Observation**	**Water level (m)**	**Drop (mm)**	
1.				
2.				
3.				
4.				
5.				
6.				

Remark / Recommendation. ……..

Signature : Signature :

Name : Name :

Date : Date :

For Contractor For Consultant

Ref No. ……..Dated …… Form No. A/TR – 10

LEAK TEST FOR ELEVATED RCC STRUCTURES

Name of work : Contract No. :

Date of Filling		**Water Level**		
Observation No.	**Date of Observation**	**Initial**	**Final**	**Time**
1.				
2.				
3.				
4.				
5.				
6.				

Remark / Recommendation. ……..

Signature : Signature :

Name : Name :

Date : Date :

For Contractor For Consultant

Name of contractor : Description :

Ref No. ……..Dated ……. Form No. A/TR – 11

WATER ABSORPTION OF BRICKS

Name of work : Contract No. :

Name of contractor : Description :

Brand …… Quantity of sample: …….

Sl. No.	Weight of Dry bricks (Kg)-A	Dimensions (mm)	Weight of Water bricks (Kg)-B	Water Absorption (B-A)/Ax100
1				
2				
3				
4				
5				

Limit: It should not be more than 20%

Remark / Recommendation. ……..

Signature : Signature :

Name : Name :

Date : Date :

For Contractor For Consultant

Ref No. ……..Dated ……. Form No. A/TR – 12

SILT CONTENT

Name of work : Contract No. :

Name of contractor : Description :

Brand : …… Quantity of sample : …….

Observations	Sample-1	Sample-2	Average	Standards
Height of sand layer (A)				**It should not be more than 8 %**
Height of silt layer (B)				
Silt content (%) Bx100/A				

Remark / Recommendation. ……..

Signature : Signature :

Name : Name :

Date : Date :

For Contractor For Consultant

Ref No. ……..Dated ……. **Form No. A/TR-13**

VERTICALITY TEST REPORT

Name of work :	I.D. of well mm
Pump Serial No.:	O.D. of disc mm
Conducted by :	Disc correction mm
In the presence at :	Point of suspension above top of well mm
Date :	static water level mm

Depth of well **housing** mm

Depth in m. Below top of Tubewell	**Reading from Arbitrary Datum**		**Deviation from Vertical at top of Tubewell**				**Calculated Deviation from Vertical at Respective depth**				**Calculated Deviation from Vertical at Respective depth adding disc correction**				**Resultant Deviation Remarks & its direction**
	X	Y	N	S	E	W	N	S	E	W	N	S	E	W	
0			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Remark / Recommendation. ……..

Signature : Signature :

Name : Name :

Date : Date :

For Contractor For Consultant

APPENDIX - B

CHECKLIST GUIDE FOR WORKS

Sl. No.	Description of Works	Form No.	Remarks
1	Tube well.	B/CL-1	Mandatory
2	Laying and jointing of pipe line, back filling, hydro testing .	B/CL-2	Mandatory
3	Pumping machinery & fittings of delivery pipe in pump chamber (Tube well based scheme)	B/CL-3	Mandatory
4	Disinfecting plant.	B/CL-4	Mandatory
5	Pump chamber.	B/CL-5	Mandatory
6	Development of water works.	B/CL-6	Mandatory
7	O.H.S.R	B/CL-7	Mandatory
8	Water treatment plant	B/CL-8	Mandatory
9	Laying of sewer & Treatment plant.	B/CL-9	Mandatory
10	Control panel for 3 phase pump & motor.	B/CL-10	
11	Centrifugal pump, motor & fittings of delivery pipe in pump chamber (Canal based scheme)	B/CL-11	
12	Quality certificate.	B/CL-12	Mandatory

CHECK LIST FOR TUBEWELL

FORM No. B/CL-1

1. Name of work :

2. Contract No. :

3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether tube well site is prone to flooding and free from filled up earth?		
2	Whether any village pond is located adjacent to water works site?		
3	Whether the drilling point of tube well is as per approved lay out plan?		
4	Whether tube well site was investigated hydro geologically & geo-physically to assess the availability of water? (applicable to area where there is water scarcity)		
5	Whether Geologist/Hydrologist has been engaged for installation of tube well?		
6	Whether the type of drilling, size of tube well boring are as per design?		
7	Whether samples of strata was collected accurately and kept in boxes for further analysis?		
8	Whether electric logging has been done?		
9	Whether screen slot size and gravel size has been designed by proper sieve analysis from approved agency?		
10	Whether M.S. Pipes used are of proper thickness, free from rust and with bituminous painted as per approved specification, Test certificate obtained and Consultant approval done?		
11	Whether Stainless steel wire cage strainers are of proper thickness, and as per approved specifications, Test certificate obtained and Departmental inspection conducted?		
12	Whether the tube well assembly has been approved by concerned RDSMC?		
13	Whether lowering of tube well assembly has been done in the presence of RDSMC in-charge or deputed by Superintending Engineer?		
14	Whether Cement/clay, seal plug is provided between the annular spaces of boring & lowering assembly to prevent contamination of good quality water bearing strata as per recommendations of the Geologist / Hydrologist?		

15	Whether certificate to the effect that "Certified that the lowering of the pipe assembly and screen/ strainer has been done in our presence and that the quality, sizes and length of pipes and screen/strainer are as per record / entry made and are correctly located and lowered in the bore" has been recorded and is duly signed by RDSMC.		
16	Whether verticality of tube well is checked and recorded?		
17	Whether capacity of Air Compressor (Both CFM and PSI) used is as per specifications given in bid document and is certified by the Engineer-in-charge?		
18	Whether capacity of Submersible pumping set used for development is sufficient w.r.to developed and designed discharge?		
19	Whether tube well development hours are as per contract and log book maintained?		
	a) With compressor		
	b) With submersible pumping set		
20	Whether running hours of air compressor and submersible pumping set are witnessed and certified by authorized officer of RDSMC and representative of WUSC?		
21	Whether final performance test done & recorded?		
22	Whether strata chart and assembly chart showing all details of tube well has been submitted by contactor to RDSMC/ WUSC?		
23	Whether result of water sample tests (Physical/Chemical/ Biological Examination) after development with submersible pumping set are conforming to drinking water standards?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Date :
Designation :	

FORM No. B/CL-2

CHECK LIST FOR LAYING AND JOINTING OF PIPE LINE, BACK FILLING, HYDROTESTING

1. Name of work :

2. Contract No. :

3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
A. Stage 60% Payment schedule: Supplying of pipe and valves, excavation, laying, jointing, and fixing of valves.			
1	a) Whether pipes are of proper specifications and as per approved make as per QAP? b) Whether pipes have been tested at manufacturer's premises and has been inspected by two officers deputed as per instructions of the RDSMC and test certificates are available?		
2	Whether the Sluice Valve/Air Valves etc. are as per Specification and MC has been obtained?		
3	Whether the CI/GI/PVC specials are as per specification and MC has been obtained?		
4	Whether the trenches have been excavated to correct depth as per specifications and dimensions?		
5	Whether the pipe line has been laid true to the alignment with proper bedding made as per specifications?		
6	Whether Jointing material used as per specification?		
7	Whether all the lanes are provided with pipe lines as per approved drawing?		
8	Whether the completion drawing of pipe line prepared and submitted with running bills?		
B. Stage 40% Payment schedule: - Completion, testing and commissioning.			
1	Any busting of pipeline noticed in the village.		
2	Whether all the leakages observed during testing have been repaired properly?		
3	Whether the trenches were backfilled in layers, and properly watered and consolidated as per specifications?		
4	The filling is carried out to required level and without any settlement?		
5	Field compaction/density test conducted?		
6	Whether the road metal was separately collected and all type of roads reinstated properly after laying of pipes?		
7	Whether WUSC/Municipality are satisfied with restoring of roads and streets and a certificate to this effect has been given by the WUSC/Municipality before clearing payments of brick paving/ cement concrete restoration work?		
8	Whether the valve chambers constructed as per drawing and tested for water tightness?		
9	Whether the distribution system hydraulically tested?		
10	Whether the distribution system properly disinfected before providing connections to consumers?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date : Designation :	Date :

FORM No. B/CL-3

CHECK LIST FOR PUMPING MACHINERY & FITTINGS OF DELIVERY PIPE IN PUMP CHAMBER (TUBEWELL BASED SCHEME)

1. Name of work :
2. Contract No. :
3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether submersible pump and motor conforming to approved specifications and make as per contract agreement, the MC obtained and RDSMC inspection done?		
2	Whether Sluice valve, reflux valve and Air valve are ISI marked and as per specifications & the MC has been obtained?		
3	Whether the pipes and specials, rubber packing, nut and bolts are as per specifications?		
4	Is there any leakage from fittings? a) Inside the pump chamber b) Outside the pump chamber		
5	Is Air Valve/Non Return Valve installed properly?		
6	Is double earthing done for machinery and is in order?		
7	Whether diameter and length of column pipe lowered is as per approved specification?		
8	Whether the jointing of column pipes is done properly to prevent leakage of water?		
9	Whether discharge available from the pump is close to actual discharge of pump? (Actual measurement of discharge by filling OHSR/ or through V-Notch)		
10	Is motor taking normal current?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Date :
Designation :	

FORM No. B/CL-4

CHECK LIST FOR DISINFECTING PLANT

1. Name of work :
2. Contract No. :
3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
	SILVER IONIZATION PLANT		
1	Whether the Silver ionization is auto switch on and off with pump?		
2	Is Silver Ionization feed water pump working properly and as per I.S: 8472- 1998?		
3	Whether Silver Ionization flow meter installed as per IS : 779- 1994?		
4	Whether the water chamber of electrodes is constructed of stainless steel with SS 304?		
5	Whether the dosing automatic set constant by the microprocessor when the power goes and come back again?		
6	Whether the flip/ flop technology of changing polarity within 30 seconds working?		
7	Whether Silver Ions Test kits available at site?		
8	Whether MC has been obtained and DT inspection conducted?		
	CHLORINATOR		
1	Whether chlorinator and accessories is as per specification?		
2	Whether MC has been obtained and DT inspection conducted?		
3	Whether the chlorinator is installed and working properly?		
4	Whether Testing kit for residual chlorine test available for water sample testing?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Designation :
Date :	

FORM No. B/CL-5

CHECK LIST FOR PUMP CHAMBER

1. Name of work :
2. Contract No. :
3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
1.	Whether Bench Mark pillars are fixed and layout is correct as per approved drawing for excavation of foundation?		
2.	Whether Depth of foundation is correct as per approved drawing?		
3.	Whether Earth bedding condition checked?		
4.	Whether following materials used are as per specifications and Test for materials conducted as per frequency? Bricks Fine aggregate Coarse aggregate		
5.	Whether following manufactured materials used are as per specification and Test for materials conducted and MC Obtained? Cement Steel for reinforcement		
6.	Whether Concrete bedding laid as per specification?		
7.	Whether proper arrangement of curing and curing period maintained as per specification?		
8.	Whether Ist class Brick work in foundation and plinth is as per specifications and necessary test for mix proportion of mortar conducted?		
9.	Whether Horizontal/vertical D.P.C. provided as per specifications?		
10.	Whether brick work in super structure is as per specifications and proper wet bricks are used. Test for mix proportion of mortar conducted?		
11.	Whether Brick work in super structure is in true plumb and top of all walls are in level?		
12.	Whether Thickness of joints in brickwork is kept 1 cm± 20 %?		
13.	Whether All horizontal and vertical joints are being filled correctly?		
14.	Whether proper curing period maintained as per specification?		
15.	Whether size of doors/windows and other joinery work as per drawing has been kept?		
16.	Whether proper section and gauge of hollow pressed steel chowkhats have been provided with proper grouting?		
17.	Whether foot rest provided as per drawing and specification?		

	Completion & finishing		
1.	Whether Proper Centering and shuttering has been provided for R.C.C. slab?		
2.	Whether steel Reinforcement laid as per design and drawing?		
3.	Whether R.C.C. Slab is laid of required thickness and in level?		
4.	Whether proper size of Girder (proper I-section) has been Provided (Medium weight)?		
5.	Whether proper size of opening in the roof has been provided with cover as per drawing for lowering of pump?		
6.	Whether surface cleaned of all loose mortar and efflorescence before plastering?		
7.	Is the finishing of plaster inside/outside is proper and mix is as per required proportion?		
8.	Whether the floor has been laid in panels, correct thickness and proper sand filling done under floor?		
9.	Whether proper underground conduit for electric cable has been provided for machinery etc?		
10.	Whether electrical fixtures installed are as per approved specifications and quantity?		
11.	Whether top finishing and slope of floor is correct?		
12.	Whether proper tile terracing has been done on roof as per specification?		
13.	Whether proper quality and type of wood has been used with correct thickness of shutters as per specification?		
14.	Whether thickness of Glass used in window panes is correct as per specification?		
15.	Have grills been provided as per standard drawings?		
16.	Whether Gravel Pit of proper size has been constructed, channels grouted and MS Sheet cover provided as per drawing?		
17.	Whether V-notch houdi with proper specifications has been constructed according to drawing?		
18.	Whether Quality of distemper/cement based paint (Snowcem) is as per specification?		
19.	Whether Quality of paint used on wood work/steel work and on other components is as per contract?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Date :
Designation :	

FORM No. B/CL-6

CHECK LIST FOR DEVLOPMENT OF WATER WORKS

1. Name of work :
2. Contract No. :
3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether Bench Mark pillars are fixed and layout is correct as per approved drawing for excavation of foundation?		
2	Whether Depth of foundation is correct as per approved drawing?		
3	Whether Earth bedding condition checked?		
4	Whether following materials used are as per specifications and Test for materials conducted as per frequency? ▪ Bricks ▪ Fine aggregate ▪ Coarse aggregate		
5	Whether following manufactured materials used are as per specifications and Test for materials conducted and MC obtained? ▪ Cement ▪ Structural steel		
6	Whether Concrete bedding laid as per specification?		
7	Whether Brick work in foundation and plinth is as per specifications and necessary test for strength of mortar conducted?		
8	Whether D.P.C. provided as per specifications?		
9	Whether brick work in super structure is as per specifications and proper wet bricks are used. Test for mix proportion and strength of mortar conducted?		
10	Whether Brick work in super structure is in true plumb and top of all pillars in level?		
11	Whether Thickness of joints in brickwork is kept 1 cm± 20 %?		
12	Whether All horizontal and vertical joints are being filled correctly?		
13	Whether proper curing period maintained as per specification?		
14	Whether Gate Pillars and corner Pillars have been constructed as per drawing?		
15	Whether proper size and number of Iron pickets has been embedded in PCC of approved mix as per drawing?		
16	Whether proper size/type of D-hooks have been provided as per drawing?		
17	Whether barbed wire provided as per IS : 278-2009 and is of proper gauge and fully stretched in correct alignment?		

18	Whether proper size of iron Gate has been fixed with proper fittings and in alignment as per drawing?		
19	Whether paths at water work has been constructed according to proper section and camber as per drawing?		
20	Whether Quality of paint on steel work and on other components is as per specification?		
21	Whether proper sign board according to specifications has been installed?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Date :
Designation :	

FORM No. B/CL-7

CHECK LIST FOR OHSR

1. Name of work :
2. Contract No. :
3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
Foundation and column up-to ring beam			
1	Is Soil Bearing Capacity has been got checked from approved/ reputed institute?		
2	Whether Bench Mark pillars and center pillar were fixed and layout/depth of foundation is correct as per approved drawing?		
3	Earth bedding condition checked for any filled up soil.		
4	Is suitable mechanical arrangement for curing of RCC work (electrical motor/diesel engine operated device) is available at site which is capable of lifting water up to top dome of OHSR.?		
5	Whether following materials used are as per specifications and W Test for materials conducted as per frequency? ▪ Fine aggregate ▪ Coarse aggregate		
6	Whether following manufactured materials used are as per specifications and Test for materials conducted and MC obtained? ▪ Cement ▪ Steel for reinforcement		
7	Whether all requisite tests have been conducted for the following items as per frequency?. ▪ Excavation and bedding ▪ Plain cement concrete ▪ R.C.C. (Slump test, Compressive strength)		
8	Whether PCC laid as per drawing and specifications?		
9	Whether proper steel centering and dent less shuttering is being used ?		
10	The reinforcement in the following members provided is as per drawing/design and whether it has been checked by EE/SDE? ▪ Foundation ▪ Columns ▪ Braces ▪ Landings		
11	Whether Concrete Mixer/Vibrator was used at site and standby arrangement made?		
12	Whether Concrete pour Register with date of casting each bit of concrete is being maintained?		
13	Whether R.C.C. in the following members laid as per dimensions given in approved drawing with desirable smooth finishing? ▪ Foundation ▪ Columns ▪ Braces		

14	Whether verticality of R.C.C. columns checked before and after pouring of concrete?		
15	Whether proper curing period maintained as per specification?		
From ring beam up-to roof slab and completion of stair case.			
1	Is the reinforcement in the following members provided is as per drawing/design and whether it has been checked by EE/SDE? ▪ Bottom Ring beam ▪ Bottom dome and gallery ▪ Tank wall ▪ Top ring beam ▪ Top dome ▪ Staircase and landings		
2	Whether R.C.C. in the following members laid as per dimensions given in approved drawing with desirable smooth finishing? ▪ Bottom Ring beam ▪ Bottom dome and gallery ▪ Tank wall ▪ Top ring beam ▪ Top dome ▪ Staircase and landings		
3	In Stair Case whether G.I. Pipe railing and angle iron pickets is as per drawing and specification?		
4	Whether Bell Mouth Puddle collars, Double Flanged Puddle Collars have been fixed in position and are of proper specifications and approved make?		
5	Whether proper curing period maintained as per specification?		
Arrangement and erection of Pipe, Fittings and specials, all balance work including plinth protection, automatic water level controller and testing of structure etc.			
1	Whether the CI/ DI/ DF pipes are as per specifications and MC and QAP Obtained and pipes have been fixed in true plumb?		
2	Whether inlet and overflow pipes have been properly installed in the tank so as to ensure proper working depth of OHSR and a free board.?		
3	Whether following C.I. valves, specials have been fixed in position and are of proper specifications and approved make?		
3.1	Duck Foot Bends (IS 13382-1992)		
3.2	Sluice Valves		
3.3	Expansion Joints (IS 1536-1989)		
3.4	M.S. Clamps		
3.5	Joining Material (Nut Bolts/Rubber insertion)		
4	Is pipes extended by 2.75 mtr. Length beyond Duck Foot Bends?		
5	Is overflow pipe further extended by providing D/F Bend at its end and vertical pipe of 2 mtr. Length and a D/F Bend duly fitted with expanded metal mesh of 10 mm sq. provided at end?		
6	Whether angle posts are painted in two coats after primer?		
7	Whether **R.C.C. roof ventilator is** provided with proper ail (mesh) cover as per drawing?		

8	Is **water level indicator** with proper specification and polythene ball of minimum 30 cm dia. Has been provided as per drawing and Whether plumb/ indicator is as per size and specifications? Or if, Electronic float system is provided it is as per specification and working properly?		
9	Whether **water sealed Manhole Cover** of suitable size with proper specifications/Drawing with locking arrangement have been provided?		
10	Whether **Lightening Conductor** with proper earth electrode and specifications and drawing has been provided?		
11	Whether **Steel Ladder** from balcony landing to top of the Dome provided as per drawing and specification?		
12	Whether **Aluminum Ladder** inside the tank provided as per specifications and drawings and one end fixed to the top dome and other end with the bottom dome?		
13	Whether vertical pipes, clamps, railings, steel ladder and fittings are painted with two coats of paints after applying primer coat?		
14	Whether the OHSR has been tested for water tightness and found no leakage or seepage?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Date :
Designation :	

FORM No. B/CL-8

CHECK LIST FOR WATER TREATMENT PLANT

1. Name of work :
2. Contract No. :
3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether Bench mark Pillars constructed for every units and the foundation, invert, hydraulic and formation levels have been ensured as per drawing?		
2	Whether following materials used are as per Specifications? Whether Test for materials conducted as per frequency? ▪ Bricks ▪ Fine aggregate ▪ Coarse aggregate ▪ Filter media		
3	Whether following manufactured materials used are as per specifications? Whether requisite Tests for materials conducted and MC obtained? ▪ Cement ▪ Steel for reinforcement ▪ Manhole cover and Footrest ▪ Vent pipes		
4	Whether all requisite tests have been conducted for the following items as per frequency?. ▪ Excavation and bedding ▪ Plain cement concrete ▪ Cement Mortar ▪ R.C.C. (Slump test, Compressive strength)		
5	Whether Intake chamber has been constructed as per drawing with screen?		
6	Whether the sedimentation cum storage tank has been constructed to correct dimensions as per drawing/ specifications and tested for water tightness? Whether the float arm has been provided as per drawing/ specification and working properly?		
7	Whether the scour cum suction well has been constructed to correct dimensions as per drawing/ specifications and tested for water tightness?		
8	Whether the high level tank has been constructed to correct dimensions as per drawing/ Specifications and tested for water tightness?		

9	Whether the filter beds has been constructed to correct dimensions as per drawings /specifications and tested for water tightness?		
10	Whether Filter Media is from approved quarry and placed in filter beds to correct position and thickness as per drawing and specification?		
11	Is the clear water tank has been constructed to correct dimensions as per drawing/specification and tested for water tightness?		
12	Whether the Valves and specials are as per specifications and MC obtained?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Date :
Designation :	

Note : Check list for components namely OHSR, Pump chamber, Centrifugal pump and motor, Control panel, Development of water works compound and Disinfecting unit shall be required to be filled separately on prescribed format .

FORM No. B/CL-9

CHECK LIST FOR SEWER LAYING & TREATMENT PLANT

1. Name of work :

2. Contract No. :

3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
	A : SEWER LAYING JOINTING AND APPURTENENT WORKS		
1	Whether Bench mark Pillars for site rail constructed for every line and the foundation, invert levels have been ensured as per drawing?		
2	Whether following materials used are as per specifications and Test for materials conducted as per frequency? ▪ Bricks ▪ Fine aggregate ▪ Coarse aggregate		
3	Whether following manufactured materials used are as per specifications? Whether Test for materials conducted and MC obtained? ▪ Cement ▪ Steel for reinforcement ▪ Manhole cover and Footrest ▪ Ventilating shaft		
4	Whether following manufactured materials used are as per specifications? Whether RDSMC Inspection for materials conducted and MC obtained? ▪ PVC / SW /CI /DI / RCC pipes etc. ▪ Manhole cover and Footrest		
5	Whether all requisite tests have been conducted for the following items as per frequency?. ▪ Foundation bedding ▪ Plain cement concrete ▪ Cement Mortar ▪ R.C.C. (Slump test, Compressive strength)		
6	Whether the alignment of sewer is in accordance with the approved plan?		
7	Whether the trenches has been excavated as per specifications?		
8	Whether the shoring and strutting has been done as per specifications?		
9	Whether the excavated earth has been kept away from trench as per specifications?		
10	Whether the suitable diversion has been made for proper movement of traffic?		
11	Whether the sewer has been laid true to the alignment and gradient with proper bedding in all streets as per drawing and specifications?		

12	Whether the jointing material used as per specification and joint tested before backfilling?		
13	Whether Oblique junctions are laid against each house?		
14	Whether the trenches were backfilled in layers, and properly watered and consolidated as per specifications?		
15	Field compaction / density test conducted?		
16	Whether all type of roads metal was separately collected and road reinstated properly after laying of sewers?		
17	Whether the manhole chambers constructed as per drawing and specifications and tested for water tightness?		
18	Whether Ventilating shaft are erected at suitable places as per drawings?		
19	Whether the completion drawing of sewer line with L-section prepared and submitted with running bills?		
	B : SEWAGE TREATMENT PLANT		
1	Whether Bench mark Pillars constructed for every units and the foundation, invert, hydraulic and formation levels have been ensured as per drawing?		
2	Whether following materials used are as per specifications and Test for materials conducted as per frequency? ▪ Bricks ▪ Fine aggregate ▪ Coarse aggregate		
3	Whether following manufactured materials used are as per specifications? Whether Test for materials conducted and MC obtained? ▪ Cement ▪ Steel for reinforcement ▪ Vent pipes		
4	Whether all requisite tests have been conducted for the following items as per frequency?. ▪ Excavation in foundation ▪ Plain cement concrete ▪ Cement Mortar ▪ R.C.C. (Slump test, Compressive strength)		
5	Whether following units of sewage treatment plant are constructed as per approved design drawing and specifications? ▪ Collecting tank/sump ▪ Pump chamber as per checklist B/CL-5 ▪ Facultative pond / Maturation pond ▪ Sludge Drying Beds ▪ Sludge Curing Platform ▪ Composting Pits etc.		
6	Whether construction of rest room including toilet as per type design, drawing and specification has been constructed?		

7	Whether the sewage pumps, control panels are as per specifications and installed properly?		
8	Whether Sluice valve and reflux valve are ISI marked and as per specifications & the MC has been obtained?		
9	Whether the pipes and specials, rubber packing, nut and bolts are as per specifications?		
10	Is there any leakage from fittings? a)Inside the pump chamber b) Outside the pump chamber		
11	Is Valves and fittings installed properly?		
12	Whether the efficiency of the plant checked?		
13	Whether Generating set has been installed as per required capacity/specifications on proper foundation?		
14	Completion drawing with actual hydraulic line prepared and submitted with running bill?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Date :
Designation :	

Note : Check list for components namely Pump chamber, Development of water works compound shall be required to be filled separately on prescribed format.

FORM No. B/CL-10

CHECK LIST FOR CONTROL PANEL FOR 3 PHASE PUMP & MOTOR

1. Name of work :
2. Contract No. :
3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether the main switch is of suitable capacity as per contract if specified or any reputed make?		
2	Whether the MCB/ MCCB units are of specified make?		
3	Whether the 3 Phase starter is of suitable capacity as per contract if specified any reputed make?		
4	Whether the single phase preventor as per contract if specified or reputed make is provided and working properly?		
5	Whether the panel box is of approved thickness and has been power painted?		
6	Whether it is suitable for 415 V AC. With variations up to 6% on either side?		
7	Whether Shunt Capacitor is of proper KVAR capacity as per contract if specified or approved by NEA?		
8	Whether Ampere meter is of suitable range and of any reputed make?		
9	Whether Volt meter is of suitable range (500V) as per contract if specified or any reputed make?		
10	Whether the ELCG is of reputed make?		
11	Whether three phase Indicators lamps are of (22.5mm Led type or equivalent) reputed make?		
12	Whether Fuse bases and HRC fuses are of reputed make?		
13	Whether selector switch for Ammeter and Voltmeter are of reputed make?		
14	CT for Ammeter are of reputed make or equivalent?		
15	Contractor's relays and timers are of reputed make?		
16	Switch fuse unit is as per contract if specified or of reputed make?		
17	Wires are of reputed make or equivalent?		
18	Whether MC has been obtained and DT inspection conducted?		
19	Whether the control panel has been fitted properly?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Date :
Designation :	

FORM No. B/CL-11

CHECK LIST FOR CENTRIFUGAL PUMP, MOTOR & FITTINGS OF DELIVERY PIPE IN PUMP CHAMBER

1. Name of work :

2. Contract No. :

3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether the pumping set is of reputed make as per technical specifications, MC obtained and DT inspection conducted?		
2	Whether the shaft, impeller and bearing are as per technical specifications?		
3	Whether the speed of motor is as per specifications?		
4	Whether the actual discharge of pump is as per specifications?		
5	Whether the alignment of the shaft is correct?		
6	Whether it is suitable for 415 V AC. with variations up to 6% on either side?		
7	Whether combined efficiency of pump set is as per specifications?		
8	Whether head and discharge are correct as per specifications?		
9	Whether foundation and base plate are as per specifications and foundation bolt are of proper size and length?		
10	Whether the pump set has been power painted?		
11	Whether the suction lift is within the limit (4.5 m IS: 9694 Part-I)?		
12	Whether the suction pipe joints are airtight and pump starts without priming?		
13	Whether Sluice valve, reflux valve and Air valve are ISI marked and as per specifications & the MC has been obtained?		
14	Whether the pipes and specials, rubber packing, nut and bolts are as per specifications?		
15	Is there any leakage from fittings? a) Inside the pump chamber b) Outside the pump chamber		
16	Is Air Valve/Non Return Valve installed properly?		
17	Is double earthing done for machinery and is in order?		
18	Is there any excess vibrations observed on running of pump?		
19	Is there any overheating of bearings?		
20	If the velocity in suction and delivery pipe is with in the Limit (Less than 1.5m,not exceed 2m)?		

FOR CONTRACTOR	FOR CONSULTANT
Signature :	Signature :
Name :	Name :
Date :	Date :
Designation :	

FORM No. B/CL-12

QUALITY CERTIFICATION

1. Name of work :
2. Contract No. :
3. Name of contractor :
4. Name of Structure/Location :

QUALITY CERTIFICATE

This is to certify that we have inspected the conduct of the works in accordance with established Quality Control procedures and that the items included in this Interim Payment Certificate satisfy the required quality of works and are acceptable with regard to the specifications and standards as prescribed under the Contract. Requisite Test Certificates are attached.

Enclosures

1
2
3
4
5
6
7
8
9
10

Signature/Date:

Date : ---------- J.E./Lab Technician CSE TL RDSMC

Note: This Quality Certificate shall be completed and attached to each Interim Payment before payment is recommended.

APPENDIX - C

SITE DOCUMENTS

Sl. No.	Name of Document	Responsibility	Remarks
C/QRF-1	Site Order book	Contractor	Mandatory
C/QRF-2	Material Register	Contractor	Mandatory
C/QRF-3	Daily Progress Report.	Contractor	Mandatory
C/QRF-4	Concrete pour Record	Contractor	Mandatory
C/QRF-5	Test Record	Contractor	Mandatory
C/QRF- 6	Design and Drawing Record	Contractor	Mandatory
C/QRF- 7	Non-Conforming Item Record	Contractor/Consultant	When test results are not O.K. and finishing is poor

Form No C/ QRF-1

SITE ORDER BOOK

Date : Name of work : Place/Site : Contract No :

Name of Contractor :

Description	
COMMENTS ON THE PROGRESS AND QUALITY	
Whether Sufficient Labor on Site :	Whether Sufficient Equipment on Site :
Overall Quality of Materials :	Overall Quality of Workmanship :
Instruction To The Contractor	
[Contractor]	Inspection Engineer/with Designation
Compliance Site Incharge /J.E.	

*(4 copies per set- one copy to Consultant, one copy to ICG's, one copy to WUSC each to be sent by the contractor, one copy to be retained by Contractor at site).

Form No C/QRF-2

MATERIAL REGISTER

Name of Work : Contract No. : Name of Contractor :

Name of Item : Total Quantity Required : Source :

Minimum Size of One Lot :

Sl. No.	Date	Previous Quantity	Invoice/ Bill No.	Additional Quantity Procured	Cumulative Quantity	Issued/ Consumed	Cumulative Issue	Balance Outstanding Quantity	Present requirement	Signature of Contractor

*To be maintained item wise in ledger form, to be filled daily by contractor.

Form No C/QRF-3

DAILY PROGRESS REPORT

Name of Work : Contract No. : Name of Contractor :

Date :

EQUIPMENT AT SITE

Available : Under Repair :

Sl. No.	Name of Component	Item Executed	Quantity	Location	Labour engaged				
					Skilled	Unskilled	Fitter	Manson	Other
1									
2									
3									

Any Special Difficulties/ happening:

Signature :

Name :

Date :

For Contractor

Signature :

Name :

Date :

For Consultant

Form No C/QRF-4

CONCRETE POUR RECORD

Name of Work : Contract No. : Name of Contractor :

Steel checked By : Form work Checked By :

Scaffolding checked By : Slump checked By :

Cube filled in the presence of :

Date	Name of Component	Structural Member	Mix Proportion	Approved by	Time of Start	Qty. laid	Cement bags used	Time of Completion

Concreting done in the presence of:

Signature : Signature :

Name : Name :

Designation :

For Contractor **For Consultant**

Form No C/QRF-5

TEST RECORD

Name of Work: Contract No.: Name of Contractor :

Sl. No.	Description of Sample	Date of Sampling	Size of Sample	Name of Laboratory	Status of Inspection	Status of Manufacturing Certificate	Date and Result of Test	Signature of Contractor	Signature of CSE

Form No C/QRF-6

DESIGN AND DRAWING RECORD

Name of Work: Contract No.: Name of Contractor:

Sl. No.	Details of Drawing Title/No	Date of Receipt of Drawing	Status of Drawing (Original/ Revised)	Contractor's Signature	TL/CSE Signature

NON CONFORMING ITEM RECORD **Form No C/QRF-7**

- Name of Work :
- Contract No. :
- Name of Contractor :
- Brief details of item :
- Name and designation of the Authority deciding the non-conformation:

Name …….. Designation …….

- **Reason for nonconforming** :
- **Nature of non-conforming-**

Comments :	**Yes**	**No**
i) Whether the item is structurally sound.		
ii) Whether the item is acceptable with in Specified tolerance limits at reduced rates.		
iii) Whether the item requires demolition and re- execution. Demolished material should be placed on a dedicated site area.		

Signature :	Signature :
Name :	Name :
Date :	Date :
For Contractor	**For Consultant**

APPENDIX - D

QUALITY FIELD INSPECTION REPORT

Ref No. : QFIR - ... .

	1. GENERAL		
1	Name of Sub-project	:	
2	Contract No.	:	
3	Name of District	:	
4	Contract Amount	:	
5	Name of the Contractor	:	
6	Name of Contractor's Representative	:	
7	Name of CSE	:	
8	Name of J.E	:	
9	Name of Chairman of WUSC	:	
10	Scheme Inspected by TL with date/reference	:	
11	Scheme Inspected by RPMO with date/reference	:	
12	Scheme Inspected by PMO with date/ reference	:	
13	Scheme Inspected by PMQAC with date/ reference	:	
14	Date of field inspection.	:	

	2. QUALITY CONTROL DOCUMENTS AND TESTING DETAILS		
1	Documents available at site as per list 1	:	
2	Whether the agreement with specification and Codes available at site?	:	
3	Whether the Approved structural drawing available at site?	:	
4	Field laboratory equipments available at site as per list 2	:	
5	Material being tested at site and lab by contractor as per list 3.	:	
6	Availability of field equipments as per list 4.	:	
7	Items for which manufacturing certificate obtained as per List 5.	:	
8	Items for which Inspection by departmental team has been done as per List 6.	:	
9	Check list of works filled up as per list 7.	:	
10	Testing of finished work carried out as per list 8.	:	
11	Penalties imposed on account of Nonconformance of work as per list 9.	:	
12	Overall Quality Control of works as per list 10.	:	
13	Samples taken for testing during field inspection by consultant as per list 11.	:	
14	Number of tests conducted in the field as per list 12.	:	
15	Field book /Engineer diary maintained by JE	:	

List-1 : SITE DOCUMENT

Sl. No.	Description	Availability at site Yes/No	Remarks
1	Site Order book		
2	Material Register		
3	Daily Progress Report.		
4	Concrete pour Record		
5	Test Record		
6	Design and Drawing Record		
7	Non Conforming Item Record		

List -2 : FIELD LABORATORY EQUIPMENT AVAILABLE AT SITE

Sl. No.	Description	Availability at Site Yes/No	Remarks
1	Compression testing machine		
2	Sieve set complete		
3	Measuring jars		
4	Screw gauge		
5	Vernier caliper		
6	Balance		
7	Slump cone		
8	Cube mould 2 sets.		
9	Hydraulic testing machine		

List - 3 : MATERIAL/ WORKS TESTED BY CONTRACTOR (FIELD & LABORATORY)

Sl. No.	Name of material	Qty. Used	Date of Test	Result Satisfactory/ Unsatisfactory	Remarks
1	Sieve analysis of Coarse aggregate				
2	Sieve analysis of Fine aggregate				
3	Bricks				
4	Cement				
5	Reinforcing Bar				
6	Water				
7	Mortar				
8	Slump Test				
9	Cube test for Concrete				
10	UPVC pipe for w/s				
11	UPVC pipe for sewerage				
12	HDPE/PE pipe				
13	R.C.C. pipes				
14	G.I. pipes				
15	Hydraulic test of sewer lines and manhole chambers				
16	Hydraulic Pressure test of water supply pipelines				

List - 4 : EQUIPMENTS/ T&P AVAILABLE AT SITE.

Sl.No.	Equipment	Availability Yes/No	Remarks
1	Mixture Machine with stand by arrangement.		
2	Vibrator with stand by arrangement.		
3	Lifting pump for curing		
4	Leveling instrument		
5	Hoisting lift		

List -5 : DETAILS OF MANUFACTURER CERTIFICATES

Sl. No.	Description	Qty. Used	MC availability Yes/ No	Acceptability by RDSMC	Remarks
1	Cement				
2	Steel for Reinforcement and structural steel				
3	Pipe such as GI, PVC, MS, CI, DI, SW, RCC etc.				
4	Manhole covers and Footrest				
5	AC/GI/Fiber glass sheets				
6	Electrical cables/fans and fixtures				
7	Switches/sockets and boards				
8	Flow measuring devices				
9	Control Panel				
10	Lightening arrestor				
11	Water Level indicator and controllers.				
12	Disinfection Units				
13	Pump and Motor				
14	All type of specials such as PVC, GI, CI etc.				
15	All types of valves such as sluice valve, Air valve etc.				
16	Any other item as per agreement				

List- 6 : DEPARTMENTAL TEAM INSPECTION AT MANUFACTURING PREMISES

Sl. No.	Description	Date of Inspection	Name of Officers	Acceptability Yes/ No	Remarks
1	Pipes such as DI, CI, PVC, MS, SW, HDPE/PE, etc.				
2	Pumps , Motors & D.G. Sets				
3	Manhole Frames and covers				
4	R.C.C. Pipes				

List -7 : CHECK LIST OF WORKS

Sl.No.	Description	Field Status	Details of rejection	Remarks
1	Tube well.			
2	Laying and jointing of pipe line, back filling, hydro testing.			
3	Pumping machinery & fittings of delivery pipe in pump chamber (Tubewell based scheme)			
4	Disinfecting plant.			
5	Pump chamber.			
6	Development of water works.			
7	O.H.S.R			
8	Water treatment plant (Canal based scheme)			
9	Laying of sewer & Treatment plant.			
10	Control panel for 3 phase pump & motor.			
11	Centrifugal pump, motor & fittings of delivery pipe in pump chamber (Canal based scheme)			
12	Quality certificate.			

List- 8 : TESTING OF FINISHED WORKS

Sl. No.	Item of work	Qty.	Test	Date of test	Results	Check level	Remarks
1	Excavation						
2	Refilling of trenches						
3	Road reinstatement						
4	DPC						
5	Thickness of cc floor						
6	Mortar for masonry						
7	Plaster						
8	PCC						
9	R.C.C						
10	Chaukhats						
11	Windows						
12	Fittings						
13	Distemper						
14	Painting						
15	Glass panes						
16	Wooden doors						
17	Water tightness of roofs						
18	Test for yield of Tube Well						
19	Efficiency of WTP i) Hydraulic ii) TDS iii) Total hardness iv) MPN						
20	Efficiency of STP (i) Hydraulic ii) BOD removal iii) s/s removal						
21	Water tightness of structures i) OHSR ii) UGSR iii)Units of WTP iv)Units of STP						

List -9 : PENALITIES ON NONCONFORMANCE OF WORK

Sl.No.	Name of work/ Material	Test	Results		Qty. of material rejected	Amount of Penalty if accepted	Remark
			Actual	Standard			
1							
2							
3							
4							

List- 10 : OVERALL QUALITY OF CONSTRUCTION FOR DIFFERENT ITEMS OF WORKS

Sl.No.	Item of works	Quality of Construction			Reasons for satisfactory quality
		Excellent	Good	Satisfactory	
1	Tube well				
2	Pump chamber				
3	OHSR				
4	UGSR				
5	Water works development				
6	Distribution system				
7	Pump set of TW				
8	Water treatment plant				
9	Sewer lines				
10	Manhole chambers				
11	Sewage treatment plant				
12	Electrical works at treatment plant				
13	Silver ionization plant				
14	Item of work requiring special attention for quality improvement				

List- 11: SAMPLE TAKEN FOR TESTING DURING FIELD VISIT.

Sl. No.	Name of item	Work where used	Qty. sealed	Name of Lab. Where delivered for testing	Remarks
1					
2					
3					

Note: For the samples taken for testing during the field visit, the results are to be reviewed and a copy of the same should be sent to QMSW/Consultant within 15 days.

List - 12: TEST CONDUCTED BY INSPECTION TEAM

Sl. No.	Name of item	Location	Type of test	Test result	Standards% Passing	Remarks
1	Coarse Aggregate 20 mm 10 mm		Sieve analysis	A/TR-2	Sieve: 20 / 10 40: 100 / - 20: 85-100 / - 12.5: - / 100 10: 0-20 / 85-100 4.75: 0-5 / 0-20 2.36: - / 0-5	
2	Fine aggregate Concrete Zone II Plaster IS:1542 MasonryIS:2116		Sieve analysis Silt content Sieve analysis Silt content Sieve analysis Silt content	A/TR-3 A/TR-12 A/TR-3 A/TR-12 A/TR-3 A/TR-12	8% Max. 8% Max. 8% Max.	
3	Steel IS:1786 8 mm 10 mm 12 mm 16 mm 20 mm 25 mm		Dia. Wt. / M in Kg Dia. Wt. / M in Kg Dia. Wt. / M in Kg Dia. Wt. / M in Kg Dia. Wt. / M in Kg Dia. Wt. / M in Kg		0.395±7% 0.617±7% 0.888±5% 1.58±5% 2.47±3% 3.85±3%	

4	UPVC pipe w/s Class – 3 Size - 90 mm Size 110 mm		OD Min. Max. Wall Thickness Make OD Min. Max. Wall Thickness Make		90 mm 88.9 91.1 3.1 to 3.7 mm 110 mm 108.6 111.4 3.7 to 4.3 mm	
5	UPVC pipe- B sewerage Size - 90 mm Size 110 mm Size 160 mm		OD Min. Max. Wall Thickness Make OD Min. Max. Wall Thickness Make OD Min. Max. Wall Thickness Make		90 mm 88.9 91.2 3.2 to 3.8 mm 110 mm 108.6 111.4 3.2 to 3.8 mm 160 mm 158.0 162.0 4.0 to 4.6 mm	
6	Bricks (20)		Color Length(mm) Width Height Comp.strength		Cherry red 4600±80 mm 2200±40 1400±40 7.5 N/mm2	
7	Barbed wire A-1		Gause(mm) Mass (gm/m)		2.5±0.04 155 to 136	
8	M.S Pipe		NB Thickness NB Thickness		150 mm 5.4 mm 200 mm 8.0 mm	
9	SS Screen in mm		NB Thickness NB Thickness		150 mm 5.0 mm upto 200 M 6.3 mm upto 350 M 200 mm 6.3 mm upto 200 M 8.00 mm upto 350 M	
10	Floor		Thickness		40 mm P.C.C	
11	Plaster		Thickness		12.5 mm	
12	Door		Thickness		40 mm	
13	Roof slab		Roof slab		150 mm	
14	M.S Girder		Size		250 mmx125 mm	
15	Angle iron Pickets		Size Thickness		40x40x6 mm 6 mm	

16	Cube test M15 M20 M25		Compressive strength Compressive strength Compressive strength		15 N/mm2 20 N/mm2 25 N/mm2	
17	Slump test		Slump in mm		40-70 mm	
18	Cement		Grade Date of Manufacture. Fineness		43 Not more than 10% Residue	
Signature of Inspecting officer						