



Rural Piped Water Supply

QUALITY MONITORING SYSTEM



PUBLIC HEALTH ENGINEERING DEPARTMENT
NIRMAN BHAWAN
PATNA-800015

ABBREVIATION

Sl. No	Abbreviation	Description
1	AC	Asbestos cement
2	BIS	Bureau of Indian standard
3	BOQ	Bill of quantities
4	°C	Degree Celsius temperature
5	CI	Cast iron
6	Cm	Centimetre
7	Cum/ M ³	Cubic meter
8	CWR	Clear water reservoir
9	Dia	Diameter
10	PD	Project Director
11	DPMC	District Programme Management Cell
12	NIT	Notice inviting tender
13	DT	Departmental Team
14	E.E.	Executive Engineer
15	FC	Fully covered
16	Fig	Figure
17	GC	Galvanized corrugated
18	GI	galvanized iron

19	Gm	Gram
20	GoB	Government of Bihar
21	Govt.	Government
22	GP	Gram Panchayat
23	HDPE	High density poly ethylene
24	HRD	Human resources development
25	IE	Independent Engineer
26	ISI	Indian Standard Institution
27	ITP	Inspection test plan
28	J.E.	Junior Engineer
29	Kg	Kilogram
30	Kl	Kilo Litre
31	Km	Kilo meter
32	M	Meter
33	MC	Manufacturer Certificate
34	MH	Manhole
35	ml	Millilitre
36	mm	Millimetres

37	M ³	Cubic meter
38	M&E	Monitoring and evaluation
39	NC	Not covered
40	No.	Number
41	OHSR	Over head service reservoir
42	O&M	Operation and Maintenance.
43	PC	Partially covered
44	PHE	Public Health Engineering.
45	PIU	Project Implementation Unit
46	PQM	Principal Quality Monitor
47	RWS	Rural water supply scheme
48	PVC	Poly vinyl chloride
49	P.W.D.	Public works department
50	QMC	Quality Monitoring Cell
51	QA/QC	Quality assurance /Quality Control
52	QAP	Quality assurance plan
53	QCC	Quality Control Check List
54	QCF	Quality control format
55	QC-M	Quality control of material
56	QC-P	Quality control Process

57	QMSW	Quality management and surveillance wing
58	QS	Quality system
59	RCC	Reinforced cement concrete
60	Re / Rs	Rupee / Rupees
61	RI	Requiring Improvement
62	SDE	Sub division Engineer
63	S.E.	Superintending Engineer
64	SPMC	State Programme management cell
65	SQMS	Sate Quality Management System
66	STP	Sewage treatment plant
67	SW	Stone ware
68	SW Ap	Sector wide approach
69	T	Tonne
70	TOR	Terms of reference
71	TMT	Thermo mechanically treated
72	TP	Third party
73	WQM&S	Water quality monitoring & surveillance
74	WS &SM	Water supply & sanitation monitoring
75	WTP	Water treatment plant

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QUALITY

MONITORING CELL

1.0 Institutional Strengthening of Public Health Engineering Department

The Public Health Engineering Department (PHED), Govt of Bihar has the overall responsibility of managing and monitoring activities to provide drinking water in the state of Bihar. Improved potable water supply and sanitation facilities and services are critical to enhance public health and improve human development outcomes, more so for rural households.

Though the State of Bihar has recorded an impressive performance in providing safe drinking water to its rural households, further improvements are required in terms of quantity, quality, equity and sustainability.

To address these issues in a coherent, concerted and urgent manner, new initiatives have to be taken in a mission mode.

The enormous task of building and maintaining water supply schemes poses a formidable challenge in so far as assuring the quality technical workmanship and overall output along with real time rectification interventions is concerned. Given the manpower constraint of the department, system of various tiers of inspection, testing and measurements, reporting and rectification complied with engineering and administrative interventions is therefore urgently required. The system aims at creating a complete institutional framework along with a complete description of roles and responsibilities, testing requirements and protocols, methods and procedures and systematic online data input and analysis.

The policy conceives of three Tier Quality Monitoring System. Existing PH Divisions will function as Programme Implementation Unit (PIU) i.e. the First Tier of the system. Graduate Engineers will be hired to function as Independent Engineer (IE) which will constitute the second Tier of the System. Retired Senior Engineers from State/Central Organisation dealing with the Water Supply/Sewerage/Sanitation Project will be hired to function as Principal Quality Monitors (PQM), which will constitute the Third Tier of the System.

Manual inspection and reporting system is being strengthened and it is supposed to use technology to obviate need of cumbersome and burdensome inspection and monitoring mechanism which has obviously proved inadequate for the Public Health Engineering Department.

It goes without saying that the framework is in addition to the codal provisions of Bihar PWD code and other relevant rules of the state.

2.0 Creation of Independent Quality Monitoring Cell

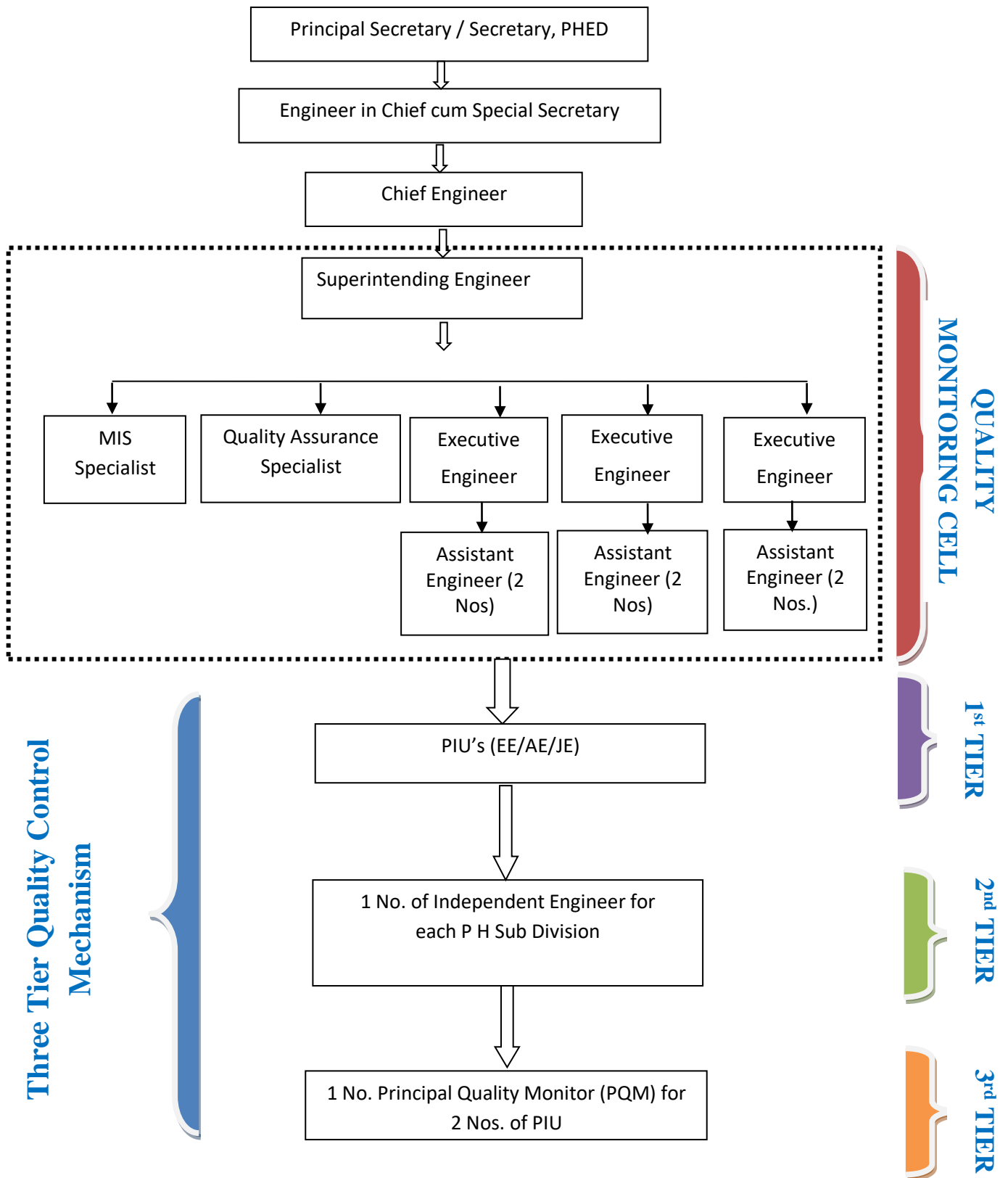
Public Health Engineering Department is the statutory authority for designing, planning, implementing, monitoring, operating and undertaking maintenance of Water Supply Schemes irrespective of the source of funds for the same.

To keep the pace of contemporary requirements, it is felt the need to set up a Quality Monitoring Cell to bring about innovative reforms and the best practices in enhancing the efficiency of the department.

Quality Monitoring Cell is primarily being made operational to take care of all the projects being taken up under the Department.

The QMC will work on a three-tier quality management mechanism, which will be operationalized with web based online system with centralised database for ensuring that the quality of assets created conform to the prescribed standards. Institutional Structure of QMC is given as under:

Institutional Structure of Quality Monitoring Cell



Note- Each P H Division will function as Project Implementation Unit (PIU)

3.0 Set up of Quality Monitoring Cell

The Quality Monitoring Cell envisages a three-tier Quality Monitoring mechanism; which has been described as below

3.1 First Tier

The first tier shall be managed by PIU. The stipulated tests as per the contract have to be conducted. The test results shall be recorded in the prescribed Quality Control Registers. If the Contractor is responsible for infrastructural arrangements for Quality Control Tests, then the following check mechanism are prescribed.

- 1) All the tests should be conducted by the designated qualified staff of the Contractor and the Quality Control Register Part-I should be maintained by him.
- 2) For effective Quality Control, the following percentages of various categories of tests will be done by the designated staff of Contractor in the presence of the JE/AE/EE:
 - a) 50 percent of the tests are conducted in the presence of the JE.
 - b) 20 percent of the tests are conducted in the presence of the AE
 - c) 5 per cent of the tests shall be conducted in the presence of the EE.

All the test results are to be recorded in Quality Control Register-I.

The monthly return of the tests will be submitted in the prescribed Performa by the Junior Engineer & Assistant Engineer to the Executive Engineer in the first week of every month. The Executive Engineer will review this return regularly to see that the Quality Control tests are being performed at the desired frequency and with required accuracy. The EE will also see that the Non-Conformance reports are issued by the AE whenever Non - Conformance occurs and the Contractor promptly takes actions on Non - Conformance reports. The reporting as enumerated above shall also be carried out on online mode on the State Quality Monitoring Portal. Restricted access

to the contractors to the online monitoring tool shall be also being provided for viewing and compliance thereof in case of Non-Conformance.

3.2 Second Tier

As the second tier of Quality Control structure, periodic inspections of works will be carried out by the Independent Engineers, whose services to be hired on contract/ empanelment/ outsourcing basis by the Department and they will be independent of the Executive Engineer/PIUs. This tier of Quality monitoring is very important and has been designed to see that the Executing agency is carrying out the Quality Controls as per specifications. The following process is to be adopted for 2nd Tier Quality Monitoring.

- 1) The programme of IE shall be drawn up through systematic sampling in online mode in such a way that every work is inspected at-least three times. The first & second inspection of every work shall be carried out during the execution of work and the last inspection shall be carried out on the completion of every work, within one month of its completion.
- 2) The Quality Monitoring Cell will draw up a monthly Schedule for IE (Sub Division/ Division wise) so as to ensure systematic coverage.
- 3) The Quality Monitoring Cell will send the IE's reports along with direction to the Project Implementing Unit with a copy to the concerned SE/CE.
- 4) The IE will interact with PIUs and the Contractors and inspect Field/ District Laboratories to ensure smooth functioning of the Quality Control Mechanism.
- 5) The IE will have to interact with the PHED HQ's in matters relating to the design, testing and execution.
- 6) IE will prepare a monthly report and send to Central Quality Monitoring Cell containing the analysis which would include findings of the PIU

reports, IE reports, action taken in individual cases and systemic deficiencies detected and remedied.

All cases of delay in reporting compliance and major cases of deviation from acceptable Quality shall be taken seriously.

It is to note that all the reports shall be submitted online into the web portal.

The IE would be given a detailed format in online mode for the inspection report that should cover the following aspects.

- a) Provisions made in estimates with regard to site requirements.
- b) Management of the contract, deployment of qualified staff by the Contractor and establishment of a functional Quality Control Laboratory by the Contractor.
- c) Construction Programme and progress of work.
- d) Execution methodology and adherence to specifications.
- e) Arrangement at Quality Testing Laboratories.
- f) Record of Tests- Quality Control Registers and their up to date maintenance.
- g) Accuracy of Quality Control Tests, issuance of Non Conformance Reports (NCR) and action of Contractor on NCRs.
- h) Inspection by departmental officer and compliance of their instructions.
- i) Other issues including the technical knowledge of the staff of the executing agency and the Contractor.

3.3 Third Tier

The third tier shall comprise of Principal Quality Monitors (PQM's), whose services to be hired on contract/ empanelment/ outsourcing basis by the Department. They will be generally retired Senior Engineers from State/Central organizations dealing with water supply, sewerage and sanitation project.

The third tier of Quality Monitoring is oriented more towards verification and review of systems and procedures being adopted at 1st and 2nd tier of Quality Monitoring, so that it can be ensured that specified requirements for Quality Management are being met.

The Principal Quality Monitors are required to visit the work in accordance with the priority indicated in the guidelines issued to them at under section "Prioritization of Works for Inspection".

Roles and Responsibilities:

- a) PQM's will carry out Quality testing of works on random sampling basis from the priority list, mainly in order to confirm that the programme implementation and Quality Control System is working satisfactorily.
- b) PQMs are expected to make constructive suggestions relating to procedural aspects in addition to locating problems at individual work level.
- c) To bring out systemic deficiencies/ shortcomings and suggestions for improvement in
 - Design and Estimation
 - Execution and Supervision
 - Quality Control
 - Contracting etc.
- d) PQM's will submit all individual work wise Inspection Reports along with a general analysis based on the works inspected by him as well as other inspection reports accessed by him.

Since the role of the PQM's is guidance and improvement rather than mere 'fault finding', the analysis is an extremely important aspect and must be prepared with care. The SE operating from Quality Monitoring Cell will be responsible for reporting compliance on the issues raised by PQMs and observations in this regard.

The analysis of the Reports of the PQMs will be done at Quality Monitoring Cell and necessary directions shall be issued for necessary compliance as quickly as possible.

4.0 Operational System of Quality Monitoring Cell

4.1 Inspection Programme

Inspection programme of the Cell shall be drawn up through systematic sampling in online mode for inspecting the works under following conditions:

- a) Systematic inspection of all sites to check quality of work and to check whether the execution of work is being carried out as per the agreement.
- b) On directions of the Principal Secretary / Secretary, PHED directs to inspect any particular Scheme
- c) Any grievances/ complaint registered against the quality of any particular Scheme

4.2 Prioritization of works for Systematic Inspection

All Schemes shall get inspected by Quality Monitoring Cell in systematic manner with following priorities:

1. **Priority 1:**

Works which are at initial stage. This is with a view to examine the system and procedures which is being followed by the PIU and the Contractor. Intervention at this stage would help in ensuring that subsequent stages of the work are carried out after system deficiencies are removed.

2. **Priority 2**

Ongoing works

3. **Priority 3**

Ongoing works that have not been inspected in the last 3 months.

4. **Priority 4**

Completed works.

5. Priority 5

Complaint cases and ATR cases on case to case basis.

4.3 Inspection, Observation and Grading of Work

The role of the officers in Quality Monitoring Cell is to critically examine the work and give feedback about quality of Scheme works and quality related shortcomings for systemic improvements.

I) How to make observations

Various items and sub-items involved in construction of a rural water supply schemes have been listed in Quality control checklist (QCC). Observation shall be recorded on following items

Sl. No.	Items
1	Quality Control Arrangements
2	Material
3	Installation, testing & Commissioning of High yield Tube well
4	Installation, testing and Commissioning of pumping plants and other electromechanical works
5	Installation, testing and commissioning of water treatment plants
6	Civil Works : Staging for Water Storage Structure, Installation of PVC Storage Tank, Construction of Pump House & Toilet
7	Laying, Testing and Commissioning of pipes, specials and other related works for Distribution Network
8	Providing House Connection
9	Trial-runs of the scheme and water quality testing of 5% total House Hold connection

ii) How to organize inspection

It is expected to traverse through the entire project to ascertain the quantum of work and other aspects of the work. After the traverse, the locations for detailed observations shall be decided.

In case of on-going work/item of work it is easier to take samples of material. However, in case of completed work/item it may be difficult to take samples.

iii) Sub-item/Item wise Grading and Overall Grading of Work

The sub-item wise grading of every item of work would be entered. The overall Item Grading would be entered and shall be calculated in the following manner:

Sl. No.	Items	Available Grade
1	Quality Control Arrangements	
2	Material	
3	Installation, testing & Commissioning of High yield Tube well	
4	Installation, testing and Commissioning of pumping sets	
5	Installation, testing and commissioning of water treatment plants sets	
6	Civil Works : Staging for Water Storage Structure, Installation of PVC Storage Tank, Construction of Pump House & Toilet	
7	Laying, Testing and Commissioning of pipes, specials and other related works for Distribution Network	
8	Providing House Connection	
9	Trial-runs of the scheme and water quality testing of 5% total House Hold connection	
Overall Grading		

Grading shall be of 3 types vis-a-vis:

1. Unsatisfactory. (U):

If, any of the items in item no. 3, 4, 5 & 7 are graded as 'U', overall grading of the work shall be **'U' i.e. 'Unsatisfactory'**.

2. Satisfactory but requires Improvement. (S-RI)

If, all the items given in above four items are 'S' but grading in any of other items is 'U' or 'RI', the overall grading of work shall be **'S-RI' i.e. Satisfactory but Requiring Improvement.**

3. Satisfactory. (S)

If grading of all items is 'S', the overall grading of work shall be **'S' i.e. 'Satisfactory'**.

4.4 Reporting and Submission of Inspection Report

All the observation compiled in desired format will be submitted on line for further action. Quality Assurance Specialist will analyse the grade given on time-to-time.

4.5 Action Taken Report

Action Taken report shall be prepared and submitted online, if grading shall be 'U' or 'S-RI'.

5.0 Guidelines on Action Taken Report

5.1 At PIU level the following action shall be taken

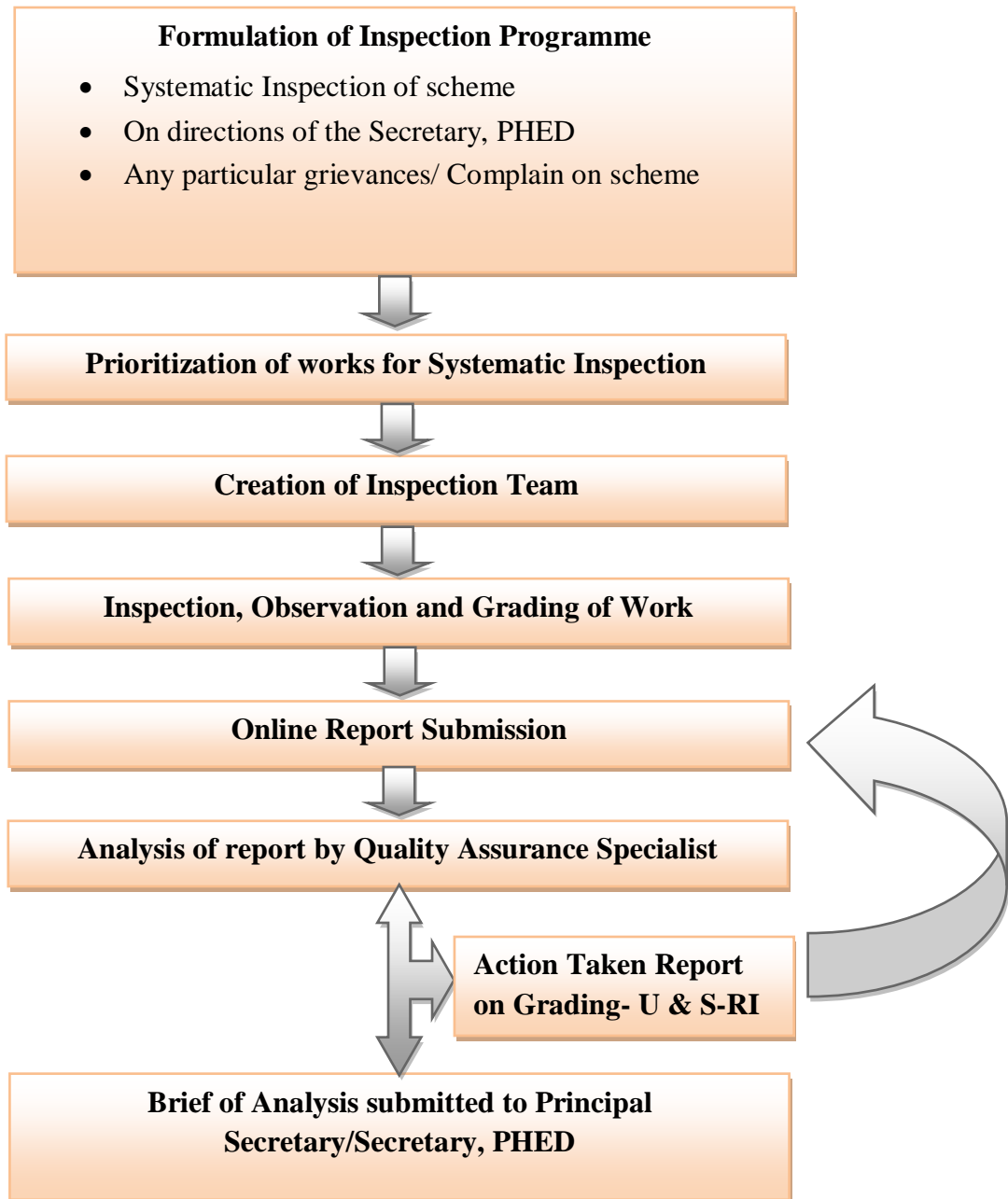
- 1) After the inspections in the district are over the copy of reporting format will be handed over by the IE to the PIU and copies will be sent to the Quality Monitoring Cell within 7 days after completing inspection. Unless the PIU disagrees with the conclusion/recommendation, rectification work should be ordered immediately by the PIU. In case the Executive Engineer PIU feels that any portion of the inspection report or the suggested rectification is not appropriate, he shall make a full report to the Quality Monitoring Cell.

- 2) The Action Taken Report will be prepared by Executive Engineer in the prescribed Format and will be sent to the Quality Monitoring Cell.
- 3) The Action taken report (ATR) submitted should be comprehensive, i.e. merely writing letter to the Quality Monitoring Cell or to the subordinate doesn't constitute action taken and should not be treated as ATR.

5.2 At Quality Monitoring Cell (QMC) level, the following actions shall be taken

- 1) On receipt of the report of the IE, the QMC will immediately remind the PIU for taking action and reporting on every para of the report. He will also initiate action on the general issues brought out by the IE in his report for remedial action by all concerned.
- 2) In case there is disagreement with the finding/recommendation in an IE Report, this should be communicated as part of the Action taken Report of PIU, duly supported by test results.
- 3) The QMC will generally compare findings of the IE and PIU to find if the two are in conformity.
- 4) The QMC will grade the works as 'satisfactory' or 'unsatisfactory' or satisfactory requiring improvement after, scrutiny of IE reports.
- 5) The QMC shall prepare and send a Report to Principal Secretary/Secretary and Engineer in Chief PHED. The report shall contain analysed performance of the IE, general deficiencies observed/highlighted through IE reports and action taken/required to be taken to remedy systematic deficiencies at organisational level in order to improve the Quality of Schemes and programme performance
- 6) The QMC will analyse ATRs for their compliance and further follow up if required.
- 7) QMC at periodic intervals shall get the IE reports as well as the Annual Quality Report, who shall make recommendations on systematic action to be taken at organizational level to improve Quality of Schemes and programme performance in the state.

Flow Diagram: Operational System of Quality Monitoring Cell



6.0 Organizational set up of Quality Monitoring Cell

The Independent Quality Monitoring Cell shall be under the administrative control of the Principal Secretary/Secretary, Public Health Engineering Department and shall be supported by the pattern as set forth above. The duties and responsibilities of individual officers are:

6.1 Chief Engineer (QMC)

His responsibilities shall include –

- Issue of appropriate instructions in regard to inspection for works wherever necessary.
- Giving guidance in the matter of design to be followed for major works or works of a complicated nature.
- Periodically inspecting all important works and also the works, which require his guidance in the matter of execution; Inspections shall be purposeful and shall cover examination of quality, progress, difficulties in execution etc.
- Giving technical advice or opinion on matters referred to him by the Government.
- Suggesting measures for improving the technical matters of the department taking into account the technical development, which has taken place and other relevant matters.
- To conduct an independent quality assurance and technical audit of works
- Suggest actions to be taken against contractors doing inferior quality works based on the report of the Quality Control team.

- To review functioning of the field testing laboratories and suggest remedial measures for improving the standard of their performance.

6.2 Superintending Engineer (QMC)

His responsibilities shall include –

- Overall responsibility of effective functioning of Quality Monitoring Cell. He will look after the day-to-day activity of cell.
- Issue of appropriate instructions in regard to inspection for works wherever necessary.
- Giving guidance in the matter of design to be followed for major works or works of a complicated nature in consultation with Chief Engineer (QMC).
- Periodically inspecting all important works and also the works, which require his guidance in the matter of execution; Inspections shall be purposeful and shall cover examination of quality, progress, difficulties in execution etc.
- Suggesting measures for improving the technical matters of the department taking into account the technical development, which has taken place and other relevant matters in consultation with Chief Engineer (QMC).
- To conduct an independent quality assurance and technical audit of works.
- To initiate action against contractors doing inferior quality works based on the report of the Quality Control Team.
- Responsible for effective functioning of the field testing laboratories and functioning of PIU and implementation of remedial measures for

improving the standard of their performance in consultation with Chief Engineer (QMC).

- Inspection of sites to check quality of work and execution of work as per agreement.

6.3 Executive Engineer (QMC)

The Executive Engineer shall be responsible for the random inspection of works under his jurisdiction. For this purpose, he shall take timely action for the following:

- Systematic inspection of sites during scrutiny of estimates for verification of the correctness of the estimates and adequacy of the provisions.
- To supervise and manage the staffs to ensure that they carry out the duties adequately and in a professional manner.
- Systematic inspections of works during site visit and give instructions wherever required through cell.
- To review activities of the cell on fortnightly basis.
- To prioritise the works in his jurisdiction at the start of the financial year
- To review Social Impact Assessment (SIA) reports Land Acquisition Plan and Rehabilitation and Resettlement Plan.
- To inspect projects on random basis, systematically under his charge.
- Test check of design, and estimate etc.,
- Review that all mandatory tests have been performed by the concerned officers at PIU level.
- Monitor to see that progress is as per schedule

- Overview the contract to ensure that the terms and conditions are adhered to.

6.4 Assistant Engineer (QMC):

An Assistant Engineer shall be responsible for the random inspection of all works under his jurisdiction. This shall include the following:

- Inspect the activities at site on systematic manner.
- Give suitable guidance to subordinates in regard to works under construction on behalf of Quality Monitoring Cell.
- Monitor to see that progress is as per schedule.
- Overview the contract to ensure that the terms and conditions are adhered to.
- Random quality check of works and compliance with environmental regulations.
- Suggest the relevant Quality Control measures to ensure the desired quality of work.
- Shall also be responsible for scrutinising plans and estimates for new works in accordance with general and special instructions in this regard.
- Random checking of site surveys, levels, nature of soil, sub soil, result of borings and field data.

6.5 Quality Assurance Specialist

Quality Assurance Specialist service will be hired on contract/ empanelment/ outsourcing basis by the Department. He shall be hired to check the quality on systematic manner. He will analyse the action taken report submitted on grading of ‘U’ or ‘S-RI’ and grading given previously on that particular Scheme. Required Educational Qualification and Expertise as Quality Assurance Specialist will be as follows:

Educational Qualification	Professional Experience	Specific Expertise and Task
B.Tech/ M. Tech in Civil/ Environmental Engineering	Minimum 10 years of Experience for B.Tech and 8 years of Experience for M. Tech as supervision consultant / key personnel in water supply project Comprising supervision and quality Assurance, Out of which 5 years should be in the area of rural water supply schemes.	At least 5 years experiences in a reputed Water Supply supervision consultancy firm as Quality Assurance Engineer. He should be well versed with testing process of water supply projects. He shall inspect the Contractor field laboratories to ensure that they are adequately equipped and capable of performing all the specified testing requirements of the contract. He shall look into the quality assurance aspect of the construction/maintenance works. He shall review and suggest modifications to all Quality and Material related aspects in the Maintenance Manual/ Program.

6.6 MIS Specialist

MIS Specialist service will be hired on contract/ empanelment/ outsourcing basis by the Department. He shall be hired to monitor projects sanctioned under the programme and progress in terms of physical, financial targets and against overall monitoring parameters. Also shall look after the IT systems developed or to be developed by the department.

Educational Qualification	Professional Experience	Specific Expertise and Task
B. Tech/M.Tech in Computer Engineering/ Information Technology	Minimum 5 years of Experience in IT sector with B. Tech and 3 years experience with M.Tech degree	She/he should have proven experience in design and development of application modules, hosting of applications, system & data integration and review of existing IT systems. Strong communications, time management and multi tasking skills.

7.0 Quality Control Mechanism

7.1 1st Tier Quality Control Mechanism

The PIU will be the first tier, whose primary responsibility will be to ensure that all the materials used and the workmanship conform to the prescribed specifications. As the first tier, the PIU will supervise the site quality laboratory to set up by the contractor as per contract. It shall also ensure that all tests prescribed are carried out at specified time and place by the specified person of the PIU.

7.2 2nd Tier Quality Control Mechanism

Independent Engineers

Independent Engineer shall be deployed in each P H Sub Division of PIU for overall quality check on field. These Independent Engineers, whose services to be hired on contract/ empanelment/ outsourcing basis by the Department. They will conduct required tests and submit reports to Quality Monitoring Cell. Other responsibilities include:

- He shall be responsible for reviewing the entire Project implementation activities of the Contractor.
- He shall ensure execution of works on site as per specification and standards and agreement; continuously interact with the Quality Monitoring Cell.
- He shall interact with the personnel's of the contractor to ensure that all the construction related activities are occurring as per the schedule.
- He shall review and prepare reports as per format on inspection of Scheme. Review of emergency response arrangements needs special attention.
- He shall undertake Project site visits and shall guide, supervise, coordinate and monitor the work.

Required Educational Qualification and **Professional Experience/ Expertise** will be as follows:

Educational Qualification	Professional Experience	Specific Expertise and Task
B.Tech / M. Tech in Civil Engineering	Minimum 3 years of Experience for B.Tech and 1 years of Experience for M. Tech as supervision consultant / key personnel in civil engineering project Comprising construction, supervision and quality Assurance works	At least 2 years experiences in a Water supply projects. Shall be proficient in computer based MIS and well versed with testing process of water supply projects.

7.3 3rd Tier Quality Control Mechanism

Principal Quality Monitors

The Principal Quality Monitors, who are the third tier in Quality Control, play a vital role in overseeing the Quality of the Project works.

Inspection by PQMs:

The PQMs shall be given the programme in advance to inspect the works in designated districts of the state in a particular month. The process to be followed is as follows:

- The PQMs will be sent the letter of request in hard form as well as through E-mail with programme of inspection of works. The copy of the same shall also be marked to the concerned PIU.
- The details of schedule of visit will be made available on website as well as in the mail in the last week of the preceding month to enable the PQMs and PIUs to make necessary arrangements.
- The programme of inspection is valid for the inspection of works for the month mentioned in letter of request; therefore, in no case the inspection should spill over to the next month.

It will be the responsibility of the QMC to ensure adequate arrangements for inspection by the PQM, including ensuring the supply of desired information to PQM by PIUs.

The selection of Scheme to be visited by PQMs in a particular district shall be provided by QMC through computerised random sampling basis. Once the project is selected, the PIU shall provide the necessary information in respect of the project and also have to ensure that all the information in regards to the selected scheme is updated in online monitoring portal.

Document to be provided to PQMs by PIU:

- Copy of DPR along with drawings of the work proposed to be inspected.
- Quality Control Registers to enable PQM to enable PQM to understand the details of tests conducted.
- Essential equipments and manpower to be provided to PQM to conduct some hand feel tests and field test under this personal supervision.

- With a view to achieve uniformity, objectivity in observations and evaluation, the method of observations and evaluation has been standardised for all the tiers of Quality Management.

The PQM has to traverse the entire Scheme. While making observations, the PQM must keep in mind that the intention is to improve and strengthen the system to achieve overall project quality. As such, the PQM would also focus on project management by the PIU and make his observations.

Post Inspection Discussion

During inspecting the Schemes, the PQM should hold an informal meeting with the PIU officers and Contractor's representatives / engineers in order to review the findings of the inspection and to suggest improvements in execution to obtain better Quality for all other works under the PIU.

Submission of Inspection Report by PQM and Action by PIU

- a. After the inspections in the District are over and copy of reporting format in hard form will be handed over by the PQM to the PIU and also enter the same in online mode in the monitoring portal so that they can be accessed by Quality Management Cell.
- b. It is open to the PQM to discuss the specific issues arising from the Scheme inspection with the head of the PIU. Unless the PIU disagrees with the conclusion/ recommendations, rectification work should be ordered immediately by the PIU. In case the head of the PIU feels that any portion of the Inspection Report or the suggested rectification is not appropriate he shall make a full report to the Quality Management Cell.

It is to note here that minimum nos. of inspections per day to be carried out by any PQM shall not be less than 2 schemes.

8.0 Budget for Proposed Quality Monitoring System

SL. No.	Position/ Items	Nos.	Amount (In Rs)	Cost for one Year	Total Cost per Year (In Rs)
1	Independent Engineer				
	Honorariums (125Nos@1 per P H Sub Division)	125	125Nos. @ 60000.00 per month	125*60000*12	9,00,00,000.00
	Data management Cost	125	125Nos.@Rs. 500 per month	125*500*12	7,50,000.00
	PQM (21nos.@1 per 2 P H Divisions/PIU)	Assuming 15 days inspection per month per PQM			
2	Honorarium per day @ 3500.00	21	21Nos. for 15days @Rs.3500per day	1102500*12	1,32,30,000.00
	Lodging and Daily Allowance	21	21Nos. for 15days @Rs.3000per day	945000*12	1,13,40,000.00
	Data management Cost	21	21Nos.@Rs. 500 per month	10500*12	1,26,000.00
3	Quality Assurance Specialist	1	1No.@Rs. 80000 per month	80000*12	9,60,000.00
4	MIS Specialist	1	1No.@Rs. 60000 per month	60000*12	7,20,000.00
5	Other Supporting Staff for QMC	10	10 No.@Rs. 10000 per month	100000*12	12,00,000.00
6	Logistic Support for QMC	LS	Rs. 1500000 per month	1500000*12	1,80,00,000.00
Sub Total (Rupee Thirteen Crore Sixty Three Lac and Twenty Six Thousand only)					13,63,26,000.00
<u>FOR SOFTWARE DEVELOPMENT</u>					
6	Development of Software along with maintenance for 5 years (On one time basis)	-	3000000.00	-	3000000.00
Sub Total (Rupee Thirty Lac only)					3000000.00
Total (Rupee Thirteen Crore Ninety Three Lac and Twenty Six Thousand only)					13,93,26,000.00

9.0 Web Based Online Monitoring System

Computerisation of data has the advantage of reliable storage, easy retrieval, immediate processing and complicated calculation ability useful in generating high level abstracted information for use in management. The advantage of a Centralised database is that the range of comparison is not only vertical in terms of the time period but also horizontal in terms of geographic spread across Districts and States. If to this is added the facility of being able to access the data anywhere/anytime through a web-based system, the utility and transparency is multiplied manifold, enabling an extremely high level of project management and monitoring.

The SQMS (State Quality Management System) software shall be designed especially for the entire scheme being executed by the department as an online web-based system with centralised database and the principles underlying the operational management of the software shall be as follows:

- Data entry will be done at the point where data will be generated i.e. at the PIU level for project data and at the IE , PQM and QMC level where their intervention contributes value addition to the data.
- The data entry shall be near real-time to enable outputs to be useful for management as well as monitoring. This implies that the data entry shall be closely parallel the actual work process and to ensure this, system checks will be in place to ensure that the data precedent is on-line before processing for the next step is done.
- Since data entry may involve some extra effort, it must be seen to be sufficiently advantageous. This involves building in the ability to generate MIS outputs closely resembling or better than existing manually generated outputs and dispensing with manually generated outputs and attendant labour.
- The full power of the software is to be brought to bear to generate outputs useful at all levels – monitoring and management output at PIU levels,

progress management and management-by-exception outputs at IE/PQM level and abstracted and analysed information policy and overall management information for use in QMC.

- Transparency will be inbuilt in the system enabling abstracted data to be drilled down to the basic data, generally ‘Habitation’.

9.1 Online Monitoring Responsibilities

Effective monitoring of the Programme being critical, the QMC must ensure that all aspects of the rural water supply programme in the State are systematically monitored and feedback used for correcting deficiencies. The Online Management & Monitoring System to be developed shall be the chief mechanism for monitoring the Programme. Officials managing the various aspects of the programme are required to furnish online all the data in respect of scheme details and transactions carried out by them in the relevant module of the Online Monitoring System.

The SQMS shall consist of the following main modules:

- *Master data Module:* - Master data includes the following
 - Area master which contains data regarding the villages/Habitations and details of facilities available at habitation level (To be entered at PIU level).
 - Scheme master which includes details regarding the name of the scheme, type etc. (To be entered at PIU level).
 - MP/MLA Constituency (To be entered at PIU level).
 - Contractor details (To be entered at PIU level).
- *Execution & Monitoring Module*
 - Entry of progress against each work in physical and financial terms (to be entered at PIU level).
 - Completion of project works (to be entered at PIU level).
- *Maintenance Module:* -Physical and financial data regarding contract-based maintenance (to be entered by PIU level).

- *Quality Monitoring* –Data Regarding QC inspection carried out by IEs & PQMs is to be entered. The monthly schedule of inspection of IE and PQM shall also enter on website.

10.0 Operating the State Quality Management System

The QMC shall hire the services of MIS specialist on contract/ outsource basis having adequate knowledge and experience of Information Technology to function as the Nodal Officer for managing the system. His function will be to oversee the regularity and accuracy of the data being furnished by the PIUs. The Nodal Officer shall also be responsible to oversee the upkeep of the Hardware and Software as well as the training requirements of the personnel dealing with the program. He shall maintain close liaison with the software developers and related parties for ensuring hassle free running of the management system.

The QMC will ensure provision of necessary manpower, space and facilities to set up the Computer Hardware at the District and Head Quarter (HQ) Level apart from ensuring regular and timely feeding of data. Since most of the data would reside on the central server located at HQ, so the Nodal Officer will ensure that the central server is functional all 24 hours of the day.

The main function of the Nodal officers will accordingly include the following:

- Ensuring proper management of the central server, including its functioning, maintenance, data backup, and connectivity.
- Overseeing the proper management of the computer system at PIU level, including their functioning, maintenance, connectivity etc.
- Monitoring the progress of data entry at PIU level and apprising the superior authorities of the QMC of persistent delays/failure to update data.
- Supervising bulk data entry, management of data entry operator deployment etc.

- Monitoring effectiveness of online connectivity status of PIU computers, devising and implementing solutions for better and more secure connectivity.
- Coordination with the QMC for ensuring updating of inspection data on the SQMS.
- Ensuring integration of data and applications with similar or complementary applications.
- Printing out monthly/quarterly MIS outputs and submitting them to the Principal Secretary/ Secretary and Engineer in Chief PHED along with his comments.
- Training needs assessment.

The Executive Engineer (Head of PIU) is pivotal to the successful operation of the SQMS and the QMC shall hold him personally responsible in case of persistent failure to keep the data updated. The Executive Engineer shall be responsible for:

- Ensuring proper management of the PIU computers and peripherals including the software, data backup etc.
- Enforcing an Annual Maintenance Contract (AMC) for the computer system.
- Ensuring internet connectivity.
- Managing the offline software and uploading of data in case of poor internet connectivity.
- Printing monthly quarterly MIS outputs and forwarding them to the Nodal officer along with his comments on the reliability of the data.

System Checks under SQMS

In order to ensure accuracy of information at all times, system checks will be placed in the software and it is necessary therefore that data entry is accurately, systematically and regularly done into the system.

11.0 Inspection, Reporting Output & Analysis (For Tier 2 & 3)

Progress of Work: For monitoring the physical and financial progress of the works at PIU level, the QMC will devise suitable mechanisms. The formats for monitoring of the progress shall be prescribed in such a way that the quarterly and monthly information required at HQ could be easily extracted out.

Implementation of Contracts: Monitoring of work under the contracts shall form an important element of the contract management. Time and quality is the essence of the Contract and therefore, these items shall be monitored by the PIU on a regular basis. The QMC shall devise a suitable mechanism for monitoring of the following aspects of the Contract at QMC level:

- **Time Control:** Suitable formats shall be prescribed. The PIU will be required to furnish phase-wise information regarding delay in execution of works to QMC. To monitor the action taken in respect of works delayed beyond 90 days the PIU will be required to furnish information.
- **Quality Control:** Once the field laboratories are established, it would be responsibility of the contracting agency to maintain Quality Control Register.

11.1 Quality Control Checklist

Sr. No.	Attribute	Available Grade
I	Quality Control Arrangements	S/S-RI/U
II	Material	S/S-RI/U
	Coarse aggregate (for individual structure of RCC works more than 25 M3)	
	Fine aggregate (for individual structure of RCC works more than 25 M3)	
	Diameter and dimension of steel bars/angles/ channels/ plates as per BIS specification	
	HDPE/MDPE/CPVC/CI/DI/GI/MS/UPVC etc. Pipes (Physical verification, Dimensions check and verification of 3 rd party inspection report)	
	Valves/ Specials/ Flow Meter/ Pressure Gauge/ Bib Cock as per specification mentioned in Bid Document.	
III	Installation ,Testing and Commissioning of High Yield Tube wells	S/S-RI/U
	Screen/Slotted, Blank and Housing Pipes (Physical verification, Dimensions check)	
	Pea Gravel size & quantity /quality	
	Drilling Bits sizes and Drilling Rods lengths	
	Drilling of Bore well [Dia. as per drawing IS : 2800 (Part-1)] preparation of Strata Chart / Well logging	
	Installing the casing and well screen as per strata chart	
	Ensure sand-free operation at maximum yield (Quality & Discharge)	
	Availability of Strata Chart	
IV	Installation ,Testing and Commissioning of Pumping Sets	S/S-RI/U
	Pump Sets as per specifications	
	Accessories like panel board, Switch Gear, Starter, Relay & Capacitors of the pump sets are provided as per specification.	
V	Installation ,Testing and Commissioning of Water Treatment Plants	S/S-RI/U
	CSIR Technology/Treatment Technology approved by	

	CSIR or endorsed by GoI- Certificates	
	FRP / MS/ Vessels as per provisions in Bid Document	
	Treatment Media (Check third party inspection report)	
	Control Valves/ SCADA System (As per provisions in the Bid Document)	
	Performance of Treatment Unit	
	Quality of Water in distribution system (As per BIS 10500) and residual chlorine at consumer end	
VI	Civil Works: Staging for Water Storage Structure, Installation of PVC Storage Tank and Construction of Pump House & Toilet.	S/S-RI/U
A	Foundation (As per design and specification)	
B	Concrete Works	
	Concrete Mixer used	
	Vibrator used	
C	Masonry	
	Bricks soaked in water before use	
	Proper jointing of Masonry Works	
D	RCC Works	
	Checking of centering before placing reinforcement	
	Checking of Reinforcement before concreting	
	Pouring of Concrete	
	Collection and testing of concrete cube samples as per BIS	
	Water proofing of roof slabs	
	Curing	
E	Plastering	
	Quality of Plastering	
	Curing	
F	Steel Staging for Water Tanks	S/S-RI/U
	Gusset Plate Fixing to foundation bolt	
	Column Joist/Channel fixing to Gusset Plate	
	Diagonal Angle fixing to Gusset Plate	
	Water tank Platform Beam (Joist/Channel) fixing to column	
	Water tank Platform Sheet fixing to Beam	

	Anti Corrosive painting on staging structure	
G	Rotational Moulded Polyethylene Water Storage Tanks	S/S-RI/U
	BIS marking	
	Cylindrical Vertical Tanks placing on staging is proper	
	Inlet and Outlet pipe of suitable Diameter	
	Outlet and Drain pipe of suitable Diameter	
VII	Laying, Testing and Commissioning of pipes, specials and other related works for Distribution Network	S/S-RI/U
	Layout as per approved construction drawings	
	Trench as per the alignment, depth, minimum cover	
	Identification of leaks, cracks & damages in MDPE Pipe	
	Specials like bends, tees, valves confirming to relevant BIS	
	Proper jointing of pipes	
	Thrust Blocks provided at bends	
	Proper backfilling	
	Air Valves conform to pipe line requirement	
	Non-return valves conform to the pipe line requirements	
	Pressure release valves conform to the pipeline requirements	
	Interconnection with source of supply	
	Pressure adequacy at tail end	
VIII	Providing House Connections	S/S-RI/U
	All households provided connections	
	Quality of Bib Cock at household level	
	Adequacy of pressure at user tap	
	Any unserved household	
	Pollution or scope of pollution in Drinking water	
	House connection and stand post as per specification	
	Identification of leaks, cracks & damages in MDPE Pipe	
IX	Trial –runs of the scheme and water quality testing of 5% of total House Hold Connection	S/S-RI/U
	Test certificate of water quality from authorized laboratories	

11.2 QUALITY FIELD INSPECTION REPORT

Ref No.:

1. GENERAL					
1	Name of scheme	:			
2	Name of Wards	:			
3	Name of Villages	:			
4	Name of GPs	:			
5	Name of Block	:			
6	Name of District	:			
7	Technically sanctioned Estimated Cost in Lacs	:			
8	Agreement value of the work	:			
8	Name of Agencies with Agreement No.				
	Package No.	Name of the agencies	Agreement No.		
	Package/Scheme No 1 :				
	Package/Scheme No 2 :				
	Package/Scheme No 3 :				
9	Detail of Package with Tendered Cost in Lacs, Date of commencement, completion and progress in Percentage.				
	Package No./Scheme	Tendered Cost in Lacs	Date of Commencement	Date of Completion	Progress in Percentage
	Package/Scheme No 1 :				
	Package/Scheme No 2 :				

	Package/ Scheme No 3 :				
10	Name of Circle	:			
11	Name of Division	:			
12	Name of Sub-division	:			
13	Name of S.E	:			
14	Name of E.E	:			
15	Name of S.D.O.	:			
16	Name of J.E	:			
17	Name of Chairman of GPWSC	:			
18	Scheme Inspected by C.E with date/ reference	:			
19	Scheme Inspected by S.E with date/ reference	:			
20	Scheme Inspected by E.E with date/ reference	:			
21	Scheme Inspected by E.E (QMC) with date/ reference	:			
22	Date of field inspection	:			

DETAILED INFORMATION ABOUT VILLAGES :

Sl. No.	Name of ward	No. of Households	Present Population	No. Of house Connections	No. of Stand Posts
1					
2					
3					

11.3 QUALITY CONTROL DOCUMENTS AND TESTING DETAILS

1	Documents available at site	:	
2	Whether the agreement with specification and copy of sanctioned estimate available at site?	:	
3	Whether the Approved drawing available at site?	:	
4	Field laboratory equipments available at site (As per provisions of SBD/Contract Document)	:	
5	Material being tested at site and lab by contractor (As per provisions of SBD/Contract Document)	:	
6	Availability of field equipments (As per provisions of SBD/Contract Document)	:	
7	Items for which certificate obtained as per Quality control report	:	
8	Testing of finished work carried out	:	
9	Penalties imposed on account of Non conformance of work	:	
10	Samples taken for testing during field inspection by consultant	:	
11	Number of tests conducted in the field	:	

11.4 AVAILABILITY OF SITE DOCUMENT

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

11.5 FIELD LABORATORY EQUIPMENT AVAILABLE AT SITE (As per provisions of SBD/Contract Document)

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

11.6 MATERIAL/ WORKS TESTED BY CONTRACTOR (FIELD LABORATORY) (As per provisions of SBD/Contract Document)

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	S.W. pipe				
12	R.C.C. pipes				
13	G.I. ,HDPE, MDPE, CPVC, CI, DI, GI, MS, UPVC				
14	Hydraulic Pressure test of water supply pipelines				

11.7 EQUIPMENTS/ T&P AVAILABLE AT SITE (As per provisions of SBD/Contract Document)

Sl. No.	Equipment	Availability Yes / No/NR	Remarks
1	Mixture Machine with standby arrangement		
2	Vibrator with standby arrangement		
3	Lifting pump for curing		
4	Levelling instrument		
5	Hoisting lift		
6	Jack Hydraulic jointing mechanism for 160mm and above dia (HDPE pipes and fittings)		
7	Butt fusion heater with control box for HDPE pipe up to 140 mm dia.		

11.8 DETAILS OF MANUFACTURER/3rd PARTY INSPECTION CERTIFICATES (As per provisions of SBD/Contract Document)

Sl. No.	Description	Qty. used	MC availability Yes / No/ NR	Acceptability By Department	Remarks
1	Cement				
2	Steel for Reinforcement and structural steel				
3	Pipe such as G.I., HDPE, MDPE, CPVC, CI, DI, GI, MS, UPVC				
4	AC/GI/Fiber glass sheets				
5	Electrical cables/fans and fixtures				
6	Switches/sockets and boards				
7	Flow measuring devices				
8	Control Panel				
9	Lightening arrestor				
10	Water Level indicator and controllers.				
11	Disinfection Units				
12	Pump and Motor				
13	Pipe such as G.I., HDPE, MDPE, CPVC, CI, DI, GI, MS, UPVC				
14	All types of valves such as sluice valve, Air valve etc.				
15	Treatment unit				

11.9 DEPARTMENTAL TEAM INSPECTION AT MANUFACTURING PREMISES (As per provisions of SBD/Contract Document)

Sl. No.	Description	Date of inspection	Name of officers	Acceptability Yes / No/NR	Remarks
1	Pipes such as DI, CI, PVC, MS, SW, HDPE/MDPE, etc.				
2	Pumps, Motors & D.G. Sets				
3	Treatment Unit				

11.10 PENALTIES ON A/C OF 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							

11.11 SAMPLE TAKEN FOR TESTING DURING FIELD VISIT

S.No.	Name of Item	Work where used	Qty. Sealed	Name of Div. where delivered for testing	Remarks
1					
2					
3					
4					

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 QMC/Consultant within 15 days.

11.12: TEST CONDUCTED BY INSPECTION TEAM (As per provisions of SBD/Contract Document)

S.No.	Name of Item	Location	Type of test	Standards % Passing	Remarks
1	Coarse Aggregate (Applicable for Service Reservoir)		Sieve analysis		
2	Fine aggregate (Applicable for Service Reservoir)		Sieve analysis Silt content		
3	Steel IS:1786		Dia. Wt. / M in Kg		
4	UPVC/MD PE/CPVC/ CI/DI/GI/ MS/UPVC pipes		OD Min. Max. Wall Thickness Make		
5	Bricks		Color Length(mm) Width Height Comp. strength		
6	Barbed wire A-1		Gauge (mm) Mass (gm/m)		
7	M.S Pipe		NB Thickness		

			NB Thickness		
8	Screen pipe		NB Thickness		
9	Floor		Thickness		
10	Plaster		Thickness		
11	Door		Thickness		
12	Roof slab		Thickness		
13	M.S Girder		Size		
14	Angle iron Pickets		Size Thickness		
15	LDPE Sheet		Thickness		
16	Cube test M15 M20 M25		Compressive strength Compressive strength Compressive strength		
17	Slump test		Slump in mm		
18	Cement		Grade Date of Manufacture Fineness		

CONSTRUCTION QUALITY
CONTROL/ASSURANCE
MANUAL

12.0 INTRODUCTION

This Manual prepared for the use of Public Health Engineering Department, Government of Bihar is based on Various Quality Assurance practices, PWD specifications, and requirement of the tender document for test of materials, Field /laboratory testing and relevant IS: codes. This is 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, construction items involved for the satisfactory completion of the work. 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.

12.1 Back Ground:

Public Health Engineering Department (PHED) is the nodal department for designing, planning, monitoring of Water Supply Schemes with operation & maintenance of its erection. It has overall responsibility of managing and monitoring of activities to enhance public health through improved water supply facilities and services in rural habitations.

Bihar is the 13th largest and third most populated state with a total population of 10.38 crore with significant proportion of rural population (9.20 crore). It is also one of the most densely populated state with 880 persons per sq km as against the national average of 324 (Census 2011). The state has 38 districts, 532 blocks, 8741 gram panchayats and 107640 habitations. Bihar is blessed with abundant surface and ground water resources and receives average rainfall of 1250 to 1350 mm. The water table during summer varies from as low as 5 m in the north eastern districts to 20 m in the southern districts.

Water Quality situation in Bihar:

Even after being rich in water resources, the drinking water is not safe in all villages and the water quality mapping of the whole state indicates that the rural population is at risk due to its poor water quality in pockets. Out of 38 districts, excess Arsenic contamination is found in some pockets of 13 districts (Begusarai, Bhagalpur, Bhojpur, Buxar, Darbhanga, Katihar, Khagaria, Lakhisarai, Munger, Patna, Samastipur, Saran & Vaishali). Excess fluoride contamination is also reported in few pockets of 11 districts (Aurangabad, Banka, Kaimur, Bhagalpur, Gaya, Jamui, Munger, Nalanda, Nawada, Rohtas & Sheikhpura). Munger & Bhagalpur are having both Arsenic and

Fluoride contamination issue. Iron is again reported in excess than its permissible limit (BIS standard) in 9 districts (Araria, Begusarai, Katihar, Khagaria, Kishanganj, Madhepura, Purnea, Saharsa & Supaul). Existing Drinking Water facilities available in Rural Bihar:

In order to overcome the above problem, the Govt. of Bihar with the support of Ministry of Drinking Water & Sanitation (MDWS), Govt. of India has launched several water supply schemes in rural areas consisting of Hand Pumps (Ordinary & India Mark II/III), Pipe Water Supply Schemes, Solar powered Mini Pipe Water Supply Schemes and Multi village Pipe Water Supply Schemes etc. Water ATMs and Jadoots (water purification units) have also been deployed in affected districts for potable water supply to habitants. In addition, under seven Nischay of Govt. of Bihar, one of the components is “Har Ghar Nal Ke Jaal” Yojna, through which each & every house hold in the water quality affected habitations is going to get potable water supply with one tap connection.

As per the DDWS website of Govt. of India, out of total 110218 habitations existing in Bihar, 83.89 percent meet out their drinking water requirement through hand pumps and meagrely 4.32 percent are getting the facility through piped water supply. This is corroborated by the census of India 2011 data. As per their report, 86.90 percent house-holds in Bihar depend on hand pumps and only 4.4 percent receive pipe water. It is evident that rural Bihar continues to depend on ground water for meeting its thirst. Therefore, quality of drinking water is a determining factor for a healthy and prosperous life of the rural community in Bihar (Ref: Study report entitled “Assessment of Functionality of Rural Drinking Water Supply Schemes in Bihar” submitted by XLRI, Jamsedpur in 2017).

12.2 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 fulfil 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.

12.3 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.

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.

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 fulfil 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/Third party inspection
- Departmental team inspections
- Checklist guide for works
- Site inspections
- Post quality testing of finished works
- Quality certification
- Monthly reporting and review meetings

12.4 Q A/Q C DUTIES

The contractor's QA/QC duties are summarized in **Table: 12.1**. 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.

Table: 12.1 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 the details, date of completion with requisite manufacturer's and calibration certificates of equipments. Maintain the equipments in good condition and calibrate as necessary.
Material receipts & Material 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 Take test samples in presence of officials when requested

	<p>Perform material tests</p> <p>Submit test reports to Department with monthly reports and maintain test logs.</p>
Rejected materials	<p>Tag and record all rejected materials</p> <p>Intimate in writing the proposed date of removal of material from site and confirm after removal</p>
Material Consumption	<p>Enter daily consumption of materials in material register and indicate balance quantity</p>
Construction Equipment	<p>Intimate the department, date of mobilization along with requisite insurance certificate</p> <p>Maintain equipment in good working condition</p> <p>Intimate breakdown of construction equipment.</p>
Construction	<p>Intimate department in writing when construction is going to commence and what activities are proposed to be undertaken.</p> <p>Intimate department in advance when critical works, such as installation of treatment unit, 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 concerned officer.</p> <p>Concreting to take place only after pour card is signed.</p> <p>To provide any other QA/QC requirement.</p>
Daily Work Progress	<p>To maintain daily log.</p>
Testing works in progress	<p>Perform tests as per contract requirements</p> <p>Submit test reports to department.</p> <p>Maintain test log during execution of works</p>
Rejected work items	<p>Rectify defective work and invite for re inspection</p>
Progress scheduling and control	<p>Prepare and maintain project schedules and undertake work in accordance with approved schedule.</p>
Reporting	<p>Prepare and submit Monthly Progress Reports and other reports as per contractual requirements.</p>
Records	<p>Maintain the following records on Site/Contractor's Office/Laboratory</p>

Workmanship	All the work executed against the contract shall be of good workmanship.
Disposal of Debris	All the Debris should be disposed of properly after completion of construction work.

12.5 QUALITY ASSURANCE BY DEPARTMENTAL ENGINEERS 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 levels will ensure the key parameters of quality assurance during inspections as per **Table 12.2**.

Table : 12.2 Quality Assurance By Departmental Engineers During Inspection (As per provisions of SBD/ Contract document)

Sl. No	Key parameters of Quality Assurance	SE	EE	AE/JE
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	TEST REPORTS AS PER PROVISIONS OF BID DOCUMENT			
2.1	Cement	-	✓	✓
2.2	Fine aggregate	-	✓	✓
2.3	Coarse aggregate	-	✓	✓
2.4	Concrete (Slump, Cube test)	-	✓	✓
2.5	Steel bars	-	✓	✓

2.6	Bricks	-	-	✓
2.7	Timber	-	-	✓
2.8	Hydro testing of pipeline	-	✓	✓
2.9	Water for construction	-	-	✓
3	AVAILABILITY OF FIELD AND LAB EQUIPMENTS	✓	✓	✓
4	MANUFACTURING / THIRD PARTY INSPECTION CERTIFICATES			
4.1	Cement	-	✓	✓
4.2	Steel for Reinforcement and structural steel	-	✓	✓
4.3	GI Pipe / GI Fittings/ PVC /MS /SW /RCC Pipes/CI/DI/UPVC/HDPE/MDPE	✓	✓	✓
4.4	AC/GI/Fiber glass sheets	-	-	✓
4.5	Flow measuring devices	-	✓	✓
4.6	Pump, motor & DG set	-	✓	✓
4.7	Chlorinator / Disinfection Unit	✓	✓	✓
4.8	Treatment Unit	✓	✓	✓
4.9	Any other item as per agreement	-	-	✓
5	DEPARTMENTAL TEAM INSPECTION			
5.1	DI, CI,PVC, MS,SW,HDPE/MDPE/UPVC PIPES etc.	✓	✓	-
5.2	Pumps , Motors & D.G. Sets	✓	✓	-
5.3	Water treatment unit	✓	✓	-
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 Tube well	-	✓	✓
6.4	Disinfecting plant		✓	✓
6.5	Pump chamber	-	✓	✓

6.6	Development of water works	-	✓	✓
6.7	O.H.S.R / U.G.S.R	✓	✓	✓
6.8	Water 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	✓	✓	✓

13.0 CONSTRUCTION QUALITY CONTROL

This section provides an overview of construction quality control activities, including testing and site inspection.

13.1 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: Shall cover the types of tests to be carried out, frequency of testing and stage of testing.
- Inspections: covers the timing of inspections, what to be inspected and the inspection procedures.

CQC should be affected at four stages:

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

13.2 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 13.1**. It should be made mandatory as per provision in the technical/contract bid.

Table: 13.1 List of Equipment Required For Testing

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

Laboratory equipment shall be properly calibrated, and certificates and its updating as and when required should be kept at the laboratory for review by Department as necessary. Specialized tests at outside laboratories shall only be undertaken with the prior approval of the Department.

Zonal laboratories one in each zone shall also be established for quality testing of materials used by the contractor. The tests to be conducted in the Zonal laboratory are given in **Table 13.2**.

Table: 13.2 Tests to be conducted in the Field Laboratory

Sl. No.	Material	Test to be conducted	Equipment
1	Cement	Consistency Soundness Setting time	Vicat apparatus Le Chatelier apparatus Vicat apparatus
2	Aggregate	Bulk density Flakiness/ Elongation Crushing value	Bulk density apparatus Thickness and length Gauge. Crushing value apparatus
3	Concrete (fresh)	Cube test	Compression testing machine
	Post concrete	Compressive strength of post concrete	Rebound hammer
4	Bricks	Compressive strength	Compression testing machine
5	Pipes	Hydraulic testing of Pipes	Hydraulic pump

13.3 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.

13.3.1 Everyday Supervision

Everyday site supervision of all construction activities shall be carried out by the Departmental officers. This includes checking of lines, layouts and levels and other relevant checks. Daily Progress monitoring shall also be carried out by the Supervising Team. The Supervising team 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 is point of concern in quality assurance system. The equipment requirements have been laid out in the Contract documents

Department involvement in the procurement of material 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.

13.3.2 Periodical Inspection for Quality

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 13.3;**

Table: 13.3 List Of Critical Activities Component Wise

Sl. No.	Component	Critical Activities
1	Pipe line	<input type="checkbox"/> Excavation <input type="checkbox"/> Completion of excavation Trenches for Pipe laying <input type="checkbox"/> Laying and jointing of pipes in correct alignment. <input type="checkbox"/> Pressure/leakage Testing of pipeline <input type="checkbox"/> Backfilling in layers and watering
2	OHSR/UGSR	<input type="checkbox"/> Centering and shuttering for R.C.C. works <input type="checkbox"/> Placing of reinforcing steel <input type="checkbox"/> Concrete mixing, vibrating and pouring <input type="checkbox"/> Testing for water tightness <input type="checkbox"/> Curing
3	Electro Mechanical	<input type="checkbox"/> Installation of electrical and mechanical equipments such as Pump & Machinery and Disinfecting units etc. <input type="checkbox"/> Testing, trial runs and commissioning of electro-mechanical equipment and plants
4	Tube Well	<input type="checkbox"/> Drilling <input type="checkbox"/> Lowering of Assembly <input type="checkbox"/> Verticality Test
5	Pump Chamber	<input type="checkbox"/> Mortar proportion in Brick masonry <input type="checkbox"/> Centering and shuttering for R.C.C. works <input type="checkbox"/> Placing of reinforcing steel <input type="checkbox"/> Concrete mixing, vibrating and pouring <input type="checkbox"/> Curing

The Supervising team 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 supervising team 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 scheme shall inspect and certify the quality of the works completed before granting approval for the next stage of the works to start.

13.4 QUALITY CERTIFICATION

The Department shall be 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 A(Form A/CL-15)**.

14.0 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.

14.1 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 to be used at site, such as cement, sand, water, aggregate, gravel, pipe & fittings
- Manufacturer's certificates and IS mark for manufactured items

14.2 MANDATORY TESTS TO BE PERFORMED

For mandatory tests the list of materials to be performed is given in **Table 14.1**. Types of test are presented in **Table 14.2** to **14.5** under the referenced procedure number. Test report formats are included in **Appendix**. To be performed in accordance to SBD/Contract Document

Table: 14.1 List of materials tested

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	Pipes and Pipe line works	QC-M -05

Table: 14.2 Type of Test for Cement (QC-M-01)

Sl. No.	Type of Test	Frequency of Test	Timing of Test/ Inspection
1	Fineness	One for each source of 10 T (Tonne) or part thereof and when called for by the Engineer. Sampling should	On receipt of material at site and before using as directed by the Engineer. Test
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	comply with IS :3535 – 1986	certificate to be produced to the Engineer before use.
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Table: 14.3 Type of Test for Sand (QC-M-02)

Sl. No.	Type of Test	Frequency of Test	Timing of Test
1	Particle Size and shape IS :2386-Part-(I)-1963	One test for 20 m3 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 m3	
3	Bulking test	One test per 20 m3 or part thereof	
4	Silt content IS 2386: Part(II)-1963	One test for 20 m3	

Table: 14.4 Type of Test for Bricks and Brick Tiles (QC-M-03)

Sl. No.	Type of Test	Frequency of Test	Timing of Test/ Inspection
1	Compressive strength	One test for each source.	On receipt at site
2	Physical properties		
3	Water absorption test		
4	Efflorescence		

Table: 14.5 Type of Test for Coarse Aggregate for Concrete (QC-M-04)

Sl. No.	Type of Test	Frequency of Test	Timing of Test/ Inspection
1	Particle size distribution IS 2386(I)-1963	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		

QC-M-05 Test for Pipes and Pipe Line works

Test shall include dimensional test for various types of pipe, fittings and pipe line as per design and drawing and site conditions.

14.3 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 and on visual inspection. These items shall bear the IS mark. Department 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 supervising team shall inspect the condition of these items. Team 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 14.6** which are meant for references only to be used while listing the manufacturer's certificates.

Table: 14.6 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 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
17	Treatment Unit	MC-17

14.4 MATERIAL AND EQUIPMENTS INSPECTED BY DEPARTMENTAL TEAM AT THE FACTORY

Materials and equipment to be inspected by Departmental Team (DT) vary from package to package, as stipulated in the contract documents. DT inspection would normally take place at the factory during or upon completion of manufacture. Upon delivery and before installation or incorporation in the works, DT 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 14.7** for a list of materials and equipment suggested for inspection by DT inspections.

Table: 14.7 Material and Equipments Inspected by Departmental Team at The Factory

Sl. No	Description
1	Pipes such as DI, CI,PVC, MS,SW,HDPE/MDPE/UPVC
2	Pumps , Motors & D.G. Sets
3	Treatment Unit

15.0 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.

15.1 CEMENT CONCRETE & MORTAR

15.1.1 Proportions of Cement Concrete

As per IS 456: 2000 Nominal mix concrete may be used for concrete of M 20 or lower. The proportions of materials for nominal mix concrete shall be in accordance with provision of BIS as given in **Table 15.1**;

Table: 15.1 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 litre.
1	2	3	4
M5	800	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 15.2**

Table: 15.2 Strength of Concrete of Different Proportions

Grade of concrete	Characteristic compressive strength In Kg/cm ²	
	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

15.1.2 Proportions of Cement Mortar

IS 2250: 1981 provides different grade of mortar for use in masonry work as given in **Table 15.3**

Table: 15.3 Grades of Masonry Mortar

Grade	Compressive strength at 28 days in N/mm ²	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
M - 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.

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: 15.4 Type of Test for Concreting

Concreting				QC-P-02
Sl. 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-05 Clause 10.4 (72-73)	One test for 1-5 m3 of concrete. Two tests for 6-15 m3 of concrete. Three tests for 16-30 m3 of concrete. Four tests for 31-50 m3 of concrete +one set every 50 m3 of additional concrete work.	Test samples to be taken while pouring. Tests to be done as specified in the contract.
2	Slump test per IS :1199-1959	A/TR-6 Clause 10.4 (72)	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: 15.5 Type of Test for Cement Sand Mortar

Table: 15.6 Type of Test for Liquid Retaining Structures

15.2 Water Works Structures

The water works structures required for further utilization of tube well water is as per specification of SBD/Contract Document

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 m3 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----- -----

15.3 CONVENTIONAL UNITS OF CANAL AND SURFACE SOURCE AS PER REQUIREMENT OF THE PROJECT BASED WATER SUPPLY SCHEMES

The various units of canal based water supply scheme with their purpose is tabulated in **Table 15.7** below;

Table: 15 .7 Units Of Water Supply Scheme

Sl. No.	Description	Purpose
1	In Take works	For with drawl of water from surface source and to ensure entrance velocity of 0.60-0.90cm/sec.
2	Inlet channel	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.
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 over flow 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	OHSR	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.

15.4 TESTING OF MATERIALS

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

16.0 CONTROL OF PIPELINE WORKS

This section of the QA/QC Manual covers the testing and inspection of workmanship for pipeline works (i.e. Water). An inspection checklist for pipeline works is included in **Appendix A**.

16.1 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.

16.2 EXCAVATION AND BACKFILLING

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

16.2.1 Laying and jointing of UPVC 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. The PVC pipes having one end socketed the care should be taken that direction of socket end should preferably be against the flow of water, the laying of PVC pipeline should be straight and in correct alignment and laid on levelled bed. While jointing PVC Pipes and specials it should be ensured that the surface of end of PVC pipe and inner side of socket where solvent solution is to be applied remain clean and dust free. After applying solvent solution on the surface of UPVC pipes it should not be jointed immediately but should be kept open for a while then it should be inserted into socket or coupler by keeping wooden log on the other end of pipe and hammering it until the pipe is inserted into full depth of socket/coupler. 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 PVC cap to prevent entry of rain water, soil, rats and any other foreign matter into the pipe. The cutting of the PVC pipe shall be cleanly cut and reasonably square to the axis of the pipe or may be chamfered.

Jointing must be carried out in minimum possible time, time of making complete joint being not more than one minute. Joints should not be disturbed for at least 5 minutes. Half strength is attained in 30 minutes and full in 24 hours. Gluing should be avoided in rainy or foggy weather.

16.2.2 Laying & jointing of HDPE pipes and specials

A pipeline is only as strong as its weakest connection. When it comes to joining HDPE pipe, there are several common methods that are used, each with its advantages and disadvantages. There are different methods: butt welding, electro fusion &, flanging – focusing predominantly on the ease and speed of installation, the need for specialised equipment and experienced personnel, and the strength and reliability of the joint.

Butt Welding

Butt welding (or butt fusion) jointing is a thermo fusion process which involves the simultaneous heating of the ends of two components which are to be joined until a melt state is attained on each contact surface, thereby producing a permanent, economical and flow-efficient connection.

The two surfaces are then brought together under controlled pressure for a specific cooling time and homogeneous fusion is formed upon cooling. The resultant joint is resistant to end thrust and has comparable performance under pressure to the pipe.

This method of jointing requires an electrically heated plate to raise the temperature of the pipe ends to the required fusion temperature and is used for PE63, PE80 and PE100 grades of material for pipe of size 32mm and above of the same Standard Dimension Ratio (SDR). When joining pipes using butt welding techniques.

The important steps involved in making a butt welded joint are:

Pre-welding procedure

1. Create an environment conducive to repeatability and reproducibility, thus a clean tidy and stable environment at the point of fusion
2. Ensure the use of clean and appropriate equipment
3. Only use trained personnel
4. Draw up preliminary welding procedures
5. Weld according to preliminary welding procedures
6. Perform a visual inspection on the welded section
7. Perform mechanical tests on welded sections
8. Make process changes until all aspects achieve a pass status
9. Continue with the welding processes and make sure to record all important parameters
10. Make use of check sheets to ensure accurate tracking of all important steps and parameters

Welding Process

1. Place the pipes in clamps with ends against the trimming tool and pipe markings aligned
2. Align and level components using support rollers
3. Tighten the pipe clamps to grip and re-round the pipes
4. Use the trimming tool to ensure continuous shavings are cut from each surface
5. Check that there is no visible gap between the trimmed faces
6. Place the heater plate in the machine and close the clamps so that the surfaces to be joined are touching the plate
7. Using the hydraulic system, apply the pressure previously determined
8. Maintain the applied pressure until the pipe begins to melt and uniform bead of 2-3mm is formed on each end
9. Check that the pipe does not slip in the clamps. The pipe ends must maintain contact with the heater plates
10. Once the heat soak time is completed, remove the heater plate, ensuring that the plate does not touch the melted surfaces
11. Immediately close the clamps and bring the melted surfaces together at the previously determined pressure
12. Hold under pressure for the appropriate cooling time

Electro fusion

Another technique using heat fusion joining technology is electro fusion. Electro fusion welding systems are considered the most highly developed cost-effective and safe method for joining polyethylene pipes today.

This jointing process uses heat generated from electricity to melt both the pipe wall and the pipe surface, creating a completely homogenous joint that is stronger than the pipe itself. Thanks to its versatility, electro fusion can be used to weld together pipes or fittings from different PE materials and different thicknesses as long as there is compatibility of melt flow index and raw material density.

Another key advantage of electro fusion is that it is particularly suited to installations where access is difficult, such as in trenches or around other pipes.

A typical electro fusion weld is carried out by a trained welder and includes the following steps:

Pre-welding procedure

1. Create an environment conducive to repeatability and reproducibility, thus a clean tidy and stable environment at the point of fusion
2. Ensure the use of clean and appropriate equipment
3. Only use trained personnel
4. Draw up preliminary welding procedures
5. Weld according to preliminary welding procedures
6. Perform a visual inspection on the welded section
7. Perform mechanical tests on welded sections
8. Make process changes until all aspects achieve a pass status
9. Continue with the welding processes and make sure to record all important parameters
10. Make use of check sheets to ensure accurate tracking of all important steps and parameters

Welding Process

1. Check that pipe is cut at 90° to the pipe axis
2. Mark the fusion zone on the pipe and scrape to remove oxide layer
3. Clean the scraped area of the pipe, and fittings (avoid touching the fusion zone)
4. Mark the insertion depth (half the length of the fitting) on both pipe ends to be joined, clamping the components in place if required
5. Insert the pipe ends into the Electro fusion fitting. For larger diameters, assembly can be assisted by tapping around the face with a plastic hammer
6. Start the fusion process, using a preheating phase if applicable
7. Wait the appropriate cooling time and quality check the fusion
8. Mark the fusion parameters on the pipe

Flanged Connections

Flanged joints are normally used to connect PE pressure pipelines to valves, pumping stations and pipelines of other pipe materials. The joint must be able to transfer long-term axial forces with maintained tightness, which requires use of suitable components and a correct assembly .

The components in a flanged joint for HDPE pipes are:

- Stub-ends or flanged adaptors
- Back-up flanges
- Gaskets (pressure and chemical appropriate)
- Bolts
- Washers

The general procedure for making flanged connections is:

1. Flanges and gasket should be centred, supporting one or both halves of the joint if necessary

2. The end surfaces of the stub-ends must be close to each other before the bolts are tightened to avoid elongation of the pipe during joint assembly
3. Bolts are tightened crosswise in at least six stages, starting with finger tightening, and consequently using a torque wrench
4. Additional tightening to the recommended torque should be carried out several hours later and also on the next day

As a rule of thumb, the sealing pressure should be at least twice the maximum internal pressure in the pipe.

16.2.3 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.

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.

16.2.4 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 CI/DI/MS pipe is a option for road crossings to mitigate the heavy vehicular traffic.

16.2.5 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 lay, together with sketch plans showing other services encountered and dimensions to locate the position of the pipe from time to time.

16.2.6 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.

16.2.7 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.

17.0 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, pumping systems, dry run sensor for submersible pumps, auto run sensor for solar pumps, power supply and distribution systems. The requirements for testing and control of input materials and components, including manufacturers' certification, and departmental party inspections.

Materials and components to be incorporated into electromechanical works shall be inspected by Department 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 Department shall be notified immediately. Installation shall proceed only after the materials and components are approved by Department

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 Department as follows:

17.1 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.

17.2 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 Department at critical points during installation. The critical points are indicated below in **Table 17.1;**

Table: 17.1-Critical Points for Inspection

Sl. No	Critical Points	Items
1.	Installation of Mechanical Equipments	Lowering of Submersible Pump to proper depth

		<p>Size of the Cables</p> <p>ISI marking as per the contract</p> <p>Efficiency of the Pump Set</p>
2	Installation of the Electrical Equipments	<p>Proper Capacitor to improve the power factor</p> <p>Double Earthing</p> <p>Power Connections are not loose</p>
3	Disinfection Unit	<p>Unit of specified quantity</p> <p>Unit connected and working properly</p>

Surveillance shall be provided by Department 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 Department

17.3 INSTALLATION VERIFICATION INSPECTIONS: Prior to all mechanical and electrical testing, verification inspection shall be performed to ensure that equipment has been satisfactorily installed.

17.4 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.

17.5 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.

17.6 COMMISSIONING TESTS: These consist of a tests performed under service operating procedures to demonstrate compatibility of the physical plant with operating procedures.

17.7 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.

17.8 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.

- (i) Model, size and serial number of the pump;
- (ii) Rated speed, total head and discharge at the guaranteed duty point;
- (iii) Range of Head;
- (iv) Motor range (kW) Prime mover rating;
- (v) Rated voltage
- (vi) Rated frequency;
- (vii) Number of phases;
- (viii) Winding connection;
- (ix) Maximum current in amperes;
- (x) Class of insulation of motor;
- (xi) Manufacture's name / trade mark;
- (xii) Power input in kW;

- (xiii) Classification;

- (xiv) Number of stages in case of multistage; and

- (xv) Self priming time at 1.5 m or 3 m static suction lift.

17.9 PUMP TEST RECORD

The Pump test record shall be maintained.

18.0 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;

18.1 CEMENT

18.1.1 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 Standards.

- 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 sub lots depending upon its total weight. Quantity of cement taken by a single operation is called increment. Aggregates of all these increments from the same sub lot is called gross sample. When these gross samples of each sub lot are reduced by suitable procedures for laboratory testing, they are called laboratory samples. Equal quantities of cement from each laboratory sample representing sub lots, 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 sub lot 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.

18.1.2 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.

1. Consistency
2. Fineness
3. Soundness
4. Initial and Final Setting Time of Cement
5. Compressive strength

18.1.3 Test for Fineness

To determine the fineness of cement by dry sieving as per IS: 4031 (Part 1) – 1996. The principle of this is that we determine the proportion of cement whose grain size is larger than specified mesh size.

The apparatus used are 90µm IS Sieve, Balance capable of weighing 10g to the nearest 10mg, a nylon or pure bristle brush, preferably with 25 to 40mm, bristle, for cleaning the sieve.

PROCEDURE TO DETERMINE FINENESS OF CEMENT

- a) Weigh approximately 10g of cement to the nearest 0.01g and place it on the sieve.
- b) Agitate the sieve by swirling, planetary and linear movements, until no more fine material passes through it.

- c) Weigh the residue and express its mass as a percentage R1, of the quantity first placed on the sieve to the nearest 0.1 percent.
- d) Gently brush all the fine material off the base of the sieve.
- e) Repeat the whole procedure using a fresh 10g sample to obtain R2. Then calculate R as the mean of R1 and R2 as a percentage, expressed to the nearest 0.1 percent. When the results differ by more than 1 percent absolute, carry out a third sieving and calculate the mean of the three values.

Reporting of Results

Report the value of R, to the nearest 0.1 percent, as the residue on the 90 μ m sieve.

18.1.4 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 $12,000 \pm 400$ 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 $27^0\text{C} \pm 2^0\text{C}$ 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/sqm (kg/sqm)/Mpa. The reporting is to be made accordingly

STANDARD

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

Test	Frequency	Ref Codes	Acceptance/Standard
1. Chemical Tests 1. Loss on ignition, percent by mass 2. Magnesia (Mgo), percent by mass 3. Sulphuric anhydride (So3) Percent by mass 4. Insoluble material, percent by mass	Once for every source approval Once for every lot Once for every 3 months	As per IS: 4032-1985	1. 5.0 % max 2. 6.0 max 3. 3.0 % max 4. $x + 4.0(100 - x)/100$ 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%

- 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:
 - (a) Name of the quarry pit, river bed etc. and address.
 - (b) Proposed use of material.
 - (c) Geographic location and shipping facilities.

18.2.2 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.

18.2.3 Sieve Analysis & Fineness Modulus

METHOD

6nos. 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 degrees 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 to be reported on Format.

STANDARDS

Test	Frequency	Ref Codes	Acceptance/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-1 (High Strength Conc.)	Zone-II (Stand. Conc.)	Plaster IS:1542	Masonry IS:2116
			10mm	100	100	100	
			4.75 mm	90-100	90-100	95-100	100
			2.36mm	60-95	75-100	95-100	90-100
			1.18mm	30-70	55-90	90-100	70-100
			600μ	15-34	35-59	80-100	40-100
			300μ	5-20	5-20	20-65	5-70
			150μ	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.

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

18.2.4 Sieve Analysis & Fineness Modulus Test (Stone)

METHOD

The stone ballast for use in all types of cement concrete 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

STANDARDS

Test	Frequency	Ref Codes	Acceptance/Standard		
			Grading	IS Sieve Designation	Percentage passing (by weight)
1. Particle Size (a) Sieve Analysis	Once for every source approval Once in a week	IS: 383-1970 IS: 2386 (Part I) – 1963	20 mm	40 mm	100
			Nominal size		
				20mm	85-100
				10mm	0-20
				4.75mm	0-5
			12.5 mm	16mm	100
			Nominal size		
				12.5mm	85-100
				10mm	0-45
				4.75mm	0-10
100mm nominal	12.5mm	100			

				10mm	85-100
				4.75mm	0-20
				2.36	0-5

(b)Flakiness Index and Elongation Index		IS: 2386(I) – 1963	35% Maximum value of combined Elongation and Flakiness Index														
2. Deleterious Materials (crushed aggregate)	Once for every source approval At every	IS: 383-1970 IS:2386(II) – 1963	<table border="1"> <thead> <tr> <th>Deleterious Material</th> <th>Percentage by weight (Maximum)</th> </tr> </thead> <tbody> <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 than 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> </tbody> </table>	Deleterious Material	Percentage by weight (Maximum)	(i) Coal and Lignite	1	(ii) Clay and Lumps	1	(iii) Material finer than 75 micron IS Sieve	3	(iv) Soft Fragment	--	(v) Shale	--	Total % of all.	5
Deleterious Material	Percentage by weight (Maximum)																
(i) Coal and Lignite	1																
(ii) Clay and Lumps	1																
(iii) Material finer than 75 micron IS Sieve	3																
(iv) Soft Fragment	--																
(v) Shale	--																
Total % of all.	5																
	change of source																
3. Specific Gravity and	Once for every source	IS: 383-1970	Test is required for maintaining uniformity of material brought from the source														

Density

Approval IS: 2386

Once in a (Part III) –

Fortnight 1963

4. Mechanical properties

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

7. Alkali Reactivity	Once for every	IS: 383-	Innocuous Aggregate
	source	1970	
	approval	IS: 2386	
		(Part VII) –	
		1963	

18.3 BRICKS

18.3.1 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 is 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.

18.3.2 Test for Bricks: IS: 1077-1992

Following test are required for bricks;

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

18.3.3 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 Classes 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.

18.3.4 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 Bricks (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 mm for 90 mm high ± 40 for 40 mm high	

18.3.5 Water Absorption

METHOD:

5 whole dry bricks shall be selected at random from the sample obtained. The test specimen shall be weighed 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.

$$\frac{B - A}{A} \times 100$$

Absorption percentage by weight =

A: Weight of dry specimen

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

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

18.3.6 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 distil 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 30°C) 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:

Sl. No	Standard	Definition	Ref. code
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 or 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 or 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.	

18.3.7 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.

The bricks shall be immersed in water at 25 to 29 °C 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.

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/cm² or 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.

Class Designation	Average compressive strength not less than		Ref. IS codes
	N / mm ²	Kg / cm ²	
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

18.4 CONCRETE

18.4.1 SAMPLING PROCEDURES AND SAMPLE COLLECTIONS

From mixer: At least three approximately equal sample increments totalling 0.02m³ (20 liters) shall be taken from a batch during its discharge. Each sample increments are 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:

- a) slump test,
- b) Preparation of cube for strength test.

18.4.2 Test of Cement Concrete

18.4.2.1 Slump Test:

METHOD

This test is carried out in the field during the course of concreting. The slump test apparatus as per IS: 7320- 1974 is 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 tamped 25 times by the 16 mm dia bullet pointed 60 cm length iron pinning rod. The stroke is 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 rising vertically and the moulded concrete is allowed to subside. The subsidence height of the specimen is measured in mm and recorded in terms of slump.

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; Strip 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

18.4.2.2 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 tamped 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 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.

STANDARDS OF CHARACTERISTIC STRENGTH

Group	Grade Designation	Compressive strength on 15 cm cubes for work test In N/mm ²	
		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		25
	M 30	17.0	30
	M 35	20.0	35
	M 40	23.5	40
	M 50	27.0	50
High strength Concrete	M 55		55
	M 60		60
	M 65		65
	M 70		70
	M 75		75
	M 80		80

18.5 STEEL

18.5.1 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.

18.5.2 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

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

Test	Frequency	Ref Codes	Acceptance/Standard							
1.Chemical Compositions	Once for every source approval Once in a project for each source	IS:2062-2006	Grade	Designation	C	mn	S	P	Si	Carbon equal value max.
			A	Fe410WA	0.23	1.5	0.05	0.05	0.04	0.42
			B	Fe410WB	0.22	1.5	0.046	0.045	0.04	0.41
			C	Fe410WC	0.20	1.5	0.04	0.04	0.04	0.39
Nitrogen Content 0.02 % Nb, V and Ti content (all or any) 0.2 %										

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

18.6 PIPES

18.6.1 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 table 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, 3and 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 r^{th} pipe so counted shall be withdrawn so as to constitute the required sample size.

18.6.2 Test of U P V C 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)		Smooth, clean, both end square cut $L_s = 0.5d_n + 6\text{mm}$ $L_s = \text{minimum socket length}$ $d_n = \text{nominal outside dia of pipe}$
Wall Thickness .Average (Min/Max) Visual appearance		
Dimensions of sockets		

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 27oC for one hour	IS : 12235 (8)-2004	Pipe shall not fail during the prescribed test duration. TIR not more than 10 %
Resistant to external blows at 0oC	IS : 12235 (9)-2004	
Vicat softening temperature	IS : 6307-1985	VST of specimen shall not be less than 800 C
Density	IS : 13360 (3) –sec-I – 1995	Density of pipe shall be between 1.40 and 1.46 gm /cc

Sulphated ash content		11.0 % (Max.)
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18.6.3 Test of Glazed Stone Ware Pipes IS: 651-2007

METHOD AND STANDARDS

The dimension test of pipe should be conducted in the field after the sampling is done by EIC. Hydraulic and other tests should be got done in the approved laboratory before use. The material should conform to relevant specifications.

Standards

Field test	Ref. codes	Standards																				
1. Dimension	As per IS: 651-2007	+4%. -1.5%																				
Length																						
Internal diameter	IS: 651-2007	As per IS: 651-2007 Table 1																				
Mean thickness																						
Internal depth of socket																						
Excess shoulder measurement																						
Length of grooving																						
2 Hydraulic test	IS: 651-2007	Should sustain minimum 0.15 Mpa (1.50 kg/cm ²) for 5 seconds																				
3 Alkali test		No evidence of pitting, softening, spalling or cracking should be observed																				
4 Other test																						
(a) Crushing strength		<table border="1"> <thead> <tr> <th>Internal dia in mm</th> <th>SP-1 KN/m</th> <th>SP-2 KN/m</th> <th>SP-3 KN/m</th> </tr> </thead> <tbody> <tr> <td>Upto 150</td> <td>16</td> <td>18</td> <td>21</td> </tr> <tr> <td>200-300</td> <td>16</td> <td>21</td> <td>24</td> </tr> <tr> <td>350-450</td> <td>16</td> <td>26</td> <td>32</td> </tr> <tr> <td>500-800</td> <td>16</td> <td>32</td> <td>60</td> </tr> </tbody> </table>	Internal dia in mm	SP-1 KN/m	SP-2 KN/m	SP-3 KN/m	Upto 150	16	18	21	200-300	16	21	24	350-450	16	26	32	500-800	16	32	60
Internal dia in mm	SP-1 KN/m	SP-2 KN/m	SP-3 KN/m																			
Upto 150	16	18	21																			
200-300	16	21	24																			
350-450	16	26	32																			
500-800	16	32	60																			
(ii) Absorption		<table border="1"> <thead> <tr> <th>Thickness in mm</th> <th>Increase in mass</th> </tr> </thead> <tbody> <tr> <td>Up to 20</td> <td>6%</td> </tr> <tr> <td>Over 20 up to 25</td> <td>7%</td> </tr> <tr> <td>Over 20 up to 32</td> <td>8%</td> </tr> <tr> <td>Over 20 up to 38</td> <td>9%</td> </tr> <tr> <td>Over 38</td> <td>10%</td> </tr> </tbody> </table>	Thickness in mm	Increase in mass	Up to 20	6%	Over 20 up to 25	7%	Over 20 up to 32	8%	Over 20 up to 38	9%	Over 38	10%								
Thickness in mm	Increase in mass																					
Up to 20	6%																					
Over 20 up to 25	7%																					
Over 20 up to 32	8%																					
Over 20 up to 38	9%																					
Over 38	10%																					
(iii) Acid resistant test		Loss in mass 2.5 % maximum																				

18.6.4 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 Internal Dia. Of pipe or socket	At the start of work for source approval Once for every Lot for each size	IS: 458-2003 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 Up to and including 300 mm \pm 3mm Over 300 mm and up to and including 600 mm \pm 5mm Over 600 mm \pm 10 mm
Overall Length		IS: 458-2003	\pm 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 3mm for every m length
6. Reinforcement		IS: 458-2003	On breaking the Pipe and extracting the reinforcement, it shall be as per the Provision

18.6.5 Test of HDPE Pipes

METHOD AND STANDARDS

The pipe shall conform to IS: 4984-2016

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 ⁰ C and shall not differ from the nominal value by more than 3kg/ m ³ 0.41 to 1.10 at 190 ⁰ C with nominal load of 5kg and shall be within 20% of the value declared by the manufacturer. 2.5+ 0.5% with uniform dispersion.

18.6.6 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 Codes	
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

18.7 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 or steel. Potable water is generally considered satisfactory for mixing concrete.

18.7.1 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.

18.7.2 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.

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	Once for every source approval Every Quarterly	IS: 3025 (Part 23) - 1987	a) 2000 mg/ l max.
(b) Organic Matter		IS: 3025 (Part 17)	b) 200 mg/ l max.
(c) Inorganic Matter		IS: 3025 (Part 18) IS: 3025 (Part 19) - 1987	c) 3000mg/l max.

18.8 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	H D -20	1988	20	Circular, Square, Rectangular
Extra 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.

18.9 PLASTIC ENCAPSULATED FOOTRES

Orange colour safety footrest of minimum 6 mm thick plastic encapsulated as per IS : 10910-1984 on 12 mm dia. steel bar conforming to IS : 1786-2008 having minimum cross section as 23 mm x 25 mm and overall minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistant test as per specifications and having manufacturer's permanent identification mark to be visible even after fixing. The step shall be tested at a load of 225 Kg. as per IS : 5455 -1969.

18.10 LDPE SHEET

LDPE plastic film shall be made of genuine virgin raw material (polymer) having a density between 0.913 to 0.923 gm/cm³ at 27⁰ C. The film shall have IS certification regarding its quality as per IS: 2508 – 1984. The film shall be of the specified thickness and shall be supplied in the form of flat sheet. The length of the single roll shall not be less than 30 M.

18.11 TEST FOR TUBE WELL

18.11.1 WATER SAMPLING

Physical, chemical and bacteriological analyses are necessary for drinking water. All samples of water should be properly labelled 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.

18.11.2 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.

18.11.3 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/cm^2 pressure for 15 minutes or by dry heat at 160°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 wrapping 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.

Recommended Guidelines for Physical and Chemical Parameters as Per Water Manual (Govt. of India) As Per BIS

Sl. No.	Characteristics	*Acceptable	**Cause for rejection
1	Turbidity (NTU)	1	10
2	Colour (Units on Platinum Cobalt scale)	5	25
3	Taste and Odour	Unobjectionable	Unobjectionable
4	pH	7.0 to 8.5	<6.5 or> 9.2
5	Total dissolve solids (mg/l)	500	2000
6	Total hardness (as CaCO ₃) (mg/l)	200	600
7	Chlorides (as Cl) (mg/l)	200	1000
8	Sulphates (as SO ₄) (mg/l)	200	400
9	Fluorides (as F) (mg/l)	1.0	1.5
10	Nitrates (as NO ₃) (mg/l)	45	45
11	Calcium (as Ca) (mg/l)	75	200
12	Magnesium (as Mg) (mg/l)	≤30	150
13	Iron (as Fe) (mg/l)	1.0	1.0
14	Manganese (as Mn) (mg/l)	0.05	0.5
15	Copper (as Cu) (mg/l)	0.05	1.5
16	Aluminium (as Al) (mg/l)	0.03	0.2
17	Alkalinity (mg/l)	200	600
18	Residual Chlorine (mg/l)	0.2	>1.0

19	Zinc (as Zn) (mg/l)	5.0	15.0
20	Phenol compounds (as Phenol)	0.001	0.002
21	Anionic detergents (as MBAS) (mg/l)	0.2	1.0
22	Mineral Oil (mg/l)	0.01	0.03
23	Arsenic (as As) (mg/l)	0.01	0.05
24	Cadmium (as Cd) (mg/l)	0.01	0.01
25	Chromium (as hexavalent Cr) (mg/l)	0.05	0.05
26	Cyanides (as CN) (mg/l)	0.05	0.05
27	Lead (as Pb) (mg/l)	0.05	0.05
28	Selenium (as Se) (mg/l)	0.01	0.01
29	Mercury (total as Hg) (mg/l)	0.001	0.001
30	Polynuclear aromatic hydrocarbons (PAH) ($\mu\text{g/l}$)	0.2	0.2
31	Pesticides (total, mg/l)	Absent	Refer to WHO guidelines for drinking water Quality Vol. I-1993
32.	Gross Alpha activity (Bq/l)	0.1	0.1
33.	Gross Beta activity (Bq/l)	1.0	1.0

Notes:

- * The figures indicated under the column “Acceptable” are the limits up to which water is generally acceptable to the consumers.
- *
- ** Figures in excess of those mentioned under “Acceptable “render the water not acceptable , but still may tolerated in the absence of an alternative and batter source but up to the limits indicated under column “ Cause for Rejection” above which the have to be rejected.
- + It is possible that some mine and spring waters may exceed these radioactive limits and in such cases it is necessary to analyze the individual radio nuclides order nuclides order to assess the acceptability or otherwise for public consumption.

BACTERIOLOGICAL GUIDELINES AS PER

The recommended guidelines for bacteriological quality are given in Table.

BACTERIOLOGICAL QUALITY OF DRINKING WATER	
Organisms	Guideline value
All water intended for drinking	
E. coli or thermo tolerant Coli form bacteria	must not be detectable in any 100-ml sample
Treated Water entering the distribution system	
E. coli or thermo tolerant Coli form bacteria	must not be detectable in any 100-ml sample
Total Coli form bacteria	must not be detectable in any 100-ml sample
Treated Water entering the distribution system	
E. coli or thermo tolerant Coli form bacteria	must not be detectable in any 100-ml sample
Total Coli form bacteria	Must not be detectable in any 100-ml sample. In case of large of supplies, where sufficient samples are examined, must not be present in 95% of samples taken throughout any 12 month period.

18.12 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 district 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 calliper and recorded in the site register of checks. The thickness of shutters shall be within the prescribed tolerances.

18.13 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 the following table.

Table: 18.1 Material Testing Standard & Frequency

Sl. No.	Name of material	Test	Reference Codes	Frequency	Mini. Samp. size	Standards	
1	2	3	4	5	6	8	
1	MORTAR						
1.1	Water	(i)PH value (ii)Limits of Acidity (iii)Limits of Alkalinity (iv)Percentage of solids (a)Chlorides (b)Suspended matter	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	> 6 Max. 5 ml of 0.02 NaoH in 100 ml water. Max. 25 ml of 0.02 H ₂ SO ₄ in 100 ml water a)2000 mg/l PCC 500 mg/l RCC b)2000	

		(c) Sulphates				mg/l Max. c)400 mg/l
		(d)Inorganic solids				d)3000 mg/l Max. e)200 mg/l
		(e)Organic solids				
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)Not > 10% ii)10mm Max. iii)Initial 30 mint. minimum Final 600 mint.Max. iv) > 43 Mpa

Sl. No.	Name of material	Test	Reference Codes	Frequency	Mini. Samp. size	Stand-ards
1	2	3	4	5	6	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	As per IS : 383-1970 Max. 8% As per IS : 383-1970
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	Is :2386-1963	Every 40 cum or part thereof or more frequently as decided by EIC	6.5 Kg	a)Max .5% As per IS: 383 -1970 e)Not less than 5T h,i) 45%

		Strength (i)Impact value				Max. 30% for wearing surface
2.2	Concrete	Slump test	IS :516- 1959	15 cum or part thereof	As directed by EIC	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 EIC	As per Grade.

Sl. No.	Name of material	Test	Reference Codes	Frequency		Mini. Samp. size	Stand-ards
1	2	3	4	5		6	8
3.2	Steel	(a) Physical	IS: 1608-2005 IS: 1599-1985 IS: 1786-2008 IS: 1786-2008 IS: 228-(1-14) 1987	Under	1	3 pieces of 100 cms. for each size.	i)485Mpa min. ii)410 Mpa min. iii)Minim. 14.5% C = 0.3 P = .06 S = .06 P&S = 0.11
		(i) Ultimate tensile strength		10mm	sample for each 25 T		
		(ii) 0.2% proof stress		10mm to 16mm	1 sample for each 35 T		
		(iii)% Elongation		Over 16mm	1 sample for each 45 T		
		(iv) Bend Test		dia.			
		(v) Re-bend Test					
		(vi) Mass per metre run (kg)					
		(b) Chemical					

							Max	
4	BRICK WORK							
4.1	Bricks and Tiles	(i) Dimension	IS: 1077-1992	1 Test for each source	20	Bricks	As per class	
		(ii) Compressive strength	IS: 3495-1992		5			
					Bricks			
					Lot size			Sample
					2001-10000			5
			10001-35000	10				
		(iii) Water absorption					Not > 20%	
		(iv) Efflorescence					by Wt.	
							Nil	
5	WOOD WORK							
5.1	Timber	Moisture Content	IS: 287-1993	Every one cum or part there of	3 Pieces of 2x2x2.5 cms		8% Max. below 50 mm 10% Max. above 50 mm	

Sl. No.	Name of material	Test	Reference Codes	Frequency	Mini. Samp. size	Stand-ards
1	2	3	4	5	6	8
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	
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	
7	Hydro testing of sewers					
7.1	Testing of M.H. chambers	Leakage	As per manual	On completion of M.H.	-	
7.2	Pipe sewer laid	Leakage	As per manual	Between every 2 M.H.	-	
8	Hydro testing of pipeline					
8.1	Pipe line laid	Pressure Testing	As per Manual / specifications	At each running bill	-	

18.14 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.

18.15 TEST REPORT FORMATS

All the test report formats for implementation of QA/QC procedures are given in **Appendix**.

- 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

18.16 BRANDS OF MATERIAL AND EQUIPMENTS

The detailed specifications of material and works are not in the preview of QA/QC manual, as these are already available with Department and the tender/ bids are invited as per these technical specifications.

For quality of goods/equipments, ISI marked or other reputed brand or equivalent standards shall be acceptable for works. However, the obligatory tests for quality assurance shall have to be conducted in both the cases.

For the small value of works the routine testing shall be limited only to physical parameters such as;

- Sieve analysis
- Dia of pipe
- Thickness of pipe
- Mass of pipe and steel per meter.
- Visual/dimension/absorption/ efflorescence test of bricks
- Silt content of fine aggregate

APPENDICES

(To be filled in by PIU)

APPENDIX-A

CHECKLIST **GUIDE FOR** **WORKS**

APPENDIX A

S.No	Form of Work	Description
1	Tube well	A/CL1
2	Laying and jointing of pipe line, back filling, hydro testing.	A/CL2
3	Pumping machinery & fittings of delivery pipe in pump chamber (Tube well based scheme)	A/CL3
4	Disinfecting plant.	A/CL4
5	Pump chamber.	A/CL5
6	Development of water works.	A/CL6
7	O.H.S.R	A/CL7
8	Water treatment plant	A/CL8
9	Control panel for 3 phase pump & motor.	A/CL9
10	Submersible Pump / VT pump/Centrifugal pump, motor & fittings of delivery pipe in pump chamber	A/CL10
11	Control Panel for Single Phase Motor & Pump	A/CL11
12	Water Treatment Unit	A/CL12
13	Steel Staging for Water Tanks	A/CL13
14	Rotational Moulded Polyethylene Water Storage Tanks	A/CL14
15	Quality certificate.	A/CL15

FORM No. A/CL-1
CHECK LIST FOR TUBEWELL

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

S.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 Geologist/Hydrologist has been engaged for installation of tube well?		
5	Whether the type of drilling, size of tube well boring is as per contract agreement?		
6	Whether samples of strata were collected accurately and kept in boxes for further analysis?		
7	Whether the gravel size is as per specification		
8	Whether M.S. Pipes used are of proper thickness, free from rust and with bituminous painted as per approved specification, Test certificate obtained and Departmental inspection conducted?		
9	Whether strainers are of proper thickness, and as per approved specifications, Test certificate obtained and Departmental inspection conducted?		
10	Whether the tube well assembly has been approved?		
11	<p>Whether lowering of tube well assembly has been done in the presence of:</p> <ul style="list-style-type: none"> • AE/JE (for ward level scheme) • EE/AE (For rest other Scheme) <p><i>Note: Lower Authority shall copy the necessary approval to the immediate Higher Authority</i></p>		

12	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 specification		
13	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 include in format and is duly signed by AE–in-charge & AE deputed for lowering from other division and duly countersigned by the Executive Engineer- in-charge?		
14	Whether capacity of Air Compressor (Both CFM and PSI) used is as per specifications given in bid document		
15	Whether capacity of pumping set used for development is sufficient w.r.to developed and designed discharge?		
16	Whether tube well development hours are as per contract and log book maintained? a) With compressor b) With pumping set		
17	Whether running hours of air compressor and submersible pumping set are witnessed and certified by authorized officer of PIU?		
18	Whether yield test of tube well done & recorded?		
19	Whether strata chart and assembly chart showing all details of tube well has been submitted by contractor to PIU?		

20	Whether result of water sample tests (Physical/Chemical/ Biological/ Bacteriological Examination) after development with pumping set are conforming to drinking water standards?		
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For Contractor	For Department
Signature....	Signature....
Name.	Name....
Date...	Date....

FORM No. A/CL-2**CHECK LIST FOR LAYING AND JOINTING OF PIPE LINE, BACK FILLING, HYDRO TESTING**

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

S.N	Description	Yes/No/NA	Remarks
A. Supplying of pipe and valves, excavation, laying, jointing, and fixing of valves.			
1	a) Whether pipes are of proper specifications and as per contract agreement? A) Whether pipes have been tested at manufacturer's premises and submitted with inspection note along with test reports?		
2	Whether the Sluice Valve/Air Valves etc. are as per specification?		
3	Whether the MS/DICI/GI/UPVC/HDPE/MDPE/CPVC specials are as per specification?		
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 laid pipe line prepared and submitted with running bills?		
B. 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 properly and consolidated as per specifications?		
4	The filling is carried out to required level and without any settlement?		

5	Whether the road metal was separately collected and all type of roads reinstated properly after laying of pipes?		
6	Whether the valve chambers constructed as per drawing and tested for water tightness?		
7	Whether the distribution system hydraulically tested?		
8	Whether the distribution system properly disinfected before providing connections to consumers?		

For Contractor	For Department
Signature....	Signature....
Name.	Name....
Date...	Date....

FORM No. A/CL-3**CHECK LIST FOR PUMPING MACHINERY & FITTINGS OF DELIVERY PIPE IN PUMP CHAMBER (TUBEWELL BASED SCHEME)**

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

S.N	Description	Yes/No/NA	Remarks
1	Whether pump and motor conforming to approved specifications and make as per contract agreement, the MC obtained and Departmental inspection done?		
2	Whether Sluice valve, reflux valve and Air valve are ISI marked and as per specifications?		
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 A) Outside the pump chamber		
5	Is Air Valve/Non Return Valve installed properly?		
6	Is proper 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/ Flow meter)		
10	Is motor taking normal current?		
For Contractor Signature.... Name. Date...		For Department Signature.... Name.... Date...	

FORM No. A/CL-4
CHECK LIST FOR DISINFECTING PLANT

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

S.No	Description	Yes/No/NA	Remarks
CHLORINATOR			
1	Whether chlorinator and accessories is as per specification?		
2	Whether MC has been obtained?		
3	Whether the chlorinator is installed and working properly?		
4	Whether Testing kit for residual chlorine test available for water sample testing?		
For Contractor Signature.... Name. Date...		For Department Signature.... Name.... Date...	

FORM No. A/CL-5
CHECK LIST FOR PUMP CHAMAER

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

S.N	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? I. Bricks II. Fine aggregate III. Coarse aggregate		
5	Whether following manufactured materials used are as per specification? I. Cement II. 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 brick work in foundation and plinth is as per specifications?		
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?		
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 $1\text{ cm} \pm 20\%$?		
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 specification?		
16	Whether proper section of chowkhats has been provided with proper grouting as per specification?		
17	Whether Proper Centering and shuttering has been provided for R.C.C. slab?		
18	Whether steel Reinforcement laid as per design and drawing?		
19	Whether R.C.C. Slab is laid of required thickness and in level?		
20	Whether proper size of Girder (proper I-section) has been provided (Medium weight)?		
21	Whether proper size of opening in the roof has been provided with cover as per drawing for lowering of pump?		
22	Whether surface cleaned of all loose mortar and efflorescence before plastering?		
23	Is the finishing of plaster inside/outside is proper and mix is as per required proportion?		
24	Whether the floor has been laid in panels, correct thickness and proper sand filling done under floor?		
25	Whether proper underground conduit for electric cable has been provided for machinery etc as per drawing & specification?		

26	Whether electrical fixtures installed are as per approved specifications and quantity?		
27	Whether top finishing and slope of floor is correct?		
28	Whether proper tile terracing/lime terracing has been done on roof as per specification as per provision for the contract?		
29	Whether proper quality and type of wood has been used with correct thickness of shutters as per specification?		
30	Whether thickness of Glass used in window panes is correct as per specification?		
31	Have grills been provided as per standard drawings?		
32	Whether Quality of distemper/cement based paint (Snowcem) is as per specification?		
33	Whether Quality of paint used on wood work/steel work and on other components is as per specification?		
<p style="text-align: center;">For Contractor Signature.... Name. Date...</p>		<p style="text-align: center;">For Department Signature..... Name.... Date...</p>	

FORM No. A/CL-6**CHECK LIST FOR DEVELOPMENT OF WATER WORKS**

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

S.N	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? <input type="checkbox"/> Bricks <input type="checkbox"/> Fine aggregate <input type="checkbox"/> Coarse aggregate		
5	Whether following manufactured materials used are as per specification? <input type="checkbox"/> Cement <input type="checkbox"/> Structural steel		
6	Whether Concrete bedding laid as per specification?		
7	Whether brick work in foundation and plinth is as per specifications?		
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?		
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 \pm 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 Signature.... Name. Date...		For Department Signature..... Name.... Date...	

FORM No. A/CL-7
CHECK LIST FOR OHSR

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

S.N	Description	Yes/No/NA	Remarks
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? <input type="checkbox"/> Fine aggregate <input type="checkbox"/> Coarse aggregate		
6	Whether following manufactured materials used are as per specifications? <input type="checkbox"/> Cement <input type="checkbox"/> Steel for reinforcement		
7	Whether all requisite tests have been conducted for the following items as per frequency? <input type="checkbox"/> Excavation and bedding <input type="checkbox"/> Plain cement concrete <input type="checkbox"/> 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	<p>The reinforcement in the following members provided is as per drawing/design and whether it has been checked by EE/AE/JE?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Foundation <input type="checkbox"/> Columns <input type="checkbox"/> Braces <input type="checkbox"/> Landings 		
11	<p>Whether Concrete Mixer/Vibrator was used at site and standby arrangement made?</p>		
12	<p>Whether R.C.C. in the following members laid as per dimensions given in approved drawing with desirable smooth finishing?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Foundation <input type="checkbox"/> Columns <input type="checkbox"/> braces 		
13	<p>Whether verticality of R.C.C. columns checked before and after pouring of concrete?</p>		
14	<p>Whether proper curing period maintained as per specification?</p>		
1	<p>Is the reinforcement in the following members provided is as per drawing/design and whether it has been checked by EE/AE?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bottom Ring beam <input type="checkbox"/> Bottom dome and gallery <input type="checkbox"/> Tank wall <input type="checkbox"/> Top ring beam <input type="checkbox"/> Top dome <input type="checkbox"/> Staircase and landings 		
2	<p>Whether R.C.C. in the following members laid as per dimensions given in approved drawing with desirable smooth finishing?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bottom Ring beam <input type="checkbox"/> Bottom dome and gallery <input type="checkbox"/> Tank wall <input type="checkbox"/> Top ring beam <input type="checkbox"/> Top dome <input type="checkbox"/> 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?		
C. Arrangement and erection of C.I D/F pipe 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 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 of 0.60 mtr.?		
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 Ay 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 Aluminium 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 Signature: Name: Designation: Date		FOR DEPARTMENT Signature: Name: Designation: Date :	

FORM No. A/CL-8**CHECK LIST FOR WATER TREATMENT PLANT (SURFACE WATER BASED)**

1. Name of work:

2. Contract Agreement No.:

3. Name of contractor:

S.N	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? <input type="checkbox"/> Bricks <input type="checkbox"/> Fine aggregate <input type="checkbox"/> Coarse aggregate <input type="checkbox"/> Filter media		
3	Whether following manufactured materials used are as per specifications? Whether requisite Tests for materials conducted and MC obtained? <input type="checkbox"/> Cement <input type="checkbox"/> Steel for reinforcement <input type="checkbox"/> LDPE sheet <input type="checkbox"/> Manhole cover and Footrest <input type="checkbox"/> Vent pipes		
4	Whether all requisite tests have been conducted for the following items as per frequency? <input type="checkbox"/> Excavation and bedding <input type="checkbox"/> Plain cement concrete <input type="checkbox"/> Cement Mortar <input type="checkbox"/> 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 have 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 Signature: Name: Designation: Date :		FOR DEPARTMENT Signature: Name: Designation: Date	

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. A/CL-9**CHECK LIST FOR CONTROL PANEL FOR 3 PHASE PUMP & MOTOR**

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

S.N	Description	Yes/No/NA	Remarks
1	Whether the main switch is of suitable capacity of approved/ reputed make?		
2	Whether the MCA/ MCCA units are of specified make?		
3	Whether the 3 Phase starter is of suitable capacity of approved/ reputed make?		
4	Whether the single phase preventer of approved/ reputed make is provided and working properly?		
5	Whether the panel box is of approved thickness and has been power painted?		
6	Whether control panel is suitable for 415 V AC. With variations up to 6 % on either side?		
7	Whether Shunt Capacitor is of proper KVAR capacity and of reputed make, or approved by BSPHCL?		
8	Whether Ampere meter is of suitable range and of approved make or any other reputed make?		
9	Whether Volt meter is of suitable range(500V) and of approved make or any other reputed make?		
10	Whether the ELCG is of approved or reputed make?		
11	Whether three phase Indicators lamps are of approved as per approved Led type or equivalent reputed make?		
12	Whether Fuse bases and HRC fuses are of approved make or equivalent?		
13	Whether selector switch for Ammeter and Voltmeter are of approved make or equivalent?		

14	CT for Ammeter are of approved make or equivalent?		
15	Contractors relays and timers are of approved make or equivalent?		
16	Switch fuse unit is of approved make or equivalent?		
17	Wires are of approved make or equivalent?		
18	Whether MC has been obtained and DT inspection conducted?		
19	Whether the control panel has been fitted properly?		
FOR CONTRACTOR Signature: Name: Designation: Date :		FOR DEPARTMENT Signature: Name: Designation: Date	

FORM No. A/CL-10**CHECK LIST FOR SUBMERSIBLE/VT/ CENTRIFUGAL PUMP, MOTOR & FITTINGS OF DELIVERY PIPE IN PUMP CHAMAER**

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

S.N	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 the alignment of the shaft is correct?		
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 with in 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 A) Outside the pump chamber		
16	Is Air Valve/Non Return Valve installed properly?		
17	Is proper 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 within the limit (Less than 1.5m, not exceed 2m)?		
FOR CONTRACTOR Signature: Name: Designation: Date :		FOR DEPARTMENT Signature: Name: Designation: Date	

FORM No. A/CL-11**CHECK LIST FOR CONTROL PANEL FOR SINGLE PHASE PUMP & MOTOR**

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

S.N	Description	Yes/No/NA	Remarks
1	whether the panel box floor mounted pillar feeder type are made of M.S sheet (minimum 2 mm thick) & duly spray powder coated painted.		
2	Whether the D.P main switch of capacity 32 Amp 240 Volt, approved/ reputed make of relevant specification are fitted properly.		
3	Whether the SPN MCA is suitable rating. approved/ reputed make of ISI marked		
4	Whether the Fully automatic starter having suitable contactor & over load rely unit. Make- as per contract agreement/appointed by competent authority.		
5	Whether the connected start & run Capacitor. capacitor of suitable MFD rating are properly fitted Make- as per contract agreement/appointed by competent authority.		
6	Whether Ammeter is of suitable range. Make- as per contract agreement/appointed by competent authority.		
7	Whether volt meter is of suitable range (0-300) Volt Make- as per contract agreement/appointed by competent authority.		
8	Whether phase indicating lamp (Led type) of suitable size. Make- as per contract agreement/appointed by competent authority.		
9	Whether Terminal block 3 way of up to 60 Amp cap are fitted for both incoming & outgoing line. Make- as per contract agreement/appointed by competent authority.		
10	Whether Fuse base and HRC fuse are fitted properly Make- as per contract		

	agreement/appointed by competent authority.		
11	Whether 5 KVA auto voltage stabilizer having input voltage range (95-272) volt. Approved Make /ISI marked if any are fitted properly		
12	Wire are of approved/ equivalent make		
13	whether the all switch gear & electrical equipment including internal wiring as per agreement has been fitted properly.		
14	Whether Meter connection has been done		
FOR CONTRACTOR Signature: Name: Designation: Date :		FOR DEPARTMENT Signature: Name: Designation: Date:	

FORM No. A/CL-12**CHECK LIST FOR WATER TREATMENT UNIT**

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

S.N	Description	Yes/No/NA	Remarks
1	Whether Raw Water (Tube Well Water) has been tested in departmental laboratory before designing of treatment unit?		
2	Whether selected treatment technology is of CSIR/ Approved Ay CSIR/ appointed or endorsed by GoI?		
3	Whether treatment unit is as per designed flow requirement of the scheme?		
4	Whether filter Media tank/ Vessels is made of FRP/ Mild Steel or any other material is as per contract conforming to BIS and FSSAI standard?		
5	Whether filter Media tank/ Vessels has been tested for maximum design pressure with due factor of safety?		
6	Whether Media tank/ Vessels are properly protected from weathering decay? <input type="checkbox"/> Mild Steel- Anticorrosive epoxy coating <input type="checkbox"/> FRP- Covering Shades		
7	Whether treatment unit is properly connected to rising main?		
8	Whether Control Valves are properly connected and it is leak proof?		
9	Whether detail specification of medias has been provided by the manufacturer of the treatment unit?		
10	Whether treatment unit performance has been tested as per BIS specification?		
11	Whether source of availability of media to be replaced has been provided?		
FOR CONTRACTOR Signature: Name: Designation: Date :		FOR DEPARTMENT Signature: Name: Designation: Date	

FORM No. A/CL-13**CHECK LIST FOR STEEL STAGING FOR WATER TANKS**

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

S.N.	Description	Yes/No/NA	Remarks
1	Whether Gusset Plate has been Fixed to foundation bolt?		
2	Whether Column Joist/Channel has been fixed to Gusset Plate?		
3	Whether Diagonal Angle/bracing has been fixed to Gusset Plate?		
4	Whether Water tank Platform beam (Joist/Channel) has been fixed to column?		
5	Whether Water tank Platform Sheet has been fixed to beam?		
6	Whether Anti Corrosive painting has been done on staging structure?		
7	Whether section/dimension of structural steel is as per approved drawing/specification?		
FOR CONTRACTOR Signature: Name: Designation: Date :		FOR DEPARTMENT Signature: Name: Designation: Date	

FORM No. A/CL-14**CHECK LIST FOR ROTATIONAL MOULDED POLYETHYLENE WATER STORAGE TANKS**

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

S.N	Description	Yes/No/NA	Remarks
1	Whether Cylindrical Vertical Tanks placing of staging has been done?		
2	Whether Inlet and overflow with bulkhead / Uniseal Holding Tank Slip has been fitted of suitable dia.?		
3	Whether Outlet and Drain with bulkhead / Uniseal Holding Tank Slip has been fitted of suitable dia.?		
4	Whether is tank is ISI marked ?		
FOR CONTRACTOR Signature: Name: Designation: Date :		FOR DEPARTMENT Signature: Name: Designation: Date	

FORM No. A/CL-15
QUALITY CERTIFICATION

1. Name of work:
2. Contract Agreement 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	A.E.	E.E.

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

APPENDIX – B

SITE DOCUMENT

APPENDIX – B

SITE DOCUMENT

Sl. No.	Name of Document	Responsibility
B/QRF-1	Site Order book	Contractor
B/QRF-2	Material Register	Contractor
B/QRF-3	Daily Progress Report.	Contractor
B/QRF-4	Concrete pour Record	Contractor
B/QRF-5	Test Record	Contractor
B/QRF-6	Design and Drawing Record	Contractor
B/QRF-7	Non Conforming Item Record	PIU

[Contractor] Designation	Inspection Engineer/with
Compliance	Site Incharge/J.E.

*(3 copies per set- one copy each to be sent to PIU by the contractor, one copy to be retained at site)

DAILY PROGRESS REPORT

Name of Work :

Contract Agreement No. :

Name of Contractor :

Date :

EQUIPMENT AT SITE

Available :

Under Repair :

Sl. No.	Name of Component	Item Executed	Quantity	Location	Labour Engaged				
					Skilled	Non Skilled	Fitter	Mason	Others
1									
2									
3									

Any Special Difficulties/ happening:

Signature :

Signature :

Name :

Name :

Date :

Date :

For Contractor**For Department**

CONCRETE POUR RECORD

Name of Work :

Contract Agreement 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 :

Name :

Designation

Signature :

Name :

Designation :

For Contractor

For Department

TEST RECORD

Name of Work :

Contract Agreement No. :

Name of Contractor :

Sl. No.	Description of Sample	Date of Sampling	Size of Sample	Name of Laboratory	Status of D T Inspection	Status of Manufacturing Certificate	Date and Result of Test	Sign of Contractor	Sign of PIU

DESIGN AND DRAWING RECORD

Name of Work :

Contract Agreement No. :

Name of Contractor :

Sl. No.	Details of Drawing Title / No.	Date of Receipt of Drawing	Status of Drawing (original/Revised)	Contractor's Signature	S.D.E. / E.E. Signature

NON CONFORMING ITEM RECORD

Name of Work :

Contract Agreement 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.

Signature :

Signature :

Name :

Name :

Date :

Date :

For Contractor

For Contractor

APPENDIX-C

QUALITY FIELD

INSPECTION

REPORT

APPENDIX – C

QUALITY FIELD INSPECTION REPORT

Ref No.: QFIR -.....

1. GENERAL			
1	Name of scheme	:	
2	Name of Ward	:	
3	Name of Village	:	
4	Name of GP	:	
5	Name of Block	:	
6	Name of District	:	
7	Technically sanctioned Estimated Cost in Lacs	:	
8	Name of Agencies with Agreement No. Package No 1: Package No 2: Package No 3: Package No 4 :	:	
9	Detail of Package with Tendered Cost in Lacs, Date of commencement, completion and progress in Percentage. Package No 1: Package No 2: Package No 3: Package No 4 :	:	
10	Name of Circle	:	
11	Name of Division	:	
12	Name of Sub-division	:	
13	Name of S.E	:	
14	Name of E.E	:	

15	Name of A.E	:	
16	Name of J.E	:	
17	Name of Chairman of GPWSC	:	
18	Scheme Inspected by C.E with date/ reference	:	
19	Scheme Inspected by S.E with date/ reference	:	
20	Scheme Inspected by E.E with date/ reference	:	
21	Scheme Inspected by E.E (QMSW) with date/ reference	:	

2. DETAILED INFORMATION ABOUT VILLAGES:

Sl. No.	Name of Village	Present Population	No. of Households	No. of Pvt. Water Connections	No. of Stand Posts
1					
2					
3					

3. QUALITY CONTROL DOCUMENTS AND TESTING DETAILS

1	Documents available at site as per list 1	:	
2	Whether the agreement with specification and copy of sanctioned estimate 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 Non-conformance 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/ NR	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/NR	Remarks
1	Compression testing machine		
2	Sieve set complete		
3	Measuring jars		
4	Screw gauge		
5	Vernier calliper		
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	S.W. pipe				
12	R.C.C. pipes				
13	G.I. pipes				
14	Hydraulic Pressure test of water supply pipelines				

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

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

List-5: DETAILS OF MANUFACTURER CERTIFICATES

Sl. No.	Description	Qty. used	MC availability Yes / No/ NR	Acceptability By PIU	Remarks
1	Cement				
2	Steel for Reinforcement and structural steel				
3	Pipe such as GI , PVC ,MS, CI, DI, SW ,RCC etc.				
4	AC/GI/Fiber glass sheets				
5	Electrical cables/fans and fixtures				
6	Switches/sockets and boards				
7	Flow measuring devices				
8	Control Panel				
9	Lightening arrestor				
10	Water Level indicator and controllers.				
11	Disinfection Units				
12	Pump and Motor				
13	All type of specials such as PVC, GI, CI etc.				
14	All types of valves such as sluice valve, Air valve etc.				
15	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/NR	Remarks
1	Pipes such as DI, CI, PVC, MS, SW, HDPE/MDPE, etc.				
2	Pumps, Motors & D.G. Sets				

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			
9	Control panel for 3 phase pump & motor.			
10	Centrifugal pump, motor & fittings of delivery pipe in pump chamber			
11	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	DCP						
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	Water tightness of structures i)OHSR ii)UGSR iii)Units of WTP						

List-9: PENALTIES ON A/C OF 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			Remarks
		Satisfactory		Unsatisfactory (RI)	
1	Tube well				
2	Pump chamber				
3	OHSR				
4	UGSR				
5	Water works development				
6	Distribution system				
7	Pump set of TW Water treatment plant				
8	Electrical works at treatment plant				
9	Treatment Unit				
10	Item of work requiring special attention for quality improvement				

List-11: SAMPLE TAKEN FOR TESTING DURING FIELD VISIT

S.No.	Name of Item	Work where used	Qty. Sealed	Name of Div. where delivered for testing	Remarks
1					
2					
3					
4					

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

S. No.	Name of Item	Location	Type of test	Test Result	Standards % Passing			Remarks
					Sieve	20	10	
1	Coarse Aggregate 20mm 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		Sieve analysis Silt content	A/TR-3 A/TR-12	8% Max.			
	Plaster IS:1542		Sieve analysis Silt content	A/TR-3 A/TR-12	8% Max.			
	Masonry IS:2116		Sieve analysis Silt content	A/TR-3 A/TR-12	8% Max.			
3	Steel IS:1786		Dia. Wt. / M in Kg		0.395±7%			
	8 mm				0.617±7%			
	10 mm				0.888±5%			
	12 mm				1.58±5%			
	16 mm				2.47±3%			
	20 mm							
	25 mm							

			Dia. Wt. /M in Kg		3.85±3%	
4	UPVC pipe w/s Class – 3 Size - 90 mm		OD Min. Max. Wall Thickness Make		90 mm 88.9 91.1 3.1 to 3.7 mm	
	Size 110 mm		OD Min. Max. Wall Thickness Make		110 mm 108.6 111.4 3.7 to 4.3 mm	
5	SW Pipe Class – SP-1 Size - 100 mm		ID Thickness Internal depth of socket Excess shoulder Length of Grooving ID Thickness Internal depth of socket Excess shoulder Length of Grooving		100 mm 12 mm 50 mm 10 mm 75 mm 150 mm 15 mm 57 mm 11 mm 85.5 mm	
6	Bricks (20)		Color Length(mm)		Cherry red 4600±80 mm	

			Width Height Comp.strength		2200±40 1400±40 7.5 N/mm ²	
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		Thickness		150 mm	
14	M.S Girder		Size		250 mmx125 mm	
15	Angle iron Pickets		Size Thickness		40x40x6 mm 6 mm	
16	LDPE Sheet		Thickness		200 micron	
17	Cube test M15 M20 M25		Compressive strength Compressive strength Compressive strength		15 N/mm ² 20 N/mm ² 25 N/mm ²	
18	Slump test		Slump in mm		40-70 mm	
19	Cement		Grade Date of Manufacture. Fineness		43 Not more than 10% Residue	
Signature of Inspecting officer						

APPENDIX-D

TEST REPORT

FORMATS

APPENDIX – D

TEST REPORT FORMATS

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

TEST CERTIFICATE FOR CEMENT

Name of work :
 Contract Agreement 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 0.075 Sieve	Percentage retained	Remarks

COMPRESSIVE STRENGTH

Temperature	Date of casting	Date of testing	Age of specimen	Crushing load (T)	Crushing strength kg/cm ²	Remark

Signature:
 Name:
 Date:
For Contractor

Signature:
 Name:
 Date:
For Department

TEST CERTIFICATE FOR COARSE AGGREGATE

Name of work :
 Contract Agreement 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 = $\frac{(C+500)}{100}$ C is cumulative % retained

Signature:
 Name:
 Date:

For Contractor

Signature:
 Name:
 Date:

For Department

Ref No.DatedForm No D/TR-3

TEST CERTIFICATE FOR FINE AGGREGATE

Name of work :
 Contract Agreement 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
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 = $\frac{(F)}{100}$

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

For Contractor **For Department**

Ref No.DatedForm No. D/TR-4

TEST CERTIFICATE FOR WATER (For saline zone only)

Name of work :
 Contract Agreement 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 (mg/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 Department			

COMPRESSIVE STRENGTH OF CONCRETE

Name of work :
 Contract Agreement 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	Cm ²			
7	Crushing Load	Kg			
8	Compressive strength	Kg/cm ²			

Average compressive strength of concrete = kg/ cm²

Remark / Recommendation.

Signature:

Name:

Date:

For Contractor

Name of DWSS/GPWSC representative

present at the time of testing.:

CONCRETE SLUMP TEST

Name of work :
 Contract Agreement 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	Kg			
5	Weight of water	Kg			
6	Slump	Mm			

Average slump of concrete mm

Remark / Recommendation.

.....

Signature:
 Name:
 Date:

Signature:
 Name:
 Date:

For Contractor

For Department

HYDROSTATIC TEST FOR NP PIPES

Name of work :
 Contract Agreement 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:
 Name:
 Date:

For Contractor

Signature:
 Name:
 Date:

For Department

Ref No.Dated Form No. D/TR –
8

HYDROSTATIC TEST FOR PRESSURE PIPES

Name of work :
 Contract Agreement No. :
 Name of contractor :
 Source of supply :
 Material description :

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

Remark / Recommendation.

.....

Signature:
 Name:
 Date:

For Contractor

Signature:
 Name:
 Date:

For Department

Ref No. Dated Form No. D/TR – 9

LEAK TEST FOR UNDER GROUND RCC STRUCTURES

Name of work :
 Contract Agreement No. :
 Name of contractor :
 Material description :

Date of Filling		Initial Water level		
Observation no.	Date of observation	Water level (m)	Drop (mm)	Remark
1				
2				
3				
4				
5				
6				
7				

Remark / Recommendation.

Signature:	Signature:
Name:	Name:
Date:	Date:
For Contractor	For Department

LEAK TEST FOR ELEVATED RCC STRUCTURES

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

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

Remark / Recommendation.

Signature: Name: Date: For Contractor	Signature: Name: Date: For Department
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SILT CONTENT

Name of work :

Contract Agreement 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:

Name:

Date:

For Contractor

Signature:

Name:

Date:

For Department

QUALITY MONITORING

SYSTEM



For Detail Contact

Engineer-in-Chief-cum-Member Secretary

Public Health Engineering Department

Nirman Bhawan, Patna-800015

Tel: (0612)-2546348. **Whatsapp Number** 85444-28865

Grievance Redressal Cell Toll Free: 1800-1231-121

9:30 AM ~ 6:00 PM