Asian Development Bank (ADB) Assisted
Delhi Water Supply Improvement Investment Program

BIDDING DOCUMENT
For
Procurement
of

DWSIIP / 02: Distribution System Improvement in UGR Command Areas Punjabi Bagh (G-02), Pitampura (H-06) and Lawrence Road (H-08),

Targeting Continuous Pressurized Water Supply and DMA based NRW Reduction and Providing House service connections

Under International Competitive Bidding

(Following ADB's single stage two envelope bidding procedure)

Technical Bid - VOLUME 5

QUALITY ASSURANCE & QUALITY CONTROL MANUAL

Executing Agency:

Delhi Jal Board,
Varunalaya
Jhandewalan
Karol Bagh
New Delhi-110005

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In Joint Venture with
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Project Management Consultancy

for

Delhi Water Supply Improvement Investment Program (DWSIIP) Project -1 in Wazirabad Water Treatment Plant Command Area

QUALITY ASSURANCE & QUALITY CONTROL MANUAL

Delhi Jal Board

Asian Development Bank

The Executive Engineer (Dwarka) WTP
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NJS Engineers India Pvt. Ltd.

FEBRUARY 2018

DWSIIP

QUALITY ASSURANCE
QUALITY CONTROL MANUAL

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List of Abbreviations and Acronyms

ADRN	Approved Design Release Note
BC	Bituminous Carpeting
BM	Bituminous Macadam
BME	Benefit Monitoring and Evaluation
CBR	California Bearing Ratio
CI	Cast Iron
CNC	Conformance/Non-Conformance (Report)
DBM	Dense Bituminous Macadam
DTN	Design Transmittal Note
GI	Galvanized Iron
GSB	Granular Sub-Base
GSW	Glazed Stoneware (Pipe)
DWSIIP	Delhi Water Supply Improvement Investment Program
ICB	International Competitive Bids
IDRN	Internal Design Review Note
IDTN	Internal Design Transmittal Note
IS	Indian Standard
JICA	Japan International Cooperation Agency
LCB	Local Competitive Bids
m	Meter
m^2	Square Meters
m^3	Cubic Meters
mm	Millimeters
MDD	Maximum Dry Density (as per Modified Proctor test)
MS	Mild Steel
MSS	Mix Seal Surfacing
NGO	Non-Government Organization
O&M	Operation and Maintenance
OMC	Optimum Moisture Content
PAPs	Project Affected Persons
PCC	Plain Cement Concrete
PIU	Project Implementation Unit (of DJB, DWSIIP)
PMC	Project Management Consultant
PMT	Project Management Team
PSC	Prestressed Concrete
PVC	Poly-Vinyl Chloride (Pipes)
DJB	Public Works Department
PHED	Public Health Engineering Department
QA	Quality Assurance
QC	Quality Control
QS	Quality System
RCC	Reinforced Cement Concrete
RDA	Request for Design Approval
RIDR	Request for Internal Design Review
SPT	Standard Penetration Test
SSM	Sized Stone Masonry
STP	Sewage Treatment Plant
TEAC	Tender Evaluation Approval Committee
TCC	Technical Clearance Committee
TEC	Tender Evaluation Committee
WBM	Water Bound Macadam
WTP	Water Treatment Plant
PPE	Personnel Protective Equipments
AEMP	Approved Environmental Management Plan

PREFACE

This Quality Assurance /Quality Control Manual has been prepared with the objective of putting in place a comprehensive, consistent and common system for quality assurance and quality control during implementation of the Delhi Water Supply Improvement Investment Program (DWSIIP) under ADB Loan No. xxxx-IND.

The Manual covers the overall quality assurance system and the field level quality control procedures for different types of works, based on the standard specifications adopted for the Project.

The QA/QC Manual covers tests and inspections for different materials and works. The acceptance/rejection limits have to be assessed in relation to the particular and standard specifications as incorporated in the construction contracts.

If there are any differences between the tests and other quality control procedures described in the Manual and those stipulated in the Project's Contract Documents/Specifications, the latter shall prevail.

It is suggested that the Manual be kept in a ring binder so that any additions or modifications can be easily incorporated later, if required.

It is mandatory for the contractors to purchase this Quality Assurance / Quality Control document.

A quality assurance plan/ manual has to be a part of the tender document

1 INTRODUCTION

This Section of the Quality Assurance/Quality Control Manual presents the Project's background, defines quality-related terms and gives an outline of the Manual.

1.1 Background

The Government of India is negotiating a loan with the Asian Development Bank (ADB) for financing the Delhi Water Supply Improvement Investment Program (DWSIIP or the investment program), which comprises improvement of the water supply system in Wazirabad Water Treatment Plant (WTP) command area of Delhi. DWSIIP will be implemented by Delhi Jal Board, Govt. of NCT Delhi as Executing Agency over a six-year period and will improve the infrastructure, management and performance of the water supply services in the proposed Wazirabad Water Treatment Plant (WTP) command area located in North Delhi. Physical investments to improve the existing water supply system to serve 2051 design population of 2.6 million people residing in North West Delhi (Wazirabad WTP command area) and improve the management capacity of Delhi Jal Board (DJB), the service utility responsible for water supply and sanitation services in the National Capital Territory of Delhi (NCTD) covering about 18.85 million people at present.

The DWSIIP will improve the infrastructure, management, and performance of the water supply services for 2.6 million people in the Wazirabad Water Treatment Plant (WTP) command area located in North Delhi. The area designated as are CD Park Jahangirpuri, Model Town, Punjabi Bagh, Shakur Basti/Harsh Nagar, Lawrence Road, Sanjay Gandhi Transport Nagar, Burari A and Burari TPA, Peragarhi, Avantika, Pitampura. The DWSIIP will help achieve the National Capital Territory of Delhi (NCTD) Water Supply Master Plan objectives of reduced non-revenue water (NRW) and equitable access to water supply services as Per JICA Study Report on Water Supply Improvement in 2011. The DWSIIP will include improvement of distribution network, water treatment and transmission systems in the Wazirabad WTP command area, and strengthening of institutional capacity and program management.

The proposed investment program will help to achieve the National Capital Territory of Delhi, (NCTD) Water Supply Master Plan objective of reduced non-revenue water (NRW) and equitable access to water supply services. It comprises (i) physical investments to improve the water supply system in the Wazirabad WTP command area and (ii) non-physical investments to improve DJB's institutional effectiveness.

1.2 Quality Definitions

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): A system of maintaining standards by reviewing, checking, inspecting and testing.
- Quality Assurance (QA): The planned and systematic actions necessary to provide adequate confidence that the work will satisfy quality requirements.
- Quality System (QS): A set of documented processes, which seek to provide confidence that the project outputs will fulfill all the requirements for which it is being planned. The Quality System should encompass 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 to ensure that the quality practices are implemented and documented in relation to the quality system; and
  - ❖ At the contract package level, inspection and testing to ensure that the works executed meet the required quality standards.

1.3 QA/QC Manual

This QA/QC Manual focuses on the implementation activities of the project following contract award, and primarily on supervision and quality control of construction works. Other aspects of project implementation are also covered but in less detail. The QA/QC Manual is intended to be used primarily by the contractors, project staff of the PIU (DJB) and the Project Management Consultants.

This shall indicate all the required test to be done during the construction stage, all relevant and applicable codes, specifications and standard as well as the acceptable criteria for each of the relevant item of work materials used and the processes employed. All these have to be checked/ tested periodically at the required intervals by the PMC/PIU (DJB) team.

Copy of all such reports at various stages shall be appended with each running account bill and the final bill failing which no payment shall be released to the contractor. It will be deemed that work so measured checked and paid is of the required quality and standard both in respect of ingredients as well as the intended function it is supported to perform.

The QA/QC Manual for the Project 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, i.e. it is looked at as a means to achieve the end results. Quality control and test results shall be interpreted as applicable for different packages, in accordance with the contract conditions.

The subsequent Sections of this Manual are as follows:

- Section 2: Contractor's Responsibilities
- Section 3: Reporting
- Section 4: Construction Quality Control – General
- Section 5: Control of Materials and Equipment Components
- Section 6: Control of General Civil and Structural Works
- Section 7: Control of Pipeline Works
- Section 8: Control of Electro-mechanical Works
- Section 9: Control of Road and bridge Works

1.4 Site Health and Safety Manual

This QA/QC Manual is to be read in conjunction with the Site Health and Safety Manual, and according to the Contractor's incorporated contract specific risk assessment and qualified safety plan.

Contractors are responsible for the execution of the works in conformance with the requirements of the contract documents.

1.5 Contractor's General Responsibilities

Notwithstanding the full provisions of the respective contracts documents, Contractors are responsible for providing the following:

- All necessary plant, labor, equipment and construction materials to be used in the permanent works;
- All materials and labor for temporary works;
- Transportation and storage facilities for all materials and equipment.
- Temporary office and proper hygienic accommodation for staff and labor;
- Drinking water and sanitation facilities at the site; and
- All necessary staff and equipment for testing and quality control.
- Personnel Protective Equipments (PPE) to field staffs
- Safety Hand Book for safety engineering practice
- Approved Environmental Management Plan (EMP)

Contractors are responsible for executing and completing the works in accordance with the specified standards and specifications, within the contractual time allowed, and within the contract price for these works. On turnkey contracts, contractors are also responsible for preparing design, drawings, quantity surveying, cost estimation etc. and obtaining their approval.

1.6 Quality Assurance/Quality Control Duties

The contractor's QA/QC duties are summarized in **Table 1.1**. Other duties shall be performed as stipulated in the contract documents or directed by the Engineer.

Compliance with the quality assurance system shall not relieve the contractor of any of his duties, obligations or responsibilities under the contractor.

1.7 Method Statement

The Method statement is a statement by which construction procedures for important activities of construction are stated, checked and approved.

Soon after the award of work, the contractor shall submit a method statement for the approval of the PMC/PIU (DJB).

Table 1.1: List of Contractor's QA/QC Duties

Activity/Item	Contractor's QA/QC Duties
Designs for turnkey contracts	• Prepare designs using appropriate QA/QC procedures • Submit designs, drawings, data sheets and implementation schedule to PIU (DJB) for review and approval • Maintain design and drawing registers at site • Use only latest revisions of approved drawings for construction, all other revisions to be marked superseded. • Prepare and submit Process Design and Schedule. • Submit Method statements.
Designs for item-rate contracts	• Maintain design register at site • Use only latest revisions of approved drawings for construction, all other revisions to be marked superseded. • Submit designs for enabling works • Submit Method statements.
Test laboratory and equipment	• Submit to PIU (DJB) and PMC the details of equipment, programme of procurement and obtain approval. All equipment shall have a valid calibration certificate. • Maintain the equipment in good condition and validate the calibration as appropriate.
Material receipts Materials testing	• Obtain approval of PIU (DJB) to the sources. • Enter receipts in material register • Materials to be tested only in approved laboratories • Materials such as cement, reinforcement steel, structural steel, etc. shall have manufacturer's test certificates. • Material received at site shall have dispatch clearance, third party inspection reports. • Materials shall be stored as per good engineering practice. • Prepare concrete mix designs as required by contract and submit for the approval of PIU (DJB) & PMC • Take test samples in presence of PIU (DJB) & PMC when requested • Routine tests shall be carried out in site laboratory by qualified staff to be posted by the contractor. • Submit test reports to PIU (DJB) & PMC with monthly reports maintain test log. Field testing registers shall be maintained by the contractor.
Rejected materials	• Enter in material register at site • Tag and record all rejected materials

Activity/Item	Contractor's QA/QC Duties
	• Intimate PIU (DJB) & PMC in writing the proposed date of removal from site and confirm after removal
Material consumption	• Enter daily consumption of materials in material register and indicate balance quantity
Construction equipment	• Intimate PIU (DJB) & PMC the details, date of mobilization along with requisite insurance certificate • Maintain equipment in good working condition • Intimate breakdown of construction equipment. • Equipment mobilized at site shall not be removed without prior approval of PIU (DJB) & PMC.
Construction	• The contractor shall prepare a detailed construction programme (to meet mile stone dates given in the contract) including resource planning, cash flow requirement, dates of requirement of drawings, etc. and submit for the approval of the PIU (DJB) & PMC. • Contractor shall submit for the approval of PIU (DJB) & PMC method statements for the permanent and temporary works to be executed. • Intimate PIU (DJB) & PMC in writing when construction is going to commence and what activities are proposed to be undertaken. • Intimate PIU (DJB) & PMC in advance when critical works, such as concreting, embankment, paving, pipeline laying and jointing, testing, etc., would be undertaken, along with the test certificates of the materials proposed to be used in these works. No critical activity shall start unless the material test certificates are verified and approved by the Engineer. • The work/activity shall commence only after the same is authorized by PIU (DJB) & PMC. • Provide any other necessary QA/QC requirement.
Daily work progress	• Maintain in daily log
Testing of works in progress	• Perform tests as per contract requirements • Submit test reports to PIU (DJB) • Maintain test log during the execution of works
Rejected work items, Materials	• Intimate PIU (DJB) in writing the proposed date of removal from site and confirm after removal, • Rectify defective work and invite PIU (DJB) & PMC for re-inspection.
Instructions from Engineer	• Enter change orders, site instructions, letters and minutes of meetings issued by the Engineer and Consultants in the Instruction Log
Inspection of Engineer	• Take instructions in Site Order Book.

Activity/Item	Contractor's QA/QC Duties
	• Intimate PIU (DJB) & PMC of compliance
Progress scheduling and control	• Prepare and maintain project schedules and undertake work in accordance with approved schedules, revise the schedules as and when required to meet the work requirement.
Reporting	• Prepare and submit Monthly Progress Reports and other reports as per contractual requirements
Records	Maintain the following records on Site/Contractor's Office/Laboratory: • Material Register • Rejected Material Register • Site Order Book • Hindrance/ Delay Register • Daily Log • Design Register • Test Log • Test Reports • Site Laboratory Record • Instruction Log (to be maintained by PMC and Contractor both) • Permissions Issued by Departments • Correspondence Record • Equipment Register • Labor Register • Approved Construction Drawings, drawing register • Copies of Monthly Progress Reports • Any other records as specified in the Contract and/or as instructed by the Engineer • Visitor's Register and • Material test Register

2 PRELIMINARY PREPARATIONS

2.1 Work Before Going on Site

The Supervising engineer should have spent some time before he goes to site examining the contract agreement and drawings, particular and standard specifications, related IS codes etc. and be familiar with all aspects of the health and safety manual. He should have also taken the opportunity to have discussions with the designers. He should get to know how the contract has been designed, so that he is able to make intelligent suggestions if the conditions revealed during the course of construction differ from those expected. He should make a file of all information, which is basic to the contract, such as soil test data on which the design has been based; levels; rainfall and run-off data; geographical information and any other relevant data.

The compilation of this file will effectively act as a check on the situation to date so that the Supervising engineer can advise the Engineer of any matters still outstanding that have to be settled. The Supervising engineer will take a large part of the responsibility for seeing that all site and contract matters are conducted in due time and in the right order. Thus, the tentative programme of construction will be one of the documents most carefully studied by the Supervising engineer so that he is ready to understand and check what the contractor proposes as soon as the work starts.

2.2 The Site office

Upon arrival on the site, one of the first things the Supervising engineer will have to decide is where he will have his office placed and what size and layout it shall have. If there is any choice in the matter, the office should be placed so that from it the main traffic in and out of the site can be observed. It is a mistake to choose a situation which overlooks the requirement but which does not have a view of the main entrance. Little worthwhile can be seen of the normal civil engineering job from a distance, whereas even a distant view of the entrance to it will enable the Supervising engineer to notice a number of happenings- the delivery of materials, plant going off the site, when callers are about to descend, and so forth.

Adequate secure storage space is essential for storage of instruments and for storing special equipment to be incorporated in the job.

2.3 Initial Coordination with the Contractor

The question of an office and its sitting having been settled with the contractor's representative, the next items to be discussed will almost certainly concern the laying on of services to the job – telephone, water supply, electric power, and drainage. Water supply will also be required; the contractor's representative will seek the Supervising engineer's consent for the source of supply used.

The Supervising engineer should go out of his way to help in these matters, not only because upon them depends the effective start of the work but also because everything he can do to help the contractor's representative at this stage will assist in building up a good relationship later.

The question of drainage and sanitation may prove difficult to solve. The Supervising engineer has to watch that what was promised to be a small 'sewage treatment works' does not get whittled down to no more than a tank and a soak well, or a tank and overflow to a near-by ditch or river. This is the time to make sure that any sewage works proposed are of the right sort and are large enough to treat all the sewage from the maximum number of men who will be employed on the site. If these sewage works are later found inadequate, it may

prove easy to get promises for their enlargement from the contractor, but considerably more difficult to get effective action if the contractor's representative feels that , given a few more weeks, the numbers of men on the job will decline and the problem will solve itself. The question of waste oil disposal from plant is very important, and should be brought to the notice of the contractor's representative. Discharge of used lubricating oil or waste diesel oil is to be controlled; to discharge it through the site sewage works may ruin their proper functioning; and the discharge of even small quantities to a river will not be acceptable. The waste oil should be led to a pit and disposed of by tanker.

2.4 Preliminary Issues and Contractor's Programme

The Supervising engineer will next need to know what part of the job the contractor's representative intends to tackle first, and from this may follow an immediate visit to that part of the site and a discussion as to the extent of the work required there and the necessary setting out that must precede it. The contractor's representative will need to know what are the local benchmarks, which have been used for the original survey of the area and, if these are some distance away, they may both agree that their staff should jointly arrange for a convenient benchmark and base line to be set out on the job.

When the immediate proposals for working have been sanctioned by the Supervising engineer the next topic is the programme as a whole, and this is the first of many such discussions that will occur. Sometimes the contractor's representative wants more information from the Supervising engineer so that he can continue with making his detailed plans, or he may have perceived some problems ahead which he thinks might be avoided if the engineer would sanction some action not exactly in line with the correct requirements.

2.5 Early tasks for the Supervising Engineer

2.5.1 Recording of Existing Conditions

It is likely that excavation for foundation will have commenced, or will commence immediately, on a large scale. It will thus be imperative for the Contractor to take levels of the natural ground over the site where the excavation is to take place, if these levels are not already available in sufficient details. This is urgent work, for there will be no chance later of finding what the natural ground levels were, and the calculations for quantities of excavation will be largely intelligent guesswork, or agreement will have to be sought on bill of quantities/figures which may well differ from the true value.

The contractor has to jointly record the existing ground levels at site with the Supervising engineer and get them certified. No claim of the contractor on account of variations in the quantities of excavation will be admissible in absence of the certified records. It is not sufficiently reliable to assume the ground levels, shown on the contract drawings are accurate, because they may have been based on previous mapping data that alterations may subsequently have taken place, or they may not be accurate enough for measuring quantities.

2.5.2 Disposal of Site Debris and Excavated materials

The question of the disposal of site debris and excavated material will have to be considered. The Supervising engineer must see that the top-soil is being stripped off and stacked separately for re-use if necessary. The removal and disposal of existing materials on the site or the pulling down of existing structures will have to be discussed.

2.5.3 Scheduled Ordering of Materials by the Contractor

The next task the Supervising engineer may well be called upon to do, if he has not done it already, will be to check the ordering of materials necessary for the first stage of the work. The type of materials to be considered will be such things as the reinforcing bars required for concrete foundations and any pipes, which may be necessary to have during the early stages of construction.

2.5.4 Setting up of Site Administration Systems

It will be necessary to set up a clerical system for the handling of correspondence, filing, measurement of quantities and checking of contractor's claims, and for log sheets of all technical data. Files, a filing cabinet, box files, diaries for everyone and a large site diary, level books, notebooks, graph paper, drawing paper etc. will be required.

2.5.5 Protection of the Environment

The contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.

The contractor shall ensure that emissions, surface discharges and effluent from the contractor's activities shall not exceed the values indicated in the Employer's requirements, and shall not exceed the values prescribed by applicable laws.

3 DOCUMENTS, RECORDS & REPORTING

Document control is intended to provide a consistent framework for transmittal, receipt, recording, processing, filing and retrieval of documents, and to ensure commonality in formats. The most important documents for QA/QC are final design documents, test reports and instructions. A flow chart for control of these documents is shown in **Figure 3.1**. Document control procedures, including guidelines for correspondence control, are outlined below.

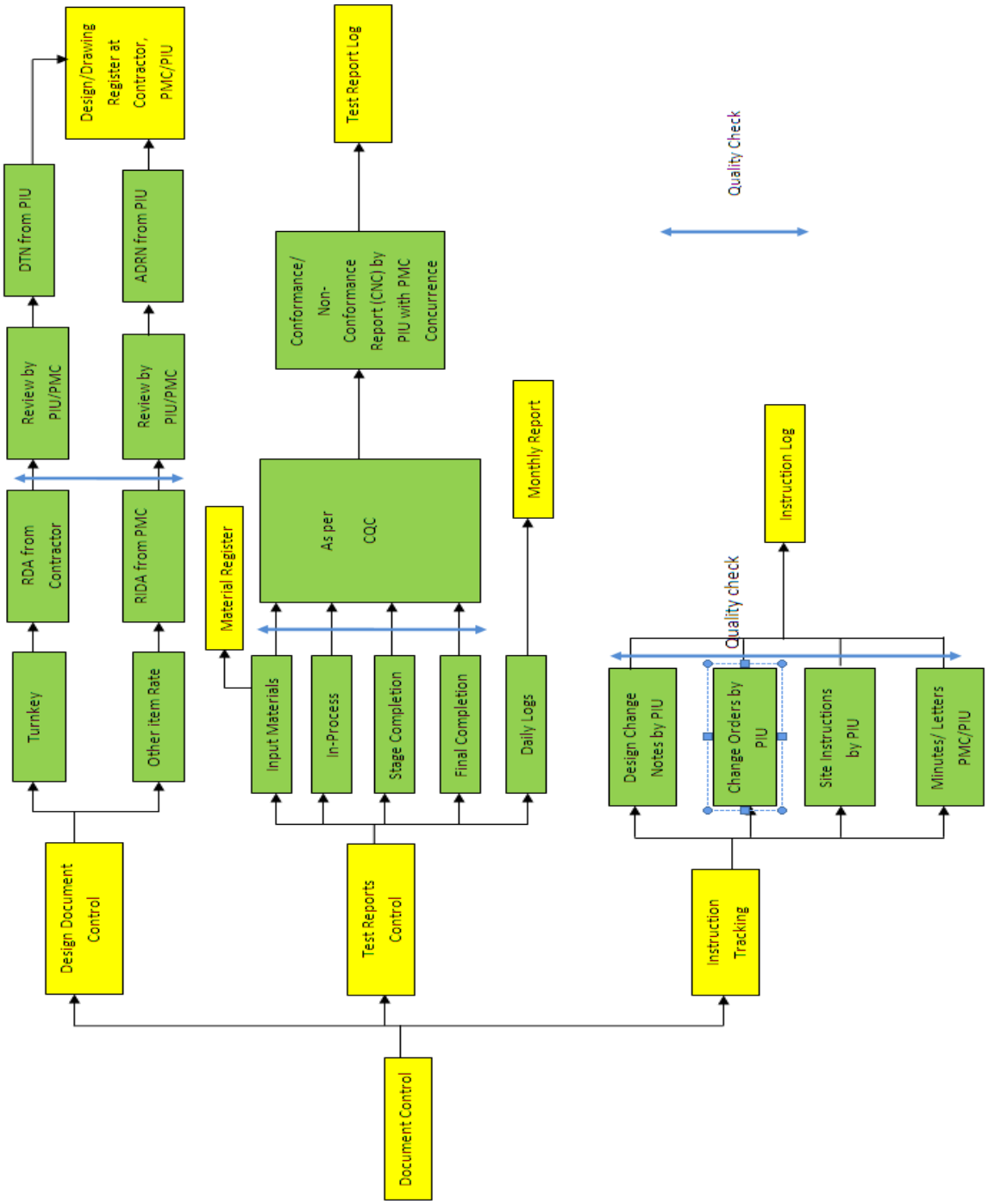


Figure 3.1: Flow Chart for Document Control

An important part of the Supervising engineer's work and QA/QC procedures is to keep adequate records. These records enable an appraisal to be made at any time of the progress of the work; they form the basis of fixing an accurate assessment in monitoring the contractor's work, they enable all materials to be ordered in good time, they enable the designers to be assured that the assumptions made for design purposes are valid, they assist in the solving of new design problems that may arise during construction; and they form a source of information throwing light on the subsequent behavior of the completed works. Records may be categorized into the following four classes:

- Historical;
- Quantitative and Financial;
- Qualitative;
- "As Built" Records.

3.1 Design Document Control

As discussed earlier (See Section 2), final design documents (drawings, calculations, estimates, etc.) are generated at three separate levels, depending on the contracting procedure and type of work. These factors have been considered in suggesting the design document control system.

3.1.1 Turnkey Contracts

The flow of final design documents prepared by the contractor in turnkey contracts shall be as follows:

1. The contractor shall submit **four copies** of design documents to PIU (DJB) for review, using the Request for Design Approval (RDA) Format F-1 of **Appendix C**.
2. The PIU (DJB) shall send **three copies** of the documents to PMC for review and comments, using the Request for Internal Design check Review and recommendation (RIDCRR) Format F-2 of **Appendix C**.
3. After review, the PMC shall return **two copy** of the documents with its comments, using the Internal Design check Review and recommendation Note (RIDCRR) Format F-3 of **Appendix C**.
4. Taking into account the comments of PMC, the PIU (DJB) shall accordingly return one copy of the approved design documents to the contractor, using the Design Transmittal Note (DTN) Format F-4 of Appendix C. Design documents shall be marked (or stamped) 'Approved', 'Approved as Noted' or 'Not Approved'.
5. For design documents marked 'Not Approved', steps 1 to 4 above shall be repeated. For documents noted 'Approved' or 'Approved as Noted', the contractor shall submit originals to PIU (DJB) for affixing 'Approved' signatures (using a format similar to F-1.).
6. The PIU (DJB) shall have the design documents signed 'Approved' and return them to the contractor (using a format similar to F-4).
7. The design document details are to be recorded in the contractor's Design/Drawing Register, using the Format F-5 of Appendix C. (Similar registers shall also be kept by PIU (DJB) & Item Rate Contracts (Wending Drawings).

- The approved drawings shall be transmitted to the contractor by PIU (DJB), using the Approved Design Release Note (ADRN) Format F-6 of **Appendix C**.
- The document details are to be recorded in the contractor's Design/Drawing Register, using Format F-7 of **Appendix C**. (Similar registers shall also be kept by PMC.)

3.2 Test Report Controls

All the tests and field checks are to be carried out as per the applicable quality control requirements. The tests are carried out by the contractor who will designate (Engineer) a laboratory-in-charge authorized to carry out and sign test reports for him. The witnessing

officer will sign the reports and put his name and designation. The flow of test report documentation shall generally be as follows:

- **Two copies** of all Test reports shall be submitted by the contractor to the PMC.
- The PMC with its comments shall forward **one copy** of the test reports to PIU (DJB).
- The PMC shall issue a Conformance/Non-Conformance Report (CNC Report) to the contractor after review of test results by the PMC, using Format F-10 of **Appendix C**. The CNC reports will have a running serial number for each contract package.
- The CNC report shall be entered in the Test Report Log by the contractor at the site, using Format F-11 of Appendix C. The details of input materials will be recorded in the Material Register, using Format F-12 of Appendix C. The contractor shall maintain all test records properly.

Other approvals given to the contractor will be recorded in the daily logs of the contractor which should form part of the contractor's monthly report. A recommended format for Daily Work Record/Site Order Book is illustrated in Format F-13 of Appendix C.

Similar procedures shall be followed for the transmittal and review of test reports for tests performed at outside laboratories, for manufacturers' certificates, and for third party inspection reports.

3.3 Tracking of Instructions

During the process of construction, different agencies are expected to conduct site visits and instruct the contractor to ensure quality and timely construction within the costs to the extent possible. The multiplicity of agencies is a special feature of the Project. Hence there may be some ambiguity in the instruction flow if these are not transmitted and recorded properly.

All the instructions to the contractor shall flow through the Engineer of the PIU (DJB). The instructions are of the following types:

- All instructions related to the contract administration including approval of the contract variation orders, time extensions, notices related to rate of progress etc. to be issued by PIU (DJB).
- The instructions regarding quality, testing, monitoring and work scheduling can be issued by the PMC also. In case of conflict of instructions of the PIU (DJB) & PMC in these matters, the instructions of the PIU (DJB) would prevail.
- Instructions issued during site visits or inspections of the PIU (DJB) & PMC, which are normally recorded in the contractor's Site Order Book, shown in Format F-13 of Appendix C; and
- Instructions issued during review meetings in the form of minutes, letters, etc.

All instructions noted above are to be recorded in the Instruction Register to be kept and maintained by the contractor using Format F-15 of Appendix C. Instructions also include notices of rejection of work inspected because it was found to be non-conforming to requirements and which has to be redone or rectified.

3.4 Contractor's Site Order Book

The Contractor shall be responsible to maintain a Site Order Book, at the site of the works at all times, and this shall be open for inspection by authorized representatives of PIU (DJB) & PMC.

The Site Order Book has two primary purposes – to record the day-to-day instructions to the Contractor and the Contractor's compliance with these instructions, and to record the

inspection and acceptance of work completion stages along with issuing approvals to the Contractor to proceed with the next stage of construction.

As noted above, the status of the Contractor's compliance with instructions issued is to be summarized in the Instruction Log (Format F-15 of Appendix C), and reviewed monthly by the PMC/PIU (DJB) and during the periodic Squad Checks. In cases where the Contractor has failed to comply with the instructions, the reasons therefore shall be determined and necessary remedial actions taken.

The PMC and PIU (DJB) will maintain a file of site orders issued to contractor for record and compliance.

3.5 Correspondence Control

3.5.1 Site Filing System

One of the first matters to be dealt with is the setting up of a correspondence and filing system. An indicative list of the files likely to be required is given in **Appendix-E**.

Out-going letters (including transmittal letters and notes) originating from various organizations involved in the Project: PIU (DJB), PMC, contractors, manufacturers, etc. shall be signed only by the designated project executive of that organization; for example: Project Director and Principal Chief Engineer, or person authorized on his behalf, PIU (DJB), PMC Resident Project Manager, Contractor or manufacturer authorized representative).

All letters should have a reference code and number, and should refer to a single subject only, which shall be clearly stated on top of the letter, after the recipient's address. All outgoing letters should be numbered sequentially. All replies should refer to the originator's reference code and number and subject.

Incoming correspondence should be stamped and dated, and preferably given an internal reference code and number. All incoming and outgoing correspondence should be logged chronologically, either in computer correspondence registers or in manual correspondence logs.

Copies of outgoing correspondence and originals of incoming should be filed in chronological files at the document center of each project organization. There should be only one chronological file for all outgoing correspondence. Regarding incoming correspondence, there could be more than one chronological file, based on the volume of correspondence expected to be received from project related organizations (for example PIU (DJB) & PMC can maintain separate incoming chronological files for each contractor, etc.)

3.5.2 Drawing Register

A register for drawings should be maintained by the contractor. The most efficient method is to set up two registers of drawings; the first recording all drawings received; the second recording all drawings made on site. The incoming drawings will need no number added to them, since they should all possess an original number. All that is necessary is to 'book' them in and mark the revision and date received.

The register for drawings made on site should show the following details:

- Consecutive number of drawing;
- Subject and revision of drawing;
- Size and type of drawing;
- To whom copies are sent and when.

A register is not consulted by a person who knows where a drawing is; it is only consulted by those who do not know. Hence a description of what one is looking for is helpful.

3.6 Historical Records

Historical records show progress stage by stage, as proposed and as achieved, including all relevant information having a bearing on this subject, such as records of weather, notes of discussions, decisions, and other key matters influencing the course of the job.

The principal records that have to be kept in this category are:

- inspection daily returns;
- the site diary and related records;
- the Supervising engineer's diary;
- the weekly and monthly reports;
- instructions to contractor; and
- sketches to contractor.

3.6.1 Inspection Daily Returns

The Inspection Daily Returns form is an excellent record of the daily work on site, to be prepared by the contractor and checked by the inspector. An example is shown in **Figure 3.2**. The sheet shown is purposely simple; it concentrates on extracting, through the inspector, information as to the work completed during the day; how many men were engaged on each part of the project; details of delays; and other related and pertinent issues.

The supervising engineer, or inspector, is not asked to answer a complicated questionnaire; he references at the top of the form to remind him of the separate parts' of the works, and he is asked to report all delays. The form not only focuses the supervisors activities for the day (he must visit all parts of the works and report thereon) but it also gives the supervisors a chance to communicate with the office.

The daily returns form an invaluable record, being of great help should any later dispute arise with the contractor as to progress or payment for standing time or extra work

3.6.2 Site Diary

The Site Diary is a day-to-a-page diary which is built up from the Inspector's time sheets, all relevant notes about visitors to site, engineers' operations, and any other related matters.

Weather records should be kept in the diary recording maximum and minimum temperatures and what time is lost due to rain. It might be thought that temperature records are not really necessary, but sometimes inexplicable events or failures occurring later, in parts of the structure, may be traced to the weather prevailing at the time.

One wall of a tank may, many months after construction, be found under test to spring an unaccountable number of leaks or damp patches in comparison with other walls, and a reference to the weather diary, which reads, 'Heavy showers throughout the day', may remind someone that a downpour of rain sent the men scattering for cover and that, in the general haste to get the wall concreted before further deluges, punning or vibrating of concrete was probably sketchily done.

Similarly, efflorescent patches on brickwork may be traced to building in wet weather, and cracks in concrete found to be probably due to high temperatures and sunshine prevailing for a period after concreting.

3.6.3 Supervising Engineer's Diary

The Supervising Engineer's Diary will be different from the site diary, as it will aim to record all major decisions made and instructions given. It is not an easy document to keep. On busy days it is often difficult to find the time to write down the day's activities; on 'off-days' there is apparently so little happening that nothing worth recording can be recalled. However, effort should be made to keep to a system, and it is as well to make a list beforehand in the front of the diary of special points to be noted.

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

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

Figure 3.2: Inspection Daily Report

Date .....

Shift: ~~Night~~/ Day

Work Done by Contractor	No. of Men
(1) Excavation, (2) Pipeline Installation, (3) Concreting, (4) Shuttering, (5) Pump House, (6) Foundations to Intake Well, (7) Miscellaneous.	
(1) Excavation: (flank of northern radius) *Visited site but no work completed by the Contractor as agreed under Site Instruction No. xyz. Testing schedule to be agreed.*	
(1) Excavation *1 dozer in poor condition to be removed from site and replaced immediately Chainage 1+254 U/S trench siding collapse rectified and trenching shoring in place on each side. Bank shoring in place as agreed.* *Placement of backfill material delayed due to requirement for improved material: imported material for the critical section due too be delivered from zone A shortly. Contrcator informed under Site Instruction abc.* *Pipe bedding preparation for section of trench chainage 1+380 to 1+ 475.* *Labourers directing traffic excavating for settlement apparatus north of wall and cleaning out term drainage channel south of wall. 2nd D8 also assisted new 38 RB down quarry road.*	*1 Forman* *1 Head Mason* *2 Deputy Masons* *2 Truck drivers (10 ton)* *1 Truck driver (5 ton)* *2 Dumper truck drivers* *1 Water Tanker driver* *1 Plate compactor (poor quality)* *2 Manual Rollers* *20 Labourers*
(4) Shuttering: (anchor blocks to 1500mm main) *Crane in place until 2.30 pm. Carpenters and masons awaiting the delivering of supporting bolts and timbers. Drillers delayed 3 hrs.* *Rock encountered at Chainage 2+500 US: extent of work to trench formation (noted as 350mm for full width of trench) in fabricating special shuttering for anchor blocks. Drilling rock faces, Shotfirer and 1 labourer Request for blasting denied. New dozer removed to excavation works.*	*1 Head Carpenter* *1 Head foreman* *1 Drilling machine* *2 Lorry driver* *4 Labourers*
(5) Pump House *13 labourers working at the dry well in preparation of bases for casting due in two days. Middle access road to site in needs of temporary works, SI to be issued to Contractor as discussed in Progress Meeting and recorded minutes.* *Sump location formation levels agreed and finalized at 12.30 pm. 13 labouere working at green road tidying up verges, helping masons to make channels for dewatering.* (6) Foundations to Intake Well *15 labourers working at the excavated formation in preparation of bases for casting due in two days.*	*3 Masons* *2 Truck drivers (5 ton)* *1 Dumper truck driver* *1 Water Tanker driver* *1 Lorry driver* *26 Labourers*
(7) Miscellaneous *Men grubbing, felling and removing trees: 10 finished at 12.30 pm.*	*1 Foreman* *16 labourer*
REPORT ALL DELAYS AND BAD WORK *1Dozer broken down all day* *1 compressor taken from site for repairs: broken down all day* *1 truck broken down from 9 am.*	Time lost and no. of men Involved *1 Dozer & driver* *1 plate compactor malfunction: 2 lab*

Hours worked by Supervisors...9 ½ ....

Signature: Contractor's Site In Charge .....

3.6.4 Weekly Monthly Reporting

The contractor will submit a Weekly Report in duplicate copy. This will be checked by the supervisor and a copy of the report sent regularly from the Supervisor to the Engineer, describing in summary the job events of the week. A typical example is shown in **Figure 3.3**.

The monthly report is a more generalized summary of progress, written in a fashion which is suitable for presentation to the PIU (DJB). It will not be so technical as the weekly report for submission to the Engineer, but it will still be clear and concise. The Supervising engineer will submit the monthly report direct to the Engineer, and copies to agreed recipients.

3.6.5 Day to Day Instructions to Contractor

There are often daily occasions when it is necessary to inform, or make requests to, the contractor about the work. Some simple system of sending notes to the contractor's representative or to member of his staff is necessary. It is best to have only one book in use at a time, all staff writing their notes in it, the carbon copy which remains in the book representing a daily log of all detailed written instructions sent to the contractor's representative.

Many small but important matters can be dealt with in such a manner—notes about levels set out, notes about shuttering, type of materials to be ordered, results of concrete tests, minor complaints and reminders, details of dimensions and setting out, elucidation sketches, and so on. The notes are handwritten, the sketches freehand, the signature being that of the person providing the information. The carbon copy remaining, forms a useful record in many ways. It forms a kind of 'central notebook' in which basic levels appear; the sketches and dimensions are useful for making alterations to the record drawings and for computing quantities of work done. In addition, it forms an excellent 'source of information', enabling the Supervising engineer to see in a moment or two what instructions his staff are currently giving the contractors staff.

For more lengthy notes to the contractor, or where more than two copies must be sent out (e.g. two for the contractor's representative and a third copy for related stakeholder), typed notes may be necessary, and these should be headed 'Memo to contractor's representative' rather than be put on official notepaper

3.7 Quantitative and Financial Records

Quantitative and financial records measure all that is done, the time and rate it is done, together with all relevant particulars, so as to form a basis of fair payment to contractors and for the furnishing of figures which show the cumulative cost of the job, the cost of separate parts of it, and the estimated total final cost at any time.

3.7.1 Quantity Records

The contractor shall submit the measurements for verification of the Supervising Engineer. Certification of the measurements/quantities will be one of the more important tasks of the Supervising engineer and his staff. Many techniques of measurement may be employed, but the main essential for them all is to comply with owing two simple rules:

- it should be possible to ascertain immediately from the records what has been measured and what has not; and
- the records must clearly show what has been paid for, as distinct from what has been measured. If this is not clear from the start, then endless confusion will result.

Figure 3.3: SAMPLE Weekly Report

Weekly Report No. xx

(For week ending xx th June 20xx)

CONTRACT PACKAGE REFERENCE NUMBER

CONTRACT TITLE:

Bill item 52. Extension to Pump house

Continuous rain delayed waterproofing of roof until 5 plastering sub-contractors started work on 21st. They will finish next week. Installation of switchboard awaits arrival of manufacturer's fitters promised for 29th.

Labour: 2 plus 2 plasterers.

Bill item 54: Electrical re-wiring

Cable laying completed but awaits connection to switchboard. Lighting wiring completed as far as possible. Contractor withdrew men from site on 24th and will return to complete after switchboard connection made.

Bill item 57: Main laying

The extra sluice valve required at Ch. 3500 was delivered. This completes all deliveries under the valve contract (Contract 53).

Materials to Site:

Delivery of steel 6oo mm dia. pipes continues. Total delivery to date 4600 m or 82 per cent order (Bill item 55).

Supply of small cast-iron pipes and fittings continued. Only a few items now outstanding (bill item 56).

Approx. 260 m of pipe laid during week by two gangs working from point 'F' forward and point 'G' back; chainages 3260—3840 and 4480—4210 respectively. Suppliers are being pressed for delivery of special T-junction Ch. 3500 which is promised for next week.

The crossing under the two main-line tracks was completed successfully at Ch. 4400 and in 14 hrs. continuous working.

Labour: I General Foreman, 2 section foremen, 3 gangers, 3 jointers, 7 drivers, II labourers.

Plant: 2 back shovels; crane; 3 dumpers; dozers; 2 concrete mixers; 4 lorries (5 ton).

Testing. Testing to point F from H was satisfactory and the section left out at Point F for testing was re-inserted and the line made good. Main has now been passed from Ch. 500 to Ch. 3260.

Miscellaneous, A director of Messrs. Smith accompanied by the sports ground manager inspected the reinstated trench through the sports ground and was satisfied.

General Notes:

Weather:	Wet. 2.55 cms rain Temp. 57° to 68° F.	
Lost time:	2.men x 6 hrs. Contract 52. Nil Contract 57.	
Visitors:	Director Messrs. Laxmi & Co.	25th
	District road inspector to Contract 57.	25th
	Representative pipe suppliers.	21st.

Signature / date ……

Contractor's Supervising Engineer

The records should therefore be divided on lines which are suggested as follows:

- A series of notebooks containing sketches and dimensions of work as executed, where different from the contract drawings;
- A book or file containing the working out of the quantities;
- A summary of the quantities from time to time worked out, classified under bill items; and
- A final summary of quantities agreed for payment on each certificate.

3.7.2 Field Note Books

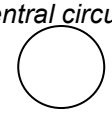
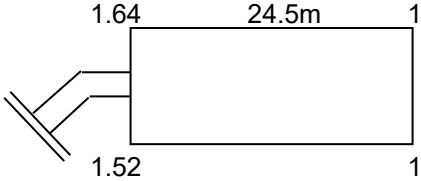
The first records for quantities mentioned above will be in field note books, and the data will be placed therein from time to time as the work proceeds. This data shall be collected by the contractor's quantity surveyor or measurement engineer and written in collaboration with the Supervising engineer acting in so that the measurements are agreed on site.

Accuracy, clarity, and sufficiency of measurements are essential. As the monthly date for measurement of quantities approaches, the supervisors and related staff will bring the certified measurement notebooks up to date and ready for use in the calculation of quantities. The items of the bill will be through in order and the necessary calculations under taken to find out the amount of work done during the month under each item.

At this point there are two alternative systems which can be used. In the first system a loose-leaf file is set up, consisting initially of a page each item, further pages being added as necessary later. Refer to **Figure 3.4**, which illustrates the necessary quantity calculations are inserted for each item.

(A page from the quantities register: Loose Leaf) **Figure 3.4: Quantities Register**

ITEM 420

		cu.m.
Item 420 Contd. *CERTIFICATE 2* ……*Brought forward*		387
Add central circular pits *2 No.* *Rad of 15m* 	*2/π, 15², 1.25 = 1782 cu. m.*	1782
	Cert. 2 (400 paid)	2169
CERTIFICATE 3. Main tank depths after stripping 1.64 24.5m 1.44  8m 1.52 1.36	Av.d = 1.58 Av.d = 1.40	1.49 Av.
V = 24.5 x 1.49 x 8.0		292
Add inlet trench: 1.0 x 2.0 x (2.1+1.2) =		6.6
Add outlet sump: 3.1 x 1.7 x 0.5 =		2.6
drain: 1.5 x 1.9 x 0.55 =		1.5
		302.7 → 303
	Cert. 3 (828 paid)	2472

Note: This is the working-out register of the quantities, and preferably Consists of a file loose -leaf sheets so that further sheets may be inserted as necessary for any particular item.

In the second system, bound calculation books are used, the quantities for the month being calculated item by item and then the month 'ruled off'. Because extra leaves cannot be inserted when bound books are used under this system, a page reference system must be used so that the quantity measured up to the last certificate for any item brought forward as the starting quantity for the current month's addition measurement.

This is necessary because the amount entered in the bill of quantities is always the cumulative total measurement since the contract started, not just the total completed for the month.

The difference between these two systems is one of convenience The first system is physically not quite so convenient as the second, since calculations have to be inserted in a bulky loose-leaf file (or in separate files) rather than in easily handled calculation books.

On the other hand, under the system all the quantity calculations for any one item are collected together; whereas under the second, the quantities for any particular item must be referenced through the calculation books, and an error of referencing may result in quantities being missed out or being measured twice. In the hands of competent staff; however, either system works well.

3.7.3 Comparison of Measured Quantities and Contractor's Claim

With regard to comparison of measured quantities with the contractor's interim claims, calculated quantities must now be compared item by item with the quantities claimed by the contractor in his monthly claim. The monthly claim form from the contractor should be presented according to the sample form shown in **Figure 3.5**.

The comparison required is between the contractor's quantities under the heading 'total to date', column (s), and the Supervising engineer's own certified quantities. Where differences are found conversations with the contractor's site staff will be necessary.

It may be that quantities put forward by the contractor are less than quantities certified by the engineer, or, as previously mentioned, they may be arbitrary figures used for payment purposes only. Thus, for bulk excavation which has only been partly completed, it is a waste of time trying to compute accurately the quantity excavated to any given day.

The quantity, as finally excavated to the underside of the foundations, and so on, is the figure that must be exact, and this calculation need only be undertaken when foundation excavations are completed.

3.7.4 Authorization and Measurement of Extra Works

Any extra or varied works must be authorized in writing by the engineer. Verbal orders may be given, provided this is later confirmed in writing either by the engineer sending some authorization to the contractor or the contractor confirming the orders by a letter to the Engineer.

It is frequently impossible for the engineer to send a written variation order to the contractor in advance of the variation being undertaken.

What happens is that agreement is reached between contractor's representative and Supervising engineer on the site that a certain matter 'shall be covered by a variation order', and it is then up to the Supervising engineer to submit a draft order to the engineer for his signature. A typical variation order issued is shown in **Figure 3.6**.

CLAIM FORMS

Section 3-Tanks Page 6

Item No.	Description	As BOQ		As Measured			As BOQ	Amount
		Quantity (1)	Unit (2)	Last Certificate (3)	Since Last Certificate (4)	Total to Date (5)	Rate Rs. (6)	Rs. (7)
	Excavation							
418	*Stripping top soil*	*483*	*cu.m.*	*110*	*-*	*110*	*68*	*7,480*
419	*General excavation*	*836*	*cu.m.*	*400*	*428*	*828*	*68*	*56,304*
120	*300mm by hand*	*92*	*cu.m.*	*-*	*74*	*74*	*68*	*5,032*
422	*Excavation for base ladder*	*210*	*cu.m.*	*-*	*-*	*-*	*68*	*-*
				Total for	*excavation*	……..	…….	*68,816*
	Mass Concrete							
423	*Plain cement concrete: Class M15*	*19.50*	*cu.m.*	*10*	*6*	*16*	*1882*	*30,112*

Section 3- Tanks – Extra BOQ Items Page 10

Item No.	Description	Comparable BOQ Item	Unit	As Measured			Agreed Rate	Amount
				Last Certificate	Since Last Certificate	Total to Date	Rs.	Rs.
422A	*Extra excavation by hand below trench*	*422*	*cu.m*	*-*	*5*	*5*	*68*	*340*
426A	*Class M25 mass concrete*	*426*	*cu.m*	*-*	*11*	*11*	*2550*	*28,050*

Figure 3.5: SAMPLE Claim Forms as Submitted by the Contractor

Note. This is the claim form as presented to the engineer for checking so that he can issue a certificate for payment. Extra bill items at agreed rates are frequently inserted on a separate sheet as shown. Verification orders should be issued to cover these extra items.

VARIATION ORDER

No……..

Job……...

Contract No…… Description……...

Contractor……

In accordance with and subject to the Conditions of Contract you are hereby instructed to execute the following work:

The prices to be allowed for the above work shall be:

This work is additional to/ substituted/ or work hitherto included in the Contract.
You are instructed to omit items of work as follows:

ESTIMATED NET EFFECT ON THE COST OF WORKS

This Variation Order ……increase/decrease

Add total effect of previous Variation Orders issued ……increase/decrease

Total estimated effect ……increase/decrease

Signed……. Signed ……..…….

Supervising Engineer Engineer

Date …… Date ……..……..

Figure 3.6: Typical Variation Order

3.7.5 Extra Incidental Works

Normally the Supervising engineer and contractor's representative would come to an agreement as to the price to be paid for the extra incidental or varied works, before the draft order is submitted to the engineer for signature. This price is an agreed rate for payment by measurement based on standard rate analysis with current costs and input for material and labour.

3.7.6 Other Records

Where long pipelines are laid it is usual to produce a pipe-laying record book which itemizes in sequence the laying of every pipe and fitting which has been laid. The invert levels of pipes are given in metres O.D. either to every pipe or at very point of change of gradient. Notes as to bedding, haunching, or surrounding in concrete are given, and each fitting or cut pipe is described. From time to time offset distances from near-by buildings or other landmarks to particular fittings, such as bends where a change of direction occurs, are noted in the record book, so that their position can be found afterwards if required. The cumulative chainage from the starting-point is given as measured on the ground. Large s and drains crossed by the trench are similarly logged in a record book.

Where plant or proprietary equipment has been included in the works, the contractor shall make up a data file which lists the maker of such plant and equipment, the original order reference and date, and any technical and other details of the plant. If the plant requires attention later on the employer will find it useful to have particulars concerning the original order. Instruction manuals and plant test data, such as performance curves of pumps, turbines, and motors, should all be submitted by the contractor to the employer in two sets of each, together with a set of the manufacturer's drawings in each case.

The impression might be gained that practically the whole of the Supervising engineer's time is occupied with paper work, but this is really not so. The size of the Supervising staff will vary with the size of the contract and it will be found that the keeping of the essential records outlined herein will only take up intermittent time. Records that are so complex that nobody can find the time to keep them going, are of no value at all, and the Supervising engineer should therefore first concentrate on getting down on to paper notes about things which cannot afterwards be checked. Sketches and dimensions of work, which is later to be hidden and notes on the number of men and hours worked on extra works are therefore the first essential records.

3.8 Qualitative Records

Qualitative records include all measurements and observations of the quality and behaviour under test of the component parts of works, the raw and made-up materials used, and the foundation - and other conditions whose characteristics have an influence on the behaviour of the works.

3.8.1 Register of Test Results

The contractor shall maintain a separate register to record results of all field tests and for every kind of testing procedure adopted on site, refer to the relevant sections of the QA/QC Manual. Initially, Register/files might be opened for the following:

- Borehole: Trial Pit: Auger hole Logs;
- Grading analyses of Fill Materials, subdivided:
  Specified requirements
  Actual results obtained.

- Proctor density tests;
- In-situ density tests;
- Concrete aggregate tests;
- Concrete cube tests; and
- Miscellaneous tests.

The above list presupposes that the work includes foundation testing, earth placing, concreting, which are all normal operations in connection with a civil engineering contract.

Other files may be opened for other sorts of test results in connection with other types of civil engineering construction, according to the nature of the contract.

3.8.2 Sample Register

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

Once this is done, the sample can always be referred to later by its number in correspondence and reporting, and all the details of how it was obtained, etc., can be traced back to the sample register. If consecutive numbering is not adopted, confusion and mix-up will sooner or later break out from trying to describe samples by other systems, such as by using grid references on site; or TP/ 1/1, TP/ 1/2 meaning Trial Pit No. 1, Sample 1; Trial Pit No. 1, Sample 2; and so on.

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

Col. 1. Sample number
2. Source (e.g. borehole, trial pit, etc.)
3. Location (e.g. chainage, grid ref.)
Col. 4. Depth
5. Description (brief only)
6. Container
7. Date taken
8. Where tested
9. Remarks/references

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

3.8.3 ‘As-built’ Records and Drawings

‘As built’ records are very important and consist of pictorial records (the Record Drawings, etc.) of all the works as completed, showing the whereabouts at dimensions of all parts as they exist at completion, together with factual descriptions of their origin, their operation as described in instruction manuals, and their performance under test.

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

The work on record drawings should continue throughout the contract, a special set of contract drawings being provided on which the contractor shall mark out all deviations from the original design. From time to time, where extensive alterations are encountered, or

where preliminary surveys are made, completely new record drawings will have to be made. The Supervising engineer will check each drawing for correctness and certify.

On numbers of occasions clarification of the existing contract drawings upon points of detail may be asked for by the contractor, such as a quick detail sketch of footing work for the bricklayer. If these freehand sketches are always drawn in a carbon-copy book the carbon copies will form an exceedingly valuable record in the Supervising engineer's office for record- drawing alterations, extra works, and so on. Even for such items as working out of sight rail heights for laying drains, position of holes to be left in concrete, and so on—if these and all the other odd little sketches produced in the Supervising engineer's office are automatically scribbled down on the carbon-copy book the record so obtained will be found to be extremely valuable.

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

3.9 Contractors' Progress Reports

The contractor's Monthly Progress Report, along with his monthly running bill, shall be submitted to the PMC (who will give a receipt) by the 8th of the month (original plus required copies as required). To facilitate timely payment, joint measurements shall be taken by the Contractor and the PMC by the 5th of each month, prior to close of the reporting period. The PMC Engineer will certify the agreed measurements.

The process of taking measurement will be witnessed by the PIU (DJB) who will verify the measurements in the Measurement Book. The reporting period would be up to end of previous month.

4 CONSTRUCTION QUALITY CONTROL – GENERAL

This section provides an overview of construction quality control activities, including testing and site inspection. Materials control requirements are presented in detail in Section 4, while specific testing and inspection requirements for each category of works are presented in Sections 5 to 9 of this Manual.

4.1 Introduction

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

- Testing
- Inspections

Testing control covers the type of tests to be carried out, frequency of testing and stage of testing. Inspection control covers the timing of inspections, what has to be inspected and the inspection procedures.

CQC should be affected at five stages:

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

The contractor is responsible for informing PIU (DJB) / PMC giving sufficient notice time so that they can witness the tests.

4.2 Testing

Various site tests on materials and works are required to be carried out by the contractor during construction. A well-equipped and properly operating site test laboratory is an important element of the quality assurance plan. A checklist showing typical testing equipment to be provided in the contractor's site laboratory is presented as **Table 4.1**.

4.2.1 Field Testing Laboratory

The contractor shall be required to establish a complete field testing laboratory and arrange all the relevant codes and standards.

The contractor shall set-up the site laboratory within 2 weeks after getting letter to proceed and inform the PIU (DJB) for conducting inspections. Laboratory equipment shall be properly calibrated, and calibration certificates and its updating as and when required should be kept at the laboratory for review by PIU (DJB) & PMC, as necessary. Specialized tests at outside laboratories, to be approved by PIU (DJB), shall only be undertaken with the prior approval of the PIU (DJB).

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

4.2.2 Outside / Independent Testing Facilities

Extensive testing of the material used for construction is a pre-requisite for attaining high quality of work. This shall also require specialize test, physical, chemical, ultrasonic, X-ray and various others type of tests which cannot possibly be carried out in a site laboratory. These laboratories may be in the Government sector, semi govt./private sector as approved by competent authority of DJB.

Table 4.1

Checklist of Testing Laboratory Equipment

Contract Package No:____ Name of Work: _____ Contractor Name: _____

Testing Equipment	Type of Test	Yes (1)	No (1)
1. Balance i. 7 KG to 10 KG capacity semi-self indicating type-accuracy 10gm. ii. 500gm. Capacity, semi-self indicating type-accuracy 1 gm. iii. Pan balance-5 kg. capacity- accuracy 10 gms. iv. Chemical balance-100 gm capacity-0.1 gm accuracy. v. Platform scale-300 kg capacity. 2. Measuring apparatus and hand tools:- i. Dial guage-25mm travel-0.01mm per division(2 nos.). ii. Graduated measuring cylinders 200 ml capacity-3 nos. and 1000 ml capacity 1nos. iii. Distant reading thermometers. iv. Steel tapes 3 mtr., v. vernier calipers , vi. micrometer screw 25 mm gauge, vii. plumb bob, viii. spirit level, ix. wire gauge disc, x. foot rule, xi. long nylon thread, xii. magnifying glass, xiii. screw driver 30 cm long, xiv. ball pin hammer 100 gm	General laboratory test		

Testing Equipment	Type of Test	Yes (1)	No (1)
Oven Electrically operated, thermostatically, controlled upto 110 ^{0}C- sensitivity 1^{0}C and upto 200 ^{0}C for determination of loss on heating of bitumen.	Drying and moisture content determination		
Sieves – As per IS 460-1962 (i) I.S. sieves - 450mm internal dia, of sizes 100 mm, 80 mm, 63mm, 50 mm, 40 mm, 25 mm, 20 mm, 12.5 mm, 10 mm, 6.3 mm, 4.75mm, complete with lid and pan. (ii) I.S. sieves- 200mm internal dia (brass frame) consisting of 2.36mm, 1.18mm, 600 microns, 425 microns, 300 microns, 212 microns, 150 microns, 90 microns, 75 microns, with lid and pan. Sieve shaker and Hydrometer- capable of 200 mm and 300 mm dia sieves, manually operated with timing switch assembly.	Grain size analysis and classification of soil and aggregates		
Atterberg limit apparatus	*Plasticity of Soil*		
Procter/modified proctor (IS heavy) density equipment	Soil compaction test		
Sand replacement cylinder and core cutter	In-situ density test for field compaction control		
Compression testing machine 100 MT and 5 MT capacity Electrically cum Manually operated	Compressive strength of cement, concrete, brick, etc.		
Cylinder and cube moulds for concrete and mortar	Concrete sampling		
Slump cone apparatus	Workability and control of water in concrete casting		
Vicat apparatus	Setting time determination of cement		
Laboratory CBR equipment	Determination of strength of road pavement and layers		
Dynamic cone penetration test equipment	Determination of strength of road pavement and layers		
SPT equipment and hand auger	Boring, sampling and soil strength test		

Testing Equipment	Type of Test	Yes (1)	No (1)
Unconfined compression testing machine	Determination of shear strength of cohesive soil		
Direct shear equipment	Determination of angle of internal friction of soil		
Consolidation test equipment	Determination of settlement /compressibility of soil		
Los Angles Abrasion test/ Impact Testing Machine	Los Angeles Abrasion test/ Impact Test		
Core drilling equipment	In-situ sampling		
Bitumen test equipment	Ductility test and Penetration test		
Pressure Gauges and Pumps	Pressure Testing		
Marshal stability test equipment	Road works. To be available at Hot Mix Plant site.		
Rapid Moisture Meter	Checking moisture content at site		
Metallic Contact Digital Thermocouple	Checking temperature of bitumen		
Sampling tins with rods 100mm dia × 50mm ht., 1/2kg capacity, and miscellaneous items like moisture tins etc., Moisture meter for timber Rebound hammer for testing concrete.	General laboratory test		

Note: 1. Yes or No to be tick marked by PIU (DJB)/PMC to indicate the equipment at the site laboratory)

In addition to tests performed on site, the contractor is responsible for specialized tests which are performed at approved laboratories, and for third party inspections at manufacturing premises of various materials and equipment components, as stipulated in the contract documents.

4.3 Site Inspections

Site inspections shall be carried out to ensure that the materials and construction activities conform to the prescribed standards. Site inspections can be divided into day-to-day supervision and periodic quality inspection. The suggestions in respect of these two have been elaborated herein.

4.3.1 Day-to-day supervision

The day-to-day site supervision of all construction activities shall be carried out by the PMC. This includes checking of lines, levels and layouts and on-site checks. Progress monitoring and expediting shall also be carried out by the PMC. The Supervising team of the PMC shall ensure that materials that have been rejected or for which a conformance report has not yet been issued are not used in works.

Construction equipment is a major component of quality assurance system. The equipment requirements have to be submitted by the contractor. The PMC will check the adequacy of the equipment used by the contractor for construction as per the prescribed standards and

specifications. The contractor shall maintain daily logs and Equipment Register for the equipment used for construction.

4.3.2 Periodic quality inspections

Senior Engineer of PMC & PIU (DJB) shall carry out periodic quality inspections during in-process, stage completion, interfacing and final completion, and during all critical activities as per the following examples:

- excavation
- formation of embankments
- placing of reinforcing steel
- concrete batching and pouring: 100% in presence of Support Engineer PMC and JE :PIU (DJB)
- hot mix operation
- laying of pavement layers
- laying and jointing of pipes
- installation of electrical and mechanical equipment
- testing, trial runs and commissioning of electro-mechanical equipment and plants
- Completion of excavation Trenches for Pipe laying
- Completion of Laying and jointing of pipes
- Pressure/leakage Testing of pipeline
- Backfilling

The PIU (DJB) & PMC shall also inspect the materials certified by manufacturers and materials and equipment components approved by third parties upon delivery to the site. The contractor shall give advance notice to the PIU (DJB) & PMC 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 (such as from sub-base to base in road works or from steel binding to concreting for RCC works) the PMC & Engineer-in-charge of PIU (DJB) shall inspect and certify the quality of the works completed before granting approval for the next stage of the works to start. The final inspection shall encompass tests on completion and trial runs. The certification of quality will be based on the documents and the periodic site visits. The PMC representative and the PIU (DJB) representative should witness not less than 30%and 10% of the test conducted respectively.

4.3.3 Squad checks

The concept of Squad Checks has been adopted to have an external review of quality of works executed. The squad checks should be conducted jointly by the PIU (DJB) and PMC. A fixed timetable is not suggested for this. The tentative agenda for the squad checks is described as follows:

- physical inspection of the works under execution and inspection of quality of workmanship;
- review of site documentation and contractor compliance;
- sample verification of test reports and quality certificates;
- review of issues, constraints and lacunae in quality system implementation;

- preparing of action plans for improving the quality; and
- Performance appraisal of the contractors.

4.4 Quality Certification and Acceptance

The PMC 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 progress bill is passed for payment. PIU (DJB) should signify acceptance of the PMC's quality certification by countersigning it. A format for this quality certification and acceptance is included in Appendix C, as Format F-18.

5 CONTROL OF MATERIALS AND EQUIPMENT COMPONENTS

This section provides an overview of control requirements for materials and equipment components, including site testing, manufacturers' certification and third party inspection.

5.1 General

Control and approval of construction materials and equipment components to be incorporated in the works shall be based on the following:

- Test reports for materials tested at site, such as cement, sand, water, aggregates and bitumen; the contractor will perform all tests. The designated PMC representative & PIU (DJB) representative shall witness as per **Section 1**. They shall sign the report in token of witnessing.
- Manufacturer's certificates and IS mark for manufactured items indicated in **Table 5.17** or as stipulated in the contract; and
- Third party inspection for various items as per contract documents.

5.2 Materials Tested on Site

The materials to be tested on site include cement, water, aggregates for concrete, bricks and stones, soil for embankments, and aggregates, concrete and bituminous materials for road works. For aggregates and soil, the contractor shall obtain the approval of the borrow source or quarry from the PIU (DJB) & PMC before extracting material. The list of materials to be tested on site is given in **Table 5.1**. Test procedures are presented in **Tables 5.2** to **5.16** under the referenced procedure numbers. Test report formats are included in **Appendix A**. The reports are to be maintained in a bound register, where in 3 copies of report will be prepared, two copies to be submitted with monthly report to PMC & PIU (DJB) and third copy to be retained by contractor.

Table 5.1: List of Materials Tested on Site

Sl. No.	Material	Test Procedure No.
1	Cement	QC-M-01
2	Sand	QC-M-02
3	Water for Construction Works (can be got tested in approved laboratory)	QC-M-03
4	Bricks	QC-M-04
5	Size Stone	QC-M-05
6	Coarse Aggregate for Concrete Work	QC-M-06
7	Soil/Earth/Sub-grade Material	QC-M-07
8	Granular Sub-base (GSB) Material	QC-M-08
9	Material for WBM / WMM	QC-M-09
10	Metal for BM/DBM/BC/Surface Dressing/MSS/Premix Carpet	QC-M-10
11	Binder for WBM	QC-M-11
12	Fine Aggregate for DBM/BC	QC-M-12
13	Lime	QC-M-13
14	Bitumen	QC-M-14
15	Borrow Material	QC-M-15
16	Steel (to be procured directly from manufacturer along with his test certificates) This shall also be got tested in local authorized test laboratory. Steel to be certified from Laboratory and Frequency of testing is 20 tonnes or part there of.	

Table 5.2: Procedures for Testing Materials on Site: Cement

CEMENT			QC-M-01	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Normal consistency	TC-M-01-01	Every 50 tones or part thereof and minimum One for each source	On receipt of material at site and before using as directed by the Engineer. Test certificate to be produced to the Engineer before use.
2	Fineness	TC-M-01-01		
3	Setting time – Initial/ final	TC-M-01-01		
4	Compressive strength -72 hrs, 168 hrs, 672 hrs.	TC-M-01-01		
5	Soundness	TC-M-01-01		
For sulphate resistant cement as per IS-12330 OPC				

Table 5.3: Procedures for Testing Materials on Site: Sand

SAND			QC-M-02	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Particle Size and shape IS 2386-Part-I	(For Sieve analysis)	One test for 40 m^3	On receipt at site and test certificate to be produced to the Engineer before use.
2	Fineness modulus	TC-M-02-01	One test for 20 m^3 or part thereof or more frequently as decided by engineers-in-charge.	
3	Deleterious constituents / Organic Impurities	TC-M-02-01	One test for 20 m^3 or part thereof or more frequently as decided by engineers-in-charge.	
4	Bulking test	TC-M-02-01	One test per 20 m^3 or part thereof or more frequently as decided by engineers-in-charge. or part thereof	
5	Silt content IS2386-PartII	-	One test for 20 m^3 or part thereof or more frequently as decided by engineers-in-charge.	

Table 5.4: Procedures for Testing Water for Construction Works

WATER FOR CONSTRUCTION WORKS			QC-M-03	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	pH Value	TC-M-03-01	Water from each source shall be got tested before the	Before use of water from that source
2	Limit of Alkalinity and acidity as per IS-3025	TC-M-03-01		

WATER FOR CONSTRUCTION WORKS			QC-M-03	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
3	Percentage of Solids – Chlorides, Suspended matters, Sulphates, Inorganic Solids, Organic Solids. IS:3025	TC-M-03-01	commencement of work and thereafter once in every three months till the completion of the work. Water from DJB source need to be tested only once in six months. Nos. of test for each source shall be 3	

Table 5.5: Procedures for Testing Bricks and Brick Tiles

BRICKS & BRICK TILES			QC-M-04	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Compressive strength	TC-M-04-01	For sl.1 & 3 Lot size: - max-50000 2001-10000=5 bricks 10001-35000=10 bricks 35001-50000=15 bricks For dimension test:- Lot size :- max-50000 2001-10000=20 bricks 10001-35000= 32 bricks 35001-50000=50 bricks	On receipt at site
2	Dimension	TC-M-04-01		
3	Water absorption test and efflorescence	TC-M-04-01		

Table 5.6: Procedures for Testing Stone

SIZE STONE			QC-M-05	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Water absorption test IS:1124	Lab format / TC-M-05-01	100 sqm. / 20cum or part thereof or change of source as per direction of engineer-in charge	On receipt at site
2	Transverse strength IS:1121	Lab format		
3	Resistance to wear and durability test IS:1706 and IS :1126	Lab format		

Table 5.7: Procedures for Testing Coarse Aggregate and Slump for Concrete

COARSE AGGREGATE FOR CONCRETE			QC-M-06	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Aggregate Impact or Los Angeles Abrasion Value as per IS-2386 Part-IV	TC-M-06-01/1 TC-M-06-01/2	For every 40cum or part thereof.	On receipt of material at site. For every 40cum or part thereof.
2	Aggregate crushing strength as per IS:2386	TC-M-06-02		
3	Deleterious material as per IS 2386-Part II	-	For all quantities	Minimum quantity of material as required by the engineer-in-charge.
4	Particle size distribution IS 2386-I	-	For every 45 cum or part thereof for RCC work only. For rest of item as decided by engineers-in-charge.	Minimum quantity of material for carrying out test 45 cum
5	10% Fine value as per IS 2386-Part IV	-	For every 40cum or part thereof.	On receipt of material at site. Minimum quantity of material for carrying out test 10cum
6	Water Absorption / Surface Moisture	TC-M-05-01		
7	Estimation of organic impurities			
8	Specific gravity			
9	Bulk density			
10	Slump test		15 cum or part thereof	Minimum quantity of material for carrying out test 10cum
When required, the contractor shall furnish the mix design along with material properties at least 15 days in advance.				

Table 5.8: Procedures for Testing Soil/Earth/Sub-grade Material

SOIL/EARTH/SUB-GRADE MATERIAL			QC-M-07	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1.	Swelling index IS 2720 part XL	TC-M-09-01	Two sets for 3000 m^3 or part thereof	On receipt at site
2.	Liquid limits and plasticity index	TC-M-09-02		
3.	Deleterious material IS 1498	Lab format	As and when required by the engineer-in-charge.	
4.	OMC & MDD Test	TC-M-09-03	Two sets for 3000 m^3	
5.	Chemical properties	Lab format		

SOIL/EARTH/SUB-GRADE MATERIAL			QC-M-07	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
6.	Grain Size Distribution Graph (by wet sieve analysis)	TC-M-09-04	or part thereof	
7.	Void ratio gradation	Lab format		
8.	Soaked CBR test (optional)	TC-M-07-01	Two sets for 3000 m^2 or part thereof and as directed by the Engineer	

Table 5.9: Procedures for Testing Granular Sub-base Material

GRANULAR SUB-BASE MATERIAL			QC-M-08	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	California Bearing Ratio Test	TC-M-07-01	As required	On receipt at site
2	Material combinations	Daily log		
3	Moisture content as per IS-2270	TC-M-07-02	1 test per 250 m^3 or part thereof	Prior to compaction
4	Fineness value BS 812 Part III	Lab format	As required	On receipt at site
5	Soundness of material	TC-M-06-02		
6	Air voids content	Lab format		
7	Gradation by wet sieve analysis	TC-M-06-04	1 test per 200 m^3 or part thereof	
8	Atterberg limits	TC-M-09-02		
9	Deleterious constituents	Lab format	As required	
10	OMC and MDD	TC-M-09-03		
The contractor shall furnish the GSB design mix along with material properties and test results at least 15 days before laying GSB at site.				

Table 5.10: Procedures for Testing Material for WBM/WMM

MATERIAL FOR WBM / WMM			QC-M-09	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Aggregate Impact Value	TC-M-06-01/1	One test for 200 m^3	On receipt at site
2	Grading by wet sieve analysis	TC-M-06-04	One test for 100 m^3	
3	Flakiness Index and Elongation Index	TC-M-06-03	One test for 200 m^3 of aggregate	
4*	Atterberg limits of binding material *(Only for WBM)	TC-M-09-02	One test for 25m^3 of binding material	
5	Atterberg limits of portion of aggregate passing 425 micron sieve.	TC-M-09-02	One test for 100 m^3 of aggregate	

MATERIAL FOR WBM / WMM			QC-M-09	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
6	Water Absorption Test	TC-M-05-01	Initially one set of 3 representative specimen for each source of supply and subsequently, when warranted by changes in the quality of aggregate	
7	Soundness Test	TC-M-06-02	One for each source of supply and when called for by the Engineer	On receipt at site and when absorption value is more 2%
8*	Density of compacted layer of WMM *(Only for WMM)		One test for 500 m^3	

Table 5.11: Procedures for Testing Materials on Site: Metal for BM/DBM/BC/Surface; Dressing/MSS/Pre-mix Carpet

METAL FOR BM / DBM / BC / SURFACE DRESSING / MSS / PRE-MIX CARPET			QC-M-10	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Aggregate Impact Value	TC-M-06-01/1	One test for 50 m^3 of aggregate or part thereof	On receipt at site and before using in the hot mixing
2	Flakiness Index and Elongation Index of aggregates	TC-M-06-03		
3	Water absorption of aggregates	TC-M-06-06	Initially one set of 3 representative specimen for each source of supply and subsequently, when warranted by changes in the quality of aggregate	
4	Stripping value	TC-M-11-01		
5	Gradation by wet sieve analysis	TC-M-06-04	As directed by the Engineer for individual component and for combined coarse, fine aggregate and filler.	
6	Soundness Test	TC-M-06-02	One for each source of supply and when called for by the Engineer	On receipt at site and when absorption value is more than 2%
7	10% Fine Value as per IS 2386 – Part IV	-	One for 45 cum of part	
For DBM and BC, the contractor shall furnish the material properties and proposed job mix formula at least 20 days in advance.				

Table 5.12: Procedures for Testing Binder for WBM

BINDER FOR WBM			QC-M-11	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Atterberg Limit Test	TC-M-09-02	One test for 100 m^3 of binding material	On receipt at site

Table 5.13: Procedures for Testing Fine Aggregate for DBM/BC

FINE AGGREGATE FOR DBM/BC			QC-M-12	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Passing 2.36 mm sieve and retained on 75 micron sieve	Daily log	As directed by the Engineer	Before use
2	Deleterious matter	Daily log	Visual observation of lot before use	

Table 5.14: Procedures for Testing Lime

LIME			QC-M-13	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Chemical properties as per IS: 6932, 1514	Lab format	3 final test samples for a lot size up to 100 tons as per Table 3 in IS 712-1984.	On receipt at site.
2	Physical properties as per IS: 6932	Lab format		

Table 5.15: Procedures for Testing Bitumen

BITUMEN			QC-M-14	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Grade of bitumen as directed/defined (Penetration Test)	TC-M-10-01	Two samples per test subject to all or some tests as directed by the Engineer	On receipt of material at site before unloading from the truck
2	Ductility Test	TC-M-10-02		
3	Flash and Fire Point Test	Lab format		
4	Viscosity Test	Lab format		
5	Softening Test	Lab format		

Table 5.16: Procedures for Testing Borrow Material

BORROW MATERIAL *(Soil to be used in Embankment / Sub grade / GSB)*			**QC-M-15**	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Digging of borrow area for sampling	No format	25 m c/c or closer depending upon soil strata variation	Before material is extracted for use in construction.
2	Sand Content	TC-M-15-01 (use relevant test report formats and summarize results in TC-M-15-01)	2 sets of observation per 3000 m^3 of soil and in each 6 observations required.	Before material is extracted for use in construction.
3	Wet Sieve Analysis			
4	Plasticity Index			
5	Modified Proctor Density			
6	Soaked CBR Test			
7	OMC			
8	MDD			
Borrow material source must be approved before extracting material.				

5.3 Materials and Equipment Certified By Manufacturer

Acceptance of certain manufactured materials and equipment components, as stipulated in the contract, shall be based on test certificate(s) from the manufacturer conforming to IS and on visual inspection. These items shall bear the IS mark. PIU (DJB) 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 PIU (DJB) & PMC shall inspect the condition of these items. Inspection criteria shall be decided jointly by PIU (DJB) & PMC. They may decide to have the material additionally tested in Laboratory. The cost of such tests will be borne by the contractor. Refer to **Table 5.17** for a list of materials and equipment subject to manufacturer's certification.

Table 5.17: List of Materials and Equipment Certified by Manufacturer

- Cement
- Steel/Reinforcing Steel
- Paint, Primers and Protective Coatings
- Glazing
- Water Proofing Compound
- GI, CI and PVC, DI & other Pipes for general civil works
- Gratings & Plates
- Manhole Covers
- Sanitary Fittings
- Metal Works such as windows, barbed wire, MS ladder, footrest, rolling shutters, etc.
- Joint Filler Material
- Pre-fabricated Water Tanks

- Traffic Signs
- Flow Measuring Devices – General
- Foot Rests
- Electrical Conduits
- Electrical Wires/Cables
- Switches & Sockets
- Distribution Boards
- Lights, Fans and Fixtures
- Earthing Material
- Insulators
- GOS
- DOLO
- Lightening Arrestor
- Batteries
- Cable Termination Kit
- Fire Fighting Equipment
- Reduction Gearboxes
- Level Indicator & Controllers
- Laboratory Equipment
- Electrical Poles
- All other items as specified in the contract documents

5.4 Materials and Equipment Inspected By Third Party

Materials and equipment to be inspected by a third party vary from package to package, as stipulated in the contract documents. Third party inspection would normally take place at the factory during or upon completion of manufacture. Before site delivery, PIU (DJB) & PMC shall review the third party inspection certificates for conformance to requirements. Upon delivery and before installation or incorporation in the works, PIU (DJB) & PMC shall inspect the physical condition of these items and, if necessary, test them on site. Inspection criteria should be stipulated in the contract document. Refer to **Table 5.18**, for a list of materials and equipment suggested for inspection by third party.

Table 5.18: List of Materials and Equipment Inspected by Third Party

- Flow Measuring Devices – Special
- Cranes & Lifting Tackles
- Electrical Cables – Special
- Butterfly Valves
- Sluice Valves
- Reflux Valves
- Air Valves
- Control Valves
- Vertical Turbine Pumps/Other Pumps
- Motors
- Gauges
- Electrical Starters
- Power Transformers
- Voltage Transformers
- Current Transformers
- Bus Ducts

- Switch Boards (HV/MV/LV)
- Battery Chargers
- DC Distribution Panel
- Steel Pipes – Lined & Coated
- Pre-stressed Concrete (PSC) Pipes
- NP Pipes (RCC) for s & Pipe Culverts
- DI, CI, BWSC, PSCC, GRP, PVC, HDPE/MDPE and other Pipes
- All specials and fittings for Water Supply and Waste Water Systems
- In-situ Welding of Pipes
- In-situ Lining of Pipes
- Aerators for STP
- Clariflocculator
- Flash Mixer for WTP
- Motor Control Centre
- Indication-cum-Enunciation Panel
- Capacitors
- Sluice Gates
- Cable Trays
- All other items as specified in the contract documents
- All type of Pumps.
- Manhole Frames & Covers
- Fire Fighting Equipment

6 CONTROL OF GENERAL CIVIL AND STRUCTURAL WORKS

This section of the QA/QC Manual covers the testing of works and the inspection of workmanship for general civil and structural works. The key elements to be inspected in these works are concreting, stone masonry, and brickwork and finishes. The requirements for testing and control of materials for these works are outlined in Section 5.

6.1 Construction Sequence and Control Flow Charts

Flow charts indicating the construction sequence and control points for cement concrete and mortar works are shown in **Figure 6.1** and **Figure 6.2** respectively.

6.2 Testing of Works

The works to be tested on site include excavation, cement concreting and stone and brick masonry. All the materials proposed to be used in these works must have been tested by the contractor and approved by the PMC well in advance of these works. The contractor shall submit the method statement for placement of concrete to the PIU (DJB) & PMC well before commencement of concreting, and shall obtain the approval of the PMC before proceeding with the work.

Tests for general civil and structural works are listed in **Table 6.1**. Test procedures are presented in **Tables 6.2** to **6.5**, under the referenced test numbers. Required materials tests are also indicated (materials testing procedures are presented in Section 5). Test report formats are included in Appendix A. The contractor shall conduct tests as stipulated. The Representative of PMC and PIU (DJB) will witness not less than 30% and 10 % of all the test conducted respectively. This minimum percentage is not applicable where a higher % of this inspection is stipulated elsewhere.

6.3 Inspection Checklists

Inspection checklists for concreting, stone masonry, and brick masonry work and finishes, and building services and finishes are presented in **Appendix B**.

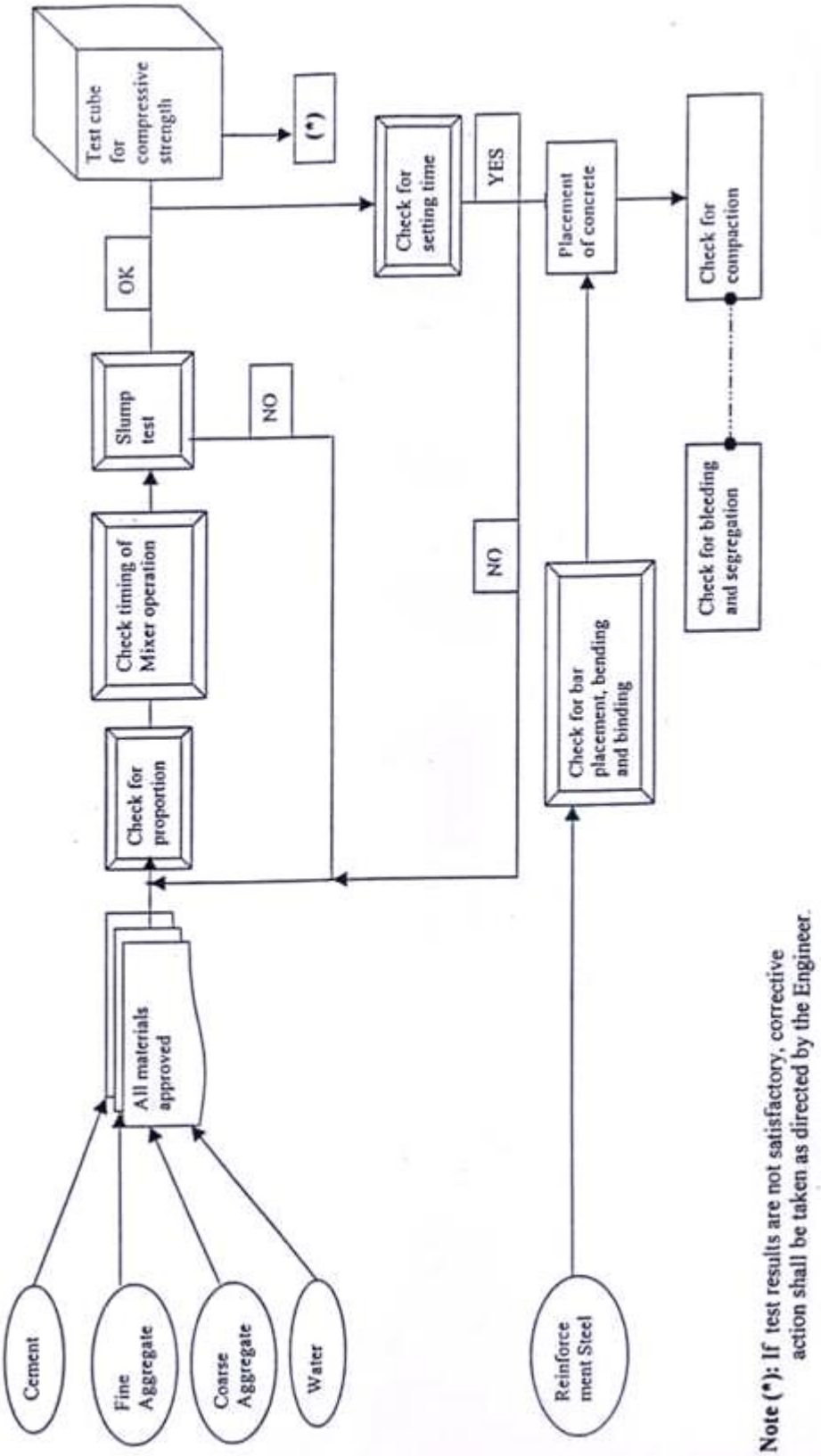
6.4 Design & Method Statements for Formwork/Staging Work

The contractor shall prepare method statements and designs for the enabling works such as form work staging, etc. and submit to PIU (DJB) & PMC for review and approval. The work shall commence after approval to the same.

Similarly the contractor shall design the shoring work for supporting sides of deep excavations and submit the same along with a method statement for construction, to the PIU (DJB) & PMC for review and approval. The construction will commence upon approval of the same.

Figure 6.1

PROCESS CHART FOR PLAIN CEMENT CONCRETING/RCC WITH STAGES OF INSPECTION



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

Figure 6.2

PROCESS CHART FOR CEMENT MORTAR WITH STAGES OF INSPECTION

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

Table 6.1: List of Tests for General Civil and Structural Works

Sl. No.	Process	Material		Test Ref. No.
		Name	Format No.	
1	Embankment Formation	Soil/Earth	QC-M-07	QC-G-01
2	Excavation/Backfilling			QC-G-02
3	Concreting	Steel	MC (1)	QC-G-03
		Cement	QC-M-01	
		Coarse Aggregates	QC-M-06	
		Sand	QC-M-02	
		Water	QC-M-03	
4	Size Stone Masonry	Size stone	QC-M-05	QC-G-04
		Cement	QC-M-01	
		Sand	QC-M-02	
		Water	QC-M-03	
5	Brick Masonry	Bricks	QC-M-04	QC-G-04
		Cement	QC-M-01	
		Sand	QC-M-02	
		Water	QC-M-03	

Note: 1. MC = manufacturer certified.

Table 6.2: Procedures for Testing Embankment Formation

Embankment Formation			QC-G-01	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Moisture content as per IS-2720	TC-M-09-03	One test for each 250 m^3 of soil	In-process
2	Field density test as per IS-2720	TC-M-09-03	5-10 density tests for each 1000 m^2 compacted area, or as directed by Engineer	
3	Compaction	Daily log	As per required number of passes	While compacting

Table 6.3: Procedures for Testing Excavation and Backfilling

Excavation/Backfilling			QC-G-02	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Layout, slopes of excavation, benching and over-burden	Daily log	As directed by the Engineer	After excavation
2	Sub-soil water, shoring and strutting	Daily log		
3	Bottom levels and compaction	Daily log		
4	Soil classification	Daily log		
5	Backfilling and compaction	Daily log		After backfilling

Table 6.4: Procedures for Testing Concreting

Concreting			QC-G-03	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Compressive strength as per IS-516 for RCC (Design Mix)	TC-G-01-01	50cum or 10 batches of 5-7 cum each for RCC work in all location taken together. RCC done in a day is less than 50 cum . test may be carried out as required by engineer-in charge.	Test samples to be taken while pouring. Testing to be done as specified in contract.
	For nominal mix concrete		Every 5 cum or part thereof in case of column and every 20 cum or part thereof or slabs beams and connected column. 20 cum for other RCC work for all other small items and where RCC done in a day less than 5 cum test may be carried out as required by the engineers'-in-charge.	

Concreting			QC-G-03	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
2	Slump test as per IS-1199	TC-G-01-02	15 cum or part thereof	Before pouring concrete
3	Inspection of steel reinforcement placement and bending, and formwork	Daily log	-	Before pouring concrete
4	Concrete Pour Report	TC-G-01-03	When pouring is done	Immediately after pouring
5	Permit for concreting	TC-G-01-03A	Before each concreting	-

Table 6.5: Procedures for Testing Mortar

Mortar			QC-G-04	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Compressive strength as per IS-2250	TC-G-01-01	One sample for every 2 m^3 of mortar subject to a minimum of three samples for a day's work	Test samples to be taken while before mortaring. Testing to be done as specified in contract.
2	Consistency as per IS-2250	TC-G-02-01		

7 CONTROL OFF PIPELINE WORKS & WATER RETAINING STRUCTURES

This section of the QA/QC Manual covers the testing and inspection of workmanship for pipeline works (i.e. water and lines) and liquid retaining structures. The requirements for testing and control of input materials are outlined in **Section 5**.

An inspection checklist for pipeline works is included in **Appendix B**.

7.1 Pipe Laying General

The art of pipe-laying appears deceptively simple, but it requires care and intelligence, along with close supervision to ensure the levels of quality assurance and control, and hence a satisfactory job. One of the basic problems is that the field conditions are often poor because the whole of the construction takes place below the ground surface; yet, at the same time, the jointing and bedding of pipes must be carried out with strict attention to detail. Pipes should be laid according to specified grade in straight lengths with minimum horizontal and vertical bends.

Two main requirements for pipe laying are that pipes are not bedded on large stones, and that joints and jointing materials are kept perfectly clean. In practice this proves to be quite difficult to achieve because the pipe trench is so often muddy and stony. Unremitting care is therefore necessary for ensuring quality of work and lack of it will prove costing in terms of future repairs, since the cost of locating and remedying leaks is very high. All specials, fittings and appurtenances should be installed at the same time of main pipe installation work, without leaving gaps for later installation by insertion.

7.1.1 Excavation and Backfilling

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

Backfilling must be completed in layers and prepared according to specified requirements. Backfilling shall be carried out simultaneously on either side of the pipe. Mechanical compaction should be conducted, in achieving the required level of compacted density, in full compliance of the contract document and specification. All large stones liable to damage the coating of the pipe must be removed from contact with the pipe. Only when a 225mm layer of selected soft material has been over the top of a pipe may the backfill be carried out using unselected material.

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. It is bad practice to not allow this ‘indenting’ of the joints and thereby impose undesirable bending stresses to the pipe barrel.

To ensure firm bedding conditions, the final excavation and dressing of the last 150 mm, to trench bed formation level, should be completed manually and not by mechanical excavator.

All excavations shall be appropriately supported, depending on the type of soil, ground conditions and depth of excavation and in accordance with the Health and Safety manual and to the direction of the Engineer.

7.1.2 Correct Handling of Pipes

The handling of DI/cast-iron pipes should be carried out with much care. A single slip, a single bump of one pipe against another or lowering too suddenly on to the ground,

significant damage may have been caused. When slung and suspended, a pipe may be tapped sharply to hear if it rings true, or whether it gives a dead sound denoting a crack in it. The test is not infallible, and the pipe should be examined visually as well.

Another method is to rub chalk over a suspected area and strike the pipe with a hammer; the crack will show up as a dark line. It is time well spent for the supervising engineer, or one of his staff, to supervise the off-loading of pipes, to see that they are not maltreated, and to give a quick but careful examination of the spigot and socket ends while the pipes are on the trailer.

Pipes are frequently discovered to be cracked at one end, particularly on the spigot, and to be able to pick out even one of those damaged before delivery will save at least one time-consuming argument between contractor, carrier, and supplier.

7.1.3 Care of Exterior Coatings

Care should be taken not to damage the exterior coating of pipes and, before laying, each pipe should be rolled over, examined, and touched up in the bad spots with bituminous solution. If cast-iron pipes are left out in the open the coating will, in time, frequently crack and flake off. The areas affected should be wire brushed and recoated before laying.

7.1.4 Basics of Pipe laying

While there is no hard-and-fast rule about which direction pipes should be laid, there is a convenience in laying them with the sockets pointing uphill. It is easier to push a pipe spigot first downhill into a socket, than socket first over a spigot; secondly, the making of a joint is slightly easier when the socket faces uphill. But unless the gradient is very steep (over 1 in 20), it would not be worth while inserting a collar so as to reverse the direction of joints when changing from an up-grade to a down-grade, or vice versa.

Pipes can be successfully laid on a downhill grade starting from the top, provided some means of pulling the pipes up tight together is arranged. Concreting in of pipes with substantial concrete blocks keyed into undisturbed ground will be necessary to prevent the joints pulling apart. The frequency of such blocks will vary according to the slope of the pipeline.

7.1.5 Importance of Good 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 boned level and made free of all sharp stones, an adequate joint hole must have been dug, the trench must be dry, and its sides must be made safe against slips or collapse. Preparation of pipe trenches is a danger spot in civil engineering. The trenches are often quite deep, and because new lengths are continuously being opened, there is always the possibility that changing ground conditions will necessitate proper trench-side support, when none has been required previously.

There is sometimes a temptation to try and get through a ‘bad spot’ as quickly as possible, in the hope that trench support will not be needed. This temptation must be resisted by all concerned, and the resident engineer should never interfere with any precautions the contractor’s representative or his foreman think are necessary, even if this means a delay in the work. Far too often a person’s death is caused because of the collapse of a trench.

If the supervising engineer thinks the contractor’s representative not taking enough precautions to support the trench he should point out the dangers and offer advice to remedy the matter. Usually, the supervising engineer should find no difficulty in convincing the contractor’s representative, but if unreasonable risks persist, the supervising engineer should discuss the problem with the engineer.

All pipes must be handled with care to prevent damage to them and their sheathing. Slings or ropes should be used to lift 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 supervising engineer to insist that proper slings in sufficient numbers are brought on the job at the very start.

7.1.6 Large Diameter Pipes and Appurtenances

Appurtenances and associated specials for the larger sized diameter of pipes, such as bends and tees, are heavy and awkward loads to handle, especially when they have to be set accurately in position one to another. When two or more fittings have to be set together there should be a lifting appliance available for each fitting. This can be dangerous work if not properly supervised. A man waiting down in a pipe trench ready to receive and set in position a heavy fitting being lowered down to him seldom has anywhere he can leap to for safety if a sling slips or the fitting rolls over when it touches the base of the trench. Timber props, baulks, and wedges in adequate numbers must be available to wedge the fitting securely into position when lowered.

It is often difficult to find out the ‘centre-line’ of a fitting, such as a large 45, or 22, degree bend. With pipe fittings for sizes of mains in the 750 mm to 2,000 mm diameter size, some time should be spent measuring the fitting so as to find and mark, on the outside and at spigot and socket ends, the diameters that lie truly on the turning axis of the pipe. These positions should be clearly marked with white paint; not with chalk, which will quickly rub off as the pipe is handled. Such marking will save time when assembling awkward bends and the like, especially when a bend is to be set so as to give both a horizontal and vertical throw.

It is also good practice to mark a line round each spigot end, parallel with the end and a distance from it equal to the required depth of insertion of the spigot in the socket. This line can be a chalk mark measured and marked just before insertion of the pipe in a socket.

7.1.7 Maintaining Required 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.

7.1.8 Pipe Jointing

Too much trouble cannot be taken over pipe joints; it is useless to let pipe-laying proceed when it is clear that insufficient attention is being paid to jointing. It is equally bad policy to allow pipes to be laid with insufficient care being paid to protecting the surface of the pipe.

Leaking joints will be discovered before the contract ends, which is inherent under good supervision and contracting practices. Damaged coatings may never be found, yet may be the cause of substantially shortening the life of the pipe.

When using fittings, such as bends, tees, and the like, and connecting up one special fitting to another, wherever possible it is good practice to have a length of straight pipe between the specials. The reason for this is that, should a burst on one special pipe occur when it is coupled direct to another special pipe, the work of repair may be complicated and more than one new special may have to be put in. If, however, a straight section of pipe intervenes between two specials this straight pipe can always be cut and a new special with a straight portion of pipe be put in and collared up.

7.1.9 Pipeline Inspection Requirements

The inspection of the pipeline is very important and must be conscientiously carried out. The trench bed must be adequately inspected before a pipe is lowered; joints are to be closely inspected and all stipulated testing of pipes conducted.

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

7.1.10 Thrust Block Considerations

At every change of direction in the pipeline, at every change of size, at connections and valves, thrust blocks are necessary—usually of mass concrete. It is not sufficient to calculate the size of thrust blocks by considering the reaction between pipe and block only. Complete or partial failure of a pipe at a bend is almost always due to soil movement behind the block.

Hence it is necessary when calculating the size of blocks required to take particular note of the safe horizontal bearing resistance of the soil. The thrust block must be well keyed into the ground, be concreted right up against undisturbed ground, and, if it is to take horizontal thrusts, have a vertical outer face and not a sloping, irregular one resulting from a poor attempt at taking out a proper vertical-sided pipe trench.

It often happens that, because of the use of machines for excavation, pipe trenches at bends are wider than necessary, and the resulting thrust blocks, when eventually put in after cleaning up the trench corners, are quite a lot larger than the thrust blocks shown on the plan. The contractor will naturally ask for payment for this larger-sized concrete block. He should not normally be entitled to this payment, though he may put forward a number of arguments in support. Since the subject is almost certain to crop up, the supervising engineer would be well advised to be explicit on this point before the work commences. He could well ask for hand excavation at bends (though he may not be able to insist upon it), or at least for final hand clearing of the walls of the trench at the point where the thrust is to be taken. He should, in any case, point out that any excess size of block resulting from careless excavation will not be paid for.

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 the ground may be particularly weak at these points.

7.1.11 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 second point is related directly to the stipulations of the appropriate IS coding, which must be strictly adhered to and which are generally followed by the manufacturers/suppliers.

7.2 Construction Sequence and Control Flow Charts

These notes are to give additional guidance on the practical side of testing pipelines in ensuring the desired levels of quality assurance and control. Flow charts indicating the construction sequence and control points for materials used in pipeline work and for pipeline works are shown in **Figures 7.1** to **7.3**.

7.3 Testing of Works

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

Tests for pipeline works and liquid retaining structures are listed in **Table 7.1**. Test procedures are presented in **Table 7.2**, under the referenced test numbers. Required materials tests are also indicated (materials testing procedures are presented in **Section 5**). Test report formats are included in **Appendix A**.

The full requirement, for the testing of pipelines, is given within the provisions of the contractor's contract and specifications. Every section of pipeline laid must be tested before it can be accepted by the supervising engineer. The personal observation of this test is one of his most important duties. The extent of pipeline to be tested at one time is usually at the discretion of the contractor, but the supervising engineer must not let the situation arise that, with so much line to be tested, it would take weeks to find leakages, should they occur.

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

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

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

7.4 Water Retaining Structures

In the case of Reinforced Cement Concrete (RCC) retaining structures, only concrete design mix designed from standard approved agencies shall be used. The associated quarry and source of sand and aggregate shall be approved by Engineer after satisfactory tests of aggregates. Application for re-approval of the design mix shall be required whenever the quarry or source of aggregates is changed.

Mechanical mixing with weight batch mixtures is mandatory. Mechanical vibrators in sufficient numbers should be used for compaction of concrete. Hand compaction cum manual compaction is not permitted under any circumstances. Adequate mixtures and vibrators, including standby should be available at site well before the start of concrete work.

Shuttering quality should be of good standard, as approved by the Engineer well before the fixing of any shuttering. Shuttering should be fixed in such a manner that no slurry or water seeps through the jointing or box outs. For this plastic tape, Plaster of Paris (POP), putty or other suitable sealants should be used at joints of shuttering.

The concrete should be kept moist throughout 24 hours a day for the specified number of days for adequate curing by flooding with water, or by putting moist gunny bags. Adequate separate labour and supervisor should be deployed for curing work, in ensuring that this important component of the work is satisfactorily conducted.

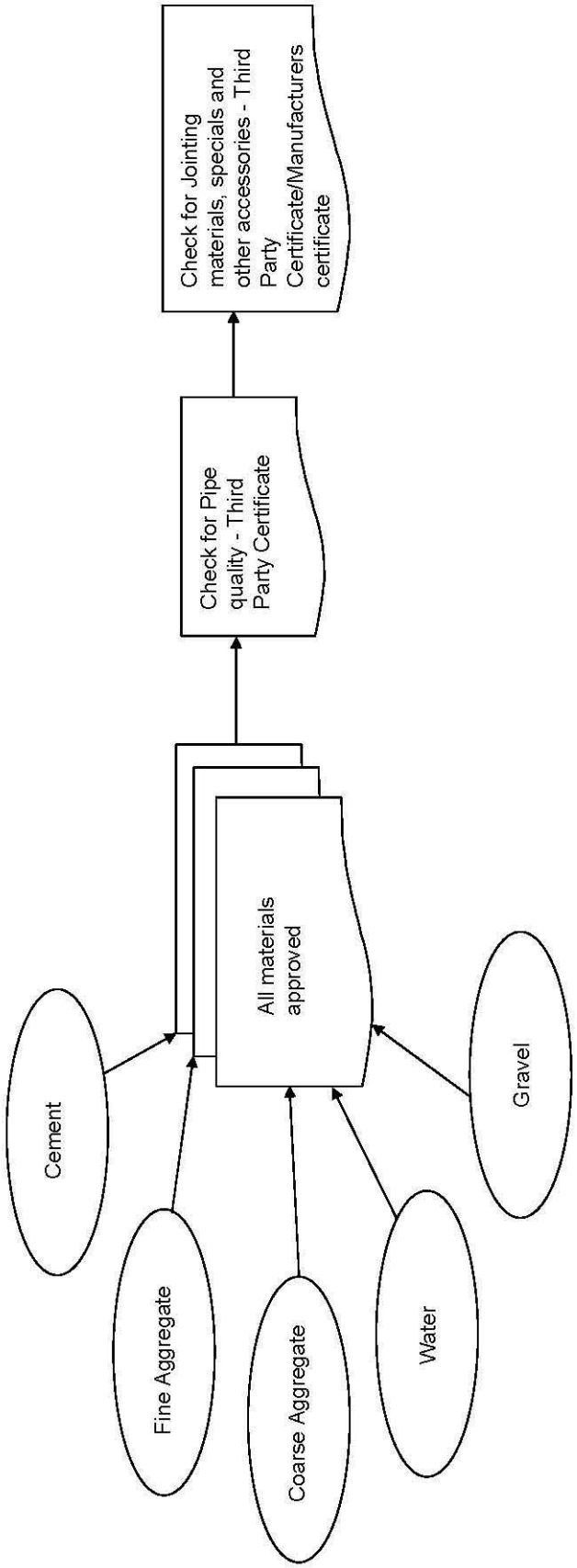
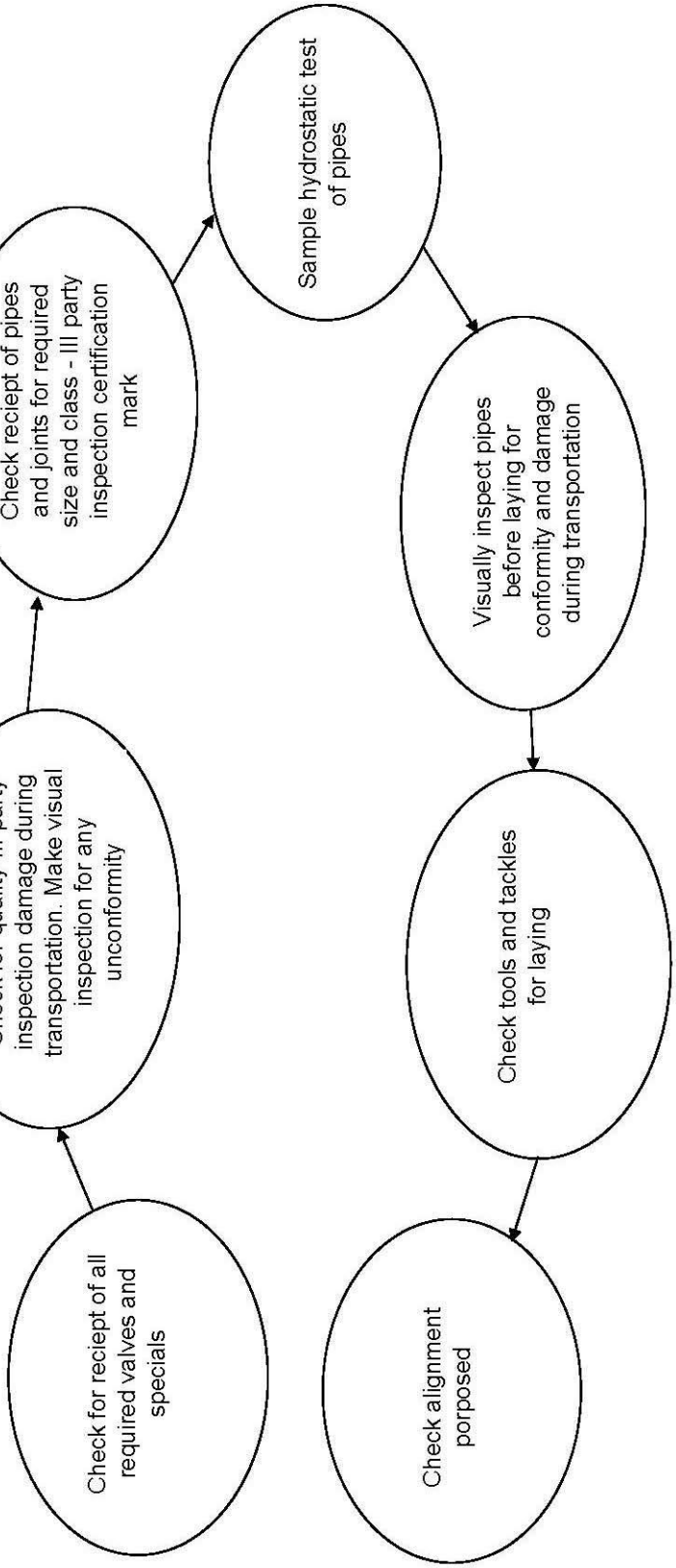


Figure 7.1
CHECKS FOR MATERIALS USED IN PIPELINE WORK

Figure 7.2
CHECKS OF PREPARATORY WORKS BEFORE LASYING WATER SUPPLY/SEWERAGE PIPE LINES



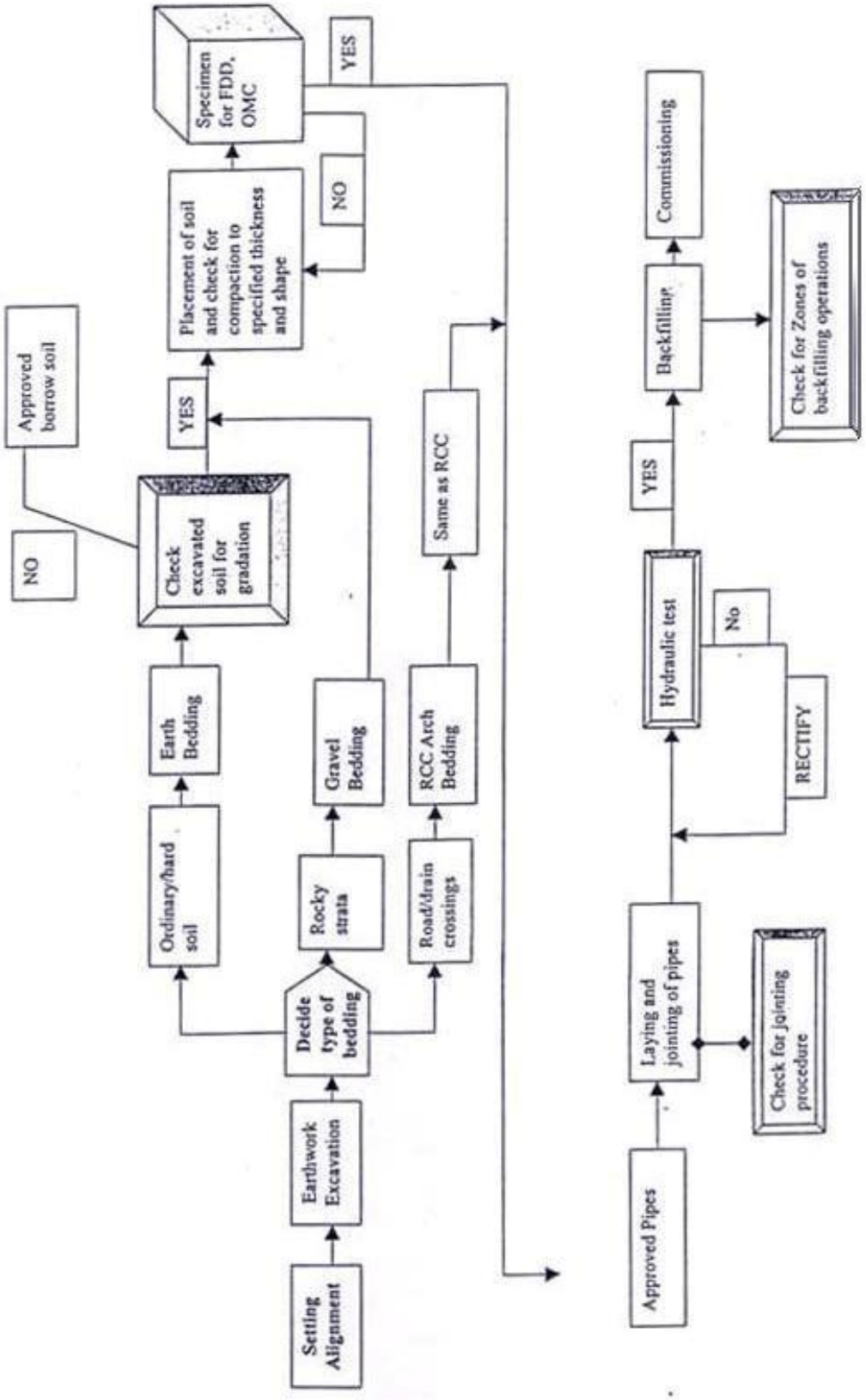


Figure 7.3

PROCESS CHART FOR PIPELINE WORKS WITH STAGES OF INSPECTION

Table 7.1: List of Tests for Pipeline Works and Liquid Retaining Structures

Sl. No.	Activity	Material		Test Ref. No.
		Name	Format No.	
1	Bedding for Pipeline			
1.1	Earth Bedding	Earth/Soil	QC-M-07	QC-P-01
1.2	Gravel Bedding	Gravel	QC-M-08	
1.3	Concrete Bedding	Cement	QC-M-01	QC-P-02
		Sand	QC-M-02	
		Water	QC-M-03	
		Coarse Aggregate	QC-M-06	
		Steel	MC (1)	
2	Pipeline Laying and Jointing			
2.1	GSW Pipe	Cement	QC-M-01	QC-P-03
		Sand	QC-M-02	
		Water	QC-M-03	
		Pipes	MC (1)	
2.2	RCC, CI and DI Pipes	Pipes	TPI/MC (1)	QC-P-02
		Gaskets	TPI/MC (1)	
2.3	Coated and Lined Steel/PSC Pipes	Coated and lined steel/ PSC pipes	TPI (1)	
3	Manhole/Valve Chamber Construction	Cement	QC-M-01	QC-P-02 QC-P-03
		Sand	QC-M-02	
		Water	QC-M-03	
		Bricks	QC-M-04	
		Coarse Aggregate	QC-M-06	
		Cover	TPI (1)	
		Frame/Vent shaft etc.	MC (1)	
		Steel	MC (1)	
4	Completion of Pipeline Laying and Jointing	Stage Completion Test		QC-P-04
5	Completion of Manhole/ Valve Chamber Construction	Stage Completion Test		QC-P-05
6	Completion of Liquid Retaining Structures (Wet Wells, Storage Reservoirs, Pretreatment Units, RCC Open Channels, etc.)	Stage Completion Test		QC-P-06

Note: 1. MC = manufacturer certified; TPI = third party inspection.

Table 7.2: Procedures for Testing Mortar

Mortar			QC-P-03	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Compressive strength as per IS-2250	TC-G-01-01	One sample for every 2 m^3 of mortar subject to a minimum of three samples for a day's work	Test samples to be taken while placing. Tests to be done as specified in the contract.
2	Consistency as per IS-2250	TC-G-01-02		

Table 7.3: Procedures for Testing Completion of Pipe Laying and Jointing

Completion of Pipeline Laying and Jointing			QC-P-04	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Hydrostatic test for NP pipes	TC-P-04-01	One test for defined stretch	On completion of stage
2	Hydrostatic test for pressure pipes	TC-P-04-02	One test for defined stretch	On completion of stage

Table 7.4: Procedures for Testing Completion of Manhole /Valve Chambers

Completion of Manhole/Valve Chamber			QC-P-05	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Leakage Test	TC-P-05-01	100% inspection	On completion of stage

Table 7.5: Procedures for Testing Completion of Liquid Retaining Structures

Completion of Liquid Retaining Structures			QC-P-06	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Water tightness for underground structures	TC-P-06-01	One test per structure	On completion of stage
2	Water tightness for elevated structures	TC-P-06-02	One test per structure	

8 CONTROL OF MECHANICAL & ELECTRICAL WORKS

This section of the QA/QC Manual gives an overview of the quality control requirements for electromechanical works, such as water treatment and supply systems, sewage treatment plants, compost plants, pumping systems, and power supply and distribution systems. The requirements for testing and control of input materials and components, including manufacturers' certification and third party inspections, are outlined in Section 5.

Materials and components to be incorporated into electromechanical works shall be inspected by PIU (DJB) & PMC 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 certifications or third party 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 PIU (DJB) & PMC shall be notified immediately. Installation shall proceed only after the materials and components are approved by PIU (DJB) & PMC.

A series of inspections and tests during installation and completion of electromechanical works shall be performed by the contractor or the equipment manufacturer and witnessed by PIU (DJB) & PMC, as follows:

- Preparatory Inspections: Prior to installation, the civil and structural works where electromechanical equipment is to be installed shall be inspected to ensure conformance with designs and equipment installation requirements.
- Installation Inspections and Tests: A system of inspections and tests, as specified in the contract or recommended by the equipment manufacturer, shall be employed throughout movement to position and installation of equipment and systems. Inspections shall be performed by PMC at critical points during installation. Surveillance shall be provided by PIU (DJB) & PMC 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 PIU (DJB) & PMC installation inspector.
- Installation Verification Inspections: Prior to all mechanical and electrical testing, verification inspections shall be performed to ensure that equipment has been satisfactorily installed.
- System Tests: These tests shall be conducted as appropriate to demonstrate that the installed systems are free from damage due to shipment and installation, and that equipment performs in accordance with specifications.
- Integrated Tests: After completion of system tests, integrated tests shall be performed to demonstrate that the system performs satisfactorily when connected to its interfacing systems or sub-systems. These tests will be followed up by commissioning tests.
- Commissioning Tests: These consist of a series of tests performed under service operating procedures to demonstrate compatibility of the physical plant with operating procedures.
- Final Inspections: Final inspections shall be performed to ensure that the completed work is in accordance with the contract and that all previously identified discrepancies have been resolved satisfactorily.

9 CONTROL OF ROAD WORKS

This section of the QA/QC Manual covers the testing of works and the inspection of workmanship for road works, including earthworks, placement of sub-base and WBM layers, application of prime and tack coats, and placement of bituminous layers. The requirements for testing and control of materials for road works are outlined in **Section 5**.

The contractor shall made preparation of 500 mm thick sub grade to the required level and camber, leveling and dressing of the filling and compaction up to 97% of lab dry density as per IS 2720 (Part-8) by vibro roller. The earth of soaked CBR value not less than 5% required for making the road including embankment or access roads by the contractor.

9.1 Compaction Control

Control shall be exercised on each in there by taking at least 1 measurement of density for each 1000 sqm of compacted area or closer as required to filled the minimum nos. of test result for evaluating a days work on statistical basis. The determination of density shall be in accordance with IS:2720 (Part-28)

9.2 Field Density

Unless otherwise specified the compaction where so called for, shall comply with minimum 90% compaction by standard proctor at moisture content differing not more than 4% from the optimum moisture content. The contractor shall demonstrate adequately by field and laboratory test that by specified density has been obtained.

9.3 Acceptance Criteria

The acceptance criteria for test shall be subject to the conditions that the mean value is not less than the specified value plus {1.65-1.65/(nos. of samples)$^{0.5}$} times the standard deviation.

9.4 Construction Sequence and Control Flow Charts

Flow charts indicating the construction sequence and control points for road works are shown in **Figures 9.1** to **9.9**.

9.5 Testing of Works

The works to be tested on site include earthworks, placement of granular sub-base and WBM layers, application of prime and tack coats, and placement of bituminous layers. All the materials proposed to be used in these works must have been tested by the contractor and approved by the PMC and PIU (DJB) well in advance of the works. The contractor shall obtain the approval of the PMC and PIU (DJB) when a particular stage is completed and before proceeding to the next stage. Surface regularity and alignments shall be checked by leveling instrument.

Hot mix designs shall be submitted by the contractor to PIU (DJB) & PMC for review and approval well before the planned start of hot mix operations. The hot mix plant shall be inspected by PIU (DJB) & PMC and approved by PIU (DJB) before commencing operations. Temperature tests on bitumen shall be carried out at the hot mix plant before delivery to the site, and immediately before placing and after compaction. Temperature tests shall be carried out by using metal contact digital thermocouple based temperature measuring device. The Contractor shall provide such devices as part of his site laboratory, and in sufficient quantity so that all required testing can be carried out as-and-when required. The

contractor shall take the temperature readings in the presence of the PMC, and shall submit his test reports on a daily basis.

Tests for road works are listed in **Table 9.1**. Test procedures are presented in **Tables 9.2** to **9.3**, under the referenced test numbers. Required materials tests are also indicated (materials testing procedures are presented in **Section 5**).

Test report formats are included in **Appendix A**.

9.6 Inspection Checklists

An inspection checklist for road works is presented in **Appendix B**.

Figure 9.1
FLOW CHART FOR THE CONSTRUCTION OF EMBANKMENT AND SUBGRADE

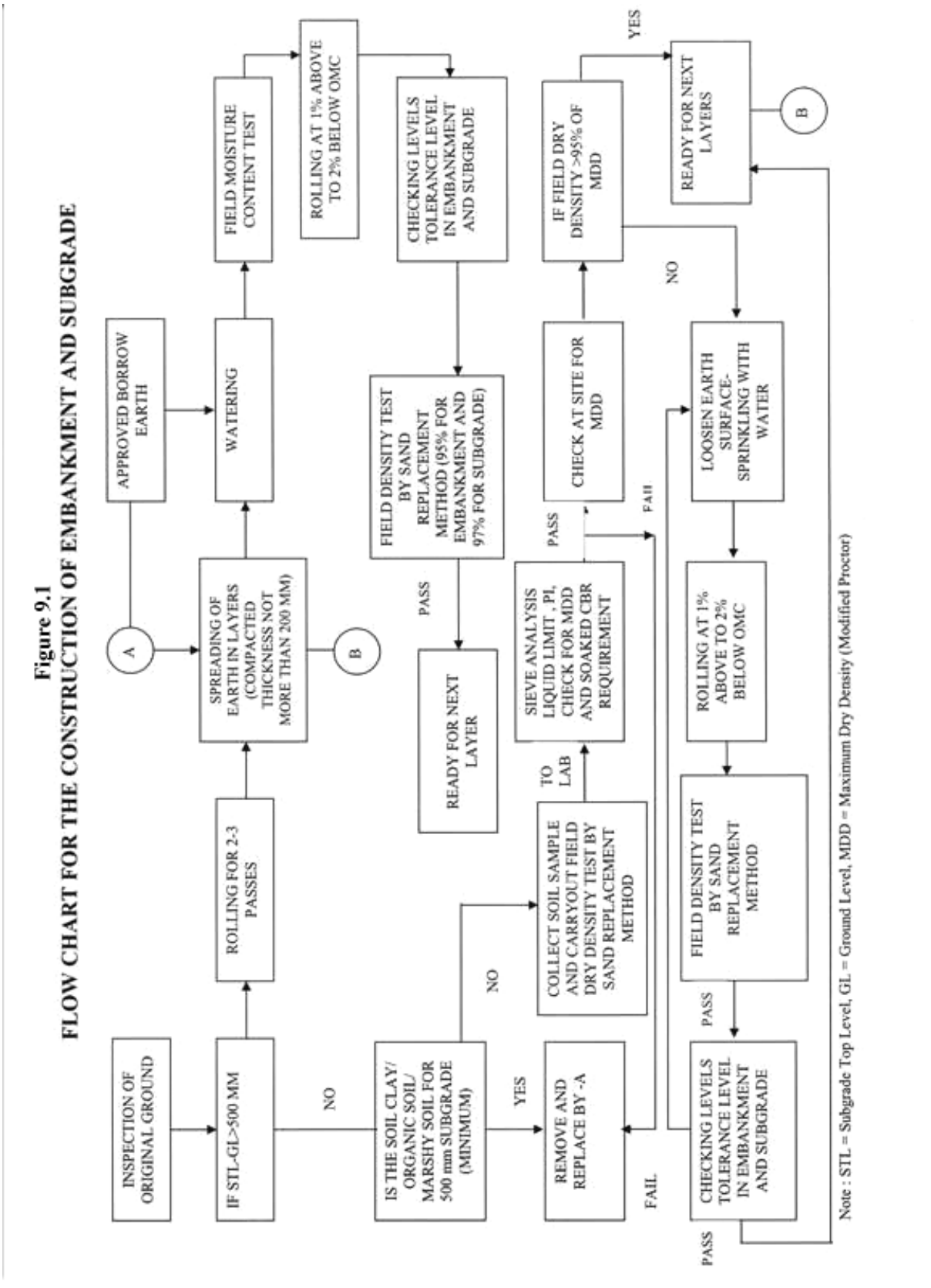
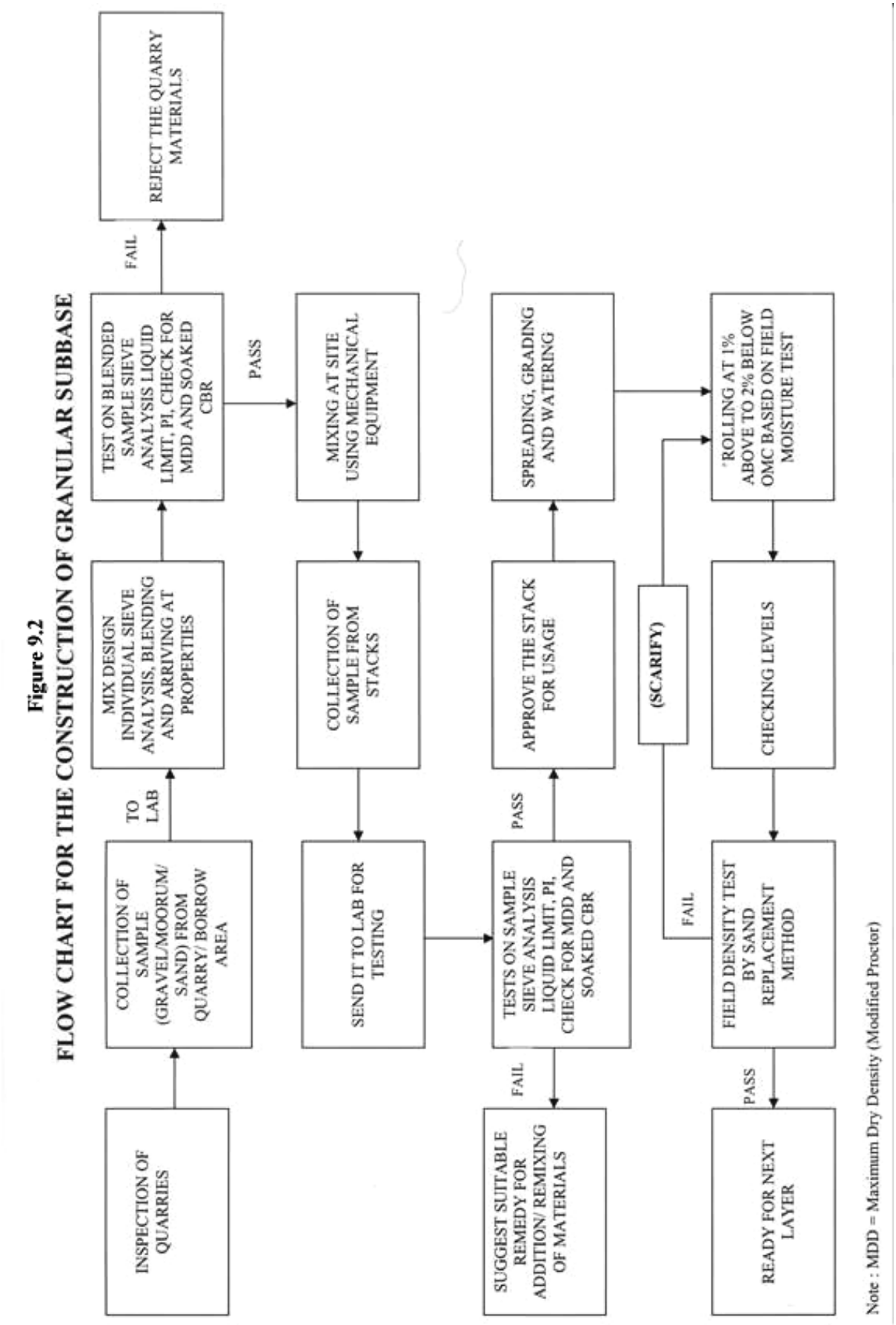


Figure 9.2

FLOW CHART FOR THE CONSTRUCTION OF GRANULAR SUBBASE



Note : MDD = Maximum Dry Density (Modified Proctor)

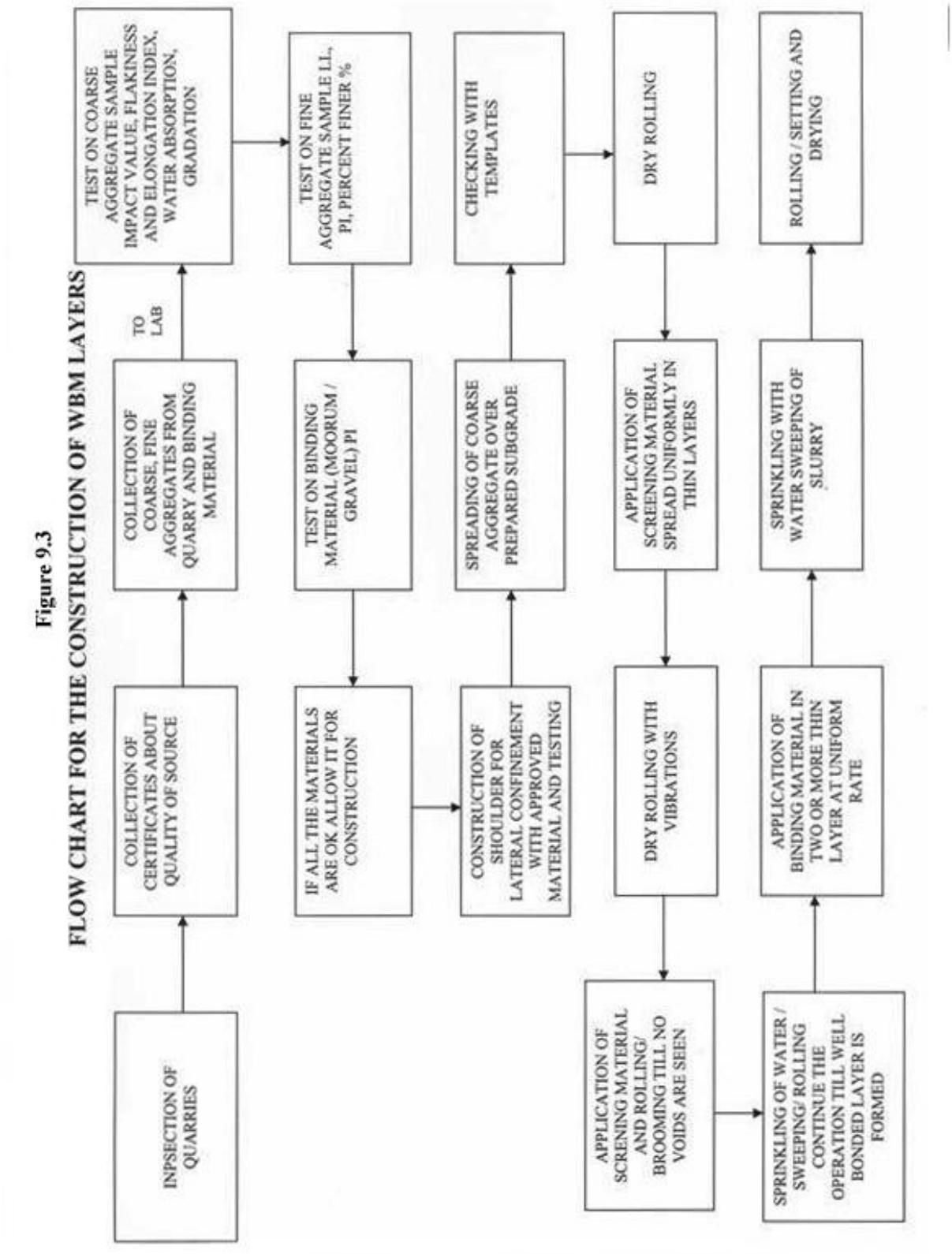


Figure 9.3

FLOW CHART FOR THE CONSTRUCTION OF WBM LAYERS

Figure 9.4
FLOW CHART FOR APPLICATION OF PRIMER/ TACK COAT

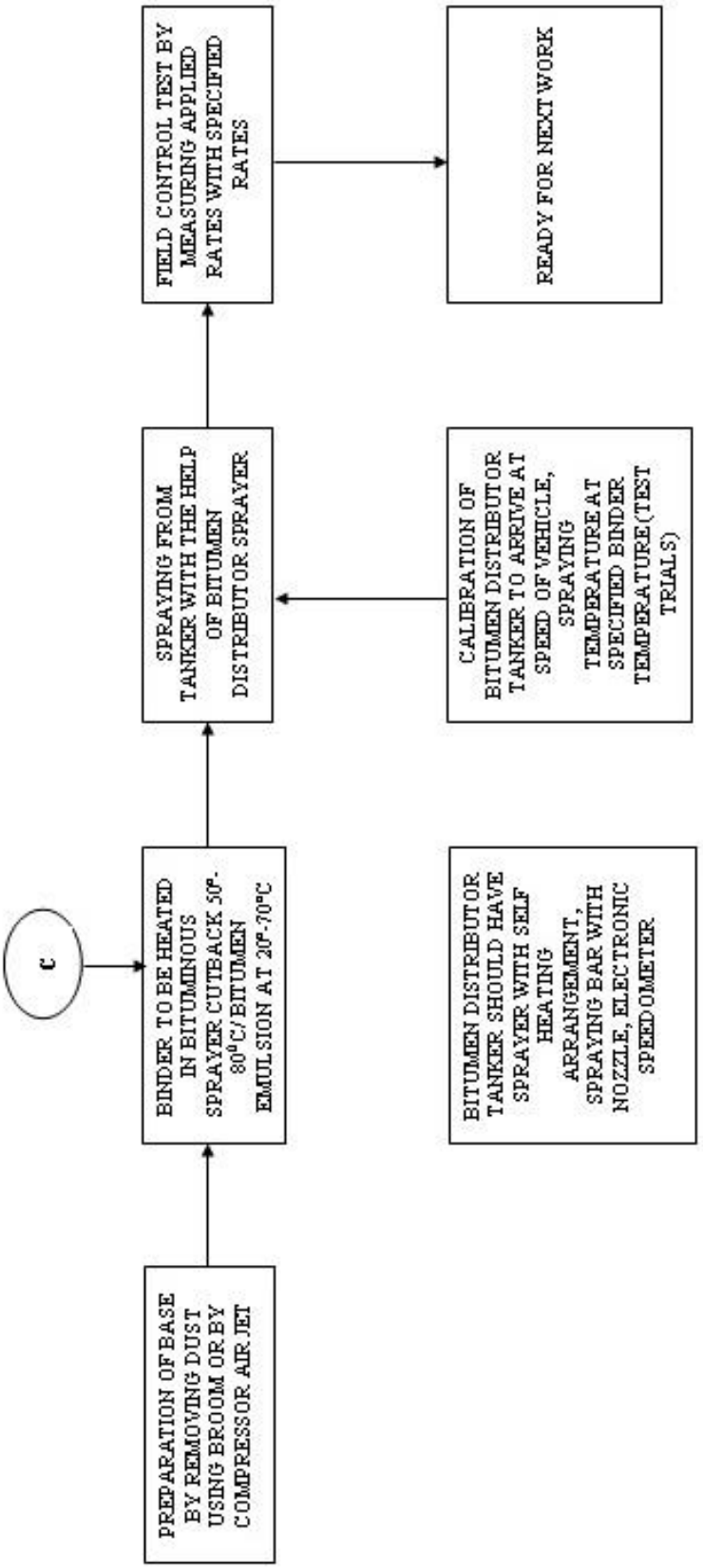
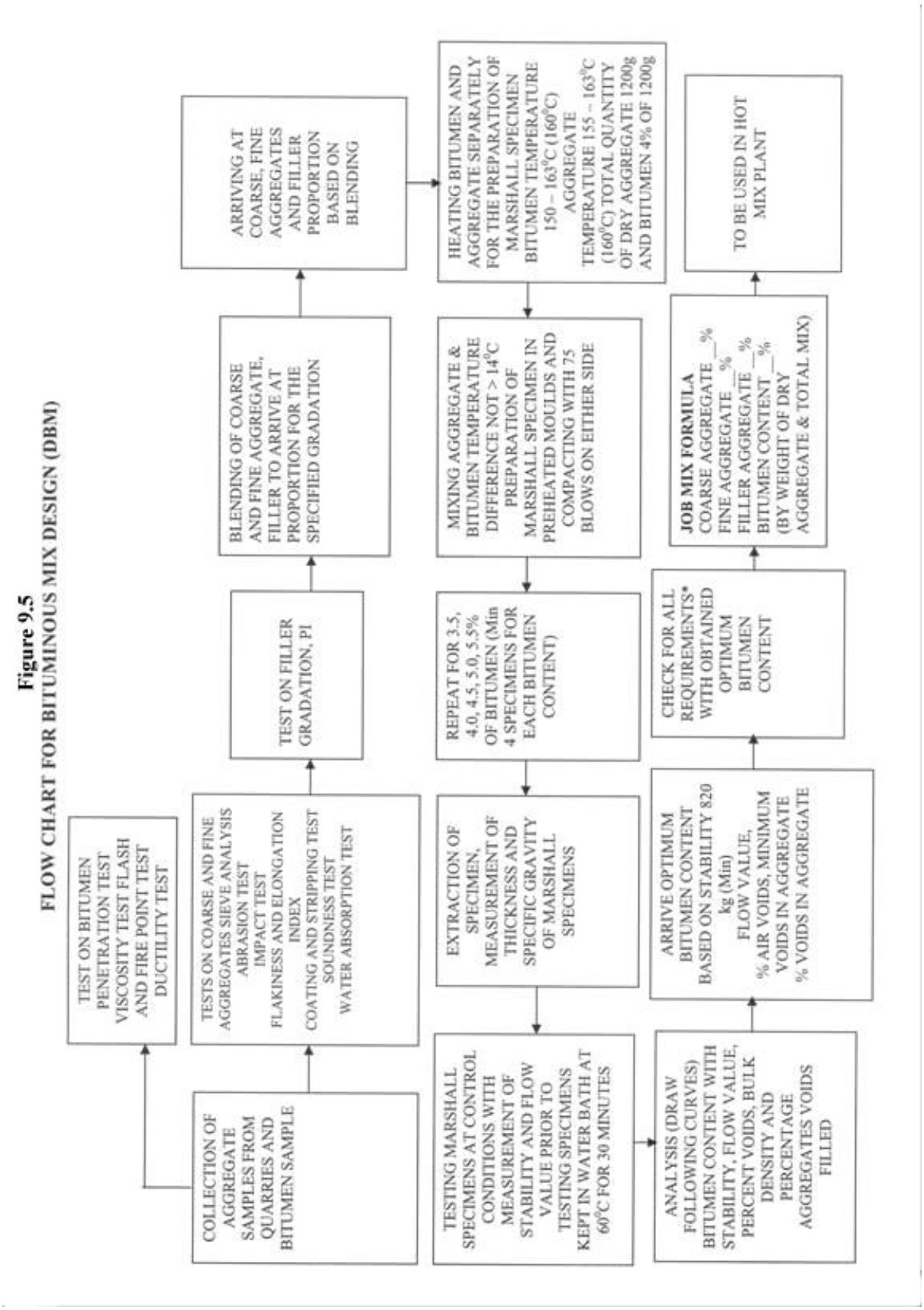


Figure 9.5

FLOW CHART FOR BITUMINOUS MIX DESIGN (DBM)



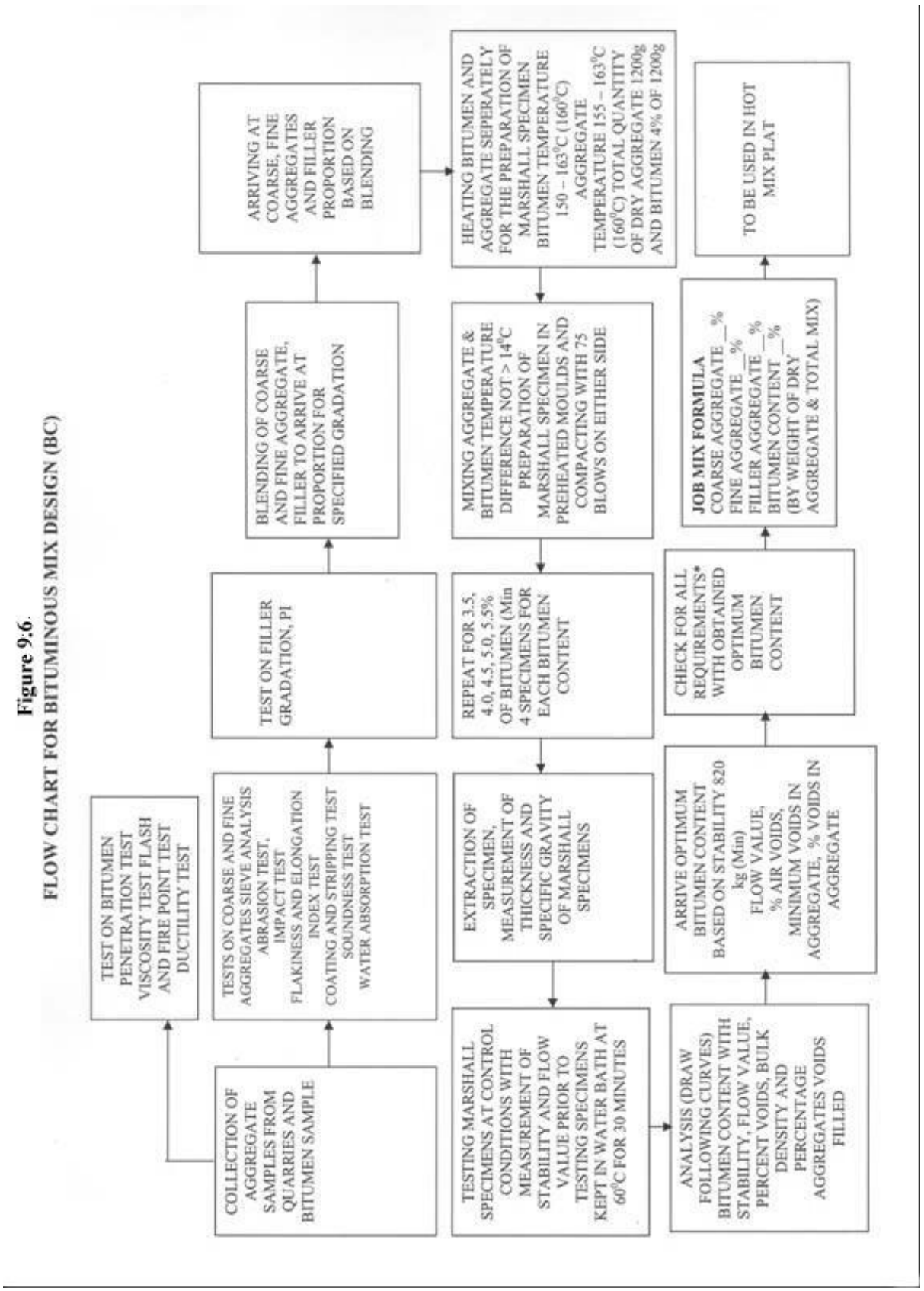


Figure 9.6.
FLOW CHART FOR BITUMINOUS MIX DESIGN (BC)

Figure 9.7

FLOW CHART FOR INSTALLATION AND RUNNING OF HOT MIX PLANT

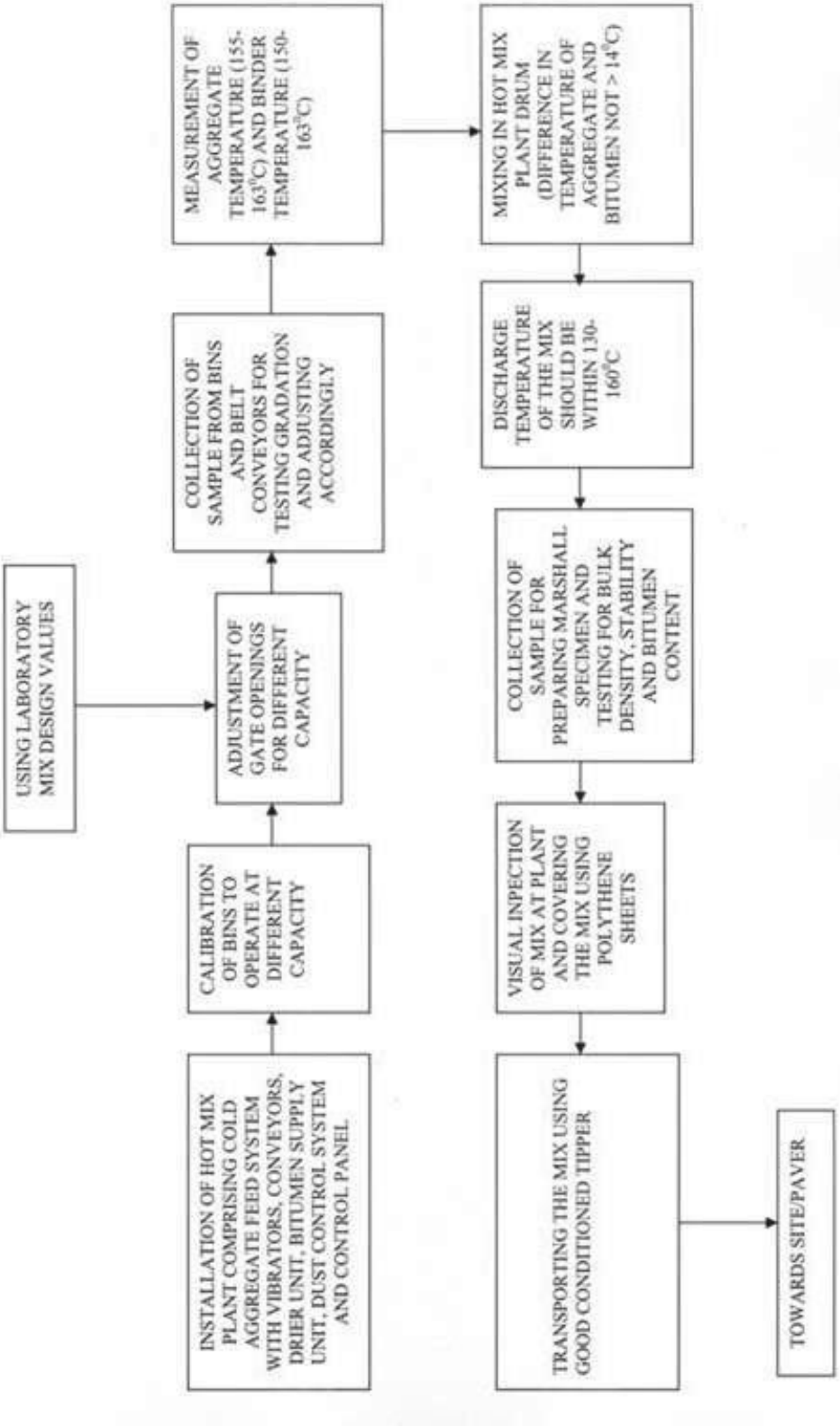
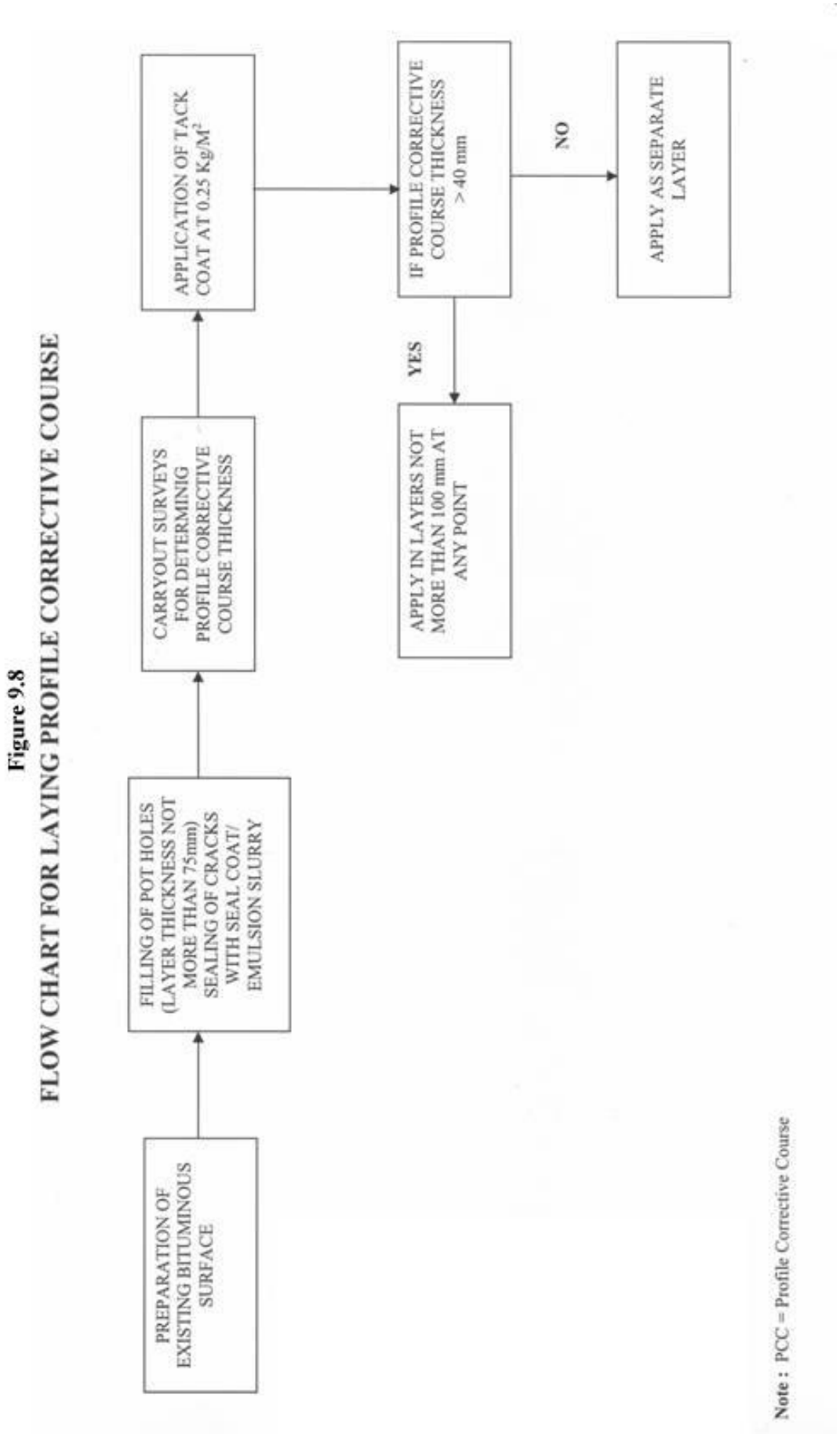


Figure 9.8

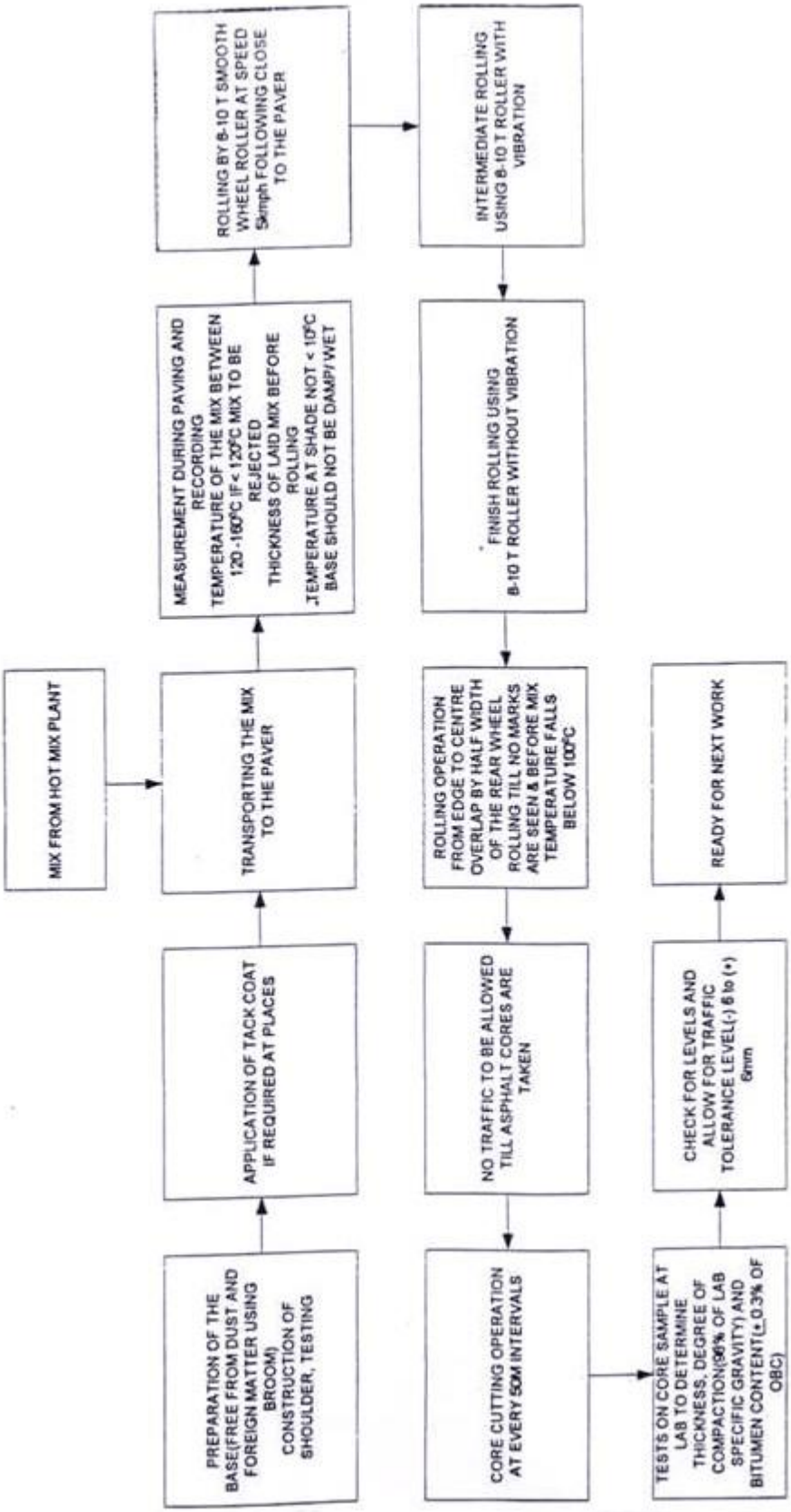
FLOW CHART FOR LAYING PROFILE CORRECTIVE COURSE



Note : PCC = Profile Corrective Course

Figure 9.9

FLOW CHART FOR CONSTRUCTION OF DBM/BC LAYERS



Note: DBM = Dense Bituminous Macadam
BC = Bituminous Concrete
OBC = Optimum Bitumen Content

Table 9.1: List of Tests for Road Works

Sl. No.	Process	Material		Test Ref. No.
		Name	Format No.	
1.	Embankment Formation	Soil/Earth	QC-M-07 QC-M-15	QC-R-01
2.	Excavation			QC-R-02
3.	Granular Sub-base Laying	Granular Sub-base	QC-M-08	QC-R-03
4.	WBM Laying	WBM	QC-M-09	QC-R-04
		Binder	QC-M-11	
5.	Prime Coat Application	Bitumen	QC-M-14	QC-R-05
6.	Tack Coat Application	Bitumen	QC-M-14	QC-R-05
7.	Surface Dressing	Bitumen	QC-M-14	QC-R-06
		Metal	QC-M-10	
8.	Bituminous Macadam Laying	Bitumen	QC-M-14	QC-R-07
		Metal	QC-M-10	
9.	DBM Laying	Bitumen	QC-M-14	QC-R-08
		Metal	QC-M-10	
		Fine Aggregates	QC-M-12	
		Filler (Lime)	QC-M-13	
10.	Mix Seal Surfacing	Bitumen	QC-M-14	QC-R-06
		Metal	QC-M-10	
		Fine Aggregates	QC-M-12	
11.	Bituminous Concrete Laying	Bitumen	QC-M-14	QC-R-08
		Metal	QC-M-10	
		Fine Aggregates	QC-M-12	
		Filler (Lime)	QC-M-13	
12.	On Completion of Laying of BM / DBM / BC	Stage completion test		QC-R-09

Table 9.2: Procedures for Testing Road Embankment Formation

Embankment Formation			QC-R-01	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Moisture content as per IS-2720	TC-M-09-03	One test for each 250 m3 of soil	In-process
2	Field density test as per IS-2720	TC-M-09-03	• For earthwork in embankment/cutting 5-10 density tests per 1000 m^2 compacted area • For earthwork in sub grade/GSB and shoulders, 10 density tests for 500 m^2 compacted area	
3	Rolling operation	Daily log	As per required number of passes	While rolling

Table 9.3: Procedures for Testing Road Excavation

Excavation			QC-R-02	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Layout, slopes of excavation, benching and over-burden	Daily log	As directed by the Engineer	After excavation
2	Sub-soil water, shoring and strutting	Daily log		
3	Bottom levels and compaction	Daily log		
4	Soil classification	Daily log		

Table 9.4: Procedures for Testing Road Granular Sub-base Laying

Granular Sub-Base Laying			QC-R-03	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Moisture content as per IS-2720	TC-M-09-03	One test for 500m2 of compacted soil (3 observations per test)	In-process
2	Field density test as per IS-2720	TC-M-09-03	10 observations selected randomly for every 500m2 of compacted area	

Granular Sub-Base Laying			QC-R-03	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
3	Rolling operation	Daily log	Required No. of passes	While rolling

Table 9.5: Procedures for Testing WBM Layer

WBM Laying			QC-R-04	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Field Density Test: sand replacement method	TC-R-06-01	As directed by the Engineer	In-process

Table 9.6: Procedures for Testing Prime Coat/Tack Coat Application

Prime Coat/Tack Coat Application			QC-R-05	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Temperature Test	Daily log	At regular close intervals	In-process
2	Rate of spreading	TC-R-02-01	Three tests for every 50 m length	

Table 9.7: Procedures for Testing Surface Dressing/Mix Seal Surfacing/Pre-mix Carpet

Surface Dressing/Mix Seal Surfacing/ Pre-mix Carpet			QC-R-06	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Rate of spread of mix material	TC-R-02-01	One test for every 500 m^3 of mix with 6 observations	In-process

Table 9.8: Procedures for Testing Bituminous Macadam Laying

Bituminous Macadam Laying			QC-R-07	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Temperature Test	Daily log	At regular close intervals	In-process
2	Rate of spread of mix material	TC-R-02-01	2-3 observations at every 10 m interval during paving	

Table 9.9: Procedures for Testing DBM/BC Laying

DBM/BC Laying			QC-R-08	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Temperature Test	Daily log	At regular close intervals	In-process
2	Rate of spread of mix material	TC-R-02-01		
3	Stability of Mix/Marshal Stability Test	TC-R-05-01	3 samples for each 400 tons of mix produced subject to a minimum of 2 tests per plant per day.	While hot mixing

Table 9.10: Procedures for Stage Completion Test on BM / DBM / BC Layers

On Completion of BM / DBM / BC Layers Stage Completion Test			QC-R-09	
Sl. No.	**Type of Test**	**Test Report Format No.**	**Frequency of Test**	**Timing of Test/ Inspection**
1	Core test for compacted layer (bitumen content, density and voids)	TC-R-07-01	One test for 250 m^2 of compacted area	On completion of stage and before proceeding to next stage
2	Surface regularity and control of alignment	TC-R-07-02	One test for every 300 m of road length	

9.7 Guidelines for Pavement Layers

Guidelines for gradation and placement of WBM layer are given in **Table 9.11** and **Table 9.12**, respectively; guidelines for application of prime and tack coats are given in **Table 9.13**; and requirements of bituminous mixes are given in **Table 9.14**. (These guidelines are provided for easy reference. Refer to **Table 9.15** for the minimum percentage voids in mineral aggregates. The standards and specifications stipulated in the contract shall be adhered to.)

Table 9.11: Gradation for WBM Layers

Grade-II (Size: 63 mm to 45 mm)		Grade-III (Size: 53 mm to 22.4 mm)		Screening Material (Size: 11.2 mm)	
IS Sieve Designation (mm)	**% by weight passing**	**IS Sieve Designation (mm)**	**% by weight passing**	**IS Sieve Designation (mm)**	**% by weight passing**
90	100	63	100	11.2	100
63	90-100	53	95-100	5.6	90-100
53	25-75	45	65-90	0.18	15-35
45	0-15	22.4	0-10		
22.4	0-5	11.2	0-5		

Table 9.12: Guidelines for Placement of WBM Layers

Quantity Required for 10 Sq. m Area (Compacted thickness 75mm)		
Grading	**Size (mm)**	**Loose Quantity (m^3)**
II	63-45	0.91-1.07
III	53-22.4	0.91-1.07
Screening Material for II	11.2	0.20-0.22
Screening Material for III	11.2	0.18-0.21
Binding Material (II/III)	---	0.06-0.09

Table 9.13: Guidelines for Prime/Tack Coat Application

Particulars	**Standard Specified Rate (kg/m2)**
Granular surface treated with primer	0.25-0.30
Granular base not primed	0.35-0.40
Normal bituminous surfaces	0.20-0.25

Table 9.14: Requirements of Bituminous Mixes

Minimum stability (kN at 60° C)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Percent air voids	3-6
Percent voids in mineral aggregate (VMA)	See table 7.6(a)
Percent voids filled with bitumen (VFB)	65-75

Table 9.15: Minimum % Voids in Mineral Aggregate (VMA)

Nominal Maximum Particle size (mm)	**Minimum VMA, percent Related to Design Air Voids, Per cent[2]**		
	3.0	4.0	5.0
9.5	14.0	15.0	16.0
12.5	13.0	14.0	15.0
19.0	12.0	13.0	14.0
25.0	11.0	12.0	13.0
37.5	10.0	11.0	12.0

Notes: 1. The nominal maximum particle size is one size larger than the first sieve to retain more than 10 per cent.
2. Interpolate minimum voids in the mineral aggregate (VMA) for design air voids values between those listed.

9.8 Tolerances

Requirements for surface regularity and tolerances are given below. (These requirements are for easy reference; the standard and special technical specifications as per the contract must be referred.)

9.8.1 Horizontal alignment tolerances

The horizontal alignment with respect to the centerline of the carriageway shall have a tolerance of ±10 mm at the edges of roadway and of ±25 mm lower layers.

9.8.2 Surface levels tolerances

Surface level tolerances are shown in **Table 9.16**.

Table 9.16: Surface Level Tolerances

Type of Surface	Tolerance in Level Compared with Longitudinal and Cross Profile
Sub-grade	+ 20 mm/- 25 mm
Sub-base	+10 mm/- 20 mm
Base Course (a) Machine laid (b) Manually laid	 ±10 mm ±15 mm
Wearing Course (a) Machine laid (b) Manually laid	 ±6 mm ±10 mm
Cement concrete pavement	+5 mm -6 mm*

* This may not exceed -8 mm at 0-30 cm from the edges.

9.8.3 Surface regularity of pavement courses

The maximum allowable difference between the road surface and a straight line parallel with or at right angles to the centerline of the road at points shall be:

- For bituminous surface: 3 mm
- For GSB/base courses: 8 mm

Refer to **Table 9.17**, for the maximum permitted number of surface irregularities measured under a 3 m long straight edge at the middle of each traffic lane along a line parallel to the center line of the road.

Table 9.17: Maximum Number of Surface Irregularities

Maximum Number of Surface Irregularities on Bituminous Road and Shoulders				
Irregularity	4 mm		7 mm	
Length (m)	300	75	300	75
National/State Highways	20	9	2	1
Town Roads	40	18	4	2

LIST OF APPENDICES

APPENDIX A

TEST REPORT FORMATS

Sl. No	Test Report Title	Format No.
1.	Test Certificate for Cement	TC-M-01-01
2.	Test Certificate for Sand	TC-M-02-01
3.	Test for Filter Media Sand	TC-M-02-02
4.	Test Certificate for Water for Construction Works	TC-M-03-01
5.	Test Certificate for Bricks	TC-M-04-01
6.	Efflorescence Test	TC-M-16-01
7.	Water Absorption Test for Aggregate	TC-M-05-01
8.	Ten Percent Fines Value	TC-M-06-01/1-A
9.	Aggregate Impact Value Test	TC-M-06-01/1
10.	Surface Moisture Test	TC-M-17-01
11.	Specific Gravity	TC-M-18-01
12.	Bulk Density	TC-M-19-01
13.	Aggregate Crushing Strength	TC-M-20-01
14.	Cube Test	TC-M-21-01
15.	Silt Content	TC-M-22-01
16.	Los Angeles Abrasion Test	TC-M-06-01/2
17.	Soundness Test	TC-M-06/02
18.	Flakiness and Elongation Index Test	TC-M-06-03
19.	Gradation/Sieve Analysis	TC-M-06-04
20.	California Bearing Ratio Test (CBR)	TC-M-07-01
21.	Moisture Content Test (Field)	TC-M-07-02
22.	Free Swell Index Test for Soils	TC-M-09-01
23.	Liquid Limit and Plasticity Index (Attterberg Limits)	TC-M-09-02
24.	OMC & MDD Test	TC-M-09-03
25.	Grain Size Distribution	TC-M-09-04
26.	Penetration Test for Grading Bitumen	TC-M-10-01
27.	Ductility Test for Bitumen	TC-M-10-02
28.	Bituminous Mix Dispatch Slip	TC-M-10-03
29.	Stripping Value for Aggregates	TC-M-11-01
30.	Approval of Borrow Material Source for Soil	TC-M-15-01
31.	Test Certificate for Filter Sand	
32.	Permit Format For Concreting	TC-G-01-03A

Sl. No	Test Report Title	Format No.
33.	Concrete Compressive Strength Test	TC-G-01-01
34.	Concrete Slump Test	TC-G-01-02
35.	Daily Concrete Report	TC-G-01-03
36.	Consistency of Mortar Test	TC-G-02-01
37.	Rate of Spreading for Road Works	TC-R-02-01
38.	Marshal Stability Test	TC-R-05-01
39.	Field Density Test by Sand Replacement Method	TC-R-06-01
40.	Core Test for Compacted Layer for BM/DBM/BC	TC-R-07-01
41.	Surface Regularity and Control of Alignment	TC-R-07-02
42.	Hydrostatic Test for NP Pipes	TC-P-04-01
43.	Hydrostatic Test for Pressure Pipes	TC-P-04-02
44.	Leak Test for Manholes	TC-P-05-01
45.	Leak Test for Underground RCC Structures	TC-P-06-01
46.	Leak Test for Elevated RCC Structures	TC-P-06-02

TEST CERTIFICATE FOR CEMENT

Format No.: TC-M-01-01 *Lab Ref. No: _____*

Date_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Brand & Type of Cement :		Quantity : _____ T, _____ Bags	
Consignment No.: _____ Stores Entry No.:_____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

Physical Requirement for 43 Grade (at 27± 2^0c and RH: 65% minimum.

1. CONSISTENCY : IS 4031 (Part-4)-1988

Trial No.	Wt. of cement (gms)	Wt. of water added (gms)	Percentage of water (%)	Reading of indicator (mm)	Consistency (P)	Remarks

2. SETTING TIME : IS 4031 (Part – 5) 1988

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

3. FINENESS (BY DRY SIEVING): IS 4031 (Part-2) 1999and soundness IS 4031 (Part-3) 1988

Wt. of cement used	Retained on 90 micron IS Sieve	Percentage retained	Remarks

4. COMPRESSIVE STRENGTH (Check for 72, 168 & 672 hrs.)

Room Temp	Date of		Age of specimen	Crushing load (T)	Crushing Strength kg/cm^2	Remarks
	Casting	Testing				

(Cube Size = 7.06 cm, Wt. of Cement = 200 gms, Wt. of Standard Sand = 600 gms)

Comments of Laboratory In-Charge _____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

TEST CERTIFICATE FOR SAND

Format No.: TC-M-02-01

*Lab Ref. No:*_____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____

Whether Bulking Test Carried out for this Source : YES/NO,
If yes, give Lab Ref. No.:_____, Date_____

Dry Bulk Density (Loose):_____

1. SIEVE ANALYSIS (IS-2386)

Sieve No.	Sieve Size (mm)	Retained on Each Sieve (% Wt)	Weight of Sample (gm)	Cumulative Percentage Retained	Passing Through (%Wt)	Grading Limits/ Remarks	Acceptability	Remarks

2. *FINENESS MODULUS :* _____

3. DELITERIOUS MATERIAL: Type of Material _____
% by Weight _____

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by: _____ _____ _____
Name Designation Signature

TEST FOR FILTER MEDIA SAND
(as per BIS 419)

Filter sand: - Filter sand be a hard grained quartz or silica sand having no constituent in any way friable or liable to mechanical breakdown when subject to pressure. The sand shall contain no carbonaceous matter, clay or silt and the loss on acid washing and ignition shall in each case be less then 2% by weight. The specific gravity shall be not less than 2.40.

The sand shall be supplied substantially free of fines and coarse material and at least 95% by weight shall be between the grading limits specified by the contractor.

The effective size is defined as the size of the aperture through which 10% of the sand (by weight) passes.

The uniformity coefficient is defined as the ratio of the size of aperture through which 60% of the sand passes to the effective size.

Fines are defined as the particles which pass through a size of aperture 0.9 times the effective size, and not more than 1% shall pass through the nearest sieve size.

All sand shall be obtained from an approved source and supplier and shall be washed, heat dried, graded and packed in plastic or polyethylene bags a approved by the Engineer-In-Charge for delivery to or storage at site.

TEST CERTIFICATE FOR WATER FOR CONSTRUCTION AND DRINKING PURPOSE

Format No: TC-M-03-01 Lab Ref. No……...

Date:

……

Package Name: -		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply			
	No. of Samples tested_____ __ Tested as per IS_____ _	Date	Sample Collected: _____ ___ Tested:_____

Sl. No.	Particular	Unit	Limit	Result
1.	Date of collection /receipt	--------	------	
2.	Date of analysis	--------	------	
	PHYSICAL EXAMINATION			
1.	Color	Hazen	5-15	
2.	Odour		-	
3.	Turbidity	N.T.U	1-5	
4.	PH Value	--------	6.5-8.5	
5.	Electrical Conductivity	umho	-	
6.	Total dissolved solids	mg/l	500-2000	
	CHEMICAL EXAMINATION			
1.	Phenolphthalein Alkalinity	mg/l	--	
2.	Total Alkalinity	mg/l	200-600	
3.	Total hardness	mg/l	200-600	
4.	Carbonate Hardness	mg/l	--	
5.	Non Carbonate Hardness	mg/l	--	
6.	Calcium as Ca	mg/l	75-200	
7.	Magnesium as Mg	mg/l	30--100	
8.	Ammonia as N	mg/l	0.5-No Relx.	
9.	Nitrite as N	mg/l	45-No Relx.	
10.	Nitrate as No3	mg/l	45-No. Relx	
11.	Sulphate	mg/l	200-400	
12.	Chloride	mg/l	250-1000	
13	Phosphate	mg/l	--	
14	Dissolved Iron	mg/l	0.3-No Relx.	
15.	Fluoride	mg/l	1-1.5	
16	Cyanide	mg/l	0.05-NoRelx.	
17.	Residual Chlorine	mg/l	0.2-1.0	
18.	N/50 H2SO4 Consumed in 100 ml sample	----	25 ml max	
19.	N/50 NaOH consumed in 100 ml sample	-----	5 ml max	
	BACTERIOLOGICAL EXAMINATION			
1.	Coliform per 100 ml at 37^0 C	MPN	0	

Remarks: -

Comments of laboratory In charge ……
……
……
……..

Signed and Sealed by Laboratory In-charge

Witnessed by: -

Name Designation
Signature

TEST CERTIFICATE FOR BRICKS

Format No.: TC-M-04-01

*Lab Ref. No:*_____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____

1. PHYSICAL PROPERTIES: -Dimensional Characteristics

Date of testing	*Identification marks of the bricks*	*Dimension obtained for 20 bricks*	*Acceptability*
		Length =	
		Breadth =	
		Depth =	

2. COMPRESSIVE STRENGTH

Date of taking sample of 5 bricks for each test	Identification mark after filling Frog	Size of Brick LxBxH mm	Crushing Surface Area (cm^2)	Crushing Load (T)	Crushing Strength (kg/cm^2)	80% of specified compressive strength in kg/cm^2	Individual Strength	Strength

3. WATER ABSORPTION TEST

Date of taking sample of 5 bricks for each test	Identification Mark	Date of Testing	Wt. of Oven Dried Brick (gms)	Wt. of Wet Brick (gms)	Wt. of Water Absorbed (gms)	% of Water Absorbed	Acceptability 20 % max

Comments of Laboratory In-Charge _____

_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

_____	_____	_____
Name	Designation	Signature

EFFLORESCENCE TEST

Format No.: TC-M-16-01

*Lab Ref. No:*_____
*Date*_____

Date of taking samples of 5 bricks for each test	Identification mark	Date of testing	Result in NIL, Slights, Moderate, Heavy, Serious	Acceptability shall not be more than Moderate	Remarks

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

WATER ABSORPTION TEST FOR AGGREGATE

Format No.: TC-M-05-01

*Lab Ref. No:*_____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____
Material Name :			

Material	Wt. of Oven Dried Material (gms) -B	Wt. of Wet Material (gms) -A	Wt. of Water Absorbed (gms) C=A-B	% of Water Absorbed C/B*100	Remarks

Water Absorption of Material : _____

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

TEN PERCENT FINES VALUE

Format No.: TC-M-06-01/1-A

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____

No.	Detail	Unit	Trial				
			1	2	3	4	5
1	Wt. of dry aggregate passing 12.5 mm and retained on 10 mm sieve (W)	Gms					
2	Load required to bring the percentage Fines within 7.5 to 12.5 (x)	Tonnes					
2.1	Weight of material passing through 2.36 mm IS Sieve (first sample) = y_1	Gms					
2.2	Percentage fine $Y= y_1/W \times 100$	Gms					
3	Load required for 10 percent fines $= \frac{14 * x}{y + 4}$	tonnes					
4	Average load required for 10% fine value						
5	Acceptability >15%						

Average Value: _____

Comments of Laboratory In-Charge _____

_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

AGGREGATE IMPACT VALUE TEST

Format No.: TC-M-06-01/1

*Lab Ref. No:*_____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____
Material Name :	**No. of Std. Blows : 15**		**Height of Fall : 380 mm**

No.	Detail	Unit	Trial				
			1	2	3	4	5
1	Wt. of dry aggregate passing 12.5 mm and retained on 10 mm sieve + cylinder measure	Gms					
2	Wt. of cylindrical measure	Gms					
3	Wt. of dry aggregate taken (1)-(2) (W)	Gms					
4	Wt. of crushed aggregate passing 2.36 mm sieve after subjecting the test specimen to 15 blows (W1)	Gms					
5	Aggregate Impact Value (W1/W) x 100	%					
6	Average of Impact Value						
7	Permissible Limit Maximum						
8	Confirming / Not Confirming						

Average Value: _____

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by: _____ _____ _____
Name Designation Signature

SURFACE MOISTURE TEST

Format No.: TC-M-17-01

*Lab Ref. No:*_____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____

Sr. No.	Date of Testing	Source & Size of Aggregate	Wt. of Wet Aggregate (A) in grms	Wt. of Saturated Surface dry material (B) in grms	Wt. of dry sample (C) in grms	Surface Moisture (%) = 100*(A-B/C)	Confirming/ Not Confirming	Remarks

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

_____	_____	_____
Name	Designation	Signature

SPECIFIC GRAVITY

Format No.: TC-M-18-01

*Lab Ref. No:*_____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.:	No. of Samples Tested:_____	Date	Sample Collected: _____
Stores Entry No.:	Tested as per IS-_____		Tested : _____

Sr. No.	Date of Testing	Source & Size of Aggregate	Empty Wt. of Pycnometer (W1) grms	Wt. of Pycu. + Sample (W2) grms	Wt. of Pycn. + Sample + Water (W3) grms	Wt. of Pycn. + Water (W4) grms	Wt. of Sample (W2-W1) grms	Wt. of Sample in Water (W3-W4) grms	Specific Gravity (W2-W1) (W2-W1) (W3-W4)	Average Specific Gravity	Remarks

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

_____	_____	_____
Name	Designation	Signature

BULK DENSITY

Format No.: TC-M-19-01

*Lab Ref. No:*_____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.:	No. of Samples Tested:_____	Date	Sample Collected: _____
Stores Entry No.:	Tested as per IS-_____		Tested : _____

Sr. No.	Date of Testing	Size & Source of Aggregate	Wt. of Empty Container (Kg)	Gross Wt. of Container with Stone Agg. Sample (Kg)	Net Wt. of Stone Agg. Smaple (A)	Volumn of Container (Litre) (B)	Bulk Density (A/B)	Confirming Yes/No	Remarks if Any

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

AGGREGATE CRUSHING STRENGTH

Format No.: TC-M-20-01

*Lab Ref. No:*_____
*Date*_____

Package Name: Contractor Name: Source of Supply:		Package No.: Contract No.: Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____

Sr. No.	Date of Testing	Size & Source of Aggregate	Wt. of Sample (W1) gms.	Applied Load MT	Wt. Passing Through 2.36 MM sieve (W2) gms.	Crushing Strength (W2/W1)x 100 in %	Average Crushing Strength in %	Conformity Yes/No Limit < 45%	Remarks if Any

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

CUBE TEST

Format No.: TC-M-21-01

*Lab Ref. No:*_____
*Date*_____

Package Name: Contractor Name: Source of Supply:		Package No.: Contract No.: Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____

Sr. No.		1	2	3	4	
Date of Testing Sample						
Items of work & Locations						
Mix & cement OPC/PPC						
Icl. Mark of cubes						
Sample taken in the presence of						
	Cont					
Date of Testing						
Wt, of Cubes in Kg						
Comp. Lead						
Comp. Strenght obained Individual cubes	**7 days**					
	28 days					
Average Strength	**7 days**					
	28 days					
Diff. of maxm & Min (A) %age of (A) over (B)						
Acceptability < 15 %						
Tested in the presence of						
	Cont					
Remarks if any						

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by: _____ _____ _____
Name Designation Signature

SILT CONTENT

Format No.: TC-M-22-01

*Lab Ref. No:*_____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.:	No. of Samples Tested:_____	Date	Sample Collected: _____
Stores Entry No.:	Tested as per IS-_____		Tested : _____

Sr. No.	Date of Testing	Name of Source/ Supplier	Wt. of Sand A-(ml)	Wt. of Silt B-(ml)	%age of Silt (B/A)x100	Limit	Signature of			Remarks (if Any)
									Cont.	

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

LOS ANGELES ABRASION TEST

Format No.: TC-M-06-01/2 *Lab Ref. No: _____*

Date_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____
Material Name :	**No. Of Revolutions** **500/100 rpm**		**No. Of Abrasive Changes**

No.	Detail	Unit	Trial				
			1	2	3	4	5
1	Weight of aggregate of specified gradation	Kg					
2	Weight of passing IS 1.7 mm sieve after specified revolution	Kg					
3	Los Angeles Abrasion Value =100*(2)/(1)	%					

Average Value: _____

Comments of Laboratory In-Charge _____

_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

SOUNDNESS TEST

Format No.: TC-M-06-02

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____
Material Name :	**Immersion Time**		**Type of Solution**

No.	Detail	Unit	Number of Cycle									
			1	2	3	4	5	6	7	8	9	10
1	Wt. Of clean dry aggregate of specified size range	Gms										
2	Wt. of dry aggregate dried in oven after each cycle	Gms										
3	Loss of aggregate after 10 number of cycles subject to immersion and oven drying after each cycle =(1)-(2)	Gms										
4	Soundness Value =100*(3) / (1)											

Average Value: _____

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by: _____ _____ _____
Name Designation Signature

FLAKINESS AND ELONGATION INDEX TEST

Format No.: TC-M-06-03

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____
Material Name :			

Sieve Range (mm)	Total Wt. of Aggregate (gms) W	Wt. Of Aggregate Passing Thickness Gauge W1	Flakiness Index (W1/W) x 100	Avg, value of FI	Wt. Of Non-flaky Sample W2	Wt. Of Aggregate Passing Elongation Gauge W3	Elongation Index W3/W2	Avg. value of elongation index
63-50								
50-40								
40-31.5								
31.5-25								
25-20								
20-16								
16-12.5								
12.5-10								
10-6.3								

Flakiness Index _____

Elongation Index _____

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

GRADATION/SIEVE ANALYSIS

Format No.: TC-M-06-04

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____
Material Name :			

Sieve No.	Sieve Size (mm)	Wt. Of material retained (g)	Retained on Each Sieve (% Wt)	Cumulative Percentage Retained	Passing Through (%Wt)	Grading Limits/Remarks

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by: _____ _____ _____
Name Designation Signature

CALIFORNIA BEARING RATIO (CBR) TEST

Format No.: TC-M-07-01 *Lab Ref. No: _____*
Date

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____

Specimen Preparation Method			
Type of Compaction Used			
Condition of Specimen at Test			

Density Determination				Moisture Content	Before Compaction			After Compaction		
Mould No.				**Mould No.**						
				Cup No.						
Wt. of mould+soil				Wt. Of cup+wet soil						
Wt. of mould				Wt. Of cup+dry soil						
Wt. of compacted soil				Wt. Of water						
Volume of mould				Wt. Of cup						
Bulk density (g/cc)				Wt. Of dry soil						
Dry density (g/cc)				Moisture content %						
MDD				OMC						
Degree of compaction				Variation						

Mould No.						
Penetration (mm)	Proving Ring Reading	Load (kg/cm^2)	Proving Ring Reading	Load (kg/cm^2)	Proving Ring Reading	Load (kg/cm^2)
0						
0.5						
1.0						
1.5						
2.0						
2.5						
3.0						
4.0						
5.0						
7.5						
10.0						
12.5						

Swell	Initial Reading	Final Reading	Net Swell	Swell	Average Swell
Mould No.					

CBR at 2.5 mm _____ CBR at 5.0 mm _____ Average CBR value at penetration ___ mm = %

Signed and Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

MOISTURE CONTENT TEST (FIELD)

Format No.: TC-M-07-02 *Lab Ref. No: _____*

Date_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ Nos.	
Consignment No.: Stores Entry No.:	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected: _____ Tested : _____

Test No.	1	2	3	4	5
Container No.					
Wt. Of wet soil taken (S_w)					
Wt. Of dry soil in pan (S_d)					
Wt. Of water ($W=S_w-S_d$)					
Moisture content $= 100* W/S_d$					

Comments of the Laboratory In-charge

Signed and Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

FREE SWELL INDEX TEST FOR SOILS

Format No.: TC-M-09-01

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source Of Supply:		Quantity : _____ T/M^3	
Consignment No.: _____ Stores Entry No.:_____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____
Oven Dry Soil Passing Through 425-micron IS Sieve	**Weight of Each Sample ____ gms**	**Glass Graduated Cylinders _____ ml size**	

1. Volume of Soil Specimen read from the Graduated Cylinder Containing Distilled Water (V_d) _____ ml

2. Volume of Soil Specimen read from the Graduated Cylinder Containing Kerosene (V_k) _____ ml

3. Free Swell Index .. 100 x $(V_d-V_k)/V_k$ _____ %

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

LIQUID LIMIT AND PLASTICITY INDEX (Atterberg limits)

Format No.: TC-M-09-02

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source Of Supply:		Quantity : _____ T/M^3	
Consignment No.: _____ Stores Entry No.:_____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

Sr. No.	Particular	Unit	Liquid Limit					Plastic limit		
			1	2	3	4	5	1	2	3
1.	No. of blows	No								
2.	Cup No.									
3.	Wt. of cup+wet soil (W1)	g								
4.	Wt. of cup+dry soil (W2)	g								
5.	Wt. of water = W3=(W1-W2)	g								
6.	Wt. of cup = W4	g								
7.	Wt. of dry soil W5=W2-W4	g								
8.	Moisture content W=W3/W5x100	%								

Liquid limit W_L: % (by graph)
Plastic limit, W_p: %
Plasticity index, Ip = W_L - W_p = %
Acceptance criteria = PI=<6

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

OMC & MDD TEST

Format No.: TC-M-09-03 *Lab Ref. No: _____*
Date_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Brand & Type of Cement :		Quantity : _____ T/M^3	
Consignment No.: _____ Stores Entry No.:_____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

a) Bulk density

Sr. No.	Particular	Unit	Test no.							
			1	2	3	4	5	6	7	8
1.	Wt. of mould + compacted soil (W1)									
2.	Wt. of mould (W2)	g								
3.	Wt. of compacted soil (W1 - W2)	g								
4.	Volume of mould (V)	cc								
5.	Wet density (rb) (W1-W2)/V	g/cc								

b) Dry density

Sr. No.	Particular	Unit	Test no.							
			1	2	3	4	5	6	7	8
1.	Wt. of cup + wet soil (W3)	g								
2.	Wt. of cup + dry soil (W4)	g								
3.	Wt. of water = W5=(W3-W4)	g								
4.	Wt. of cup (W6)	g								
5.	Wt. of dry soil, W7=W4-W6	g								
6.	Moisture content =W=(W5/W7)x100	%								
7.	Dry density = rd=rb(1+W/100)	g/cc								

Maximum dry density
Mean MDD: g/cc _____
Mean OMC: % _____

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by: _____ _____ _____
Name Designation Signature

GRAIN SIZE DISTRIBUTION GRAPH

Format No.: TC-M-09-04

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source Of Supply:		Quantity : _____ T/M^3	
Consignment No.: _____ Stores Entry No.:_____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

1. Description of soil :
2. Type of sieve analysis : day/wet
3. Total wt. of soil sample : W (g) =

IS Sieve opening	Wt. of sieve dish (g)	Wt. of sieve + dry soil (g)	Wt. of soil retained (g)	Cumulative wt. retained (g)	Cumulative percent retained	----
100 mm						
63 mm						
22 mm						
6.3 mm						
4.75 mm						
2.0 mm						
600 micron						
212 micron						
75 micron						
63 micron						
Passing 63 micron						

Report on gradation of curve:

Uniformity coefficient =Cu = D60/D10 =

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

PENETRATION TEST FOR GRADING BITUMEN

Format No.: TC-M-10-01

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Brand & Type of Cement :		Quantity : _____ T	
Consignment No.: _____ Stores Entry No.:_____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

1. Pouring temperature, ^{0}C :
2. Period of cooling in atmosphere, minutes :
3. Room temperatures, ^{0}C :
4. Period of cooling in water bath, minutes :
5. Actual test temperatures, ^{0}C :

Sr. No.	Particulars	Test no.		
		1	2	3
1.	Initial Penetrometer dial reading (R1)			
2.	Final Penetrometer dial reading (R2)			
3.	Penetration value R2 - R1			

Mean Penetration Value

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

DUCTILITY TEST FOR BITUMEN

Format No.: TC-M-10-02

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply :		Quantity : _____ T	
Consignment No.: _____ Stores Entry No.:_____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

1. Grade of bitumen :
2. Pouring temperatures, ^{0}C :
3. Test temperatures, ^{0}C :
4. Periods of coding, minutes :
   a) In air :
   b) In water bath before trimming :
   c) In water bath after trimming :

Sr. No.	Particulars	Briquette Number		
		1	2	3
1.	Ductility (cm)			

Mean Ductility (cm):

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

BITUMINOUS MIX DISPATCH SLIP

Format No.: TC-M-10-03

Lab Ref. No: _____
Date_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Location of Hot Mix Plant :	Date : Time

1. Truck No :
2. Weight of Loaded Truck :
3. Weight of Empty Truck :
4. Net Weight :
5. Temperature of Mix :
6. Type of Mix :
7. % of Bitumen :

Signature of Hot Mix Plant Agent

Signature of PMC/PIU (DJB) Representative

STRIPPING VALUE FOR AGGREGATES

Format No.: TC-M-11-01

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Source of Supply:		Quantity : _____ T/M^3	
Consignment No.: _____ Stores Entry No.:_____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

Sr. No.	Particulars	Unit	Test no.		
			1	2	3
1.	Type of aggregate				
2.	Type of binder				
3.	% binder used				
4.	Total wt. of aggregate	g			
5.	Total wt. of binder				
6.	Temperature of water-bath				
7.	Stripping value				

Mean stripping value (%)

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

_____	_____	_____
Name	Designation	Signature

APPROVAL OF BORROW MATERIAL SOURCE FOR SOIL TO BE USED IN EMBANKMENT/SUBGRADE/GSB

Format No.: TC-M-15-01

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Location of Borrow Material Source:			
Inspected By	No. of Samples Tested:_____	Date	Sample Collected : _____
Inspection Date	Tested as per IS-_____		Tested : _____

Sample No	Sand content %	Wet sieve analysis					Plasticity Index %	Proctor Density g/cc	CBR %	Compaction test	
		4.75	0.60	0.30	0.15	0.075				MDD %	OMC %

Comments of the Engineer _____
_____

☐ **APPROVED** ☐ **NOT APPROVED**

Give Source Reference No. _____

(This ref no. is to be quoted by the contractor whenever material from this source is used)

Signature of the Engineer/Consultant Signature of the Contractor

Witnessed by:

Name	Designation	Signature
_____	_____	_____

PERMIT FORMAT FOR CONCRETING

Format No.: TC-G-01-03A

Conc. Pour Permit No._____
Date_____
Date of Concreting _____

This Permit Format must be presented to PIU (DJB) & PMC at least one day advance of proposed concreting. Concreting can be done only if Permit Format is duly signed by authorized representative of PMC / PIU (DJB).

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Where the concrete used:			
Supervised By:		Quantity : _____ T/M^3	
Daily Log Ref._____ Date _____	Mix Grade: _____ Time Start _____ Finish ____	Date	Sample Collected : _____ Tested : _____

Materials	Status of Testing and Approval	Quantity available at site
Cement		
CA1		
CA2		
Fine Aggregate		
Water		

Equipments	Status
Mixer	
Weight Batching M/C	
Vibrator	
Cube moulds	
Cone, Alternative Power Labour	
Availability of Skilled manpower	
Availability of Labour	

Centering & Shuttering

1. IS formwork plan submitted and approved.
2. IS formwork checked by PMC/PIU (DJB).

Reinforcement

IS reinforcement placed as per approved drawings and design and checked by PMC/PIU (DJB).

Plasticizers

1. IS use of plasticizers approved.
2. Name and make of plasticizer
3. Type of plasticizer

Labor Amenities

Approved for concreting

Signature of PMC and PIU (DJB) Engineer.

CONCRETE COMPRESSIVE STRENGTH TEST

Format No.: TC-G-01-01

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Pour Card No:	Pour Card Date:	Quantity : _____ T/M^3	
Daily Log Ref._____ Date _____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

Sr. No.	Particulars	Unit	Test no.		
			1	2	3
1.	Identification mark/Sample No.				
2.	Wt. of specimen	kg			
3.	Length of specimen	cm			
4.	Breadth of specimen	cm			
5.	Height of specimen	cm			
6.	Cross sectional area of the specimen	cm^2			
7.	Crushing load	kg			
8.	Compressive strength	kg/cm^2			

Average compressive strength of concrete = _____ kg/cm^2

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

CONCRETE SLUMP TEST

Format No.: TC-G-01-02

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Pour Card No:	Pour Card Date:	Quantity : _____ T/M^3	
Daily Log Ref._____ Date _____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

Sr. No.	Particulars	Unit	Test no.		
			1	2	3
1.	Quantity of water added per bag of cement in ltrs.	Ltr.			
2.	Height of specimen after removal of mould	mm			
3.	Slump	mm			
4.	Required slump	mm			
5.	Confirming Yes /No	Yes/No			

Comments of Laboratory In-Charge _____
_____

Signed and Sealed by Laboratory In-Charge

Witnessed by: _____ _____ _____
Name Designation Signature

DAILY CONCRETE REPORT

Format No.: TC-G-01-03

*Pour Card No.*_____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Where the concrete used:			
Supervised By:		Quantity : _____ T/M^3	
Daily Log Ref._____ Date _____	Mix Grade: _____ Time Start _____ Finish ____	Date	Sample Collected : _____ Tested : _____

Concrete materials per bag of cement							
Material	Size	TC Ref	Fineness module	Specific gravity	Impact value	Water absorption	Dry batch weight
Cement							
Coarse Aggregate 1 CA1							
Coarse Aggregate 2 CA2							
Fine Aggregate							
Water							

Sieve Size mm	**Gradation** % Finer		
	CA1	CA2	FA
40			
20			
4.75			
2.36			
1.18			
0.60			
0.30			
0.15			

No. of Concrete Cubes for Testing			
Cube No			
Time			
Cube No			
Time			

Slump Test						**Temperature Test**		
Sl.No	Time	Value	Sl.No	Time	Value	Time	Air Temperature	Concrete Temperature
1			5					
2			6					
3			7					
4			8					

Signature of Contractor Signature of Engineer

Witnessed by:

Name	Designation	Signature

CONSISTENCY OF MORTAR TEST

Format No.: TC-G-02-01

Lab Ref. No: _____
Date_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Pour Card No:	Pour Card Date:	Quantity : _____ T/M^3	
Daily Log Ref._____ Date _____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

Sr. No.	Particulars	Unit	Test No.	
			1	2
1.	Wt. of cement	kg		
2.	Wt. of sand	kg		
3.	Water/cement ratio			
4.	Wt. of water	kg		
5.	Dial gauge reading before penetration	mm		
6.	Dial gauge reading after penetration	mm		
7.	Consistency of mortar	mm		

Average Consistency of mortar = _____ mm

Comments of Laboratory In-Charge _____
_____

Signature of Test Lab

Witnessed by:

Name	Designation	Signature

RATE OF SPREADING FOR ROAD WORKS

Format No.: TC-R-02-01

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Work Type: Primer/Tack Coat/Surface Dressing/MSS/Pre-mix Carpet/BM/DBM/BC Chainage: from _____ to _____		Quantity : _____ T/M^3	
Daily Log Ref._____ Date _____	Vehicle Speed: ____ km/h Temperature: _____ Pressure: _____	Date	Sample Collected : _____ Tested : _____

TRAY IDENTIFICATION	1	2	3	4	5
Weight of empty tray (g) W_e					
Weight of empty tray+bitumen sprayed (g) W_b					
Wt. Of bitumen sprayed on tray $W_n = W_b - W_e$					
Area of tray (m^2) A					
Rate of application $= 100 * W_n/A$					

Average rate of application = kg/m^2

Specification limits = kg/m^2

Comments of Inspector _____
_____

Signature of the Engineer with Date Signature of Contractor

Witnessed by:

Name	Designation	Signature

MARSHAL STABILITY TEST

Format No.: TC-R-05-01

Lab Ref. No: _____
Date_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Hot Mix Plant Data:		Quantity : _____ T/M^3	
Daily Log Ref._____ Date _____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

Stability and flow value determinations

Type of grading of aggregates :

Grade of bitumen :

Mixing temperature, ^0C

Compacting temperature, ^0C

Number of blows on either side =

Proving ring calibration factor =

Flow value dial, 1 division =

Sample No.	Bitumen content percent	Maximum proving ring reading	Stability value, kg		Flow dial reading	Flow value, 0.25/0.1 mm units
			Measured	Corrected		
1						
2						
3						
Average						
1						
2						
3						
Average						
1						
2						
3						
Average						
1						
2						
3						
Average						
1						
2						
3						
Average						
1						
2						
3						
Average						

...continued

DENSITY AND VOID DETERMINATIONS

W1 = G1 = W2 = G2 =
W3 = G3 = W4 = G4 =

Sample No.	Bitumen content, percent	Height of sample, mm	Weight, g		Bulk Density, G_b	V_v	V_b	VMA	VFB
			in air	in water					
1									
2									
3									
Average									
1									
2									
3									
Average									
1									
2									
3									
Average									
1									
2									
3									
Average									
1									
2									
3									
Average									

Result

(i) Maximum stability, kg = , at bitumen content, % =
(ii) Maximum bulk density, g/cc = , at bitumen content, % =
(iii) Percent air voids = , at bitumen content, % =

Average bitumen content =

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

FIELD DENSITY TEST BY SAND REPLACEMENT METHOD

Format No.: TC-R-06-01 *Lab Ref. No: _____*
Date_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
		Quantity : _____ T/M^3	
Daily Log Ref._____ Date _____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

I. Determination of Bulk Density of Sand : MDD = OMC=

Sl.No	Particulars	Unit	Trial No		
			1	2	3
1	Wt. of calibrating container + Water (M1)	Gm			
2	Empty weight of calibrating container (M2)	Cm			
3	Volume of calibrating container, Vc = M1-M2	CC			
4	Wt. of sand + cylinder before pouring W1	Gm			
5	Wt. Of sand in the cone W2	Gm			
6	Wt. Of sand + pouring cylinder after pouring in calibrating container W3	Gm			
7	Wt. Of sand filling with calibrating container Wa = W1-W3-W2	Gm			
8	Bulk density of sand Ya= Wa/Vc	Gm/cc			

II. Determination of Bulk Density of Soil In-situ

Sl.No	Particulars	Unit	Trial No		
			1	2	3
1	Wt. Of excavated soil from hole Ww	Gm			
2	Wt. Of sand + cylinder after pouring into the hole W4	Gm			
3	Wt. Of sand in the soil Wb= W1-W4-W2	Gm			
4	Volume of the hole	CC			
5	Bulk density of soil in-situ Yb = Ww/Wb x Ya	Gm/cc			

III. Determination of Dry Density of Soil In-situ

Sl.No	Particulars	Unit	Trial No		
			1	2	3
1	Container No.				
2	Wt. Of container	Gm			
3	Wt. Of container + wet soil	Gm			
4	Wt. Of container + dry soil	Gm			
5	Wt. Of dry soil	Gm			
6	Wt. Of water	Gm			
7	Water content %	%			
8	Dry density Yd	Gm/cc			
9	Degree of compaction = Yd /MDD X 100				

Sl.No	Particulars	Unit	Trial No		
			1	2	3
10	Average of Compaction				
11	Confirming /Not confirming (More than 97 %)				

Signed by Lab in-charge

Witnessed by:

Name	Designation	Signature

CORE TEST FOR COMPACTED LAYER FOR BM/DBM/BC

Format No.: TC-R-07-01 *Lab Ref. No: _____*
Date_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Hot Mix Plant Data:		Quantity : _____ T/M^3	
Daily Log Ref._____ Date _____	No. of Samples Tested:_____ Tested as per IS-_____	Date	Sample Collected : _____ Tested : _____

Stability and flow value determinations

Type of grading of aggregates : Grade of bitumen :

Mixing temperature, ^0C Compacting temperature, ^0C

Number of blows on either side = Proving ring calibration factor =

Flow value dial, 1 division =

Sample No.	Bitumen content from analysis %	Maximum proving ring reading	Stability value, kg		Flow dial reading	Flow value, 0.25/0.1 mm units
			Measured	Corrected		
1						
2						
3						
Average						
1						
2						
3						
Average						
1						
2						
3						
Average						
1						
2						
3						
Average						
1						
2						
3						
Average						
1						
2						
3						
Average						

(Continued)

DENSITY AND VOID DETERMINATIONS

W1 = G1 = W2 = G2 =
W3 = G3 = W4 = G4 =

Sample No.	Bitumen content from analysis, %	Height of sample, mm	Weight, g		Bulk Density, G_b	V_v	V_b	VMA	VFB
			in air	in water					
1									
2									
3									
Average									
1									
2									
3									
Average									
1									
2									
3									
Average									
1									
2									
3									
Average									
1									
2									
3									
Average									
1									
2									
3									
Average									

Result

(i) Maximum stability, kg = , at bitumen content, % =
(ii) Maximum bulk density, g/cc = , at bitumen content, % =
(iii) Percent air voids = , at bitumen content, % =

Average bitumen content =

Comments of Laboratory In-Charge _____
_____

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name	Designation	Signature

SURFACE REGULARITY AND CONTROL OF ALIGNMENT

Format No.: TC-R-07-02 *Lab Ref. No: _____*
Date_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Road Name:	Total Stretch Length Inspected:
Daily Log Ref:	Date Inspected
Date	Inspected By

1. Horizontal Alignment *(permissible limits as per Section 4)*

Chainage (m)		**Horizontal Alignment Tolerances reckoned from center line of carriageway**	
From	To	At the edges of the carriageway	At the edge of the road and lower layers

2. Tolerances in Surface Levels *(permissible limits as per Section 4)*

Chainage (m)		**Sub-grade**	**Sub-base**	**Base**		**Wearing Course**	
From	To			Machine Laid	Manual Laid	Machine Laid	Manual Laid

3. Surface Regularity of Pavement Courses *(permissible limits as per Section 4)*

Chainage (m)		**Irregularity – 4 mm**		**Irregularity – 7 mm**	
From	*To*	*Length*		*Length*	
		300 m	*75 m*	*300 m*	*75 m*
		No. of Irregularities		*No. of Irregularities*	

Signature of Inspecting Authority

HYDROSTATIC TEST FOR NP-PIPES

Format No.: TC-P-04-01

Lab Ref. No: _____
Date_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Daily Log Ref._____ Date _____	Tested as per CPHEEO _____	Date Tested	Test Head : 2.5 m at highest point Observation: 1 hr

Sl. No	ID (mm)	Time in hrs	Stretch	Length (m)	Water level Drop (mm)		Volume of water to restore to original level (liters)	
					10 min	30 min	10 min	30 min

Comments of the Engineer/Consultant _____

_____

Any rectification to be done by the contractor _____

Signature of the Engineer/Consultant Signature of the Contractor

Witnessed by:

Name	Designation	Signature

HYDROSTATIC TEST FOR PRESSURE PIPES

Format No.: TC-P-04-02

Lab Ref. No: _____
Date_____

Package Name:		Package No.:
Contractor Name:		Contract No.:
Daily Log Ref._____ Date _____	Tested as per CPHEEO _____	Date Tested

Sl. No	Material of pipe	ID (mm)	Stretch	Length (m)	Applied test pressure (kg/cm^2)	Time in hrs)			Observations
						1	2	4	

Comments of the Engineer/Consultant _____
_____

Any rectification to be done by the contractor _____

Signature of the Engineer/Consultant Signature of the Contractor

Witnessed by:

Name	Designation	Signature

LEAK TEST FOR MANHOLE

Format No.: TC-P-05-01

Lab Ref. No: _____
*Date*_____

Package Name:		Package No.:	
Contractor Name:		Contract No.:	
Daily Log Ref._____ Date _____	Tested as per CPHEEO _____	Date Tested	Duration of Water Retention: 24 hrs

Sl. No	Manhole No.	Water Level (m)		Sign	Drop in water level (mm)	Remarks
		Initial	Final			

Comments of the Engineer/Consultant _____
_____
_____

Any rectification to be done by the contractor _____
_____

Signature of the Engineer/Consultant Signature of the Contractor

Witnessed by: _____ _____ _____
Name Designation Signature

LEAK TEST FOR UNDERGROUND RCC STRUCTURES

Format No.: TC-P-06-01

Lab Ref. No: _____
*Date*_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Name of Structure:	Size:

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

Comments of the Engineer/Consultant _____
_____
_____

Any rectification to be done by the contractor _____
_____

Signature of the Engineer/Consultant Signature of the Contractor

Witnessed by:

Name	Designation	Signature

LEAK TEST FOR ELEVATED RCC STRUCTURES

Format No.: TC-P-06-02

Lab Ref. No: _____
*Date*_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Name of Structure:	Size:

Date of Filling		**Initial Water level (m)**	
Observation No.	Date of Observation	Observation	Remark
1			
2			
3			
4			
5			
6			
7			

Comments of the Engineer/Consultant _____
_____
_____

Any rectification to be done by the contractor _____
_____

Signature of the Engineer/Consultant Signature of the Contractor

Witnessed by:

_____	_____	_____
Name	Designation	Signature

APPENDIX B

INSPECTION CHECKLISTS

APPENDIX B.1

INSPECTION CHECKLIST FOR CONCRETING WORKS

APPENDIX B.2

INSPECTION CHECKLIST FOR BRICKWORK AND FINISHES

APPENDIX B.3

INSPECTION CHECKLIST FOR BUILDING SERVICES AND FINISHES

APPENDIX B.4

INSPECTION CHECKLIST FOR ROAD WORKS

APPENDIX B.5

INSPECTION CHECKLIST FOR PIPELINE WORKS

APPENDIX B.1

INSPECTION CHECKLIST FOR CONCRETING WORKS

1. Form work Check list

Format No.: TC-P-06-02 *Lab Ref. No: _____*
Date_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Name of Structure:	Size:

S. No.	Name of Activities	Contractor's Engineer	Engineer-in-charge (PIU DJB)/PMC
1	Form work design/drawing/sketch approved including dishuttering arrangements.		
2	Trial panel approved (if required)		
3	Formwork alignment correct		
4	Formwork level correct		
5	Formwork dimensions correct		
6	Formwork member quality acceptable		
7	False work member sizes correct		
8	Face boarding/playwood/metal thickness correct		
9	Joints between panels closed (no gaps)		
10	Joints between panels flush (no steps /lips)		
11	Panel flatness acceptable		
12	Tie rod material sizes/ spacing/material correct		
13	Tie rodstight, facecone flush		
14	Box outs, cast-in-items, ducts fixed correctly, securely		
15	Chamfers/ fillets sizes, straightness, fixing acceptable.		
16	Formwork clean		
17	Formwork release oil material approved		
18	Formwork release oil applied correctly		
19	Contraction/ expension joint preparation satisfactory		
20	Shutter vibrators (if required) location and fixing arrangement approved .		

2. REINFORCEMENT INSPECTION CHECK LIST

Format No.: TC-P-06-02

Lab Ref. No: _____
*Date*_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Name of Structure:	Size:

S. No.	Name of Activities	Contractor's Engineer	Engineer-in-charge (PIU DJB)/PMC
1	Working drawing checked and approved		
2	Location revision being used		
3	Bar schedules approved		
4	Reinforcement steel material approved		
5	Bar bending and cutting satisfactory		
6	All corroded bars rejected		
7	Bar sizes correct		
8	Bar spacig correct		
9	Bar lap lengths correct		
10	Bar laps at correct locations		
11	Bar ties as specified and precoated binding wire used		
12	Bar assembly rigid and adequately supported		
13	All bars crossing tied up with binding wire		
14	Cover to bottom bars correct		
15	Cover to top bars correct		
16	Covers to side bars correct		
17	Cover blocks approved including fixing		
18	Only approved cover block used		
19	Quality & size of binding wire approved.		

3. CONCRETE POUR CARD

Format No.: TC-P-06-02

Lab Ref. No: _____
*Date*_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Name of Structure:	Size:

S. No.	Name of Activities	Contractor's Engineer	Engineer-in-charge (PIU DJB)/PMC
1	Method statement approved		
2	Batching Plant/mixers in working order		
3	Standby batcher in working order		
4	Water, Coarse aggregates, Cement, sand, admixture approved		
5	Water, coarse aggregate, cement , sand, admixture stock sufficient		
6	Concrete conveying arrangement availability in working condition		
7	Formwork approved		
8	Reinforcement approved		
9	Concrete gang present : including carpenter, steel fixer, mechanics and electricians		
10	Access provided		
11	Safety arrangements sufficient		
12	Lighting provided		
13	Communication between various points provided		
14	Arrangements for arranging suspension stoppage of concrete provided.		
15	Curing arrangements made		
16	Laboratory notified.		

4. POST CONCRETE CHECKLIST

Format No.: TC-P-06-02 *Lab Ref. No: _____*
Date_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Name of Structure:	Size:

S. No.	Name of Activities	Contractor's Engineer	Engineer-in-charge (PIU DJB)/PMC
1	Concrete started on		
2	Concrete completed on		
3	Curing satisfactory		
4	Cube strength (…….days)		
5	Concrete surface condition		
6	Any repairing required		
	Remarks for rectifications by Engineer-In-Charge Concrete quality acceptable Yes/No		

5. BAR BENDING SCHEDULE

Format No.: TC-P-06-02 *Lab Ref. No: _____*
Date_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Name of Structure:	Size:

Member	Bar No.	Dia of Bars	No. Per Member	No. Of Members	Total no. of Bars	Cutting Length	Total Length	Shapes

APPENDIX B.2

INSPECTION CHECKLIST FOR BRICKWORK

1. CHECK LIST FOR BRICKWORK

Format No.: TC-P-06-02

Lab Ref. No: _____
*Date*_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Name of Structure:	Size:

S. No.	Name of Activities	Contractor's Engineer	Engineer-in-charge (PIU DJB)/PMC
1	Whether materials used conform to relevant specifications and whether mandatory test done? a) Sand b) Bricks c) Location		
2	Whether structural drawing co-related with architectural drawing?		
3	Whether the centre line of brickwork checked with reference to grid lines as per architectural drawing?		
4	Whether bricks soaked in water before use for sufficient period?		
5	Whether queen closer are used at junction of walls?		
6	Whether brickwork is in true plumb and vertical and all layers truly horizontal?		
7	Whether graduated woodedn straight edge storey rod being used for keeping height of brick courses uniform?		
8.	Whether wall ehight being constructed in a day is being restricted to 1 m height?		
9	Whether parts of wall left at different levels are raked back at an angle of 45 degrees or less with the horizontal? (toothing is not to be permissted)		
10	Whether top courses of all plinths, parapets, steps and top of walls below floor and roof slabs laid with brick on edge? Whether marucona provided at corners is such brickworks?		
11.	Whether thickness of joints in brickwork is kept 1 cm ±20% ?		
12.	Whether mortar of approved mix within maximum permissible water cement ratio is		

	used?		
13.	Whether all orizontal and vertical joints are being filled?		
14.	Whether proper arrangements of curing and curing period maintained as per specification?		
15.	Whether date of work done written		

APPENDIX B.3
INSPECTION CHECKLIST FOR FINISHING (PLASTER WORK)

1. INSPECTION CHECKLIST FOR FINISHING (PLASTER WORK)

Format No.: TC-P-06-02 *Lab Ref. No: _____*
Date_____

Package Name:	Package No.:
Contractor Name:	Contract No.:
Name of Structure:	Size:

S. No.	Name of Activities	Contractor's Engineer	Engineer-in-charge (PIU DJB)/PMC
1	Block manosry and concrete surface are found clean, free from duct loose material, oil, grease, mortar droppings, nails, steel patti, wooden pieces, wire etc.		
2	Joints in blocks masonry are racked to a depth of 10 mm		
3	Surface to be plastered is made ssufficiently damp.		
4	Unavoidable projections in samonry and concrete is chiseled		
5	Hacking on concrete surface is sufficiently deep and distance between hacking is not more than 25-40 mm		
6	Any leakage's observed before plastering.		
7	If yes, leakages have been rectified.		
8.	Joints between concrete surface and masonry are properly filled with cement mortar or sealant before applying plaster		
9	Joints, concealing and repaired areas are covered with chicken mesh of 300 mm wide.		
10	Mark up are made before plaster at interval not more than the size of bottom ----to be used.		
11.	Grading of sand, silt and dust are within the permissible limit.		
12.	Thickness of single coat plaster is not less than 12 mm and not more than 15mm		
13.	Door frames are free from cracks, knots etc.		
14.	6 Nos. hold fast fixed properly		
15.	Frames are fixed in plumb		
16	All above points cheaked and permitted to		

	start plaster		
	Observations		
	Plaster is in line and level, the difference in plumb is not more than 2 mm		
	Neeru finish is of 2 mm to 3mm and is applied over the plaster when it has just Hardened.		
	Curing is done on neeru plaster by slightly sprinkling water.		
	After neeru finish the room dimensions are checked and they are of size…….mm x…….mmx……mm.		

APPENDIX B.4

INSPECTION CHECKLIST FOR ROAD WORKS

Items	Remarks
❑ The Engineer must check all layouts and staking completed by the contractor before starting roadwork. ❑ To check whether all sub-grade areas where road materials are to be placed. To check whether the quality of sub-grade prepared by testing procedures has been verified as provided in the contract documents. To check whether all the mandatory tests (filed and lab test) of materials arranged at site has got done by the contractor and confirms to the BIS standard/contract agreement. To check whether the base course on which bituminous layers is to be laid is swept clean, free from dust and foreign matter. ❑ To check whether the inspection of Hot Mix plant, Bitumen distributor tanker/ sprayer rollers and other TNP to be employed for bituminous work has been made and satisfied the conditions of contract agreement. Whether the job mix formula for BM/ DBM/AC has been received at least 20 days before start the work. To check that the job mix formula is based on a correct and truly representative sample of the materials that will be actually used in the works. To check whether the temperature of binder and aggregate is within the specified range and the difference in temperature between the binder and aggregate is not exceed 14^0C. ❑ Whether the mix for bituminous construction has been visually inspected at the plant after delivery and transported to site by covered tipper trucks. Whether the temperature of the mix at the time of laying has been continuously monitored using a digital thermocouple based thermometer. To check whether the longitudinal joints and edges has been constructed true to the delineating lines parallel to the centerline of the road. ❑ To check whether the mix has been thoroughly compacted by rolling with a set of rollers moving at a speed not more than 5 Km/hour immediately following the Paver. For BM/ DBM / AC, the initial rolling shall be done with 8-10 T Static Weight Smooth Wheeled Roller, intermediate rolling shall be done with 8-10 T Static Weight	

Vibratory Roller or 15-25 T Pneumatic Tyred Roller and the finish rolling shall be done with 6-8 T Smooth Wheeled Tandem Roller. For Mix Seal Surfacing layer, rolling should be done with 8-10T Smooth Wheeled Tandem Roller. ❑ Traffic on bituminous layer may only be allowed after completion of the final rolling when the mix cools down to surrounding temperature.	

APPENDIX B.5

INSPECTION CHECKLIST FOR PIPELINE WORKS

Items	Remarks
❑ The engineer should ensure that all required specials, valves and pipes with jointing material duly tested are available before planning for excavation of trenches. No gaps are to be permitted with laying pipes. ❑ To check whether materials used conform to relevant specifications and whether mandatory test done ❑ The Engineer must ensure that pipe bedding has been prepared to the proper shape as shown in the drawing and properly compacted. ❑ Wherever a socket or collar of pipe or fitting/ special will occur a grip should be cut at the bottom of the trench or concrete bed to a depth of at least 75 mm below the bed of the pipe. When welding is to be carried out with the pipes and the specials in the trench, additional excavation of not more than 60 cm in depth and 90 cm in length should be made at joints in order to facilitate welding. ❑ Whether plumber employed is licensed or not. ❑ Whether plan for piping system has been prepared and got approved ❑ Whether all pipes and fittings are ISI marked and or any standard park specified in Contract Agreement. ❑ Whether a sample system has been prepared and got approved. ❑ The pipes should be thoroughly investigated for any defects before lowering in the trench. The socket or spigot end of pipes should never be allowed to be chipped and any deviation in the dimension of the pipe should be reported by the contractor. ❑ During jointing of pipe special care should be taken so that spigot and socket of adjoining pipes fit snugly into each other. ❑ For water distribution network projects, water pipes, fittings and connections must be carefully inspected during placement and verified as to compliance with the plans and specifications. ❑ All open ends of the pipes must be covered with suitable cover at the end of the day before close of work to prevent entry of dirt and water in the pipe. ❑ Whether pipe lines checked at required pressure before covering. ❑ Whether weight of flushing pipes and fittings checked. ❑ Connection to existing water supply mains must be scheduled under provision of the specifications and the field engineer must actively participate in the arrangements and in insuring that the contractor performs the work as scheduled. ❑ The Engineer must ensure that the pipes have been laid as per the design gradient and should also ensure that the minimum gradient has been achieved in all sections of line.	

APPENDIX C

DOCUMENTATION FORMATS

Format No.	Document Type	Responsibility
F-1	Request For Design Approval (RDA) **of Document Transmittal Note**	Issued by Contractor
F-2	Request for Internal Design Check , Review and Recommendations	Issued by IA
F-3	Internal Design check Review and Recommendation Note	Issued by PMC
F-4	Design Transmittal Note (for Turnkey Contracts)	Issued by IA
F-5	Design/Drawing Register (for Turnkey Contracts)	Maintained by Contractor
F-6	Approved Design Release Note (for All Item Rate Contracts)	Issued by IA
F-7	Design/Drawing Register (for Item Rate Contracts)	Maintained by Contractor
F-8	Request for Internal Design Approval	Issued by PMC
F-9	Internal Design Transmittal Note	Issued by IA
F-9 (a)	Design Approval Note	Issued by IA
F-10	Conformance/Non-Conformance Report	Issued by IA
F-11	Test Report Log	Maintained by Contractor
F-12	Material Register / Dismantle Material Record	Maintained by Contractor
F-13	Daily Work Record/Site Order Book	Maintained by Contractor
F-14	Site Order Book	Maintained by Contractor
F-15	Variation Order	Issued by IA
F-16	Instruction Log / Inspection Record	Maintained by Contractor
F-17	Minutes of Progress Review Meeting	Prepared by PMC
F-18	Interim Evaluation of Contractor Performance	Prepared by IA
F-19	Quality Certification and Acceptance	Issued by PMC

Format F-1

REQUEST FOR DESIGN APPROVAL (RDA) OF DOCUMENT TRANSMITTAL NOTE

Ref: RDA____ Date: _____

To
[PIU (DJB)]

Package No. : _____ Contract No.: _____

Title of work : _____

We are herewith enclosing the following designs/drawings listed below for your review and approval.

Document No./ Design/ Drawing No.	Rev	Description	Category	Copy	Remarks

_____

[Contractor]

ACKNOWLEDGEMENT COPY Date received _____

Ref No.: RDA_____ Date: _____

To

[Contractor]

Package No. : _____ Contract No.: _____

Title of work : _____

Received the above referred RDA along with enclosures.

_____

[PIU (DJB)]

Format F-2

REQUEST FOR INTERNAL DESIGN CHECK/REVIEW AND RECOMMENDATIONS (RIDCRR)

Ref: Date: _____

To
[PMC/PIU (DJB) (as applicable)]

Package No. : _____ Contract No.:

_____

Title of works :

_____

Please check/review and recommend on the enclosed designs/drawings and communicate your comments.

Document No./ Design/ Drawing No.	Rev	Description	Category	Copy	Remarks

_____

[PIU (DJB)]/ PMC (as applicable)

Copy to PIU (DJB) for information

Format F-3

INTERNAL DESIGN CHECK /REVIEW AND RECOMMONDATION NOTE (IDCRRN)

Ref: Date: _____

To
[PIU (DJB)] (as applicable)

Package No. : _____ Contract No.: _____

Title of works : _____

Please find enclosed our comments and recommendations on the following documents of designs/drawings after checking/reviewing

Document / Title	Document/ Design/ Drawing No.	Rev	Category	Copy	Comments and Recommendations

It is certified that the document has been checked reviewed and is recommended for its approval/modification.

_____

[PMC or PMC as applicable]

Format F-4

DESIGN TRANSMITTAL NOTE (DTN)

Ref: RDA___ DTN____ Date: _____

To
[Contractor]

Package No. : _____ Contract No.: _____

Title of work : _____

Your RDA No.: _____ Date _____

Following are our comments on the designs and drawings submitted by you under above referred RDA.

Document / Title	Design/ Drawing No.	Rev.	Category	Comments and Recommendations
				Not approved, refer drawing for comments
				Approved as Noted
				Approved

The drawings / documents have been checked as per contract agreemet by the consultant (PMC). The above submission shall be resubmitted by incorporating the comments given above.

_____

[PIU (DJB)]

ACKNOWLEDGEMENT COPY Date received _____

Ref: DTN_____ Date _____

To
[PIU (DJB)]

Package No. : _____ Contract No.: _____

Title of work : _____

Received the above referred DTN along with enclosures.

_____

[Contractor]

Format F-5

TURNKEY CONTRACTS

DESIGN/DRAWING REGISTER

Package No. :_____ Title of work :_____

Contract No. :_____ _____

Contractor :_____ Date started :_____

Date to complete: _____

RDA No.	Date sent	Date Received	Design No.	Rev.	Description	DTN No.	Date No.	Date Sent	Date received	comments	Used for Contn. Yes/No	Inspecting Authority Sign.

Format F-6

APPROVED DESIGN RELEASE NOTE (ADRN)

Ref: ADRN____ Date: _____

To
[Contractor]

Package No. : _____ Contract No.: _____

Title of works : _____

The following drawings / documents have been checked as per contract agreement by the consultant (PMC) and issued for commencing the construction. Please bring to our notice if any changes are required to be incorporated additionally.

Design/Drawing No.	Rev	Date	Description

_____

[PIU (DJB)]

ACKNOWLEDGEMENT COPY Date received _____

To
[PIU (DJB)]

Ref: ADRN____ Date: _____

Package No. : _____ Contract No.: _____

Title of work : _____

Received your above referred ADRN along with enclosures.

_____

[Contractor]

Format F-7

ITEM RATE CONTRACTS

DESIGN/DRAWING REGISTER

Package No. :_____ Title of work :_____

Contract No. :_____ _____

Contractor :_____ Date started :_____

Date to complete: _____

ADRN No.	Date sent	Date Received	Design No.	Rev.	Description	All drawings signed Yes/No	Used for Constn. Yes/No.	Consultant Sign	Inspecting Authority Sign.

Format F-8

REQUEST FOR INTERNAL DESIGN APPROVAL (RIDA)

Ref: Date: _____

To
[PIU (DJB)/PMC]

Package No. : _____ Contract No.: _____

Title of works : _____

Please check/review and recommend on the enclosed modified designs/drawings and communicate your approval & signatures.

Document No. / Design/ Drawing No.	Rev	Description	Category	Copy	Remarks

_____

[PMC]

Certified that the designs/drawings has been reviewed and comments has been incorporated by PMC if any, and signed.

Certified that the designs/drawings has been checked, reviewed and recommended for its approval and signed.

[PMC]

Format F-9

INTERNAL DESIGN TRANSMITTAL NOTE (IDTN)

Ref: Date: _____

To
[PMC]

Package No. : _____ Contract No.: _____

Title of works : _____

Following are the comments from PIU (DJB)/PMC on the enclosed designs/drawings submitted by you. Submit after necessary modifications if any, for their approval.

Document / Title	Document / Design/ Drawing No.	Rev.	Category	Copy	Comments and Recommendations
					Not Approved, refer drawing for comments
					Recommended for *Approved as Noted*
					Approved

_____

[PIU (DJB)]

Format F-9(a)

DESIGN APPROVAL NOTE

To
[PMC/PIU (DJB)]

The enclosed designs/drawings are herby approved.

Document / Title	Document / Design/ Drawing No.	Rev.	Category	Copy	Comments and Recommendations

_____

[PIU (DJB)]

Format F-10

CONFORMANCE\NON-CONFORMANCE REPORT (CNC)

Date: _____

Ref:

To
[Contractor]

Package No. : _____ Contract No.: _____

Title of works : _____

Ref: Your letter _____ dated _____.

Based on the review of the submitted test reports, as mentioned in the table below, our comments and instructions are mentioned herein for your suitable action.

Test Report No.	**Date**	**Test Laboratory**	**Material**	**Comments** *(Conforms/ Does not conform. See instructions below)*

Instructions (Actions to be taken by Contractor): _____
_____
_____
_____
_____
_____

_____
[PIU (DJB)]

Format F-11

TEST REPORT LOG

Contract Package No :_____ Title of work :_____

Contract No. :_____ Contractor :_____

Date of Sample	Lab Name	Material/Process	Test Report No.	Date of TR	CNC Report No.	Date	Conformance/ Non-Conformance	Action to be taken by contractor	Consultant sign	Inspecting Authority Sign.

Format F-12

MATERIAL REGISTER / DISMANTLE MATERIAL RECORD

Contract Package No. :_____ Title of work : _____

Contract No. :_____ Contractor : _____

Name of Materiel :_____ Unit of Measure: MT/Bags/Drums/M^3/M^2

Inward Date	Inward No.	Source of Supply	Quantity	Test Report No.	CNC Report No.	Date of Issue	Quantity Issued	Quantity Balance	Consultant sign	Inspecting Authority Sign
Cumulative Inward including this _____										
Cumulative Inward including this _____										

Signature of Contractor verified by Consultant/ Engineer

Format F-13

DAILY WORK RECORD

DATE :	WEATHER :	TIME WORKED : From To	
CONTRACT NO. / NAME :			
NAME OF CONTRACTOR :			
DATE OF NOTICE TO PROCEED	DATE WORK STARTED	SCHEDULED COMPLETION DATE	TIME LAPSED (%)
NO. OF PERSONNEL ON SITE : Supervisory: Skilled Labor: Labor (M): Labor (F) : Total:			
EQUIPMENT ON SITE (List):			
DRAWINGS & DATA RECEIVED (Describe)			
SITE VISITORS/MEETINGS/OTHER EVENTS (Describe)			

MATERIALS RECEIVED	QUALITY OF MATERIALS		
	Sample Date	Test Report No.	Quality

WORK IN PROGRESS (Describe):
Signature [Contractor]

...continued page 2

Format F-13
(Continued)

DAILY WORK RECORD

Page 2

DATE: CONTRACT NO./NAME:
COMMENTS ON THE PROGRESS AND QUALITY : Overall Progress of the Work : Ahead of schedule ____ : On schedule____ : Behind schedule:____ Sufficient Labor on Site : Yes _____ : No _____ Sufficient Equipment on Site : Yes _____ : No _____ Overall Quality of Materials : Good _____ : Satisfactory _____ : Unsatisfactory:_____ Overall Quality of Workmanship : Good _____ : Satisfactory _____ : Unsatisfactory:_____
INSTRUCTIONS TO THE CONTRACTOR AND/ OR APPROVALS GIVEN :
EXPLAIN ANY UNSATISFACTORY OBSERVATIONS
Signatures [Contractor] [Site Inspector/Engineer] [Visiting Office (PIU (DJB)/PMC]

(3 copies per set – one copy each to be sent to PIU (DJB) and PMC by the contractor; one copy to be retained at site)

Format F-14

SITE ORDER BOOK

Package No. : _____ Contract No.: _____

Title of works : _____

S. No.	Remarks of the inspection Or contractor	Action taken any by whom	Remarks

Format F-15

VARIATION ORDER

Ref : VO___	Date :
Package No. :	Contract No. :
Title of Work:	
From	[PIU (DJB)]
To	[Contractor]

You are hereby instructed to make the following changes in the Contract:

Description of Change

Estimated Cost of Change

Item of work	Quantity	Unit cost	Estimated cost	Change in cost

Summary of cumulative changes including this one:

- Original contract price Rs. _____
- Net of cumulative changes prior to this change Rs. _____
- Net change in this order Rs. _____

Final contract price net of all changes so far **Rs.** _____

Time for completion :	Original _____ months
	Prior to this change _____ months
	Change in this order _____ months
	Final time for completion _____ months

Signatures

_____ _____

[PIU (DJB)] [PMC]

Format F-16

INSPECTION REGISTER / INSTRUCTION LOG

Contract Package No :_____ Title of work :_____

Contract No. :_____ Contractor :_____

Date of Instruction	Name of officer and designation	Item inspected and specific defect noticed and action to be taken	Inspection authority signature	Defects taken over to site order book / letter			Compliance Action by Contractor	Consultant Signature	Signature by PMC/ PIU
				Side order book / letter number	Date	Signature			

Signature of Contractor

Format F-17

MINUTES OF PROGRESS REVIEW MEETING

Meeting Conducted on: _____ Previous Meeting on: _____

Contract No.	**: _____**
Name of the Works	**: _____**
Contract Amount	**: _____**
Name of Contractor	**: _____**
	_____
Notice to Proceed	**: _____**
Contract Duration	**: _____**
Completion Date	**: _____**

Elapsed Time: _____mos._____%
Scheduled Work Completion: _____% **Actual Work Completed:** _____%

Compliance with commitments made during last review meeting

Sl. No.	COMMITMENTS BY CONTRACTOR / PIU (DJB) DURING LAST REVIEW MEETING	WHETHER COMPLIED	IF NOT, WHY & WHEN WILL BE COMPLIED

Sheet 1 of 3

Meeting Conducted on: _____

Contract No.	**: _____**
Name of the Works	**: _____**

Review of Progress, Quality and Coordination during this Period

Sl. No.	PROBLEMS, ISSUES, ACTIONS TO BE TAKEN	ACTION BY	DUE DATE

Sheet 2 of 3

Meeting Conducted on: _____

Contract No.	**: _____**
Name of the Works	**: _____**

Any Other Business / General Comments:

[Affix dated signatures]

_____	_____	_____
[PMC/PIU (DJB)]	[PMC]	[Contractor]

Sheet 3 of 3

Format F-18

INTERIM EVALUATION OF CONTRACTOR PERFORMANCE

Evaluation Conducted on : _____ **Previous Evaluation:** _____
Contract No. : _____
Name of the Works : _____
Contract Amount : _____
Name of Contractor : _____
Notice to Proceed : _____ **Work Started on:** _____
Scheduled Completion Date : _____
Elapsed Time: _____mos._____% **Work Completed**: _____%

Factors to be considered in evaluation:		**Contractor's Performance this Period**		
		Good	**Satisfactory**	**Poor**
Progress of the Works this Period	:	_____	_____	_____
Compliance with Engineers instructions	:	_____	_____	_____
Quality of Contractor's supervision	:	_____	_____	_____
Quality of materials supplied	:	_____	_____	_____
Storage and handling of materials	:	_____	_____	_____
Quality of workmanship	:	_____	_____	_____
Provision of adequate and skilled labor	:	_____	_____	_____
Provision of adequate materials in time	:	_____	_____	_____
Provision of adequate construction equipment	:	_____	_____	_____
Provision of necessary testing equipment	:	_____	_____	_____
Provision of signboard	:	_____	_____	_____
Site conditions/maintenance of site	:	_____	_____	_____
Site safety and public convenience	:	_____	_____	_____
Cooperation for inspection and measurement	:	_____	_____	_____
CONTRACTOR'S PERFORMANCE THIS PERIOD:		_____	_____	_____

The performance of the Contractor at the date of this review has IMPROVED/ REMAINED THE SAME/ DETERIORATED *[delete non-applicable sections]* since the last evaluation. The above notwithstanding, the overall performance of the Contractor is judged to be GOOD/ SATISFACTORY/ POOR *[delete non-applicable sections]* up to this date.

It is hereby agreed that improvements in any deficient areas indicated above and/or as detailed on the attached list are to be immediately taken up by the Contractor, and that the Contractor's performance is to be brought up to an acceptable standard by _____ *[date]*. A further review of the Contractors performance will be conducted on _____ *[date]*, and actions will be taken as per contract in case the deficiencies have not been satisfactorily rectified.
[Affix dated signatures]

_____	_____	_____
[PIU (DJB)]	[PMC]	[Contractor]

Format F-19

PARTICULARS OF CONTRACT

Name of Works : _____

Contract No. : _____

Contractor : _____

R.A. Bill No. /Date : _____

Period Covered : _____ to _____

QUALITY CERTIFICATE

This is to certify that we have inspected the conduct of the works in accordance with the 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 proscribed under the Contract.

Signature/Date:

_____

[Design & Supervision Consultant]

ACCEPTANCE NOTE

This is to certify we accept the Consultant's Quality Certificate.

Signature/Date:

_____

[PIU (DJB) Engineer]

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

APPENDIX D

MONTHLY REPORT FORMATS

APPENDIX D.1

FORMAT FOR CONTRACTORS' MONTHLY PROGRESS REPORTS

APPENDIX D.1

FORMAT FOR CONTRACTORS' MONTHLY PROGRESS REPORTS

GOVERNMENT OF DELHI

DELHI WATER SUPPLY IMPROVEMENT INVESTMENT PROGRAM
(ADB Loan No……-IND)

PACKAGE REF. No._____

CONTRACT No. _____

MONTHLY PROGRESS REPORT NO. _____

[MONTH, YEAR]

[NAME OF CONTRACTOR]

DELHI WATER SUPPLY IMPROVEMENT INVESTMENT PROGRAM

PACKAGE REF. No. _____
CONTRACT No. _____

Name of Contractor_____

MONTHLY PROGRESS REPORT OF CONTRACTOR

For *[Month, Year]*
(Due on every 1st of the month)

TABLE OF CONTENTS

Table of Contents **Page No**.

1. Contract Scope and Data

1.1 Contract Scope

[Provide package name, reference number and location, and give a brief description of the works.]

1.2 Contract Data

Contract Number	
Contractor	
Employer	
Engineer	
Date of Letter of Acceptance	
Date of Contract Signing	
Date of Notice to Proceed	
Original Contract Period (months)	
Original Completion Date	
Approved Time Extension (months)	
Revised Completion Date	
Original Contract Amount (Rs.)	
Approved Total Value of Variation Orders (Rs.)	
Revised Contract Amount (Rs.)	

1.3 Contact Data

Contact Data	Contractor's Home Office	Contractor's Site Office	Employer	Engineer
Representative				
Street Address				
City				
State				
Post Code				
Country				
Telephone Number(s)				
Fax Number(s)				
E-mail				

2. Progress Summary

Item	Cumulative up to Previous Month	This Month	Cumulative to Date
Scheduled Progress (%)			
Actual Progress (%)			
Slippage (%)			
Contract Time Lapsed (months)			
Contract Time Lapsed (%)			
Interim Payment Certificate Amount (Rs.)			
Interim Payment Certificate Amount (% Contract)			

Notes:

1. "Progress" is the ratio, expressed as a percentage, of:

   Value of completed Permanent Works and approved Variation Orders /

   Contract amount for Permanent Works and approved Variation Orders

2. The "Interim Payment Certificate (IPC) Amount" consists of the value of permanent works and approved variation orders, plus amounts for advances, price variation and other items, minus deductions for retention, repayment of mobilization advance, damages, etc. The value of statutory deductions for taxes, royalties, etc., which are deducted from the Contractor's payments and paid by the Employer on behalf of the Contractor, are not considered in determining the "IPC Amount".

3. Financial Status

3.1 Interim Payment Certificate Summary

IPC No.: IPC Date:	Period: [Month Year] (All Amounts in Rs.)			
Component	Contract Amount	Total Amount Certified Previously (Actual)	Amount Submitted this Period	Total Amount to Date
1. Mobilization Advance	___			
2. Permanent Works 2.1 Part A 2.2 Part B 2.3 Part C etc.				
3. Approved Variation Orders Nos. ___ to ____				
4. Extra for Changes in Cost and Legislation				
5. Other Items 5.1 (Describe) 5.2 etc.	___			
6. TOTAL VALUE OF WORKS (Total of items 1 through 5)	___			
7. Contract Deductions 7.1 Retention (@10% up to 5% of Contract Value) 7.2 Recovery of Mobilization Advance 7.3 Other Items (Describe) 7.4 etc.	___ ___ ___ ___			
8. TOTAL AMOUNT OF CONTRACT DEDUCTIONS	___			
9. INTERIM PAYMENT CERTIFICATE AMOUNT (Item 6 minus Item 8)				

3.2 Status of IPC Payments

IPC No.	Date Submitted	Amount Submitted (Rs.)	Date Paid	Amount Paid (Rs.)
Advance 1 2 etc.				
Total to Date				

Note:

1. "Amount Paid" is the amount paid for the Interim Payment Certificate or Advance, before the statutory deductions for taxes, royalties, etc., which are deducted from the Contractor's payments and paid by the Employer on behalf of the Contractor.

4. Progress of Works

4.1 Mobilization

[Describe mobilization activities and status during report period and compare with planned activities.]

4.2 Civil Works

[Describe civil works completed in report period, and total completed to date; describe civil works in progress during report period and % completed to date; and compare actual and planned achievements. Refer to photographs in Appendix A.4.2.1.]

4.3 Plant and Equipment Supply

[Describe plant and equipment supply activities during report period, and total to date; and compare actual and planned achievements. Follow the format shown below and repeat for each major equipment item to be supplied. Refer to photographs in Appendix A.4.3.1.]

[Equipment Item]	
Activity	Description of Activities During Month / Status / % Complete
Design	
Purchase Order	
Manufacturing	
Factory Inspection and Testing	
Shipping	
Delivery	
On-Site Inspection	
Erection	
Testing	
Commissioning	
Trial Runs	

4.4 Work Program

The scheduled and actual progress of each category of works is shown in the Bar-Chart and S-Curves in the following page.

Work Program

[Insert the data on Scheduled Progress, in accordance with the approved Work Program, and on Actual Progress in the format shown below; draw the bar-charts for each category of work, showing scheduled and actual progress; and draw the S-curves of scheduled and actual cumulative progress.]

Package Name and Ref. No.: Contract No.: Month: Year:

Items identified in agreed work programe (Summarize Works by major Categories)	Total quantity (Rs.)	Bill Item Weight (%)	% Item Complete Previous Months	% Item Complete This Month	% Item Complete To Date	Calendar Year																		Cumul. Progress (%)
						Calendar Month																		
						Contract Month																		
																								100%
																								80%
																								60%
																								40%
																								20%
																								0%
Scheduled Monthly Progress (%)																								
Actual Monthly Progress (%)																								
Slippage this Month (%)																								
Scheduled Cumulative Progress (%)																								
Actual Cumulative Progress (%)																								
Cumulative Slippage (%)																								
Time Elapsed (%)																								

5. Organization and Resources

[Discuss contractor's organization, personnel and equipment employed on the project.]

6. Quality Assurance/Quality Control

[Discuss quality related issues, particularly failures. Refer to list of quality control tests and results, test sheets and materials certificates in Appendices A.6.1 and A.6.2.]

7. Engineer's Instructions and Site Orders

[Discuss instructions and site orders issued during the month and actions taken to comply with them. Refer to copies of instructions and site orders in Appendix A.7.1.]

8. Variation Orders

8.1 Variation Orders Issued

[Maintain a running account of all Variation Orders issued since the start of the contract. Attach copies of Variation Orders issued during the month in Appendix A.8.1.1.]

VO No.	Date Issued	Description	Additional Amount (Rs.)	Additional Time (days)	Remarks
Total					

8.2 Variation Orders Proposed

[Maintain a running account of proposed variation orders that have not yet been acted upon by the Engineer or the Employer. Attach copies of variation orders proposed during the month in Appendix A.8.2.1.]

Ref. No.	Date Submitted	Description	Additional Amount (Rs.)	Additional Time (days)	Remarks

9. Quarterly Cash Flow Forecast

Forecast Revision No.:_____ Date Prepared: _____

Calendar Year								
Quarter (Month-Month)	J-F-M	A-M-J	J-A-S	O-N-D	J-F-M	A-M-J	J-A-S	O-N-D
Forecast Amount (Lakhs Rs.)								
Actual Amount (Lakhs Rs.)								

10. Other Activities and Events

[Discuss other significant activities and events during the report month, such as force majeure circumstances, accidents, etc.]

APPENDICES

Appendix A.4.2.1 Progress Photographs – Civil Works

[Insert photographs of milestones and important stages of civil works.]

Appendix A.4.3.1 Progress Photographs – Plant and Equipment Supply

[Insert photographs of milestones and important stages of equipment manufacturing and erection.]

Appendix A.6.1 Quality Control Tests

[For the contractually required tests performed during the month complete the list below and attach copies of test results.]

[Contract No. _____]
Quality Control Tests during [Month, Year]

Type of Test	No. of Tests Specified / Required	No. of Tests Performed to Date	No. Passed	No. Failed	Remarks
[List all types of tests required]					

Submitted by: Verified by: Confirmed by:

_____ _____ _____
(Contractor) (Engineer) (Consultant)

Appendix A.6.2 Materials Certificates

[For the contractually required materials certificates obtained during the report month complete list below and attach copies of certificates.]

[Contract No. _____]
Materials Certificates Obtained during [Month, Year]

Type of Material	Name of Manufacturer or Supplier	Origin Location	Certificate Ref. Number	Certificate Description
[List all types of materials for which certificates are required]				

Submitted by: Verified by: Confirmed by:

_____ _____ _____
(Contractor) (Engineer) (Consultant)

Appendix A.7.1 Engineer's Instructions and Site Orders

[Attach copies of Engineer's Instructions and Site Orders issued during the report month.]

Appendix A.8.1.1 Variation Orders Issued

[Attach copies of Variation Orders issued during the report month.]

Appendix A.8.2.1 Variation Orders Proposed

[Attach copies of Variation Orders first proposed during the report month.]

APPENDIX E

INDICATIVE GENERAL FILING SYSTEM

APPENDIX-E
Indicative General Filing System

File Number: Prefixed by Project Ref. eg: DWSIIP/WS/….		Notes on Material filed
Ref		
1-	Employer: Delhi Jal Board, ADB Loan Project	
2-	Notes of meetings	Minutes or notes of all meetings attended all relevant site in date order, including notes of meetings formal meetings with the contractor, meetings with Planning Authorities, etc.
3-	Contractor's head office	
4-	Contractor's agent	Formal letters only
5-	Weekly progress reports	Copies of the reports sent to the engineer
6-	Monthly progress reports	Copies of draft reports for submission to the engineer plus copies of report as sent.
7-	Planning Authorities	
8-	Engineer/ Engineer's Representative: PIU (DJB)/ PMC	This will form one of the most used and most important correspondence file.
9-	Informal letters to designers	Here will be filed copies of correspondence the Supervising engineer will periodically write to his colleagues at head office (Copy to the engineer)
10-	Specialist advisers	Correspondence with all independent experts and advisors associated with the Project.
11-	Nominated sub-contractors	This file may be split into several files, each dealing with a single subcontractor
12-	Supply contractors	Subdivided into a separate file for each contractor if necessary, this being correspondence with contractors other than the main construction contractor
13-	Miscellaneous suppliers	Correspondence with suppliers who will be supplying chosen materials through the main contractor, under P.C. items etc.
14-	Staffing	All staff related correspondence re the appointment of inspectors, office staff, etc.
15-	Miscellaneous (Works)	Re such matters as telephone, visitors to site, site services, etc.

File Number: Prefixed by Project Ref. eg: DWSIIP/WS/….		Notes on Material filed
Ref		
16-	Miscellaneous (personal)	Dealing with personal correspondence arising from his position as Supervising engineer, e.g. invitations to speak at meetings, references given to staff, etc.
	Financial files:	
17-	Claims from main contractor	
18-	Day works —current	
19-	Claims passed	
20-	Day works and extras passed	
21-	Engineer's certificates and correspondence thereon	
22-	Variation Orders passed	
23-	Variation Orders pending or in draft	
24-	Other contractor's invoices and claims (subdivided, a file to each contractor)	
25-	Claims pending for extra charges by main contractor	
26-	Estimates of future expenditure	
27-	Petty cash, miscellaneous	

Notes:

- The number of separate files required will depend upon the size of the contract and how many contractors/ subcontractors are engaged on the site.
- The Notes of Meetings File (No. 2) is very useful. An extra copy should be taken of all minutes or notes of meetings, and placed on this file so that a lot of time is saved not having to hunt up particular instructions which would otherwise be hidden away in files I, 3,8, or 10.
- Correspondence with contractors and subcontractors (Files 11 and 12) should preferably be separated, a file to each contractor.
- The distinction under the financial files (Nos.17—23) between that which has been done and that which is 'pending' should be noticed; there is always something pending, and it is helpful to keep this separate.
- Under File 21 lies that part of the correspondence with the engineer that deals purely with financial matters relating to claims and certificates for payment. This correspondence needs to be kept out of File 8, where it might otherwise be 'lost'.

IMPORTANT: This filing system is to be considered a dynamic system, essentially requiring continual updating, as per requirement.

APPENDIX F

LIST OF INDIAN STANDARD SPECIFICATION CODES

APPENDIX F

List of Indian Standard Specification Codes

The procurement of civil works, materials and testing has to conform to relevant Indian Standard Specification code. The following list contains most of the relevant I.S. codes for types of civil works, materials and testing to be implemented under the UUSDIP. Although, the list is exhaustive, but still many of the codes may not be included in it and these have to be identified at the time of preparation of the bid documents and during execution. The latest version of the code should be used. It will be the primary duty of DSC and IPIU to identify the relevant IS code for the nature of works, material or testing. If, for any nature of work, there is no IS code then DSC or IPIU will decide the appropriate BIS code or international code to which the procurement should conform.

Code	Description of IS Code
Quality Control on Works and Materials	
IS 1702: 1967	Specification for spring Balances.
IS 1707: 1979	Specification for wood wool for general packaging purposes.
IS 1717: 1985	Method for simple torsion test for wise.
Dismantling and Demolition	
IS:1200-1974	Method of Measurements of Building and Civil Engineering Works.
(Part : XVIII)	Demolition and Dismantling (Reaffirmed 1992) (3rd Revision).
IS:4130-1991	Demolition of Buildings - Code of Safety (2nd Revision).
Earthwork, Erosion Control and Drainage	
IS: 783	Code of practice for laying of concrete pipes.
IS: 1200	Method of Measurement of Building Works (Part I)
IS: 3764	Safety code for excavation work.
IS: 3385	Code of practice for measurement of Civil Engineering Works.
IS: 2720	Method of test of soils (All parts)
IS 2720 : Part 1 : 1983	Methods of Test for Soils - Part 1 : Preparation of Dry Soil Samples for Various Tests
IS 2720 : Part 2 : 1973	Methods of test for soils: Part 2 Determination of water content
IS 2720 : Part 3 : Sec 1 : 1980	Methods of test for soils: Part 3 Determination of specific gravity Section 1 fine grained soils
IS 2720 : Part III : Sec 2: 1980	Test for Soils - Part III : Determination of Specific Gravity - Section 2 : Fine, Medium and Coarse Grained Soils
IS 2720 : Part 4 : 1985	Methods of Test for Soils - Part 4 : Grain Size Analysis
IS 2720 : Part 5 : 1985	Method of Test for Soils - Part 5 : Determination of Liquid and Plastic Limit

Code	Description of IS Code
IS 2720 : Part 6 : 1972	Methods of test for soils: Part 6 Determination of shrinkage factors
IS 2720 : Part VII : 1980	Methods of Test for Soils - Part VII : Determination of Water Content-Dry Density Relation Using Light Compaction
IS 2720 : Part 8 : 1983	Methods of Test for Soils - Part 8 : Determination of Water Content- Dry Density Relation Using Heavy Compaction
IS 2720 : Part 9 : 1992	Methods of test for soils: Part 9 Determination of dry density-moisture content relation by constant weight of soil method
IS 2720 : Part 10 : 1991	Methods of test for soils: Part 10 Determination of unconfined compressive strength
IS 2720 : Part 11 : 1993	Methods of test for soils: Part 11 Determination of the Shear Strength Parameters of a specimen tested in inconsolidated, indrained triaxial compression without the measurement of pore water pressure
IS 2720 : Part 12 : 1981	Methods of test for soils: Part 12 Determination of shear strength parameters of soil from consolidated undrained triaxial compression test with measurement of pore water pressure
IS 2720 : Part 13 : 1986	Methods of Test for Soils - Part 13 : Direct Shear Test
IS 2720 : Part 14 : 1983	Methods of Test for Soils - Part 14 : Determination of Density Index (Relative Density) of Cohesionless Soils
IS 2720 : Part XV : 1965	Methods of Test for Soils - Part XV : Determination of Consolidation Properties
IS 2720 : Part 16 : 1987	Methods of Test for Soil - Part 16 : Laboratory Determination of CBR
IS 2720 : Part 17 : 1986	Methods of Test for Soils - Part 17 : Laboratory Determination of Permeability
IS 2720 : Part 18 : 1992	Methods of test for Soils - Part 18 : Determination of Field Moisture Equivalent
IS 2720 : Part 19 : 1992	Methods of Test for Soils - Part 19 : Determination of Centrifuge Moisture Equivalent
IS 2720 : Part 20 : 1992	Methods of test for soils: Part 20 Determination of linear shrinkage
IS 2720 : Part 21 : 1977	Methods of Test for Soils - Part XXI : Determination of Total Soluble Solids
IS 2720 : Part 22 : 1972	Methods of test for soils: Part 22 Determination of organic matter
IS 2720 : Part 23 : 1976	Methods of test for soils: Part 23 Determination of calcium carbonate
IS 2720 : Part XXIV : 1976	Methods of Test for Soils - Part XXIV : Determination of Cation Exchange Capacity

Code	Description of IS Code
IS 2720 : Part 25 : 1982	Methods of test for soils: Part 25 Determination silica sesquioxide ratio
IS 2720 : Part 26 : 1987	Method of Test for Soils - Part 26 : Determination of pH Value
IS 2720 : Part 27 : 1977	Methods of test for soils: Part 27 Determination of total soluble sulphates
IS 2720 : Part 28 : 1974	Methods of test for soils: Part 28 Determination of dry density of soils in place, by the sand replacement method
IS 2720 : Part XXIX : 1975	Methods of Test for Soils - Part XXIX : Determination of Dry Density of Soils In-place by the Core-cutter Method
IS 2720 : Part 30 : 1980	Methods of test for soils: Part 30 Laboratory vane shear test
IS 2720 : Part 31 : 1990	Methods of Test for Soils - Part 31 : Field Determination of California Bearing Ratio
IS 2720 : Part 32 : 1970	North dakota cone test
IS 2720 : Part 33 : 1971	Methods of test for soils: Part 33 Determination of the density in place by the ring and water replacement method
IS 2720 : Part XXXIV : 1972	Methods of Test for Soils - Part XXXIV : Determination of Density of Soil In-place by Rubber-balloon Method
IS 2720 : Part 35 : 1974	Methods of test for soils: Part 35 Measurement of negative pore water pressure
IS 2720 : Part 36 : 1987	Methods of test for soils: Part 36 Laboratory determination of permeability of granular soils (constant head)
IS 2720 : Part 37 : 1976	Methods of test for soils: Part 37 Determination of sand equivalent values of soils and fine aggregates
IS 2720 : Part 38 : 1976	Methods of test for soils: Part 38 Compaction control test (hilf method)
IS 2720 : Part XXXIX : Sec 1 : 1977	Methods of Test for Soils - Part XXXIX : Direct Shear Test for Soils Containing Gravel - Section I : Laboratory Test
IS 2720 : Part XXXIX : Sec 2 : 1979	Methods of Test for Soils - Part XXXIX : Direct Shear Test for Soils Containing Gravel - Section 2 : In-Situ Shear Test
IS 2720 : Part XL : 1977	Methods of Test for Soils - Part XL : Determination of Free Swell Index of Soils
IS 2720 : Part XLI : 1977	Methods of Test for Soils - Part XLI : Measurement of Swelling Pressure of Soils
IS: 1498	Classification and identification of soils for General Engineering purposes
IS: 2809	Glossary of terms and symbols relating to Soil Engineering

Code	Description of IS Code
Surface and Sub-Surface Geotechnical Exploration	
IS:1892: 1979	Subsurface Investigation for foundations.
IS: 4453: 1980	Code of practice for sub surface exploration by pits tranches, drifts and shafts
Exploration For Bridge Foundations Resting On Rock	
IS:7292: 1974	Code of practice for in-situ determination of rock properties by flat jack.
IS:7317: 1993	Code of practice for Univrial Jacking test for modulus of Deformation of rock.
IS:7746: 1991	In-situ shear test on rock- code of practice.
IS 5878 : Part 5 : 1976	Code of practice for construction of tunnels conveying water: Part 5 Concrete lining
Tests For Exploration Of Shallow Foundations Of Bridges & soils	
IS:1888: 1982	Method of load test on soils
IS:2131: 1981	Method for standard protection test for soils
IS:4434: 1978	Code of practice for In-situ vane shear test for soils.
IS:4968: 1976	Method for subsurface sounding for soils.(Part I,II,III)
Testing Of Material For Guide Bund And High Embankment And Its Foundations	
IS:2132	Code of practice for Thin-walled Tube sampling of soils.
Testing others	
IS 6441 : Part 1 : 1972	Methods of test for autoclaved cellular concrete products: Part I Determination of unit weight or bulk density and moisture content
IS 6441 : Part II : 1972	Methods of Test for Autoclaved Cellular Concrete Products - Part II : Determination of Drying Shrinkage
IS 6441 : Part IV : 1972	Methods of Test for Autoclaved Cellular Concrete Products - Part IV : Corrosion Protection of Steel Reinforcement in Autoclave Cellular Concrete
IS 6441 : Part V : 1972	Methods of Test for Autoclaved Cellular Concrete Products - Part V : Determination of Compressive Strength
IS 6441 : Part 6 : 1973	Methods of test for autoclaved cellular concrete products: Part VI Strength, deformation and cracking of flexural members subjects to bending, short duration loading test
IS 6441 : Part 7 : 1973	Methods of test for autoclaved cellular concrete products: Part VII Strength, deformation and cracking of flexural members subject to bending sustained loading test
IS 6441 : Part VIII : 1973	Methods of Tests for Autoclave Cellular Concrete Products - Part VIII : Loading Tests for Flexural Members in Diagonal Tension

Code	Description of IS Code
IS 6441 : Part 9 : 1973	Methods of test for autoclaved cellular concrete products: Part IX Jointing of autoclaved cellular concrete elements
IS 10079 : 1982	Specification for cylindrical metal measures for use in tests of aggregates and concrete
IS 10086 : 1982	Specification for moulds for use in tests of cement and concrete
IS 14591 : 1999	Temperature Control of Mass Concrete for Dams – Guideline
IS 14687 : 1999	False work for Concrete Structures – Guidelines
IS 14750 : 2000	Code of Practice for Installation, Maintenance and Observation of Seepage Measuring Devices for Concrete/Masonry and Earth / Rockfill Dams
IS 14858 : 2000	Compression Testing Machine Used for Testing of Concrete and Mortar – Requirements
IS 14959 : Part 1 : 2001	Determination of Water Soluble and Acid Soluble Chlorides in Mortar and Concrete - Method of Test : Part 1 Fresh Mortar and Concrete
IS 14959 : Part 2 : 2001	Determination of Water Soluble and Acid Soluble Chlorides in Mortar and Concrete - Method of Test - Part 2 : Hardened Mortar and Concrete
IS 15058 : 2002	PVC Water-Stops at Transverse Contraction Joints for Use in Masonry and Concrete Dams – Specification
ISO: 1167	Thermoplastics pipes for the transport of fluids - Resistance to internal pressure - Test method and basic specification
ISO 3451-5	Determination of Ash: Part-5 - Poly vinyl chloride
BS: 4772	Specification for DI fittings
IS: 779	Water meters
IS 460 : Part 1 : 1985	Specification for test sieves: Part I Wire cloth test sieves
IS 460 : Part 2 : 1985	Specification for test sieves: Part II Perforated plate test sieves
IS 460 : Part 3 : 1985	Specification for test sieves: Part III Methods of examination of apertures of test sieves
IS 13030 : 1991	Method of test for laboratory determination of water content, porosity, density and related properties of rock material
IS 2270 : 1965	Method for assaying of platinum and platinum alloys
IS 6935 : 1973	Method for determination of water level in a bore hole
IS 1514 : 1990	Methods of sampling and test for quick lime and hydrated lime
Cement	
IS:269	Ordinary Portland Cement, 33 Grade
IS:8041	Rapid Hardening Portland Cement

Code	Description of IS Code
IS:8112	Ordinary Portland Cement, 43 Grade
IS:12269	Ordinary Portland Cement, 53 Grade
IS:12269	Sulphate Resistant Portland Cement
IS:12330	Sulphate resisting Portland cement
IS 9459 : 1980	Specification for apparatus for use in measurement of length change of hardened cement paste, mortar and concrete
IS 6909	Super sulphated cement
IS 12600	Low heat Portland Cement Electrical
Lime	
IS:712-1984	Specification for Building Line
IS:383 :1970	Specification for coarse and fine aggregates from natural sources for concrete
IS 2541 : 1991	Code of practice for preparation and use of lime concrete
IS 2686 : 1977	Specification for Cinder as Fine Aggregates for use in Lime Concrete
IS 3068 : 1986	Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete
IS 5817 : 1992	Code of practice for preparation and use of lime-pozzolana mixture concrete in buildings and roads
IS 7873 : 1975	Code of practice for lime concrete lining for canals
IS 6932 : Part 1 : 1973	Method of test for building limes Part 1 Determination of insoluble residue, loss on ignition, insoluble matter, silicone dioxide, ferric and aluminium oxide, calcium oxide and magnesium oxide
IS 6932 : Part 2 : 1973	Method of test for building limes Determination of carbon dioxide content
IS 6932 : Part 3 : 1973	Method of test for building limes Determination of residue on slaking of quicklime
IS 6932 : Part 4 : 1973	Method of test for building limes Determination of fineness of hydrated lime
IS 6932 : Part 5 : 1973	Method of test for building limes Determination of unhydrated oxide
IS 6932 : Part 6 : 1973	Method of test for building limes Determination of volume yield of quicklime
IS 6932 : Part 7 : 1973	Method of test for building limes Determination of compressive and transverse strength
IS 6932 : Part 8 : 1973	Method of test for building limes Determination of workability
IS 6932 : Part 9 : 1973	Method of test for building limes Determination of soundness

Code	Description of IS Code
IS 6932 : Part 10 : 1973	Methods of Tests for Building Limes - Part X : Determination of Popping and Pitting of Hydrated Lime
IS 6932 : Part 11 : 1983	Methods of Tests for Building Limes - Part 11 : Determination of Insoluble Setting Time of Hydrated Lime
Sand and Fine Aggregates	
IS:2116: 1980	Specification for sand for masonry mortars.
IS 2430 : 1986	Methods for Sampling of Aggregates for Concrete
IS 9142 : 1979	Specification for Artificial Lightweight Aggregates for Concrete Masonry Units
Steel	
IS: 1030: 1998	Carbon steel castings for general engineering purposes.
IS:1785 (Part I)	Specification for Plain Hard-drawn Steel Wire for prestressed Concrete - Part I : Cold Drawn Stress-relieved Wire
IS:1785 (Part II)	Specification for plain hard-drawn steel wire for prestressed concrete: Part 2 As drawn wire
IS:6003	Cold drawn indented wire
IS:2090	Specification for high tensile steel bars used in pre-stressed concrete
IS:6006: 1983	Specification for uncoated stress relieved strand for prestressed concrete
IS:226	Structural Steel (Standard Quality)
IS:961	Structural Steel (High Tensile)
IS:2062	Weldable Structural Steel
IS:8500	Weldable Structural Steel (medium & high strength qualities)
IS:1148	Hot rolled rivet bars (upto 40mm dia) for structural purposes
IS:1149	High tensile rivet bars for structural purposes
IS:1161	Steel tubes for structural purposes
IS:4923	Hollow Steel sections for structural use
IS:11587	Structural weather resistant steel
IS:808	Specifications for Rolled Steel Beam, Channel and Angle Sections
IS:1239	Mild Steel Tubes
IS:1730	Dimension for Steel Plate, sheet and strip for structural and general engineering purposes
IS:1731	Dimension for Steel flats for structural and general engineering purposes
IS:1732	Dimension for round and square steel bars for structural and general engineering purposes

Code	Description of IS Code
IS:1852	Rolling and cutting tolerances for hot rolled steel products
IS 10790 : Part 1 : 1984	Methods of sampling of steel for prestressed and reinforced Concrete part 1 Prestressing steel
IS 10790 : Part 2 : 1984	Methods of sampling of steel for prestressed and reinforced concrete Part 2 Reinforcing steel
Concrete Admixtures	
IS 9103 : 1999	Concrete Admixtures – Specification
IS 6925 : 1973	Methods of Test for Determination of Water Soluble Chlorides in Concrete Admixtures
IS 5891 : 1970	Specification for hand-operated concrete mixer
IS 5892 : 2004	Concrete Transit Mixers – Specification
IS 6461 : Part 1 : 1972	Glossary of terms relating to cement concrete: Part I Concrete aggregates
IS 6461 : Part 2 : 1972	Glossary of Terms Relating to Cement Concrete - Part II : Materials (Other than Cement and Aggregate)
IS 6461 : Part 3 : 1972	Glossary of Terms Relating to Cement Concrete - Part III : Concrete Reinforcement
IS 6461 : Part 4 : 1972	Glossary of terms relating to cement concrete: Part IV Types of concrete
IS 6461 : Part 5 : 1972	Glossary of terms relating to cement concrete: Part V Formwork for concrete
IS 6461 : Part 6 : 1972	Glossary of terms relating to cement concrete: Part VI Equipment, tools and plant
IS 6461 : Part 7 : 1973	Glossary of Terms Relating to Cement Concrete - Part VII : Mixing, Laying, Compaction, Curing and Other Construction Aspects
IS 6461 : Part 8 : 1973	Glossary of terms relating to cement concrete: Part VIII Properties of concrete
IS 6461 : Part 9 : 1973	Glossary of terms relating of cement concrete: Part 9 Structural aspects
IS 6461 : Part 10 : 1973	Glossary of Terms Relating to Cement Concrete - Part X : Tests and Testing Apparatus
IS 6461 : Part 11 : 1973	Glossary of terms relating to cement concrete: Part 11 Prestressed concrete
IS 6461 : Part 12 : 1973	Glossary of terms relating to cement concrete: Part 12 Miscellaneous
IS 11386 : 1985	Glossary of terms relating to concrete mixers
Structural Steel	
IS 226	Structural Steel (Standard Quality)
IS:800	Code Of Practice For Use Of Structural Steel In General Building Construction
IS:814	Covered Electrodes For Metal Are Welding Of Structural Steel (Part I & II).

Code	Description of IS Code
IS:815	Classification And Coding Of Covered Electrodes For Metal Are Welding Of Structural Steel.
IS:816	Code Of Practice For Use Of Metal Are Welding For General Construction In Mild Steel.
IS:817	Code Of Practice For Training And Testing Of Metal Are Welders.
IS:822	Code Of Procedures For Inspection Of Welds.
IS:823	Code Of Procedure For Manual Metal Are Welding Of Mild Steel.
IS:1024	Code Of Practice For Use Of Welding In Bridges.
IS:1148	Hot Rolled Steel Rivet Bars (Upto 40 Mm Diameters) For Structural Purposes.
IS:1387	General Requirements For The Supply Of Metallurgical Material.
IS:1477	Part I, Code Of Practice For Painting Of Ferrous Metals In Buildings - Pretreatment.
IS:1599	Method For Bend Test For Steel Products Other Then Sheets, Strip., Wire And Tube.
IS:1608	Method For Tensile Testing Of Steel Products.
IS:1731	Dimensions For Steel Flats For Structural And General Engineering Purposes.
IS:1852	Rolling And Cutting Tolerances For Hot-Rolled Steel Products.
IS:1915	Code Of Practice For Steel Bridges.
IS:2101	Allowable Deviations For Dimensions Without Specified Tolerances.
IS:7318	Part I Fusion For Assembly Of Structural Joints Using High Tensile Friction Grip Fasteners.
IS:7318	Part I Fusion Welding Of Steel.
IS 11384 : 1985	Code of Practice for Composite Construction in Structural Steel and Concrete
Materials	
IS:1030	Carbon Steel Castings For General Engineering Purposes
IS:1875	Carbon Steel Billets, Blooms, Slabs, Bars For Forgings
IS:2004	Carbon Steel Forgings For General Engineering Purposes
IS:2644	High Tensile Steel Castings
IS:4367	Alloy & Tool Steel Forgings For General Industrial Use
IS 12594 : 1988	Hot-dip Zinc Coating on Structural Steel Bars for Concrete Reinforcement – Specification
Fasteners : Bolts, nuts, washers and rivets shall comply with following or relevant IS standards as appropriate :	

Code	Description of IS Code
IS:1929	Hot Forges Steel Rivets For Hot Closing (12-36 Mm Dia)
IS:2155	Cold Forged Steel Rivets For Hot Closing (6-16 Mm Dia)
IS:1363	Hexagon Head Bolts, Screw And Nuts Product Grade C
IS:1364	Hexagon Head Bolts, Screw & Nuts Product Grade A & B
IS:1367	Technical Supply Conditions For Threaded Steel Fastener (Parts 1 To 18)
IS:3640	Hexagon Fit Bolts
IS:3757	High Tensile Friction Grip Bolts
IS:6623	High Strength Structural Nuts
IS:6639	Hexagon Bolts For Steel Structure
IS:5624	Foundation Bolts
IS:7002	Prevailing Torque Type Steel Hexagon Lock Nuts
IS:5369	Plain Washers And Lock Washers - General Requirements
IS:5370	Plain Washers With Outside Dia = 3 X Inside Dia
IS:5372	Taper Washers For Channels (ISMC)
IS:5374	Taper Washers For I Beams (ISMB)
IS:6610	Heavy Washers For Steel Structures
IS:6649	Hardened And Tempered Washers For High Strength Structural Bolts And Nuts
Welding consumable: Welding consumable shall comply with the following Indian Standards as appropriate:	
IS:814 (Part I)	Covered Electrodes For Metal Arc Welding Of Structural (Part 1) Steel For Welding Other Than Sheets.
IS:814 (Part II)	Covered Electrodes For Metal Arc Welding Of Structural (Part 2) Steel For Welding Sheets
IS:1278	Filler Rods And Wires For Gas Welding
IS:1395	Low And Medium Alloy Steel Covered Electrodes For Manual Metal Arc Welding
IS:3613	Acceptance Test For Wire Flux Combinations For Submerged Arc Welding Of Structural Steel
IS:7280	Bare Wire Electrodes For Gas Shielded Arc Welding Of Structural Steel
IS:6419	Welding Rods And Bare Electrodes For Gas Shielded Arc Welding of Structural Steel
IS:6560	Molybdenum And Chromium-Molybdenum Low Alloy Steel Welding Rods And Bare Electrodes for Gas Shielded Arc Welding
IS:8613: 1977	Stub milling arbors with morse taper and positive duve.

Code	Description of IS Code
IS:1966: 1975	Methods for determination of bursting strength and building distention of fabrics- Diaphragm method.
IS:1393: 1961	Code of practice for training and testing of any acetylene welders.
IS:7307 (part I): 1974	Approval tests for welding procedures Part I fusion welding of steel.
IS:7310 (Part I): 1974	Approval tests for welders working to approved welding procedures- Part I
IS 9417 : 1989	Recommendations for welding cold worked bars for reinforced concrete construction
IS 812 : 1957	Glossary of terms relating to welding and cutting of metals
Erection	
IS:7205: 1974	Safety code for erection of structural steel work.
IS:7273: 1974	Method of testing fusion welded joints in aluminum and aluminum alloys.
IS:7293: 1974	Safety code for working with contraction machinery.
IS:7969: 1975	Safety code for handling and storage of building materials.
IS:1977: 1996	Low tensile structural steels- specifications.
IS:9595: 1996	Metal are welding of carbon manganese steels- Recommendations.
Painting	
IS:887: 1977	Specification for Animal Tallow.
Coatings	
IS:2074: 1992	Ready mixed paint, Air drying, Red oxide Zinc chrome, Printing specification
Structural Concrete And Mortar	
IS:269	Specification For Ordinary, Rapid-Hardening And Low Heat Portland Cement.
IS:455	Specification For Portland Blast Furnace Slag Cement.
IS:1489	Specification For Portland-Pozzolana Cement.
IS:4031	Methods Of Physical Tests For Hydraulic Cement.
IS 4031 : Part 1 : 1996	Methods of physical tests for hydraulic cement: Part 1 Determination of fineness by dry sieving
IS 4031 : Part 2 : 1999	Methods of physical tests for hydraulic cement: Part 2 Determination of fineness by specific surface by Blaine air permeability method
IS 4031 : Part 3 : 1988	Methods of physical tests for hydraulic cement: Part 3 Determination of soundness
IS 4031 : Part 4 : 1988	Methods of physical tests for hydraulic cement: Part 4 Determination of consistency of standard cement paste
IS 4031 : Part 5 : 1988	Methods of physical tests for hydraulic cement: Part 5 Determination of initial and final setting times

Code	Description of IS Code
IS 4031 : Part 6 : 1988	Methods of physical tests for hydraulic cement: Part 6 Determination of compressive strength of hydraulic cement (other than masonry cement)
IS 4031 : Part 7 : 1988	Methods of physical tests for hydraulic cement: Part 7 Determination compressive strength of masonry cement of
IS 4031 : Part 8 : 1988	Methods of physical tests for hydraulic cement: Part 8 Determination of transverse and compressive strength of plastic mortar using prism
IS 4031 : Part 9 : 1988	Methods of physical tests for hydraulic cement: Part 9 Determination of heat of hydration
IS 4031 : Part 10 : 1988	Methods of physical tests for hydraulic cement: Part 10 Determination of drying shrinkage
IS 4031 : Part 11 : 1988	Methods of physical tests for hydraulic cement: Part 11 Determination of density
IS 4031 : Part 12 : 1988	Methods of physical tests for hydraulic cement: Part 12 Determination of air content of hydraulic cement mortar
IS 4031 : Part 13 : 1988	Methods of Physical Tests for Hydraulic Cement - Part 13 : Measurement of Water Retentively of Masonry Cement
IS 4031 : Part 14 : 1989	Methods of physical test for hydraulic cement Part 14 Determination of false set
IS 4031 : Part 15 : 1991	Methods of physical test for hydraulic cement Part 15 Determination of fineness by wet sieving
IS:650	Specification For Standard Sand For Testing Of Cement.
IS:383	Specification For Coarse And Fine Aggregates From Natural Sources For Concrete.
IS:2386	Methods Of Test For Aggregates For Concrete. (Part I To VIII)
IS 2386 : Part I : 1963	Methods of Test for Aggregates for Concrete - Part I : Particle Size and Shape
IS 2386 : Part 2 : 1963	Methods of test for aggreegates for concrete Part 2 Estimation of deleterious materials and organic impurities
IS 2386 : Part 3 : 1963	Methods of test for aggregates for concrete Part 3 Specific gravity, density, voids, absorption and bulking
IS 2386 : Part 4 : 1963	Methods of test for aggregates for concrete Part 4 Mechanical properties
IS 2386 : Part 5 : 1963	Methods of Test for Aggregates for Concrete - Part V : Soundness
IS 2386 : Part 6 : 1963	Methods of test for aggregates for concrete : Part 6 Measuring mortar making properties of fine aggregates
IS 2386 : Part 7 : 1963	Methods of Test for Aggregates for Concrete - Part VII : Alkali Aggregate Reactivity

Code	Description of IS Code
IS 2386 : Part 8 : 1963	Methods of Test for Aggregates for Concrete - Part VIII : Petrographic Examination
IS:516	Method Of Test For Strength Of Concrete.
IS:1199	Method Of Sampling And Analysis Of Concrete.
IS:3025	Method Of Sampling And Test (Physical And Chemical) Water Used In Industry.
IS:432	Specification For Mild Steel And Medium Tensile Steel Bars And Hard Drawn Steel Wire For Concrete Reinforcement. (Part I & II)
IS:1139	Specification For Hot Rolled Mild Steel And Medium Tensile Steel Deformed Bar For Concrete Reinforcement.
IS:1566	Specification For Plain Hard Drawn Steel Wire Fabric For Concrete (Part I) Reinforcement.
IS:1785	Specification For Plain Hard Drawn Steel Wire For Prestressed Concrete.
IS:1786	Specification For Cold Twisted Steel Bars For Concrete Reinforcement.
IS:2090	Specification For High Tensile Steel Bars Used In Prestressed Concrete.
IS:4990	Specification For Plywood For Concrete Shuttering Work.
IS:2645	Specification For Integral Cement Water-Proofing Compounds.
BS4461	Cold Worked Steel Bars For The Reinforcement Of Concrete.
IS:4098	Lime Pozzolana Mixture (1st Revision) (Amendment 2)
IS 515 : 1959	Natural and manufactured aggregates for use in mass concrete
IS 785 : 1998	Reinforced Concrete Poles for Overhead Power and Telecommunication Lines – Specification
IS 1678 : 1998	Specification for prestressed concrete poles for overhead power, traction and telecommunication lines
IS 1834 : 1984	Specification for Hot Applied Sealing Compounds for Joints in Concrete
IS 2174 : 1962	Specification for reinforced concrete dust bins
IS 2770 : Part 1 : 1967	Methods of testing bond in reinforced concrete Part 1 Pull-out test
IS 3085 : 1965	Method of Test for Permeability of Cement Mortar and Concrete
IS 3453 : 1966	Code of practice for construction of hexagonal type concrete-cum-masonry bins for bulk storage of food grains

Code	Description of IS Code
IS 3812 : PART 1 : 2003	Pulverized Fuel Ash - Specification - Part 1 : For Use as Pozzolana in Cement, Cement Mortar and Concrete
IS 3812 : PART 2 : 2003	Pulverized Fuel Ash - Specification - Part 2 : For Use as Admixture in Cement Mortar and Concrete
IS 4350 : 1967	Specification for concrete porous pipes for under-drainage
IS 4634 : 1991	Methods for testing performance of batch-type concrete mixers
IS 4851 : 1987	Proforma for Estimating Unit Rate of Concrete Used in Mechanized Construction of River Valley Projects
IS 4880 : Part 4 : 1971	Code of practice for design of tunnels conveying water: Part 4 Structural design of concrete lining in rock
IS 4880 : Part V : 1972	Code of Practice for Design of Tunnels Conveying Water - Part V : Structural Design of Concrete Lining in Soft Strata and Soils
IS 5256 : 1992	Sealing Expansion Joints in Concrete Lining of Canals - Code of practice
IS 6598 : 1972	Cellular concrete for thermal insulation
IS 7436 : Part 2 : 1997	Guide for types of measurements for structures in river valley projects and criteria for choice and location of measuring instruments: Part 2 Concrete and masonry dams
IS 7563 : 1985	Code of practice for structural design of cut and cover concrete conduits
IS 8142 : 1976	Method of test for determining setting time of concrete by penetration resistance
IS 9013 : 1978	Method of making, curing and determining compressive strength of accelerated cured concrete test specimens
IS 9284 : 1979	Method of test for abrasion resistance of concrete
IS 11150 : 1993	Construction of concrete barrages - Code of practice
SP 23 : 1982	Handbook on Concrete Mixes
Equipment	
IS:1791	Specification For Batch Type Concrete Mixers.
IS:2438	Specification For Roller Pan Mixer.
IS:2505	Specification For Concrete Vibrators, Immersion Type.
IS:2506	Specification For Screen Board Concrete Vibrators.
IS:2514	Specification For Concrete Vibrating Tables.
IS:3366	Specification For Pan Vibrators.
IS:4656	Specification For Form Vibrators For Concrete.
IS:2722	Specification For Portable Swing Weigh Batchers For Concrete (Single And Double Bucket Type).
IS:2750	Specification For Steel Scaffoldings.
IS:2438	Roller Fan Mixer (Reaffirmed 1990)

Code	Description of IS Code
IS 4925 : 2004	Concrete Batching and Mixing Plant – Specification
IS 4926 : 2003	Ready-Mixed Concrete - Code of Practice
IS 4969 : 1968	Method of Test for Determining Flexural Strength of Precast Cement Concrete Slabs for Canal Lining
IS 5820 : 1970	Specification for precast concrete cable cover
IS 6276 : 1971	Specification for Flexible Shafts Used in
IS 6923 : 1973	Methods of test for performance of screed board concrete vibrators
IS 7995 : 1994	Pneumatic concrete breaker shanks – Dimensions
IS: 3624	Pressure and vacuum gauges
IS: 7328	High density polyethylene materials for molding and extrusion
IS: 4984	Specification for high density polyethylene pipes for potable water supplies; sewage and industrial effluents
IS: 4988	Glossary of terms and classifications of earth moving machinery (All Parts)
IS :4081	Safety code for blasting and related drilling operations
Codes of Practice	
IS:456	Code Of Practice For Plain And Reinforced Concrete.
IS:1343	Code Of Practice For Prestressed Concrete.
IS:457	Code Of Practice For General Construction Of Plain and Reinforced Concrete For Dams And Other Massive Structures.
IS:3370	Code Of Practice For Concrete Structures For Storage Of Liquids (Part I to IV)
IS:3955	Code Of Practice For Composite Construction.
IS:3201	Criteria For Design And Construction Of Precast Concrete Trusses.
IS:2204	Code Of Practice For Construction Of Reinforced Concrete Shell Roof.
IS:2210	Criteria For The Design Of R.C. Shell Structures And Folded Plates.
IS:2751	Code Of Practice For Welding Of Mild Steel Bars Used For Reinforced Concrete Construction.
IS:2502	Code Of Practice For Bending And Fixing Vibrators For Consolidating Concrete.
IS:3558	Code Of Practice For Use Of Immersion Vibrators For Consolidating Concrete.
IS 3559 : 1966	Specification for pneumatic concrete breakers
IS:3414	Code Of Practice For Design And Installation Of Joints In Buildings.
IS:4014	Code Of Practice For Steel Tubular Scaffolding. (Part I & II)

Code	Description of IS Code
IS:2571	Code Of Practice For Laying Inside Cement Concrete Flooring.
IS:2250	Code Of Practice For Preparation and Use of Masonry Mortar (1st Revision)
IS 2542 : (Part 1 to 12) 1978	Methods of Test for Gypsum Plaster, Concrete and Products - Part I : Plaster and Concrete
IS 2542 : Part 2 : Sec 1 to 8 : 1981	Methods of Test for Gypsum Plaster, Concrete and Products - Part II : Gypsum Products
IS 3873 : 1993	Laying cement concrete/stone slab lining on canals
IS 4101 : Part 2 : 1967	Code of Practice for External Facings and Veneers - Part II : Cement Concrete Facing
IS 4996 : 1984	Specification for reinforced concrete fence posts
IS 5491 : 1969	Code of practice for laying of in-situ granolithic concrete flooring topping
IS 5525 : 1969	Recommendations for Detailing of Reinforcement in Reinforced Concrete Works
IS 5816 : 1999	Splitting Tensile Strength of Concrete Method of Test
IS 6072 : 1971	Specification for autoclaved reinforced cellular concrete wall slabs
IS 6073 : 1971	Specification for autoclaved reinforced cellular concrete floor and roof slabs
IS 7242 : 1974	Specification for concrete spreaders
IS 7245 : 1974	Specification for concrete pavers
IS 7246 : 1974	Recommendations for use of table vibrators for consolidating concrete
IS 7251 : 1974	Specification for concrete finishers
IS 7320 : 1974	Specification for concrete slump test apparatus
IS 7325 : 1974	Specification for apparatus for determining constituents of fresh concrete
IS 8989 : 1978	Safety code for erection of concrete framed structures
IS 9375 : 1979	Specification for precast reinforced concrete plant guards
IS 9399 : 1979	Specification for apparatus for flexural testing of concrete
IS 9401 : Part 4 : 1980	Method of measurement of works in river valley projects (dams and appurtenant structures): Part 4 Concrete work
IS 9799 : 1981	Specification for pressure meter for determination of air content of mixed concrete
IS 9872 : 1981	Specification for precast concrete septic tanks
IS 12727 : 1989	Code of practice for no fines cast in situ cement concrete

Code	Description of IS Code
IS 14278 : 1995	Stress measuring devices in concrete and masonry dams - Installation, commissioning and observations - Code of practice
SP 16 : 1980	Design Aids for Reinforced Concrete to IS 456 : 1978
SP 24 (S and T) : 1983	Explanatory Handbook on Indian Standard Code of Practice for Plain and Reinforced Concrete
Construction Safety	
IS:3696	Safety Code For Scaffolds And Ladders. (Part I& II)
IS:3385	Code Of Practice For Measurement Of Civil Engineering Works.
Measurement	
IS: 1200-1974 (Part: XVIII)	Method of Measurements of Building and Civil Engineering Works. Demolition and Dismantling (Reaffirmed 1992) (3rd Revision)
IS:3385	Code Of Practice For Measurement Of Civil Engineering Works.
Brick Masonry	
IS - 1077	Specifications for common burnt clay building bricks
IS - 1725	Specifications for solid cement blocks used in general building construction
IS - 1905	Code of practice for structural safety of buildings : Masonry walls.
IS - 2116	Sand for masonry mortars
IS - 2180	Specification for heavy duty burnt clay building bricks
IS - 2185	Specification for concrete masonry units: Hollow and solid concrete blocks
IS - 2185 Part 2	Specification for concrete masonry units: Part 2 Hollow and solid light weight concrete blocks
IS - 2185 Part 3	Specification for concrete masonry units Part 3 Autoclaved cellular Aerated concrete blocks
IS - 2212	Code of practice for brick work
IS - 2222	Specification for burnt clay perforated building bricks
IS - 2691	Specification for burnt clay facing bricks
IS - 3115	Specification for lime based blocks
IS - 3414	Code of practice for design and installation of joints in buildings
IS - 3466	Specification for masonry cement
IS - 3861	Method of measurement of plinth, carpet and rentable areas of buildings.
IS - 3952	Specification for burnt clay hollow blocks for walls and partitions
IS - 4098	Specification for lime-pozzolana mixture
IS - 4139	Specification for sand lime bricks

Code	Description of IS Code
IS - 4441	Code of practice for use of silicate type chemical resistant mortars.
IS - 4442	Code of practice for use of sulphur type chemical resistant mortars
IS 2119 : 1980	Code of practice for construction of brick-cum-concrete composite (madras terrace) floor and roof
IS 3495 Part 1 to 4 : 1992	Methods of Tests of Burnt Clay Building Bricks - Part 1 : Determination of Compressive Strength - Part 2 : Determination of Water Absorption - Part 3 : Determination of Efflorescence - Part 4 : Determination of Warpage
Stone Masonry	
IS:1129: 1972	Recommendation of Dressing of Natural building stones.
IS 12440 : 1988	Specification for precast concrete stone masonry blocks
Finishing	
IS:16-1991 (Part:I)	Shellac: Part:I-Hand Made Shellac (3rd Revision).
	Shellac: Part: II-Machine Made Shellac (3rd Revision)
IS:16-1991 (Part :II)	
IS:75-1973	Linseed Oil, Raw and Refined (Reaffirmed 1990) (2nd Revision)
IS:77-1976	Ready Mixed Paint, Brushing, Red Lead, Non setting, Priming (Reaffirmed 1991)(Revised)
IS:102-1962	Specification For Ready Mixed Paint, Brushing, Zinc Chrome, Priming (Reaffirmed 1993) (2nd Revision)
IS:104-1979	Ready Mixed Paint, brushing, priming Plaster to Indian Standard Color No. 361, 631 White and off White (Reaffirmed 1993) (1st Revision)
IS:109-1968	Ready Mixed Paint, Brushing, priming Plaster to Indian Standard Color No. 361, 631 White and off White (Reaffirmed 1993) (1st Revision)
IS:117-1964	Ready Mixed Paint, Brushing, Finishing Exterior, Semigloss For General Purposes to Indian Standards Colors (Reaffirmed 1988) (Revised)
IS:133-1993	Enamel, Interior (a) Under Coating (b) Finishing (3rd Revision)
IS:137-1965	Ready Mixed Paint, Brushing, Matt Or Egg Shell Flat, Finishing Interior to Indian Standard Color as required (Revised 1993)
IS:158-1981	Ready Mixed Paint, Brushing, Bituminous Black, Lead Free, Acid, Alkali and Heat Resisting (Reaffirmed 1988) (3rd Revision)
IS:217-1988	Specification For Cut Back Bitumen (2nd Revision)

Code	Description of IS Code
IS:218-1983	Specification For Creosote and Anthracene Oil For Use As Wood Preservatives (Reaffirmed 1990) (2nd Revision)
IS:290-1961	Coal Tar Black Paint (Reaffirmed 1991) (1st Revision)
IS:337-1975	Varnish, Finishing Interior (Reaffirmed 1991) (1st Revision)
IS:341-1973	Black Japan, Types 'A', 'B' & 'C' (Reaffirmed 1991) (1st Revision)
IS:345-1952	Wood Filter, Transparent - Liquid (withdrawn)
IS:347-1975	Varnish, Shellac For General Purposes (Reaffirmed 1991) (1st Revision)
IS:348-1968	French Polish (Reaffirmed 1991) (1st Revision)
IS:419-1967	Putty For Use On Window Frames (Reaffirmed 1992) (1st Revision)
IS:427-1965	Distemper, Dry Color as Required (Reaffirmed 1993) (Revised)
IS:428-1969	Distemper, Oil Emulsion, Color as Required (Reaffirmed 1993) (1st Revision)
IS:524-1983	Varnish, Finishing, Exterior, Synthetic Air Drying (Reaffirmed 1990) (2nd Edition)
IS:533-1973	Gum Spirit of Turpentine (Oil of Turpentine) (Reaffirmed 1990) (1st Revision)
IS:712-1984	Specification For Building Limes (Reaffirmed 1991) (3rd Revision)
IS:1200-1976 (Part:XII)	Method of Measurements of Building and Civil Engineering Works: Part:XII-Plastering and Pointing (Reaffirmed 1992) (3rd Revision)
IS:1200-1987	Method of Measurements of Building and Civil Engineering Works:
IS:1200-1994 (Part:XIII)	Method of Measurements of Building and Civil Engineering Works: Part 13 White Washing, Color Washing Distempering and Painting of Building surfaces. (5th Revision)
IS:1200-1987 (Part:XV)	Method of Measurements of Building and Civil Engineering Works: Part:XV-Painting Polishing, Varnishing etc. (Reaffirmed 1992) (4th Revision)
IS:2339-1963	Aluminum Paint For General Purposes, In Dual Container (Reaffirmed 1993)
IS:2932-1994	Enamel, Synthetic, Exterior (a) Undercoating, (b) Finishing (2nd Revision)
IS:2933-1975	Enamel, Exterior (a) Undercoating (b) Finishing (Reaffirmed 1991) (1st Revision)
IS:5410-1992	Cement Paint (1st Revision)

Code	Description of IS Code
IS:5411-1974 (Part:I)	Plastic Emulsion : Paint Part I For Interior Use (Reaffirmed 1991) (1st Revision)
IS:6278-1971	Code of Practice For White Washing and Color Washing (Reaffirmed 1991).
IS 2395 : Part 1 1994	Painting of Concrete, Masonry and Plaster Surfaces - Code of Practice - Part 1 : Operations and Workmanship
IS 2395 : Part 2 : 1994	Code of practice for painting concrete, masonry and plaster surfaces: Part 2 Schedule
Roads and Pavements	
IS:2386 (Part 1)	Methods of Test for Aggregates for Concrete - Part I : Particle Size and Shape
IS:2386 (Part 2)	Methods of test for aggreegates for concrete Part 2 Estimation of deleterious materials and organic impurities
IS:2386 (Part 3)	Methods of test for aggregates for concrete Part 3 Specific gravity, density, voids, absorption and bulking
IS:2386 (Part 4)	Methods of test for aggregates for concrete Part 4 Mechanical properties
IS:2386 (Part 5)	Methods of Test for Aggregates for Concrete - Part V : Soundness
IS:2386 (Part 6)	Methods of test for aggregates for concrete : Part 6 Measuring mortar making properties of fine aggregates
IS:2386 (Part 7)	Methods of Test for Aggregates for Concrete - Part VII : Alkali Aggregate Reactivity
IS:2386 (Part 8)	Methods of Test for Aggregates for Concrete - Part VIII : Petrographic Examination
IS 6509 : 1985	Code of practice for installation of joints in concrete pavements
IS 10360 : 1982	Specification for lime-pozzolana concrete blocks for paving
Manufacturing / Supplying Laying and Jointing of Pipes	
IS:458	Specification For Concrete Pipes (With And Without Reinforcement).
IS:3597	Method Of Tests For Concrete Pipes.
IS:5382	Specification For Rubber Sealing Rings For Gas Mains, Water Mains And Sewers.
IS:456	Code Of Practice For Plain And Reinforced Concrete.
IS: 783	Code Of Practice For Laying Of Concrete Pipes.
Design	
IS:454	Design of RCC pipes shall be in accordance with the relevant clauses
IS:458	The details of reinforcement shall be as per Clause 5.2
IS:458	The ends of pipes shall be in accordance with relevant clauses

Code	Description of IS Code
IS 4090 : 1967	Criteria for design of reinforced concrete arches
IS 4995 : Part 1 : 1974	Criteria for design of reinforced concrete bins for storage of granular and powdery materials: Part 1 General requirements and assessment of bin loads
IS 4995 : Part 2 : 1974	Criteria for Design of Reinforced Concrete Bins for Storage of Granular and Powdery Materials - Part II : Design Criteria
IS 4998 : Part 1 : 1992	Criteria for design of reinforced concrete chimneys: Part 1 Assessment of loads
IS 7418 : 1991	Criteria for design of spiral casing (concrete and steel)
IS 10262 : 1982	Recommended guidelines for concrete mix design
IS 10297 : 1982	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab unit
IS 10334 : 1982	Code of practice for selection, splicing, installation and providing protection to the open ends of cables used for connecting resistance type measuring devices in concrete and masonry dams
IS 10359 : 1982	Code of practice for manufacture and use of lime-pozzolana concrete blocks for paving
IS 10421 : 1983	Performa for analysis of unit rate of shuttering/formwork for concrete items
IS 10434 : Part 1 : 2003	Installation, Maintenance and Observation of Deformation Measuring Devices in Concrete and Masonry Dams - Guidelines - Part 1 : Resistance Type Joint meters
IS 10434 : Part 2 : 1996	Guidelines for installation, maintenance and observation of deformation measuring devices in concrete and masonry dams: Part 2 Vibrating wire type joint meter
IS 11293 : Part 2 : 1993	Guidelines for the Design of Grout Curtains - Part 2 : Masonry and Concrete Gravity Dams
IS 11389 : 1986	Methods of test for performance of concrete vibrators; Immersion type
IS 11485 : 1985	Criteria for hydraulic design of sluices in concrete and masonry dams
IS 11504 : 1985	Criteria for structural design of reinforced concrete natural draught cooling towers
IS 11993 : 1987	Code of practice for use of screed board concrete vibrators
IS 12119 : 1987	General requirements for pan mixers for concrete
IS 12200 : 2001	Provision of Water-Stops at Transverse Contraction Joints in Masonry and Concrete Dams - Code of Practice

Code	Description of IS Code
IS 13073 : Part 1 : 2002	Installation, Maintenance and Observation of Displacement Measuring Devices in Concrete and Masonry Dams - Code of Practice - Part 1 : Deflection Measurement Using Plumb Lines
IS 13073 : Part 2 : 2000	Code of Practice for Installation, Maintenance and Observation of Displacement Measuring Devices for Concrete and Masonry Dams - Part 2 : Geodetic Observation - Crest Collimation
IS 13143 : 1991	Joints in concrete lining of canals - sealing compound – specification
IS 13311 : Part 2 : 1992	Methods of non-destructive testing of concrete: Part 2 Rebound hammer
IS 13920 : 1993	Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice
SP 34 : 1987	Handbook on Concrete Reinforcement and Detailing
SP 43 (S and T) : 1987	Handbook on Structures with Reinforced Concrete Portal Frames (Without Cranes)
Materials	
IS:651 and IS:4127	Specification For GSW Pipes.
IS:651 and IS:4127	Method Of Tests For GSW Pipes.
IS: 5531	CI specials for Asbestos cement pressure pipes for water gas & sewage
IS: 780	Sluice valve for water works purposes
IS: 2906	Specifications for sluice valves for water works purposes
IS: 8543	Methods of testing plastics: Determination of density of solid plastics
IS: 7181	Horizontally cast iron double flanged pipes for water, gas and sewage
IS: 8794	CI detachable joints for use with Asbestos cement pressure pipes
Centrifugally Cast Iron Pipes	
IS:1536	Specification For Centrifugally Cast (Spun) Iron Pressure Pipes For Water, Gas And Sewage
IS: 1537	Vertically cast iron pressure pipe for water, gas and sewage
IS:1538	Specification For Cast Iron Fittings For Pressure Pipes For Water, Gas And Sewage
IS:11606	Methods For Sampling Of Cast Iron Pipes And Fittings
IS:3114	Code Of Practice For Laying Of CI Pipes
Galvanised Iron Pipes	
IS:1239 (Part-I)	Specification For Medium Grade GI Pipes
IS:1239 (Part-II)	MS Tubular Or Wrought Steel Fittings For GI Pipes
IS:4736	Specification For Galvanizing

Code	Description of IS Code
IS:554.	Specifications For Pipe Threads Of Screwed Tubes And Sockets
Centrifugally Cast (Spun) Ductile Iron Pressure Pipes	
IS:8329	Specifications For Centrifugally Cast (Spun) Ductile Iron Pressure
	Pipes For Water, Gas And Sewage
IS:9523	Specifications For Ductile Iron Fittings For Pressure Pipes For Water,
	Gas And Sewage
IS:12288	Code Of Practice For Laying Of DI Pipes
IS: 1387	General requirements for the supply of metallurgical material
IS:11606	Methods For Sampling Of Cast Iron Pipes And Fittings
Un-plasticized PVC (u PVC) Pipes	
IS: 4985	Specifications for un-plasticized PVC Pipes for potable water supplies (Third revision)
IS: 7634	Code of practice for plastics work for potable water supplies
IS: 7634 Part I	Choice of materials and general recommendations
IS: 7634 Part III	Laying and Jointing if un-plasticized PVC pipes
IS:12235 (Part 1 to Part 11)	Methods of test for un-plasticized PVC pipes for potable water supplies
IS: 7834 (Part 1 to Part 8)	Specifications for injection molded PVC rocket fittings with solvent cement joints for water supplies
IS 694	PVC insulated cables for working Voltages upto and including 1100 V
IS: 10151	PVC and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals, and drinking water
IS: 10500	Drinking water specification
IS: 12818	Unplasticized PVC screen and casing pipes for bore/tube well
IS: 1592	Asbestos cement pressure pipes – Specifications
ISO: 2045	Single socket for uPVC and uPVC pressure pipes with elastic sealing ring type joints - Minimum depth of engagement
ISO: 2507	PVC pipes and fittings- Vicat softening temperature - Test method and specification
ISO: 3603	Fittings for PVC pipe with elastic sealing ring joints pressure test for leak proofness
Electrically Welded Steel Pipes	
IS:3589	Seamless/Electrically Welded Steel Pipes for Water, Gas , Sewage- Specification
IS:5822	Code Of Practice For Laying Of Electrically Welded Steel Pipes For Water Supply-
IS:7322	Specification For Specials For Steel Cylinder Reinforced Concrete Pipes

Code	Description of IS Code
IS:432 Part I	Mild Steel And Medium Tensile Bars Reinforcement
IS:432 Part II	Specifications For Mild Steel And Medium Tensile Bars And Hard Drawn Steel Wire (Third Revision)
IS:2328	Flattening Test For Seamless Pipes
IS:12269	Specification For 53 Grade Ordinary Portland Cement (OPC)
IS:6452	Specification For High Alumina Cement For Structural Use (Revision I)
IS:8112	Specifications For Curing Of High Strength OPC
IS:8041	Specifications For Curing Of Rapid Hardening Cement
IS:269	Specification For Ordinary Portland Cement (OPC)
IS:455	Specification For Portland Slag Cement
IS 1489(Pt1 & Pt2)	Portland pozzolana cement - Part 1 Fly Ash based and Part 2 Calcined Clay based
IS:8043	Specification For Hydrophobic Portland Cement
IS:4853	Recommended Practice For Radiographic Inspection Of Fusion Welded Butt Joints In Steel Pipes (First Revision)
IS:4260	Recommended Practice For Ultrasonic Butt Welds In Ferritic Steel
IS:3600 (Part I)	Methods Of Testing Fusion Welded Joints And Weld Metal In Steel : Part I Cruciform Fillet Weld Tensile Test
IS 8282 : Part 1 : 1976	Code of practice for installation, maintenance and observation of pore pressure measuring devices in concrete and masonry dams: Part 1 Electrical resistance type cell
IS 8282 : Part 2 : 1996	Installation, Maintenance and Observations of Pore Pressure Measuring Devices in Concrete and Masonry Dams - Code of Practice - Part 2 : Vibrating Wire Type Cell
IS 13232 : 1992	Code of practice for installation, maintenance and observation of electrical strain measuring devices in concrete dams
IS 3854	Switches for domestic and similar purposes
IS 8828	Electrical Accessories - Circuit Breakers for over current protection for household and similar installations
IS 9968 (Pt.1)	Elastomer insulated cables (Pt.1): For working voltages upto and including 1100 V
IS 12640 (Pt.1)	Residual current operated circuit breakers for household and similar uses - (Pt.1) : Circuit breakers without integral over current protection (RCCBs)
IS 12640(pt.2)	Residual current operated circuit breakers for household and similar uses - (Pt.2) : Circuit breakers with integral over current protection (RCVOs)
IS 13010	AC Watt-hour meters, class 0.5, 1 & 2
IS 13779	ac static watt-hour meters, class 1 & 2
IS 14697	ac static transformer operated watt-hour and VAR- hour meters, class 0.2S & 0.5S Structural Steel

Code	Description of IS Code
IS:813	Scheme For Symbols For Welding.
Prestressed Concrete (PSC) Pipes	
IS:784 : 2001	Specifications For Prestressed Concrete Pipes (Including Fittings)
IS:783	Code Of Practice For Laying Of Concrete Pipes
IS:1343	Code Of Practice For Prestressed Concrete
IS:7322	Specifications For Specials For Steel Cylinder Reinforced Concrete Pipes
IS:3597	Methods Of Test For Concrete Pipes
IS:5382	Specifications For Rubber Sealing Rings For Gas Mains, Water Mains And Sewers
IS:226	Specifications For Structural Steel (Standard Quality)
IS 1332 : 1986	Specification for precast reinforced concrete street lighting poles
IS 2193 : 1986	Specification for Precast Pre-stressed Concrete Street Lighting Poles
IS 6003 : 1983	Specification for indented wire for prestressed concrete
IS 7319 : 1974	Specification for perforated concrete pipes
IS 7321 : 1974	Code of practice for selection, handling and erection of concrete poles for overhead power and telecommunication lines

Note: 1. All relevant IS code to be followed.
2. In case of revision / amendment in code, latest updated codes are to be followed.

APPENDIX G

CONVERSION FACTORS

APPENDIX G

Conversion Factors

Metric to British units	British to metric units
Length:	
1 m = 3.280 84 ft	1 in = 25.400 00 mm
1 m = 1.093 61 yd	1 ft = 304.800 00mm
1 km = 0.621 37 mile	1 yd = 0.914 40 m
	1 mile = 1.609 34 km
Area:	
1 m^2 = 1.195 99 yd^2	1 ft^2 = 0.092 m^2
1 ha = 2.471 05 acre	1 yd^2 = 0.836 13 m^2
1 km^2 = 0.386 10 sq. mile	1 acre = 0. 404 69 ha
(1km^2 = 100 ha)	1 sq. mile = 2.589 99 km^2
(1 ha = 10 000 m^2)	(1 sq. mile = 640 acre)
	(1 acre = 4840 sq. yd.)
Volume:	
0.01 m^2 = 0. 353 15 ft^3	1ft^3 0.028 32 m^3
1 m^2 = 1.307 95 yd^3	1yd^3 = 0.764 56m^3
I litre = 0. 219 97 gallon	1 gallon = 4. 546 07 litre
1 m^3 = 219. 969 gallon	1 gallon = 0.004 55 m^3
Weight:	
1kg = 2.204 62 1b	1 lb = 0.453 59 kg
50 kg = 0. 984 20 cwt	1 cwt = 50.802 kg
1Mg = 19.684 10 cwt	1 ton = 1. 016 05 Mg
(1 tonne = 0.984 20 ton)	
Pressure:	
1 kgf/cm^2 = 14.223 lb/in^2	1 lb/in^2 = 0.070 31 kgf/cm^2
1 N/mm^2 = 145.038 lb/in^2	1 lb/in^2 = 0.006 89 N/mm^2
(1 N/mm^2 = 9. 807 kgf/cm^2)	
Density:	
1 kg/rn^3 = 0.062 43 lb/ft^3	1 lb/ft^3 = 16.018 5 kg/m^3
1 Mg/rn^3 = 0.48 ton/yd^3	1 ton/yd^3 = 1.328 94 Mg/m^3

Project Management Consultancy

for

Delhi Water Supply Improvement Investment Program (DWSIIP) Project -1 in Wazirabad Water Treatment Plant Command Area

SAFETY MANUAL
(REVISED)

Delhi Jal Board

Asian Development Bank

The Executive Engineer (Dwarka) WTP
Delhi Jal Board,
Over Head Tank: Ashok Vihar,
New Delhi – 110 052

NJS Consultants Co., Ltd., Japan

In Joint Venture with
ICRA Management Consulting Services Ltd.
Tata Consulting Engineers Ltd.
NJS Engineers India Pvt. Ltd.

March 2018

DWSIIP

SAFETY MANUAL

CONTENTS

List of Annexures:

PREFACE

This Construction Safety Manual has been prepared with the objective of putting in place a comprehensive, consistent and common system for assuring safety aspects during implementation of the Delhi Water Supply Improvement Investment Program (DWSIIP-ADB Project No. IND-47176-002) under ADB Loan No. xxxx-IND.

The Manual covers the overall safety system and the field construction safety control procedures for different types of works, based on the standard specifications adopted for the Project.

The Construction Safety Manual covers various steps and guidelines for different work activities.

It is suggested that the Manual be kept in a ring binder so that any additions or modifications can be easily incorporated later, if required.

It is mandatory for the Contractors to follow this Construction Safety Manual document.

A Construction Safety Manual has to be a part of the tender document

1. INTRODUCTION

This Section of the Construction Safety Manual presents the Project's background, defines safety-related terms and gives an outline of the Manual.

1.1 Background

The Government of India is negotiating a loan with the Asian Development Bank (ADB) for financing the Delhi Water Supply Improvement Investment Program (DWSIIP or the investment program), which comprises improvement of the water supply system in Wazirabad Water Treatment Plant (WTP) command area of Delhi. DWSIIP will be implemented by Delhi Jal Board, Govt. of NCT Delhi as Executing Agency over a six-year period and will improve the infrastructure, management and performance of the water supply services in the proposed Wazirabad Water Treatment Plant (WTP) command area located in North Delhi. Physical investments to improve the existing water supply system to serve 2051 design population of 2.6 million people residing in North West Delhi (Wazirabad WTP command area) and improve the management capacity of Delhi Jal Board (DJB), the service utility responsible for water supply and sanitation services in the National Capital Territory of Delhi (NCTD) covering about 18.85 million people at present.

The DWSIIP will improve the infrastructure, management, and performance of the water supply services for 2.6 million people in the Wazirabad Water Treatment Plant (WTP) command area located in North Delhi. The area designated as are CD Park Jahangirpuri, Model Town, Punjabi Bagh, Shakur Basti/Harsh Nagar, Lawrence Road, Sanjay Gandhi Transport Nagar, Burari A and Burari TPA, Peragarhi, Avantika, Pitampura. The DWSIIP will help achieve the National Capital Territory of Delhi (NCTD) Water Supply Master Plan objectives of reduced non-revenue water (NRW) and equitable access to water supply services as Per JICA Study Report on Water Supply Improvement in 2011. The DWSIIP will include improvement of distribution network, water treatment and transmission systems in the Wazirabad WTP command area, and strengthening of institutional capacity and program management.

The proposed investment program will help to achieve the National Capital Territory of Delhi, (NCTD) Water Supply Master Plan objective of reduced non-revenue water (NRW) and equitable access to water supply services. It comprises (i) physical investments to improve the water supply system in the Wazirabad WTP command area and (ii) non-physical investments to improve DJB's institutional effectiveness.

Contractor has to follow DJB's Safety Code, including Safety in Construction (as per CPWD Specifications-Volume -1) enclosed as Annexures. The Contractor shall employ only such methods of construction, tools and plant as are appropriate for the type of work or as approved by Engineer-in-Charge in writing.

The Contractor shall take all precautions and measures to ensure safety of works and workman and shall be fully responsible for the same. Safety pertaining to construction works such as excavation, centering and shuttering, trenching, blasting, demolition, electric connections, scaffolds, ladders, working platforms, gangway, mixing of bituminous materials, electric and gas welding, use of hoisting and construction machinery shall be governed by CPWD safety code, relevant safety codes, guidelines and the direction of Engineer-in-Charge.

Apart from DJB & CPWD's safety guideline, the NHRC Guideline, Tree Protection guideline and NGT Guideline (enclosed as Annexures) along with BIS requirement strictly have to be followed to adhere the safety norms at site during implementation of the ADB assisted DWSIIP Packages under proposed Wazirabad WTP Command Area.

2. CONSTRUCTION SAFETY PROGRAM

The effectiveness of the construction safety program depends upon the active participation and cooperation of the Contractor site engineers, supervisors and employees and co-ordination of their efforts with clients, local authorities, police, fire brigade etc. Contractor on inception will hand over a written "Construction Safety Program" detailing how contractor intends to achieve safety during construction Safety program in addition to others will include:

2.1 Accident Prevention

- Prevention of Job Site Accidents
- Protection of the public and property
- Work Preparation

A. Prevention of Job Site Accidents

The Project Manager/Site Engineer or his nominated official shall

- Take immediate action to remove workers from the hazard and stop work until corrective actions can be implemented to eliminate the hazard.
- Immediately notify PIU/PMC and local government offices of the condition
- Identify and implement corrective correction to eliminate the hazard. Emergency service personnel to be notified if the danger cannot be promptly corrected and could develop into emergency condition.

B. Protection of the Public and Property

The construction safety program will provide following or similar precautions for protection of the public and property.

1. Barrier/Barricades

   All barrier /barricades must comply with relevant IS or equivalent International Specifications. The contractor shall provide adequate visibility and protection when public use of work areas must be maintained on sidewalks, entrances to buildings, lobbies, corridors, aisles, stairways and vehicular roadways. Appropriate barriers (i.e. guardrails, barricades, temporary fences or partitions, overhead protection, shields) shall be secured against accidental displacement and will be maintained in place except where temporary removal is required to perform the work. When a barricade is temporarily removed, a guard shall be placed at all openings.

2. Caution Tape

   The use of caution tape for marking unsafe conditions or open hazards should be prohibited. Only plastic orange safety fences or other devices of similar construction shall be used.

3. Entry and Exit of Public

   Sidewalks, building entrances, lobbies, corridors, airless, doors or exits in use by the public shall be clear of obstructions

4. Guardrails

   Guardrails shall be provided on both sides of vehicular and pedestrian bridges, ramps, etc. The height of guardrail should be approximately 106 cms. Guardrails shall be made of rigid materials able to withstand a force of at least 100 kg applied in any direction at any point in their structure.

5. Overhead Protection

   Side work sheds, canopies, catch platforms and appropriate fencing shall be provided when it is necessary to safety maintain public pedestrian traffic adjacent to the erection, demolition or structural alteration of outside walls on any structure.

6. Perimeter Fencing

   Temporary fencing shall be provided around the perimeter of above ground operations adjacent to public areas except where a sidewalk shed or fencing is provided.

7. Public Areas

   Work shall not be performed in any area occupied or in public use unless specifically permitted by the contract or in writing from the authority.

8. Signs and Warnings

   Appropriate warnings, signs and instructional safety signs shall be conspicuously posted where necessary.

9. Temporary Sidewalks

   Temporary sidewalks with guardrails shall be provided when a permanent sidewalk is obstructed by the contractor’s operations.

10. Warning Light

    Signs and lighting shall be placed at both ends of any public protection or obstructions. Warning signs and lights including lanterns, torches, flares and electric lights shall be maintained from dusk to sunrise along the guardrails, barricades, temporary sidewalks and at every obstruction to the public.

C. Work Preparation

Before commencing work, contractor shall follow and act as under:

1. Contractor will submit a safety program in writing to PIU/PMC
2. The contractor shall provide personal protective equipment and other safety items, which have been identified as per contract, safety program, Applicable Regulations or written instructions of PMC/PIU. The contractor shall not receive additional payment or reimbursement for safety items.
3. Safety Professional
   Project Manager will identify one of Site Engineers to work as safety officer.

3. SAFETY REQUIREMENTS

Basic Safety Requirement

1. Barricades

Adequate and proper fencing, barricading, marking and lighting of construction, maintenance and other areas that are occupied for construction.

2. Communication

A telephone or other means of two-way communication should be available at the site before construction begins.

3. Confined Space

It should be ensured that all confined space entries are made only under the supervision of a qualified person. Each entry must have a permit signed by the authorized person and should be shown at the entry points.

4. Cylinders

Compressed gas cylinders shall be secured in upright position at all times. Valve caps shall be in place when not in use.

5. Demolition

It should be ensured that material is not dropped outside the exterior wall at the building where the drop distance is more than 6 m high. If the drop distance is less than 6m high, the landing area must be barricades.

6. Electronic Interference

The contractor shall not use any vehicles, equipment, excavations, materials that could degrade or otherwise interfere with electronic signals from radios or electronic navigational aids.

7. Emergency Access

Prevent construction/maintenance activities or materials from hampering access to firefighting or police vehicles in the project area.

8. Equipment Perimeter Protection

Heavy equipment with rotating superstructure such as backhoes and power shovels.

9. Flagging

On all such roads where vehicular and pedestrian traffic is envisaged, properly trained and equipped flaggers at designated locations should be used.

10. Ladders

Defective ladders must not be used. All ladders must have firm footing, be secured at the top and should be extended 1 m beyond landing level. Aluminium ladders must not be used in conjuction with electric work.

11. Scaffolding

Appropriate base plates will be utilized at all time under scaffold legs to support the scaffold.

12. Temporary Lighting

All outdoor temporary electrical wiring within the construction area will be either direct burial type or installed in rigid conduits. All indoor temporary electrical lighting shall be a three-wire type system.

3.1 Personal Protective Equipment

The contractor is responsible for providing and requiring the use of appropriate personal protective equipment for all employees.

1. Clothing

Full length trousers without excessive length or flared bottoms are required shirts must cover the entire mid-section and the sleeves must cover the entire shoulder.

2. Fall Protection

Guardrail System, safety nets or personal fall protection system must be used during any activity where a worker is exposed to a fall hazard greater than 2m.

3. Hard Hats

Approved hard hats shall be worn at all times while on the construction site. Hard hat shall be worn properly with the bill forward unless the eye protection prevents this as with welders. The bill is designed to protect the face from walling objects.

4. Hearing Protection

Hearing protection shall be worn when required

5. Work Shoes

A serviceable pair or work shoes or boots made of leather or similar material shall be worn. Steel toe shoes are required for operating jackhammers, earth compacting equipment, etc.

3.2 Trenches, Excavations etc.

1. Barricades

Barricades around open holes, trenches, excavations or other identified hazards shall be secured to the ground to prevent displacement.

2. Marking

Open trenches, excavation and stockpiled material at the top job site must be prominently marked with red flags and lighted during hours of restricted visibility or darkness.

3. Soil Stability

In the event of concern by PMC/PIU on soil stability, the contractor shall supply specific calculations on the stability of the materials including support calculations.

4. Trench Banks

All trench banks more than 1.5 m high shall be sloped to a proper angle. If the angle cannot be achieved, the trench shall be shored unless the trench is in solid rock. All shoring system must be approved by PMC/PIU. Approved sharing system shall consist of sheathing, tight planking or a trenching box.

3.3 Fire Safety

Contractors shall be responsible for prudent practice on fire prevention/safety requirements as per Govt. rules and regulations.

3.4 Protection of Overhead and Underground Services

- The Contractor will be held responsible for any damage to known services (i.e. overhead services that are visible within the Site and underground services shown on the drawings) and he shall take all necessary measures to protect them. All work or protective measures shall be subject to approval of the Employer. In the event of a service being damaged he shall inform the Employer and the authority concerned, the Contractor shall not repair any such service unless instructed to do so.
- Contractor will map the underground utilities. Where no underground services are shown on the drawings or scheduled but the possibility of their presence can reasonably be inferred, the Contractor shall, in collaboration with the Employer, ascertain whether any such services exist within the relevant section of the Site. The Contractor shall complete such an investigation well in advance of the start of construction work in the said section and he shall submit a report in good time to enable the Employer to make whatever arrangements are necessary for the protection, removal or diversion of the services before any construction activities commences.

- In main roads and junctions, irrespective of utility services indicated in the drawing, the Contractor need to take proper care prior to commencement of Construction activities so as to ensure minimum disruption to the services. This may require even making a cross sectional trail pit to determine the exact alignments of different utilities.
- Taking care of other utility services infrastructure during the execution of the works is the responsibility of the Contractor. Nothing in the Contract should relieve the Contractor from his responsibility towards safety of other utility services infrastructure during project execution. The Contractor's Construction program should include such activities into consideration and no extra claim towards time of completion and cost in this regard shall be entertained.
- As soon as any underground service not shown on the drawings is discovered, it shall be deemed to be a known service and the Contractor will be held responsible for any subsequent damage to it. If such a service is damaged during the course of its discovery, the cost of making good such damage will be met by the Employer unless he establishes that the Contractor did not exercise reasonable diligence and that the damage was avoidable.
- Where the authority concerned elects to carry out on its own account any alterations or protective measures, the Contractor shall co-operate with and allow such authority reasonable access and sufficient space and time to carry out the requiredwork.

Signboards

- Signboards shall be placed at each of the project offices, at important locations and in each UGR area, in English, information about the project and Employer, and the names of the Employer and Contractor in a form and size to be agreed by the Employer. They shall be of durable construction capable of withstanding the effects of the climate until the end of the design build Period.
- The Contractor shall keep the signboards in good condition for the duration of the contract and shall remove them on completion of the Contract.
- Besides these signboards the Contractor shall not, except with the written authority of the Employer, exhibit or permit to be exhibited on the Site any other form of advertisement.

Site Drainage

- The Contractor shall keep each Section of the Works well drained until the Employer certifies that it is substantially complete and shall ensure that, so far as is practicable, all work is carried out in the dry. Site areas shall be kept well drained and free from standing water except where this is impracticable having regard to methods of Temporary Works properly adopted by the Contractor.

- The Contractor shall provide, operate and maintain in sufficient quantity such pumping equipment, well points, pipes and other equipment as may be necessary to minimize damage, inconvenience and interference and shall construct, operate and maintain all temporary coffer-dams, sumps, ditches, drains and other temporary works as may be necessary to remove water from the Site while construction is in progress. Such Temporary Works and construction equipment shall not be removed without the approval of the Employer.
- Notwithstanding any approval by the Employer of the Contractor's arrangements for the removal of water, the Contractor shall be responsible for the sufficiency thereof and for keeping the Works safe at all times and for making good at his own expense any damage to the Works.
- The Contractor shall be responsible to keep the Site clear of water at whatever pump rate is found necessary.
- The Contractor's site drainage facilities shall not cause pollution in any local watercourses, he shall be responsible for any legal action resulting from pollution events.

Detours and Traffic Control

- The Contractor shall program his work in such a way that, wherever the temporary closure of street sections to public thoroughfare cannot be avoided, the duration of traffic diversion can be kept as short as possible. No streets shall be closed and no detours shall be introduced and no traffic diverted until the Contractor's proposals have been approved by the Employer and the appropriate Government authorities, such as the Public Works Department.
- Where work is to be carried out in public roads, the Contractor shall give notice to the Employer sufficiently in advance of the date on which he wishes to commence such work.
- The Contractor shall be responsible for obtaining the permission of the Employer, Road Department and the Police for activities he intends to carry out in public roads. Two copies of the Contractor's proposals to the relevant authorities shall be submitted to the Employer. One copy of all obtained approvals shall be submitted to the Employer.
- The Contractor's attention is drawn to the fact that processing of the documentation required by the local authorities prior to the cutting of existing public roads takes approximately 30 days. During the Monsoon period (June to September) no road cuttings are normally allowed. The Contractor to consider the same while finalising their Construction Program and SIP.

- Detours shall be selected in such a way that the inconvenience to the affected traffic as well as to the inhabitants of the affected areas is kept to a minimum.
- The Contractor shall furnish, install and maintain at all times during the execution of the Works all necessary traffic signs, barricades, lights, signals and other traffic control devices, including flagging and other means of guiding traffic through the work zone. Traffic control shall be managed in accordance with prevailing rules and regulations, and with the approval and to the satisfaction of the Employer.
- All devices mentioned above shall be in conformity with the requirements of the Roads Department. All traffic signs and control devices to be furnished and installed by the Contractor shall be approved by the Employer for their location, position, visibility, adequacy and manner of use under specific job conditions.
- All traffic control devices necessary for the initial stage of construction shall be properly placed and operational before any construction is allowed to start. When work of a progressive nature is involved, the necessary signs shall be moved concurrently where they are needed.
- If the Employer determines that proper provisions for safe traffic control are not being provided or maintained, he may restrict construction operations affected by such defective signs or devices until such provisions are established or maintained, or may altogether order suspension of the Work until a proper traffic control is achieved. In case of serious or willful disregard by the Contractor of the safety of the public or his employees, the Employer may take necessary steps to rectify the situation and deduct the cost thereof from monies due or becoming due to the Contractor. The Contractor shall be responsible for all resulting delays.
- The Contractor shall designate or otherwise employ personnel to furnish continuous surveillance of the traffic control operations. The designated personnel shall be available day and night to respond to calls involving damage due to traffic accidents.
- At sections where traffic is in operation and when ordered by the Employer, the movements of the Contractor's equipment from one place of work to another shall be subject to traffic control. During rush hours movement of larger vehicles, such as trucks, cranes, dumpers, etc. through main thoroughfare are not permitted by the police. Spillage resulting from hauling operations along or across the road way shall be removed immediately at the Contractor's expense.

Provision of Temporary Services

- When the execution of the Works requires the temporary disconnection of existing public utilities, the Contractor shall provide the affected users with temporary services in at least the same standard as the original services.
- For water supply he may install temporary lines or arrange for regular supply by tankers. The amount of water to be provided for the interruption period for a specific area shall be assessed by the Contractor. The Contractor shall submit to the Employer, for its approval, the recommended volume of water to be provided.
- No valve or other controls in public service facilities shall be operated by the Contractor without approval of the Employer and the relevant authorities. All users affected by such operation shall be notified by the Contractor at least one hour before the operation and advised of the probable time when service will be restored.

Protection of Adjoining Property and Reinstatement upon Completion

- The Contractor shall be responsible and take all measures in order to protect adjoining property including buildings, electrical and telephone poles, bridges and culverts, retaining walls, compound walls and fences, and other structures. Prior to the commencement of the activities, the Contractor shall assess the probability and extent of unavoidable damages, if any, to the building and properties and submit his assessment to the Employer. The Employer may make his own opinion and if required may order arrangements for protection or repair of such likely unavoidable damage in which event the Contractor shall complete the activities.
- Temporary facilities shall be provided by the Contractor, only for as long as required after which he shall dismantle and remove the same from their place of use as speedily as possible. Re-usable components shall be safely stored by the Contractor in his yard. The place of use shall be cleared and reinstated immediately to at least the condition existing before the temporary facilities were provided, and to the satisfaction of the Employer.

Coordination with Other

Authorities Statutory Services

- As far as possible the Contractor shall acquaint himself with the actual location of all existing public utilities such as sewers, water mains, drains, cables for electricity, telephone lines, gas lines, lighting poles, masts, etc., before commencing any activities likely to affect the existing utilities. The Contractor shall with the assistance of the Employer obtain such information directly from the responsible authorities as early as possible.

Notices, Permits

- Well in advance of the programmed start of any work which may affect traffic or any existing utilities the Contractor shall give advance information to the Employer/Employer indicating the type, the exact location, the programmed starting time and the expected duration of the activities and shall provide whatever particulars may be required by the authorities to issue any required permits and make all necessary arrangements. The Employer will provide necessary permissions. Separate permits need to be taken from the Employer and other authorities when the Contractor is planning for night work.

3.5 Reporting Procedures

Construction Safety/Security Inspection Report

Construction safety/Security Inspection Report Form is enclosed in Appendix 1. The following instructions apply to the use of the form.

1. Classification

   Unsafe conditions or acts having potential to cause bodily injury or property damage should be classified as either imminent danger or serious. In either case, immediate action should be taken to correct the hazard.

2. Corrective Action

   The column under Contractor's correcting action will indicate Abatement Action and deadline date.

3. Detailed Information

   Specific information to be provided under "Safety Violations". Give exact location of safety violations.

4. Distribution

   All forms will be distributed to all concerned on the site.

5. Item Number: Number each item
6. Legible

   Print or write legibly with a ball point pen so that all copies are readable.

7. Report Signature

   The person conducting the inspection must sign and date the form in the space.

8. Review

   The violations or comments marked on the inspection report shall be reviewed by the Project Manager. After taking corrective action, the report will be sent to PMC/PIU.

ANNEXURE I

CONSTRUCTION SAFETY/SECURITY INSPECTION REPORT FORM

ADB Assisted Delhi Water Supply Improvement Investment Project

Contractor_____

Contract Package No._____

CONSTRUCTION SAFETY/SECURITY INSPECTION REPORT

Item No.	*Safety/Security Violations*	*Reference*	*Contractor's Correcting Action*	*Date Item Corrected*

Report Prepared by:_____

Signature:_____

Title:_____

Date :_____

Contractor's Project Manager

Signature:_____

Date:_____

Signature:_____

ANNEXURE - II

Delhi Jal Board Safety Code

The Employer's Safety Code shall be strictly adhered to Provisions include:

1. Suitable scaffolds should be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable footholds and hand-hold shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1 (¼ horizontal and 1 vertical.).
2. Scaffolding of staging more than 3.6 m (12 ft.) above the ground or floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached or bolted, braced and otherwise secured at least 90 cm. (3 ft.) high above the floor, or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.
3. Working platforms, gangways and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6 m (12 ft.) above ground level or floor level, they should be closely boarded; should have adequate width and should be suitably fastened as described in (2) above.
4. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of person or materials by providing suitable Fencing or railing whose minimum height shall be 90 cm. (3 ft.).
5. Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m. (30 ft.) in length while the width between side rails in rung ladder shall in no case be less than 29 cm. (1 11/2") for ladder up to and including 3 m. (10 ft.) in length. For longer ladders this width should be increased at least 1/4" for each additional 30 cm. (1 foot) of length. Uniform step spacing of not more than 30 cm shall be kept. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites or work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect the public from accident and shall be bound to bear the expenses of defense of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and

to pay any damages and cost which may be awarded in any such suit, action or proceedings to any such person or which may, with the consent of the contractor, be paid to compensate any claim by any such person.

6. Excavation and Trenching - All trenches 1.2 m. (4 ft.) or more in depth, shall at all times be supplied with at least one ladder for each 30 m. (100 ft.) in length or fraction thereof Ladder shall extend from bottom of the trench to at least 90 cm. (3 ft.) above the surface of the ground. The sides of the trenches which are 1.5 m. (5 ft.) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 m. (5 ft) of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.
7. Demolition - Before any demolition work is commenced and also during the progress of the Work,
   i) All roads and open areas adjacent to the work site shall either be closed or suitably protected.
   ii) No electric cable or apparatus which is liable to be a source of danger ore cable or apparatus used by the operator shall remain electrically charged.
   iii) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.
8. All necessary personal safety equipment as considered adequate by the Employer should be kept available for the use of the person employed on the site and maintained in a condition suitable for immediate use, and the contractor should take adequate steps to ensure proper use of equipment by those concerned: - The following safety equipment shall invariably be provided.

   i) Workers employed on mixing asphalt materials, cement and lime mortars shall be provided with protective footwear and protective goggles.

   ii) Those engaged in white washing and mixing or stacking of cement bags or any material which is injurious to the eyes shall be provided with protective goggles.

   iii) Those engaged in welding works shall be-provided with welder’s protective eye Shields.

   iv) Stone breaker shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

v) When workers are employed in sewers and manholes, which are in active use, the contractors shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public, in addition, the contractor shall ensure that the following safety measures are adhered to:

a) Entry for workers into the line shall not be allowed except under supervision of the JE or any other higher officer.

b) At least 5 to 6 manholes upstream and downstream should be kept open for at least 2 to 3 hours before any man is allowed to enter into the manhole for working inside.

c) Before entry presence of Toxic gases should be tested by inserting wet lead acetate paper which changes colour in the presence of such gases and gives indication of their presence.

d) Presence of Oxygen should be verified by lowering a detector lamp into the manhole. In case, no Oxygen is found inside the sewer line, workers should be sent only with Oxygen kit.

e) Safety belt with rope should be provided to the workers. While working inside the manholes such rope should be handled by two men standing outside to enable him to be pulled out during emergency.

f) The area should be barricaded or cordoned off by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public whenever cleaning works are undertaken during night or day.

g) No smoking or open flames shall be allowed near the blocked manhole being cleaned.

h) The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of slippery nature of the malba.

i) Workers should not be allowed to work inside the manhole continuously. He should be given rest intermittently. The Employer-in-Charge may decide the time up to which a worker may be allowed to work continuously inside the manhole.

j) Gas masks with Oxygen Cylinder should be kept at site for use in emergency.

k) Air-blowers should be used for flow of fresh air through the manholes. Whenever called for portable air blowers are recommended for ventilating the manholes. The Motors for these shall be vapour proof and of totally enclosed type. Non sparking gas engines also could be used but they should be placed at least 2 meters away from the opening and on the leeward side protected from wind so that they will not be a source of friction on any inflammable gas that might be present.

l) The workers engaged for cleaning the manholes/sewers should be properly trained before allowing working in the manhole.

m) The workers shall be provided with Gumboots or non sparking shoes bump helmets and gloves non sparking tools safety lights and gas masks and portable air blowers (when necessary). They must be supplied with barrier cream for anointing the limbs before working inside the sewer lines.

n) Workmen descending a manhole shall try each ladder stop or rung careful before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole well.

o) If a man has received a physical injury, he should be brought out of the sewer immediately and adequate medical aid should be provided to him.

p) The extents to which these precautions are to be taken depend on individual situation but the decision of the Employer-in-Charge regarding the steps to be taken in this regard in an individual case will be final.

vi) The Contractor shall not employ men and women below the age of 18 years on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following precaution should be taken:-

a) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

b) Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scraped.

c) Overalls shall be supplied by the contractors to the workmen and adequate facilities shall be provided to enable the working painters to wash during and on the cessation of work.

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

i) White lead, sulphate of lead or product containing these pigment, shall not be used in painting operation except in the form of pastes or paint ready for use.

ii) Measures shall be taken, wherever required in order to prevent danger arising from the application of paint in the form of spray.

iii) Measures shall be taken, wherever practicable, to prevent danger arising out of from dust caused by dry rubbing down and scraping.

iv) Adequate facilities shall be provided to enable working painters to wash during and on cessation of work.

v) Overall shall be worn by working painters during the whole of working period.

vi) Suitable arrangement shall be made to prevent clothing put off during working hours being spoiled by painting materials.

vii) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by medical man appointed by competent authority of DJB.

viii) DJB may require, when necessary medical examination of workers.

ix) Instructions with regard to special hygienic precautions to be taken in the painting.

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

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

    i) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defects and shall be kept repaired and in good working order.

    ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent detects.

    iii) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to operator.

    iv) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension the safe working load shall be ascertained by adequate means. Every hoisting machine and all pears referred to above shall be plainly marked with the safe working load. In case of a hoisting machine having a variable safe working load each safe working load and the condition under which It Is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

    v) In case of departmental machines, the safe working load shall be notified by the Electrical Employer-in-charge. As regards Contractors machines, the Contractors shall notify the safe working load of the machine to the Employer-in-charge whenever he brings any machinery to site of work and get it verified by the Electrical Employer concerned.

12. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulating mats, wearing apparel, such as. Gloves, sleeves and boots as may be necessary should be provided. The worker should not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.

All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work

13. These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place at work spot. The person responsible for compliance of the safety code shall be named therein by the contractor.
14. To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the contractor shall be open to inspection by the Labour Officer or Employer-in-Charge of the department or their representatives.
15. Notwithstanding the above Clauses from (1) to (15) there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force In the Republic of India.

Additional Safety Guidelines as per DJB

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

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

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

ANNEXURE III

SAFETY IN CONSTRUCTION (Reference: CPWD Specifications –Volume-1)

The CONTRACTOR shall abide by the safety code provision as per CPWD Safety Code framed from time to time.

The Contractor shall employ only such methods of construction, tools and plant as are appropriate for the type of work or as approved by Engineer-in-Charge in writing.

The Contractor shall take all precautions and measures to ensure safety of works and workman and shall be fully responsible for the same. Safety pertaining to construction works such as excavation, centering and shuttering, trenching, blasting, demolition, electric connections, scaffolds, ladders, working platforms, gangway, mixing of bituminous materials, electric and gas welding, use of hoisting and construction machinery shall be governed by CPWD safety code, relevant safety codes and the direction of Engineer-in-Charge.

The list of IS Safety Codes are given in Appendix-I for further reference.

ANNEXURE-IV

NHRC GUIDELINES

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

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

1. The medical examination and medical treatment will be given free of charge to sewer workers and the treatment will continue for all such workers found to be suffering from an occupational disease, ailment or accident until the workman is cured or until death.

2. The services of the sewer workers are not to be terminated, either by the respondents or the contractors engaged by them during the period of illness and they shall be treated as if on duty and will be paid their wages.

3. The respondents shall pay on the death of any worker including any contract worker, an immediate ex-gratia solatium of ₹ One lakh with liberty to recover the same from contractors, if permissible in law.

4. The respondents shall pay/insure payment of all statutory dues such as Provident Fund, Gratuity and Bonus to all the sewer workers including contract workers, as applicable in law.

5. The respondents shall provide as soon as possible modern protective equipment to all the sewer workers in consultation with the petitioner organization.

6. The respondents shall provide soap and oil to all the workmen according to the present quota but on monthly basis and not at the end of the year.

7. The respondents shall provide all workmen including contract workmen with an accident-card-cum-wage-slip as set out in clause 8 of the CPWD/PWD (DA)/Delhi Jal Board Contractors Labour Regulations (for short "Labour Regulations").

8. The respondents shall authenticate by signing the payment of wages register for contract workers in terms of clause 5 of the Labour Regulations.

9. The Delhi Jal Board is directed to ensure that the ex-gratia payment in case of deaths of sewer workers has been paid to the families of deceased workmen and in case such compensation is not paid, release the same within a period of eight weeks.

ANNEXURE-V

TREE PROTECTION GUIDELINES

The following direction are hereby issued to be followed strictly in compliance of the instructional order issued by Member (WS) on dt. 04-02-2015:

(i) All the sign boards, names, advertisements, any kind of boards or signage's, electric wires and high tension cables to otherwise shall be removed from the tress forthwith.

(ii) It shall be ensured by the contractor that any concrete within one meter of the trees are removed forthwith and all the trees are looked after well due precaution is taken in future so that no concrete or construction or repairing work is done at least within one meter radius of the trunk of trees;

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

(iv) Every prohibitive measures shall be taken by the contractor to prevent the defacing of the trees in any manner whatsoever, so only its trimming in accordance with law;

(v) No display boards or markers shall be fixed by the contractor on the tree. Any violation shall make the concerned liable for prosecution by the authorities in accordance with the relevant law;

(vi) The contractor shall ensure a damage free liability to the trees in the area upto the date of completion of the work;

(vii) The contractor will retain photographs of the area worked upon before and after the work showing the condition of the trees of they exist along the alignment of the work. The photograph so taken shall be submitted to the Engineer-in-Charge during execution of work for permanent record.

ANNEXURE VI

National Green Tribunal (NGT) Guidelines

The following directions are hereby issued in compliance of the Hon'ble National Green Tribunal order in the matter of Vardhman Kaushik Vs. UOI & Ors. Regarding air pollution in original application No.21 of 2014 (issued by Member (WS) vide order dated 11.05.2015).

NGT issued guidelines to the various departments for the information of the builders and general public.

The Hon'ble Green Tribunal has directed as follows:-

1. No government, authority, contractor, builders or any person would be permitted to store/ dump construction material or debris on the metalled road.
2. Beyond the metalled road the area where such construction material or debris can be stored shall be physically demarcated by the officers of all the concerned Authorities/Corporation. It shall be ensured that such storage does not cause any obstruction to the free flow of traffic and/ or inconvenience to the pedestrians. It should be ensured that no accidents occur on account of such permissible storage.
3. Every Builder or owner shall put tarpaulin on scaffolding around the area of construction and the building. No person including builder, owner can be permitted to store any construction material particularly sand on any part of the street, roads in anycolony.
4. The construction material of any kind that is stored at the site will be fully covered in all respects so that it does not disperse in the Air in any form.
5. All the construction material and debris shall be carried in the trucks or other vehicles which are fully covered and protected so as to ensure that the construction debris or the construction material does not get dispersed into the air or atmosphere, in any form whatsoever.
6. The dust emissions from the construction site should be completely controlled and all precautions taken in that behalf.
7. Every worker working at the construction site and involved in loading, unloading and carriage of construction material and construction debris shall be provided with mask to prevent inhalation of dust particles.
8. Every owner and or builder shall be under obligation to provide all medical help, investigation and treatment to the workers, involved in the construction of building and carry of construction material and debris relatable to dust emission.
9. It shall be the responsibility of every builder to transport construction material and debris waste to construction site, dumping site or any other place in accordance with rules and in terms of this order.

10. All to take appropriate measures and to ensure that the terms and conditions of the earlier order and these orders should strictly comply with by fixing sprinklers, creations of green air barriers.
11. Compulsory use of wet jet in grinding and stone cutting.
12. Wind breaking walls around construction in site.
13. In the event of default they shall be liable to pay compensation for such environmental degradation or for pollution of ambient air quality in NCR, Delhi particularly.
14. If any person, owner and or builders is found to be violating any of the conditions stated in this order and or for their non-compliance such person, owner, builder shall be liable to pay compensation of Rs. 50,000/- per default in relation to construction activity at its site and Rs. 5,000/- for each violation during carriage and transportation of construction material, debris through trucks or other vehicles, in terms of section 15 of the NCT Act on the principle of polluter Pay. Such action would be in addition not in derogation to the other action that the Authority made take against such builder, owner, person and transporter under the laws in force.

ANNEXURE-VII

MODEL RULES FOR THE PROTECTION OF HEALTH AND SANITARY ARRANGEMENTS FOR WORKERS EMPLOYED BY C.P.W.D. / DELHI JAL BOARD OR ITS CONTRACTORS

1. **APPLICATION**

These rules shall apply to all buildings and construction works in charge of C.P.W.D./ P.W.D. (D.A.) / Delhi Jal Board in which twenty or more workers are ordinarily employed or are proposed to be employed in any day during the period during which the contract work is in progress.

2. **DEFINITION**

Work place means a place where twenty or more workers are ordinarily employed in connection with construction work on any day during the period during which the contract work is in progress.

3. FIRST-AIDFACILITIES

(i) At every work place there shall be provided and maintained, so as to be easily accessible during working hours, first-aid boxes at the rate of not less than one box for 150 contract labour or part thereof ordinarily employed.

(ii) The first-aid box shall be distinctly marked with a red cross on white back ground and shall contain the following equipment, :

(a) For work places in which the number of contract labour employed does not exceed 50 –Each first-aid box shall contain the following equipments: -

1. 6 small sterilized dressings.

2. 3 medium size sterilized dressings.

3. 3 large size sterilized dressings.

4. 3 large sterilized burn dressings.

5. 1 (30 ml.) bottle containing a two per cant alcoholic solution iodine.

6. 1 (30 ml.) bottle containing Sal volatile having the dose and mode of administration indicated on the label.

7. 1 snakebite lancet.

8. 1 (30 gms.) bottle of potassium permanganate crystals.

9. 1 pair scissors.

10. 1 copy of the first-aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.

11. 1 bottle containing 100 tablets (each of 5 gms.) of aspirin.

12. Ointment for bums.

13. A bottle of suitable surgical antiseptic solution.

(b) For Work places in which the number of contract labour exceed 50 - Each first-aid box shall contain the following equipments:

1. 12 small sterilized dressings

2. 6 medium size sterilized dressings.

3. 6 large size sterilized dressings.

4. 6 large size sterilized burn dressings.

5. 6 (15 gms.) packets sterilized cotton wool.

6. 1 (60 ml.) bottle containing two percent alcoholic solution iodine.

7. 1 (60 ml.) bottle containing Sal volatile having the dose and mode of administration indicated on the label.

8. 1 roll of adhesive plaster.

9. 1 snakebite lancet.

10. 1(30 gms.) bottle of potassium permanganate crystals.

11. 1 pair scissors.

12. 1 copy of the first-aid leaflet Issued by the Director General Factory Advice Service and Labour Institutes / Government of India.

13. A bottle containing 100 tablets (each of 5 gms.) of aspirin.

14. Ointment for bums.

15. A bottle of suitable surgical antiseptic solution.

(iii) Adequate arrangements shall be made for immediate recoupment of the equipment, when necessary.

(iv) Nothing except the prescribed contents shall be kept in the First-aid box.

(v) The first-aid box shall be kept in charge of a responsible person who shall always be readily available during the working hours of the work place.

(vi) A person in charge of the First-aid box shall be a person trained in First-aid treatment in the work places where the number of contract labour employed is 150 or more.

(vii) In work places where the number of contract labour employed is 500 or more and hospital facilities are not available within easy distance from the works. First-aid posts shall be established and run by a trained compounder. The compounder shall be on duty and shall be available at all hours when the workers are at work.

(viii) Where work places are situated in places which are not towns or cities, a suitable motor transport shall be kept readily available to carry injured person or person suddenly taken ill to the nearest hospital.

4. DRINKINGWATER

i)In every work place, there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.

ii) Where drinking water is obtained from an intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored.

iii)Every water supply or storage shall be at a distance of not less than 50 feet from any latrine, drain or other source of pollution. Where water has to be drawn from an existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn form it for drinking. All such wells shall be entirely closed in and be provided with a trap door which shall be dust and waterproof.

iv)A reliable pump shall be fitted to each covered well, the trap door shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

5. WASHING FACILITIES

i) In every work place adequate and suitable facilities for washing shall be provided and maintained for the use of contract labour employed therein.

ii) Separate and adequate cleaning facilities shall be provided for the use of male and female workers.

iii)Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition.

6. LATRINES AND URINALS

i) Latrines shall be provided in every work place on the following scale namely :-

a) Where female are employed there shall be at least one latrine for every 25 females.

b) Where males are employed, there shall be at least one latrine for every 25 males. Provided that where the number of males or females exceeds 100, it shall be sufficient if there is one latrine for 25 males or females as the case may be up to the first 100, and one for every 50 thereafter.

ii) Every latrine shall be under cover and so partitioned off as to secure privacy and shall have a proper door and fastenings.

iii) Construction of latrines: The inside walls shall be constructed of masonry or some suitable heat-resisting nonabsorbent materials and shall be cement washed inside and outside at least once a year, latrines shall not be of a standard lower than borehole system.

iv) a) Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal, a notice in the language understood by the majority of the workers “For Men only” or “For Women Only” as the case may be.

b) The notice shall also bear the figure of a man or of a woman, as the case may be.

v) There shall be at least one urinal for male workers up to 50 and one for female workers up to fifty employed at a time, provided that where the number of male or female workmen, as the case may be exceeds 500, it shall be sufficient if there is one urinal for every 50 males or females up to the first 500 and one for every 100 or part thereafter.

vi) a) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.

b) Latrines *and* urinals other than those connected with a flush sewage system shall comply with the requirements of the Public Health Authorities.

vii) Water shall be provided by means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.

viii)Disposal of excreta: - Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator. Alternately excreta may be disposed of by putting a layer of night soil at the bottom of a pucca tank prepared for the purpose and covering it with a 15 cm. layer of waste or refuse and then covering it with a layer of earth for a fortnight (when it will turn to manure).

ix)The contractor shall at his own expense, carry out all instructions issued to him by the Engineer-in-Charge to effect proper disposal of night soil and other conservancy work in respect of the contractor's workmen or employees on the site. The contractor shall be responsible for payment of any charts, which may be levied by Municipal or Cantonment Authority for execution of such on his behalf.

7. PROVISION OF SHELTER DURING REST

At every place there shall be provided, free of cost, four suitable sheds, two for meals and the other two for rest separately for the use of men *and* women labour. The height of each shelter shall not be less than 3 meters (10 ft.) from the floor level to the lowest part of the roof. These shall be kept clean and the space provided shall be on the basis of 0.6 Sq.M. (6.00 Sq.Ft) per head. Provided that the Engineer-in-Charge may permit subject to his satisfaction, a portion of the building under construction or other alternative accommodation to be used for the purpose.

8. CRECHES

(i) At every work place, at which 20 or more women worker are ordinarily employed, there shall be provided two rooms of reasonable dimensions for the use of their children under at the age of six years. One room shall be used as a playroom for the children and the other as their bedroom. The rooms shall be constructed with specifications as per clause 19H(ii)a, b & c.

(ii) The rooms shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean.

(iii) The contractor shall supply adequate number of toys and games in the playroom and sufficient number of cots and beddings in the bedroom.

(iv) The contractor shall provide one '*ayaa'* to look after the children in the crèche when the number of women workers does not exceed 50 and two when the number of women workers exceeds 50.

(v) The use of the rooms earmarked as crèches shall be restricted to children, their attendants and mothers of the children.

9. CANTEENS

i) In every work place where the work regarding the employment of contract labour is likely to continue for six months and where in contract labour numbering one hundred or more are ordinarily employed an adequate canteen shall be provided by the contractor for the use of such contract labour.

ii) The canteen shall be maintained by the contractor in an efficient manner.

iii) The canteen shaft consist of at least a dining hall, kitchen, storeroom, pantry and washing places separately for workers and utensils.

iv) The canteen shall be sufficiently lighted at all times when any person has access to it.

v) The floor shall be made of smooth *and* impervious materials and inside walls shall be lime washed or colour washed at least once in each year. Provided that the inside walls of tile kitchen shall be Semi-washed every four months.

vi) The premises of the canteen shall be maintained in a clean and sanitary condition.

vii) Waste water shall be carried away in suitable covered *drainsand* shall not be allowed to accumulate so as to cause a nuisance.

viii) Suitable arrangements shall be made for the collection and disposal of garbage.

ix) The dining hall shall accommodate at a time 30 per cent of the contract labour working at a ti**me**.

x) The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chairs shall not be less than one square meter (10 sft) per diner to be accommodated as prescribed in sub-Rule 9.

xi) a) A portion of the dining hall and service counter shall be partitioned off and reserved for women workers in proportion to their number.

b) Washing places for women shall be separate and screened to secure privacy

xii) Sufficient tables, stools, chair or benches shall be available for the number of diners to be accommodated as prescribed In sub-Rule 9.

xiii) a) 1.There shall be provided and maintained sufficient utensils crockery, furniture and any other equipment necessary for the efficient running of the canteen.

2. The furniture utensils and offer equipment shall be maintained in a clean and hygienic condition.

b) 1. Suitable clean clothes for the employees serving in the canteen shall be provided and maintained.

2. A service counter, if provided, shall have top of smooth and impervious material.

3. Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipment.

xiv) The food stuffs and other items to be served in the canteen shall be in conformity with the normal habits of the contract labour.

xv) The charges for food stuffs, beverages and any other items served in the canteen shall be based on 'No profit, *No* loss' and shall be conspicuously displayed in the canteen.

xvi) In arriving at the price of foodstuffs, and other article served in the canteen, the following items shall not be taken into consideration as expenditure namely :-

a) The rent of land and building.

b) The depreciation and maintenance charges for the building and equipment provided for the canteen.

c) The cost of purchase, repairs and replacements of equipment including furniture, crockery, cutlery and utensils.

d) The water charges and other charges incurred for lighting and ventilation.

e) The interest and amounts spent on the provision and maintenance of equipment provided for the canteen.

xvii) The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors.

10. ANTI-MALARIAL PRECAUTIONS

The contractor shall at his own expense, conform to all anti-malarial instructions given to him by the Engineer-in-Charge including the filling up of any borrow pits which may have been dug by him.

11. The above rules shall be incorporated in the contracts and in notices inviting tenders and shall from an integral part of the contracts.

12. AMENDMENTS

Government may, from time to time, add to or amend these rules and issue directions it may consider necessary for the purpose of removing any difficulty which may arise in the administration thereof.

APPENDIX-I

LIST OF SAFETY CODES FOR CIVIL WORKS PUBLISHED BY BUREAU OF INDIAN STANDARDS

Sr. No	Code No.	Title
01.	IS : 818	Code of Practice for Safety and Health Requirements in Electric and Gas Welding and Cutting Operations – First Revision.
02.	IS : 875	Code of practice for Structural safety of buildings: Masonry walls
03.	IS : 933	Specification for Portable Chemical Fire Extinguisher, Foam Type - Second Revision.
04.	IS : 1179	Specification for Equipment for Eye and Face Protection during Welding - First Revision.
05.	IS : 1904	Code of practice for Structural safety of buildings: Shallow foundations
06.	IS : 1905	Code of practice for Structural safety of buildings: Masonry walls
07.	IS : 2171	Specification for Portable Fire Extinguishers, Dry Powder Type -Second Revision.
08.	IS : 2361	Specification for Building Grips - First Revision.
09.	IS : 2750	Specification for Steel Scaffoldings.
10.	IS : 2925	Specification for Industrial Safety Helmets - First Revision.
11.	IS : 3016	Code of Practice for Fires Precautions in Welding and Cutting Operations - First Revision.
12.	IS : 3521	Industrial safety belts and harnesses
13.	IS : 3696 - Part I	Safety Code for Scaffolds and Ladders : Part I - Scaffolds.
14.	IS : 3696 - Part II	Safety Code for Scaffolds and Ladders : Part II - Ladders.
15.	IS : 3764	Safety Code for Excavation Work.
16.	IS : 4014 -Part I & II	Code of practice for Steel tubular scaffolding
17.	IS : 4081	Safety Code for Blasting and Related Drilling Operations.
18.	IS : 4082	Recommendations on staking and storage of construction materials at site
19.	IS : 4130	Safety Code for Demolition of Buildings - First Revision.
20.	IS : 4138	Safety Code Working in Compressed Air-First Revision
21.	IS : 4756	Safety code for Tunneling works
22.	IS : 4912	Safety requirements for Floor and Wall Openings, Railings and toe Boards -First Revision.
23.	IS : 5121	Safety Code for Piling and other Deep Foundations.
24.	IS : 5916	Safety Code for Construction involving use of Hot Bituminous Materials.
25.	IS : 5983	Specification for Eye Protectors - First Revision.
26.	IS : 6922	Structures subject to underground blasts, criteria for safety and design of
27.	IS : 7155	Code of recommended practices for conveyor safety

28.	IS : 7205	Safety Code for Erection on Structural Steel Works.
29.	IS : 7069	Safety Code for Handling and Storage of Building Materials.
30.	IS : 7293	Safety Code for Working with Construction Machinery.
31.	IS : 7323	Guidelines for operation of Reservoirs
32.	IS : 7969	Safety code for handling and storage of building material
33.	IS : 8758	Recommendation for Fire Precautionary Measures in construction of Temporary Structures and Pandals.
34.	IS : 8989	Safety Code for Erection of Concrete Framed Structures.
35.	IS : 9706	Code of Practices for construction of Arial ropeways for transportation of material
36.	IS : 9759	Guidelines for de-watering during construction
37.	IS : 9944	Recommendations on safe working load for natural and manmade fibre roap slings
38.	IS : 10291	Safety code for dress divers in civil engineering works
39.	IS :10386 - Part I	Safety Code for Construction, Operation and Maintenance for River Valley Projects.
40.	IS :10386 - Part II	Safety Code for Construction, Operation and Maintenance of River Valley Projects.
41.	IS : 11057	Code of practice for Industrial safety nets
42.	IS : 13415	Code of Practice on safety for Protective barriers in and around building
43.	IS : 13416	Recommendations for preventive measures against hazards at working places