



QUALITY ASSURANCE PLAN (QAP)

ASOM MALA 3.0 FOR THE YEAR 2025-26



Government of Assam

PUBLIC WORKS ROADS DEPARTMENT | O/O THE CHIEF ENGINEER, PWD (ROADS), ASSAM

Preface

The Asom Mala 3.0 (RIDF-XXXII & SOPD) initiative is a prestigious flagship project envisioned to be executed with the highest standards of precision and excellence. The implementing agency shall ensure that rigorous quality control measures are applied at every stage of construction. All materials used, methods adopted, and works performed must strictly conform to the prescribed specifications.

Execution of works shall adhere to the guidelines and specifications of the Indian Roads Congress (IRC). The implementing agency will conduct all mandatory tests as stipulated in the contract specifications and MoRTH guidelines, while monitoring quality control of input materials and construction activities in accordance with the Manual for Quality Control in Road & Bridge Works (IRC-SP:112). Contractors are required to carry out testing at the prescribed frequency to ensure compliance with these standards.

Unlike earlier phases under Asom Mala 1.0 and 2.0, this project does not provide for the engagement of Third-Party Quality Control Consultants. The responsibility for quality control will rest solely with the implementing agency, which shall ensure strict compliance with all prescribed protocols.

The success of this project depends on unwavering adherence to quality assurance measures. The Public Works Roads Department (PWRD) is committed to ensuring that the project roads meet national benchmarks of safety, durability, and serviceability.

This Quality Assurance Plan (QAP) has been prepared for the flagship Asom Mala 3.0 project to enforce strict compliance with quality control measures under the Department.

This QAP is designed to be adaptable and may also be applied to other highway projects under PWRD as per MORT&H specifications, thereby institutionalizing quality assurance practices across the department. This will ensure uniformity, transparency, and adherence to prescribed standards, while strengthening accountability and ensuring durability of assets created under flagship programs such as Asom Mala.

Table of Content

Section	Description	Page
1.	Introduction	3
1.1	Project Background	3
1.2	Implementation Arrangement	4
1.3	Need for Monitoring and Quality Control Assurance	4
1.4	Purpose of Quality Control by Implementing Agencies	4
2.	Scope & Duties	6
2.1	General	6
2.2	Scope of Quality Control	6
2.3	Role and Responsibilities	7
3.	Approach and Methodology	11
3.1	General	11
3.2	Quality Control Activities	11
3.3	Reporting	13
4.	Quality Control Tests - Frequency, Procedure & Formats	14
4.1	General	14
4.2	Frequency of Quality Control Tests	14
4.3	Quality Control Test Procedure and Formats	71

Section 1: Introduction

1.1. Project Background

Government of Assam initiated the flagship programme Asom Mala for improvement and upgradation of the secondary road network comprising of state highways and major district roads, launched by the Hon'ble Prime Minister at Dhekiajuli on February 7, 2021.

Government of Assam has adopted Road Network Master Plan with a 20-year horizon in August, 2023. In Consistency with the long-term policy of the State Govt, roads upgradation was taken up mostly out of the priority corridors defined in the Assam Road Network Master Plan prepared with the objective of achieving enhanced mobility accommodating the current and future travel demand, confirming accessibility and connectivity of various areas of importance within and surrounding the state.

The objective has been to develop best quality infrastructure by improving and upgrading state highways and major district roads to high-speed road corridors for efficient transportation meeting highway standards with road safety norms and economic development of the State.

The roads are to be improved and upgraded to 2-lanes with paved shoulders along with construction of bridges with an aim to:

- ✓ To improve the SH & MDRs network in the next 20 years for fueling economic growth and bringing the state road infrastructure at par with comparable economies
- ✓ To provide quality inter-linkage roads between the National Highways and the rural roads network as well as facilitate seamless multi-modal transportation
- ✓ To interconnect economic growth centers with quality developing quality transportation corridors and improve inter-state connectivity

Government has already taken up 2 phases of Asom Mala:

1. Asom Mala 1.0 during the FY from 2018-19 to 2022-23: It is an umbrella programme with different sources of funding involving SOPD; two EAPs – AIIB aided ASRIP and ADB aided ASCCIP; and NIDA.
2. Asom Mala 2.0 during the FY 2023-24: Driven by the success of Asom Mala 1.0, it is proposed to continue with the programme for improvement of SH and MDRs and another 1000 km of SH & MDRs is to be taken up under NIDA with funding from NABARD.

Government of Assam has now proposed for Asom Mala 3.0

The Asom Mala 3.0 is proposed to be taken up during the FY 2025-26 with the following scope of work:

- | | |
|--------------------------------|----------------------------------|
| ✓ District covered | : 34 Nos. (excluding Dima Hasao) |
| ✓ Total Roads proposed | : 69 Nos. |
| ✓ Total Road length | : 916.79KM |
| ✓ Total Bridge proposed | : 32 Nos. / 2955.10RM |
| ✓ Total Estimated Project Cost | : Rs. 3217.00 Crore |

1.2. Implementation Arrangement

The PWRD, Assam is the Employer & executing agency for the project and will be responsible for the overall supervision, execution, and management.

The Project Management Unit (PMU) headed by the Chief Engineer, PWD (Roads), Assam will be responsible for project preparation and implementation, such as managing technical designs, environment and social safeguards, procurement, financial management and monitoring results. It would also facilitate coordination with various units of PWRD and other concerned departments of Government of Assam. PWRD's field divisions in each district, corresponding to the locations of project roads, will support PMU to mainly carry out the project implementation in their respective districts.

The Project Implementation Units (PIUs), comprising of the PWRD field Divisions headed by Executive Engineers, shall be responsible for implementation of the program and the projects at the field level under the directions of the Chief Engineer and the Project Management Unit. PIUs will be responsible to implement all the project related activities in their respective districts/divisions including the road improvement and widening works, rehabilitation works, pre-construction activities including land acquisition, utility shifting, tree cutting, etc. They will coordinate with local administration and local communities for support and coordination in smooth implementation of the program. The EEs will be designated "Engineer" for works as per the provisions in the contracts and will be responsible for monitoring the works in the field including quality control and certify the payments of works to the contractors.

1.3. Need for Monitoring and Quality Control Assurance

Quality Control is an essential part of any construction Process for ensuring quality. All materials to be used, all methods adopted and all works performed are strictly to be in accordance with the requirements of the specifications. Quality Control besides leading to construction of improved quality and conformity and ensuring better utilization of materials and timely execution of the project as per Work Programme.

The quality of product is controlled in following three stages:

- (a) Material selection stage
- (b) Construction stage
- (c) Finished stage

1.4. Purpose of Quality Control by Implementing Agencies

The Technical Specifications applicable to the project provide for Quality Assurance and Quality Control of the work executed by use of a Quality Management System (QMS). The basic concept of this process is that the contractors perform inspection & testing as per specifications to ensure a quality product and the Implementing Agencies performs testing and Inspection as per Manual for quality control in Road & Bridge Works (IRC SP 112) to ensure that the Contractor's Quality Control test results are in order.

The system requires that both the contractor and the Implementing Agencies have technical personnel who are competent in testing and inspection of all technical works. The general idea is that the contractor has to perform the necessary tests along with Video & still photography of progress of implementation at the project site before commencement, intermediate stages, and critical stages and at completion stage. Inspection to ensure the likelihood that all works in his scope meet the specifications instead of “after the fact” testing to see if all works meets the specifications. This approach enables the contractor much more control over his operations. He is responsible for his product from the beginning to the end from the design to the construction of all his works till the final acceptance of all the works. The Implementing Agency monitors, his process of testing to make sure that what he is doing, is adequate and accurate. Ensuring production of a quality work of durability and uniform performance by a Construction is the most important aspect of the quality supervision assignment of a Implementing Agency. The Implementing Agencies also follow up the physical achievements of the civil contractors as per Mile stones.

Section 2: Scope & Duties

2.1. General

The basic notion of Monitoring and Quality Control under PIU is to carry out Periodic Performance Monitoring and conducting Technical Auditing of the quality of civil works to enable the PMU to assess critically the implementation, progress, effectiveness and the high standards of quality assurance of the works, wherein contractors execute the awarded work as per Contract agreement including the monitoring of performance and quality assurance, inspections, testing etc.

The very purpose of Monitoring and Quality Control under PIU is to objectively evaluate the extent of compliance with the quality systems and their effectiveness. The work shall include the process and product quality audit as well as the assessment of the adequacy of systems as required for Quality Assurance.

2.2. Scope of Quality Control

The scope of Quality Control under PIUs will also include and not limited to the following:

- ✓ Monitoring & Inspection.
- ✓ Testing Plan of construction materials.
- ✓ Testing & Inspection Plan of Construction activities.
- ✓ Initiative to complete the project and information to be provided to the implanting agency on proportionate progress of the work as per work programme.

With compliance to the above, PIUs shall strictly perform the following:

1. Carry out detailed checking and verification of the setting-out data for the work including lines, levels and layout to ensure conformity with the working drawings.
2. Carry out supervision of all works as per approved method statements of various items of work and ensure proper supervision as per requirement.
3. Examine Contractor's preparation and the completed portion of work as per specifications and promptly advise the contractor for rectification if required.
4. Monitor closely and regularly the progress of work and advise the contractor about corrective measures.
5. Carry out regular inspection of the contractor's equipment, plant, machinery, installations.
6. Supervise the Contractor in all matters concerning safety and care of the work including environmental aspects and labour welfare.
7. Witness sampling and testing being carried out by staff of the Contractor and undertake additional audit tests as necessary to ensure the quality of works and promptly inform the contractor of the results.

8. Review the test results/certificates of all construction materials and/or sources of materials and undertake additional tests as necessary to assess the quality of works.
9. Review all mix designs proposed by the contractors and approve/suggest modifications in the mix design, laying methods, sampling and testing procedure, and quality control measures, to ensure required standard and consistency in quality at the commencement of items.
10. Ensure that all works are carried out as per specifications and approved drawings.
11. Ensure that bridge bearings, expansion joints, Reinforced Earth wall components etc. are as per specification and approved drawings.
12. Ensure that bridge bearings are placed accurately and placed in proper orientation.
13. Maintain a permanent record of all tests carried out for monitoring the quality of works.
14. Review of Manufacturer's Certificates/Test results from outside approved laboratory for all bought out items.
15. Monitor the quality control test on input materials and construction activity as per Manual for Quality Control in Road & Bridge Works (IRC: SP:112) on the fact that contractor shall carry all the testing as per prescribed frequency for the mandatory test recommended in the contract specification/MORTH guideline.
16. Conduct independently 10% of the prescribed frequency for the mandatory test recommended as per contract specifications/MORTH guideline from outside laboratory approved by the Executive Engineer and the cost of such tests shall be borne by the Contractor. Random sampling of materials for testing to be done by PIU.
17. Review all the reports & record for the regular field-testing carried out by construction agency as per the requirement of standard codes.
18. Randomly check the workmanship & methods adopted for completing the activities of work by construction agency and any shortcoming will be directed for rectification.
19. Preparation & submission of monthly Monitoring/QA/QC report & Quarterly and Periodic Reports for the tests and inspections carried out by PIU.

2.3. Role and Responsibilities

In addition to the responsibilities of PIUs to implement all the project related activities in their respective districts/divisions including the road improvement and widening works, rehabilitation works, pre-construction activities including land acquisition, utility shifting, tree cutting, etc., the Role and Responsibilities of Quality Control under PIUs will also include and not limited to the following:

A. Additional Chief Engineer, PWRD:

The Additional Chief Engineer, PWRD will be responsible for:

- i. Formulate and enforce zone-wide quality control policies.
- ii. Conduct periodic audits to ensure uniform standards.
- iii. Review performance reports from circles and divisions to identify systemic issues.

B. Superintending Engineer, PWRD:

The Superintending Engineer, PWRD will be responsible for:

- i. Overall superintendence and control over entire PIU teams.
- ii. Project management and administration as per Contract provisions.
- iii. Ensure application/ implementation of “Quality Assurance Plan” in the project with respect to all relevant Standards/Specifications.
- iv. Monitor activities and performance of PIUs and confirm adequacy of work on site.
- v. Review and scrutiny of test results produced by respective PIUs.
- vi. Checking of QA reports and other deliverables for the project prepared by the PIU and recommendation/ submission thereof to PMU.
- vii. Periodic site visit and review/monitor quality and progress of works and advise the PIU about corrective measures (if required) or report PMU for any support.
- viii. Assist PIU team in development and monitoring of quality control/assurance programme for the project.

C. Executive Engineer, PWRD:

The Executive Engineer, PWRD will be responsible for:

- i. Review of working drawings, BOQ of all the Project Roads under the project with respect to defined scope of works as per the Contract with applicable Standards/Specifications.
- ii. Review of Work Programme and Contractor’s Planning and suggest for necessary correction, amendment time to time.
- iii. Confirm quality of works and materials for the project roads under their project through the deployed assistants and Approve mix designs for bituminous and concrete works.
- iv. Ensure all contractual compliances of the Contractors on site and confirm adequacy of Contractor’s resources (Manpower/ Machinery/ Equipment/ Materials/ Establishment) deployed/ available at site with periodic review of its ability/ performance.
- v. Ensure adequate sampling of construction materials and testing thereof in the inside/ outside laboratories as per test frequency specified in applicable Standards/ Specifications.
- vi. Review progress/ quality reports and test results produced by support staff and compile thereof for all roads section.
- vii. Responsible for checking of road geometrics, verify all survey records, check surface profile, check structural work and all works related to quality control of the project roads.
- viii. Monitor daily activities and performance of support staff working under the project and confirm adequacy of work on site.
- ix. Preparation of monitoring and quality control report on daily/ monthly/ quarterly basis and submit to the Superintending Engineer within provided timeline.
- x. Monitor road safety audits of critical components during construction or before opening of roads for traffic.
- xi. Ensure fulfilment of Environmental Management Plan of the project.
- xii. Close coordination with the Assistant Executive Engineer & his team and the Contractor with all reporting to the Superintending Engineer. Conduct monthly review meetings to

track progress and resolving issues.

- xiii. Assist Superintending Engineer in performing his assigned duties.

D. Assistant Executive Engineer, PWRD:

The Assistant Executive Engineer, PWRD and his team of Section Officers/ Assistant Engineers and Junior Engineers will be responsible for:

- i. Assisting Executive Engineer in performing his assigned duties.
- ii. Assistant Executive Engineer will act as the immediate supervisory authority over Section Officers/ Assistant Engineers and Junior Engineers.
- iii. For Road Works:
 - a) Checking and review of typical Cross Section of the roads including cross-drainage works (Bridges/Culvert) and its elements applicable for all project roads as per the standards/specifications.
 - b) Checking road geometrics, verifying all survey records, checking surface profile and all other aspects related to pavement construction adhering to the contract/approved drawings.
 - c) Checking and review of Geometric Design (Horizontal and Vertical Design), Alignment Report (HAR & VAR), intersection design as per the codes and specifications and bringing the shortfalls in the knowledge of Resident Engineer.
 - d) Review and checking of Bill of Quantities (BoQ) with respect to the Geometric Design and typical cross-section/working drawings.
 - e) Review of road furniture drawings such as Traffic Signages, marking and Road appurtenances drawings (Protection work etc.)
 - f) Checking of curve layout and superelevation provided at site with respect to Geometric Design as per working drawing.
 - g) Ensure execution of all items/works of the project roads with approved construction materials and working drawing in compliance with standards/specifications.
 - h) Special emphasis on Road Safety during construction and bringing the shortfalls in knowledge of Resident and the Client.
- iv. For Bridge/ Structure Works:
 - i) Review and checking of Cross Drainage Proposal as per the site and improvement proposal for the road.
 - j) Review and checking of Cross Drainage Drawings, Drawings of Culvert, Drawings of Major and Minor Bridge as per the code and specifications.
 - k) Review of BoQ of Bridges/Cross Drainage Structures.
 - l) Review of Proposed Protection work design and drawings.
 - m) Verify site work according to the contract/working drawings of bridges and culverts, checking dimensions, checking the adequacy of formwork and concreting.
- v. Checking of Laboratory establishment and available testing facilities as per the Contract/MORTH specifications.
- vi. The adequacy of site laboratory, calibration details of equipment, testing records etc.

- vii. Maintain quality registers documenting test results, site inspections, and corrective actions.
- viii. Carry out road safety audits of critical components during construction or before opening of roads for traffic.
- ix. Review the records related to fulfilment of Environmental Management Plan of the project.
- x. Ensure all compliances as per the environmental regulations/ conditions to environmental clearance and forest land diversion relevant to the project.
- xi. Sample checks of above compliances and those relating to social safeguards.
- xii. Perform all assigned duties with reporting to the Executive Engineer.

E. Section Officers/ Assistant Engineers and Junior Engineers, PWRD:

The team of Section Officers/ Assistant Engineers and Junior Engineers will be responsible for:

- i. Assist Assistant Executive Engineer in performing his assigned duties.
- ii. Perform day-to-day site supervision and ensure execution of all items/works of the project roads with approved construction materials and working drawing in compliance with standards/specifications.
- iii. Carry out physical tests on samples including destructive and non-destructive tests on completed and ongoing works.
- iv. Maintain site diaries with detailed records of material usage and workmanship.
- v. Report deviations immediately to Assistant Executive Engineer/ higher authorities.

Section 3: Approach and Methodology

3.1. General

The Project Implementation Units (PIU) is to monitor the periodic performance and ensure high standards of quality assurance of the works for road/ bridge segments under Assam Mala 3.0 by conducting technical audit of the quality of civil works being executed at site and submit the findings of such audits to the Project Management Unit (PMU) for taking further necessary actions in accordance with the Agreement.

In order to meet the main objective of Quality control, the PIUs during construction of all road/ bridge segments to ensure that all works are carried in full compliance with the engineering design, technical specifications, agreement and also keeping “Best Practices” in vogue. The PIUs will discharge its duties in a fair, impartial and efficient manner, consistent with the highest standards of professional integrity and good industry practice.

3.2. Quality Control Activities

Quality Control is an essential part of any construction Process for ensuring quality. All materials to be used, all methods adopted, and all works performed are strictly to be in accordance with the requirements of the specifications. Quality Control besides leading to construction of improved quality and conformity and ensuring better utilization of materials and timely execution of the project as per Work Programme.

Quality control of civil works is considered as a process, which is based on inspection of daily activities, duly examining quality control records, conducting tests etc. Quality control of ongoing civil works is considered as Process Audit through which adherence to procedures and technical specifications during construction is examined.

Quality Control under the project necessitates conducting technical quality checks of civil works for their adequacy to physical dimensions vis-à-vis approved design and drawings and adherence to of works to quality standards for road works / structures and duly carrying out independent testing of materials and works based on statistical sampling techniques.

The Quality Control activities shall broadly cover the following:

- i. Implementation of planned procedures and methods for Quality Assurance and Quality Plan to achieve the desired quality objective.
- ii. Study and review of documents related to Quality Assurance, Method Statement, quality control tests, source of material, non-conformity management, identification and removal of non-conforming materials, plant operations connected with the project etc. Review of rectification of non-conformities and corrective actions.
- iii. Review of Operation of plants and equipment deployed for the project.
- iv. Calibration status of plants and equipment.
- v. Compliance and corrective action taken on earlier Quality Audit observations.
- vi. Suggestions for improvements and better control for achieving quality objectives.

The Following general procedure to be followed for quality control of project:

- i. The PIU shall interact with the Contractor's Engineer for a common understanding of the scope of work before start of Quality audit.
- ii. Carrying out pre-audit document review.
- iii. Conducting on site Quality audit and note compliance/ clarifications given by the Contractors for non-conformities intimated to them by the PIU/ PWRD.
- iv. Preparing and submitting monthly Quality control reports to the Authority. Audit findings shall generally be evidence based. Copies of all such observations and suggestions shall be communicated to the Contractor and the PWRD for further necessary action.
- v. Carry out inspection of Contractor's equipment, plant, machinery etc. to check their adequacy and operating to produce a quality product.
- vi. Review of calibration of field laboratory equipment including hot mix plant, concrete batching plant etc.
- vii. Review Contractor's working practices in relation to materials receipt, storing, consumption procedures, materials testing, construction methods and documentation system in order to assess whether sound and effective techniques are being employed.
- viii. Review test results/Manufacturer's Test Certificates and/or sources of materials to assess the quality of materials used in works.
- ix. The PIU shall select the test stretches from the uniform sections to have representative samples using statistical sampling techniques for completed roads.
- x. PIU shall adopt non-destructive and/ or destructive methods of field tests in order to assess quality of completed works.
- xi. Observation holes/ test pits shall be excavated using Contractor's resources in order to examine the Density and thickness of pavement layers, collect cores and sample of materials, conduct grading, bitumen contents and other tests as per Specifications in the Contractor's site laboratory.
- xii. Test pits shall be made in progressive manner so that each layer above sub- grade may be examined properly.
- xiii. The PIU shall witness sample field and laboratory testing carried out by the Contractors as per approved QAP and applicable standards namely MoRTH's Specifications for Road and Bridge Works (5th Rev.) published by Indian Roads Congress (IRC).
- xiv. For testing of construction materials at field laboratory, the sampling of materials shall be done jointly with Contractor/ Representative of PWRD. Sampling of the materials shall be done with the assistance and facility available with the Contractor.
- xv. Material samples for outside laboratory testing shall be sealed in presence of representatives of Contractor and forwarding letter shall be given to the Contractor who will carry the sample and submit it to the approved laboratory.

- xvi. Site inspection of construction activities of structures shall be carried out as per approved QAP along with the Contractor.
- xvii. The PIU shall also carry out independent testing of materials and works in progress.
- xviii. Post conducting technical audit of on-going works and review of test reports, the PIU shall prepare the reports which would form part of Monthly reports. Based on the Quality check findings, the PIU shall suggest improvements, rectifications etc. in the reports.
- xix. The standard formats for recording various test values shall be in accordance with the pertinent IRC and BIS Standards and approved QAP.
- xx. The PIU shall take physical measurements and dimensions and geometrical features of the completed works on random basis for their adequacy to approved design and drawings.
- xxi. The PIU shall conduct pre-opening safety audit of road segments as per standard guidelines and suggest improvements, if any.

3.3. Reporting

The PIU shall be submitting the following Reports:

3.3.1. Monthly Reports

The PIU, no later than the 10th of each month, prepare a brief progress report summarizing the work accomplished by each of the monitoring teams for the preceding month. The report will outline any problems encountered (administrative, technical or financial) and give recommendations on how these problems may be overcome. Brief work progress summaries will be included for ongoing road and bridge works, outlining problems encountered and recommending solutions.

3.3.2. Quarterly and Periodic Reports

The PIU will prepare a comprehensive report summarizing all activities under the services at the end of each quarter, and also at other times when considered warranted by the PMU because of delay of the construction works or because of the occurrence of technical or contractual difficulties. Such reports shall summarize not only the activities of the civil contractor and the Client's Representative but also the progress of the Contracts, all contract variations and change orders, the status of Contractor claims, if any, brief descriptions of the technical and contractual problems being encountered and other relevant information for each of the ongoing contracts.

Quarterly reports consisting of the summary of observations made during the previous quarter which will be structured for the project as a whole. This report to list out technical issues observed, non-compliance cases and corrective measures recommended, including action taken by the implementing agencies on the recommendations.

3.3.3. Final Completion Report

The PIU will prepare a comprehensive final Completion Report for each of the packages, which reaches a stage of substantial completion during the period of the services. These reports which must be submitted immediately after the Taking Over of each contract shall summarize the method of construction and the construction supervision.

Section 4: Quality Control Tests - Frequency, Procedure & Formats

4.1 General

The standard formats for recording various test values shall be in accordance with the pertinent IRC and BIS Standards.

The relevant standards for materials, as well as the testing procedures, which shall be generally adopted while conducting technical checks are in accordance with MoRTH's Specifications for Road and Bridge Works (5th Rev.) published by Indian Roads Congress (IRC).

Formats given in relevant codes and MoRTH's Specifications for Road and Bridge Works (5th Rev.) shall be generally used for recording test results.

However, submitting the Quality Control activities in monthly and subsequent reports are given in the formats shown in Section 4.3.

4.2 Frequency of Quality Control Tests

The various Tests & their frequency should be maintained as per table mentioned below:

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
1. Original Ground as Embankment foundation: -				
a)	MDD & OMC (By heavy compaction)	IS:2720 (Part 8)	1 test/ 3000sqm	MDD not less than 15.2 kN/cum.
b)	Moisture content during field compaction	IS:2720 (Part 2)	Frequently (speedy tester/nuclear meter)	+1% to –2 % of OMC (for expensive clay on wet side of OMC)
c)	Free swell index	IS:2720 (Part 40)	As directed by E - in - C	Soils with FSI more than 50% shall not be used as fill material as per Cl. 4.4.2 of IRC 36-2010
d)	Degree of compaction (Sand Replacement Method)	IS:2720 (Part 28)	10 test/1000sqm	95% (90% for expensive clay)
e)	Test for high embankment	Special specification	As required	Special. Specification.
Note: Testing Register Shall be maintained for ensuring frequency of tests.				
2. Original Ground as Subgrade (500mm thick)				
a)	MDD & OMC (By heavy compaction)	IS:2720 (Part 8)	1 test/ 3000sqm	MDD not less than 17.5kN/cum
b)	CBR at 97% MDD	IS:2720 (Part 16)	1 test/ 3000sqm	As in Special. Specification.
c)	Maximum Particle size	IS:2720 (Part 4)	Frequently	50mm
d)	Moisture content during field compaction	IS:2720 (Part 2)	Frequently	+1% to –2 % of OMC
e)	Degree of compaction (Sand Replacement Method)	IS:2720 (Part 28)	1 test/ 1000sqm	97%
Note: Testing Register Shall be maintained for ensuring frequency of tests.				

3. Unsuitable Materials (in embankment foundation filling)				
Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
a)	Soil classification	IS:1498	1 per source	Soil classification as OL, OI, OH, or Pt
b)	Free swell index of expansive clay	IS:2720 (Part 40)	1 per source	Exceeding 50%
c)	Liquid limit of clay	IS:2720 (Part 5)	1 per source	Exceeding 70%
d)	Plastic index of clay	IS:2720 (Part 5)	1 per source	Exceeding 45%
e)	Visual inspection	Visual	1 per source	Swamps, marshes, bogs, vegetation, debris, frozen, combustible & salty.
f)	Depth of removal from existing ground		As directed by the Engineer	Min 500mm
Note: Material Register Shall be maintained for record.				
4. Earthwork (MoRTH Specifications clauses 903 & 305)				
a)	Grain size Analysis/ sand content	IS 2720 (Part 4)	Frequently/ 2 test per 3000 cum	75mm
b)	Liquid limit and plasticity Index	IS 2720 (Part 5)	Two tests per 3000 Cum.	Max 50% and Max 25% respectively
c)	Optimum Moisture content/ Maximum dry density relation (by heavy compaction)	IS 2720 (Part 8)	Two Tests per 3000 Cum.	MDD not less than 15.2 kN /Cum up to 3m ht. & 16KN/Cum for exceeding 3m.
d)	Free swell index (Expansive clay)	IS 2720 (Part 40)	One per grid	Max. 50% (MoRTH clause 305.2.1.2)
e)	Deleterious content - Organic Matter - Soluble Matter	IS 2720 (Part 22) & IS 2720 (Part 27) respectively	As and when required by Engineer (Borrow Area)	As per MoRTH Specifications Cl. 305.2.13 and IRC SP 11-1998 Organic Matter-1% Sodium Sulphate-0.2%
f)	Specific gravity	IS 2720 (Part 3)	As and when required by Engineer	

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
g)	Soluble sulphate content	BS 1377 Test 10	As and when required by Engineer	As per MoRTH specifications clause 305.2.1.3
h)	Moisture Content during field compaction	IS 2720 (Part 2)	Two Test per 3000sqm	+1% to –2 % of OMC
i)	Field Density	IS 2720 (Part 28)	1 Set of ten measurements per 3000 sqm	Mean density is not less than the specified density plus $[1.65 - 1.65 / (\text{No. of Samples}) 0.5]$ times the Standard Deviation & Relative compaction as 95% of M.D.D As per table 300-2 of MoRTH Specifications.

Note: Material Register Shall be maintained for ensuring frequency of tests.

5. Additional test on material for Embankment filling under water

(a)	Gradation	IS 2720 (Part 4)	1 test per batch	Well graded granular
(b)	Max size	IS 2720 (Part 4)	1 test per batch	75mm
(c)	Plasticity	IS 2720 (Part 5)	1 test per batch	Non plastic
(d)	Uniformity coefficient	IS 2720 (Part 4)	1 test per batch	Min 10

Note: Material & Testing Register Shall be maintained for ensuring frequency of tests.

6. Rock fill Embankment

(a)	Material quality	Visual	1 test per source or batch	Hard, durable & inert
(b)	Maximum size	Measuring	1 test per source or batch	300mm
(c)	Rock fragments and binding material finer than 125mm	Sieving	frequently	Max 10%

Note: Material & Testing Register Shall be maintained for ensuring frequency of tests.

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria			
7. Backfilling to Sub-Surface drains							
(a)	Grading of filler material NOTE: I) Use class I filter if soil in trench is fine grained (e.g. Silt, clay or mixture thereof ii) use class II filter if soil in trench is coarse silt to medium sand or sandy type iii)use class III filter if soil in trench is gravelly sand	IS 2720 (Part 4)	Each batch	Sieve size	% passing		
				Class I	Class II	Class III	
				53mm	-	-	100
				45mm	-	-	97-100
				26.5mm	-	100	-
				22.4mm	-	95-100	58-100
				11.2mm	100	48-100	20-60
				5.6mm	92-100	28-54	4-32
				2.8mm	83-100	20-35	0-10
				1.4mm	59-96	-	0-5
				710mic	35-80	6-18	-
				355mic	14-40	2-9	-
				180mic	3-15	-	-
				90mic	0-5	0-4	0-3
(b)	Size of holes in perforated pipe		Each batch	Less than D85 size of material surrounding pipe.			
Note: Material & Testing Register Shall be maintained for ensuring frequency of tests.							
8. Sand fill as Embankment Layer							
(a)	Earth work/ Gradation/Sieve Analysis	IS 2720 (Part-4)	2 test/3000 m ³	Size of Coarse Material less than 75mm			

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(b)	Atterberg Limits	IS 2720 (Part-5)	2 test/3000 m ³	LL<50% & PI <25
(c)	MDD & OMC Test	IS 2720 (Part-8)	2 test/3000 m ³	>15.2 KN/m ³ (Embankment Height 3m)
(d)	Moisture Content	IS 2720 (Part-2)	2 test/3000 m ³	-2% to +1% of OMC
(e)	CBR	IS 2720 (Part-16)/ASTM	1 test/3000 m ³	As required
(f)	Free Swell Index	IS 2720 (Part-40)	1 test/3000 m ³	<50%
(g)	Field Density Compaction for Embankment (Sand Replacement Method)	IS 2720 (Part-28) & ASTM D6938	1 test/3000 m ³	>95% of MoRTH Cl. 903.2.2
(h)	Sand filling/Relative Density	IS 2720 (Part-14)	1 test /Source	
(i)	Field Density Compaction for Embankment	IS 2720 (Part-28) & ASTM D6938	1 test /Source	75-80% of Lab MDD
Note: Material Register Shall be maintained for ensuring frequency of tests.				
9. Sub Grade (MoRTH specifications clauses 903 & 305)				
a)	Grain size Analysis/sand content	IS 2720 (Part 4) & MoRTH Clause 05.2.1.4	Frequently/two tests per 3000cum.	50mm
b)	Liquid limit and plasticity Index	IS 2720 (Part 5)	Two Tests per 3000 cum.	Max 50% and 25% (As per T.S.)
c)	Optimum Moisture content/Max dry density relation	IS 2720 (Part 8)	Two Tests per 3000 Sqm.	MDD not less than 17.5KN/Cum As per Table 300-1 of MoRTH Specifications
d)	Deleterious content - Organic Matter - Soluble Matter	IS 2720 (Part 22) & IS 2720 (Part 27) respectively	As and when required by Engineer	As per MoRTH Specifications Cl. 305.2.1.3 & IRC SP 11-1998 Organic Matter- <1% Sodium Sulphate- <0.2%

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
e)	CBR	IS 2720 (Part 16)	One Test per 3000 Cum or closer as when required by the Engineer	Not less than the design C.B.R value of 7% at 97 % of M.D.D (4 Days-Soaked value)
f)	Specific gravity	IS 2720 (Part 3)	As and when required by Engineer	-
g)	Soluble sulphate content	BS 1377 Test 10	As and when required by Engineer	As per MoRTH specification clause 305 .2.1.3
h)	Moisture Content	IS 2720 (Part 2)	Two Test for 3000 Cum.	+1% to –2 % of OMC
i)	Field Density	IS 2720 (Part 28)	One set of Ten measurements per 2000 sqm.	Mean density is not less than the specified density plus [1.65 –1.65 / (No. of Samples) 0.5] times the Standard Deviation. Relative compaction as 97% of M.D.D. As per table 300-2 of MoRTH Specifications.
Note: Material Register Shall be maintained for ensuring frequency of tests.				
10. Granular Sub-base (MoRTH Specifications Clause 401 & Table 900-3)				
a).	Gradation i) Filter Layer, ii) Drainage Layer	IS 2386 (Part 1)	One test per 400 cum.	As per Table 400-1 of MoRTH Specifications (Required Grading)
(b).	Atterberg's Limits	IS 2720 (Part 5)	One Test per 400 cum.	Liquid limit not greater than 25% & PI not greater than 6%
(c).	OMC & MDD using heavy proctor	IS 2720 (Part 8)	As required	-
(d).	Deleterious constituents	IS 2386 (Part -II)	As required by	Organic Matter- <1.0%

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
			Engineer	Sodium Sulphate- <0.2%
(e).	CBR at 98% compaction	IS 2720 (Part 16)	As required by Engineer	Not less than 30%, otherwise specified in contract.
(f).	Wet AIV	IS 5640, MoRTH Specification Cl. 401.2.2	One test per Source, if Water Absorption tested as per (g) exceeds 2%	Not greater than 40%
(g).	Water Absorption	IS 2386 (Part 3)	1 per 400 cum.	Not greater than 2%. If the value is more than 2% Wet AIV to be carried out.
(h).	10% Fine Value (Wet)	BS: 812 (Part 3)	1 per 400 cum.	Min 50 kN
(i).	Moisture content prior to compaction	IS 2720 (Part 2) Speedy Tester/ Nuclear meter	One test per 400 cum.	+1% to -2% of O.M.C
(j).	Density of compacted layer	IS 2720 (Part 8)	One test per 1000 m ² .	Mean density is not less than the specified density plus [1.65 -1.65 / (No. of Samples) 0.5] times the standard deviation. Relative compaction as % of M.D.D not less than 98.

Note: Material Register Shall be maintained for ensuring frequency of tests.

11. Water Bound Macadam (MoRTH Specifications Clause 404 & Table 900-3)

(a)	Aggregate Impact Value	IS: 2386 (Part-4) or IS:5640	One test per 1000m ³	30% Max as per MoRTH Table 400-8
(b)	Aggregate Abrasion Value	IS: 2386 (Part-4) or IS:5640	One test per 1000m ³	40% Max MoRTH Table 400-8 Either AIV or Abrasion value to be tested
(c)	Grading	IS: 2386 (Part-1)	One test per 250m ³	As per MoRTH Tables 400-9 & 400-10

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(d)	FI & EI (Combined)	IS: 2386 (Part-1)	One test per 500m ³	35% Max MoRTH Table 400-8
(e)	Atterberg limits for binding material	IS 2720 (Part-5)	One test per 50m ³ of binding material	PI= 6% Max as per MoRTH Cl. 404.2.7
	Atterberg limits of screenings	IS 2720 (Part-5)	One test per 100m ³ of Aggregates	Liquid Limit= 20 Max and PI= 6% Max as per MoRTH Cl. 404.2.6
(f)	Water Absorption	IS: 2386 (Part-3)	One test per Source	2% Max
(g)	Soundness (if water absorption exceeds 2%) 5 cycles with Na ₂ SO ₄	IS: 2386 (Part-V)	One test per source	Max 20% (As per IS 6579)
(h)	Soundness (if water absorption exceeds 2%) 5 cycles with MgSO ₄	IS: 2386 (Part-V)	One test per source	Max 30% (As per IS 6579)
(i)	OMC & MDD (By heavy compaction)	IS 2720 (Part 5)	One test per 200m ³	-
(j)	Moisture content during compaction at site	IS 2720 (Part 2) Speedy Tester/ Nuclear meter	As required	Within -1% to +2% of the OMC may be accepted (however there is no accepted method of comparison between laboratory compaction and field compaction)
(k)	Density of Compacted layer	MoRTH Specs. Cl. 404	-	For Coarse Aggregates , compaction shall continue till the road metal is partially compacted; For Screenings , compaction shall continue until no more screenings can be forced into voids of the coarse aggregates; For Binding Materials , compaction shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(l)	Surface Irregularity	MoRTH Cl. 902.4	As required	8 mm max
(m)	Horizontal alignment	MoRTH Cl. 902.2	As required	-25 mm to + 25 mm
(n)	Surface levels	MoRTH Table 901	As required	+10 mm to -10 mm (machine laid) +15 mm to -15 mm (manually laid)
(o)	Layer thickness	MoRTH Cl. 902.3	As required	As per approved drawing, such that wearing course thickness is not reduced, as detailed in MoRTH Cl. 902.3

Note: Material Register Shall be maintained for ensuring frequency of tests.

12. Wet Mix Macadam (MoRTH Specifications Clause 406 & Table 900-3)

(a)	Aggregate Impact Value	IS: 2386 (Part-4) or IS:5640	One test per 1000m ³	30% Max as per MoRTH Table 400-12
(b)	Aggregate Abrasion Value	IS: 2386 (Part-4) or IS:5640	One test per 1000m ³	40% Max MoRTH Table 400-12 Either AIV or Abrasion value to be tested
(c)	Grading	IS: 2386 (Part-1)	One test per 200m ³	As per MoRTH Table 400-13
(d)	FI & EI (Combined)	IS: 2386 (Part-1)	One test per 500m ³	35% Max MoRTH Table 400-12
(e)	Atterberg limits of portion of aggregate passing 425-micron sieve.	IS 2720 (Part-5)	One test per 200m ³	PI= 6% Max as per MoRTH Cl. 406.2.1.2
(f)	Water Absorption	IS: 2386 (Part-3)	One test per Source	2% Max
(g)	Soundness (if water absorption exceeds 2%) 5 cycles with Na ₂ SO ₄	IS: 2386 (Part-V)	One test per source	Max 12%
(h)	Soundness (if water absorption exceeds 2%) 5 cycles with MgSO ₄	IS: 2386 (Part-V)	One test per source	Max 18%

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(i)	OMC & MDD (By heavy compaction)	IS 2720 (Part 5)	One test per 200m ³	-
(j)	Moisture content during compaction at site	IS 2720 (Part 2), Calcium Carbide Method (Rapid Moisture Meter)	1 test per 250 cum, 3 tests daily or as required	Within -1% to +2% of the OMC may be accepted (however there is no accepted method of comparison between laboratory compaction and compaction at site)
(k)	Density of Compacted layer	IS:2720 (Part-8)	One set of 3 tests per 1000m ²	98% of MDD or Mean is not less than specified density or Specified density + $S * (1.65 - 1.65/N^{1/2})$
(l)	Surface Irregularity	MoRTH Cl. 902.4	As required	8 mm max
(m)	Horizontal alignment	MoRTH Cl. 902.2	As required	-25 mm to + 25 mm
(n)	Surface levels	MoRTH Table 901	As required	+10 mm to -10 mm (machine laid) +15 mm to -15 mm (manually laid)
(o)	Layer thickness	MoRTH Cl. 902.3	As required	As per approved drawing, such that wearing course thickness is not reduced, as detailed in MoRTH Cl. 902.3

Note: Material Register Shall be maintained for ensuring frequency of tests.

13. Prime Coat/Tack Coat

(a)	Quality of binder	IS:73, IS:217, IS: 8887	As Required	Bitumen emulsion/Bitumen 80/100 respectively
(b)	Rate of spread of Binder	IS: 8887	3 tests per day	Primer – as per MoRTH Table 500-3 & 500-4 Tack coat – as per MoRTH Table 500-5
(c)	Binder Temperature of application	IS: 8887	At regular close Interval	For Bitumen emulsion 20 – 70°C & For cutback- 50 – 80°C.

Note: Material & Testing Register Shall be maintained for ensuring frequency of tests.

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
14. Quality of Bitumen (IS: 1201 to IS: 1220)				
(a)	Flash Point Test	IS: 1209	Every Consignment	As per IS: 73-2013
(b)	Penetration at 25°C	IS: 1203	Every Consignment	As per IS: 73-2013
(c)	Absolute Viscosity at 60°C	IS: 1206 Part 2	Every Consignment	As per IS: 73-2013
(d)	Kinematic Viscosity at 135°C	IS: 1206 Part 2	Every Consignment	As per IS: 73-2013
(e)	Softening Point, °C	IS: 1205	Every Consignment	As per IS: 73-2013
(f)	Suitability in Trichloroethylene	IS: 1216	Once per source	As per IS: 73-2013
(g)	Specific Gravity	IS: 1202	Every Consignment	As per IS: 73-2013
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.				
15. Bituminous Macadam (MORTH Specifications Clause 504)				
(a)	Quality of binder	IS: 73, IRC: SP 53, IS: 15462	2 No's of samples per lot or As Per IS: 73	Special Specification.
(b)	Grain size analysis	IS: 2386 (Part-1)	One test per 350 m ³	Max. 5% passing through 0.075-micron sieve.
(c)	Impact value	IS: 2386 (Part-4)	One test per 350 m ³ & whenever there is change in the quality of aggregates	30% Max
(d)	Abrasion Value	IS: 2386 (Part-4)		40% Max
(e)	FI & EI (Combined)	IS: 2386 (Part-1)	One test per 350 m ³	35 % Max
(f)	Stripping Value	IS: 6241	One per source	Min. retained coating 95%

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria		
(g)	Grading of the aggregates	MoRTH Table 500-7	One set per 400 MT or Min two tests/plant/day	Sieve size	% Passing	
					Grading 1	Grading 2
				45mm	100	-
				37.5mm	90-100	-
				26.5mm	75-100	100
				19.0mm	-	90-100
				13.2mm	35-61	56-88
				4.75mm	13-22	16-36
				2.36mm	4-19	4-19
				0.3mm	2-10	2-10
				0.075mm	0-8	0-8
(h)	Soundness 5 cycles with Na ₂ SO ₄	IS: 2386 (Part-V)	One per source	Max 12%		
(i)	Soundness 5 cycles with MgSO ₄	IS: 2386 (Part-V)	One per source	Max 18%		
(j)	Water Absorption	IS: 2386 (Part-3)	One per source	Max 2%		
(k)	Binder Content of mix	MoRTH Table 500-7	One set per 400 MT or Min two tests/plant/day	As per mix design		
(l)	Density of compacted layer	MoRTH clause 500.3.4	Not less than 98% of lab design density	One test per 700m ²		

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(m)	Layer thickness	Site check	At regular intervals	Special specification
(n)	Control of temperature of binder, aggregates & mix for BM and of the mix at the time of laying & rolling		At regular intervals	MoRTH Table 500-2
(o)	Water sensitivity of Mix	AASHTO T 283	One test for each source & whenever there is a change in quality of Aggregates	As per AASHTO T 283
(p)	Percentage of Fractured Faces	ASTM D5821	One test per 100 cum. of Aggregates	As per ASTM D5821
(q)	Rate of Spread of Mixed Material	As Per Manual for Construction and Supervision of Bituminous Construction	At regular intervals	As per MoRTH Cl. 509.2.3
Note: Material Register Shall be maintained for ensuring frequency of tests.				
16. Dense Bituminous Macadam (MoRTH Specifications Clause 505)				
(a)	Quality of binder (grade VG-30 to VG-40)	IS: 73, IRC SP:53	2 per lot	No. of Sample per lot and test as per IS 73 or IRC SP 53, IS 15462
(b)	Grain size analysis	IS: 2386 (Part-1)	One test per 350 m ³	Max. 5% passing through 0.075-micron sieve.
(c)	Impact value	IS: 2386 (Part-4)	One test per 350 m ³ & whenever there is change in the quality	27% Max
(d)	Abrasion Value	IS: 2386 (Part-4)		35% Max

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria		
(e)	FI & EI (Combined)	IS: 2386 (Part-1)	of aggregates	35 % Max		
(f)	Stripping Value	IS: 6241	One per source	Min retained coating 95%		
(g)	Soundness 5 cycles with Na ₂ SO ₄	IS: 2386 (Part-V)	One per source & whenever there is change in the quality of aggregates	Max 12%		
(h)	Soundness 5 cycles with Mg SO ₄	IS: 2386 (Part-V)		Max 18%		
(i)	Water Absorption	IS: 2386 (Part-3)		Max 2%		
(j)	Sand equivalent value	IS: 2720 (Part-37)		Not less than 50		
(k)	Grading of the mix	MoRTH Table 500-17	One set per 400 MT or Min two tests/plant/day	As per mix design		
(l)	Job mix Formula	Mix design	Every change of material	As per mix design		
(m)	Requirements of mix	ASTM D 1559	Each mix design	Sl. No.	Description	Requirement
				1.	Marshall stability	Min 900 Kg
				2.	Marshall flow	2 - 4 mm
				3	Air voids	3 – 5%
				4.	VMA	As per MoRTH Table 500-12
				5	VFB	65% - 75%
				6.	Binder content	Min 4%
(n)	Permissible variations from job mix	Bitumen extraction &	2 tests per day	Sl. No.	Description	variation

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria		
	Formula (JMF) by weight of total mix in percentage	sieving (Table 500-13 of MORTH Specifications, 5th Revision)		1.	Agg. Passing 19mm or larger	± 8%
				2.	Agg. Passing 13.2mm & 9.5mm	± 7%
				3.	Agg. Passing 4.75mm	± 6%
				4.	Agg. Passing 2.36, 1.18 & 0.6mm	± 5%
				5.	Agg. Passing 0.3 & 0.15mm	± 4%
				6.	Agg. Passing 75micron	± 2%
				7.	Binder content	± 0.3%
				8.	Mixing temperature	± 10°C
(o)	Control of binder content and gradation of the mix	Bitumen extraction & sieving	2 tests per day per plant	Job mix formula.		
(p)	Density of compacted layer		One test per 700m ²	Equal to or more than 92% of the G _{mm} obtained on the day of compaction in accordance with ASTM D 2041.		
(q)	Control of temperature of binder & aggregates for mix and of the mix at the time of laying & rolling		At regular intervals	MoRTH Table 500-2		

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(r)	Rate of spread of mix	Site check		After every 5 th truck load
(s)	Layer thickness	Site check	At regular intervals	Special specification
(t)	Moisture Susceptibility of Mix	AASHTO T 283	One test for each mix type whenever there is change in the quality or source of coarse or fine aggregate	As per AASHTO T 283
(u)	Plasticity Index	IS:2720 (Part 5)	One test for each source and whenever there is change in the quality of aggregate	MoRTH Cl. 501.2.3
(v)	Polished Stone Value	BS:812-114	One test for each source and whenever there is change in the quality of aggregate	Min 55 (As per MoRTH Table 500-16)
(w)	Percentage of Fractured Faces	ASTM D5821	One test per 100 cum. of Aggregates	As per ASTM D5821
(x)	Stability and voids analysis of mix including theoretical maximum specific of loose mix	MoRTH Specs. Table 900-4, ASTM D6927 and AASHTO T 245	Three tests for stability, flow value, density and void contents	As per ASTM D6927 and AASHTO T 245

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
			for each 400 tonnes of mix subject to minimum of two tests per day per plant	
Note: Material Register Shall be maintained for ensuring frequency of tests.				
17. Bituminous Concrete (MoRTH Specifications Clause 507)				
(a)	Quality of binder	IS: 73	2 tests per lot	Special specification
(b)	Grain size analysis	IS: 2386 (Part-1)	One test per 350 m ³	Max. 5% passing through 0.075-micron sieve.
(c)	Impact value	IS: 2386 (Part-4)	One test per 350 m ³ & whenever there is change in the quality of aggregates	24 % Max
(d)	Abrasion Value	IS: 2386 (Part-4)		30% Max
(e)	FI & EI (Combined)	IS: 2386 (Part-1)		35 % Max
(f)	Coating & Stripping Value	IS: 6241, AASHTO T:182	One per source	Min retained coating 95%
(g)	Soundness 5 cycles with Na ₂ SO ₄	IS: 2386 (Part-V)	One test per source & whenever there is change in the quality of aggregates	Max 12%
(h)	Soundness 5 cycles with Mg SO ₄	IS: 2386 (Part-V)		Max 18%
(i)	Water Absorption	IS: 2386 (Part-3)		Max 2%
(j)	Stone Polishing Value	BS 812 (Part 114)		Min 55
(k)	Grading of the mix Aggregates	IS: 2683 (Part 1)	One set per 400MT Min two	MoRTH Table 500-17

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria		
			tests/plant/day			
(l)	Binder Content	Bitumen extraction & sieving	2 tests per day/plant	Job mix formula.		
(m)	Job mix Formula	Mix design	Every change of material	As per mix design		
(n)	Requirements of mix	ASTM D 1559	Each mix design	S. No.	Description	Requirement
				1.	Marshall stability	Min 900kg
				2.	Marshall flow	2 -4 mm
				3	Air voids in mix	3 – 5%
				4.	VMA	11% -13%
				5	VFB	65% - 75%
				6.	Binder content	Min 5.2%
				7.	Water sensitivity	Min 80%
(o)	Density of compacted layer	Density of core	One test per 700m ²	Equal to or more than 92% of the G _{mm} obtained on the day of compaction in accordance with ASTM D 2041.		
(p)	Permissible variations from job mix Formula (JMF) by weight of total mix in percentage	Bitumen extraction & sieving (Table 500-13 of MORTH Specifications, 5th	2 tests per day	Sl. No.	Description	variation
				1.	Agg. Passing 19mm or larger	± 7%

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria		
		Revision)		2.	Agg. Passing 13.2mm & 9.5mm	± 6%
				3.	Agg. Passing 4.75mm	± 5%
				4.	Agg. Passing 2.36, 1.18 & 0.6mm	± 4%
				5.	Agg. Passing 0.3 & 0.15mm	± 3%
				6.	Agg. Passing 75micron	± 1.5%
				7.	Binder content	± 0.3%
				8.	Mixing temperature	± 10°C
(q)	Stability of Mix	Asphalt Institute MS-2	One set per 400 MT or Min two tests/plant/day	MoRTH Table 500-11		
(r)	Control of temperature of binder & aggregates for mix and of the mix at the time of laying & rolling		At regular intervals	MoRTH Table 500-2		
(s)	Rate of spread of mix		After every 5 th truck load			
(t)	Layer thickness	Site check	At regular intervals	Special specification		

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(u)	Sand equivalent value	IS: 2720 (Part-37)	One per source & whenever there is change in the quality of aggregates	Not less than 50
(v)	Plasticity Index	IS:2720 (Part 5)	One test for each source and whenever there is change in the quality of aggregate	MoRTH Cl. 501.2.3
(w)	Percentage of Fractured Faces	ASTM D5821	One test per 100 cum. of Aggregates	As per ASTM D5821
(x)	Stability and voids analysis of mix including theoretical maximum specific of loose mix	MoRTH Specs. Table 900-4, ASTM D6927 and AASHTO T 245	Three tests for stability, flow value, density and void contents for each 400 tonnes of mix subject to	As per ASTM D6927 and AASHTO T 245

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria		
			minimum of two tests per day per plant			
Note: Material Register Shall be maintained for ensuring frequency of tests.						
18. Dry Lean Cement Concrete Subbase (MoRTH Specifications Clause 601)						
(a)	Cement (physical and chemical tests)	IS 269, 455, 1489, 8112, 12269	1 Per source of supply occasionally for long or improperly stored batch also manufacture`s certificate	As per relevant IS code		
(b)	Coarse and fine aggregate gradation	IS:2386 (PART1), Table 600-1 of MoRTH Specifications	1 per day	Sieve size	% passing	Remarks
				26.5mm	100	
				19.0mm	75-95	
				9.5mm	50-70	
				4.75mm	30-55	
				2.36mm	17-42	
				600mic	8-22	
				300mic	7-17	
				150mic	2-12	
				75mic	0-10	

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(c)	Deleterious constituent in aggregate	IS:2386 (PART2), Table 600-2 of MoRTH Specifications	1 per day	IS:383-2016, Table 600-2 of MoRTH Specifications
(d)	Water absorption of Coarse Aggregate	IS:2386 (PART3), Cl. 602.2.6.2 of MoRTH Specifications	Regularly as required	Max 2%
(e)	LAA or AIV of coarse aggregate	IS:2386 (PART3), Cl. 602.2.6.2 of MoRTH Specifications	1/source per month	LAA max 35%; AIV max 30%
(f)	Soundness in sodium sulphate	IS:2386 (PART5), Cl. 602.2.6.2 of MoRTH Specifications	1/source per month	Max 12 %
(g)	Alkali aggregate reactivity (For CA & FA)	IS:2386 (PART7), Cl. 601.2.4.1 of MoRTH Specifications	1/source per month	Non-reactive
(h)	PH value of water	Cl. 1010 of MoRTH Specifications	1 per source	Min. 6
(i)	Titration of water with 0.2N H ₂ SO ₄ (using mixed indicator)	Cl. 1010 of MoRTH Specifications, IS:3025(Part 23).	1 per source	Max. 25ml H ₂ SO ₄ for 100ml water
(j)	Titration of water with 0.2N NaOH (using phenolphthalein as an Indicator)	Cl. 1010 of MoRTH Specifications, IS:3025(Part 22).	1 per source	Max. 5ml NaOH for 100ml water
(k)	Solids in water	IS:3025, Cl. 1010 of MoRTH Specifications	1 per source	Max. limits per liter Organic -200mg/l (IS:3025, Pt-18); Inorganic – 3000mg/l (IS:3025 Pt-18), Sulphate – 400mg/l (IS:3025 Pt-28), Chloride – 500mg/l (IS:3025 Pt-32), Suspended matter 2000mg/l (IS:3025 Pt-17)

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(l)	Concrete cube test (7 day)	IS: 516, MoRTH Specification Cl. 903.5.1.1 & Cl. 601.3.4	3 Samples/ 1000 sqm. m	Min 7.5 MPa (Individual Strength) at 7-day age and Min 10 MPa (Average Strength) at 7-day age for each consecutive group of 5 cubes made in accordance with MoRTH Specification Cl. 903.5.1.1 (Ref. Cl. 601.3.4 of MoRTH Specification)
(m)	Core strength on hardened concrete	IS 1199 & IS: 516	In case of doubt	85% of cube strength of the grade of concrete (Avg. Strength), 75% (Individual Strength) As per Cl. 17.4 of IS: 456 (2000)
(n)	Thickness measurement of trial length	Core sampling (Ref. Table 900-6 of MoRTH Specifications)	3 cores per trial	Special specification
(o)	Thickness determination	By The Level Data (Cl. 903.5.1.3 of MoRTH Specifications)	Grid points of 5 or 6.25m * 3.5m	Special specification
(p)	Verification of level of form	Site check (Ref. Table 900-6 of MoRTH Specifications)	5.0m or 6.25m	Variation 2mm
(q)	Mix design a) Max aggregate cement ratio b) Optimum moisture content c) Min cement content d) In-situ density of trial length (wet density)	Trial mix Trial mix Trial mix Sand replacement (Ref. Cl. 01.7 of MoRTH Specifications)	1 per mix 1 per mix 1 per mix 3 per trial	15:1 - 150 kg per cum Avg of 3 tests

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(r)	Moisture content while laying	Site check (Ref. Cl. 601.3.2 of MoRTH Specifications)	Frequently	Between OMC and OMC +2%
(s)	Compaction of concrete pavement (wet density)	IS 2720 Pt.-28(Sand Replacement Method)	3 per day	shall not be less than 98 percent of that achieved during the trial length construction (at the edges i.e. 0.5 m from the edge shall not be less than 96 percent) (Ref. Cl. 601.6.5.1 of MoRTH)
19. CEMENT CONCRETE PAVEMENT (MoRTH Specifications 600)				
(a)	Cement (physical & chemical test)	IS: 4031(Physical Tests) & IS: 4032(Cheical Tests)	1 per sources of supply and occasionally for long or improperly stored batch also manufacture`s certificate required	OPC 33 Grade (IS: 269); OPC 43 Grade (IS: 8112); OPC 53 Grade (IS: 12269); Portland slag cement (IS: 455); Portland Pozzolana cement (IS: 1489 Pt.1)
	i) OPC 33 Grade (IS: 269)			
	ii) OPC 43 Grade (IS: 8112)			
	iii) OPC 53 Grade (IS: 12269)			
	iv) Portland slag cement (IS: 455)			
	v) Portland Pozzolana cement (IS: 1489 Pt.1)			
(b)	Silica Fumes (Proportion= 3 to 10%, as per MoRTH Specifications)	IS: 15388, IS: 1727, IS:456, IRC: SP:76 and IRC:44-2008, Cl. 602.2.4 of MoRTH Specifications	As per IS: 15388, IS: 1727 & IS: 6491	As per IS: 15388

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(c)	LAAV or AIV of coarse aggregate	IS:2386 (PART4), MoRTH Specification Cl. 602.2.6.2	1/source per month	LAA max 35%; AIV max 30%
(d)	FI & EI (Combined)	IS: 2386 (Part-1), MoRTH Specification Cl. 602.2.6.2	One test per 500m ³	35% Max (FI & EI Combined w.r.t. MoRTH Cl. 602.2.6.2)
(e)	i) Deleterious constituent in coarse agg.	IS:2386 (PART2), MoRTH Specification Table 600-2	1/source per month	IS: 383 & MoRTH Table 600-2
	ii) Deleterious constituent in fine agg.	IS:2386 (PART2), MoRTH Specification Table 600-2	1/source per month	Clay lumps - 1%, coal & lignite – 1% passing finer than 75mic – 3% (MoRTH Table 600-2)
(f)	Total chloride content in aggregate	BS: 812 (PT17), MoRTH Specification Cl. 602.2.6.1	1 per source	Max 0.06%
(g)	Total sulphate content in aggregate	BS: 812 (PT18), MoRTH Specification Cl. 602.2.6.1	1 per source	Max 0.25%
(h)	Soundness of Coarse Aggregates	IS:2386 (PART 5), MoRTH Specification Cl. 602.2.6.2	1/source per month	Max 12 % if sodium sulphate & 18% magnesium sulphate is used.

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(i)	Water absorption of Coarse Aggregates	IS:2386 (PART3), MoRTH Specification Cl. 602.2.6.2	Regularly as required	Max 2% (Ref. MoRTH Specification Cl. 602.2.6.2)
(j)	Alkali aggregate reactivity (For CA & FA)	IS:2386 (PART7), MoRTH Specification Cl. 602.2.6.1	1/source per month	Non – reactive
(k)	Aggregate gradation	IS:2386 (PART1), MoRTH Specification Cl. 602.2.6.4 & Table 600-3	1/source per month	IS: 383, Table 600-3
(l)	Max size of aggregate	IS:2386 (PART1), MoRTH Specification Cl. 602.2.6.2	1/source per month	31.5mm
(m)	Combined gradation of fine & Coarse agg.	IS:2386 (PART1), MoRTH Specification Cl. 602.2.6.4	1/source per month	As per MoRTH Specification Table 600-3
(n)	Concrete mix design	MoRTH Specification Cl. 602.3.5, IRC-44, IS: 10262	1 per source	a) Min. cement content – 360 kg/m ³ , Max cement content – 450 kg/m ³ b) Max WC ratio – 0.4 c) Compressive strength / flexural strength as per special specification = $F_{ck} / 0.7(F_{ck})^{0.5}$ d) Slump = Up to 50mm (Ref. IRC 44)
(o)	PH value of water	Cl. 1010 of MoRTH Specifications	1 per source	Min. 6

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(p)	Titration of water with 0.2N H ₂ SO ₄ (using mixed indicator)	Cl. 1010 of MoRTH Specifications, IS:3025(Part 23).	1 per source	Max. 25ml H ₂ SO ₄ for 100ml water
(q)	Titration of water with 0.2N NaOH (using phenolphthalein as an Indicator)	Cl. 1010 of MoRTH Specifications, IS:3025(Part 22).	1 per source	Max. 5ml NaOH for 100ml water
(r)	Solids in water	IS:3025, Cl. 1010 of MoRTH Specifications	1 per source	Max. limits per litre Organic -200mg/l (IS:3025, Pt-18); Inorganic – 3000mg/l (IS:3025 Pt-18), Sulphate – 400mg/l (IS:3025 Pt-28), Chloride – 500mg/l (IS:3025 Pt-32), Suspended matter 2000mg/l (IS:3025 Pt-17)
(s)	Concrete cube strength (7 day & 28 day)	IS: 516, MoRTH Specifications Cl. 602.3.3 & Cl. 903.5.2.1	3 Cubes / 150 cum. or 3 cubes per day for each type of Mix (each cube shall be from a different delivery of concrete & paired with a beam)	As per Cl. 602.3.3 of MoRTH Specifications
(t)	Concrete beam flexural strength (3 day & 7 day)	IS: 516, Cl. 903.5.2.1 & Cl. 602.3.3.1 of MoRTH Specifications	3 Beams / 150 cum. or 3 Beams per day for each type of Mix (each beam shall be from a different delivery of concrete & paired with a cube)	Min 4.5 MPa (Unless Specified Otherwise) (Ref. Cl. 602.3.3 of MoRTH Specifications)

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(u)	Core strength on hardened concrete	IS 1199 & IS: 516	In case of doubt	85% of cube strength of the grade of concrete (Avg. Strength), 75% (Individual Strength) As per Cl. 17.4 of IS: 456 (2000)
(v)	Slump test for workability	IS: 1199	1 per dumper initially and 1 per alternate dumper subsequently	25 +/- 15mm (OR As Established by slump tests carried out during trial paving)
(w)	Thickness measurement of trial length	Core sampling (Ref. Table 900-6 of MoRTH Specifications)	3 cores per trial	Special specification
(x)	Thickness determination	By The Level Data (Cl. 903.5.1.3 of MoRTH Specifications)	Grid points of 5 or 6.25m * 3.5m	Special specification
(y)	Verification of level of form	Site check (Ref. Table 900-6 of MoRTH Specifications)	5.0m or 6.25m	Variation 2mm
(z)	Texture depth	Sand Patch Test (At least 2m apart anywhere along a diagonal line across a lane width between points 50 m apart along the pavement. No measurement shall	5 measurements in 50m length	1 +/- 0.25 mm (b/w 24 hr. to 7 day after construction of lab or until the slab is first used by vehicles) 1 +0.25mm/-0.35mm (Not Later than 6 weeks before the road is opened to traffic) Ref. MoRTH Specification Table 600-5(Tolerance) & Cl. 602.12(Test)

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
		be taken within 300 mm of the longitudinal edges of a concrete slab constructed in one pass.)		
Note: Material Register Shall be maintained for ensuring frequency of tests.				
20. Coarse Aggregate for Structures (MoRTH Specification clause 1007 & IS 383- 2016)				
(a)	Grading	MoRTH Specifications Table 1000-1, IS: 383, IS: 2386(Pt. 1)	1per month/ source	As per Table 1000-1 of MoRTH Specifications & As per Table -7 Clause 6.1 & 6.2 of IS 383 -2016
(b)	Estimation of deleterious materials and organic impurities			Table -2 Clause 5.2.1 of IS 383 – 2016, MoRTH Specifications cl. 1007
i.	Coal and Lignite	IS:2386-1963 (Part 2)	One test per source	Max. 1%
ii.	Clay Lumps	IS:2386-1963 (Part 2)	One test per source	Max. 1%
iii.	Material finer than 75 micron	IS:2386-1963 (Part 2)	One test per source & one test per day	Max. 1% (As per IS 383 – 2016)
iv.	Total of all Deleterious Matters	IS:2386-1963 (Part 2)	One test per source	Table -2 Clause 5.2.1 of IS 383 – 2016
(C)	Specific gravity, density, voids, water absorption and bulking	IS:2386-1963 (Part 3)	One test per source	Water absorption max-2% & Specific gravity min-2.50, (As per IS 383 – 2016)

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
(d)	Mechanical properties (AIV& LAA)	IS:2386-1963 (Part 4), IS 383-2016 Clause 5.4.2, MoRTH Specifications Cl. 1007	One test per source	AIV - 45% max for concrete other than wearing surfaces and 30% max for concrete for wearing surfaces. LAAV - 50% max for concrete other than wearing surfaces and 30 % Max for concrete for wearing surfaces, (As per IS 383 – 2016)
(e)	Soundness in Sodium Sulphate and Magnesium Sulphate	IS:2386-1963 (Part 5) IS: 383-2016 Clause 5.4.1 (b)	One test per source	Max. 12% and Max. 18% respectively, (As per IS 383 – 2016)
(f)	Alkali aggregate reactivity	IS:2386-1963 (Part 7) & IS 383-2016 Clause 5.6	One test per source	Innocuous aggregate, (As per IS 383 – 2016)
(g)	Petrographic examination	IS: 2386-1963 (Part 8) & IS:383 – 2016	At the beginning for approval of each source and change of source	Information required for approval of source
(h)	Flakiness Index	IS: 2386-1963 (Part 1), MoRTH Specifications Cl. 1007	One test per source	Not greater than 35% (MoRTH Specifications Cl. 1007)
(i)	Water absorption	IS: 2386 (Part 3), MoRTH Specifications Cl. 1007	One test per source	Max. 2% (As per IS 383 – 2016)
Note: Material Register Shall be maintained for ensuring frequency of tests.				

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
21. Sand/ Fine Aggregate for Structures (MoRTH Specifications Clause 1008 & IS: 383-2016)				
i.	General requirement	Visual inspection	Every batch	Clean, hard & free from deleterious materials except in traces.
ii.	Fineness modulus of fine aggregate	IS: 383 – 2016	One test per day	Min. 2.0 and Max. 3.5 (As per IS 383 – 2016)
iii.	Soundness in Sodium Sulphate and Magnesium Sulphate	IS: 2386 (Part 5)	One test per source	Max. 10% when tested with Na ₂ SO ₄ and Max. 15% when tested with MgSO ₄ respectively. As per Clause 5.5.1 (a) of IS 383 – 2016
(iv)	Deleterious Constituents	IS: 2386 (Part 2)	One test per source	Table -2 Clause 5.2.1 of IS 383 – 2016
a.	Coal and Lignite	IS: 2386 (Part 2)	One test per source	Max. 1%
b.	Clay Lumps	IS: 2386 (Part 2)	One test per source	Max. 1%
c.	Shale	IS: 2386 (Part 2)	One test per source	Max. 1%
d.	Total of all Deleterious Matters	IS: 2386 (Part 2)	One test per source	Max. 5%
v.	Material Passing 75 micron	IS: 2386 (Part 1)	One test per day	Max. 3% for natural sand and 15% for crushed aggregate (Table -2 Clause 5.2.1 of IS 383 - 2016)
vi.	Specific Gravity	IS: 2386 (Part 3)	One test per source	Min 2.5 (As per IS 383 – 2016)
vii.	Water Absorption	IS: 2386 (Part 3)	One test per source	Max. 2% (As per IS 383 – 2016)
viii.	Surface Moisture Content (Free moisture)	IS: 2386 (Part 3)	Two test per day	Max. 5% (As per IS 383 – 2016)
ix.	Total chloride content	BS: 812 (Part 17)	Every batch	Max 0.06% (As per IS 383 – 2016)
x.	Total sulphate content	BS: 812 (Part 18)	Every batch	Max 0.25% (As per IS 383 – 2016)
xi.	Alkali – Aggregate Reactivity	IS: 2386 (Part 7)	One test per source	Innocuous aggregate (As per IS 383 – 2016)
xii.	Grading Requirement	IS: 2386 (Part 1)	One test per day	As per Table 1000-2 of MoRTH Specifications &

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
				Table -9 Clause 6.3
Note: Material Register Shall be maintained for ensuring frequency of tests.				
22. Water (MoRTH Specifications clause 1010)				
i.	pH value	IRC 21-2000	One test per source	Min. 6
ii.	Alkalinity limit by titration using phenolphthalein as an indicator.	IS: 3025 (Part-23)	One test per source	Max. 25 ml of 0.02 normal H ₂ SO ₄ to Neutralize 100ml of water (using mixed indicator)
iii.	Acidity limit by titration using mixed indicator.	IS: 3025 (Part-22)	One test per source	Max. 5 ml of 0.02 normal NaOH to Neutralize 100 ml water (Using Phenolphthalein as indicator)
iv.	Solids in water	IS: 3025 (Pt .18) IS: 3025 (Pt .18) IS: 3025 (Pt .28) IS: 3025 (Pt .17) IS: 3025 (Pt .32)	One test per source	Max limits per liter: Organic – 200 mg/lit; Inorganic – 3000 mg/lit; Sulphate – 400 mg/lit; Suspended matter- 2000 mg per liter. Chloride – 500 mg per liter for prestress/reinforced concrete work
Note: Testing Register Shall be maintained for ensuring frequency of tests				
23. Admixtures (MoRTH Specifications clause 1012)				
i.	Chloride content	IS: 6925 & IS: 9103	One test per batch	Within 10% of the value or within 0.2% whichever is greater as related to the manufacturer
ii.	a) Dry material content	IS: 9103	One test per batch	Within 3% and 5% of liquid and solid admixture respectively of the value stated by the manufacturer
	b) Ash content	IS: 9103	One test per batch	Within 1% of the value stated by the manufacturer
	c) Relative density	IS: 9103	One test per batch	Within 2% of the value stated by the manufacturer

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria		
	d) pH Value	IS: 3025 & IS: 9103	One test per batch	7-8		
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.						
24. Cement (MoRTH Specifications clause 1006)						
(a)	Physical Test			OPC 33	OPC 43	OPC 53
	Fineness					
(i)	Fineness by dry sieving	IS: 269-2015, IS: 4031 Part-1		>90% passing 90 micron IS Sieve	>90% passing 90 micron IS Sieve	-
(ii)	Fineness BAP method	IS: 269-2015, IS: 4031 Part-2	1. At the beginning for approval of each source and change of source 2. Once for every lot 3. once in three months	225	225	225
(iii)	Soundness by ‘Le chatelier’ method	IS: 269- 2015, IS: 4031 Part-3		Not more than 10mm	Not more than 10mm	Not more than 10mm
	and By Auto Clave Method			Not more than 8mm	Not more than 8mm	Not more than 8mm

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria		
(iv)	Initial setting time / Final setting time	IS: 269 -2015, IS: 4031 Part-4, IS: 4031 Part-5		30 minutes/ 600 minutes	30 minutes/ 600 minutes	30 minutes/ 600 minutes
(v)	Compressive strength 3, 7 and 28 days	IS: 269- 2015, IS: 4031 Part-6		Not less than 22.0 Mpa in 7 days & 33 after 28 days	Not less than 33.0 Mpa in 7 days & 43 after 28 days	Not less than 37.0 Mpa in 7 days & 53 after 28 days
(b)	Chemical Test	IS: 4032(Test Procedure)		OPC -33 Grade	OPC -43 Grade	OPC 53 Grade
(i)	Ratio of percentage of lime to percentages of silica, alumina & iron oxide.	IS 269 -2015	1. At the beginning for approval of each source and change of source 2. Once for every lot 3. Once in three months	0.66 -1.02	0.66 -1.02	0.80-1.02
(ii)	Ratio of percentage of alumina to that of iron oxide Min	IS 269 -2015		0.66	0.66	0.66
(iii)	Insoluble residue, percent by mass	IS 269 -2015		5.0	5.0	5.0
(iv)	Magnesia, percent by mass	IS 269 -2015		6.0	6.0	6.0
(v)	Total Sulphur content, calculated as Sulphuric anhydride (SO ₃), percent by mass.	IS 269 -2015		3.5	3.5	3.5
(vi)	Total loss on ignition	IS 269 -2015		5.0	5.0	4.0
(vii)	Total chloride content, percent by mass	IS 269 -2015		0.1% for general	0.1% for	0.1% for general

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria		
				purpose & 0.05% for prestressed structure	general purpose & 0.05% for prestressed structure	purpose & 0.05% for prestressed structure
(viii)	Alkali content	IS 269 -2015		0.6	0.6	0.6
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.						
25. Steel Reinforcement (TMT Bars)						
(i)	Physical Tests	IS: 1786	1 Test per lot/heat/cast of each dia. and MTC for each consignment	IS: 1786 Table 3		
(ii)	Chemical Tests	IS: 1786	1 Test per lot/heat/cast of each dia. and MTC for each consignment	IS: 1786 Clause 4.2		
Note: Material Register Shall be maintained for ensuring frequency of tests.						
26. Curing Compound						
i.	Curing compound, Type 2 white pigmented compound, solid dissolved in vehicle shall be either A (no restrictions or Class B)	ASTM C –309-81 /ASTM D -883		Brand/ trade name of compound and source of supply and manufactural acceptance testing shall be carried out after demonstrating		

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
a.	Drying Time	ASTM C –309-81	Random sampling every batch of the compound	Dry to touch in not moiré than 4 hrs. and after 12 hrs. it shall not be tacky or tack off (peel off)
b.	Water Retention	ASTM C –156-80	Random sampling every batch of the compound	Loss of water not more than 0.55 Kg/m ² of exposed surface in 72 hrs.
c.	Light reflective	ASTM E-79	Random sampling every batch of the compound	Not less than 60% of that of magnesium oxide

Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.

27. Structural Concrete (MoRTH Specifications Clause 1700)

Sl. No.	Description of Work/ Tests	Ref. Codes	Frequency	Acceptance Standards			
I	Requirement of Concrete for Different Exposure Condition using 20mm Aggregate	Mix Design	Throughout	Exposure Condition	Maximum Water Cement Ratio	Minimum Cement Content, kg/cum	Minimum Grade of Concrete
				Moderate	0.45	340	M25
				Severe	0.45	360	M30

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria			
				Very Severe	0.40	380	M40
	b) Mix design method	IS:10262/ IS: SP23	All cases				
II	Current margin and target mean strength			Concrete Grade	Current Margin (MPa)	Target Mean Strength (MPa)	
				M15	10	25	
				M20	10	30	
				M25	11	36	
				M30	12	42	
				M35	12	47	
				M40	12	52	
				M45	13	58	
				M50	13	63	
				M55	14	69	
III	Optimum consistency by slump test	IS:1199	Each trial mix	a) PCC 25mm b) RCC structure inclined exposed surface: 25mm c) RCC with widely spaced reinforcement: 40-50mm. d) RCC with fairly congested reinforcement: 50-75mm e) RCC & PSC with highly congested reinforcement:			

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria	
				72-125mm	
				f) Under water concreting through tremie: 100-200mm	
IV	Total Chloride content of all constituents of concrete as a percentage of mass of cement in mix	BS:1377 (Part 17)	Each Trial Mix	a) Prestressed concrete: 0.1% b) Reinforced concrete exposed to chlorides in service (i.e. structures located near seacoast): 0.2% c) Other RCC: 0.3%	
V	Total sulphate content	BS:1377 (Part 18)	Each Trial Mix	Max 3.5% As per Table 20 Clause 6.1 IS 269-2015	
vi	Maximum normal size of aggregate	sieving	Each Trial Mix	Components	Max nominal size of Coarse Aggregate
				a) RCC well curb b) RCC/PCC well steining c) Well cap or Pile cap solid type piers and abutments d) RCC work in girders, slabs, wearing coat, kerb, approach slab, hollow piers & abutments, pier / abutment caps, piles e) PSC work	20 mm 40 mm 40 mm 20 mm 20 mm
VIII	Cube strength (9 cubes on 7 days & 9 cubes on 28 days)	IS:516	Each trial mix	a) 7 days strength: for preliminary assessment only b) 28 days strength: Average 9 cube shall exceed target mean strength	
IX	Density of fresh concrete	IS:1199	Each trial mix	Mean of any four consecutive samples shall not be	

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
				less than specified value and any individual sample result not be less than 97.5% of specified value
X	Density of hardened concrete	IS:1199	Each trial mix	Mean of any four consecutive samples shall not be less than specified value and any individual sample result is not less than 97.5% of specified value
XI	Frequency of sampling of concrete for each grade at site and compressive strength	IS: 1199	MoRTH Specifications Clause 1717.7.1 a) The mean strength determined from any group of four consecutive non overlapping samples exceed the specified characteristic compressive strength by 3mpa. b) Strength of any sample is not less than the specified characteristic compressive strength minus 3 MPa	
			Qty of concrete (m³)	No. of Samples
			1 – 5 6 – 15 16 – 30 31 – 50 51 and above	1 2 3 4 4 plus one additional sample for each additional 50 m³ are part there of
Note: Each sample will contain 3 cubes for testing at 28 days, additional cubes be taken for strength of concrete at 7 days.				
Note: Material Register Shall be maintained for ensuring frequency of tests.				
28. RCC Hume Pipes				
I	Tolerance in Dimensions			

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
	(a) Barrel Wall thickness	IS: 458, Cl. 8.2	As per Cl. 10 & 11 of IS: 458	up to & incl. 30mm (+2/-1 mm), over 30mm and up to & incl. 50mm (+3/-1.5 mm), over 50mm and up to & incl. 65mm (+4/-2 mm), over 65mm and up to & incl. 80mm (+5/-2.5 mm), over 80mm and up to & incl. 95mm (+6/-3 mm), over 95mm (+7/-3.5 mm)
	(b) Internal Dia. Of Pipes			up to & incl. 300mm (+/- 3mm), 300mm and up to & incl. 600mm (+/- 5mm), over 600mm (+/- 10mm)
	(c) Overall Length			+/- 1% of Standard Length
II	Three Edge Bearing Test	IS: 3597		As per IS: 3597
III	Hydrostatic Test			
III	Permeability Test			

Note: Material & Testing Register Shall be maintained for ensuring frequency of tests.

29. H.T. Strands (Uncoated Stress relieved low relaxation seven ply strand) Class 1 Steel for Pre-tensioning

I	Chemical Test a) Sulphur b) Phosphorus	IS: 228 (Part-3) IS: 228 (Part-9)	One test per lot of 10 tonnes	Not greater than 0.05% Not greater than 0.05%
II	Elongation (%)	IS: 14268-1995	One test per lot of 10 tonnes	Min. 3.5% on min. gauge length of 600mm
III	Relaxation Properties a) 100 hrs	IS: 14268-1995	One test per lot of 10 tonnes	Relaxation losses not more than 1.8% when loaded to 70% of specified minimum breaking load.

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
	b) 1000 hrs			Relaxation losses not more than 2.5% when loaded to 70% of specified minimum breading load
IV	Modulus of Elasticity	IS: 14268-1995	One test per lot of 10 tonnes	18870 to 20910 Kg/mm2
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.				
30. Steel for Post/ Pre-tensioning				
I	Stress relieved low relaxation seven-ply strand for prestressed concrete	IS: 14268		One test per lot of 10 tonnes
II	Cold rolled Cold Annealed Sheathing	IS: 513		One test per lot of 10 tonnes
III	Nominal & Cross Section, tensile strength and elongations.	IS: 1786 -2008		One test per lot of 10 tonnes
IV	Structural Steel	IS: 2062-1999		One test per lot of 10 tonnes
V	Welding	IS: 816-1969 & IS: 1323-1982		One test per lot of 10 tonnes
VI	Rivets	IS: 1148-1982, IS: 1923-1961 & IS: 800-1984		One test per lot of 10 tonnes
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.				
31. Non-Shrink Grout				
i.	Compressive Strength	IS: 516	One Sample per day's work per site	The compressive strength of 100 mm cube of the grout shall not be less than 27 MPa at 7 days or 30 MPa at 28 days

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
ii.	Water Cement Ratio	Appendix 1800/III of MoRTH Specs.	To be ensured for each batch	shall not exceed 0.45
iii.	Grout Temperature		One for each batch	shall not exceed 25°C
iv.	Full Injection Pressure and Closing Time		One for each duct	0.5 MPa, >1 minute
v.	Deleterious Materials		At the time of source approval	Chlorides (Cl) not more than 0.1 percent by weight of cement. Sulphate (SO ₃) not more than 4 percent by weight of cement. Sulphide-ions(s) not more than 0.01 percent by weight of cement
vi.	Fluidity	ASTM C 939	Once per lot	As per ASTM C 939
vii.	Setting Time	IS: 269, IS: 8112, IS: 12269, IS: 4031 Part-4, IS: 4031 Part-5		IST>=30 min., FST< 600 min.
viii.	Bleeding	Appendix 1800/III of MoRTH Specs.		The bleeding shall not exceed 0.3 percent of volume of the initial volume of grout after three hours kept at rest.
ix.	Volume Change	ASTM C 1090		shall be within range of 1% and 5 % of the original volume.
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.				
32. Elastomeric Bearings (MoRTH Specifications Clause 2005 and IRC 83 Part-II 1987)				
i.	Steel Insert	IS: 226	Two tests per lot/ Change of source	

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
ii.	Raw Elastomer Content	Table 2000-1 of MoRTH, Chloroprene (CR)	Two tests per lot/ Change of source	Not less than 60% by its weight
iii.	Ash Content	ASTM D-297 (Sub-section 10)	Two tests per lot/ Change of source	Not greater than 5%
iv.	Adhesion Strength (Elastomer to steel plates)	IS: 3400 (part XIV)	Two tests per lot/ Change of source	Not less than 7KN/m
v.	Sp. Gr. Test	ASTM D-297 (Sub-section 15)	Two tests per lot/ Change of source	
vi.	Polymer content test	ASTM D-297 (Sub-section 10)	Two tests per lot/ Change of source	
vii.	Identification of polymer	ASTM D-297 (Sub-section 15)	Two tests per lot/ Change of source	
viii	Visual Inspection	IRC: 83 Part II – 1987	Two tests per lot/ Change of source	There shall be no visual defects in surface finish, shape or any other specific defect.
ix.	Dimension Test	IRC: 83 Part II – 1987	Two tests per lot/ Change of source	
	a) Overall Plan dimension		Two tests per lot/ Change of source	-0, +6 mm
	b) Total bearing thickness		Two tests per lot/ Change of source	-0, + 5 mm
	c) Parallelism		Two tests per lot/ Change of source	
	c.1) Of top surface of bearing with respect to bottom surface as datum		Two tests per lot/ Change of source	1 in 200

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
	c.2) Of one side surface with respect to the other as datum		Two tests per lot/ Change of source	1 in 100
	d.1) Thickness of individual internal layer of elastomer		Two tests per lot/ Change of source	± 20% (Maximum of 2 mm)
	d.2.) Thickness of individual outer layer		Two tests per lot/ Change of source	-0, +1 mm
	e.1) Plan dimensions of laminate		Two tests per lot/ Change of source	-3 mm, +0
	e.2) Thickness of laminates		Two tests per lot/ Change of source	± 10%
	e.3) Parallelism of laminate with respect to bearing base as datum		Two tests per lot/ Change of source	1 in 100
x.	Axial Load Test	IRC: 83 Part II – 1987	Two bearings selected at random from each lot.	Deflection under axial load of 5 MPa to 15 MPa for individual bearings shall not vary by more than 20% of the mean value for the entire lot.
xi.	Elastic Modulus (Short term loading)	IRC: 83 Part II – 1987	Two bearings selected at random from each lot.	Elastic Modulus shall be 1 ± 0.2 of $1/(0.2/S^2 + 0.0005)$
xii	Adhesion strength	IRC: 83 Part II – 1987	Two bearings selected at random from each lot.	No peeling or separation
xiii	Ultimate compressive strength	IRC: 83 Part II – 1987	Two bearings selected at random from each lot.	Not less 60 MPa

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
xiv	Shear Modulus	IRC: 83 Part II – 1987	Two bearings selected at random from each lot.	Shear Modulus shall be 1 ± 0.2 MPa provided that there is no instability, defect or damage
a.	Level 1 acceptance testing	Section 2005.3.3.1 of MoRTH Specifications	Two extra bearing for each lot/ change of source	
b.	Level 2 acceptance testing	Section 2005.3.3.2 of MoRTH Specifications	One bearing selected at random/ change of source	
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.				
33. Pot cum PTFE Bearings (MoRTH Specifications Cl. 2006 and IRC 83 Part-III 2002)				
i.	POT			
a.	Structural Steel	IS: 226 / IS: 2062	Two tests per lot/ change of source	
b.	Cast Steel	IS: 1030	Two tests per lot/ change of source	
c.	Stainless Steel	AISI: 304 / AISI: 316 L	Two tests per lot/ change of source	
ii.	PTFE	BS: 3784	Two tests per lot/ change of source	
iii.	Elastomer			
a.	Hardness (IRHD)	IS: 3400 (Part 2)	Two tests per lot/ change of source	50+5

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
b.	Minimum tensile strength (MPa)	IS: 3400 (Part 1)	Two tests per lot/ change of source	15.5
c.	Minimum elongation at break (%)	IS: 3400 (Part 1)	Two tests per lot/ change of source	400
iv	Dimensional Tolerance 1. Plan dimensions 2. Overall Height 3. Height of any steel component a) Machined b) Unmachined 4. Height of Elastomer	IRC: 83 Part-I	All bearing to be tested for overall dimension	1. 0 to 5 mm 2. 0 to 3 mm 3. a) 0 to 1 mm b) Class 2 of IS: 4897 4. $\pm 5\%$
v.	Stainless Steel Sliding Surface 1. Flatness 2. Surface Finish	IRC: 83 Part-I	All bearing to be tested for overall dimension	1. $0.0004 L$ Where L = Length of Direction of Measurement 2. $R_a \leq 0.25\mu m$ as per IS: 3073
vi.	Load Test Vertically and Horizontally incl Rotation capacity	IRC: 83 Part-I	All bearing to be tested	All bearings shall be load tested to 1.1 times maximum design capacity including seismic forces. Bearing tested at higher loads cannot be used.
vii.	Friction Test	IRC: 83 Part-I	Two bearings selected at random per lot	The coefficient of friction shall be less than or equal to 0.05 at the design load.
viii.	Ultrasonic Test	IRC: 83 Part-I	All castings to be tested	Quality level of castings shall be level 3 as per IS: 9565
ix.	Dye Penetration Test	IRC: 83 Part-I	All Welding to be tested	There shall be no holes or flaws.

Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
34. Expansion Joint (MORTH Specifications Section 2600 & IRC SP: 69 -2005)				
i.	Steel Plate Sliding Expansion Joints	IS: 2026	Once test for each lot	12 mm thick and 200mm wide minimum no. of pieces not exceeding 2 pieces/ traffic lane width
ii.	Filler Joints	IS: 1838, MoRTH Specifications clause 2605	Once test for each lot	
iii.	Elastomeric Slab Seal Expansion Joint	MoRTH Specifications clause 2606	Once test for each lot	
a.	Steel Inserts	IS: 226	Once test for each lot	
b.	Elastomer	IRC: 83(part 2)	Once test for each lot	
iv.	Strip Seal Expansion Joint	MoRTH Specifications clause 2607	Once test for each lot	
a.	Steel (Edge Beam)	Steel Grade RSt37-2 of German Standard	Once test for each lot	
b.	Chloroprene	IRC: 83 (part 2)	Once test for each lot	
c.	Anchorage Steel	IS: 2062, 1999	Once test for each lot	
d.	Anchorage Loop	IS: 2062, 1999	Once test for each lot	
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.				

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
35. Pile Foundation				
i.	Initial Load Test (Vertical & Lateral Load Test)	IS: 2911(Part 4), IRC: 78 – 2000 and MoRTH specifications clause 1113	Not less than 2 nos. for each category per bridge site	The safe vertical load shall be min. of: i. 50% of final load corresponding to displacement of 1/10th pile dia. ii. 2/3rd of final load at which displacement is 12mm The safe lateral load shall be the least of the following: i. 50% of the final load at which the total displacement increases to 12 mm ii. final load at which the total displacement corresponds to 5 mm and iii. Load corresponding to any other specified displacement as per performance requirements
ii.	Routine Load Test			
	a) Vertical Test	IS: 2911(Part 4) & IRC: 78 – 2000	2% of total piles subject to Min. 2 tests for each size.	Max. Settlement at a test load of 1.5 times the working load shall not exceed 12mm
	b) Integrity Test	IS: 2911(Part 4) & IRC: 78 – 2000	Not be less than 2% of the total number of working piles on each bridge site.	There shall be no unacceptable flaws in concrete as per the recommendation of the specified agency carrying out the test.
36. Bentonite (MoRTH Specifications Clause 1115.2.3)				
i.	Density	IS: 2720 (Part 8)	Once for each Pile	1.05 gm/cc

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
ii.	pH value	IS: 3025	Once for each Pile	9.5 – 12
iii.	Silt content	IS: 2720 (Part 4)	Once for each Pile	Less than 1%
iv.	Liquid limit	IS: 2720 (Part 5)	Once for each Pile	Not less than 400%
v.	Marsh cone viscosity	Marsh Cone	Once for each Pile	30-40
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.				
37. Pre-stressing (MoRTH Specifications 1800)				
a. i.	Pre-stressing System Static Load test with tendon – anchorage assembly		a) Once at the start of work for the approval of the Prestressing system/source of strands b) Once in the project for change in each Prestressing system/source of strands c) Once at the start of work for the approval of the Prestressing system/source of strands d) Once in the project for change in each Prestressing system/source of strands	The increase in the displacements between the anchorage components as well as between the pre-stressing steel & anchorage components should not be disproportionate to the increase in tendon force. The above relative displacement during 0.8 Fpk load should stabilize within 1 st 30 minutes of the load duration of 1 hour. The mode of failure & tendon should be by the fracture of the prestressing steel. Anchorage Efficiency (η_a) ≥ 0.95 Total elongation ϵ_u in the free length of the tendon under the measured ultimate force F_{TU} shall be $\geq 2\%$
ii.	Dynamic Load Test with Tendon anchorage assembly	FIP recommendations	a) Manufacturer's test certificate. b) Once for every source approval	Fatigue failure of anchorage components should not occur Minimum fatigue strength of post tensioning system = 80 MPa.
iii.	Load Transfer Test	FIP recommendations	a) Once at the start of work for the approval of the Prestressing system	Crack width upon first attainment of upper force 0.8 $F_{PK} \leq 0.10\text{mm}$

Sl. No.	Description of Works/ Tests		Ref. Codes	Frequency	Acceptance Criteria
		ons	b) Once for every source approval c) Once in the project for change in each Prestressing system/source of strands		Crack width upon last attainment of lower force $0.12 F_{PK} \leq 0.10\text{mm}$ Crack width upon final attainment of upper force $0.8 F_{PK} \leq 0.25\text{mm}$ Reading of longitudinal & Transverse strains should have stabilized during cyclic loading (increase in strain in last 2 load cycles <5%) Reading of crack width should have stabilized (increase in crack width in last 2 load cycles > .02mm) Measured failure load $F_u \geq F_{PK} (f_{cm,e} / f_{ck,o})$ and $\geq 1.1 F_{PK}$
Note: Testing Register Shall be maintained as proper record.					
38. Prestressing Hardware (MS Sheathing)					
i.	Physical Test	IRC: 18-2000 (appendix – I A)	Once in the beginning for approval of source Once in every lot not exceeding 700m		
	a) Workability Test				No failure or opening takes place
	b) Transverse Load Rating Test				The permanent deformation shall be less than 5%
	c) Tension Load Test				No deformation of joints and no slippage of couplers
	d) Water Loss Test				Water loss should not exceed 1.5% of the volume
ii.	Dimensions		Size of Tendons		Min. Inner dia.

Sl. No.	Description of Works/ Tests		Ref. Codes	Frequency	Acceptance Criteria
			12 K 13		90 mm
			19 K 15		100 mm
			Minimum Dia. = 3 times the area of tendons		
			Internal dia. of tube		Min thickness
			90 mm		0.4 mm
			110 mm		0.5 mm
			More than 110 mm		As per the recommendation of manufacturers and as per the directions of Engineer
iii.	Chemical Composition		Cold Rolled Cold Annealed Mild Steel		
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.					
39. Other Prestressing Hardware					
	i. Anchor Head	DIN 17200/ Manufacturer's Specifications	Once in the beginning for approval of source		
	1) Ultrasound Test				Satisfactory as reported by radiologist
	2) Chemical Analysis				As per manufacturer's recommendations
	3) Dimensional Test				As per manufacturer's recommendations
	4) Hardness				446 to 506 or as per manufacturer's recommendations

Sl. No.	Description of Works/ Tests		Ref. Codes	Frequency	Acceptance Criteria
	ii. Barrel	DIN 17200/ Manufacturer's Specifications			
	1) Chemical Analysis				As per manufacturer's recommendations
	2) Dimensional Test				As per manufacturer's recommendations
	3) Hardness				446 to 506 or as per manufacturer's recommendations
	ii. Barrel	DIN 17200/ Manufacturer's Specifications			
	1) Chemical Analysis				As per manufacturer's recommendations
	2) Dimensional Test				As per manufacturer's recommendations
	3) Hardness				446 to 506 or as per manufacturer's recommendations
	iii. Bearing Plates	DIN 1691/ Manufacturer's Specifications			
	1) Chemical Analysis				As per manufacturer's recommendations
	2) Dimensional Test				± 5 mm for outer dimensions and ± 5 mm for inner dimensions
	3) Hardness				197 to 241 BHN (as tested by Poldi Tester) or as per manufacturer's recommendations

Sl. No.	Description of Works/ Tests		Ref. Codes	Frequency	Acceptance Criteria
	iv. Wedges	Manufacturer's Specifications			
	1) Dimensional Test				As per manufacturer's recommendations
	2) Surface Hardness				Minimum 700
	3) Load Test				Satisfactory as per visual examination
	v. Trumpet Cone	Manufacturer's Specifications			
	1) Dimensional Test				As per manufacturer's recommendations
	2) Chemical Test				As per manufacturer's recommendations
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.					
41. Retro Reflective Road Marking Paints (MoRTH Specifications Clause 803.4)					
i.	Thermoplastic Material				
a.	1. White day light luminance	AASHTO M 249	Once test for each lot	At 45 degree - 65% minimum At 45 degree – 45% minimum	
	2. Yellow day light luminance			At 45 degree - 45% minimum At 45 degree – 45% minimum	
b.	Drying Time	AASHTO M 250	Once test for each lot	Traffic bear in not more than 15 minutes	
c.	Skid Resistance	BS: 6044	Once test for each lot	Not less than 45	

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
d.	Yellow ness index	AASHTO M 249	Once test for each lot	Not more than 0.12
e.	Cracking resistance at low temperature	MoRTH 803.4.1.2	Once test for each lot	No cracks on application to concrete blocks
f.	Softening Point	ASTM D 36	Once test for each lot	102.5 ± 9.5° C
g.	Flow resistance	AASHTO M 249	Once test for each lot	Not more than 25 %
ii.	Reflection of Glass Beads	MoRTH: 803.4.2		
a.	Gradation	BS: 6088	Once test for each lot	As per MoRTH Table 800.10
b.	Round ness	BS: 3262 (Part I)	Once test for each lot	Glass beads shall have a minimum of 70% true spheres
c.	Refractive index	MoRTH 803.1	Once test for each lot	Minimum Refractive index of 1.5
d.	Free Flow	MoRTH 803.1	Once test for each lot	Free of hard lumps and clusters or pass in free flow test.
Note: Material Register Shall be maintained for ensuring frequency of tests, MTC for each delivery needs to be checked and kept as record.				
42. Crash Barrier Accessories: Ref. MoRTH Specifications Cl. 811; IRC 119-2015				
i.	G.I. Pipes			
a.	Dimension's	IS: 1239(part 1), 1990	Once test for each lot	
b.	Tensile Strength, % elongation and Bend Test	IS: 1239(part 1 & part 2), 1990 & IS: 1608,	Once test for each lot	

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
		1995		
c.	Galvanization Test	IS: 1239 (part 1), 1990	Once test for each lot	
ii.	M.S. Plate & M 16 U Bolt			
a.	Tensile Strength, % elongation and Bend Test	IS: 2062, 1999, IS: 1608, 1995 & IS: 1364 & 1367	Once test for each lot	
b.	Chemical Analysis	IS: 2062, 1999 & IS: 1608, 1995	Once test for each lot	
iii.	“W” profiled corrugated beam in single or double row and single or double face	IS: 5986 or ST: 42 grade	Once test for each lot	3mm thick cold role steel strip & hot dip galvanized should be 550 gm/ m ²
Note: Material Register Shall be maintained for ensuring frequency of tests, , MTC for each delivery needs to be checked and kept as record.				
43. Traffic Signs (MoRTH Specifications Clause 801)				
i.	Traffic Sign Post Galvanized (hot dip process) MS pipe			
	a) Reinforcing steel	IS: 1786-2008	Once test for each lot	80mm dia. (NB – MW)
	b) Bolts, Nuts & Washers	IS: 1364 & IS: 1367	Once test for each lot	As per MoRTH Clause no 801.2.3
	c) Plates & Support Sections	IS: 226 & IS: 2062	Once test for each lot	As per MoRTH Clause no 801.2.4
	d) Aluminum Sheets	IS: 736, Gr. 24345 / Clause 801.2 of MoRTH Specifications	Once test for each lot	ACM shall be of low-density polyethylene between two thick sheets of aluminum with overall thickness 3 or 4mm as specified in contract & aluminum skin of thickness 0.5mm & 0.3mm respectively on both side. & MoRTH

Sl. No.	Description of Works/ Tests	Ref. Codes	Frequency	Acceptance Criteria
				Table no 801-1.
ii.	Traffic Retro-Reflective Sign Sheeting			MoRTH Specifications Clause 801.3
	a) High Intensity grade Sheeting	ASTM D: 4956-09	Once test for each lot	As per ASTM E: 810 / Table 800-2 of MoRTH Specifications
	b) High Intensity Micro Prismatic Grade Sheeting	ASTM D: 4956-09	Once test for each lot	As per ASTM E: 810 / Table 800-3, 800-4, 800-5 & 800-6 of MoRTH Specifications
	c) Colour	IRC: 67 / ASTM D: 4956-09.	Once test for each lot	Indian standards colour no. 284. Indian green background and white letters or Section 800 of MoRTH Specifications
Note: Material Register Shall be maintained for ensuring frequency of tests, , MTC for each delivery needs to be checked and kept as record.				

4.3 Quality Control Test Procedure and Formats

The various quality control test procedure along with reporting formats are to be maintained for performing all works strictly in accordance with the requirements of the specifications and relevant codes to ensure quality control are shown on the following pages.



FORMAT FOR DAILY REPORT

Sl. No.	Name of Work	Package No.	Chainage/ Location	Observations	Report (Conforming/ Non-conforming)	Suggestion for Rectification/ Improvement	Reference (Photos/ Lab Reports etc.)



FORMAT FOR NON-CONFORMANCE REPORT

Name of Road:		
Division: District:		
Employer / Authority		
Consultant Contractor		
Non-Conformance Report		
Inspected by:	Report	
	(NCR)No.	
	Date:	
Non-Conformance:	Location:	Details:

Detailed Description of Non-Conformance:								
Name & Signature	NCR Category							
	1	2	3	4	5	6	7	8
Recommended Remedial Action:								
Issued by Name/ Designation / Signature							Completion Target Date:	
Copy								
1 – Consultant:			2. Contractor			3. Client:		
Category:								
1. Safety Arrangements				-	Minor	/Major		
2. Defective Concrete works				-	Minor	/Major		
3. Defective Road Works				-	Minor	/Major		
4. Tests not conducted as specified				-	Minor	/Major		
5. Check lists and records not authenticated				-	Minor	/Major		
6. Non-compliance with specifications and standards				-	Major			
7. Non-compliance with Recommendations				-	Major			
8. Product not to acceptable standards. (Requires rejection).				-	Major			



FORMAT FOR ACCEPTANCE ON COMPLIANCE OF NON-CONFORMANCE REPORT

Name of Road:		
Division :		
District :		
Employer / Authority		
Consultant		
Contractor		
Corrective Action Taken Report		
Inspected by:		Ref. Report (NCR) No.
		Date:
Non-Conformance:	Location:	Details:
Detailed Description of Non-Conformance:		

NCR Issued by (Name / Designation)	NCR Category							
	1	2	3	4	5	6	7	8
Remedial Action Taken:								
Witnessed by IE and Concessionaire (Name/ Designation / Signature)							Completion Date:	
Copy 1-Consultant 2. Contractor 3.Client								
Category: 1. Safety Arrangements 2. Defective Concrete works 3. Defective Road Works 4. Tests not conducted as specified 5. Check lists and records not authenticated 6. Non-compliance with specifications and standards 7. Non-compliance with Recommendations 8. Product not to acceptable standards. (Requires rejection).	-		Minor /Major					
	-		Minor /Major					
	-		Minor /Major					
	-		Minor /Major					
	-		Minor /Major					
	-		Major					
	-		Major					
	-		Major					

QUALITY SURVEILLANCE FORM FOR WORKMANSHIP OF CONCRETE

ELEMENTS OF
STRUCTURE

LOCATION

SURVEILLANCE OBSERVATIONS

The following items should be observed during concrete pour by the QA surveillance team.

1. Mixing of concrete

- i. Check the concrete class and the respective mix design already approved. (YES / NO)
- ii. Check the condition of aggregates to be used. (YES / NO)
- iii. Check the weighing and water dispensing methods adopted during the mixing. (YES / NO)
- iv. Check that the mixer machine has been cleaned properly. (YES / NO)
- v. Check that the required mixing time is allowed. (YES / NO)

2. Transportation/conveyance (as specified, but generally to cover following)

- i. Check if the equipment is in proper working order. (YES / NO)
- ii. Check if the specified methods are being followed. (YES / NO)
- iii. Check if the stipulated time limits are observed. (YES / NO)
- iv. Check if the non-conforming wet concrete is being rejected and disposed off. (YES / NO)

3. Placing of concrete Check that:

- i. The concrete is not segregated during pour. The height of dropping is controlled. (YES / NO)
- ii. The concrete is poured in layers. (YES / NO)
- iii. The vibrators are being applied systematically to compact uniformly and adequately, avoiding over vibration. (YES / NO)
- iv. The concrete is not being pulled or pushed. Pouring is being done close to the final position. (YES / NO)
- v. The cold joints are not allowed to be developed. (YES / NO)
- vi. The underwater concrete is being poured only by tremies or pipeline. (YES / NO)
- vii. The forms are not getting displaced or deformed during the concrete pour and vibrating. (YES / NO)
- viii. No cement slurry is getting lost. Suitable numbers of carpenters are present to watch and repair formwork during pour, if required. (YES / NO)



- ix. The concrete is being poured within the allowable time limits from the time of batching. (YES / NO)
 - x. The concrete cubes are taken as required. (YES / NO)
 - xi. The curing arrangements are satisfactory. (YES / NO)
 - xii. The equipment is in working condition. (YES / NO)
 - xiii. The equipment is cleaned properly. (YES / NO)
 - xiv. The quality of wet concrete is as per specifications (slump, homogenous mix etc.) (YES / NO)
 - xv. Continuous supply of concrete is assured. (YES / NO)
-

Inspected by: (For
PIU)

Name:

Signed:

Date:

In presence of: (For
Contractor)

Name:

Signed:

Date:



QUALITY SURVEILLANCE FORM FOR PAVEMENT LAYERS

SURVEILLANCE OBSERVATIONS

PAVEMENT LAYER DESIGNATION	LAYER NO./REQUIRED LEVEL	LOCATION
Materials/Workmanship Earthwork/Granular sub-base 1. Check material is from approved borrow (YES / NO) 2. Free from roots and other perishable material (YES / NO) 3. Grading is acceptable (YES / NO) 4. Spread layer thickness is acceptable (YES / NO) 5. Moisture is near optimum prior to compaction (YES / NO) 6. Lines/levels are within tolerance (YES / NO) Equipment Check 1. Adequate for the work (YES / NO) 2. In condition (YES / NO)	Wet mix macadam 1. Conforms to job mix formula (YES / NO) 2. Free from deleterious materials (YES / NO) 3. Spread layer thickness is acceptable (YES / NO) 4. Moisture is near optimum prior to compaction (YES / NO) 5. No segregation during transport (YES / NO) 6. No segregation during paving (YES / NO) 7. Lines and levels within tolerance (YES / NO) Equipment Check 1. Adequate for the work (YES / NO) 2. In condition (YES / NO)	Asphalt 1. Conforms to job mix formula (YES / NO) 2. Free from deleterious materials (YES / NO) 3. Spread layer thickness is acceptable (YES / NO) 4. Temperature at break down rolling is within specs (YES / NO) 5. No segregation during transport (YES / NO) 6. No segregation during paving (YES / NO) 7. Lines and levels within tolerance (YES / NO) Equipment Check 1. Adequate for the work (YES / NO) 2. In condition (YES / NO)

Inspected by: (For PIU)

Name:

Signed:

Date:

In presence of: (For Contractor)

Name:

Signed:

Date:

GRAIN SIZE ANALYSIS (IS: 2720 –PART 4)

Object:

To determine the amount and proportion of coarse material by the use of sieves.

Apparatus:

Various apparatus include set of standard sieves of different sieve sizes, balance, rubber covered pestle and mortar, oven, riffle and sieves shaker.

Procedure:

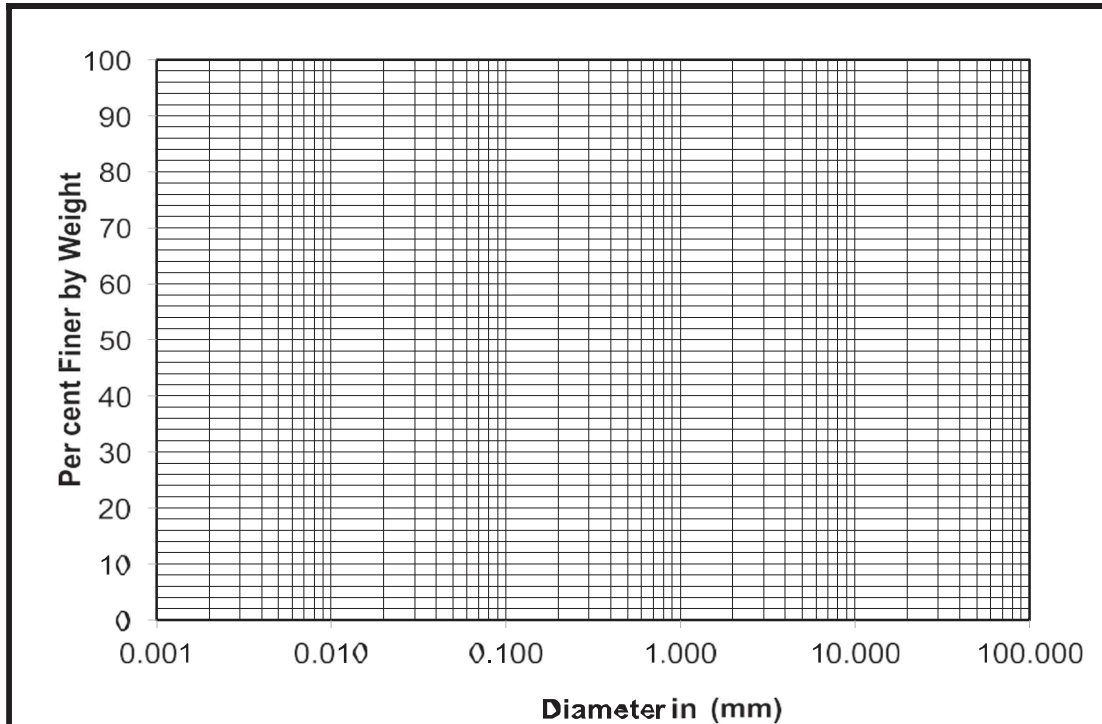
- i. **For the fraction retained on 2.0mm sieve:** Sufficient quantity of the dry soil retained on 2.0mm sieve is weighed out. The quantity of sample taken may be increased when the maximum size of particles is higher. The sample is separated into various fractions by sieving through the set of sieves of sizes 100, 63, 20, 6, 4.75 and 2 mm IS sieves. Additional sieve size may also be introduced if necessary. After initial sieving, the material retained on each sieve is collected, the lumps broken down using mortar and rubber covered pestle and is re-sieved thus the soil fraction retained on each sieve is carefully collected and weighed.
- ii. **For the fraction passing 2.0mm sieve and retained on 0.075mm sieve:** Dry sieving may be done in the case of soils which are cohesion less, single grained and without lumps. Riffling or quartering method takes the required quantity of soil sample, dried in oven at 105⁰ to 110⁰C and is subjected to dry sieve analysis using a set of sieves with sieve openings 2.0, 0.6, 0.425, 0.15 and 0.075 mm, pan and lid, additional sieves may be used or any of the sieves removed, depending upon the requirement of the test. The material retained on each sieve and on the pan are separately collected and weighed.
- iii. Wet sieving may be adopted in the case of clayey or cohesive soils. Required quantity of sample taken by riffling is weighed. The sample is spread in a tray or bucket and covered with water. In case of soils having fractions that are likely to flocculate a dispersing agent like sodium hexametaphosphate (2.0g) or sodium hydroxide (1.0g) and sodium carbonate (1.0g) per liter of water may be added to the water. The mix is stirred and left for soaking. The soaked soil specimen is placed over the set of sieves of sizes with the finest sieve and pan at the bottom and washed thoroughly. Washing is continued till the water passing each sieve is substantially clean. The fraction of each sieve is emptied carefully without loss of material in separate trays, oven dried at 105⁰ to 110⁰C and each fraction weighed separately.

Reporting Format:

Lab location	:	Sampled on	:
		Location/Chainage	:
Date of Testing	:	Weight of Sample taken	:
Wt. of Sample retained on			
0.075mm Sieve	:		
Empty weight of Container(W_1):		Wt. of Water ($W_4=W_2-W_3$):	
Wt. Container + Wet Soil			
(g) (W_2)	:		
Wt. of Container+dry :		Moisture Content	
Soil(g)(W_3)	:	$(w_4)/(w_3)-(w_1))*100$:	

I.S Sieve Designation (mm)	Weight of Soil retained (g)	Cumulative Wt. of Soil retained (g)	Cumulative Percentage retained (%)	Cumulative Percentage Passing (%)	Results
100.000					Gravel =
75.000					
60.000					
40.000					
19.000					
10.000					
4.750					Sand =
2.000					
1.180					
0.425					
0.075					
Pan					Silt & Clay =

Grain size distribution curve



Remarks:

Type of soil:

Contractor

PWRD

DETERMINATION OF PARTICLE SIZE BY HYDROMETER METHOD (IS:2720 PART-4)

Object:

To do the analysis for the fine-grained fraction by sedimentation method.

Apparatus:

- a) Density hydrometer confirming to IS: 3104-1965 –(Range 0.995 – 1.030),
- b) Two glass-measuring cylinders of 1000ml capacity with ground glass or rubber stoppers about 7cm diameter and 33cm high marked at 1000ml volume,
- c) Thermometer to cover the range 0 to 50°C, accurate to 0.50°C,
- d) Water bath or constant temperature room,
- e) Stirring apparatus,
- f) 75-micron sieve,
- g) Balance accurate to 0.01g,
- h) Stop watch,
- i) Wash bottles containing distilled water,
- j) Glass rod, about 15 to 20 cm long and 4 to 5 mm in diameter,
- k) Reagents: Hydrogen peroxide, Hydrochloric acid N solution and Sodium hexametaphosphate,
- l) Conical flask of 1000ml capacity
- m) Funnel, filter paper, measuring cylinder of 100ml capacity and blue litmus papers

Procedure:

- i. Insert a rubber bung or any other suitable cover on the top of the 1000ml-measuring cylinder containing the soil suspension and shake it vigorously end over end. Stop shaking and allow it to stand. Immediately, start the stopwatch, and remove the top cover from the cylinder.
- ii. Immerse the hydrometer gently to a depth slightly below its floating position and then allow it to float freely. Take the hydrometer readings after periods of 0.5, 1, 2 and 4 minutes. Take out the hydrometer, rinse it with distilled water and allow it to stand in a jar containing distilled water at the same temperature as that of the test cylinder.
- iii. The hydrometer is re-inserted in the suspension and readings are taken after periods of 8, 15 and 30 minutes; 1, 2 and 4 hours after shaking. The hydrometer should be removed, rinsed and placed in the distilled water after each reading. After the end of 4 hours, readings should be taken once or twice within 24 hours.
- iv. Composite correction (C): In order to determine the composite correction, put 100ml of dispersing agent solution in another 1000ml measuring cylinder and make it to 1000ml by adding distilled water. The cylinder should be maintained at the same temperature as that of the test cylinder containing soil specimen. Insert the hydrometer in this comparison cylinder containing distilled water and the dispersing agent and take the reading corresponding to the top of the meniscus. The negative of the hydrometer reading so obtained gives the composite correction (C). The composite correction is found before the start of the test, and also at every time intervals of 30 minutes, 1 hour, 2 hours and 4 hours after the beginning of the test, and afterwards, just after each hydrometer reading is taken in test cylinder.
- v. The temperature of the suspension should be observed and recorded once during the first 15 minutes and then after every subsequent reading.

Reporting Format:

DETERMINATION OF PARTICLE SIZE BY HYDROMETER METHOD (IS:2720 PART-4)

a) Percentage of soil passing 75m IS Sieve: b) Mass of sample taken for sedimentation Analysis: c) Specific Gravity (G): d) Meniscus Correction (cm):	Height of the bulb (h): cm Volume of the Hydrometer (vh)l: ml Cross sectional area of the Cylinder (A): Sq cm Constant = $(1/2(h-(Vh/A)))$
---	---

S. NO	Observations					Calculations							
	Elapsed Time (t) min	Hydrometer Reading (Rh')	Meniscus correction Cm	Temperature (t)	Composite Correction (C)	Corrected Reading (Rh) = Rh' +Cm (2) +(3)	Height (He) cm	R=Rh' +C	Value (η) in poise	Factor (M) = $\sqrt[3]{30\eta/g(G-1)}$	Particle Size D = (MvHe/t) mm	% Finer (N') = $100 * G / (Ms * (G-1)) * R$	% finer based on whole weight N=N' *(w' /w)
	1	2	3	4	5	6	7	8	9	10	11	12	13
1													
2													
3													
4													
5													

Contractor

PWRD

LIQUID LIMIT AND PLASTIC LIMIT TEST (IS:2720 PART-5)

A. LIQUID LIMIT TEST

Object:

To determine the liquid limit of soil.

Apparatus:

- i) Mechanical liquid limit device consists of a cup and arrangement for raising and dropping through a specified height and standard grooving tools.
- ii) Balance of 200 g capacity and sensitive to 0.01 g.
- iii) Oven to maintain 105° to 110°C .

Procedure:

About 120 g of dry pulverized soil sample passing 425 micron IS sieve is weighed, and mixed thoroughly with distilled water in the evaporating dish to form a uniform thick paste. The liquid limit device is adjusted to have a free fall of cup through 10 mm. A portion of the paste is placed in the cup above the lowest spot, and squeezed down with the spatula to have a horizontal surface. The specimen is trimmed by firm strokes of spatula in such a way that the maximum depth of soil sample in the cup is 10 mm. The soil in the cup is divided along the diameter through the center line of the cam followed by firm strokes of the grooving tool so as to get a clean sharp groove. Grooving tool (b) may be used for all soils, where as grooving tool (a) may be used only in clayey soils free from sand particles or fibrous materials.

The crank is rotated at the rate of two revolutions per second (either by hand or electrically operation) so that the cup is lifted and dropped. This is continued till the two halves of the soil cake come into contact at the bottom of the groove along a distance of about 10 mm, and the number of blows given is recorded. A representative soil is taken, placed in the moisture container, lid placed over it and weighed. The container is dried in oven and the dry weight determined the next day for finding the moisture content of the soil. The operations are repeated for at least three more trials with slightly increased moisture contents each time, noting the number of blows so that there are at least four uniformly distributed readings of number of blows between 10 and 40 blows.

B. PLASTIC LIMIT TEST

Object:

To determine the Plastic limit of soil.

Apparatus:

- i) Evaporating dish, spatula, glass plate, moisture containers, rod of 3 mm diameter,
- ii) balance sensitive to 0.01 g and
- iii) oven controlled at temperature 105° to 110°C .

Procedure:

About 20 g of dry pulverized soil passing 425 micron IS sieve is weighed. The soil is mixed thoroughly with distilled water in the evaporating dish till the soil paste is plastic enough to be easily moulded with fingers. A small ball is formed with the fingers and this is rolled between the fingers and the glass plate to a thread. The pressure just sufficient to roll into a thread of uniform diameter should be used. The rate of rolling should be between 80 to 90 strokes per minute counting a stroke as one complete motion of hand forward and back to the starting position again. The rolling is done till the diameter of the thread is 3 mm. Then the soil is kneaded together to a ball and rolled again to form thread. This process of alternate rolling and kneading is continued until the thread crumbles under pressure required for rolling and the soil can no longer be rolled into a thread.

If the crumbling starts at diameter less than 3 mm, then moisture content is more than plastic limit and if the diameter is greater while crumbling starts, the moisture content is lower. By trial, the thread that starts crumbling at 3 mm diameter under normal rolling should be obtained and this should be immediately transferred to the moisture container, lid placed over it and weighed. The container is kept in the oven for about a day and dry weight found to determine the moisture content of the thread. The above process is repeated to get at least three consistent values of the plastic limit (PL or wp).

Reporting Format:

LIQUID LIMIT AND PLASTIC LIMIT (IS:2720 PART-5)

Lab location :		Sampled Location/Chainage :	
Date of Testing :		Weight of Sample Taken :	

Liquid Limit: -						Plastic Limit: -				
Determination no.		1	2	3	4	5		1	2	3
No. of Blows Container										
no.										
Wt. of empty Container(g)										
Wt. of Container + wet soil (g)										
Wt. of Container + dry soil (g)										
Wt. of Water (g)										
Wt. of oven dry soil (g)										
Moisture Content (%)										

Test Results

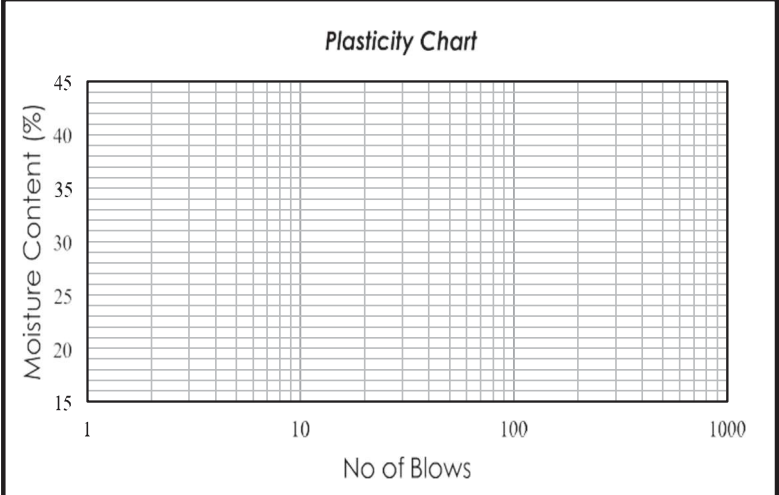
Liquid Limit (LL%):

Plastic Limit (PL%):

(Average Value)

Plasticity Index:

(LL-PL)



Plasticity Chart

Remarks:

Contractor

PWRD

FREE SWELL INDEX (FSI) (IS:2720 PART-40)

Object:

To determine the free swell index of soils.

Apparatus:

- 1) 425 micron IS sieve,
- 2) Glass graduated cylinders – 2 nos 100ml capacity,
- 3) Distilled water and kerosene.

Procedure:

- i. Take two 10 grams soil specimens of oven dry soil passing through 425-micron IS sieve.
- ii. Each soil specimen shall be poured in each of the two glass graduated cylinders of 100ml capacity.
- iii. One cylinder shall then be filled with kerosene oil and the other with distilled water up to the 100ml mark.
- iv. After removal of entrapped air the soils in both the cylinders shall be allowed to settle. Sufficient time (not less than 24 hours) shall be allowed for the soil sample to attain equilibrium state of volume without any further change in the volume of the soils.
- v. The final volume of soils in each of the cylinders shall be read out.

Reporting Format:



FREE SWELL INDEX (FSI) (IS:2720 PART-40)

Section/Lab location :				Sampled Location/Chainage :				
Date of Testing :				Weight of Sample Taken :				
S. No.	Chainage/ Side/Depth	Date of Sampling	Date of Testing	Duration in Hrs	Wt. of Sample (g)	Volume of Soil in Water (W ₁ cc)	Volume of Soil in Kerosene (W ₂ cc)	FSI = (W ₁ - W ₂)/W ₂ (%)
Remarks:								
Contractor								
PWRD								

SOIL SPECIFIC GRAVITY TEST (IS:2720 PART-III/II)

Object:

To determine the specific gravity of soil fraction passing 4.75 mm sieve by density bottle.

Apparatus:

- 1) Density bottle of 50ml / 100ml capacity.
- 2) Balance sensitive to 0.01g.
- 3) Wash bottle with deaired distilled water
- 4) Vacuum source

Procedure:

- i. To clean and dry the density bottle, wash it thoroughly with distilled water and allow it to drain. Weigh the empty cleaned bottle (W_1) accurate to 0.01g with its stopper.
- ii. Take about 10 to 20 grams of oven dried soil sample; find the weight (W_2) of the bottle and the soil, with the stopper.
- iii. Put about 10ml of deaired distilled water in the bottle, so that the soil is fully soaked. Leave it for a period of 2 to 10 hours. Add more distilled water so that the bottle is about half full. Remove the entrapped air by subjecting the contents to a partial vacuum, then find out the weight (W_3).
- iv. Clean the bottle thoroughly and fill it with distilled water and weighed (W_4). Temperature should be maintained 27°C throughout the test.

Reporting Format:

Section/Location of Lab :		Date of Sampling :			
Location/Chainage Date of :		Source of Material :			
Testing :		Sample Code/No :			
S. No.	Description	Trial 1	Trial 2	Trial 3	Average
1	Wt. of Density Bottle with Lid (W_1)				
2	Wt. Density Bottle + soil (W_2)				
3	Wt. Density Bottle + Soil + Water (W_3)				
4	Wt. Density Bottle + Water (W_4)				
5	Weight of Soil ($W_2 - W_1$)				
6	Specific Gravity (G) = $W_5 / (W_4 - W_1) - (W_3 - W_2)$				
Remarks:					
Contractor					PWRD

COMPACTION TEST (MAXIMUM DRY DENSITY TEST) (IS:2720 PART-8)

Object:

To determine the compaction test by light / heavy compaction test method.

Apparatus:

- a) Cylindrical mould of capacity 1000 cc, with an internal diameter of 10cm and height 12.73 cm or a mould of capacity 2250 cc, with an internal diameter of 15 cm and height of 12.73 cm. The mould is fitted with a detachable base plate and removable collar or extension of about 6 cm high.
- b) For light compaction, a metal rammer having 5 cm diameter circular face, and weight 2.6 kg is used which has a free drop of 31 cm. For heavy compaction, the rammer has 5 cm diameter circular face, but having weight 4.89 kg and free drop of 45 cm.
- c) Steel straight edge having be leveled edge for trimming the top of the specimen.
- d) Other accessories include moisture containers, balances of capacity 10 kg and 200 g , oven, sieves and mixing tools.

Procedure:

- i. For light compaction, about 20 kg of the representative soil is air-dried, mixed pulverized and sieved through 19 mm IS sieve. The fraction retained on 19 mm sieve is not used in this test. If there is note worthy proportion of materials retained on 19 mm sieve, allowance for larger size materials is made by replacing it by an equal weight of material passing 19 mm sieve and retained on 4.75 mm sieve.
- ii. For heavy compaction, about 45 kg of the representative soil is air-dried, mixed pulverized and sieved through 37.5 mm IS sieve. The fraction retained on 37.5 mm is not used in this test. If there is note worthy proportion of materials retained on 37.5 mm sieve, allowance for large size materials is made by replacing it by an equal weight of material passing 37.5 mm and retained on 4.75 mm sieve.
- iii. For compacting the soil in the mould every time the required quantity will depend on the soil type, size of the mould, moisture content and amount of compaction. As a rough guidance, for each test 2.5 kg of soil may be taken for light compaction and 5.8 kg for heavy compaction. The estimated weight of water to be added to the soil every time may be measured with a graduated jar in cc.
- iv. Enough water is added to the specimen to bring the moisture content to about 7% less than the estimated OMC for sandy soils and 10% less for clayey soils. The processed soil is stored in an airtight container for about 18 to 20 hours to enable moisture to spread uniformly in the soil mass.
- v. The mould with base plate fitted in is weighed. The process soil-water mixture is mixed thoroughly and divided into eight equal parts.
 - a) For light compaction the wet soils is compacted into the mould in three equal layers, each layer being given 25 blows of the 2.6 kg hammer, if 10 cm diameter mould is used. When the 15 cm diameter mould is used, 56 blows are given to each of the three layers by the 2.6 kg hammer.
 - b) For heavy compaction, the wet soil mix is compacted in the mould in five layers each layer being given 25 blows of 4.89 kg hammer when the 10 cm diameter of mould is used. When the 15 cm diameter mould is used, 56 blows are given to each of the five layers by 4.89 kg

hammer. The blows should be uniformly distributed over the surface of each layer. Each layer of the compacted soil is scored with a spatula before placing the soil for the succeeding layer. The amount of soil used should be just sufficient to fill the mould leaving about 5mm to be struck off on the top after compacting the final layer.

- c) The collar is removed and the compacted soil is leveled off to the top of the mould by means of the straight edge. The mould and the soil is then weighed. The soil is then ejected out of the mould and cut in the middle and a representative sample is taken in airtight container from the cut surface. The moisture content of this representative specimen is determined by finding the wet weight, keeping in the oven at 105° to 110°C and finding the dry weight the next day.
- d) This procedure is repeated five to six times using fresh part of the soil specimen and after adding a higher water content than the preceding specimen every time so that the last compaction is carried out at moisture 7 to 10 percent higher than estimated optimum moisture content.

Reporting Format:

COMPACTION TEST (MAXIMUM DRY DENSITY TEST) (IS:2720 PART-8)

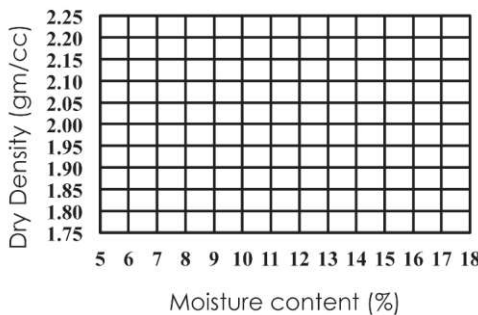
Sampled Location	:							
Source of Sample	:							
Date of testing	:							
Volume of Mould	:							
Type of Compaction	:							

Serial No.			1	2	3	4	5	6
Wt. of Mould	(g)							
Wt. of Mould + Soil	(g)							
Wt. of Soil	(g)							
Wet Density	(g/cc)							
Container No.								
Wt. of Container	(g)							
Wt. of C + Wet Soil	(g)							
Wt. of C + Dry Soil	(g)							
Wt. of Wet Soil	(g)							
Wt. of Dry Soil	(g)							
Wt. of Moisture	(g)							
Moisture Content	(%)							
Dry Density	(g/cc)							

Test Results:

Maximum dry density (MDD) g/cc =

Optimum moisture content (OMC) % =



Remarks:

Contractor

PWRD

CALIFORNIA BEARING RATIO (CBR) TEST (IS:2720 PART-16)

Object:

The CBR is a measure of resistance of a material to penetration of standard plunger under controlled density and moisture conditions. The test consists of causing a cylindrical plunger of 50mm diameter to penetrate a pavement component material at 1.25mm/minute. The loads, for 2.5mm and 5mm are recorded. This load is expressed as a percentage of standard load value at a respective deformation level to obtain CBR value.

Apparatus:

- Loading Machine: Any compression machine, which can operate at a constant rate of 1.25mm/minute, can be used. A metal penetration piston or plunger of diameter 50mm is attached to the loading machine.
- Cylindrical moulds: Moulds of 150mm diameter and 175mm height provided with a collar of about 50mm length and detachable perforated base are used for this purpose. A spacer disc of 148mm diameter and 47.7mm thickness is used to obtain a specimen of exactly 127.3mm height.
- Compaction Rammer: The material is usually compacted as specified for the work, either by dynamic compaction or by static compaction. The details for dynamic compaction suggested by the ISI are given.

Type of compaction	No. of layers	Hammer Wt. Kg	Fall, cm	No. of blows
Light compaction	3	2.6	31	56
Heavy compaction	5	4.89	45	56

- Adjustable stem, perforated plate, tripod and dial gauge: The standard procedure requires that the soil sample before testing should be soaked in water to measure swelling. For this purpose the above listed accessories are required.
- Annular weight: In order to simulate the effect of the overlaying pavement weight, annular weights each of 2.5 kg weight and 147mm diameter are placed on the top of the specimen, both at the time of soaking and testing the samples, as surcharge.

Procedure:

The CBR test may be performed either on undisturbed soil specimens obtained by fitting a cutting edge to the mould or on remoulded specimens. Remoulded soil specimens may be compacted either by static compaction or by dynamic compaction. When static compaction is adopted, the batch of soil is mixed with water to give the required moisture content; the correct weight of moist soil to obtain the desired density is placed in the mould and compaction is attained by pressing in the spacer disc using a compaction machine or jack. The preparation of soil specimens by dynamic compaction or ramming is more commonly adopted.

About 45 kg of material is dried and sieved through 19mm sieve. If there is note worthy proportion of materials retained on 19mm sieve, allowance for larger size materials is made by replacing it by an equal weight of material passing 19mm sieve and retained on 4.75mm sieve. The optimum moisture content and maximum dry density of the soil are determined by adopting either light compaction or heavy compaction as per the requirement.

Each batch of soil (of at least 5.5 kg weight for granular soil and 4.5 to 5.0 kg weight for fine grained soils) is mixed with water up to the optimum moisture content or the field moisture content if specified so. The spacer disc is placed at the bottom of the mould over the base plate and a coarse filter paper is placed over the spacer disc. The moist soil sample is to be compacted over this in the mould by adopting either the light compaction or heavy compaction.

- i. For IS light compaction or Proctor compaction the soil to be compacted is divided into three equal parts; the soil is compacted in three equal layers, each of compacted thickness about 44mm by applying 56 evenly distributed blows of the 2.6 kg rammer.
- ii. For IS heavy compaction or the modified Proctor compaction, the soil is divided into five equal parts; the soil is compacted in five equal layers, each of compacted thickness about 26.5mm by applying 56 evenly distributed blows of the 4.89 kg rammer. After compacting the last layer, the collar is removed and the excess soil above the top of the mould is evenly trimmed off by means of the straight edge. It is important to see if the excess soil to be trimmed off while preparing each specimen is of thickness about 5.0mm; if not the weight of soil taken for compacting each specimen is suitably adjusted for the repeat tests so that the thickness of the excess layer to be trimmed off is about 5.0mm. Any hole that develops on the surface due to the removal of coarse particles during trimming may be patched with smaller size material. Three such compacted specimens are prepared for the CBR test. About 100g of soil samples are collected from each mould for moisture content determination, from the trimmed off portion.

The clamps are removed and the mould with the compacted soil is lifted leaving below the perforated base plate and the spacer disc, which is removed. The mould with the compacted soil is weighed. A filter paper is placed on the perforated base plate, the mould with compacted soil is inverted and placed in position over the base plate (such that the top of the soil sample is now placed over the base plate) and the clamps of the base plate are tightened. Another filter paper is placed on the top surface of the sample and the perforated plate with adjustable stem is placed over it. Surcharge weights of 2.5 or 5.0 kg weight are placed over the perforated plate and the whole mould with the weights is placed in a water tank for soaking such that water can enter the specimen both from the top and bottom. The swell measuring device consisting of the tripod and the dial gauge are placed on the top edge of the mould and the spindle of the dial gauge is placed touching the top of the adjustable stem of the perforated plate. The initial dial gauge reading is recorded and the test set up is kept undisturbed in the water tank to allow soaking of the soil specimen for four full days or 96 hours. The final dial gauge reading is noted to measure the expansion or swelling of the soil specimen due to soaking.

The swell measuring assembly is removed, the mould is taken out of the water tank and the sample is allowed to drain in a vertical position for 15 minutes. The surcharge weights, the perforated plate with stem and the filter paper are removed. The mould with the soil sample is removed from the base plate and is weighed again to determine the weight of water absorption.

The mould with the specimen is clamped over the base plate and the same surcharge weights are placed on the specimen centrally such that the penetration test could be conducted. The mould with base plate is placed under the penetration plunger of the loading machine. The penetration plunger is seated at the center of the specimen and is brought in contact with the top surface of the soil sample by applying a seating load of 4.0 kg. The dial gauge for measuring the penetration values of the plunger is fitted in position. The dial gauge of the proving ring (for load readings) and the

penetration dial gauge are set to zero. The load is applied through the penetration plunger at a uniform rate of 1.25 mm/min. The load readings are recorded at penetration readings of 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.5, 10.0 and 12.5 mm. In case the load readings start decreasing before 12.5mm penetration, the maximum load value and the corresponding penetration value are recorded. After the final reading, the load is released and the mould is removed from the loading machine. The proving ring calibration factor is noted so that the load dial values can be converted into load in kg. About 50g of soil is collected from the top three cm depth of the soil sample for the determination of moisture content.

Reporting Format:

CALIFORNIA BEARING RATIO (CBR) TEST (IS:2720 PART-16)

Section/Location of Lab :	Surcharge Wt. :
Location of Sample :	O.M.C/N.M.C (%) :
Type of Test : Un-Soaked/Soaked	M.D.D./ F.D.D (g/cc) :Date of
Moulding :	97% OF M.D.D (g/cc) :
Date of Testing :	Type of Compaction :

C.B.R. Compaction: -

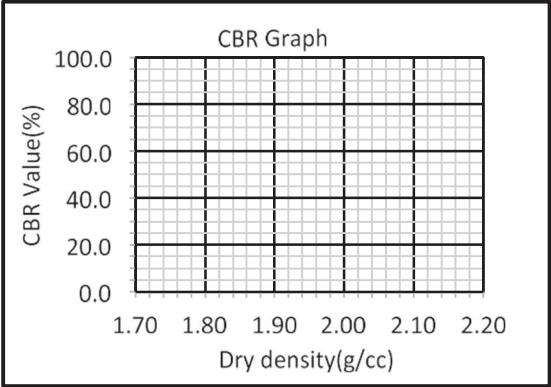
No. of Blows	10	30	65
Mould No			

Moisture Determination

Wt. of Mould (g)			
Wt. of Mould + Soil (g)			
Wt. of Soil (g)			
Volume of the mould (cc)			
Bulk density (g/cc)			
Container No.			
Wt. of Container (g)			
Wt. of C + Wet Soil (g)			
Wt. of C + Dry Soil (g)			
Moisture Content (%)			
Dry density (g/cc)			

TEST RESULTS:

CBR Value @ 97% of MDD =



Remarks:

PWRD

Contractor

PWRD

UNCONFINED COMPRESSIVE STRENGTH TEST (IS:2720 PART-10)

Object:

Determination of unconfined compressive strength.

Apparatus:

- a) Compression Device,
- b) Sample Ejector,
- c) Test sample mould (Circular cross section with diameter of 38mm and height 75mm),
- d) Deformation Dial Gauge (0.01mm sensitivity),
- e) Vernier Callipers,
- f) Timer.

Procedure:

The initial length, diameter and weight of the specimen shall be measured and the specimen placed on the bottom plate of the loading device. The upper plate shall be adjusted to make contact with the specimen. The deformation dial gauge shall be adjusted to zero. Force shall be applied so as to produce axial strain at a rate of 1.25mm per minute. Force and deformation readings shall be recorded at suitable intervals.

The specimen shall be compressed until failure surfaces have definitely developed or the stress-strain curve is well past its peak or until an axial strain of 20 percent is reached.

The failure pattern shall be sketched carefully and shown on the data sheet or on the sheet presenting the stress-strain plot. The angle between the failure surface and the horizontal may be measured, if possible, and reported.

Reporting Format:

UNCONFINED COMPRESSIVE STRENGTH TEST (IS:2720 PART-10)

Section/Location of Lab :				Date of Testing :			
Initial Height of Sample :				Rate of Strain :			
Initial Dia. of Sample :				Sample Code :			
OMC % :				MDD(g/cc) :			

Sampl e No.	Vol. of Sample	Weight of Sample	Container No	Container Wt	Wt. of Container + Wet Soil	Wt. of Container + Dry Soil	M.C %	dry g/cc
1								
2								
3								

Sl. No.	Strain Dial Gauge Reading (mm)	Stress Dial Gauge Readings (div.)		
		Sample 1	Sample 2	Sample 3
1	0.0			
2	0.2			
3	0.4			
4	0.6			
5	0.8			
6	1.0			
7	1.2			
8	1.4			
9	1.6			
10	1.8			
11	2.0			
12	2.2			
13	2.4			
14	2.6			



Sl. No.	Strain Dial Gauge Reading (mm)	Stress Dial Gauge Readings (div.)		
		Sample 1	Sample 2	Sample 3
15	2.8			
16	3.0			
17	3.2			
18	3.4			
19	3.6			
20	3.8			
21	4.0			
22	4.2			
23	4.4			
24	4.6			
25	4.8			
26	5.0			
27	5.2			
28	5.4			
29	5.6			
30	5.8			
Remarks:				
Contractor				
PWRD				

DETERMINATION OF FIELD DRY DENSITY OF SOIL BY SAND REPLACEMENT METHOD (IS:2720-PART 28)

Object:

Determination of field density by sand replacement method.

Apparatus:

- a) Sand pouring cylinder equipment:
 - (i) Small pouring cylinder: suitable for fine and medium grained soils. This consists of a metal cylinder of capacity 3 liters, 100mm in diameter and 380 mm length with an inverted funnel or cone at one end and a shutter to open and close the entry of sand and a cap on the other end. Metal tray to excavate the hole with suitable shape and size. Calibration container of the small pouring cylinder (size 100X150mm)
 - (ii) Large pouring cylinder: suitable for fine, medium and coarse grained soils. This consists a metal cylinder of capacity 16.5 liters, 200mm in diameter and 610mm length with all arrangements mentioned above. Calibration container size 200X250mm
 - (iii) Medium pouring cylinder: suitable for fine, medium and coarse grained soils. This cylinder with 150mm diameter and length 450mm. The calibration container size is 150X200mm.
- b) Tools for leveling and excavating: Hand tools such as scraper with handle for leveling the surface; a dibber or an elongated trowel for digging and excavating the material.
- c) Containers: Metal containers of any convenient size (about 150mm diameter and 200mm depth) with removable lid for collecting the excavated material.
- d) Sand: Dry and clean test sand of uniform gradation, passing 1.0mm and retained 600-micron sieve.
- e) Balance: A suitable balance of capacity 15 or 30 kg accuracy 1.0 g and necessary set of weights.

Procedure:

- (i) The site where the field density test is to be conducted is cleaned and leveled using a scraper for an area of about 450 mm square. The metal tray central hole is placed on the prepared surface. Using this central hole as a pattern, the soil/material is excavated using a dibber or a trowel up to a required depth and the loose material removed is carefully collected in the metal container and is weighed.
- (ii) The sand-pouring cylinder is refilled with sand such that its weight is again W_1 . The metal tray with the central hole is removed and the sand-pouring cylinder is placed centrally over the excavated hole. The shutter is opened till the sand fills the excavated hole and the cone completely and there is no further movement of sand in the cylinder. The shutter is closed, and the cylinder is weighed again, so that the weight of sand filling the excavated hole alone can be found.
- (iii) The moisture content of the excavated soil, $w\%$ is determined by taking a sample of soil from it in a moisture content dish, weighing, drying in oven at 110°C and re-weighing. Alternatively, the moisture content ($w\%$) is determined by placing the entire excavated soil collected from the hole (of weight W) in the oven and finding its dry weight = W_d .
- (iv) The above steps for the determination of the weights of excavated soil, the weight of the sand filling the hole and the weights of samples for the moisture content determination are repeated at least three times and the average values taken for the determination of field density (wet and dry) values.

Reporting Format:

DETERMINATION OF FIELD DRY DENSITY OF SOIL BY SAND REPLACEMENT METHOD (IS:2720-PART 28)

Source/Location of Lab:								
Material Source Details								
1	Borrow area Name/ Pit No /Any other Reference						Date:	
2	Optimum Moisture Content (OMC) % :						MDD. (g/cc):	
Pre-Test Data								
1	Chainage of Stretch (From Km - To Km)							
2	Layer No:							
3	Bulk Density of Sand, g_s (g/cc)							
4	Weight of sand in Cone w_3 (grams from lab)							
Field Density Determination								
Sl. No.	Description	Unit	Observations at Pit Location					
1	Chainage & Pit location	g						
2	Weight of wet soil from hole W	g						
3	Weight of sand with cylinder before pouring (W_1)	g						
4	Weight of sand with cylinder after pouring (W_2)	g						
5	Weight of sand in hole ($W_5=W_1-W_2-W_3$)	g						
6	Volume of the hole $V = W_5/g_s$	g						
7	Bulk Density of Soil $g_{bulk} = (W/V)$	g/cm ³						
Moisture Content Determination								
1	Container No.	-						
2	Weight of Container (W_4)	g						
3	Wt. of Container + wet soil (W_5)	g						
4	Weight of Container + dry Soil (W_6)	g						
5	Moisture Content ' w ' = $(W_5-W_6)/(W_6-W_4) \times 100$	%						
Test Results								
1	Dry Density $g_d = g_{bulk}/(1+w/100)$	g/cm ³						
2	Percentage Compaction = $(g_d/MDD) \times 100$	-						
3	Mean Density (g/cc)							
4	Compaction Density Required (g/cc) (97% of MDD)							
5	Standard Deviation, SD							
6	Acceptance Criteria {Mean > Required Compaction+ $[1.65 - (1.65/(\text{No of Samples})^{0.5})] \times \text{SD}$ }							
Remarks								
Contractor						PWRD		

DETERMINATION OF FIELD DRY DENSITY OF SOIL BY CORE CUTTER METHOD (IS:2720-PART 29)

Object:

To determine the field density by Core Cutter Method.

Apparatus:

- a) Cylindrical Core Cutter
- b) Steel Dolly
- c) Steel Rammer
- d) Balance, with an accuracy of 1 gm
- e) Straightedge
- f) Square metal tray – 300mm x 300mm x 40mm
- g) Trowel

Procedure:

- (i) The internal volume of the core cutter in cc should be calculated from its dimensions which should be measured to the nearest 0.25mm.
- (ii) The core cutter should be weighed to the nearest gram.
- (iii) A small area, approximately 30cm square of the soil layer to be tested should be exposed and levelled. The steel dolly should be placed on top of the cutter and the latter should be rammed down vertically into the soil layer until only about 15mm of the dolly protrudes above the surface, care being taken not to rock the cutter. The cutter should then be dug out of the surrounding soil, care being taken to allow some soil to project from the lower end of the cutter. The ends of the soil core should then be trimmed flat in level with the ends of the cutter by means of the straightedge.
- (iv) The cutter containing the soil core should be weighed to the nearest gram.
- (v) The soil core should be removed from the cutter and a representative sample should be placed in an air-tight container and its water content determined.

Note: Average of at least three determinations should be reported to the second place of decimal in g/cc.

Reporting Format:

DETERMINATION OF FIELD DRY DENSITY OF SOIL BY CORE CUTTER METHOD (IS:2720-PART 29)

Reduced level:		Layer No.			MDD = g/cc		
Bulk Density: g/cc		Layer Thickness			OMC = %		
No.	CHAINAGE	Unit	1	2	3	4	5
1	Mass of mould+Compacted soil	g					
2	Mass of mould	g					
3	Mass of compacted soil (2-1)	g					
4	Volume of mould	cc					
5	Wet Density of soil (3/4)	g/cc					
	Moisture Determination	-					
6	Wt. Wet soil	g					
7	Wt. Dry soil	g					
8	Wt. Water (6)-(7)	g					
9	Moisture content (8)/(7)x100	%					
10	Field Dry density of soil (5)/1+(9)/100	g/cc					
Degree of Compaction (10/MDD x 100)		%					
Average degree of Compaction :							
Standard Deviation :							
REMARKS:							
Contractor				PWRD			

AGGREGATE IMPACT VALUE TEST (IS: 2386 PART-IV)

Object:

To determine the toughness of road stone materials by Impact test.

Apparatus:

- a) Impact testing machine: The machine consists of a metal base with a plane lower surface supported well on a firm floor, without rocking. A detachable cylindrical steel cup of internal diameter 102mm and depth 50mm is rigidly fastened centrally to the base plate. A metal hammer of weight between 13.5 and 14.0 kg having the lower end cylindrical in shape, 100mm in diameter and 50mm long, with 2mm chamfer at the lower edge is capable of sliding freely between vertical guides, and fall concentric over the cup. There is an arrangement for raising the hammer and allowing it to fall freely between vertical guides from a height of 380mm on the test sample in the cup, the height of fall being adjustable up to 5mm. A key is provided for supporting the hammer while fastening or removing the cup.
- b) Measure: A cylindrical metal measure having internal diameter 75mm and depth 50mm for measuring aggregates.
- c) Tamping rod: A straight metal tamping rod of circular cross section, 10mm in diameter and 230mm long, rounded at one end.
- d) Sieve: IS sieve of sizes 12.5mm, 10mm, and 2.36mm for sieving the aggregates.
- e) Balance: A balance of capacity not less than 500 gm to weigh accurate up to 0.1 gm.
- f) Oven: A thermostatically controlled drying oven capable of maintaining constant temperature between 100°C to 110°C.

Procedure:

The test sample consists of aggregates passing 12.5mm sieve and retained on 10mm sieve and dried in an oven for four hours at a temperature 100°C to 110°C and cooled. Test aggregates are filled up to about one-third full in the cylindrical measure and tamped 25 times with rounded end of the tamping rod. Further quantity of aggregates is then added up to two-third full in the cylinder and 25 strokes of the tamping rod are given. The measure is now filled with the aggregates to over flow, tamped 25 times. The surplus aggregates are struck off using the tamping rod as straight edge. The net weight of the aggregates in the measure is determined to the nearest gram and this weight of the aggregates is used for carrying out duplicate test on the same material. The impact machine is placed with its bottom plate flat on the floor so that the hammer guide columns are vertical. The cup is fixed firmly in position on the base of the machine and the whole of the test sample from the cylindrical measure is transferred to the cup and compacted by tamping with 25 strokes.

The hammer is raised until its lower face is 380mm above the upper surface of the aggregates in the cup, and allowed to fall freely on the aggregates. The test sample is subjected to a total 15 such blows, each being delivered at an interval of not less than one second. The crushed aggregate is then removed from the cup and the whole of it sieved on the 2.36mm sieve. The fraction passing the sieve is weighed accurate to 0.1gm. The fraction retained on the sieve is also weighed and if the total weight of the fractions passing and retained on the sieve is added it should not be less the original weight of the specimen by more than one gram, if the total weight is less than the original by over one gram the results should be discarded and a fresh test made.

Reporting Format:

AGGREGATE IMPACT VALUE TEST (IS: 2386 PART-IV)

Location/Section of Lab: Sample Location: Purpose of Use: Sample size: 12.5 mm Passing & 10 mm retained			Source of Material : Date of testing :		
Description	Symbol	unit	Determinations		
			1	2	3
Weight of aggregate(dry) passing through IS Sieve 12.5 mm & retained on 10 mm	W_1	g			
Weight of fraction retained on 2.36 mm IS sieve	W_2	g			
Weight of fraction passing through 2.36 mm IS sieve	$W_3 = W_1 - W_2$	g			
$W_4 = W_1 - (W_2 + W_3)$ (if $W_4 > 1g$, discard and carry out fresh test)	W_4	%			
Aggregate Impact value	$(W_3/W_1) \times 100$	%			
Average Aggregate Impact value					
Remarks:					
Contractor PWRD					

FLAKINESS INDEX AND ELONGATION INDEX (IS:2386 PART-I)

Object:

To determine the flakiness and elongation of the aggregates by standard flakiness gauge and elongation gauges.

Apparatus:

- a) Flakiness gauge (Thickness gauge): The Flakiness index of aggregates is the percentages by weight of particles whose least dimension is less than three-fifths (0.6) of their mean dimension. The test is not applicable to sizes smaller than 6.3mm. The apparatus consists of a standard thickness gauge of IS sieve sizes 63, 50, 40, 31.5, 25, 20, 16, 12.5, 10 and 6.3mm and a balance to weigh the samples.
- b) Elongation gauge (Length gauge): The elongation index of aggregate is the percentage by weight of particles whose greatest dimension (length) is greater than one and four fifth times (1.8) their mean dimension. The elongation test is not applicable to sizes smaller than 6.3mm. The apparatus consists of a standard length gauge of IS sieve sizes 50, 40, 31.5, 25, 20, 16, 12.5, 10 and 6.3mm.

Procedure:

- (i) Flakiness Index: The sample is sieved with the sieves mentioned in above. A minimum of 200 pieces of each fraction to be tested is taken and weighed. In order to separate flaky materials, each fraction is then gauged for thickness on a thickness gauge. The amount of flaky material passing the gauge is weighed to an accuracy of at least 0.1 percent of the test sample.
- (ii) Elongation Index: The sample is sieved through the IS sieves specified as above. A minimum of 200 pieces of each fraction is taken and weighed. In order to separate elongated material, each fraction is then gauged individually for length in a length gauge. The pieces of aggregates from each fraction tested which could not pass through the specified gauge length with its long side are elongated particles and are collected separately to find the total weight of aggregates retained on the length gauge from each fraction. The total amount of elongated material retained by the length gauge is weighed to an accuracy of at least 0.1 percent of the weight of the sample.
- (iii) Combined Flakiness & Elongation Index: To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particle is separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

Reporting Format:

FLAKINESS INDEX AND ELONGATION INDEX (IS:2386 PART-I)

Section/Location of Lab :		Purpose of Use :			
Sampling location :		Date of Sampling :			
Source of Materials :		Date of Testing :			
Type of Material :					

IS: Sieve Size mm		Total Weight of Aggregate taken (g)	Weight of Aggregate retained on Thickness gauge (g)	Weight of Aggregate passing through Thickness gauge (g)	Weight of Aggregate retained on length gauge after retained on Thickness gauge (g)
Passing	Retained				
63	50				
50	40				
40	31.5				
31.5	25				
25	20				
20	16				
16	12.5				
12.5	10				
10	6.3				
Total (gm)		A=	B=	C=	D=
Flakiness Index (C/A) =			Elongation Index (D/B) =		
Combined Flakiness and Elongation Indices = ((C/A) + D/B) X 100 =					
Remarks:					
Contractor			PWRD		

GRADATION OF COARSE AGGREGATES (IS:2386 PART-1)

Object:

To determine the Gradation of Coarse Aggregates

Apparatus:

- a) The apparatus consists of IS sieve sizes 80mm, 63mm, 50mm, 40mm, 20mm, 16mm, 12.5mm, 10mm, 6.3mm, 4.75mm, 2.36mm, 1.18mm, 600microns, 425 microns, 300 microns, 150 microns and 75 microns.
- b) Balance: The Sufficient capacity and having accuracy 1gram.

Procedure:

- (i) The minimum sample to be taken for sieving obtained by quartering or by means of a sample divider.
- (ii) Take the sample of aggregate and weigh to the nearest gram.
- (iii) Take the sieves for gradation analysis and place these one over another i.e; larger size sieves on the top.
- (iv) Care should be taken, that the sieves are clean before use.
- (v) If sieving is carried out by hand, then each sieve should be taken separately over a clean tray and sieving carried out for a period of not less than 2 minutes.
- (vi) The shaking should be done with a varied motion backwards and forwards left to right circular clockwise and anticlockwise with frequent jerking, so that the material is kept moving over the sieve surface in frequently changing directions.
- (vii) Material smaller than 20 mm should not be helped through the sieve by hand or by brushing.
- (viii) If lumps of fine material are present it may be broken with gentle pressure with fingers against the side of the sieve.
- (ix) If sieving is carried out by a mechanical sieve shaker, then it should be carried out for a period of not less than 10 minutes.
- (x) On completion of sieving the material retained on each sieve shall be weighed to the nearest gram.

Reporting Format:

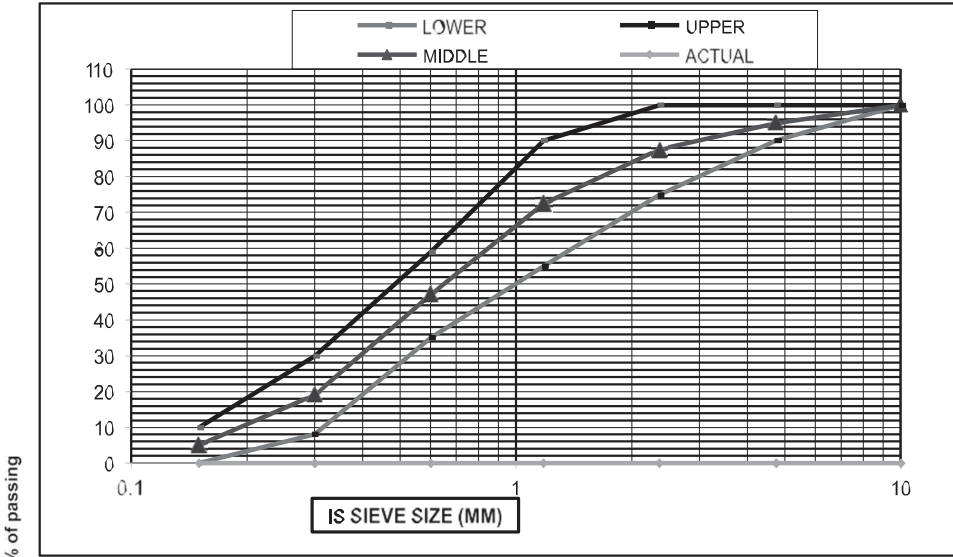
GRADATION OF COARSE AGGREGATES (IS:2386 PART-1)

Location of Lab :					Date of Sampling:			
Location/Chainage :					Source of Material:			
Date of Testing :					Total wt. of sample (g):			
Sieve size (mm)	Wt. Retained (g)	Cumulative wt. Retained = (g)	% Cumulative wt. Retained	% passing	Specified % of passing			
					40mm	20mm	12.5mm	10mm
63mm					100	-	-	-
40mm					85-100	100	-	-
20mm					0-20	85-100	-	-
16mm					-	-	100	-
12.5mm					-	-	85-100	100
10.0mm					0-5	0-20	0-45	85-100
4.75mm					-	0-5	0-10	0-20
2.36mm					-	-	-	0-5
Remarks:								
Contractor					PWRD			

SIEVE ANALYSIS OF FINE AGGREGATE (IS: 383)

Location of Lab :				Date of Sampling :			
Location/Chainage :				Source of Material Total :			
Date of Testing :				wt. of sample (g) :			

IS Sieve Size (mm)	Wt. of Material Retained (g)	Cum. Wt. of Material Ret. (g)	Cum. % of Material Retained	Percentage Weight of Passing			
				As per Test	Specification Limits (1000-2)		
					ZONE-I	ZONE-II	ZONE-III
10.00					100	100	100
4.75					90-100	90-100	90-100
2.36					60-95	75-100	85-100
1.18					30-70	55-90	75-100
0.60					15-34	35-59	60-79
0.30					5-20	8-30	12-40
0.15					0-10	0-10	0-10
FINENESS MODULUS							



The graph plots the percentage of material passing through various sieve sizes (0.15 mm to 10 mm) against the sieve size in millimeters on a logarithmic scale. Four curves are shown: LOWER (solid line with circles), MIDDLE (solid line with triangles), UPPER (solid line with squares), and ACTUAL (dashed line with diamonds). The y-axis represents '% of passing' from 0 to 110, and the x-axis represents 'IS SIEVE SIZE (MM)' from 0.1 to 10. The ACTUAL curve is plotted within the specification limits defined by the UPPER and LOWER curves.

Remarks:

Contractor **PWRD**

DELETERIOUS MATERIALS AND ORGANIC IMPURITIES (IS:2386 PART-II)

Object:

Determination of Deleterious materials and organic impurities.

Apparatus:

- 1) Balance – sensitive to 0.001 g,
- 2) Containers – size and shape that will permit the spreading of the sample on the bottom in a thin layer
- 3) Sieves – conforming to IS : 460-1962.

Procedure:

The sample shall be spread in a thin layer on the bottom of the container and examined for clay lumps. Any particles, which can be broken into finely divided particles with the fingers, shall be classified as clay lumps. After all discernible clay lumps have been broken, the residue from the clay lumps shall be removed by the use of sieves indicated below:

Size of Particles Making up the Sample	Size of Sieve for Sieving Residue of Clay Lumps
Fine aggregate (retained on 1.18mm IS sieve)	850 - micron
4.75 to 10 mm	2.36 mm
10 mm to 20 mm	4.75 mm
20 mm to 40 mm	4.75 mm
Over 40 mm	4.75 mm

Reporting Format:

DELETERIOUS MATERIALS AND ORGANIC IMPURITIES (IS:2386 PART-II)

Section/Location of Lab	:	Purpose of Use	: :	
Location/Chainage	:	Date of Sampling	: :	
Source of material	:	Date of testing	: :	
Description of material	:			

S. NO	DETERMINATION NO.	1	2	AVERAGE
1	Total weight of sample (W) g			
2	Total weight of sample after removing clay lumps (R) g			
3	Percentage of clay (%); (L = (W – R)/(W) x 100)			

Remarks:

Contractor
PWRD

SOUNDNESS TEST BY USING SODIUM SULPHATE (IS:2386 PART-V)

Object:

Determination of the soundness of aggregates.

Apparatus:

The apparatus required for the test are containers for aggregates, sieves (63, 50, 40, 31.5, 20, 16, 10, 8, 4.75 and 4mm), balance of capacity 5kg to weight accurate to at least 0.1g and oven to maintain 105°C to 110°C.

Procedure:

Saturated solution of Sodium sulphate (the anhydrous Na_2SO_4 or the crystalline $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$) is prepared in water at a temperature of 25 to 30°C. The solution is maintained at a temperature of 27°C $\pm$ 2°C and stirred at frequent intervals, until it is used. At the time of using the solution should have a specific gravity of not less than 1.151 and not more than 1.171, and discolored solution should not be used. It may be necessary to use not less than 420g of anhydrous salt or 1300g of the crystalline decahydrate salt per liter of water.

Alternatively saturated solution of Magnesium sulphate may be prepared by dissolving either anhydrous (MgSO_4) or crystalline ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$) magnesium sulphate. At the time of using, the solution should have a specific gravity of not less than 1.295 and not more than 1.308. Not less than 400g of the anhydrous salt or 1600g of the crystalline heptahydrate may be used per liter of water.

The specimen of coarse aggregate for the test may be prepared after removing the fraction finer than 4.75mm IS sieve. The sample should be of such a size that it would yield not less than the following amounts of the different sizes, which should be available in amount of 5 percent or more.

- | | | | | |
|-------|---------------------------|---|--------|--------------------------------|
| (i) | 20mm to 10mm | - | 1000 g | |
| | 10mm to 4.75mm | - | 300 g | consisting |
| | | | | of 20 to 12.5mm – 67% |
| | | | | 2.5 to 10mm – 33% |
| (ii) | 40mm to 20mm | - | 1500 g | |
| | | | | consisting of 40 to 25mm – 67% |
| | | | | 25 to 20mm – 33% |
| (iii) | 63mm to 40mm | - | 3000 g | |
| | | | | consisting of 63 to 50mm – 50% |
| | | | | 50 to 40mm – 50% |
| (iv) | 80mm and large sizes by | | | |
| | 20mm spread in sieve size | | | |
| | each fraction | | | |
| | | | | } - 3000 g |

The sample of coarse aggregate should be thoroughly washed and dried to a constant weight at 105 to 110°C and is separated to different size ranges, as given above, by sieving. The proper weight of the sample for each fraction is weighed and placed in separate containers for the test. In the case of fraction coarser than 20mm, the particles are also counted. The samples are immersed

in the prepared solution of sodium sulphate or magnesium sulphate for 16 to 18 hours in such a manner that the solution covers them to a depth of at least 15mm. The containers are kept covered to reduce evaporation and during the period of immersion, the temperature of the solution is maintained at $270 \pm 10^\circ\text{C}$.

After the immersion period, the aggregates are removed from the solution, drained for about 15 minutes, and placed in the drying oven maintained at a temperature of 1050 to 1100°C . The samples are dried to a constant weight at this temperature by checking the weights after 4 hours up to 18 hours. When the successive weights differ by less than 1 g, it may be considered that constant weight has been attained and then it may be allowed to cool to room temperature. Then the aggregates are again immersed in the prepared solution, for the next cycle of immersion and drying. The number of cycles of alternate immersion and drying are minimum 5 for road aggregates.

After completion of the final cycle, the sample is cooled washed free from the sulphate. This may be determined when there is no more reaction of the wash water with barium chloride (i.e., when there is no white precipitation when barium chloride is added to wash water, it can be said that there is no sulphate with wash water). Each fraction of the sample is then dried to constant temperature of 1050 to 1100°C and weighed. Coarse aggregate fractions are sieved by IS sieves of sizes indicated below:

Size of Aggregate	Sieve Size used to determine Loss
63 – 40 mm	31.5 mm
40 – 20 mm	16 mm
20 – 10 mm	8 mm
10 – 4.75 mm	4 mm

Each fraction of aggregate is examined visually to see if there is any evidence of excessive splitting, crumbling or disintegration of the grains. A combined sieve analysis of all the materials subjected to the above test cycles, may also be carried out to note the variation from the original grain size distribution of the sample.

Reporting Format:

SOUNDNESS TEST BY USING SODIUM SULPHATE (IS:2386 PART-V)

Location of Lab	:	Date of Sampling Source	:			
Location/Chainage	:	of Material Tested by	:			
Type of material	:	Proposed Use	:			
Date of Testing	:					
COARSE AGGREGATE						
Passing sieve size	Retained sieve size	Grading of Original Sample Percent	Weight of Test Fraction Before Test (g)	Weight of Test Fraction After Test (g)	Percentage Passing Finer Sieve After Test (Actual Percentage Loss)	Weighted Average (Corrected Percent Loss)
63mm	40mm					
40mm	20mm					
20mm	10mm					
10mm	4.75mm					
Total						

Passing sieve size	Retained sieve size	Grading of Original Sample Percent	Weight of Test Fraction Before Test (g)	Weight of Test Fraction After Test (g)	Percentage Passing Finer Sieve After Test (Actual Percentage Loss)	Weighted Average (Corrected Percent Loss)
600 mic	300mic					
1.18 mm	600mic					
2.36mm	1.18mm					
4.75mm	2.36mm					
10mm	4.75mm					
Total						
Remarks: 						
Contractor						PWRD

SPECIFIC GRAVITY & WATER ABSORPTION OF FINE AGGREGATES (IS:2386 PART-III)

Object:

Determination of the water absorption and Specific gravity.

Apparatus:

- 1) Balance and Oven.
- 2) A glass vessel (Pycnometer) of about 1 litre capacity having a metal conical screw top with a 6 mm diameter hole at its apex. The screw top shall be watertight when it is screwed on to the jar, and, if necessary, a rubber or fibre washer shall be inserted in the joint. If such a washer is used, a mark shall be made on the jar to correspond with the mark on the screw top so that the screw is tightened to the same position every time and the volume contained by the air is constant throughout the test.
- 3) A means of supplying a current of warm air, such as a hair dryer.
- 4) A tray of area not less than 325 sqcm.
- 5) A airtight container large enough to take the sample.
- 6) Filter papers and funnel.

Procedure:

- (i) A sample of about 1 kg for 10 mm to 4.75 mm or 500 g if finer than 4.75 mm shall be placed in a tray and covered with distilled water at a temperature of 22°C to 32°C. Soon after immersion, air entrapped in or bubbles on the surface of the aggregate shall be removed by gentle agitation with a rod. The sample shall remain immersed for $24 \pm \frac{1}{2}$ hours.
- (ii) The water shall then be carefully drained from the sample, by decantation through filter paper and any material retained returned to the sample. The aggregate including any solid matter retained on the filter paper shall be exposed to a gentle current of warm air to evaporate surface moisture and shall be stirred at frequent intervals to ensure uniform drying until no free surface moisture can be seen and the material just attains a free running condition. The saturated and surface dry sample shall be weighed.
- (iii) The aggregate shall then be placed in the pycnometer, which shall be filled with distilled water. Any trapped air shall be eliminated by rotating the pycnometer on its side, the hole in the apex of the cone being covered with a finger. The pycnometer shall be topped up with distilled water to remove any froth from the surface and so that the surface of the water in the hole is flat. The pycnometer shall be dried on the outside and weighed.
- (iv) The contents of the pycnometer shall be emptied into the tray, care being taken to ensure that all the aggregate is transferred. The pycnometer shall be refilled with distilled water to the same level as before, dried on the outside and weighed. The difference in temperature of the water in the pycnometer during the first and second weighing shall not exceed 2°C.
- (v) The water shall then be carefully drained from the sample by decantation through a filter paper and any material retained returned to the sample. The sample shall be placed in the oven in the tray at a temperature of 100°C to 110°C for $24 \pm \frac{1}{2}$ hours, during which period it shall be stirred occasionally to facilitate drying. It shall be cooled in an airtight container and weighed.

Reporting Format:

SPECIFIC GRAVITY & WATER ABSORPTION OF FINE AGGREGATES (IS:2386 PART-III)

Section/Location of Lab Source	:	Proposed Use	:	
Location	:	Date of sampling	:	
	:	Date of testing	:	
BY PYCNOMETER METHOD				
Description		1	2	3
Pycnometer Bottle Number				
Weight of SSD Sample (W_1) (g)				
Weight of Pycnometer bottle + water + Sample(W_2) (g)				
Weight of Pycnometer bottle + water (W_3) (g)				
Weight of oven dry sample (W_4) (g)				
Bulk Specific Gravity = $W_4 / (W_1 - (W_2 - W_3))$				
Apparent Specific Gravity = $W_4 / (W_4 - (W_2 - W_3))$				
Water Absorption = $(W_1 - W_4) / W_4 * 100$				
Average Specific Gravity				
Average Water absorption (%)				
Remarks:				
Contractor		PWRD		

SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES (IS:2386 PART-III)

Object:

To determine the specific gravity and water absorption of aggregates.

Apparatus:

- a) A wire basket of not more than 6.3mm mesh or a perforated container of convenient size with thin wire hangers for suspending it from the balance.
- b) A thermostatically controlled oven to maintain temperature of 100° to 110°C.
- c) A container for filling water and suspending the basket.
- d) An airtight container of capacity similar to that of the basket.
- e) A balance of capacity about 5 kg, to weigh accurate to 0.5 g, and of such a type and shape as to permit weighing of the sample container when suspended in water.
- f) A shallow tray and two dry absorbent clothes, each not less than 750 X 450 mm.

Procedure:

About 2 kg of the aggregate sample is washed thoroughly to remove fines, drained and then placed in the wire basket and immersed in distilled water at a temperature between 22 to 32°C with a cover of at least 50mm of water above the top of the basket. Immediately after immersion the entrapped air is removed from the sample by lifting the basket containing it 25mm above the base of the tank and allowing it to drop 25 times at the rate of about one drop per second. The basket and the aggregate should remain completely immersed in water for a period of 24 +/- 0.5 hours afterwards.

The basket and the sample are then weighed while suspended in water at a temperature of 22 to 32°C. In case it is necessary to transfer the basket and the sample to a different tank for weighing, they should be jolted 25 times as described above in the new tank to remove air before weighing. This weight is noted while suspended in water W1 g. The basket and the aggregate are then removed from water and allowed to drain for a few minutes, after which the aggregates are transferred to one of the dry absorbent clothes. The empty basket is then returned to the tank of water, jolted 25 times and weight in water W2 g.

The aggregates placed on the absorbent clothes are surface dried till no further moisture could be removed by this cloth. Then the aggregates are transferred to the second dry cloth spread in a single layer, covered and allowed to dry for at least 10 minutes until the aggregates are completely surface dry. 10 to 60 minutes drying may be needed. The aggregates should not be exposed to the atmosphere, direct sunlight or any other source of heat while surface drying. A gentle current of unheated air may be used during the first ten minutes to accelerate the drying of aggregate surface. The surface dried aggregate is then weighed W3 g. The aggregate is placed in a shallow tray and kept in an oven maintained at a temperature of 110°C for 24 hours. It is then removed from the oven, cooled in an airtight container and weighed W4 g. At least two tests should be carried out, but not concurrently.

Reporting Format:

SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES (IS:2386 PART-III)

PROJECT	:		
Type of Sample	: (Rock sample/ Aggregate)		
Sample Location	:		
Co-ordinate/Chainage	:		
Date of Sampling	:		
Date of Testing	:		
Determination			
Before Soaking			
Weight of sample in air (W_1)g			
Weight of sample in water (W_2)g			
Volume of Specimen ($V = W_2 - W_1$) cc			
After Soaking			
Weight of SSD sample in water (W_3)g			
S.S.D weight of sample (W_4)			
Volume of specimen $V = (W_4 - W_3)$ cc			
Bulk Density of sample			
Weight of Oven dried Sample (W_5)g			
Moisture Content (w)%			
Dry density $\gamma_d = \gamma_b / 1 + (w/100)$			
Specific Gravity of sample (G)			
Apparent Specific gravity (G_m)			
Water Absorption			
Void ratio (e)			
Porosity = $(e/1+e) \times 100$			
Remarks:			
Contractor		PWRD	

10% FINES VALUE TEST (BS: 812 PART-III)

Object:

To determine the ten percent value of aggregates by crushing machine apparatus.

Apparatus:

- a) Steel cylinder with open ends, and internal diameter 152mm, square base plate, plunger having a piston of diameter 150mm, with a hole provided across the stem of the plunger so that a rod could be inserted for lifting or placing the plunger in the cylinder.
- b) Cylindrical measure having internal diameter of 115mm and height 180mm.
- c) Steel tamping rod with one rounded end, having a diameter of 16mm and length 450 to 600mm.
- d) Balance of capacity 3 kg with accuracy up to 1gm.
- e) Compressive testing machine capable of applying load of 40 tonnes, at a uniform rate of loading of 4 tonnes per minute

Procedure:

The aggregate passing 14mm IS sieve and retained on 10mm IS sieve is selected for test. The aggregate should be in surface-dry condition before testing. The aggregate may be dried by heating at a temperature 100°C to 110°C for a period of 4 hours and is tested after being cooled to room temperature.

The cylindrical measure is filled by the test sample of aggregate in three layers of approximately equal depth, each layer being tamped 25 times. The same sample poured in to the cylinder with three equal layers, each layer being tamped 25 times. The test sample in the cylinder with the plunger in position is placed in the compression-testing machine. The load is applied at a uniform rate so as to cause a total penetration of the plunger of about 20mm for normal crushed aggregates in 10 minutes. But for rounded or partially rounded aggregates, the load required to cause a total penetration of 15mm is applied where as for honeycombed aggregate like expanded shale or slag that for a total penetration of 24mm is applied in 10 minutes. After the maximum specified penetration is reached, the load is released and the aggregate from the cylinder is sieved on a

2.36mm IS sieve. The fines' passing this sieve is weighed and is expressed as a percentage by weight of the test sample. This percentage normally falls in the range of 7.5 to 12.5; but if it does not fall in this range, the test is repeated with necessary adjustment of the load.

Two tests are carried out at the load 'X tonnes', which give the percentage fines between 7.5 to 12.5 and let the mean of the percent fines be 'Y' for calculating the load required for ten percent fines.

Load for 10 percent fines = $14 X / (Y + 4)$

Reporting Format:

10% FINES VALUE TEST (BS: 812 PART-III)

Location of Lab	:	te of sampling	:
Location/Chainage Date	:	urce of Material	:
of Testing	:	oposed Use	:
Determination	Trial No		
	1	2	3
Weight of Saturated surface dry Sample passing IS Sieve 14 mm and retained on IS Sieve 10mm (A) g			
Oven dried weight of fraction retained on IS Sieve 2.36 mm after the test (g)			
Oven dried weight of fraction passing IS Sieve 2.36 mm after the test (B) g			
The Maximum force 'X' (Tonne)			
Y = % of material passing IS Sieve 2.36 mm at the maximum force (B/A X100)			
10 % Fines Value (TFV) = $14X / (Y+4)$ (kN)			
Average Value of 10 % Fines Value (kN)			
Remarks:			
Contractor PWRD			

FINENESS OF CEMENT (IS:4031 PART-1)

Object:

To determine the fineness of cement by dry sieving.

Apparatus:

- a) Standard balance with 100 gm. weighing capacity.
- b) IS : 90 micron sieve confirming to IS : 460 – 1962 and a Brush

Procedure:

- (i) Break down any air-set lumps in the cement sample with fingers.
- (ii) Weigh accurately 100 gms of the cement and place it on a standard 90 micron IS.sieve.
- (iii) Continuously sieve the sample for 15 minutes.
- (iv) Weigh the residue left after 15 minutes of sieving. This completes the test.

Reporting Format:

Section/Location of Lab	:					
Description of cement	:			Date of Sampling	:	
No.	:			Date of testing	:	
OBSERVATIONS:						
S. No.	DESCRIPTION	1	2	3	AVERAGE (%)	SPECIFIED LIMITS AS PER IS: 8112
1	Wt. of Sample taken (W_1) gm					Max. 10%
2	Wt. of residue on 90 μ sieve (W_2) gm					
3	Fineness (%) (W_2/W_1) X100					
Remarks:						
Contractor						PWRD

NORMAL CONSISTENCY OF CEMENT (IS:4031 PART-V)

Object:

Determination of the quantity of water required to produce a cement paste of standard consistency.

Apparatus:

Vicat apparatus (confirming to IS : 5513 – 1968) with plunger (10mm in dia.).

Procedure:

Prepare a paste of weighted quantity of cement (350 gms) with a weighted quantity of water, start with 30% water of 350 gms of cement taking care that the time of gauging is not less than 3 minutes and not more than 5 minutes and the gauging shall be completed before any sign of setting occurs. The gauging time shall be counted from the time of adding the water to the dry cement until commencing to fill the mould. Fill the vicat mould with this paste, the mould resting upon a non- porous plate. After completely filling the mould, trim off the surface of the paste, making it in level with the top of the mould. The mould may slightly be shaken to expel the air.

Place the test block with the mould, together with the non-porous resting plate, under the rod bearing the plunger (10mm dia.) lower the plunger gently to touch the surface of the test block and quickly release, allowing it to penetrate into the paste. This operation shall carried out immediately after filling the mould.

Prepare trial pastes with varying percentages of water and test as described above until the amount of water necessary for making the standard consistency as defined above is obtained. Express the amount of water as a percentage by weight of the dry cement.

Note: Use clean appliances for gauging. The temperature of cement and water and that of test room, at the time when the above operations are being performed, shall be 27°C +/- 2°C. the room temperature shall be maintained at 27°C +/- 2°C.

Reporting Format:

NORMAL CONSISTENCY OF CEMENT (IS:4031 PART-V)

Section/Location of Lab		:			
Description of cement Week		:		Date of Sampling	:
No.		:		Date of testing	:
Temperature (°C)		:	28°C		
<u>NORMAL CONSISTENCY</u>					
Sl. No.	Weight of Cement taken (g)	Weight of water taken (g)	Plunger penetration from bottom of Mould (mm)	Time taken from adding water to Cement (min)	Consistency of Cement (%)
1					
2					
3					
Remarks:					
Contractor PWRD					

INITIAL AND FINAL SETTING TIME OF CEMENT (IS:4031 PART-V)

Object:

Determination of the Initial and Final setting times of cement.

Apparatus:

The vicat apparatus (conforming to IS : 5513 – 1968).

Procedure:

Preparation of Test Block: Prepare a neat cement paste by gauging 350 gms of cement with

0.85 times the water required to give a paste of standard consistency. The paste shall be gauged in the manner and under the conditions prescribed in determination of consistency of standard cement paste. Start a stopwatch at the instant when water is added to the cement. Fill the mould with the cement paste gauged as above, the mould resting on a non-porous plate, fill the mould completely and smooth off the surface of the paste making it level with the top of the mould. The cement block thus prepared in the mould is the test block.

Use clean appliances for gauging. The temperature of water and that of the test room, and the time gauging, shall be $27^{\circ}\text{C} \pm 2^{\circ}\text{C}$.

During the test, the block shall be kept at a temperature of $27^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and at not less than 90% relative humidity.

Determination of Initial Setting Time: Place the test block confined in the mould and resting on the non-porous plate, under the rod bearing initial setting needle, lower the needle gently in contact with the surface of the test block and quickly release, allowing it to penetrate into the test block. In the beginning the needle will completely pierce the test block. Repeat this procedure until the needle, when brought in contact with the test block and released as described above, fails to pierce the block for 5 ± 0.5 mm measured from the bottom of the mould. The period lapsing between the time water is added to the cement and the time at which the needle fails to pierce the test block by 5 ± 0.5 mm shall be the initial setting time.

Determination of Final Setting Time: Replace the needle of the vicat apparatus by the needle with an annular ring. The cement shall be considered as finally set when, upon applying the needle gently to the surface of the test block, the needle makes an impression thereon, while the outer ring fails to do so. The period elapsing between the time when water is added to the cement and the time at which the needle makes an impression on the surface of the test block while the attachment fails to do so, shall be the final setting time.

Reporting Format:

INITIAL AND FINAL SETTING TIME OF CEMENT (IS:4031 PART-V)

Location of Lab	:							
Description of cement	:							
Week No.	:		Date of Sampling	:				
Temperature (°C): 28°C			Date of testing	:				
A) INITIAL SETTING TIME								
Weight of Cement taken (g):								
Weight of water added = 0.85 of Normal Consistency:								
A) INITIAL SETTING TIME				B) FINAL SETTING TIME				
S. No.	Time of water added	Needle penetration (mm)	Initial Setting Time (min)		S. No.	Time of water added	Needle penetration (mm)	Final Setting Time (min)
1					1			
2					2			
3					3			
4					4			
5					5			
Initial Setting time:				Final Setting time:				
Acceptance Criteria:								
Initial Setting Time		: $\geq 30\text{min}$						
Final Setting Time		: $\leq 600\text{min}$						
Remarks:								
Contractor				PWRD				

SOUNDNESS OF CEMENT BY LE-CHATELIER METHOD (IS:4031 PART-III)

Object:

Determination of the Soundness of cement by the Le Chatelier method.

Apparatus:

The apparatus for conducting the test consists of small split cylinder of spring brass or other suitable metal of 0.5 mm thickness, forming a mould 30 mm internal diameter and 30 mm high. On either side of the split mould are attached two indicators with pointed ends, the distance from these ends to the center of the cylinder being 165 mm. The mould shall be kept in good condition with the Jaws not more than 0.50 mm apart.

Procedure:

Place the mould on a glass sheet and fill it with cement paste formed by gauging cement with 0.78 times the water required to give a paste of standard consistency. The paste shall be gauged in the manner and under the conditions prescribed in determination of consistency of standard cement paste, taking care to keep the edges of the mould gently together while this operation is being performed. Cover the mould with another piece of glass sheet, place a small weight on this covering glass sheet and immediately submerge the whole assembly in water at a temperature of $27^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and keep there for 24 hours.

Measure the distance separating the indicator points. Submerge the moulds again in water at the temperature prescribed above. Bring the water to boiling, with the mould kept submerged, in 25 to 30 minutes, and keep it boiling for three hours. Remove the mould from the water, allow it to cool and measure the distance between the indicator points. The difference between these two measurements represents the expansion of the cement.

Reporting Format:

SOUNDNESS OF CEMENT BY LE-CHATELIER METHOD (IS:4031 PART-III)

Section/ Location of Lab	:			
Description of cement	:		Sample Code	:
Week No.	:		Date of testing	:
Temperature (°C)	:	28°C	Date of testing	:
Quantity of Water Added (0.78*Standard Consistency)	:		Quantity of Cement Added	:

SOUNDNESS OF CEMENT:

S. No.	Initial Distance Between Indicators (L ₁)	Distance Between Indicators after 24 hrs of submersion in water at 27±2°C(L)	Distance Between Indicators after submersion in boiling water for three hours(L ₃)	Soundness of cement (L ₂ -L ₃)-(mm)
1				
2				
3				
4				
5				

Remarks:

Contractor
PWRD

SPECIFIC GRAVITY OF CEMENT (IS: 4031)

Object:

To determine the specific gravity of cement using Le Chatelier Flask or Specific Gravity Bottle.

Apparatus:

- a) Le Chatelier Flask or Specific gravity Bottle – 100 ml capacity.
- b) Balance capable of weighing accurately upto 0.1gm.

Procedure:

- (i) Weigh a clean and dry Le Chatelier Flask or Specific Gravity Bottle with its stopper.
- (ii) Place a sample of cement upto half of the flask (about 50 gm) and weight with its stopper
- (iii) Add kerosene (polar liquid) to cement in flask till it is about half full. Mix thoroughly with glass rod to remove entrapped air. Continue stirring and add more kerosene till it is flush with the graduated mark. Dry the outside and weigh.
- (iv) Entrapped air may be removed by vacuum pump, if available. Empty the flask, clean it refills with clean kerosene flush with the graduated mark wipe dry the outside and weigh.

Reporting Format:

SPECIFIC GRAVITY OF CEMENT (IS: 4031)

Section/Location of Lab :				
Name/ Brand of cement :		Date of Sampling :		
Grade of Cement :		Date of testing :		
Week No. :				
Determination	Trial No.			
	1	2	3	Average
Weight of bottle (w_1)				
Weight of bottle with sample (w_2)				
Weight of bottle with sample and kerosene (w_3)				
Weight of bottle with water (w_4)				
Weight of bottle with kerosene (w_5)				
Specific Gravity of Kerosene(w_6) $= (w_5 - w_1) / (w_4 - w_1)$				
Specific Gravity of Sample= $(w_2 - w_1) * w_6 / (w_2 - w_1) - (w_3 - w_5)$				
Remarks:				
Contractor				
PWRD				

COMPRESSIVE STRENGTH OF CONCRETE CUBES (IS:516)

Object:

Determination of compressive strength of concrete.

Apparatus:

The testing machine may be of any reliable type of sufficient capacity for the tests and capable of applying the load at the specified rate. The permissible error shall not be greater than 2 percent of the maximum load. The testing machine shall be equipped with two steel bearing platens with hardened faces. One of the platens shall be fitted with a ball seating in the form the portion of a sphere, the center of which coincides with the central point of the face of the platen. The other compression platen shall be plain rigid bearing block. The bearing faces of both platens shall be at least as large as, and preferably larger than the nominal size of the specimen to which the load is applied. The bearing surface of the platens, when new, shall not depart from a plane by more than 0.01mm at any point, and they shall be maintained with a permissible variation limit of 0.02mm. the movable portion of the spherical seated compression platen shall be held on the spherical seat, but the design shall be such that the bearing face can be rotated freely and tilted through small angles in any direction.

Procedure:

Specimens stored in water shall be tested immediately on removal from the water and while they are still in the wet condition. Surface water and grit shall be wiped off the specimens and any projecting find removed specimens when received dry shall be kept in water for 24 hours before they are taken for testing. The dimensions of the specimens to the nearest 0.2mm and their weight shall be noted before testing. Placing the specimen in the testing machine the bearing surface of the testing machine shall be wiped clean and any loose sand or other material removed from the surface of the specimen, which are to be in contact with the compression plates. In the case of cubes, the specimen shall be placed in the machine in such a manner that the load shall be applied to opposite sides of the cubes as cast, that is, not to the top and bottom. The axis of the specimen shall be carefully aligned with the center of thrust of the spherically seated platen. No packing shall be used between the faces of the test specimen and the steel platen of the testing machine. As the spherically seated block is brought to bear on the specimen the movable portion shall be rotated gently by hand so that uniform seating may be obtained. The load shall be applied without shock and increased continuously at a rate of approximately 140 kg/cm²/min. until the resistance of the specimen to the increasing load breaks down and no grater load can be sustained. The maximum load applied to the specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

Reporting Format:



COMPRESSIVE STRENGTH OF CONCRETE CUBES (IS:516)

Section/Location of Lab :				Grade of Concrete :		
Date of Casting :				Water-Cement Ratio :		
Date of testing :				Description of Cement :		
Structure location :				Size of Concrete Cube :		
Part of Structure :						
Sl. No	Age in Days	Weight (g)	Density (g/cc)	Load at Failure (kN)	Compressive Strength of Individual Sample (f_1) in (N/mm ²)	Average Compressive Strength (f_{avg}) in (N/mm ²)
f_{ck} : Characteristic Compressive Strength of Concrete						
Remarks:						
Contractor				PWRD		

PENETRATION VALUE OF BITUMEN (IS:1203-1978)

Object:

To determine the penetration of bitumen by penetration test.

Apparatus:

- a) Le Chatelier Flask or Specific gravity Bottle – 100 ml capacity.
- b) Container: A flat-bottomed cylindrical metallic container 55mm in diameter and 35mm or 57mm in height.
- c) Needle: A straight, highly polished hard steel needle.
- d) Water bath: A water bath is maintained at $25 \pm 10^\circ\text{C}$ containing not less than 10 liters of water, the sample is immersed to depth not less than 100mm from the top and supported on a perforated shelf not less than 50mm from the bottom of the bath.
- e) Penetrometer: Electrically operated automatic penetrometer / Manually operated penetrometer. It is an apparatus, which allows the needle assembly of gross weight 100gm to penetrate without appreciable friction for the desired duration of time 5 sec. The dial is accurately calibrated to give penetration value in units of one tenth of an mm.
- f) Transfer tray: A small tray, which can keep the container fully immersed in water during the test.
- g) Stopwatch.

Procedure:

The bitumen is softened to a pouring consistency between 75°C and 100°C above the approximate temperature at which bitumen softens. The sample material is thoroughly stirred to make it homogenous and free from air bubbles and water. The sample material is then poured into the containers to a depth at least 15 mm more than the expected penetration. The sample containers are cooled in atmosphere temperature not lower than 13°C for one hour. Then they are placed in temperature controlled water bath at a temperature of 25°C for a period of one hour.

The sample container is placed in the transfer tray with water from the water bath and placed under the needle of the penetrometer. The weight of needle, shaft and additional weight are checked. The total weight of this assembly should be 100gm.

Using the adjusting screw, the needle assembly is lowered and the tip of the needle is made to just touch the top surface of the sample, the needle assembly is clamped in this position. The contact of the tip of the needle is checked using the mirror placed on the rear of the needle. The initial reading of the penetrometer dial is either adjusted to zero or the initial reading is taken before releasing the needle. The needle is released exactly for a period of 5 sec. by pressing the knob and the final reading is taken on the dial. At least three measurements are made on this sample by testing at distance of not less than 10mm apart. After each test the needle is disengaged and cleaned with benzene and carefully dried. The sample container is also transferred in the water bath before next testing is done so as to maintain a constant temperature of 25°C . The test is repeated with sample in the other containers.

Reporting Format:

PENETRATION VALUE OF BITUMEN (IS:1203-1978)

Location of Lab :	Date of Sampling :
Location/Chainage :	Source of Material :
Date of Testing :	Sample Code/No :
Bitumen grade :	Proposed Use :

Sl. No	Test temp (°C)	Dial Reading (0.1 mm)		Penetration (0.1mm)	Remarks
		Initial	Final		
1					
2					
3					
Average					
Remarks:					
Contractor				PWRD	

BITUMEN SPECIFIC GRAVITY (IS:1202-1978)

Object:

To determine the specific gravity of the bitumen by specific gravity bottle.

Apparatus:

- Pycnometer / specific gravity bottle – 50 ml capacity.
- Balance – sensitivity 0.1mg.

Procedure:

The specific gravity bottle is cleaned, dried and weighed along with the stopper. It is filled with fresh distilled water, stopper placed and the same is kept in water container for at least half an hour at temperature 27°C +/- 10C. The bottle is then removed and cleaned from outside. The specific gravity bottle containing distilled water is now weighed.

The bituminous material is heated to a pouring temperature and is poured in the above empty bottle taking all the precautions that it is clean and dry before filling sample materials. The material is filled up to the half taking care to prevent entry of air bubbles. To permit an escape of air bubbles, the sample bottle is allowed to stand for half an hour at suitable temperature cooled to 27°C and then weighed. The remaining space in the specific gravity bottle is filled with distilled water at 27°C, stopper placed and is placed in water container at 27°C. The bottle containing bituminous material and remaining water is removed, cleaned from outside and is again weighed.

Reporting Format:

Source of Material :		Date of Sampling :		
Location :		Date of Testing :		
S. No.	Description	Trial 1	Trial 2	Trial 3
1	Weight of Pycnometer (W_1) g			
2	Weight of Pycnometer + Sample (W_2) g			
3	Weight of Pycnometer + Sample + Water (W_3) g			
4	Weight of Pycnometer + Water (W_4) g			
5	Weight of Sample ($W_2 - W_1$) g			
6	Specific Gravity of Sample = $(W_2 - W_1) / (W_4 - W_1) - (W_3 - W_2)$			
Average				
Remarks:				
Contractor PWRD				

DETERMINATION OF SOFTENING POINT (IS:1205-1978)

Object:

To determine the softening point of the bitumen by 'Ring and Ball' apparatus.

Apparatus:

- a) Ring and Ball apparatus – It consists
 - i. Steel Balls – 2 nos. each has a diameter of 9.5mm and weight is 2.5 ± 0.05 gm.
 - ii. Brass Rings – 2 nos. each 6.4mm depth, inside diameter at top 17.5mm, inside diameter at bottom 15.9mm and outside diameter 20.6mm and three equally spaced ball guides.
 - iii. Support - The metallic support is used for placing pair of rings. The upper surface of the rings is adjusted to be 50mm below the surface of water or liquid contained in the bath. A distance of 25mm between the bottom of the rings and top surface of the bottom plate of support is provided. It has a housing for a suitable thermometer.
- b) Thermometer – 0°C to 350°C – sensitivity 0.10C.
- c) Bath and stirrer – A heat resistant glass container of 85mm diameter and 120mm depth is used.

Procedure:

Sample material is heated to a temperature between 75 and 100°C above the approximate softening point until it is completely fluid and is poured in heated rings placed on metal plate. To avoid sticking of the bitumen to metal plate, coating is done to this with a solution of glycerin and dextrin. After cooling the rings in air for 30 minutes, the excess bitumen is trimmed and rings are placed in the support as mentioned in item(iii) above. At this time the temperature of distilled water is kept at 50°C. This temperature is maintained for 15 minutes after which the balls are placed in position. The temperature of water is raised at uniform rate of 5°C per minute with a controlled heating unit, until the bitumen softens and touches the bottom plate by sinking of balls. At least two observations are made.

Reporting Format:

DETERMINATION OF SOFTENING POINT (IS:1205-1978)

Section/Location of Lab :			
Source of Material :		Date of Sampling :	
Bitumen Grade Apparatus :		Date of Testing :	
Used : Ring and Ball Apparatus			
Period of Cooling at Room Temperature (min) : 30°C		Period of Cooling in Water bath @ 5°C Temperature (min) :	
Rate of Heating : 5°C ± 0.5°C			
Time (min)	Temperature of water bath °C	Time (min)	Temperature of water bath °C
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	
Description	Bill No. 1	Bill No. 2	Mean Value of Softening Point
Temperature at which sample touches the bottom plate (°C)			
Remarks:			
Contractor		PWRD	

FLASH AND FIRE POINT TEST (IS:1209-1978)

Object:

To determine the flash and fire point of bitumen by Pensky-Martens closed tester.

Apparatus:

- Pensky-Martens closed tester consist of cup, lid, stirrer device, shutter, flame exposure device.
- Thermometer (0 – 350°C) – sensitivity – 0.1°C.

Procedure:

The material is filled in the cup up to a filling mark. The lid is placed to close the cup in a closed system. All accessories including thermometer of the specified range are suitably fixed. The bitumen sample is then heated. The test flame is lit and adjusted in such a way that the size of a bleed is of 4mm diameter. The heating is done at the rate of 5°C to 6°C per minute. The stirring is done at a rate of approximately 60 revolutions per minute. The test flame is applied at intervals depending upon the expected flash and fire points. First application is made at least 17°C below the actual flash point and then at every 1°C to 3°C. The stirring is discontinued during the application of the test flame.

Reporting Format:

Section/Location of Lab:						Source :							
Date of sampling :						Location :							
Date of testing :						Proposed Use :							
Bitumen grade/ Cutback type & grade:													
Type of equipment: Closed cup/ Open cup													
<u>Rate of heating</u>													
Time, minutes	1	2	3	4	5	6	7	8	9	10	11	12	
Temperature, °C													
Test property						Test Number						Mean value	
						1	2	3					
1. Flash point													
2. Fire point													
3. Mean value													
Remarks:													
Contractor													
PWRD													

BINDER CONTENT PAVING MIX BY CENTRIFUGAL METHOD (IRC: SP: 11)

Object:

To determine the binder content in the bituminous mix by cold solvent extraction.

Apparatus:

- a) Centrifugal extraction machine electrically operated.
- b) Balance – 15 kg capacity – sensitivity 0.1gm.
- c) Cold solvent – Commercial grade of Benzene.
- d) Filter paper – Wat 60.
- e) Oven.

Procedure:

A representative sample about 1000gm is exactly weighed and placed in the bowl of the extraction apparatus and covered with commercial grade of benzene. Sufficient time (not more than 1 hour) is allowed for the solvent to disintegrate the sample before running the centrifuge. The filter paper of the extractor is dried, weighed and then fitted around the edge of the bowl. The cover of the bowl is clamped tightly. A beaker placed under to collect the extract.

The machine is revolved slowly and then gradually increases the speed, maximum of 3600 rpm. This speed is maintained till the solvent ceases to flow from the drain. The machine is allowed to stop and 200ml of benzene is added and the above procedure is repeated. A number of 200ml solvent additions (not less than three) are used till the extract is clear and not darker than a light straw colour.

The filter paper removed from the bowl, dried in air then in oven to constant weight at 1150C and weighted the fine materials that might have passed through the filter paper are collected back from the extract preferably by centrifuging. The material is washed and dried to constant weight as before.

Reporting Format:

BINDER CONTENT PAVING MIX BY CENTRIFUGAL METHOD (IRC: SP: 11)

Section/Location of Lab: Date				
of Sampling		:	Date of Location	
Date of Testing		:	Layer	
BINDER CONTENT TEST				
S. No.	Details		Sample No.	
			1	2
1	Weight of Mix	: W_1 g		
2	Initial weight of filter paper	:		
3	Weight of Aggregate after extraction	: W_2 g		
4	Weight of filter paper after extraction with fine materials	: W_3 g		
5	Increased weight of filter	: W_4 g		
6	Weight of Binder $W_1 - (W_2 + W_4)$	: W_5 g		
7	Binder Content (BC) $= W_5 / W_1 \times 100$	: BC %		
Remarks:				
Contractor			PWRD	

AGGREGATE GRADING FOR BITUMINOUS MIXES

Object:

To determine the combined grading of the coarse aggregates and fine aggregates, tested in accordance with IS:2386 Part 1(wet sieving method).

Apparatus:

1. A set of IS Sieves of sizes – Conforming to IS 460-1962.
2. Balance or scale with an accuracy to measure 0.1 percent of the weight of the test sample
3. Trays, scoops and miscellaneous accessories.

Procedure:

1. The test samples of Coarse Aggregates & Fine Aggregates shall be dried for 24 hours to a constant weight at a temperature of 110 +/- 5 Degree Celcius and weighed. Minimum weight of sample dispatched for testing shall be as under:
For 4.75 mm Maximum Size of Aggregate = 10 Kg
For 10 mm Maximum Size of Aggregate = 10 Kg
For 20 mm Maximum Size of Aggregate = 25 Kg
The sample for sieving shall be prepared from the larger sample either by quartering or by means of a sample divider. The sample shall be sieved by using a set of IS Sieves as per the maximum size of aggregate & by separating the same as per Cl. 2.5 of IS 2386 Part-1 for 'All in Aggregates'.
2. Sieving shall be done for not less than 10 minutes & shall be conforming to Cl. 2.4 of IS 2386 Part-1.
3. On completion of sieving, the material on each sieve shall be weighed. Cumulative weight passing through each sieve shall be calculated as a percentage of the total sample weight.
4. Fineness modulus of fine aggregates shall be obtained by adding cumulative percentage of fine aggregates retained on each sieve and dividing the sum by 100, it shall be performed as per IS: 383.
5. Wet sieving shall be performed on the oven dried sample of appropriate weight by adding water to separate all the material followed by sieving the same & calculating the percentage of material finer than 75 microns. (test procedure shall conforming to Cl. 3 of IS 2386 Part-1)
6. Calculation is performed by calculating the percentage by weight of the total sample passing through one sieve and retained on the next smaller sieve, to the nearest 0.1 percent. The results of the sieve analysis may be recorded graphically on a semi-log graph with particle size as abscissa (log scale) and the percentage smaller than the specified diameter as ordinate.
4. Results shall fall within the limits given in Table 500-10 of MoRTH Specifications for grading 1 or 2 as specified in the Contract (for DBM) & results shall conform to limits given in Table 500-8 of MoRTH Specifications(For Bituminous Macadam). The type and quantity of bitumen and appropriate thickness is also given in Table 500-7 of MoRTH Specifications (For Bituminous Macadam).

Reporting Format

AGGREGATE GRADING FOR BITUMINOUS MIXES

DENSE BITUMINOUS MACADAM

(MoRTH Specifications: Table 500-10)

Location of Lab :				Date of Sampling :		
Location/Chainage : Date				Source of Material :		
of Testing :				Total wt. of sample (gm):		
Sieve size (mm)	Wt. Retained (g)	Cumulative wt. Retained = (g)	% Cumulative wt. Retained	% passing	Specified % by Wt. of passing	
					Grading-1	Grading-2
45mm					100	-
37.5mm					90-100	100
26.5mm					63-93	90-100
19mm					-	71-95
13.2mm					55-75	56-80
9.5mm					-	-
4.75mm					38-54	38-54
2.36mm					28-42	28-42
1.18mm					-	-
0.6mm					-	-
0.3mm					7-21	7-21
0.15mm					-	-
0.075mm					2-8	2-8
Remarks:						
Contractor				PWRD		

AGGREGATE GRADING FOR BITUMINOUS MIXES BITUMINOUS CONCRETE (MoRTH Specifications: Table 500-17)

Location of Lab :				Date of Sampling :		
Location/Chainage : Date				Source of Material :		
of Testing :				Total wt. of sample (gm):		
Sieve size (mm)	Wt. Retained (g)	Cumulative wt. Retained = (g)	% Cumulative wt. Retained	% passing	Specified % by Wt. of passing	
					Grading-1	Grading-2
26.5mm					100	-
19mm					90-100	100
13.2mm					59-79	90-100
9.5mm					52-72	70-88
4.75mm					35-55	53-71
2.36mm					28-44	42-58
1.18mm					20-34	34-48
0.6mm					15-27	26-38
0.3mm					10-20	18-28
0.15mm					5-13	12-20
0.075mm					2-8	4-10
Remarks: Contractor PWRD						

MARSHALL TEST RESULTS (ASTM:D- 1559)

Object:

To determine the stability, flow, voids, voids in mineral aggregates, voids filled with asphalt and density of the asphalt mixture by Marshall stability test.

Apparatus:

- a) Specimen Mould Assembly – For Standard Marshall, Mould cylinders 101.6mm (4 in.) in diameter by 75mm (3 in.) in height, base plates, and extension collars. For Modified Marshall, mould cylinders 152.4mm (6 in.) in diameter by 95.2mm (3.75 in.) in height.
- b) Specimen Extractor – Steel disk with a diameter 100mm/150mm, and 12.7mm thick for extracting the compacting specimen from the specimen mould with the use of the mould collar. A suitable bar is required to transfer the load from the proving ring adapter to the extension collar while extracting the specimen.
- c) Compaction Hammer – The compaction hammer shall have a flat, circular tamping face and a 4.5kg (10 lb) sliding weight with a free fall of 457mm (18 in.) for Standard Marshall Method. For Modified Marshall Method, the weight of hammer is 10.2kg (22.5 lb) and height of fall is 457mm (18 in.). Two compaction hammers are recommended for each method
- d) Compaction Pedestal – The compaction pedestal shall consist of 200X200X460mm(8X8X18 in.) wooden post capped with a 305X305X25mm(12X12X1 in.) steel plate. The pedestal should be installed on concrete slab so that the post is plumb and the cap is level. Mould holder provided consisting of spring tension device designed to hold compaction mould centered in place on compaction pedestal.
- e) Breaking Head – It consists of upper and lower cylindrical segments or test heads having an inside radius of curvature of 50 mm. The lower segment is mounted on a base having two vertical guide rods, which facilitate insertion in the holes of upper test head.
- f) Loading Machine – The loading machine is provided with a gear system to lift the base in upward direction. on the upper end of the machine, a calibrated proving ring of 5 tonne capacity is fixed. In between the base and the proving ring, the specimen contained in test head is placed. The loading machine produces a movement at the rate of 50mm per minute. Machine is capable of reversing its movement downward also.
- g) Flow meter – One dial gauge fixed to the guide rods of a testing machine can serve the purpose. Least count of 0.25mm (0.01 in.) is adequate.
- h) Oven or hot plates
- i) Mixing apparatus.
- j) Thermostatically control water bath.
- k) Thermometers of range 0 – 360°C with 1°C sensitivity.

Procedure:

- (i) Approximately 1200 g of the mixed aggregate and the filler are taken (which satisfies the specified grading) and heated to a temperature of 175 to 190°C.

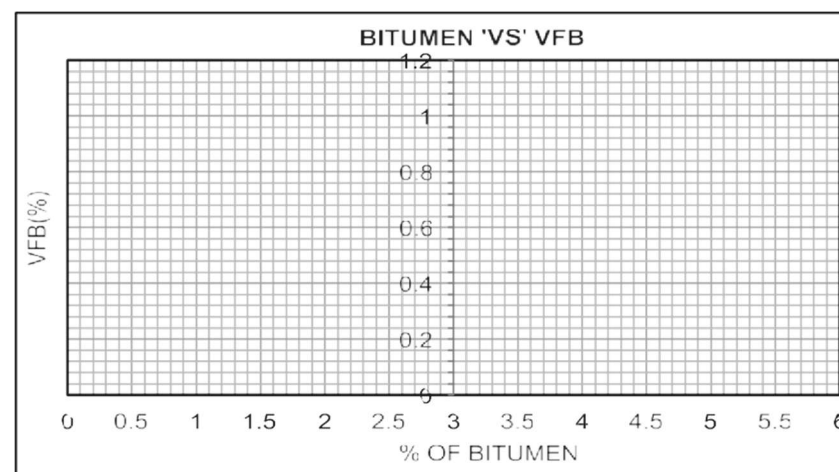
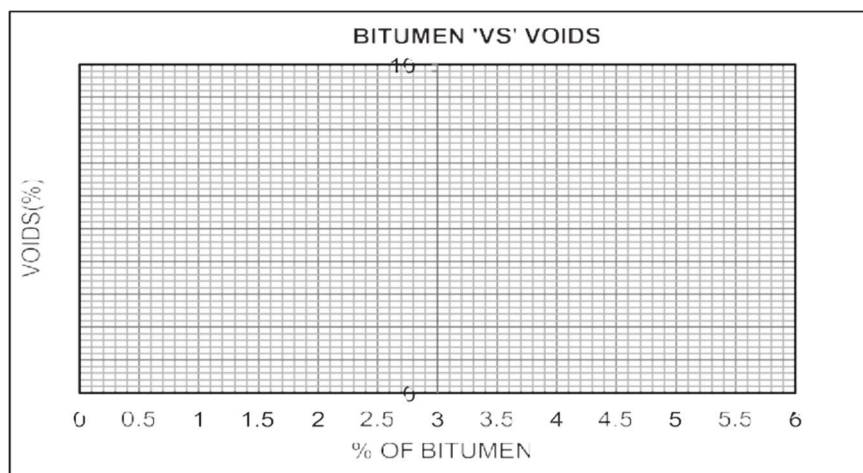
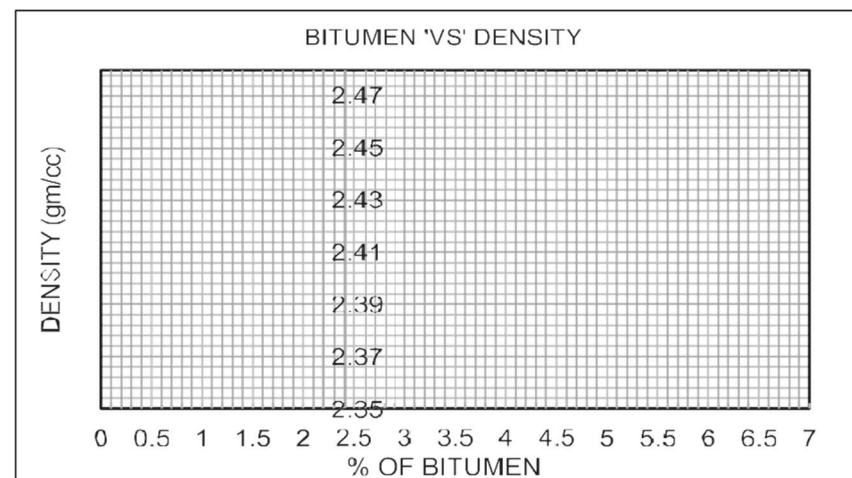
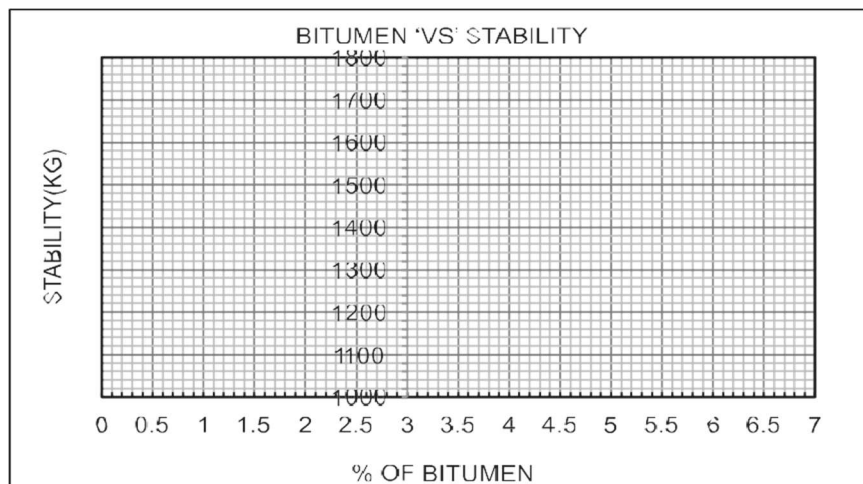
- (ii) Bitumen is heated to a temperature of 121 to 145°C and the required quantity of first trial is (say, 3.0 or 3.5 % by weight of aggregate material) taken and added to the heated aggregates and thoroughly mixed at the desired temperature of 154 to 164°C.
- (iii) The mix is placed in preheated mould and compacted by a rammer, with 50 blows (for medium traffic loads) or 75 blows (for heavy traffic loads) on either side at temperature of 138 to 149°C.
- (iv) The weight of the mixed aggregate taken for the preparation of specimen may be suitably altered to obtain a compacted thickness of 63.5 ± 3.0 mm.
- (v) For each bitumen content trial 3 or 4 specimens are prepared.
- (vi) The compacted specimens are cooled to room temperature in the moulds and then removed from the moulds using a specimen extractor.
- (vii) The diameter and mean height of the specimens are measured and weighed and recorded. If the average height of the specimen is not exactly 63.5 mm, the correction factors shall be applied.
- (viii) Then the specimens are kept immersed in water in thermostatically controlled water bath at $60 \pm 1^\circ\text{C}$ for 30 to 40 minutes.
- (ix) The submerged weight of the specimens are weighed and recorded.
- (x) Then the specimens taken out one by one placed in the Marshall test measuring and testing equipment.
- (xi) Load is applied at a rate of 5 cm per minute, deformation in the units of 0.25 mm and the corresponding load taken upto the maximum load at failure. The maximum load at failure is the stability value. The flow value is the total deformation in units of 0.25 mm, occurring in the specimen between no load and maximum load during the test.
- (xii) For each trial 3 or 4 specimens are tested and the average values are recorded.

Reporting Format:

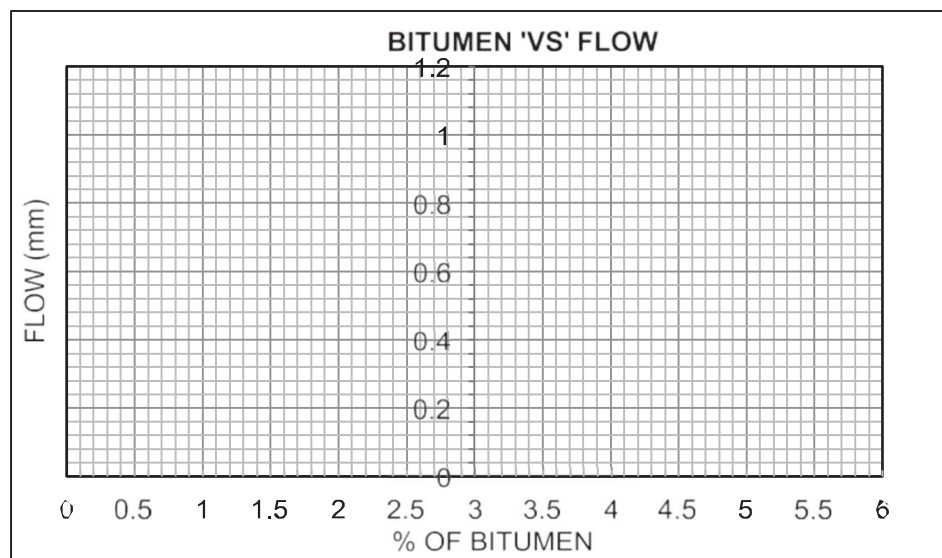
MARSHALL TEST RESULTS (ASTM:D- 1559)

Type of Mix: Max. Sp. Gr of Paving				Date of Testing: Mix (Gmm):				Grade of Bitumen:									
Compaction: 75 Blows (Both Sides)				BC Trial -1 Blend:													
Specific Gravity of Bitumen (Gb) :																	
Bulk Sp. Gr. of Aggregates (Gsb) :				Effective Sp. Gr. Of Agg. (Gse):													
% Bitumen by Wt. of Mix.	Specimen No	% of Agg.	Spec. Ht. (mm)	Mass in grams.			Properties						Stability in kg.			Flow (mm)	
				In Air	In Water	SSD	Bulk Volume (cc)	Bulk Density (g/cc)	Max. Sp.Gr.	Air Voids (%)	VMA (%)	VFA (%)	Measured Kgs	Corr. factor	Adjusted		
	Average																
	Average																
Marshal Test Results																	
Bitumen Content (%)			Stability (kN)		Flow (mm)		Air Voids V_a (%)			VMA (%)			VFB (%)				

MARSHALL CURVES



MARSHALL CURVES





Narrow Range Acceptable Limit						
Stability						
Flow						
Density						
Air Voids						
VFB						
VMA						
	3.50%	4.00%	4.50%	5.00%	5.50%	6.00%
	6.50%					
	% of Bitumen					

Final Optimum Bitumen Content (Narrow Strip Method)

Bitumen % Max Stability	=	Properties of Mix at Average Bitumen Content of %		Specific Limits
Bitumen % Max Density	=	Stability (Kg)	=	
		Density (g/cc)	=	
		Air Voids (%)	=	
Bitumen % @ 4% voids	=	V.F.B (%)	=	
		V.M.A (%)	=	
Average (%)	=	Flow (mm)	=	

Remarks:

Contractor

PWRD

FIELD DENSITY TEST BY CORE CUTTER METHOD

-

Object:

To determine the field density of compacted layer by destructive test.

Apparatus:

Core cutter Machine.

Procedure:

In this method, a core is cut using core cutting machine from the completed mat after the mat has cooled down, generally the next day. The core is 10 cm dia. and thickness is as layer thickness. A series of test are conducted on the extracted core including its density, stability, flow, percent air voids and the percent voids filled by bitumen etc.

Reporting Format:

FIELD DENSITY TEST BY CORE CUTTER METHOD

LOCATION:		DATE SAMPLED:		DATE TESTED:		MATERIAL DESCRIPTION:	
Density Determination	Core	JMF density					
	UNIT	1	2	3	4	5	6
SAMPLE NO.							
1. Core no.							
2. Core chainage		km					
3. Core Thickness		mm					
4. Wt. in air		g					
5. Wt. in water		g					
6. Volume		cc					
7. Density		g/cc					
8. Compaction (Core)		%					
Remarks:							
Contractor						PWRD	