……Project

Quality Assurance Plan
And
Method Statement

Contract ID No ……

Submitted by-	*Submitted to-*
……	……
	Submitted on:

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Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
AIV	Aggregate Impact Value
ASTM	American Society for Testing and Materials
BOQ	Bill of Quantity
BS	British Standard
CBR	California Bearing Ratio
^{O}C	Centigrade
CM	Contract Manager
CR	Contractor's Representative
CSC	Construction Supervision Consultant
Cum.	Cubic Meter
Cm	Centimeter
Dia.	Diameter
DoR	Department of Roads
DoLI	Department of Local Infrastructure
FD	Field Density
HDPE	High Density poly ethylene
IOW	Inspector of Works
IRC	Indian Road Congress
IS	Indian Standard
KN	Kilo Newton
LAA	Los Angeles Abrasion
m^2	Square meter
m^3	Cubic meter

MC	Moisture Content
MDD	Maximum Dry Density
ME	Material Engineer
Mpa	Mega Pascal
mm	Millimeter
NC	Non Confromance
NS	Nepal Standard
OHS	Occupational Health Safety
OMC	Optimum Moisture Content
OST	offsite Test
PI	Plasticity Index
PM	Project Manager
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
RCC	Reinforce Cement Concrete
RE	Road Engineer
SLT	Senior Lab Technician
SWG	Standard Wire gauge
sqm	Square meter
T	Ton
TS	Technical Specification
WRF	Work Request Form

1. QUALITY ASSURANCE PLAN

1.1 General

The definition, terms and conditions, general requirement and provision mentioned in the Quality Assurance Plan (QAP) shall be read exactly as stated in the Technical Specification. The defination and terms used in the QAP shall be clearly in accordance with the Technical Specifications and unless otherwise defined in this document.

1.2 Quality

Quality is construction works means that a project is completed with the requirements of the client meeting specification and contractual agreement. The quality of any product or service is achieved when it conforms to the desired specifications. Achieving quality in construction industry in long run is a tough issue and has been a problem. Inefficient or no practice of quality management procedures will result in great loss of time, money, material, resources. For example, in construction site, the designer would specify a particular grade of concrete. The contractor will use the ingredients of the concrete such that the desired grade of concrete is obtained.

1.2.1 Objective of Quality in Construction

The quality in construction relates to the following objectives:

- Satisfaction of Contract Specifications
- Completion of Project within Time
- Enhancing Customer/ Owner Satisfaction
- Motivation and Empowerment of Employees
- Avoiding Disputes and Claims
- Performance based on Purpose

1.3 Quality Assurance

Quality assurance is the planning and systemic activities implemented in a quality system to fill quality requirements. So, quality assurance is looking at the quality requirements and making a plan to meet requirements and focused on providing confidence that quality requirements will be fulfilled.

Quality Assurance is Not **Quality Control**. Contractors occasionally combine the ideas of quality assurance and quality control while conducting everyday construction operations. It makes sense to combine the two into a single process as they are in fact responsive to one another. However, combining the two is incorrect.

Construction companies will struggle to guarantee high-quality outcomes from the construction process until owner and employees correctly apply the differences between construction project QA and construction project QC. These two elements of quality management are distinct from one another. Each fulfills a certain set of procedures, objectives, and purposes.

The QA is process oriented and QC is product oriented. Quality assurance specifies standards, quality control verifies compliance to standards. A successful QA program aims to ensure that the quality procedures implemented during the design phase of a construction project effectively meet the company-established standards for quality service, performance, and production. The core specs focus on:

- Qualifications established for architects, designers, and engineers
- Markup rules pertaining to plans and drawings from preparation thru revision and into final approval
- AND the assurance that specified materials comply with company-established quality standards.

QC is the process that ensures that materials used on the project actually comply with properly signed drawings and plans. Secondly, QC ensures that task-specific personnel actually perform construction project processes according to the specified QA standards.

QA provides method, QC ensures accurate application.

Whereas Quality Assurance defines a method for determining the how and when of construction standards, Quality Control ensures that workers, operators, and management correctly respond to the specified QA standards. Quality Assurance defines a methodology that enables your team to evaluate and identify construction standards that best satisfy:

- Specifications
- Legal provisions
- Construction safety necessities
- Customer quality expectations.

Quality Control verifies correct applied quality methodology, material selection, and labor performance efficiency. QC is also responsible for testing finished goods and services to ensure compliance to the QA standards.

- **QA establishes processes, QC selects according to established standards**

Quality Assurance crafts procedures that enable management and work crews to identify properly qualified suppliers. It sets the specs for supplier selection, including requirements for:

- Visit and inspection of supplier facilities
- Materials testing
- Existence of a supplier-side QA program
- Any other criteria necessary to ensure that the proposed supplier is qualified to meet the company-established Quality Assurance specs.

Quality Control examines the established QA standards, certifies that prospective suppliers meet the criteria, and follows through by testing supplied parts and services as dictated by the existing company-establish construction project QA program.

1.4 Quality Assurance Plan (QAP)

The Quality Assurance Plan (QAP) is the documentation confirmation that identify procedures used to obtain the standards of quality required by the contract plans and specifications for the construction of the project are met. The purpose of this QAP document is to provide organization policy and procedures for progressing the project from Quality Assurance to letting in an effective manner to meet the Technical Specification as stated in Contract Document. This document gives only an outline procedure to attain qulity of costruction project and thus stated procedure shall be followed strictly to minimze the non conformity through as continual improvement process.

This QA Plan:

- Identifies the organization, roles, and responsibilities of individuals who will be participating in the project during construction.
- Provides a preliminary construction schedule with a summary of planned construction activities, their sequence, interrelationships, durations, and terminations.
- Briefly summarizes the minimum qualifications of lead project participants from the Engineer’s and Contractor’s organizations.

- Provides a description of the construction inspection program that includes inspection responsibility, anticipated inspection frequency, deficiency resolution, and inspector qualifications.
- Describes key activities that will take place and processes that will be used to meet the quality standards, including communication, technical records handling, review and observation functions, sampling and testing requirements, acceptance/rejection criteria that will be followed, and corrective measures to be used when deficiencies are found.
- Includes a summary of documentation procedures for work clarification and changes to the work.

1.4.1 Objectives of QA Plan

The main objectives of this Quality Assurance plan is to attain quality of the construction work in accordance with Technical Specification are but not limited the following:

- To assure that all the steps of Quality control have been properly planned and implemented at the completion of each activity.
- To assure that the completed works meet or exceed desired performance criteria/quality standards (specified in Drawings & Technical Specification which are part of the Contract Documents.)

1.5 Scope and Application of QAP

This QAP is intended to use by client, the supervision consultant and contractor for the execution of the work as described in specification and drawing.

Quality Assurance plan provides a highest importance to the achievement of the quality of works and materials as envisaged in the design and specification. It is further envisaged the highest standards of workmanship in the works such that the full value for the investments made is realized and the road performs in the best way during the design life. The quality assurance systems are needed for this contract at level but not limited the following

I. Design and project preparation
II. Construction
III. Operation and maintenance
IV. Production of manufactured Items

The organizations involved in the design construction and operation and maintenance of this contract are:

I. The client

II. The Design Consultant

III. The supervision Consultant

IV. The contractor

1.6 Content of Quality Assurance plan

The QAP shall include the following but not limited to:

a. The recapitulative tests schedule and testing program detailing the list of tests for compliance, laboratory trails, site trails, trail sections, construction control tests and their frequencies, tests for acceptance of the completed works with their dates. Recapitulative list of “critical” acceptance testing procedures, for equipment or parts of the work which corresponds to the tasks on the critical path according to the construction program.

b. Estimate the number of tests to be carried out, list and number of appropriate equipment required to conduct them, list of tests to be conducted outside the site laboratory, if any, identification of the outside laboratory where proposed to carry out the test.

c. List of staffs assigned to the laboratory, their position and responsibility in the quality control procedure, their qualification and experience, general description and detailed organization of the laboratory activities.

d. The list of sources of materials and/or manufactured article, their main characteristics, their identification mode as provided by the supplier when required; the program of supply and procurement of material and/or manufactured articles in accordance with the program submitted by the contractor.

e. The list of tests and quality control procedure to be implemented by the contractor, if any pointing out the “criteria” acceptance testing procedures relating to the contracted works, which correspond to the tasks on the critical path inclined in the subcontracted works.

The contractor shall implement the quality control in compliance with the approved QAP.

2. ORGANIZATIONAL SETUP

2.1 General

Quality Assurance (QA) and Quality Control (QC) is the most important action to prevent any defects or make improvements to the services to be delivered to its valued Employer. It is a function that identifies documents and reviews for continual improvement of the process that deliver products. It is the policies, procedure, and systematic actions established in the bid document where the employer had primary listed out all the activities, processess to be performed by the contractor and implementation of such resposibility to be bestowed at later stage to the construction site for the purpose of ensuring quality. Therefore, QA and QC are the prime responsibility of contractor with the continous support and supervision from employer, engineer. Hence, it is triparty relationship between employer, enginerr and contract to deliver products as per requirement and specification.

2.2 Parties to the contract

There are three parties defined in the contract agreement

- Employer
- Engineer/Engineer Representative from Employer (Employer Representative)
- Contractor

2.2.1 The Employer

Name of Office: ……

Employer's Representative will delegate some or most of his duties to supervision engineer. It nevertheless remains his responsibility to ensure that those duties are discharged correctly.

2.2.2 Engineer / Employer Representative

The Engineer in a contract may be a site engineer or RE. The Engineer is responsible for the administration and control of the contract, and in particular the supervision of the works to ensure that the contractor fulfils the requirements of the contract. Engineer is assigned to construction site to manage both technical and managerial functions.

The Employer may delegate in writing some of his powers under the contract to his representative on site such as RE, and will formally notify the Contractor of the powers in question prior to commencement of the works. Notwithstanding any delegation of powers, responsibility for those powers remains with the Engineer.

On most projects the Engineer's Representative is supported by field staff engaged on specific activities (e.g. setting out, measurements, quality control tests, etc.). Support staffs are not authorized to give instructions to the contractor, nor either to accept or reject the works, responsibility for which rests firmly with the Engineer

2.2.3 The Contractor

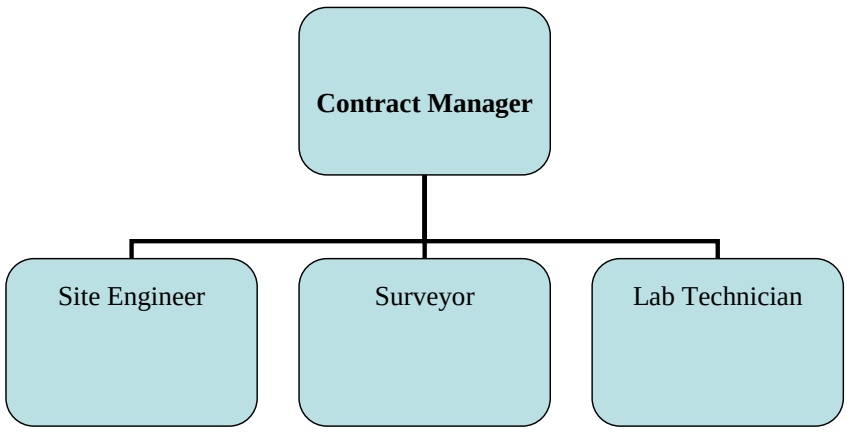
Name of Contractor: ………

The majority of construction of quality work is the responsibility of the Head Office of the contractor since it supplies required human resources and construction materials except the locally available items. It is therefore the responsibility of the site office to assure the execution of the required quality control activities. The overall project management role is to be played by the Contractor's Representativ who have legal power (Power of Attorney from Board of Directors) to act on behalf of contractor. He is also liaison to the Engineer and Employer. **The contractor shall take approval from the client before the mobilization of Contractor's Representative.** The proposed CV of the Contractor Representative are in **Annex-1.**

2.3 Organization Structure

Contractor's quality control organization will be as given in fig. 2.1

Figure 2.1 Organization Structure of Contractor



2.4 Job Description of Key Personnel

The job descriptions for the key personnel of the Quality Control Organization are as follows:

I. Contract Manager (CM)

The contract manager is responsible for contract management, communication and coordination and construction of works in accordance to standard specification and contract document. His/her major responsibilities are:

- Planning, scheduling, monitoring and controlling of tasks.
- Conformity of all materials and all workmanship performed strictly with the requirements of specifications.
- Prepare QAP
- Set up of laboratory with adequate laboratory equipment operated by competent staff for carrying out tests for selection and control and quality of material and workmanship in accordance of specification.
- Inspect materials upon receipt.
- Prepare Monthly Progress Report, S-Curve, Bar Charts etc. and submit to Client.
- Define activities affecting quality of works
- Prepare and submit working drawing for approval.
- Ensure compliance with drawing, specification and environmental provision.
- Implement site instruction given by the client.
- Establish and maintain quality management system.
- Carry out construction activities in accordance Method Statement
- Correspondence with client
- Monitoring and Implementation of QAP.
- Maintain coordination with stakeholders and own staffs.
- Timely instruction and decision.

II. Site Engineer (SE)

- Day to day planning of site works
- Prepare construction method statements
- Prepare site specific working drawing
- Setting out of works and carry out construction in accordance with working drawing
- Carry out and monitor all test specified in QAP.

- Implement QAP and control of quality of work and workmanship
- Implement work request form and site instruction
- Carryout construction activities in accordance Method Statement.
- Inform immediately to the client/PM for any obstruction to the progress of the work and or any fact found in the drawing.
- Execute all works according to specifications, departmental procedure and instructions etc.
- Arrange all materials, plants and labor well in advance and has to see that progress of work does not suffer for want of material
- Take measurement of the work done or supply and to record in the measurement book
- Keep note of important points on works in note book during the inspection of works and he has to keep his not book up- to date.

III. Surveyor

- Setting out of works including joint survey.
- Marking of alignment and structure
- Checking of line and level
- Preparation of Survey Drawing and calculations
- Assist SE and CM in construction of work.

IV. Lab Technician

- Set up laboratory and testing facilities
- Carry out quality control test and process control
- Supervise compaction of subgrade, subbase and base likewise asphalt work.
- Prepare day to day testing of materials and maintain documentation of lab reports systematically.
- Prepare laboratory and site testing Records and register
- Provide data to material engineer to maintain site record
- Jointly sampling of materials
- Carry field test such as FD, MC etc.
- Maintain test register
- Fully accountable to Engineer
- Supply test report to client

2.5 Contractor's Establishment on Site

The contractor has established contractor's organization camps, infrastructures facilities on site located at……. The contractor shall remove the camp after completion of contract.

3. QUALITY CONTROL OF WORK

3.1 General

In simple terms **Quality control** (QC) is a procedure or set of procedures intended to ensure that a construction works or performed service adheres to a defined set of **quality** criteria i.e., specification or meets the requirements of the client.

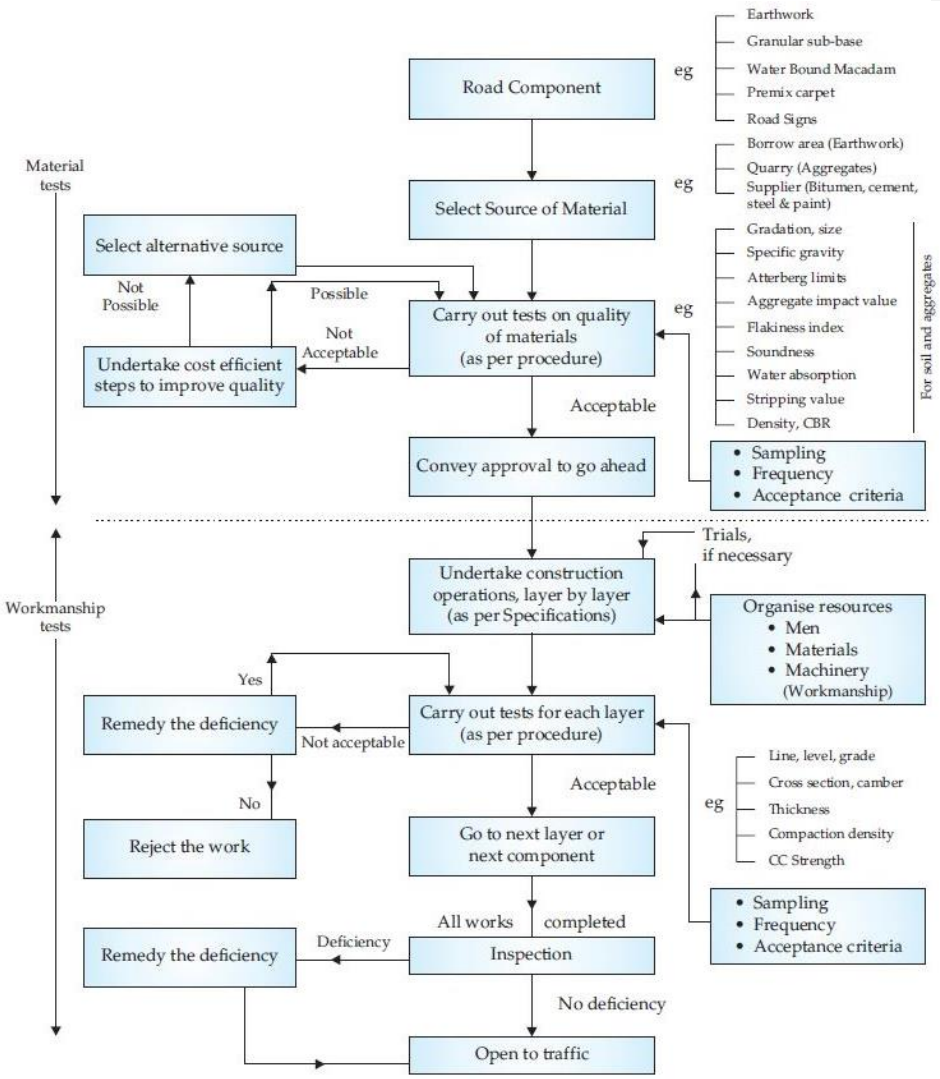
The Contractor is responsible for achieving the quality standards specified in the contract agreement. The Engineer is responsible for ensuring that the works are constructed to those standards.

It is routine application, at prescribed frequencies, of a system of procedures for the sampling and testing of materials prior to placing and following completion that ensures that specified standards are achieved. Each procedure relates to a specific aspect of the works and usually involves a test or combination of tests to determine compliance or otherwise with a Specification. QC does not specify "who, where and how" the procedures will be implemented.

3.2 PROCESS OF QUALITY CONTROL

In addition to serving the prime function of assisting site staff in fulfilling technical and procedural requirements of a contract, the QA Plan will also be used by the Employer Monitoring Team as a basis for measuring contract performance against agreed standar procedures. Quality Control of works is implemented in the following sequences:

Figure 3.1 Typical Flow Chart for Quality Control Process in Road Work



I. Compliant testing for materials including laboratory trials,

II. Compliant testing for methods and equipment prior to commencement of work, including site trials or trial sections,

III. Control testing during construction (process control),

IV. Acceptant testing on completed works or parts of works.

V. Contractor carries out all necessary tests and reports to the Engineer results of such tests before submitting materials and/or finished works or part of works to Engineer for approval

VI. For satisfying himself about quality of works, quality control tests shall be carried out by Engineer himself or by any other agencies deemed fit by Engineer.

VII. Before commencement of works, Contractor demonstrates a trial run of all construction equipment for establishing their capability to achieve requirement of Specifications and tolerances to satisfaction of Engineer.

VIII. Supply, testing and monitoring shall be in compliance with a Quality Assurance Plan.

It is the responsibility of the contractor to carry out all necessary tests for material and works and submit reports of such tests to the engineer for approval in accordance with the specification. Additional tests may also be required to be conducted where in the opinion of the engineer when such tests are needed.

The supply, testing and monitoring shall be in compliance with a quality Assurance Plan, as per the provisions made in the contract. The list of sources of materials and/or manufactured article, their main characteristics, their identification mode as provided by the supplier when required; the program of supply and procurement of material and/or manufactured articles in accordance with the program submitted by the contractor.

The list of tests and quality control procedure to be implemented by the sub-contractor, If any pointing out the ***"criteria"*** acceptance testing procedures relating to the sub-contracted works, which correspond to the tasks on the critical path inclined in the subcontracted works.

The contractor shall implement the quality control in compliance with the approved QAP.

3.2.1 Quality Assurance Program

The intent of this program is to provide adequate assurance that the materials, workmanship and completion of work incorporated in this project are in reasonable conformity with the requirements of plans and specifications including any changes.

3.2.2 Qualified Laboratories

Laboratories those are capable of performing test procedures. This program includes, as a minimum provision of checking test equipment and a requirement that the laboratory maintain

records of all calibration checks. The laboratory must be located within the limits of the Works area and be fully established before the Works commence. Subject to the approval of the Engineer some tests may be carried out at an alternative laboratory containing more complex testing equipment.

Testing equipment and apparatus are to be initially approved, and periodically checked by the consultant to assure proper operation, accuracy, correct calibration and complete conformance to specification requirements instructed by the engineer. The engineer/consultant shall supervise, monitor and check all aspects of the testing procedures including sample storage, preparation, testing and analysis and reporting of test results.

The Contractor must carry out regular routine testing in the site laboratory (supervised by the Engineer) on all materials delivered to the site. This will include additional tests on site on those samples collected at random as part of the quality control check system.

The Contractor shall be responsible to set up and maintain a fully equipped field laboratory for routine tests for quality control requirement that do not require electrical power supply and are relevant to the project specification. Field laboratory will be managed by suitably trained personnel in material testing and quality control works, as specified in the contract document. The requirement of a quality control organization will vary for different project depends on size of project. The minimum suggested organization of quality control laboratory set-up at field is as follow.

Field Laboratory- At ……..Road

3.2.3 Qualifications of Laboratories and Sampling and testing Personnel

The laboratory at the camp or contract premises will be fully equipped for performing all the tests required for the projects as specified in the contract documents except some special tests. The calibration will be done from the related government agency. The qualification and calibration records will be documented properly. Sampling and testing personnel will be capable to perform all the required tests.

3.2.4 Planning of Works

Planning of Construction Materials to the Site

Materials to the site will be stocked at such placed where no foreign materials will be mixed up. Any materials from unapproved source or stock pile which do not comply with the specification will be immediately removed from the site. The working site will be neat and

clean i.e., the construction material will not be scattered. The gabion boxes will be woven in a separate yard at one place so that it will be easy to control the box quality. Only approved boxes will be transported to the site. The storing of cement and other materials will be approved manner.

Work Instructions

Work instructions will be issued at different stages when required. Unusual section of work are will be identified and considered as the work requiring work instructions. Work instructions will be issued with the signature of Contract Manager or Site Engineer.

Check Lists

In consultation with the engineer, check lists will be developed for different structures e.g. masonry wall, gabion wall, RCC structure, culvert, earth cutting work, side drainage, pavement work etc. and approved from the engineer. Each of these lists will contain the check for all the steps and test required. These will be filled up every day by site quality-controlled engineer and signed by both the parties at its completion and submitted to the QC engineer. These lists will be used in quality auditing

3.2.5 Verification Sampling and Testing of Project Material

Prior to the commencement of the Works, tests must be carried out by an approved laboratory on material samples (or mix designs) submitted to the Engineer for approval. No deliveries of materials will be permitted until samples and a Materials Control System have been approved in writing.

These materials can generally be described as those that are used/produced to meet the requirements of a specific project. They are characterized by being sampled at the borrow/construction project site and tested either at the project site or at a qualified laboratory. Aggregates, PCC, Mortar, Base and sub-base materials, gabion boxes etc. are considered project produced materials.

3.2.6 Verification Sampling and Testing of Manufactured Material

These are the materials manufactured to meet the specific requirements and can be used on numerous construction projects provided they meet the requirements for those projects. These materials (GI wires, Geotextiles, cement, Bitumen etc.) will be sampled at the project site and forwarded for testing to central laboratory of DoR or other recognized laboratory for testing.

The manufacturer certification and/or manufacturer certified test reports will be documented and a copy will be supplied as per provision of the contract.

3.2.7 Setting Specific Standards for Construction Performance

The standards set out in the drawings and specification of the contract documents will be strictly followed.

3.2.8 Measuring Variances from the Standards

For measuring variances of materials and work from the standards as set out above, standard formats will be developed and approved from the engineer. For lab tests, the formats are included in the **Annex-II and Annex-III.**

3.2.9 Minimizing adverse variances

To minimize adverse variances, Contractor will develop and submit a stepwise control procedure for most of the important items of work and will be strictly followed after its approval. Procedures for some major items of work are presented in the **Chapter 4**. For the work which is totally out of control will be rejected and reconstructed.

3.3 Quality Control Tests

- The Specification defines the quality control tests to be undertaken at each stage of the Works, together with frequency and results that should be achieved. **The list and frequency of tests that shall be conducted are in Annex-IV.** Works that are not covered by the General Specification must be included in a Particular Specification, including tests, frequencies and results for materials and workmanship. **However, the number of tests recommended as per Specification may be reduced at the decision of the Engineer if it is felt that consistency in the quality of materials can still be maintained with reduced numbe of tests.** A summary of the tests undertaken should be maintained in a Record Book the format of which is contained in **Annex-II and Annex-III.**
    - A detailed description of each test procedure is contained in the Standard Test Procedures
    - Where any test result fails to meet the requirements of the Specification the Employer/Engineer must be notified immediately by SMS, mail, telephone, and a copy of the failed test report dispatched to him if required. The Employer will direct the support staff on what action is required.

- Copies of all test results, together with a summary sheet for each test, should be submitted to the employer at the end of each month, or at such other frequency required by him. The formats are given in **Annex-II and Annex-III.**
- Many of the tests may be undertaken on site using basic test equipment. Others will need to be carried out in an off-site laboratory equipped with more complex machinery that has been approved by the Engineer. In all cases the tests are to be undertaken by the Contractor at his own expense, the cost of which is deemed to be included in the rate for the relevant work item.
- When a contract requires specialized materials or components to be used and the Specification does not require tests on those items the Engineer must ensure that the items proposed comply with the Specification.
- The contractor must submit samples at the earliest opportunity to allow sufficient time for testing and analysis results and to avoid delays to the construction program.

Quality Control tests are undertaken in following stages of the works:

I. Quality Control Tests of Material Prior to Construction
II. Quality Control Test of Workmanship and Works during construction
III. Stage Passing
IV. Acceptance of Work after construction

3.3.1 Quality Control Tests of Material before Works

Commented [u1]: Equipment Missing

All materils before use in the works shall be tested by the contractor for the tests indicated under **"Tests to be carried out prior to Construction" for an approval.** The tests shall be carriedout from each source identified by the contractor. The test samples shall be representative of the material available from the source. Any change in the quality of material with depth of strata shall be reported. Important tests for base subbase like the MC, MDD, AIV, PI, CBR, marshal stability flow test for Asphalt concrete mix and other tests specified by the engineer. The tests results shall form the basis for approval of the source and the material for incorporation in the work and shall be approved by the engineer. For manufactured items, however, such as concrete pipes, a test certificate obtained by the manufacturer from an approved Test House shall be accepted.

3.3.1.1 Sampling of Materials

I. Sampling Requirement

Sample is a portion, piece, or segment that is representative of a whole. All Construction materials to be used in the permanent works are to be sampled jointly by the engineer and contractor prior to commencement of the work. This operation includes sampling for materials to be tested for approval of the material source as well as sampling of materials for approval of the individual construction material. **In both cases, and for each instance the engineer the contractor must give notification of a request for such sampling to the engineer in advance (48 hours) by way of the request for Inspection.**

Sampling instruments and equipment, bag and labor are to be provided by the contractor. For sampling activities, the consultant is to be represented by the material engineer or his subordinate.

II. Sampling Procedure

All sampling is to be carried out in accordance with instructions to be given by the engineer. Sampling procedures are to follow recognized guidelines of good engineering practice. Sampling method shall be in accordance with

- Sampling of **STONE, AGGREGATE, SAND AND FILLERS** shall be done as per ASTM–D75
- Cement shall be sampled according to IS 3535.
- Sampling of straight-run and cut-back bitumen shall be done in accordance with ASTM D 140.
- The sampling of **Reinforcing Steel** shall be as per the NS 84-2042 and NS 191-2045 Sampling of **soils and gravels** shall be carried out as specified or as directed by the Engineer.
- Sampling of **Bituminous Mixtures** shall be carried out in accordance with ASTM Method D 979
- Obtaining samples from at least three locations.
- Ensuring that the sampled materials and locations are “typical” for the material to be used Ensure that sufficient quantity are sampled to enable all tests to the conducted, plus additional material, to be stored for subsequent testing, if required.

3.3.1.2 Preparation and storage of Samples

Sample collected are prepared as per standard methods, with an additional sufficient quantity retained in sealed bags or container and separately kept in the sample storage room of the laboratory for additional testing and future reference as required. Concrete samples are to be

carefully cured and kept in curing tank of the laboratory. Detailed of all samples stored are to be kept in a register to be administered by the material engineer. Ensure that each sample bag is marked both inside and outside, giving the sample number, material type, sample location, date and the number of bag as well as any other information as follow

SAMPLE TAG:

a. Project- ……..……
b. Contract Identification No…….....
c. Sample number ……..
d. Date of sampling ……..
e. Sampling material…….
f. Depth ……..……
g. Location/Chainage ……..……
h. Sample taken by …….…
i. Tests to be performed ……..

3.3.1.3 Approval of Material

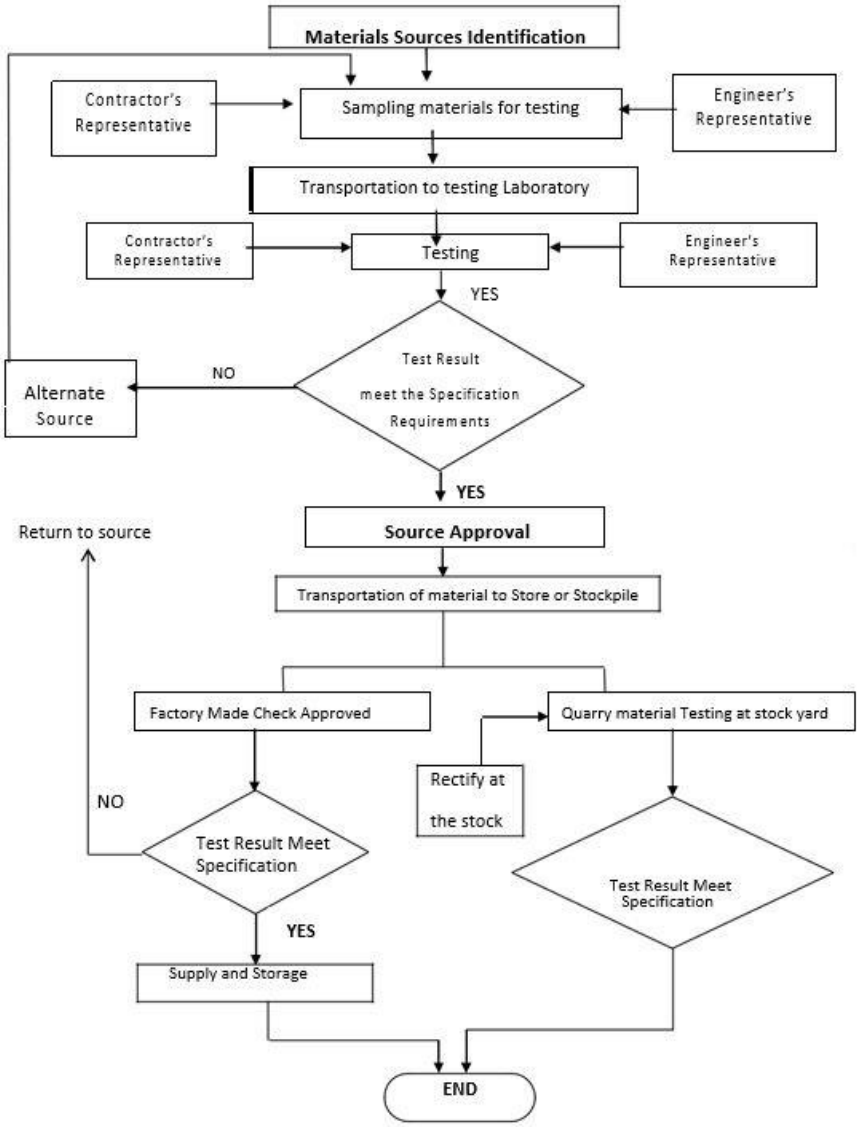
I. The Contractor must obtain written approval from the Engineer before bringing materials to the site. Approval will be based on testing of samples to demonstrate compliance with the specification, together with approved storage and management procedures that ensure consistent quality control will be maintained.

II. Records must be kept of all materials brought to the site, together with corresponding tests to confirm compliance with the specification, and the location of all materials incorporated into the permanent works. Materials that fail to meet the specification requirements must be rejected by the Engineer and removed from the site by the Contractor.

III. The Contractor must obtain written approval from the Engineer before commencing each stage of the works. Approval will be based upon satisfactory preparation for the works and quality control tests on the preceding stage of works together with other requirements of the specification.

IV. The quality control system comprises the methods, procedures and organization for the quality control of the work. The quality control system is implemented in following sequences. All materials proposed by the contractor to be used in the project work are to be approved first.

Figure 3.2 Material Quality Control Flow-chart



I. Approval of Natural Material

Materials with little or no processing except for perhaps screening for oversize and removal of unsatisfactory particles Approval of natural material shall be obtained for the borrow area. Approval of construction material is obtained by submission of test results for all tests required as per specification, and in some cases by construction of trail sections to prove this material can be placed in the field so as to attain minimum required field properties.

II. Approval of Manufactured Material

Especially homogenous construction materials, like cement, bitumen that are used for blending with natural material. Approval of manufactured materials is generally given in two stages:

Initial Approval- It is given prior to receipt of the materials based on submittal of appropriate testing results confirmed by the manufacturer.

Final Approval- It is given based on initial approval in addition to positive results being obtained for all "acceptance" test required by the specifications or as directed by the engineer. The Quality Assurance System and plan of the manufactured shall also be examined before approval.

III. Approval of Designed Material

Designed materials that involve the mixture of specific proportions of two or more different natural, processed or manufactured materials to obtain a modified material giving a set of desired specific properties. Final approval of designed material is deferred until completion of the followings:

- Approval of sources for each processed material constituents to be included in the final mix design.
- Approval of individual processed and manufactured material to be included in final mix design
- Tentative approval of a laboratory mix design, based on proportioning of aggregate bins materials and manufactured materials to closely approximate the proportioning of materials for the laboratory-based mix design.
- Conduct trail section of works using tentatively approved plant mix design and placing the mixture in accordance with a previously approved construction methodology that conforms to specifications requirements.

IV. Materials storage and control on site

The Contractor's site management arrangements will be submitted to the Engineer for approval prior to the delivery of any materials to the site. The submission will include the site layout, handling arrangements and a delivery and draw-down system to record the position of all materials in the final works.

All materials brought to the site shall be kept free from contact with deleterious matter and shall be deposited as near as possible to the site of mixing. Aggregates of different sizes and types shall be stored in different stockpile heaps that are separated from each other by suitable partitions. Cement shall be stored in a weatherproof godown with proper humidity control and water proofing arrangements may be acceptable to the Engineer. Gabion wires shall be stored in a store

3.3.2 Quality Control Tests during Construction

During execution of the work, quality control for ensuring conformance to specification and workmanship shall be exercised on the basis of tests indicated under, **"Field Quality control Tests During Construction**". The tests shall be carriedout by the contractor independently or in the presence of employer representative, normally a sub-engineer, when available at site or where association of the employer representative in test is prescribed. The sub engineer shall record the result in his own handwriting. The contractor shall be fully responsible for all the tests carried out for the work. The engineer during during site visit shall have a few tests carried out in their presence and sign the Quality Control Register.

3.3.2.1 Quality Control of Workmanship

Testing is required to confirm that approved construction materials are correctly mixed, placed and compacted during the works. Preparatory works for concrete must be checked and approved at each stage, e.g., reinforcement, formwork, mixing control. In the case of backfill behind abutments, each layer must be tested and approved before the next is placed, since failure of an underlying layer will result in rejection of the layers above it. All testing and approvals must be in writing using standard forms.

3.3.2.2 Quality Control of Works

The prescribed tests, frequencies and the procedure for stage passing by supervisory officer shall be mandatory and shall form the part of the contract.

I. **Random Check**

For the purpose of quality monitoring, only random checks are envisaged. For soils other road materials being used at site, a representative sample from the borrow pit in use or stockpiled material can be collected at random, Similarly, while checking placement moisture content during compaction, a random sample can be collected and its moisture determined using a Rapid Moisture Meter. For insitu density determinetion by sand replacement method, the location of the tests can be selected at random. A similar approach can be adopted during bituminous and cement concrete construction. However, where a compacted section is to be checked, the entire compacted section should be divided into 10 sections, of equal length. Two such sub-sections may be selected at random for carrying out the identified tests.

Where random checking has been recommended, the procedure to be adopted for random checking shall be as follow;

The complete section to be checked shall be divided into ten sub sections of equal length viz. 0-50,50-100,100-150 etc. Of these only two sub sections shall be selected for carrying out tests by draw of lots.

II. Hand feels tests

For checking the quality of work, generally it may not be possible to carry out the detailed quality control tests and therefore, for the purpose of quality monitoring simple hand feel tests can be performed. Normally various simple tests have been used by the experienced engineers in the field to make a quick assessment of the quality of product. However, these procedures have not been standardized and involve human judgement. Therefore, these tests which provide useful guidance for supervisory officer during inspections should by no means be used as a replacement of the specified quality control tests.

III. Laboratory

Field Laboratory: The Contractor is responsible for establishing a site laboratory for carrying out quality control tests on his materials and workmanship to demonstrate compliance with the Specification. Before commencement of the work the corresponding testing facilities must be available for examples:

- Laboratory must be established and fully equipped
- Laboratory equipment must be calibrated and tested
- Test formats must be prepared
- Laboratory Technician must be employed and trained

Offsite Laboratory: The tests which are required to be done during the initial stage/before lab set-up such as those pertaining to suitability of construction materials, selection of quarries to be carried out before incorporation in the works as part of quality control or as the tests which cannot be carried out in the field laboratory. **The contractor should send request letter to employer for conduction of the tests in private laboratories, if its reasonable employer will issue letter to offsite laboratory to conduct prescribed tests.**

Test requiring high level of skilled and sophisticated test equipment and those tests which cannot be conducted in the field will be carried out at the central laboratory of DoR, Pulchowk Engineering college laboratory and Nepal Bureau of standard and Measuremen

3.3.3 Stage Passing

The engineer shall exercise quality control checks and certify the work of various stage on the basis of tests and frequencies indicated in the Quality Assurance Plan (QAP). The material engineer certifying the work at vrious stages as per prescribed shall be responsible for the quality and quality of the work certified by him.

3.3.4 Acceptance of Tests for Finished Work

All materials required for construction works for which quality test are specified, and for which approval by the Engineer has been previously given are to be inspected and checked for acceptability in accordance with the specification requirement. Any of the completed construction works in which unapproved or untested or unaccepted materials are incorporated without approval or written permission from the consultant is supposed performed at the contractor's risk and is considered unacceptable and unauthorized.

3.3.4.1 Routine Acceptance of Tests

All sample and quality control tests as well as checks tests to verify quality of materials, are to be conducted by the contractor at his own expenses under the direct supervision of the consultant. The types of tests and frequency of testing should conform to the minimum Quality Control Testing Requirements of the Specifications. Testing and sampling shall be in accordance with relevant IS code.

3.3.4.2 Special Tests

Special tests are generally ordered by the engineer when there is some concern with some aspect of the routine acceptance tests such as sampling technique, sample contamination, error

in testing equipment, operator error etc. The engineer will get prior approval of client in issuing the order of special tests.

The following procedure is generally adopted for special testing

- Identify routine testing concern and request from the material engineer and the senior residential engineer that a special test required.
- Identify that what/how/where/when the special test is to be conducted (by contractor within the field laboratory or by external independent testing or by internal independent testing)
- Obtain approval of the client for making the special test, if needed by contract provision
- Based on the result of the special tests, identify who is responsible for the payment for this test
- Following implementation of any relevant actions indicated based on the results of the special tests, records and test results and also include the results as part of the
- "Quality Control Test Statement" to be submitted with and part of the supervision consultant monthly and quarterly progress Report.

3.4 Non-Compliance and Corrective Measures

It is mandatory to meet quality standard, workmanship and test frequencies of each material and works. Nonconforming works and material shall be rejected.

The non-conformance refers to not meeting quality standard as per contract requirement. These may be non-conformance with strength and workmanship.

3.4.1.1 Non-Compliance other than strength

All the tests results will be compared to the standards specified by the Drawings and respective specifications. Any non-complying result will be immediately informed to the corresponding site staff and engineer with the approved corrective measures if any. Any suggestion or instruction from the engineer will be strictly honored.

Return of the request for inspection form signed "not Approved" with the reason for rejection stated. The contractor is asked for proposal to rectify the non-conformance, which may involve re-submission of materials, new trails mixes and revised method statement.

The acceptance or rejection of any unapproved work shall be reported to the engineer When satisfied with the measures taken to ensure future compliance, the engineer shall confirm approval to continue work for permanent work

3.4.1.2 Corrective Measures

A detail list of the possible areas of non-compliance of the test results and possible corrective measures will be prepared and seek the approval of the engineer. When non-compliance occurs, if it is possible and acceptable to correct, correction will be done in accordance with the approved correction plan and methodology otherwise it will be rejected.

3.5 Monitoring of Quality Control

The engineer has the authority and responsibility for monitoring the use of the Quality Control System for ensuring that the above policies are being implemented, and to consider the need for change.

The contractor is responsible to carry out

- Sampling and testing
- Measurements
- The engineer shall carry out duties
- Decisions
- Certificates
- Order as specified in the contract

The engineer/RE contractual duties are to watch and supervise the works

- Tests and examine materials and workmanship
- Exercise 'Process control" where ever needed

3.6 Quality Auditing & Reporting

A systematic and an independent examination to determine whether quality activities and related results comply with planned arrangements are implemented effectively and are suitable to achieve objectives.

3.6.1 Internal Correspondence

All the test results will be informed to the corresponding site and office staff through site memo and recorded also. A copy of stepwise working procedure will be given to the site engineer and supervisor and they will keep it all time with them in the site and strictly follow it. Any change in the design or of working procedure will be immediately inform to the site staff and send the change order to the project office.

3.6.2 External Correspondence

The correspondence to the suppliers/vendors, engineer and other parties will be under this category. Contractor will prepare and send to the supplier/vendor a specification of the materials required and we will ask them the factory test certificates for each lot of supply. All the quality related information or reports will be given as per provision of the contract.

3.6.3 Filing

Filing of data like site instructions from the engineer, material testing reports, factory test certificates of construction materials (like bitumen, cement, Geotextile, Hume pipes etc.), quality auditing (internal) reports, joint measurements, change orders, daily records of materials and resources used etc. will be maintained properly and updated it as required. All the lab test records as well as factory test certificates of materials will be maintained systematically in the lab.

3.6.4 Weekly/Monthly Testing Schedule

The contractor shall prepare weekly test plan of material and works, submit to employer and get approval as per the provision of the contract. Minimum content of the plan shall be planned date, types of tests, venue (Laboratory or field), responsible person and time. Also include availability of staffs and testing equipment. Then the tests shall be carried out jointly with lab technician/IOW.

Weekly test schedule provides a clear picture of what to do and when to do? When the different activities and their time schedule is previously known, it will be easy to manage all the resources required for performing these activities, to control the quantity of materials and works and hence easy to handle.

3.6.5 Material Management Schedule

It will be prepared based on the project schedule. Its use will be for planning the major tests required for testing the material quality

3.6.6 Short Time Work Program

This will be prepared based on the main project schedule and submitted as per the provision of the contract. It will be used for regular planning of different lab tests, field tests, manpower planning etc.

3.6.7 Tests Statement (Monthly Report)

The list of laboratory test results completed during the month, and the statistical interpretation are to be included as an integral part of each of the supervision consultant monthly progress Report to be submitted to client. The contractor shall submit summary of monthly test report using formats given in **Annex-II and Annex-III**. The test statement shall include but not limited the following:

- Item description and type of test
- Number of tests completed, passed and failed
- Analysis of test results and trends
- Remarks, comments based on the trend detected and any corrective action needed.

4. CONSTRUCTION METHOD STATEMENT

4.1 Introduction

Method Statement is a descriptive document that explains execution methods and procedures of individual tasks involved in a construction project, often listed in a project tender. A method statement explains how the work carried out, involvement of labor & other staffs, plant & machinery, time required, and output expected. For more clarity of the description, method statement must contain sketches, small drawings, schemes and flow charts to avoid misconceptions from both client and contractor.

Method Statement is widely used in the construction industry to control identified quality, health and safety risks, time and money. Method statements outline the safe way of performing a specific job or accomplishing a project and ensure that necessary precautions or control measures are communicated to those involved.

Method statements must be clear and should not be too complicated. They should be easy to understand by those who carry out the work and their immediate supervisors to avoid any confusion.

Prior to start of the construction activities at site, the Contractor shall submit to the Engineer for approval, the detailed method statement. The method statement has two parts:

I. General Part

The general part of the method statement shall describe the Contractor's proposals regarding preliminary works, common facilities and other items that require consideration at the early stage of the contract. The general part shall include information on:

- Sources of materials like coarse aggregates and fine aggregates, quantity and quality of materials available in different sources.
- Sources of manufactured materials like bitumen, cement, steel reinforcement, pre-stressing strands and bearings etc. He shall also submit samples/test certificates of materials for consideration of the Engineer.
- Locations of the site facilities such as batching plant, hot mix plant, crushing plant, etc.
- Details of facilities available for transportation of men/material and equipment.

- Information on procedure to be adopted by the Contractor for prevention and mitigation of negative environmental impact due to construction activities.
- Safety and traffic arrangement during construction.
- Implementation of activities provided in environment management plan.
- Any other information required by the Engineer.

II. Special part

Special part of the method statement shall be submitted to the Engineer by the Contractor for each important item of work as directed by the Engineer. The statement shall be submitted at least 4 weeks in advance of the commencement of the activity of item of work unless otherwise stipulated in the contract. The statement shall give information on:

- Details of the personnel both for execution and quality control of the work;
- Equipment deployment with details of the number of units, capacity, standby arrangement.
- Sequence of construction and details of temporary or enabling works like diversion, cofferdam, formwork including specialized formwork for superstructure, details of borrow areas, method of construction of embankment, sub-grade and pavement, pile concreting, and products and equipment to be deployed. Wherever required technical literature, design calculations and drawings shall be included in the method statement.

Method Statement is prepared as a request come from client before execution of the work. Whatever the situations, each party has to make sure the risk involved in the Method Statement submitted by contractor. Testing and acceptance procedure including documentation: Engineer shall examine and approve the method statement with the required modifications. The modified method statement if required shall be submitted within 14 days of the receipt of the Engineer's approval. The sole responsibility for adequacy and safety of the method adopted by the Contractor shall rest on the Contractor irrespective of any approval given by the Engineer.

A method statement should fundamentally contain the following key elements:

***What work is to be done*?** - This includes scope, problem statement or description of work, and equipment and tools to be used.

What are the tasks involved? - List all tasks or processes to finish the work. Also determine the responsible staff or member for each task.

What are the hazards that may cause potential harm to workers? - perform a basic risk assessment to identify hazards associated with the tasks.

What measures are to be implemented? - determine control and preventive measures including emergency procedures in place.

Was the method statement validated? - validate the method statement by approving by the client.

Role of Method statement in a project depends on task that to be executed. Hence the detailing are varying project to project and task to task. Here, major contents a typical method statement included shown.

I. Introduction and Scope of work
II. Applicable Project Specification and standard
III. Drawings
IV. Location of activities
V. Operation
VI. Responsibility
VII. Equipment Requirements for execution
VIII. Health and Safety
IX. Inspection and Test Plan

4.2 Order of Sequence of execution of works

The contractor shall take prior approval from employer before the execution of any work. The contractor shall submit Work Request Form (WRF) as in Annex V with Working Drawing and Method of Statement to employer for approval at least 2 days (48 hours) before the construction work starts. Any changes in design and drawing shall be immediately informed to enginner and employer and start the work only after consent from employer. **All the works deviation from design and constructed without approval of employer shall be rejected by employer.**

The Sequence of construction of main works is presented as follows.

I. Joint Construction survey

II. Site Clearance/Tree clearance if any

III. Earth work Excavation for road way

IV. Earthwork for filling in embankment construction

V. Earthwork Excvation for Structure

VI. Gabion and Masonry retaining structure including backfilling

VII. Bio-engineering works after completion of earthwork (June to September)

VIII. Hume pipe and RCC slab culverts including protection works

IX. RCC causeway and river training works

X. Construction of road side drain

XI. Construction of sub grade

XII. Construction of sub base

XIII. Construction of Shoulders

XIV. Construction of base

XV. Prime coat, tack coat and Pavement (Asphalt Concrete, DBST, Premix etc.)

XVI. Concreting Works (PCC/RCC) for Structures, Rigid Pavement.

XVII. Other ancillary works- road furniture, traffic signs etc.

XVIII. Preparation and approval of as built drawing.

XIX. Handover the project

XX. Maintenance of the project

4.3 Method Statement of Works

The overall construction work shall comply with Standard Specification for Road and Bridge Works with its Ammendments.

4.3.1 Earthwork

4.3.1.1 Earth work in cutting (DoR Specification Section 905)

1 Approval of joint construction survey drawing

2 Find existing survey points and bench marks

3 Site clearance, cleaning and grumbling done as specified in section 200 including tree cutting

4 Establish extreme points at uphill from where excavation starts

5 Excavation with adequate precaution against soil erosion, private property on hillside and valley side.

6 Suitable excavated material shall be used in filling. Excess material shall be disposed in environmentally safe point as specified in EMP

7 Slope of side cutting maintained perfectly in line and level as shown in the drawing or as directed by the engineer. No points on slope shall vary from the designated slopes by more than 150mm measured at right angle to the slope.

8 Formation level checked and shall be truly in line and level as shown on drawing

9 Joint measurement by taking level of formation level, measuring width of road and slope ratio and slope length

4.3.1.2 Earth work excavation for foundation (DoR Spec. Section 907)

1 Excavation shall include removal of material for construction of foundation for gabion work, retaining structure, head wall, cutoff walls, chutes, culverts, causeways and other similar structures. Excavation will be done as per flow diagram.

2 Finalization of construction spot as specified in drawing

3 Before commencement of the excavation the contractor shall request for works filling the WRF indicating location of work with typical working drawing and get approval from the Engineer.

4 Layout for structure as shown in the drawing

5 Site clearance, cleaning and grumbling done as specified in section 200

6 Manual excavation with adequate precaution against wall collapse and slides.

7 Excess material shall be used in backfilling if the quality is better otherwise disposed in environmentally safe point as specified in EMP

8 Slope of side cutting maintained perfectly vertical where natural soil stands. Where the nature of soil or the depth of excavation does not permit vertical

9 Excavation the contractor will put necessary shoring and shuttering and planking.

10 The depth of excavation shall be as shown in the drawing or as directed by the engineer. Bottom level checked with reference to Bench marks.

11 Joint measurement

4.3.1.3 E/W for Formation of Embankment (DoR Spec Section 909)

1 Before commencement of the excavation the contractor shall request for works filling the WRF indicating location of work with joint construction survey drawing and get approval from the Engineer.

2 The use of any borrow/quarry sites will be chosen by thinking of the stability & safety of the works. All areas susceptible to erosion will be protected as soon as possible either by temporary drainage works. Borrows/ quarries will be located away from the inhabitant's centers, drinking water intakes, cultivable lands and drainage systems. Permission of the Engineer will be obtained before opening up any borrows pits or quarries.

3 Clearing Grubbing of embankment site by removing top 15cms organic soil and stored for covering the embankment slopes if the embankment is not good for vegetation growth.

4 Setup the boundary of embankment by fixing batter pegs and marking toe lines on both sides at regular interval as directed by the engineer. The embankment shall be built 300mm wider on either side of roadway than the specified formation width so that to get proper compaction of the edge and side slopes after trimming excess width.

5 Removal of top organic soil of borrow pit to the specified depth not exceeding 150mm

6 Foundation for embankment construction after removing top soil shall be prepared as follow:

- The embankment height less than 1.0 m over natural ground the ground surface should be loosened up minimum 150 mm by scarifying and compacted to the specified density
- For embankment less than 0.50 meter over an existing blacktop or gravel surface the black topping shall be removed and the pavement/gravel surface should be

scarified to a minimum depth of 150mm. All particles shall be reduced to a minimum size of 75mm and compacted accordingly.

- If the granular/blacktop lies within 0.50 to 1.0meter of the new subgrade level, the same should be scarified to a depth of 50mm for achieving bond between old and new material

7 The size of the coarse material in the mixture of earth used for embankment construction should not exceed 75mm

8 The soil should be spread n line and level over the entire width of the embankment in layers not exceeding 150 mm compacted thicknesses. Each layer is thoroughly compacted by roller at moisture content within (±2%) of OMC.

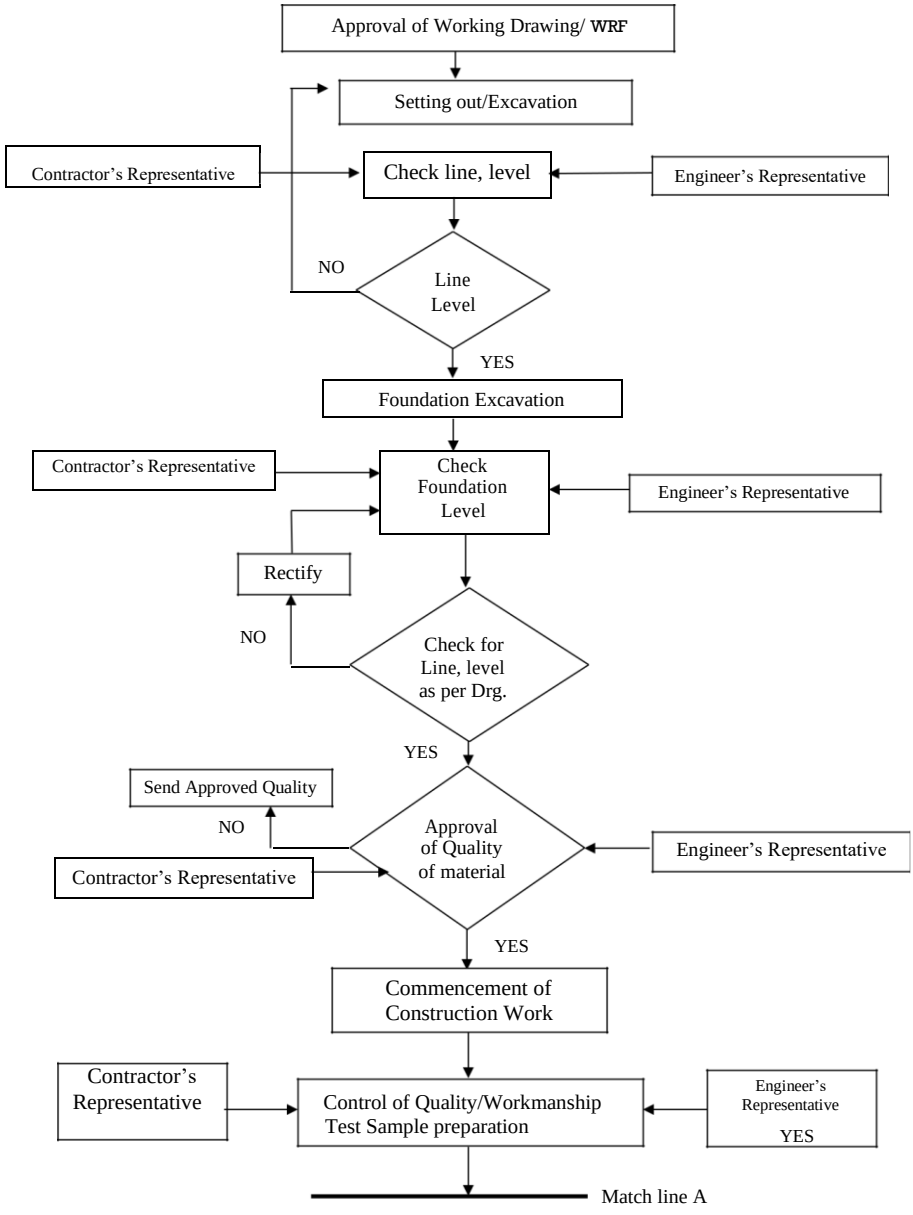
9 Each layer below 500mm should be compacted to at least 93% of MDD. The top 500mm depth of the embankment constituting the subgrade should be compacted to 95% of modified Proctor density.

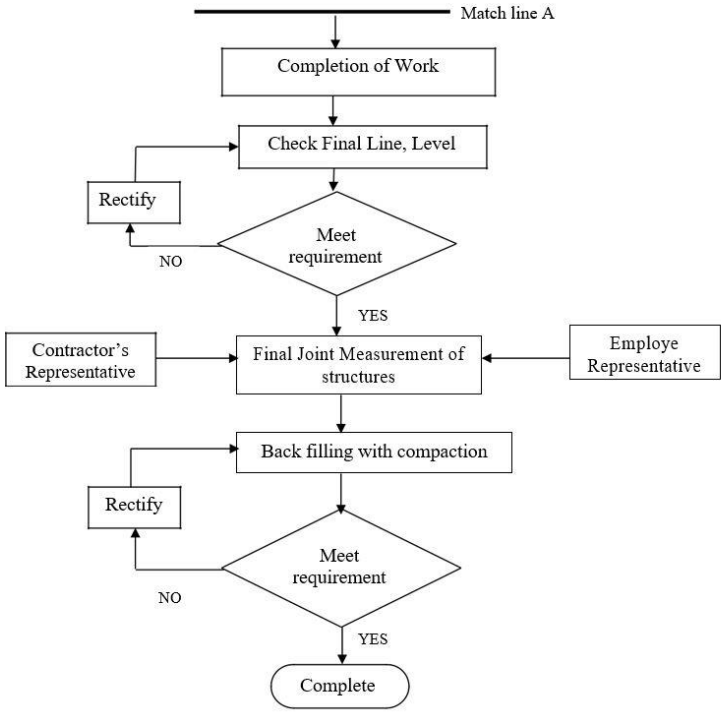
10 Ensure the longitudinal and cross profile should be in conformity with the approved drawing.

11 Approval (surface level and compaction control tests) of each layer from the engineer should be obtained for each finished layer. Subsequent layers shall be placed only after the finished layer has been tested and accepted by engineer.

4.3.2 Construction of Structures

Figure 4.1 Flow Chart of Construction of Structures





4.3.2.1 Gabion Work (DoR Specification Section 2400)

1 Tool and Equpments: Gabion boxes and binding wire pick axe, showel, thread, geo textile, compactor, stones, pliers etc.

2 Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical construction drawing and get approval from the Engineer.

3 Approval of material e.g. stone, gabion wire as well as mesh

4 Mesh weaving mesh type 100x120mm, meshwire-10 SWG, Selvage wire 8 SWG and binding wire 12 SWG heavy zinc coated

5 Construction and approval of demo block of gabion and get approval.

6 Layout of wall perfectly as shown in drawing or as directed by the engineer

7 Excavation of foundation as specified in **Section 4.3.1**

8 Assembling of gabion boxes by installing diaphragm, spiral lacing of selvedges

9 Laying of gabion boxes on prepared foundation in line and level and binding of adjacent gabion box.

10 Laying of stone in gabion boxes in equal three layers

11 Erection of bracing from both direction at a distance of 0.33meter interval

12 Tying down the lids and spiral binding with 10SWG wire.

13 Placing another layer of gabion box with vertical joint staggered as shown in layer plan and tying of gabions with binding wire from bottom, and sides of adjacent boxes

14 Same process will be repeated for another successive layer of gabion

15 Checking by engineer and Joint measurement

16 Laying of geo-textile and back filling with compaction (15cms each) and Compaction tests of backfill material each layer (15cms each).

4.3.2.2 Stone Masonry Wall (DoR Spec Section 2600)

1. Tools and equipment: Concrete mixer, batching boxes, cube moulds, pick axe, trowel, mason hammer, head pan, 5 Kg hammer, thread, compactor, stones.
2. Material approval (stone, sand, cement, aggregate)
3. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical working drawing prepared after site verification and get approval from the Engineer.
4. Layout of wall with respect to approved working drawing
5. Foundation excavation mechanically and manually. If the depth is adequate check, width, cross slope and foundation level with reference to the drawing
6. Fixation of thread/wooden template equivalent to the cross section of proposed wall
7. Laying of stone soling filling of voids if provided
8. Erection of formwork for edge for placing concrete
9. Lean concrete laying to required thickness and grade as shown in the drawing
10. Laying of masonry work to line, level and dimension as shown in the drawing after getting approval from the engineer. The stone shall be laid on their natural bed in

horizontal course keeping height of each stone same, fine tooled on all bed, joints and faces, full and true.

11. Lay outer layers of masonry first, fix the location of headers and bond stones and lay them.
12. Prepare sample of mortar cube of 70.5X70.5x70.5 mm 6 nos for each 10 cum of masonry work
13. Lay all stones, full with mortar both in bed and vertical joints and settled fully in place with a wooden mallet, immediately on placement and solidity embedded in mortar before it has set.
14. Clean and wet chips and spalls can be used whenever necessary to avoid thick joints or bed of mortar. Ensure that no hollow spaces are left anywhere in masonry. Chips and spalls shall be used in the interstice between the adjacent stones in hearting only and shall not be more than 20% of the quantity of masonry.
15. Provision of weep hole of HDPE Pipe 100 mm dia as shown in the drawing
16. Make vertical joints truly vertical and staggered as far as possible. Finish top level of wall by checking design level as shown in the drawing.
17. Cube test in laboratory jointly
18. Request for Field Inspection (RFI) and get approval from engineer
19. Joint measurement
20. Backfilling in layers and compaction up to 95% of MDD

4.3.2.3 Plum concrete (DoR Spec Section 2400)

The use of aggregate as a filter can be extended by using of stone of 150-300 mm size in a normal concrete. The resulting concrete is termed as “Plum Concrete”. The large stones are called plum and used in large concrete mass. The volume of plum should not exceed 30-40% of the total volume of the finished concrete.

The length of stone shall not exceed 3 times its height. The water cement ratio shall be adjusted at site to maintain good flow of concrete to fill the voids properly. The plums are laid in layers using concrete as mortar. All plums shall be hard, durable, clean and free from soft materials or loose pieces or deleterious substance and shall not have sharp corners.

1. Material, tools and equipment- Concrete mixer, batching boxes, vibrator, cube moulds 150x150x150 mm, pick axe, trowel, mason hammer, head pan/wheel barrow, 5 Kg hammer, thread, soil compactor,
2. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical construction drawing and get approval from the Engineer.
3. Excavation of foundation is as described in Paragraph 4.3.1 (b)
4. Formwork shall be placed in position and approved before placing plum concrete. The formwork shall be according to **Section 4.3.4** of this methodology.
5. Provide at least 10-15 cms of concrete on the bed foundation as levelling course
6. Plum shall be washed and all dripping surface water removed before being embedded in the concrete.
7. Lay the plum on the laid concrete approximately covering 30-40% of the volume of concrete used for each layer. No stone shall be closer than 10 cm to an exposed surface nor nearer than 10 cm to an adjacent stone.
8. Place the concrete to fill half height of the plum throughout the layer.
9. Prepare cube moulds of 150x150x150 mm 6 nos for each 20 cum of concrete.
10. Place another layer of plum in scatter position and fill the concrete to the half-height of the newly laid plum.
11. Compaction is carried out in each layer of concrete with the help of vibrator.
12. The stones shall not be dropped in place, but each stone shall be laid and carefully embedded so as to avoid any injury to the form or adjacent masonry and in such a manner that no planes of weakness of unnecessary joins occurs in the structure.
13. Concrete shall be deposited in shallow layer and at such rate as to maintain, until the completion of the unit, a plastic surface approximately horizontal throughout.
14. Each layer shall be thoroughly compacted before placing the successive layer. These plums shall remain half embedded in the concrete and the other half exposed so as to form a key with the next layer of concrete. No plums shall be used for concrete which is laid under water.

15. Weep holes shall be provided by HDPE pipe. The end of the weep holes on the sides shall be covered by geo-membrane and filled by gravels of size 40mm
16. All plum concrete/plum masonry shall be thoroughly wet for at least 7 days.
17. Joint Measurement
18. Backfilling in layers and compaction up to 95% of MDD
19. Cube test in the laboratory

4.3.2.4 Road side drain

There are two types of drain in the contract i.e. trapezoidal and tick type. The section of drain is small so great care shall be taken during construction.

1. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical working drawing prepared after site verification and get approval from the Engineer.
2. Layout of drain alignment with respect to approved working drawing.
3. Foundation excavation manually exactly in longitudinal level.
4. Fixation of thread/wooden template equivalent to the cross section of proposed drain
5. Laying of stone soling filling of voids if provided
6. Lean concrete laying to required thickness and grade as shown in the drawing
7. Laying of masonry work to line, level and dimension as shown in the drawing after getting approval from the engineer. The stone shall be laid on their natural bed in horizontal course keeping height of each stone same, fine tooled on all bed, joints and faces, full and true.
8. Prepare sample of mortar cube of 70.5X70.5x70.5 mm 6 nos for each 10 cum of masonry work or part of it.
9. Prepare sample of mortar cube of 150X150x150 mm 6 nos for each 20 cum of Concrete work or part of it.
10. Finish top level of wall by checking design level as shown in the drawing.
11. Cube test in laboratory jointly
12. Joint measurement

4.3.2.5 PCC and RCC work (DoR Spec Section 2000)

1. ***Material, tools and equipment***- Concrete mixer, batching boxes, vibrator cube moulds 150x150x150 mm, head pan/wheel barrow
2. Before commencement of the concrete work the contractor shall request for works filling the WRF indicating location of work along with ***Concrete Pouring Card*** with typical construction drawing of the member and get approval from the Engineer.
3. Reinforcement and formwork shall be approved beforehand.
4. Choose of concrete grade as shown in the drawing or as directed by the engineer
5. Concrete is mixed using mechanical mixer of one bag capacity. Avoid hand mixing of concrete for the use in structural concrete except for isolated culvert up to 2 meter in remote areas. Add 10% extra cement for such situation.
6. Concrete is batched with the use of batching box of 1 bag capacity.
7. After mixing, transport green concrete to formwork as quickly as possible in wheel barrow to site.
8. Proceed with concreting contentiously, over the area between constructions joint. Deposit concrete in horizontal layer to a compacted depth of not more than 450mm when internal vibrator are used and not more than 300mm in other cases
9. Choose appropriate method of placing of concrete so as to avoid segregation.
10. Care should be taken to maintain cover and to avoid displacement of reinforcement or movement of formwork. Free fall of concrete should not more than 1.0 meter
11. Compact concrete with needle vibrator for deep member and plate compactor for slab in combination with needle vibrator. Compaction shall be complete before 30 min of mixing.
12. Before concreting fix a stopping board at predetermined position for vertical joint which has adequate lateral rigidity to withstand lateral displacement of bulging during concreting.
13. Prepare cube moulds of 150x150x150 mm 6 nos for each 10 cum of concrete work or part of it.
14. Joint measurement.

4.3.2.6 RCC Hume Pipe culverts (DoR Spec Section 2400)

1. Tools anf Equipments: Chain pulley, concrete mixer, rope, mortar cube mould, batching boxes.
2. Material approval (NP3 RCC Hume pipe, stone, sand, cement, aggregate)
3. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical construction drawing and get approval from the Engineer.
4. Layout of individual components of the culvert in accordance with drawing.
5. Excavation for foundation for head wall in line and level as shown in the drawing.
6. Construction of bedding for pipe as shown in the drawing
7. Lower the pipe in bed either by pulley or by manual labor using chain pulley blocks. When two or more pipes are laid adjacent to each other place them separated by 500mm or half diameter of the pipe and the longitudinal slope 1:20
8. While constructing head wall, first construct the wall up to the bottom level of pipe (invert level), place the pipe in position and fill the pipe with suitable materials up to the road level compact the material as required and construct the remaining part of the wall.
9. The pipes are jointed either by collar or by flush joint. Fill the joint space with 1:2 cement mortars, which remain in position when forced with a trowel or rammer.
10. All joints made with care so that their interior surface is smooth and consistent with the interior surface of the pipe. After finishing the joints are covered with wet jute at least for four days.
11. Joint measurement before back filling
12. Back fill trenches after the pipes have been laid after jointing material has hardened. On top of pipe up to 300mm thoroughly ram, tamp or vibrate the soil in two layers. Carry out filling of the trench simultaneously on both sides of the pipe, such that unequal pressure does not occur.
13. Provide minimum cushion of 600mm or diameter of pipe whichever is greater by filling with the suitable material over the pipe after its laying.

14. The construction of apron and other protection works are carried out as shown in the drawing.

4.3.2.7 Slab Culverts

Foundation

1. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical construction drawing and get approval from the Engineer.
2. Approval of working drawing
3. Setout plan dimension of the foundation at the bottom of foundation trench and check with respect to original reference line axis
4. Excavation for foundation for abutment in line and level as shown in the drawing. Ensure embedment of foundation into the rock below the minimum depth of 500 mm for hard rock and 1200mm for soft rock or as specified in the drawing. Provide 300mm thick M15 grade concrete footing, unless otherwise specified on the drawing. Provide minimum 150mm for the base of structure.
5. Before laying foundation concrete check RL of bottom level. Provide side formwork as per requirement and mark top level of concrete bed. Prepare Concrete cube 150x150x150mm
6. Lay concrete contentiously with compaction to the top level as already marked. Finish the concrete level smooth with wooden batten
7. Carry dewatering where necessary for laying concrete so as to keep the water level below foundation level with adequate precaution.

Sub structure

This part covers abutment, wing wall return wall abutment cap RCC dirt walls. Abutment may be of masonry, plum, Brick or RCC.

1. Setting out of abutment and wing wall over concrete bed as shown on the drawing. Make threaded or wooden frame/template equivalent to the section of abutment or wing wall.
2. Lay masonry/brick work within the template. Make provision of weep holes.

3. Masonry work shall be done as described in **Section 4.3.2.2** up to abutment cap level and wing wall at slab top level.
4. Make provision of vertical expansion joints between abutment and wing walls.
5. Provide abutment RCC cap and dirt wall
6. Take measurement of foundation and sub- structure before back filling.
7. Back filling of behind abutment and wing wall with compaction up to desirable height.

Super structure

1. Approval of Re- bar Schedule and temporary works
2. Approve concrete pouring card
3. Setout dimensions, line and level and check with respect to permanent line and permanent bench marks.
4. Erect form works as described in **Section 4.3.4** and get approval
5. Prepare and mix concrete as described in **Section 4.3.2.5**
6. Cast whole slab with reinforcement embedded for kerb and railing post.
7. Sampling of Concrete cubes for 7and 28 days test.
8. Provide wearing course after the slab has been casted
9. Curing by ponding for 7 days
10. Construction of other ancillary works, appurtenances as specified in the drawing

4.3.2.8 RCC Flush Causeway

1. Choose flush causeway to cross shallow water course.
2. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical construction drawing and get approval from the Engineer.
3. Layout of causeway head walls as shown in the drawing.

4. Excavate foundation for upstream and downstream cut-off walls; keep it sufficiently deep to avoid exposure to scouring in line and level as shown in the drawing.
5. Keep top level of causeway same as that of bed of water course
6. Build cutoff walls in masonry work as described in **Section 4.3.2.2** or gabion as described in **Section 4.3.2.1**
7. Carry subgrade preparation in exact line, level and profile as shown in the drawing
8. Carryout stone soling over sand bed, in perfect line and level
9. Divide whole length of causeway in to panel as shown in the drawing. Erect formwork and planks to separate each panel
10. Erect reinforcement as shown in the drawing
11. Encase dowel bars by HDPE pipes and place as shown in the drawing or as directed by the engineer.
12. Place machine mixed concrete and compact as described in **Section 4.3.2.5.** Prepare sample of concrete for tests
13. Providing US and DS protection work
14. Provide guidepost as required

4.3.2.9 RCC Vented Causeway

1. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical construction drawing and get approval from the Engineer.
2. Approval of material
3. Layout of individual components of the causeway in accordance with drawing.
4. Excavate foundation for upstream and downstream cut-off walls; keep it sufficiently deep to avoid exposure to scouring.
5. While constructing head wall, first construct the wall up to the bottom level of pipe (invert level), place the pipe in position and fill the pipe with suitable materials up to the crown level compact the material as required and construct the remaining part of the wall.

6. The pipes are jointed either by collar or by flush joint. Fill the joint space with 1:2 cement mortar, which remain in position when forced with a trowel or rammer.
7. All joints made with care so that their interior surface is smooth and consistent with the interior surface of the pipe. After finishing the joints are covered with wet jute.
8. Carry bed preparation in exact line, level and profile as shown in the drawing
9. Carryout stone soling over sand bed, in perfect line and level
10. Divide whole length of causeway in to panel of 4 meter as shown in the drawing. Erect side formwork and planks to separate each panel
11. Erect reinforcement as shown in the drawing
12. Encase dowel bars by HDPE pipes and place as shown in the drawing or as directed by the engineer.
13. Place machine mixed concrete and compact as described in **Section 4.3.2.5**
14. Provide 150mm thick M20 Concrete slab with a cross slope of 5% toward downstream side of deck slab or as shown in the drawing. In the same time prepare sample of six moulds for tests
15. Discontinue wearing coat at expansion joint locations. Expand joint filler up to the top of wearing coat.
16. Batter the downstream side of headwall on the outside and round the corner
17. Raise end portion of the faces wall and protect entire top of causeway by desirable non-erodible wearing coat.
18. For cement concrete wearing course provide 8mm dia bars@200mm c/c reducing to 100mm in both direction over the strip length of 300mm near the expansion joint or as per design
19. Use open type filler joint with appropriate nose protection

4.3.3 Steel Reinforcement (DOR Specification 2014)

1. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with approval of formwork
2. Submit typical bar bending schedule and get approval from the Engineer for cutting and placing of reinforcement.

3. Straighten the bars which get bend during transportation or handling. And cutting as shown in the drawing.
4. Place reinforcement bars accurately in position as shown on drawing. Make the skeleton of reinforcement rigid by tying all bars crossing one over another at every intersection using annealed binding wire not less than 1mm diameter.
5. Position the bars on cover blocks of required thickness to provide cover to reinforcement.
6. Position the vertical projected reinforcement from sub-structure by means of timber, steel pipe with slot cuts in them accurately or with blocks tied to the reinforcement.
7. Separate layers of reinforcement by spacer or chair bars at a maximum length of 1 meter.
8. All construction joints bend aside reinforcing bars and bend back to the original position, by ensuring that concrete around the bars is not damaged beyond the bend.
9. Stagger the lapped splices and located at point along span where stress are low.
10. Lap length shall be 65 times diameter in tension and 45 times diameter in compression or as shown in the drawing.
11. Checked by engineer and get approval for concreting
12. Joint measurement before concreting.

4.3.4 Form works (DOR Specification 1800)

1. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical erection drawing and get approval from the Engineer.
2. Examine all materials and component used for formwork, for damage of excessive deterioration before use and reuse only if found suitable after repair. Preparation and stockpiling of prepared forms adjacent to sites so as to protect with damp, water excess heat etc.
3. Use familiar material such as plywood, steel, concrete and masonry for false work. For metal forms, the thickness should be adequate to keep them true to shape. Use counter sunk bolts and permit use of approved internal steel ties or plastic spacers.

4. Bamboo props shall not be provided.
5. Ensure false work is designed to meet the requirements of permanent structure including ease of erection and dismantling and is approved by the engineer.
6. Provide proper and safe access to all parts of formwork for inspection
7. Make formwork robust and use bellies of 100 mm dia. of height not more than 4m provide cross and diagonal bracing of 75mm dia. ballies in both directions. For metal forms, the diagonal bracing shall be of the same size of angles used for column.
8. Check for design deficiencies such as shoring or re shoring, insufficient allowance for unsymmetrical or eccentric loading due to placement sequence of concrete.
9. In case of falsework erected on normal ground, ensure distribution of loading to the ground through timber or base plates to avoid differential settlement.

Preparation before concreting

1. Make the formwork sufficiently tight and rigid by the use of ties and bracings to prevent any displacement or sagging between the supports.
2. Apply thin coat of form oil inside surface of the formwork
3. Check line level rigidity depression of slab
4. Make the formwork leak proof to prevent escape of cement slurry during compaction
5. Make ensure that the formwork does not hinder the shrinkage of concrete.

Removal of formwork

Removal of form work depends upon the nature of structure, climate and other condition. Lower the centering gradually and uniformly to avoid shock and vibration so as to permit the concrete to take self-weight. Formwork shall be removed as directed by the engineer or as described below.

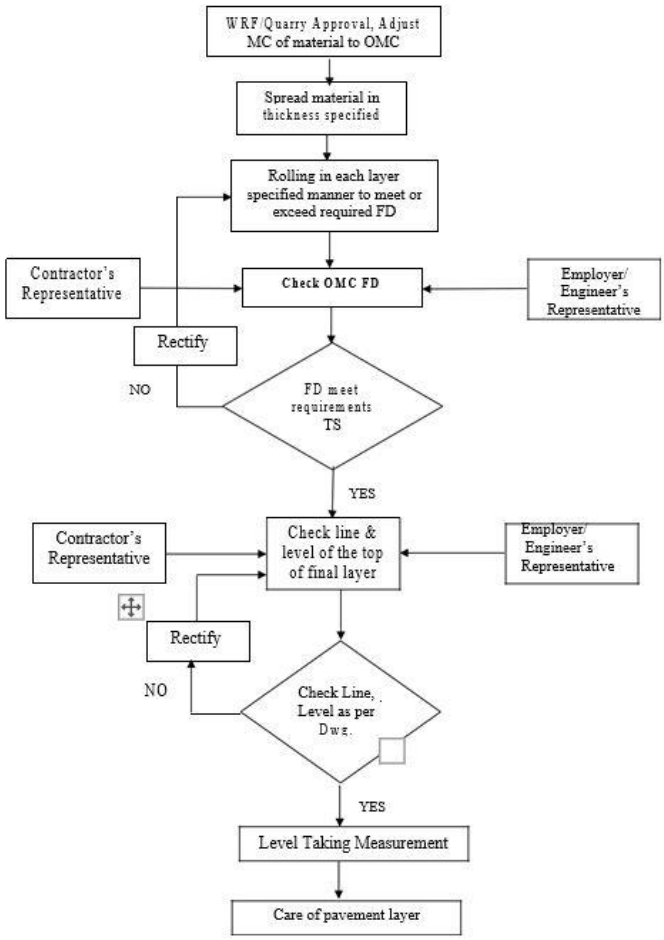
Table 4.1 Removal Time of formwork

SN	Types of Members	Nos of days
1	Wall, abutment, sides of slab, vertical faces of structure	1-2 days
2	Soffits of slab	3 days
3	Props under slab	14 days

4	Props under girder	21 days
5	Soffits of girder	7 days

4.3.5 Pavement

Figure 4.2 Flow Diagram of Construction of Pavement Layer



4.3.5.1 Sub-Grade (DoR Specification section-1200)

The subgrade is top 500 mm compacted layers in embankment or cutting just beneath the pavement crust. The subgrade in embankment is compacted to a higher standard than the lower layers of the embankment. In cutting the cut formation which serves as the subgrade, is treated similarly to achieve the specified density to provide a suitable foundation for the pavement.

Equipment

- Vibrating roller
- Water browser
- Motor grader
- Level machine
- FD measurement apparatus

Construction Methodology

1. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical working drawing and get approval from the Engineer.
2. Ensure the soil of subgrade meets the specified requirement in term of physical properties and the specify CBR value for pavement design.
3. If the subgrade soil does not possess the engineering properties like high plastic black cotton soil and other weak soil yielding very low soaked CBR values, the same should be improved in CBR and workability by replacing suitable material having high CBR value as instructed by the engineer.
4. For a road in cutting, prepare the subgrade in accordance with excavation of roadway formation.
5. Prepared the subgrade in the perfect level and camber with the help of grader and existing potholes are properly repaired
6. If the surface is gravel, the surface is loosened to a depth of 200mm cambered perfectly.
7. Sprinkling with water to OMC and compaction by roller at OMC (± 2%) to at least 95% MDD.

8. Rolling is carried out longitudinally from outer edge proceeding toward center at straight portion of road. In case of curve rolling is carried out from lower level edge toward upper level edge (outer edge) by moving roller parallel to centerline of road
9. Sub-base course shall be laid after obtaining approval from the engineer for subgrade. Such approval would require surface level data and compaction control test data.

4.3.5.2 Sub- base (DoR Specification section-1200)

Equipment

- Vibrating roller
- Water browser
- Motor grader
- Trippers
- Loader
- FD measurement apparatus
- Wheel barrow or hand tractor
- Level machine

Construction Methodology

1. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical erection drawing and get approval of subgrade layer from the Engineer.
2. Selection of the sources of material for the sub- base courses. Approval of sources by the Engineer.
3. If the material is the combination from different approved sources, mechanical mixing properly done at stock pile yard.
4. Conformity tests which will be carried out from stockpile material as specified in QAP
5. Fixation of width and depth of laying of sub base with respect to centerline by driving pegs on both side of the road.
6. Before laying of subbase material remove extraneous material from the prepared sub-grade, repair any defects on prepared subgrade, lightly sprinkle with water and roll with 2-3 passes of 80-100 KN road roller.

7. The subbase material spread in layer by motor grader not more than 150mm compacted
8. If the total thickness is more than 150mm successive layer shall be laid after obtaining approval from the engineer for previous layer. Such approval would require surface level data and compaction control test data.
9. Compaction will be done at OMC at a tolerance limit of ±2%. OMC shall be maintained by spiking water and thoroughly mixing for uniform wetting.
10. Rolling is carried out longitudinally from outer edge proceeding toward center at straight portion of road.
11. In case of curve rolling is carried out from lower level edge toward upper level edge (outer edge) by moving roller parallel to centerline of road.
12. Shoulder shall be constructed simultaneously with subbase construction.
13. Density test as specified in specification section 1200 and QAP
14. Joint measurement/ Final level checking with level machine

4.3.5.3 Base course (DoR Specification section-1200)

Equipment

- Vibrating roller
- Water browser
- Motor grader
- Trippers
- Loader
- Wheel barrow or hand tractor
- Level machine
- FD measurement apparatus

Construction Methodology

1. Selection of the sources of material for the base course and approval of sources by the Engineer

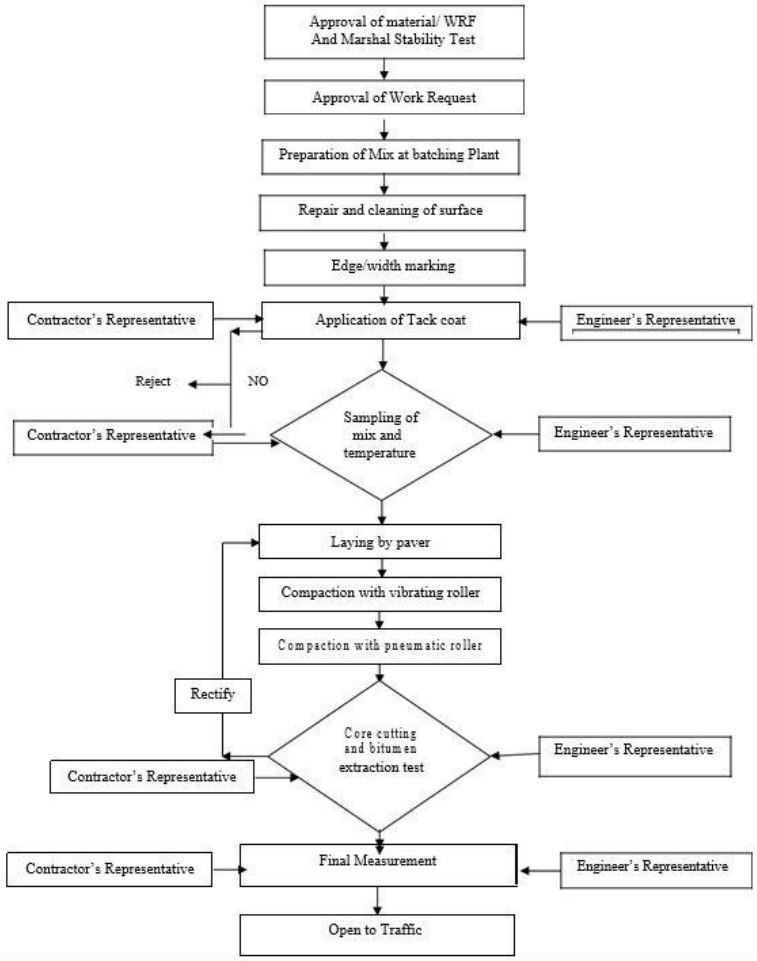
2. Before commencement of the work the contractor shall request for works filling the WRF indicating location of work with typical erection drawing and get approval of base layer from the Engineer.
3. Confirmatory tests of material from stockpiling at project site.
4. Wet mixing at stock pile and transportation to road side.
5. All ruts, deformations, soft spots should be repaired and the surface compacted to required density before placing base there of
6. Marking by driving pegs on either side of road edge, then the aggregate uniformly deposited on the prepared surface, spread over the surface covering full width of carriage way to specified depth not more than 150mm.
7. After spreading the material should be mixed by grading to full depth. By grading bring the material from edge to the center forming windows. Spray the window with water if required.
8. Stone dust must be available at stock at road side to add when segregation occurred.
9. The window is spread back the road depositing all the material to give the correct camber
10. A second application of water may be required to obtain the correct to obtain the correct moisture content for compaction.
11. The layer compacted with the use of vibrating roller to 98% dry density.
12. The compacted thickness of any layer laid, processed and compacted at a time should not be more than 150mm where greater thickness is required the graded crushed stone shall be laid in two layers or more.
13. Successive layers shall be laid only after the approval of the previous layer by the engineer. The approval shall be level data and compaction of such layer.
14. Finally, surface is finished by rolling with steel tire static roller.
15. The hole made for field density test shall be filled with M15 concrete with compaction.
16. Joint measurement by taking level at finished surface.

4.3.5.4 Asphalt Concrete (DoR Specification section-1300)

Commented [u2]: Premix and DBST Add

This work shall consist of mixing graded aggregate and bitumen binder in a central asphalt batching plant, transporting, spreading and compacting the mixture (asphalt) on a primed base course, existing bituminous or concrete surface.

Figure 4.3 Flow Chart of Laying of Asphalt Concrete



Method of statement is stated hereunder.

Equipment

- Asphalt Batching Plant-One
- Tendon roller-One

- Pneumatic roller-One
- Self-propelled mechanical paver-one
- Thermometer-2 Nos
- Tripper with cover- as required depending upon production rate
- Bitumen distributor (with deep rod, tray)-One
- Electronic Balance-One
- Containers for sample collection-12 Nos for each day
- Level machine

Construction Methodology

1. Installation of Asphalt concrete plant in a selected area
2. Source approval for coarse aggregates, fine aggregate and filler material as specified in Technical Specification and QAP
3. Marshal stability test and determination of bitumen content.
4. Traffic diversion and traffic management
5. Cleaning of surface, dust removal and get approval from the engineer before application of tack coat and apply tack coat over prepared base course using bitumen distributor.
6. Preparation of asphalt concrete in a batching plant of adequate capacity by ensuring manufacturing and rolling temperature.
7. For VG-30 Bitumen, Aggregate is heated in between 150^0 to 170^0C, bitumen temperature 150^0-165^0 C and mix material temperature 150^0-165^0 C.
8. Transportation of hot mixed asphalt quickly and laying of mix in within the minimum temperature of 140^0C a specified thickness by means of approved self-propelled mechanical paver in perfect camber
9. Initial rolling is done in a minimum temperature of 90^0 C with tendon roller, beginning from the edge and proceeding toward center longitudinally.
10. Intermediate rolling with pneumatic roller. This should be followed by rolling while the material is still workable. Rolling shall be continued until the voids measured in

the compacted layer are within the range of 2-4% and average density after compaction shall be not less than 98%.

11. Any high spots or depressions noticed after the roller has passed over the whole area once should be corrected by removing or adding premixed material. Rolling should be recommencing thereafter. Each pass should have an overlap of at least one third of the track made in the preceding pass
12. For single lane no longitudinal joint provided, while double lane road longitudinal joints may be required depending on the paver width.
13. Straight edge is used to check the cross fall regularly.
14. Joint cut is performed vertically and tacking is applied thoroughly before laying the AC mix
15. Traffic management is carried out as above.
16. Core cutting and joint measurement for the pavement

4.3.6 Other Ancillary works

Sub surface drain

- Prepare and make approval of the drawing
- Transportation of approved material (perforated pipes, filter material, Geo-textile) etc to the site.
- Layout of the system at site.
- Approval of the section by the Engineer.
- Construction of section in sequence as shown in the approved drawing.
- Conduct flushing test for any blockage.
- Approval of the completed section
- Joint measurement.

4.3.7 Road Maintenance (DoR Specification section-2900)

- Assignment of length man with tools and other accessories as required.
- Arrangement of Flags, Traffic Cones, etc for complete safety.
- Supervision supervisor.
- Joint Record for the payment

Annexes

ANNEX- I
CV

ANNEX- II

Materials Delivery & Testing Summary Sheet

Book -1 **Annex-II**

Materials Delivery & Testing Summary Sheet

Contract No. ……

Contractor' name-

Period: ----------to ----------

Name of the Road-

a. Coarse Aggregate /Fine Aggregate

Date	Source Name	Quantity	Unit	Cumulative Quantity	Test parameter	Test No	Test Result		Frequency		Remarks
							Specified	Actual	Specified	Actual	
					Gradation						
					Crushing strength						
					Flakiness						

					.....						
					.....						
					.....						
					.....						
					.....						

Materials Delivery & Testing Summary Sheet

Contract No. ……

Annex-II

Contractor' name-

Period: ----------to ----------

Name of the Road-

b. Cement

Date	Brand Name	Quantity	Unit	Cumulative Quantity	Test parameter	Test No	Test Result Specified	Test Result Actual	Frequency Specified	Frequency Actual	Remarks
					Setting Time						
					Compressive strength						
					……						
					……						

					.....						

Annex-II

Materials Delivery & Testing Summary Sheet

Contract No. ……

Contractor' name-

Period: ----------to ----------

Name of the Road-

c. Reinforcement Steel

Date	Brand Name	Lot No	Dia.mm	Quantity	Unit	Cumulative Quantity	Test parameter	Test No	Test Result		Cumulative Frequency		Remarks
									Specified	Actual	Specified	Actual	
							Elongation						DoR Lab
							Tensile strength						
							Bend rebend						
							……						

							.....						
							.....						

Annex-II

Materials Delivery & Testing Summary Sheet

Contract No. ……

Contractor' name-

Period: ----------to ----------

Name of the Road-

d. Gabion Wire

Date	Brand Name	Lot No	Dia.mm	Quantity	Unit	Cumulative Quantity	Test parameter	Test No	Test Result		Cumulative Frequency		Remarks
									Specified	Actual	Specified	Actual	
							Mass of zinc						DoR Lab
							Tensile strength						
							Adhesion						
							diameter						

							.....						
							.....						
							.....						
							.....						

Annex-II

Materials Delivery & Testing Summary Sheet

Contract No. ……

Contractor' name-

Period: ----------to ----------

Name of the Road-

e. Sub-base Material

Date	Brand Name	Quantity	Unit	Cumulative Quantity	Test parameter	Test No	Test Result		Frequency		Remarks
							Specified	Actual	Specified	Actual	
					Gradation						
					CBR						
					Plasticity Index						
					Crushing Ratio						

					FI						
					PI						
					.....						
					.....						
					.....						

Annex-II

Materials Delivery & Testing Summary Sheet

Contract No. ……

Contractor' name-

Period: ----------to ----------

Name of the Road-

f. Base Material

Date	Brand Name	Quantity	Unit	Cumulative Quantity	Test parameter	Test No	Test Result		Frequency		Remarks
							Specified	Actual	Specified	Actual	
					Gradation						
					CBR						
					Plasticity Index						
					Crushing Ratio						

					FI						
					AIV						
					Crushing Ratio (min)						
					LAA						
					PI						
					…….						
					…….						
					……..						

ANNEX- III

TEST RESULT SUMMARY SHEET

Book-2

SOIL COMPACTION TEST SUMMARY SHEET **Annex-III**

Contract No. **.....**

Period: ----------to ----------

Road Formation/Behind Structure:

Date of Test	Location in the works	Embankment or Back filling	Depth below surface (m)	**GPS Coordinate of Hole**		**Test Results**				Remarks
				X	Y	OMC	MDD In- situ dry density (gm/cm^3)	FDD In- situ dry density (gm/m^3)	Relative Compaction (%)	

COMPACTION TEST SUMMARY SHEET FOR SUB-BASE, BASE

Annex-III

Contract No.

Period: ----------to ----------

Component: Base/Sub-base

Date of Test	Location in the Road	Depth below surface (cm)	GPS Coordinate of Hole		Test Results				Remarks
			X	Y	OMC	MDD In- situ maximum dry density (gm/cm^3)	FDD In- situ field density (gm/m^3)	Relative Compaction (%)	

MORTAR/CONCRETE TEST CUBE SUMMARY SHEET

(To be kept in a book)

Annex-III

Contract No. …… Road No……. Concrete Grade…… Batching …… Cement Brand…….

Source of Coarse Aggregate…… Source of Fines aggregate……

Request Form No.	Date of Cast	Structure Name	Location	Slump (mm)	Specified Strength MPa	**……. day results**							Compliance (Y/N)	Remarks (Follow-up action)
						Test Certificate No.	Cube Mark	Date of Test	Age (days)	Density (N/mm2	Compressive Strength (N/mm2)	Test Result		

ANNEX- IV

LIST OF TESTS AND THEIR FREQUENCIES

Table-1 Recapitulative Test Schedule and Frequencies

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
1	**Cement (SS DoR-614)**	Setting Time	Initial-45 min Final-600 min	200 Ton or part of it	**3352.00**	17	IS 4031 Part 5	Vicat apparatus	Field Lab	SLT	
		Fineness	>225 sqm/kg	200 Ton or part of it		17	IS 4031 Part 2	Blaine's apparatus	Field Lab	SLT	
		Soundness	<10mm	200 Ton or part of it		17	IS 4031 Part3	Vicat apparatus	Field Lab	SLT	
		Comp. Strength -7days	22 N/mm2	200 Ton or part of it		17	IS 4031 Part 6	Cube crushing machine	Field Lab	SLT	
		Comp. Strength-28 days	33 N/mm2	200 Ton or part of it		17	IS 4031 Part 6	Cube crushing machine	Field Lab	SLT	
2	**Sand**		Table -6.5 SS DOR / Table-1	1 set (3nos) for 10-50 cum and							

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
	(SS DoR-613)	Gradation	IS 2116 (1980)	additional 1 test for 50 cum of mortar	**9369.00**	312	IS 2386 Part 1	Sieves, balance, trays	Field Lab	SLT	
		Clay/Mica content	<2%	1 set (3nos) for 10-50 cum and additional 1 test for 50 cum of mortar		312	IS 2386 Part 2	Measuring cylinder, Balance	Field Lab	SLT	
3	**Stone (SS DOR – 2602)**	Water absorption	<5%	3 sets of tests per source		15	IS 2210 IS 2386 Part 3	Balance, oven, desiccator, glass vessel	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		Specific Gravity	>2.5	3 sets of tests per source		15	IS 1124	Pycnometer, balance, basket, Immersing bucket, oven	Field Lab	SLT	
4	**Cement Concrete (SS DOR – 2000)**	Compressive Strength	Table 20.3 SS DOR Section -2000	1 set for 1-5 cum 2 set for 5- 15 cum 3 set for 15-30 cum 4 set for 30-50 cum For more than 50cum, 4 set of samples plus one additional for each 50 cum or part thereof.	**3524.00**	453	IS 456	Cube mould 150x150x150 Crushing Machine Tamping Rod	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
5	**Cement Mortar (SS DOR-2511)**	Compressive Strength	5.0-7.5MPa	1 set for 10 m3 or part of it	**14868.00**	1487	IS 2250-1981	Cube mould 70.5x70.5x70.5 crushing machine	Field Lab	SLT	
6	**RCC Hume pipe- NP3 (SS DOR- 701)**	Three edge bearing	NS-80 :2045; Table 7.1 and 7.2 of DOR SS		900-512.5 600- 17.50 450-15		NS-80 :2045	3 edge Hydraulic testing machine	Factory		OST
		Dimension & Reinforcementa					NS-80 :2045	Measuring Tape, Vernier	Factory		
7	**Water**	Quality	3 from each source	as required			IS 456	Chemical Test	Field Lab	SLT	
8	**GI wire**	Diameter (Gauge)	Tolerance 2.5%	Table- 24.3	**5350 coil**	Tab- 24.3	NS 163/169-	Gauge meter/Vernier	DoR central		OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
	(SS-DOR 2400)			Section 2400		Sec. 2400	2045		lab		
		Zinc Coating	> (260to290)	Table- 24.3 Section 2400		Tab- 24.3 Sec. 2400	NS 163/169-2045	HCL acid, Antimony Trioxide Balance, measuring cylinder, Vernier caliper, stop watch	DoR central lab		OST
		Tensile Strength	300-550Mpa	Table- 24.3 Section 2400		Tab- 24.3 Sec. 2400	NS 163/169-2045	Tensile strength test machine	DoR central lab		OST
		Adhesion	No flaking off	Table- 24.3 Section 2400		Tab- 24.3 Sec. 2400	NS 163/169-2046	Cylindrical Mandrel	DoR central lab		OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		Uniformity	No Copper deposition	Table- 24.3 Section 2400		Tab- 24.3 Sec. 2400	NS 163/169-2047	Measuring cylinder, Beaker, Balance, Vernier, stop watch	DoR central lab		OST
9	**Reinforcement Steel (SS-DOR 2014)**	Elongation	Attached Annex-A	-one sample up to 10mm dia. for each 25 Ton -one sample for 10-16 mm dia for each 35 Ton and -one sample for	**31.52**	1	IS 432 and IS 1786		DoR, NBSM		OST
		Weight	As specified in NS			1	NS-191	Balance, Vernier caliper	DoR, NBSM		OST
		Bend and Rebend	As specified in NS			1	IS 1599,1786		DoR,		OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
									NBSM		
		Tensile Strength	Attached Annex-A	more than 16mm dia for each 45 Ton		1	NS-203	T. strength machine	DoR, NBSM		OST
10	**Aggregate for concrete work (SS-DOR 2003)**	Gradation	Table-2 IS 383 (1970)	250 Ton	**10071.00**	40	IS 2386 Part 1	Sieves , balance, trays	Field Lab	SLT	
		Flakiness Index	<25	250 Ton		40	IS2386 Part 1	Standard gauge 383x150x6mm	Field Lab	SLT	
		Water absorption	<2%	250 Ton		40	IS 2386	Balance, oven, desiccator,	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
							part 3	glass vessel			
		LAA	<45%	250 Ton		40	IS 2386 part 4	LAA machine, Abrasive charge, sieves, Balance, Trey	Field Lab	SLT	
		ACV	<45	250 Ton		40	IS 2386 part 4	Steel cylinder, tamping rod, Balance, Compression testing machine, Sieve 12.5 and 2.36	Field Lab	SLT	
		Organic impurities	>2.5	250 Ton		40	IS 2386 part 2	Pycnometer, balance, basket, Immersing bucket,	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted At	Conducted by	Remarks
								oven			
11	**Bitumen VG-30 / VG -10 (DOR SS-618)**	Penetration at 25^{0}C, Min	45 / 80	One set of tests for each 50 ton of supply or part of it	**824 ton**	17	NS 221:2047-part 3 / IS 1203	Penetrometer, water bath, Metallic cylinder, transfer Bath, Bath Thermometer	DoR Lab		OST
		Absolute Viscosity at 60^{0}C Poises	2400-3600 / 800-1200	One set of tests for each 50 ton of supply or part of it		17	NS 237:2050-part 8/IS:1206-2	viscometer apparatus, thermometer, stop watch	DoR Lab		OST
		Kinematic Viscosity at 135^{0}C, cSt, Min	350 / 250	One set of tests for each 50 ton of supply or part of it		17	NS 237:2050-part 8/IS:1206-2	viscometer apparatus, thermometer, stop watch	DoR Lab		OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		Flash Point (Cleveland opn cup), ^{0}C, Min	220 / 220	One set of tests for each 50 ton of supply or part of it		17	NS 237:49 part VII / IS: 1448-69	Pensky-Martens Close bath, pulling machine, thermometer	DoR Lab		OST
		Solubility Test in trichloroethylene, percent, Min	99 / 99	One set of tests for each 50 ton of supply or part of it		17	NS: 221:2047 Part IV / IS:1216	Gooch Crucible, Solvent, Conical Glass Flask	DoR Lab		OST
		Softening point (R&B),^{0}C, Min	47 / 40	One set of tests for each 50 ton of		17	NS/IS:1205	Ring and ball arrangements, Water bath, stirrer, thermometer	DoR Lab		OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
				supply or part of it							
		Test on residue from rolling thin film overn test:				17	NS 221:47 part 4 IS-1216-1978	Gooch Crucible, Solvent, Conical Glass Flask	DoR Lab		OST
		(a) Viscosity ratio at 60^0C, Max	4 / 4	One set of tests for each 50 ton of supply or part of it		17	NS 221:2046 Part III / IS 1206-2	viscometer apparatus, thermometer, stop watch	DoR Lab		OST
		(b) Ductility at 25^0C, cm Min	40 / 75	One set of tests for each 50 ton of supply or part of it		17	NS 221:2046 Part I / IS 1206-2		DoR Lab		OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
12	**Subgrade** **SS DOR 1000**	Field density	>95%	1 test per 1000 m^2	**209876.00**	210	IS 2720 part 7	Compaction mould, controlled fall rammer, sieve, balance	Field Lab	SLT	
		Soaked CBR	>5	For each new source and in every 1500 cum or part of it		21	IS 2720 part 16	Balance, CBR machine set, Mechanical Loading Press	Field Lab	SLT	
		MDD / OMC	as specified at lab	For each new source and in every 1500 cum or part of it		21	IS 2720 part 8	Oven, can, balance	Field Lab		
		Swell	<1%	For each new source and in		21	IS 2720				OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
				every 1500 cum or part of it			part 40				
		Plasticity Index	<40%	For each new source and in every 1500 cum or part of it		21	IS 2720 part 5	Atterberg limit apparatus, grooving tools, evaporation dish	Field Lab	SLT	
		Particle size	<60mm	For each new source and in every 1500 cum or part of it		21	IS 2720 Part-4	sieve, balance, oven	Field Lab	SLT	
		Organic Content	<3%	For each new source and in every 1500 cum or part of it		21	IS 2720 part 22	Chemical, Flask			OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
13	**Granular Sub base material SS DOR 1201**	Gradation	Table 12.1 SS DOR section 1201	1 for 400 m^3, every change of source	**49559.00**	248	IS 2386 Part 1	Sieves , balance, trays	Field Lab	SLT	
		CBR (soaked)	>30% at 95% MDD	1for 400m3, every change of source		100	IS 2720 part 16	Balance, CBR machine set, Mechanical Loading Press	Field Lab	SLT	
		Plasticity Index	<6	1 for every 400 m3, every change of source		33	IS 2720 part 1	Atterberg limit apparatus, grooving tools, evaporation dish etc.	Field Lab	SLT	
				one test in every			IS 2720	Balance, Sand Pouring			

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		Field Density and MC	>95%	1000 sqm		100	part 8	Cylinder, Standard sand, Chisel	Field Lab	SLT	
		MDD/OMC	as specified at lab	1 for 400m3, every change of source		50	IS 2720 part 8 ASTM D1557-70	Heavy Mould, rammer, sieve, ,measuring cylinder	Field Lab	SLT	
		Liquid Limit	<25	1 for 400m3, every change of source		181	ISTM 2720-5				
		AIV	40%	1 for 400 m3, every change of source		248	IS 2386 part 4	Impact testing machine with hammer, IS Sieve, Balance, Oven, cylindrical	Field Lab	SLT	
14	**Crusher run**	Gradation	Table 12.1 SS	1 for 400 m3, every	**49559.00**	248	IS 2386 Part 1	Sieves , balance, trays	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
	Sub base Material (SS DOR 1201 & 1204)		DOR section 1201	change of source							
		Combined FI & EI	35%	1 for 400 m3, every change of source		248	IS 2720 part 5	Standard gauge 383x150x6mm, Balance	Field Lab	SLT	
		Plasticity Index	<6	1 for 400 m3, every change of source		248	IS 2720 part 5	Atterberg limit apparatus, grooving tools, evaporation dish	Field Lab	SLT	
		CBR (soaked)	>30% at 95%	1 for 400 m3, every		100	IS 2720 part 5	Balance, CBR machine set, Mechanical Loading	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
			MDD	change of source				Press			
		Liquid Limit	<25	1 for 400 m3, every change of source		248	Manual Counting		Field Lab	SLT	
		Field Density and MC	>95%	One test in every 1000 sqm.		100	IS 2720 part 8	Balance, Sand Pouring Cylinder, Standard sand, Chisel	Field Lab	SLT	
		MDD/OMC	as specified at lab	1 for 400 m3, every y change of source		50	IS 2720 part 8 ASTM D1557-70	Mould, rammer, Vernier caliper, measuring cylinder	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		Los Angeles Abrasion	40%	1 for 400 m3, every change of source		248	IS 2386 part 4	LAA machine, Abrasive charge, sieves, Balance, Trey	Field Lab	SLT	
		Aggregate Impact Value	30%	1 for 400 m3, every change of source		248	IS 2386 part 4	Impact testing machine with hammer, IS Sieve, Balance, Oven, cylindrical steel cup	Field Lab	SLT	
		Water absorption	<2%	1 for 400 m3, every		30	IS 2386 part 5	Pycnometer, balance, basket, Immersing bucket,	Field Lab	SLT	
		Uncrushed	<10%	1 for 400 m3, every		30	IS 2386 part iv	Balance, trays, sieve	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
				change of source							
		Surface Level, Width and Thickness	As per design	20 meter		3629					
15	**Crushed Stone Base Course (SS DOR 1204)**	Gradation	Table 12.8 of SS DOR section 1200	1 for 400 m3, every change of source	**29156.00**	146	IS 2386 Part 1	Sieves , balance, trays	Field Lab	SLT	
		Uncrushed	<10%	1 for 400 m3, every change of source		30	IS 2386 part iv	Balance, trays, sieve	Field Lab	SLT	
		Los Angeles Abrasion	<40%	1 for 400 m3, every change of source		146	IS 2386 part iv	LAA machine, Abrasive charge, sieves, Balance, Trey	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
16	**Crushed Stone Base Course (SS DOR 1204)**	Aggregate Impact Value	<30%	1 for 400 m3, every change of source	**29156.00**	58	IS 2386 part 4 IS 5640	AIV machine, measuring cylinder, test mould, 2.36 mm sieve	Field Lab	SLT	
		Water absorption	<2%	1 for 400 m3, every change of source		30	IS 2386 part 5	Pycnometer, balance, basket, Immersing bucket, oven	Field Lab	SLT	
		Sodium Sulphate Soundness (SSS) if Water aborption > 2%	<12%	1 for 400 m3, every change of source		58	IS 2386 part 5	Balance, Oven, IS Sieve, Container, Wire mesh basket			OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		Liquid limit of material passing 425 microns	<25	1 for 400 m3, every change of source		146	IS 2720-5		Field Lab	SLT	
		Combined FI &EI	<35%	1 for 400 m3, every change of source		146	IS 2386 part 1	Standard gauge 383x150x6mm, Balance	Field Lab	SLT	
		CBR	>80%	1 for 400 m3, every change of source		58	IS 2720 part 16	Balance, CBR machine set, balance, oven	Field Lab	SLT	
		PI of material passing 425 microns	<6	1 for 400 m3, every change of source		146	IS 2720 part 1	Atterberg limit apparatus, grooving tools, evaporation dish etc.	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		Field Density/OMC	>98%	one test in every 1000 m^2		58	IS 2720 part-8	Sand cone density apparatus, Balance, standard sand, Chisel, rapid moisture meter	Field Lab	SLT	
		MDD/OMC	as specified at lab	1 for 400 m3, every change of source		30	IS 2720 part-8	cylindrical mould, controlled fall rammer, sieve, balance, oven	Field Lab	SLT	
		smoothness	As per design	1 Test per 40 sqm		5247					
		Thickness	As per design	1 Test per 25 meter		1452					

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		Surface Level	As per design	1 Test per 10meter		3629	Table- Section 1202				
17	**Aggregate for Asphalt** **DOR SS 1300**	Gradation	Table 13.33 Section-1300	1 test for every 500 cum of part of it	**5833.00**	58	IS 2386 Part 1	Sieves , balance, trays	Field Lab	SLT	
		Los Angeles Abrasion	<30%	1 test for every 500 cum of part of it		12	IS 2386 part 4	LAA machine, Abrasive charge, sieves, Balance, Trey	Field Lab	SLT	
		Aggregate Impact Value	<24%	1 test for every 500		12	IS 2386 part 4	Impact testing machine with hammer, IS sieve,	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
				cum of part of it				Balance, Oven, cylindrical steel cup			
17	**Aggregate for Asphalt** **DOR SS 1300**	Combined Flakiness & Elongation Index	<35	1 test for every 100 cum of part of it		58	IS2386 Part 1	Standard gauge 383x150x6mm	Field Lab	SLT	
		Sodium Suplhate Soundness Magnesium Sulphate	<12% <18%	1 test for every 500 cum of part of it		12	IS 2720 part 5	Balance, Oven, IS Sieve, Container, Wire mesh basket	Field Lab	SLT	
		Stripping Value	Minimum	1 test for every 500		12	IS 6241	Thermostatically controlled water bath, Oven, Sieve,	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
			retained coating 95%	cum of part of it				Mixer,			
		Water absorption	<2	1 test for every 500 cum of part of it		12	IS 2386 part 5	Pycnometer, balance, basket, Immersing bucket, oven	Field Lab	SLT	
		Polishing (Polished Stone Value)	<55	1 test for every 500 cum of part of it		6	BS 812-114		Field Lab	SLT	
		Water Sensitivity	<80%	1 test for every 500 cum of part of it			AASHTO 283		Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
18	**Asphalt Mix (DOR SS 1307/1308/1309)**	Grading and bitumen content	As per mix design and Table 13.33	one test per 400 ton of mix or part of it	**12833.00**	129	IS 2386 Part 1	Sieves , balance, trays			OST
		Marshal Stability- 50 blow	>9 KN	one test per 100 ton of mix or part of it		129	AASHTO T245	Loading Machine, Oven or hot plate, Water bath, thermometer			OST
		Flow value	2.00-4.00 (mm)	one test per 100 ton of mix or part of it		129	AASHTO T245				OST

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		Air void in total volume	3.00-5.00%	one test per 100 ton of mix or part of it		129					OST
		Compression/immersion ratio	>0.75	one test per 100 ton of mix or part of it		129					OST
		Thickness / Core cutting		1 test per 700 sqm	**162033.00**	810					OST
		Density of Cpmacted Pavement	>92%	1 test per 700 sqm		324					OST
		Surface level and Smootness		Every 50 meter or at		726					

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
19	**Prime Coat (DOR SS 1300)**	Quality of Binder	As specified in SN11	One set of test for a tanker or lot of 50 tonne	**170.00**	4	IS:217 for cutback bitumen and IS:8887 for emulsion	As specified in SN11			OST
		Spray Rate	0.9	1 test per 1000 m^2 and not less than two tests per day	**161971.0**	162	IRC 16-2008	Tray, Deeping rod, balance	Field Lab	SLT	
		Binder Temperature for application		Regular Intervals				Thermometer	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
20	**Tack Coat (DOR SS 1300)**	Quality of Binder	As specified in SN11	One test for a tanker or lot of 50 tonne				As specified in SN11			
		Spray Rate	0.50	1 test per 1000 m2 and not less than two tests per day	**80988.00**	81	IRC 16-2008	Tray, Deeping rod, balance	Field Lab		
		Binder Temperature		Regular Intervals		50^0-80^0C	IRC 16-2008	Thermometer	Field Lab		

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		for application									
21	**Fill material** **Formation of** **Embankment (DOR SS 900)**	Particle size	<75mm	1 for 1500 cum, each layer	**722972.00**	482	IS 2720 Part-4	Sieve, balance, oven	Field Lab	SLT	
		Organic matter	<3%	1 for 1500 cum, each layer		482	IS 456	Chemical Test	Field Lab		OST
		Plasticity Index	<45%	1 for 1500 cum, each layer		482	IS 2720 part 5	Atterberg limit apparatus, grooving tools, evaporation dish	Field Lab	SLT	

Road Name:

ANNEX IV

SN	Material / Specification Number	Tests	Specification limit Requirement	Test Frequency	BOQ Quantity	Nos tests Required	Code Reference	Equipment	Conducted		Remarks
									At	by	
		MDD/OMC	Lab Test	1 for 1500 cum, each layer	**180743.00**	482	IS 2720 part 8	cylindrical mould, controlled fall rammer, sieve, balance, oven	Field Lab	SLT	
		Field density	>95%	One set per 1000 m^2, each layer	**722972.00**	1445	IS 2720 part 8	Balance, Sand Pouring Cylinder, Standard sand, Chisel	Field Lab	SLT	
		Soaked CBR	>5	1 for 1500 cum	**180743.00**	121	IS 2720 part 16	Balance, CBR machine set, Mechanical Loading Press			OST

Note: All the mentioned frequency frequncy are just indicative number and shall be calculated on the basis of actual quanity in BOQ. The test beyond above mentioned test shall be added as per requirement.

ANNEX -V

WORK REQUEST FORM (WRF)

Provincial Government
Ministry of Physical Infrastructure Development
Transport Infrastructure Directorate
Bagamati Province, Hetauda

Work Request Form

Project-
Contractor- Employer-
Contract No-

Description of Work requested	Location

Request by contractor Date- Time-

Received By Site Supervision Engineer Date- Time-

Position	Observed Parameters	Status
Site Supervision Engineer		
Signature		
	Equipments and Materials to perform requested work	
date	Equipments	
	Materials	
	Technician	
	Lab Technicians	
Project Manager		*Sign*

Comments by *Consultant Engineer-*

Signature Date-

Note: Working drawing and suitabilty test reports of material should be submitted with Work Request Form .

ANNEX VI

SITE INSTRUCTION BOOK

Transport Infrastructure Directorate Bagamati Province, Hetauda, Makawanpur	
Name of the Project: Contractor: Contract no:	
Site Instruction	
From:	Date/Time:
To:	Location:
☐ Dismantle ☐ Expedite the work ☐ Improve the quality of work ☐ Delay of work ☐ Prioritize the work ☐ For discussion ☐ Any Other.....	☐ Redo ☐ Rectify the defects ☐ Addition of equipment ☐ Addition of manpower ☐ Change material as per specification
Detail Notes:	
Site instruction issued by: Signature:	
Copy to:	
☐ Consultant Engineer ☐ Project Manager	

ANNEX VII

DAILY DIARY BOOK

Commented [u3]: Weekly Meeting Report
Monthly Progress Report

Transport Infrastructure Directorate
Bagamati Province,Hetauda, Makawanpur

Daily Site Diary

Name of the Project:	Contract No:
	Date :
Contractor:	Weather : @ 9:00 Weather : @ 14:00

Daily Diary For Construction Works

A. Construction Activity

Activity	Unit	From	To	Tentative Quantity	Remarks R/L

B. Equipment at Site

Name of Equipment	No.	Condition	Remarks

C. Material at site

Material	Previous stock	Purchase/ production	Consume	Balance	Remarks

C. Staff at site

Contract Manager	Site In-charge	Lab Technician	Skill Labor	Un-skill labor	Other

D. Visitor:

E. Other (if any)

Submitted By Contractor	Received By: Client/Consultant

Note: Add extra sheet if required