CPWD

Central Public Works Department

168 Years of Engineering Excellence



Quality Assurance Manual for Building Works 2022

Sir Visvesvaraya Kendriya Bhawan at Bengaluru

CBI Office Building at Mumbai

Azadi Ka Amrit Mahotsav

सत्यमेव जयते

Quality Assurance Manual for Building Works 2022

CPWD

GOVERNMENT OF INDIA
MINISTRY OF HOUSING AND URBAN AFFAIRS
CENTRAL PUBLIC WORKS DEPARTMENT



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भारत सरकार
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FOREWORD

Central Public Works Department has traditionally taken a lead role in establishing standards and benchmarks for the building construction industry in India.CPWD is committed to achieving customer satisfaction through Quality, Timely delivery & Transparency in effective execution of works and delivery of services while adhering to the principles of sustainable development. In line with the objective of the department, for ensuring word class quality, this Quality Assurance Manual for Building Works is being brought out for the guidance of field Engineers. This Quality Assurance Manual is an endeavor to supplement the existing literature on the subject and to serve as a guiding light in ensuring quality in building projects.

This Manual is made for use in CPWD, though it may be beneficial to other Government Departments and Public Sector Undertakings, who have adopted a similar system of working. I am sure this will be well received by all concerned.

I would like to express my sincere thanks to Sh. D.C.Goel, ADG (Tech), Sh. Vinayak Rai, CE (CSQ) and Sh. A.K. Gupta, SE, DC-1, Sh. Divakar Agrawal, SE, TLQA and other team members with whose efforts this publication could become possible.

Place : New Delhi
July, 2022

(Shailendra Sharma)



Dharmesh Chandra Goel
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PREFACE

Central Public Works Department is committed for excellence in public works through quality, timely delivery, and sustainability. Quality has been the corner stone in the delivery mechanism of public works ever since the inception of CPWD. In our commitment for Total Quality Management (TQM), it is now envisioned that every member of the organization must be committed to maintain high standards in public works in every aspect of the organization.

This Quality Assurance Manual is being published to standardize the Quality Assurance aspects at various links in the long chain of management of works. The provisions in this Manual are for guidance purpose.

I am thankful to Shri Vinayak Rai, Chief Engineer (CSQ), Shri A K Gupta, Superintending Engineer, Delhi Circle-1, Shri Divakar Agrawal, Superintending Engineer (Techno-Legal & Quality Assurance), Ms. Bhumika Mishra, Executive Engineer (Techno-Legal Cell) and Shri D S Adhikari, Assistant Engineer (Retd.) and the entire team of Techno-Legal & Quality Assurance Unit who has worked relentlessly to bring out this publication.

This publication is a participative effort as it was subjected to review through CPWD website and valuable inputs were received from field officers. Their participation is appreciated. The entire CSQ Unit looks forward for a still better participation from one and all so that CPWD publications remain the ultimate resource books for construction industry, at large.

I owe my gratitude to Shri B B Makkar, Special Director General (Head Quarter) (Retd.) who has contributed tremendously to alleviate this publication.

Last but not the least, Shri Shailendra Sharma, Director General, CPWD had been a guiding force behind this streamlining to meet our commitment for assuring quality in the works executed by CPWD.

Place : New Delhi
Date: July, 2022

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CHAPTER 1

Introduction

1.1. Quality Eras

Inspection is considered the first era in quality process out of four eras described by Crosby and is probably still in vogue in most places in construction industry. Inspections are customary, costly and painstaking. Theory of probability is applied during testing by taking samples. Eventually, inspections do not contribute much to reducing the error rate. The problem is addressed after it has arisen. Thus, even 100% inspections will not mean that all the defects have been removed or rooted out.

According to Crosby, second era was of the quality control in which emphasis was given on product uniformity with reduced inspections. **Quality Control** is defined as "all those operational techniques and activities that are used to fulfill requirements for quality" (ISO). Therefore, emphasis in quality control is on techniques and activities. Inspections, monitoring and feedback are carried out in quality control. It has nothing to do directly with the customer's satisfaction. Inspections do not ensure conformance of specifications of one hundred percent work. Inspections in a work may also result to corrective action rather than preventive action. Operational techniques and monitoring also lead to "paper quality" in which the papers assure the quality with or without any consideration of the work.

Quality Assurance as per ISO is defined as "all the planned and systematic activities, implemented within the organization for quality management, to provide adequate confidence that a product or service will satisfy given requirements for quality." Therefore, quality assurance is essentially a preventive activity and is therefore to be systematically planned in advance. The activity includes identification and planning of the checks, inspection and control of process as a part of quality control. Quality assurance also means establishment of a quality system which can demonstrate the requirements. Therefore, concept of quality assurance if not adopted over quality control by any organization, simple change of name will not lead to any improvement.

Total Quality Management (TQM) is defined as "the management approach of an organization, centered on quality, based on the participation of all its members and aiming at long term success through customer satisfaction, and benefits to all members of the organization and to society." In fact, in this approach, customer is the person who accepts the product of any process. Suppose, cement is received by a person, then person receiving cement is customer. When cement is mixed with aggregate and concrete is produced in a mixer, the person receiving concrete at site becomes the customer and so on so forth. Thus, participation of all members is essential in TQM. Everybody must be involved, from all levels and across all functions. A culture of continuous improvement must be established.

TQM is also a philosophy based on the quest for progress and continuous improvement. In Japanese, process of continuous improvement has been termed as Kaizen. In quality improvement, waste and total cost must reduce. Quality improvement can only result from planned management action. Importance of TQM can be understood from the statement of Crosby's four eras of quality as organizations adopting inspections only say, "We don't know

why we have quality problems" while in TQM, they say, "We know we don't have quality problems". Errors can be caused at any stage of management and thus, involvement of everyone is essential in TQM. Question is whether error can be stopped and the answer is very simple-no as it is natural to make errors. But the errors have to be eliminated and not at later stage but right at the stage it is likely to occur or it has occurred by preventing it or correcting it as the case may be. It cannot be passed on to other person or process. Thus, TMQ includes self-inspection.

Inspections, Quality Control, Quality Assurance and Total Quality Management can be best described pictorially as following:



1.2. Concept of Zero Defects

Any variation that is caused while translating customer needs into correct specifications or while producing the required entity is considered as a defect. In fact, many people believe that it is uneconomical to eliminate all defects and some believe that defects or variations are normal, particularly in civil engineering works. But as per quality guru, Philip B. Crosby, 'Zero defects' are both technically and economically possible. An example has shown that once management demanded perfection, it happened and workers produced it. Of the three most common causes of workers errors, lack of knowledge, lack of proper facilities, and lack of attention, management concluded that the lack of attention was often addressed. Therefore, a goal was set to promote a constant, conscious desire to do a job right the first time as per Garvin. The resulting program was called zero defects.

Crosby argues that if management is serious about achieving zero defects, it has to be serious about prevention. He proposed four absolutes of quality management as given below:

(i) Quality means conformance to the requirements.

(ii) Quality comes from prevention.

(iii) Quality performances standard is zero defects.

(iv) Quality measurement is the price of non-conformance i.e. cost of quality.

CPWD brings out specifications by which the requirements are well defined. Wherever specifications of items are not available in CPWD Specifications, NIT approving authorities have to clearly elaborate them in the tender documents. Preventive action has to be taken to achieve the quality and for the same, CPWD has the system of approval of samples. Zero defect performance can only be achieved if architects, designers, NIT approving authorities, supervisory staff, contractors, suppliers and workers are following the concept of quality. CPWD has well-established system of defining the responsibilities of individuals, training and skilling the workers to achieve quality. Therefore, every stakeholder has to contribute to achieve the quality and this is a challenging task.

As per Crosby, it takes a long time to transfer from conviction to conversion but as soon as the transfer process begin, it is a positive sign that improvement has started to take place. The concepts that “Work cannot be done as per the documents” or “Quality is better than others” are considered road blocks.

Zero defects are only possible if each and everyone are involved in quality process. Though difficult but not impossible, concept of zero defects can be implemented if zero defects concept is implemented in every product, every process and by every person in the process. Since, stakeholders in a construction work are many including architect, engineers, contractors, suppliers, local bodies, zero defects become more complex and very difficult to achieve in construction and maintenance.

1.3. Stated and Implied needs

In a construction work, architects, planning engineers and supervising engineers consider stated needs stated by the customer. Therefore, needs are to be stated at the very initial stage and thereafter to be implemented. In a construction work, even if needs are stated initially by the customer, changes are likely to crop up during construction process, hence deviations from the stated needs becomes essential for customer satisfaction, as samples are not available in a construction work as in case of factory made products.

Stated needs are compiled in the form of drawings, specifications, conditions - general or special and clauses of the contract. Implied needs are part of the dimensions of quality. The dimensions of quality for a product are performance, features, reliability, conformity to specifications/standards, durability, serviceability, aesthetics and perceived quality. Time and timeliness of service, completeness, consistency, courtesy, accessibility and convenience, and responsiveness are the dimensions of quality for a service but are also to be included in construction. Construction is also part of a service given to a customer. Thus for a construction work, the dimensions of a product as well as a service are to be considered for a quality work. In fact, product plays a major role during construction and service dimensions play a major role during maintenance. It must be understood that a customer who is not expert in the architectural and engineering profession will not be in position to spell out all the implied needs and hence, these are to be considered by the architect, engineers and builders.

Implied needs are most important. An architect or an engineer has to plan and construct the structure which conforms to local bye laws, is safe during normal and exceptional conditions like disasters, conforms to prevalent codes and guidelines and satisfies the customer’s end

use requirement. A customer must feel happy and satisfied while using the product/work. In fact, it is more of the implied needs which contribute to happiness to the customer and hence these are more important. Sometimes, architects and engineers may insist the customer/ client about the inclusion of implied needs in the tender documents or during execution, but we must understand that it is the client that has upper hand and as such his needs are to be attended as part of quality. Remember, client will be satisfied only if we have understood his needs in detail and the same are incorporated in tender documents and implemented during execution of work.

A building is a fixed asset and one that does not change and thus the owner gets attached sometimes emotionally to it. Therefore, the dimensions of the quality and problems/comfort received from the asset during life of the building affect customer satisfaction. Thus, it becomes essential that the life cycle concept is considered by the architects, engineers and construction agencies. In fact, many times it is the maintenance stage from which customer forms a view about the quality of a work and hence, TQM in construction sector has to include life cycle concept. Life cycle concept includes all the stages right from the inception to dismantling. In fact, quality costs in a civil engineering structure should not only include prevention, appraisal costs and failure costs during construction but also such costs incurred during its useful life in maintenance stage. The needs of maintenance stage are to be considered while planning and executing a work. A work should require minimum maintenance and operational costs for a customer's satisfaction.

Thus, quality is not an absolute word but interrelated with stated or implied needs. Quality would depend upon the customer needs. For example, granite flooring cannot be said to be a quality work compared to cement concrete flooring just because granite flooring is of richer specifications. Both are to be assessed separately for quality. Therefore, we and the customer should be very clear about the needs and specifications otherwise the difference between quality and specifications may not be appreciated. This is so because many a times superior specifications are wrongly misunderstood as the parameters of quality.

1.4. Human Resource and Quality

In TQM, everyone has to contribute to quality. Therefore, personnel involved in achieving quality, have to be quality conscious and trained. Thus, to achieve quality in any work, one must:

I. Know, understand and agree to the requirements of the job.

II. Know how to do the job and why it is being done.

III. Have the knowledge of materials, process and equipment to do the job.

IV. Know what to do when the things go wrong.

For above, it is essential that orientation and development training to the supervisors is imparted in quality which includes new materials, methods, and machinery in a systematic manner for the customer satisfaction. Therefore, the persons involved in construction or maintenance activities must have the knowledge and capability of doing quality work. Hence, personnel management i.e. right person for right job is essential to achieve quality. National

CPWD Academy and Regional Training Institutes are equipped and responsible for the training. From above concept, quality cannot be achieved in cases of:

I. Accepting work not upto the mark may be because of urgency or any other reason at first stage itself.

II. Delaying decision on rejecting the sub-standard work or not taking action for a sub-standard work right in first instance.

III. Passing the instructions overlooking quality.

IV. Putting off the job till somebody else takes over the charge and thus not taking action right for the first time.

V. Not solving the problem but delaying or shirking of own responsibility.

VI. Refusing to listen and solve the problems.

VII. Technically incompetent personnel.

It is also said that most people want to do a quality job, contrary to general belief. Therefore, management should ensure that:

a. Personnel engaged in works are technically competent and have the right training, placement, and knowledge.

b. Quality conscious contractors are selected for the work.

c. Co-ordination and feedback system is available.

d. A system is designed for co-ordination between architects, engineers, contractors and workers and implemented.

e. System of reward and punishment is available and implemented for not following quality.

1.4.1. Training and Quality

Education and training are very important for continuous improvement process. Therefore, CPWD National Academy and Regional Training Institutes have to ensure that education and training is imparted to all involved in the process. Early in the process, all levels of management must be trained to implement their part of the quality improvement programs. Thus training and skill up gradation of all the stakeholders like architects, engineers, contractors and workers is the part of quality.

1.5. Skill Development and Quality

Construction industry employs millions of young people where most of them are less skilled/ unskilled workers with low education profile. As per estimates of the National Skill Development Corporation (NSDC) in 2018, India will need around 76.5 million workers in various segments of the construction landscape, but only 4% of them are skilled. From plumbers to machine operators, the skilling need is urgent to keep pace with India's infrastructure development plans. In order to encourage Skill India Policy of the government, necessary onsite training shall be imparted to minimum 30% of the unskilled workers engaged in the project. Suitable

provisions are to be made in the contract. The contractor is required, at all stages of work, to deploy skilled/semi-skilled tradesmen who are qualified and possess certificate in particular trade from National CPWD Academy /Industrial Training Institute/ NICMAR/ National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/semi- skilled workers required in each trade at any stage of work.

1.6. Contract and Quality

Quality in construction is achieved through joint efforts of employer, architects, engineers, contractors and other stakeholders. Since, contractor not only arranges the material but implements the quality, his role in achieving quality is very critical. Therefore, selection of a contractor is extremely essential to achieve quality. Also, contract document and conditions play an important role in selection of a contractor; contract is thus also related to quality. Quality is to be included by the planners, engineers, quantity surveyors, and then quality manager. Hence, quality may depend upon:

i. Client's coordination with the planner's and his "stated needs"
ii. Planners (Engineers and Architects)
iii. Designers
iv. Supervisory staff
v. Contractors
vi. Suppliers
vii. Quality control managers
viii. Workers
ix. Accounts officers making payments
x. Quality management concept being followed

Since drawings, designs, selection of contractor, inspections, time, quality control measures, specifications, rates, welfare and safety measures, payment conditions etc. are part of contract document; contract document also has a bearing on quality. Thus,contract document has to be prepared considering the quality requirements. Quality requirements are to be well defined in the tender document. CPWD prepares and revises General Conditions of Contract (GCC) from time to time and leaves on NIT approving authority for inclusion of conditions required as per site. General provisions are included and even requirements of lab and other equipment are to be included by NIT approving authority hence NIT approving authority has a vital role in drafting the conditions.

As men (Workers and technical supervisors), materials, financial resources and methods required in a work are arranged by the contractor, quality is also largely dependent upon its implementation by the contractor. Thus, it is essential that a quality conscious contractor is selected to achieve the quality. Though CPWD has its own system of enlistment of contractors and selection criterion of contractors for major works are also included in the tender or contract

documents, this has to be reviewed from time to time based on feedback on quality control. Evaluation of quality may be required from time to time rather than only during revalidation for CPWD enlisted contractors. Time over run and quality are also linked and as such completion of work on time and before time has to be given considerable weight age. Thus it is essential that quality conscious contractor is selected and if found not following quality, action right at first time should be taken against the contractor rather than during revalidation.

1.7. Specifications and Quality

Specifications are backbone of a contract both in terms of materials and workmanship. A material of poor specifications with best of workmanship will never lead to satisfaction so also best material with poor workmanship. Therefore, a right combination of material and workmanship and their incorporation in the contract are essential requirements of a quality work. Hence, the role of architects, quantity surveyors and planners become important who have a vital role in preparing contract documents. Drawings and designs are part of specifications. Contractors quote the rates based on the specifications of the materials, intricacy and skill involved in providing and fixing. A single piece of granite slab fixed on the stairs will have different rates compared to pieces fixed, as wastage and cutting will be different in both the cases. As such even if the same material is used, specifications for fixing should be available in contract document for quality. If all specifications are not included, contractor may quote rates as per his wisdom and later will try to work according to rates quoted and not as per actual requirements or implied needs. Thus, specifications in a contract are the part of the quality.As such all drawings whether architectural, structural or services have to be part of the tender documents. In EPC contract documents, specifications and requirement of works including the scope needs to be adequately specified so as to achieve quality during actual construction.

1.8. Contract conditions and Quality

Contract document may include technical specifications, general conditions and special conditions. Some conditions may have financial implications. If effect of such conditions is not included by the contractors or during evaluation of tenders by the employer, implementation of conditions becomes very difficult which may affect the quality also. For example, suppose a condition is included that the earthwork will be inclusive of rates of pumping of water in case of high ground water table expected or during rains. If the item of pumping water is not available in Bill of Quantities and thus not payable separately as per condition available, contractor will avoid work during rains or will delay to pump out the water as it may be costing more than earthwork in excavation itself.Similarly, if small patch is required to be plastered in a multistoried building, cost of repair may be negligible compared to scaffolding cost and if a condition is included that cost of scaffolding is included in the plaster without considering site conditions, the item may not be executed or may be done from the openings available with some temporary and unsafe arrangements affecting the quality. Similarly if safety provisions and welfare provisions of construction workers are included without considering their financial implications, it may result mostly in non-implementation which may affect the quality.

1.9. Acceptance Criterion

Since acceptance criterion of a work is stipulated in the contract, quality of work should be same whosoever is Engineer-in-charge. But even after specifications and contract clauses is same, quality of work differs in two works sometimes when carried out by different contractors and sometimes even if same contractor has carried out the work. This may be due to acceptance criterion set by engineers. Acceptance criterion of an engineer may be depending upon his/her qualification, knowledge, exposure, experience, ethics and management practices adopted by him. Hence, through training, reward and punishment, it is to be ensured that the acceptance criterion does not change and is quality based. As acceptance of a work is important, rejection is equally or more important. Time factor has more weightage in case of rejection than the acceptance. Timely rejection of a work, right at first time leads to better quality. Poor quality concrete in a basement column is to be rejected during casting or immediately after casting. In case, it is not done and upper floors are casted, it is very difficult to recast or rectify the defects. It is the duty of an engineer to follow it and clearly spell the intention to contractor and take timely decision on rejection of substandard work to ensure quality.

1.10. Mechanization and Quality

Mechanization has a great potential and can be adopted almost in every facet of building construction. Now a days number of new and emerging technologies have been adopted to ensure quality. Mechanization and use of power-driven small equipment and tools lead to quality.

1.11. Safety, Health & Environment (SHE) and Quality

Safety, health and environment are growing concerns in a construction project during both construction and operation. As soon as the wok is awarded, the contractor shall submit a detailed and comprehensive contract specific SHE plan. The SHE plan shall include detailed policies, procedure regulations etc. For guidance, CPWD Handbook on Safety, Health and Environment may be referred. All necessary safety measures must be implemented to achieve quality. Structural safety of a structure is important at execution stage and during post construction stage. Failure of a structure during execution stage is mostly due to some of the following reasons: -

i. **Unsafe design: -** Technical Sanctioning Authority has to ensure structural safety. In case of EPC contracts, where design is done by the contractor, the contractor shall ensure safe design of the building.

ii. **Non-conformance to latest drawings: -** The design might have been revised but execution may be done based on old drawings. Old drawing is not discarded, but is kept at site and no record of the revision is kept. Field engineers must take adequate precautions to ensure that only latest revision of drawings is available at site and old revisions are discarded.

iii. **Collapse of temporary structures: -** Failure of scaffolding, temporary soil retaining structures etc. is a common cause of failure at execution stage. Such structures have to be designed particularly when double height scaffolding is required. Field engineers must check the scaffolding and inspect before giving clearance, record it and then only casting of concrete is allowed. In case or poor soil conditions, temporary structures are to be properly designed for retaining the soil to carry out works.

iv. **Incorrect site practices:** Practices such as removal of props from fixed side in a cantilever or removal of centering and shuttering before the stripping period can lead to failure during execution of works.

v. **Incorrect usage of materials:** Use of different grades and types of materials than that considered in the design can also lead to failures.

vi. **Change in site conditions:** Sudden change of conditions at site such as flooding, landslides, high speed winds etc. can also trigger failures.

Collapse of the structures in post construction period is also possible. These failures may be under normal conditions as well as during critical conditions like earthquakes, cyclones and floods. Some of the reasons are elaborated below: -

a. **Removal of load bearing structural members:** It should not be allowed in any case without taking structural safety precautions.

b. **Additions and alterations: -** Addition/alteration should only be carried out with the approval of the architect and structural engineer.

c. **Change in boundary conditions: -** Due to construction of other structures in the vicinity like underground metro construction may create distress in adjoining structures. Field engineers should examine it and take up the matter with concerned authorities in advance.

d. **Natural disasters: -** Natural disasters like earthquakes etc. Field engineers should immediately assess the damage and report to be submitted to higher authorities.

e. **Aging of structures: -** Residual strength of structures may not be adequate to take loads. Inspections should be carried out and report submitted for unsafe structures by the field engineers.

f. **Poor maintenance conditions: -** Such conditions lead to deterioration of strength of the structural members. Maintenance should be carried out after restoration of the structure.

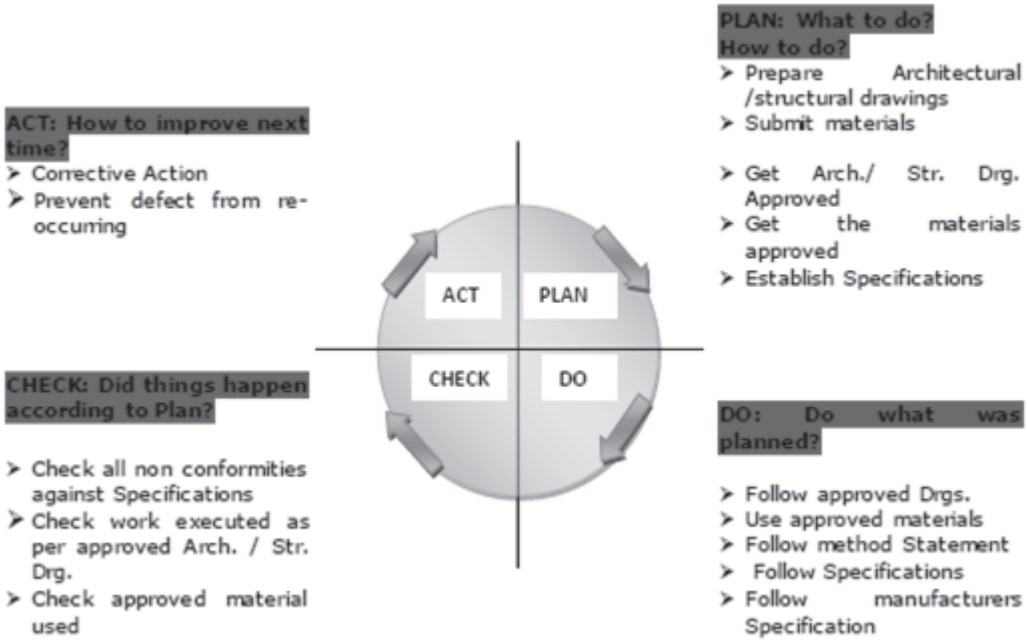
g. **Modified usage of the building: -** Building designed for office building being used as a library building. Field engineers should take up the matter with the client when such instances are noticed. They should also send their advisory to the clients. Advisory should be given to the client in case of Post Tensioned slabs, not to drill the holes in slabs which may lead to failure.

h. **Drainage: -** Poor drainage conditions around the building or rise of ground water table leads to reduction in bearing capacity of the soil. All drainage points should be inspected and action taken before rains by field staff.

For workers safety, all precautions should be taken as a worker who is not feeling safe cannot deliver the quality. Public safety and environmental issues like pollution are also to be taken care of as they also affect the quality.

1.12. Continuous Improvement

PDCA is well-known tool for continual process improvement. The contractor/Engineers may use the PDCA cycle (Deming Wheel) principle to improve the construction/installation process and avoid rejection of works by the Engineer-in-Charge or quality inspection team. Following figure illustrates the PDCA Cycle for the improvement in execution of construction projects/ work.



1.13 Conclusion

As already stated, quality is a relative and not absolute. CPWD has system of inspections, testing of materials and a procedure to ensure quality of works. Responsibility for quality is also defined based on the items and a comprehensive quality assurance plan. Though inspections and quality control are age old concepts, quality is not the outcome of only inspections and quality control by engineers but the outcome of one and all involved in the process and that is called Total Quality Management (TQM). Thus, be the contractor, supplier, engineer, designer, quality control engineers or the workers involved in the process, all have to contribute to quality, though their duties and responsibilities may be different. Quality has to be built in planning process and implemented in field ultimately.

CHAPTER 2
ORGANISATION FOR QUALITY ASSURANCE

2.1 Organization for Quality Assurance

Both owner of the project (Department responsible for execution of work) and the contractor shall be responsible for quality of work. Roles and responsibilities of different engineers of the owner and contractor should be adequately predefined to ensure quality of work. The duties and responsibilities may vary from job to job, and should be laid down for each project and should be also part of the quality assurance plan.

2.2 Roles and Responsibility of Contractor's Organization

The foremost responsibility to maintain the quality of works lies with the contractor. If the contractor is quality conscious, then the quality of work can be easily ensured. As men, (workers and technical supervisors) materials, financial resources and methods required in a work are arranged by the contractor, quality is largely dependent upon its implementation by the contractor. The indicative role of contractor's organization for quality of work is given below. The role of contractor in quality becomes extremely crucial in case of EPC contracts where the responsibility of design is also with the contractor. However, this may vary depending upon availability of engineers in the project and they may be assigned multiple responsibilities depending upon actual numbers deployed by contractor as per contract document

2.2.1 Project Manager (PM)

(i) To oversee the preparation and implementation of the quality assurance plan.
(ii) Organize & manage all resources and field activities to achieve an efficient and economic completion of the project, within the agreed time and cost, whilst paying due regard to safety and meeting product quality requirements.
(iii) To impart training and motivation for quality awareness to field engineers, supervisors and workers as per mandate for skilling provided in contract.
(iv) Coordinate with the various consultants to ensure availability of drawings and work methods at the required points of time.
(v) Make available the latest approved drawings for use in construction and to withdraw all superseded ones.
(vi) Submit and obtain customer approvals for materials samples from owner of project well in time.
(vii) To co-ordinate the preparation of the monthly and quarterly reports on Quality System

2.2.2 Deputy Project Manager (DPM)

(i) To prepare Quality Assurance Plan (QAP) and ensure its implementation.
(ii) To ensure that construction of the works is supervised in accordance with established procedures.
(iii) To establish and maintain a quality plan for site activities under his control and to ensure compliance of all activities.
(iv) To establish and maintain site laboratory and testing procedures.
(v) To inspect and review material testing methods and operations.
(vi) To prepare method statements for each activity well in advance.
(vii) To ensure that the construction drawings are reviewed in advance for construction.
(viii) To organize and supervise the inspection of the execution of construction work to ensure compliance with the drawings, specifications, safety and environmental provisions.
(ix) To supervise and instruct the work supervisors/site engineers with respect to inspection of the works and carrying out measurement checks and testing to ensure the accuracy of works.
(x) To prepare monthly progress report for submission to the owner.

2.2.3 Quality Assurance Engineer (QAE)

Quality Assurance Engineer shall remain responsible for all Quality Assurance and acceptance requirements of the project and will directly report to the Project Manager or project head. He will regularly supervise the activities of Asst. QA Engineer; QA Engineer will provide all necessary assistance to the construction team with reference to acceptance of all raw, manufactured, mixed materials used in the project. His responsibilities include the following:

(i) Preparation of Quality Assurance Plan.
(i) Providing inputs to Deputy Project Manager for preparation of work method statement.
(ii) Setting up of field laboratories.
(iii) Calibration of equipment.
(iv) To maintain an effective documentation system for QA/QC throughout the project. To monitor and coordinate quality control activities on site.
(v) Ensure that tests are carried out as per relevant IS/applicable international code of practice.
(vi) Maintain the test records for all the construction material/ Products used in the project.
(vii) To verify the system for reporting and disposing non- conformance and corrective action requests.
(viii) To perform internal quality audit on site in accordance with applicable procedure.
(ix) Advising on, planning and organizing inspections, maintenance and repairs.

2.2.4 Site Engineer

(i) Draw the resources for the requirement as per the approved schedule, for the assigned area/scope of work.
(ii) Preparation of work method statements for incorporating in Project Quality Assurance Plan.
(iii) To watch over the execution of construction work to ensure compliance with the drawings, specifications, safety and environmental provisions.
(iv) To conduct Quality checks.
(v) To carry out measurement of works

2.2.5 Site Supervisor

(i) Conduct all activities to meet the cycle time requirement for the assigned area/scope of work.
(ii) Supervision of the workmen to ensure strict conformance to methods, Quality & Safety.
(iii) To check all formwork and shuttering.
(iv) To check temporary works.
(v) To watch over the execution of construction work to ensure compliance with the drawings, specifications, safety and environmental provisions.
(vi) To carry out measurement and testing as per instruction of PM/DPM/QAE.

2.2.6 Assistant QA Engineer

Assistant QA Engineer will be directly responsible for quality control. He will report to the QA Engineer. He will supervise the activities of the Lab Technician. Besides he will carry out the following activities himself: -

(i) Inspect and conduct tests on raw materials/ products/ works.
(ii) Inform acceptance/ rejection of materials to Project manager.
(iii) Associate in setting up the field Laboratories.
(iv) Ensuring calibration of all laboratory equipment.
(v) Conducting laboratory and field tests as per specifications/ IS code etc. and on random basis.
(vi) Calculation of test results from test observations carried out by Lab Technician.
(vii) Maintaining respective records.
(viii) Periodical checking of calibration of concrete Batching plants, hot mix plant etc.
(ix) Preparation of summary test results for monthly progress report.

2.2.7 Lab Technician

Lab Technician will work under the guidance of QA/ Assistant QA Engineer. He will carry out the following activities:-

(i) Sampling of construction materials and preparation for testing as per IS code.
(ii) Conducting laboratory test of aggregates, cement soil, bitumen and other materials.
(iii) Recording of test observations.
(iv) Conducting field tests at site and recording test observations.

2.2.8 Surveyor

(i) To draw up survey plan.
(ii) To establish control points as per survey plan and carry out day to day surveying.
(iii) Line & level of all construction.
(iv) To carryout post construction survey and record as built status.

2.2.9 Plant &Machinery Engineer

(i) Making Plant & Machinery continuously available at site during the course of work.
(ii) Periodic preventive maintenance & timely breakdown repairs of all machinery & electrical equipment as per their catalogues.
(iii) Operation of P&M as per norms.

2.2.10 Environment Health & Safety in-Charge

(i) Preparation & implementation of the project Environment, Health and Safety Plan.
(ii) Identify potentially unsafe acts, areas and practice and educate people.
(iii) Work method modification and improvement.
(iv) Monitor Environment Healthy and Safety Plan.
(v) Report incidents beyond control and unsafe occurrences.
(vi) Investigate unsafe occurrences and initiate preventive steps.
(vii) Conduct safety training programs.
(viii) To enforce & ensure safety norms implementation at site

2.3 Role and Responsibility of Departmental Engineers

The Engineer-in-Charge/ Executive Engineer and his/her representatives shall be responsible for execution of works and contract management according to the drawings, design, specifications, quality and agreement etc. Time of completion of work with desired quality shall be considered as an essential factor of contract management

2.3.1 Responsibility of Quality of Work

The officer who records/ test check the measurement for an item of work will be responsible for the quality, quantity measurements and dimensional accuracy of that item of work. In respect of various works the responsibility of various officers for checking of materials and workmanship of items of works is given in Annexure-1 for reference. The Executive Engineer shall be overall responsible for quality of work.

In case, the quality has been checked by the departmental QA unit, the removal of defects shall be ensured within reasonable time by the Engineer-in-Charge/ Executive Engineer. The role of departmental engineers is briefly given below: -

2.3.1.1 Chief Engineer/ Superintending Engineer or equivalent

(i) Monitoring the compliance of quality assurance plan by Field Engineers either with assistance of Regional Quality Assurance Team or Third Party Assurance Team.
(ii) Coordinate with the various Consultants/Architects to ensure timely availability of drawings.
(iii) Oversee timely decisions are given so that there are no hindrances in work.

2.3.1.2 Executive Engineer or Equivalent

(i) Timely approval of Quality Assurance Plan and monthly review of its implementation.
(ii) Approval of materials.
(iii) Ensuring availability of check list for important and costly items for checking by AE/JE.
(iv) Review of rectification of non-conformities.
(v) Review of third-party quality audit reports and other inspection reports for timely action.
(vi) Test check of at least 10% of measurements including hidden items to ensure their dimensional accuracy and quality.
(vii) Ensuring availability of drawings and timely decisions to avoid any hindrance in work.
(viii) Issue periodic inspection reports including details of outcome of inspection, observation, non-conformities etc.

2.3.1.3 Assistant Engineer/ Junior Engineer or Equivalent

(i) Ensuring that QAP is implemented in letter and spirit.
(ii) Ensuring only approved materials are used in the work.
(iii) Ensuring each item of work is checked including formwork as per check list before the execution is taken up.
(iv) Ensuring that the material non-conforming to specifications is promptly reported, rejected and removed from site.

(v) Ensuring that non-conformities as reported by Senior officers/Audit reports are timely rectified.

(vi) 100% of measurements are checked/verified to ensure their dimensional accuracy and quality.

(vii) Timely notifying hindrances to senior officers for their decisions to ensure that work is completed timely.

(viii) Ensuring that instructions given to the contractor either through separate letter or through site order book by any departmental engineer is complied timely by the contractor.

(ix) Ensuring that instructions given by senior officers either through inspection note or through inspection registers related to quality/progress of work are communicated to the contractor through site order book or other communication and is complied with by the contractor.

2.4 Check lists

Sample checklists for examination of various items of building construction works like Reinforcement, CC/ Concrete for raft,columns / beams/ slabs, water supply lines, brickwork, plastering etc. are given in the chapter-8.

2.5 Site Documentation

During the currency of a project, it is essential to keep certain documents at site for making a permanent record of each and every item related to the project. Such items may include test conducted at site (Material Test Register), instructions issued to the contractor (Site Order Book), record of working drawings issued to the contractor (Drawing Register), Inventory of the materials at site (Materials at Site Account Register), inspection register of senior officers and so on. All such documents play a vital role not only in assuring the quality of the work but also in making the total management of the project comparatively easier. Sample formats of such documents are given in the annexures.

2.5.1 Site Order Book

A site order book (SOB) is a register duly certified by the Engineer-In-Charge/Executive Engineer of the department regarding number of pages it contains, each page being machine numbered and docketed by the organization. The name of work, name of contractor, reference of contract agreement etc. and the aforesaid certificate should be recorded on its first page. SOB shall be maintained on its site of work and should never be removed there from under any circumstances. The Engineer-in-charge or his authorized representative shall duly record his observations regarding any work which needs action on the part of the contractor like improvement in the quality of work, failure to adhere to the scheduled program etc. as per

contract agreement. The contractor shall promptly sign the SOB and note the orders given therein by the Engineer-in-charge or his representative and comply with them. The compliance shall be reported timely by the contractor to the Engineer-in-charge or his representative so that it can be checked and recorded by the Project Engineer. Sample format of site order book is given at Annexure-2.

2.5.2 Inspection Register

An inspection register is a register duly certified by the Engineer-In-Charge/Executive Engineer of the department regarding number of pages it contains, each page being machine numbered and docketed by the organization. The works shall be inspected frequently by various officers concerned with the work to ensure that the work in general is being carried out according to quality, design, drawing, and specifications. Senior Officers above the rank of Executive Engineer generally either issue inspection note or records their observations in the inspection register maintained at site. The Engineer-in-Charge and his/her subordinate officers notes such observation and defects on which action is to be taken by contractor into the Site Order Book with appropriate cross references of the Inspection register/ reports. The concerned Project Manager shall send the compliance report against the observations and also attach the site photographs, if any to the Executive Engineer. Sample format of inspection register is given at Annexure -3.

2.5.3 Video Recoding

It is desirable that in Large Projects provision is made for video recording of important activities of site. During the construction period, the contractor shall provide to the department in every calendar quarter, a video recording, which will be compiled into a 15 minutes digital video disc or any substitute thereof, covering the status and progress of works in that quarter including quality assurance activities. The video recording shall be provided to the department not later than 15 (fifteen) days after the close of each quarter and should be part of quarterly progress report.

CHAPTER 3

QUALITY ASSURANCE PLAN

3.1 Introduction

The Quality Assurance Plan (QAP) is the methodology that is selected for ensuring that the project incorporates all elements that are needed for the successful design, construction and maintenance of a project. Since projects vary in scope, the QAP has to be project-specific. The QAP should deal with all aspects of selection and testing of materials, acceptance criteria, guidelines for non-conforming materials and works and documentation. For proper appreciation of the subject, definition of the following terms as stipulated in ISO 8402 of 1994 is reproduced below.

Quality Policy: - The overall quality intentions and directions of an organization as regards quality as formally expressed by top management.

Quality Assurance: - All the planned and systematic activities implemented within the quality system and demonstrated as needed to provide adequate confidence that as entity will fulfill requirements of quality.

Quality Plan: - A document setting out the specific quality practices, resources and sequence of activities relevant to a particular product, project or contract.

3.2 Objective

The objectives of preparing a Quality Assurance Plan (QAP) are as follows:

(a) Understanding the project requirements/ features in totality.
(b) Assessing the impact of environment on quality.
(c) Developing quality systems to ensure that the process and product fulfill quality requirements consistently.
(d) Assignment of responsibilities with absolute clarity.
(e) Establishing methods for meaningful evaluation.
(f) Establishing documentation processes and systems to minute details.

3.3 Quality Control

3.3.1 Types of Quality Control

One of the most important tasks of the supervision during the execution of a construction work is technical quality control, i.e. control as to whether the materials and work supplied by the Contractor meet the technical requirements in the contract specifications. There are two types of quality control, which are described below:

(a) Control of Methods: Method control is carried out by the field engineers whose job is to be on site and supervise the work of contractor during execution of the works. Method

control is carried out according to the type of work. Where the work method is of considerable importance and requires constant supervision to achieve the quality, or where in some case, the quality is difficult to improve on, there should always be a field engineer on the site. Examples are concreting, water proofing, etc. Where work methods are of less importance or quality is constantly being achieved by the contractor, there may be no need for continuous surveillance. Examples are excavation etc.

(b) Control of End-Results: End-result control includes field tests and a combination of field and laboratory tests. The frequency of end-result control depends on the quality parameters that are to be checked. Parameters which can vary considerably are continuously controlled. An example of this is the compaction control of earthworks where the achieved density is determined by means of a field test. As regards regulating laboratory tests the specification usually determines the number of tests. When the works are started and in cases where difficulties as regards compliance with quality requirements are encountered, laboratory testing will normally be intensified.

3.3.2 Performing Quality Control

3.3.2.1 Testing Facilities

Before the Contractor initiates earthwork, foundation work etc., the corresponding test facilities at site must be available, i.e.

(a) Laboratories must be built and equipped;
(b) Laboratory equipment must be procured and tested;
(c) Test forms must be prepared; and
(d) Laboratory technicians must be employed and trained.

Infrastructure and other minimum requirements of site laboratory must be specified in the agreement. General guidance for establishment of site laboratory and equipment calibration etc., are given in the CPWD Specifications and also mentioned in the chapter 4 of the Manual. The testing equipment must be regularly serviced as recommended by the suppliers. QAP shall customize it to meet the specific needs of a particular project.

Procedure for calibration of instruments and frequency thereof as recommended by the manufacturer shall be elaborated in QAP keeping in view the specific needs of the project. A calibration chart must be available for each equipment along with summary sheet of calibration of plant/ equipment, form for calibration summary is given at Annexure 15.

The Contractor may also get the tests carried out in approved outside testing laboratories for tests of a special nature not covered by the site laboratory. Such testing must be preceded by approval of the Engineer-in-Charge.

3.3.2.2 Test Specification & Frequency

For determining that the Works conform to the Specifications and Standards, the Engineer-in-Charge shall require the Contractor to carry out or direct to be carried out, tests, at such time and frequency and in such manner as specified in the Agreement and in accordance with Good Industry Practice for quality assurance. Frequency and the manner in which tests shall be conducted shall be in accordance with the relevant Contract Documents, CPWD specifications, BIS codes, IRC codes, MoRTH Specifications, International codes, or Manufacturer's specifications in this order of preference. A testing plan giving the testing frequency, standards, acceptance criteria shall be included in the QAP (Quality assurance Plan) prepared by the Contractor and got approved by the Engineer-in-Charge. List of Quality Control Tests and Acceptance Criteria, assembled from CPWD Specifications, IRC, MoRTH and other documents are shown in the Testing plan.

3.3.2.3 Reporting of Test Results

The test results must be recorded systematically in a register, which must be signed by the testing authority and the representative of the Engineer-in-Charge, if present during the tests. Testing of either 50% of samples or as decided by NIT approving authority is to be witnessed by representative of the Engineer-in-Charge.

3.3.2.4 Statistical Quality Control

Quality control based individual tests do not ensure well defined qualities of a product. One has therefore, for many years in the industry, used statistical methods where works and supplies are approved or rejected after an evaluation of the average and standard deviation of a number of test results.

3.4 Approval of Quarries and Borrow Areas

The Contractor is to obtain approval from the Engineer-in-Charge for each Quarry and Borrow Area to be used in the project prior to commencement of quarrying and/or borrow area excavation activities. The primary considerations to be considered by the Engineer in granting approval are whether:

- The proposed materials meet specification requirements
- The Contractor has legal approval by the owner to excavate/remove materials from the proposed quarry/borrow area

- The Contractor submits an acceptable "Environmental Management Plan" for development; use and closing down of the proposed quarry/borrow area, together with any other approvals or documents that may be required from the Ministry of Environment and Forests or other concerned authorities.

However as per project requirements, wherever approval of quarry is not required, then in such cases, approval of source of procurement of material is to be given.

3.5 Approval of Materials

All materials proposed by the contractor to be used in the project works are to be approved by the Engineer-in-Charge. In general, there are four types of materials i.e., Natural Materials, Processed Materials, Manufactured Materials and Designed Materials. Approval of each of these material types is required, however the requirements for obtaining approval of materials for each type differs slightly.

3.5.1 Approval of Natural Materials

Natural materials are mined (i.e., excavated) and hence the first step, following assurance that the material(s) is acceptable for its intended purpose, is to obtain approval for the Borrow Area or Quarry. Where quarry is not approved as per project requirements, the source of procurement of material may be approved.

Approval of the material for construction is then obtained by submittal of test results for all tests required as per the Specifications (i.e., to prove that the material meets all the desired properties), and, in some cases, by construction of trial sections to prove that this material can be placed in the field so as to attain the required field properties (e.g. to meet minimum density, etc.)

3.5.2 Approval of Processed Materials

Approval of processed materials follows that noted above for "natural" materials, except that usually the specifications are tighter (e.g. the material may also have to meet stringent gradation limits), and a greater variety of tests (and production/storage) conditions are required to be met.

3.5.3 Approval of Manufactured Materials

Approval of manufactured materials, based on specific Specifications requirements, is generally given in two stages.

(a) Initial Approval – given prior to receipt of the materials based on submittal of samples of manufactured Materials, appropriate Manufacturer's test reports.

(b) Final Approval – given based on initial approval plus satisfactory results being obtained for all "acceptance" tests required by the Specifications, or as directed by the Engineer.

3.5.4 Approval of Designed Mixes/Materials

Approval of "designed" materials for the project concerns those mix designs for Cement Concrete, Asphaltic Concrete etc. required in the project. Due to the complexity of these "mixed" materials, and the plants for producing the range of material sizes, final approval is deferred until completion of the following steps:

(a) Approval of sources for each of the manufactured material, processed material constituents etc. to be included in the final mix design.

(b) Tentative approval of a laboratory-based mix design, based on a mixture of approved materials so that the mixture meets all Specifications requirements.

(c) Tentative approval of a plant mix design, based on proportioning of aggregate bins, materials and manufactured materials to closely approximate the proportioning of material types/sizes finalized based on the laboratory-based mix design so that the mixture meets all Specifications requirements.

(d) Conduct trial of works using the tentatively approved plant mix design and placing the mixture in accordance with an approved construction methodology that conforms to Specifications requirements.

(e) Based on successful laying of the mixture in accordance to the approved method statement, conformance of the placed mixture to required placing temperatures, levels and finish, etc. and conformance to QC requirements, the QA/Material Engineer shall submit proposal for final approval of mix/ material to the Engineer-in-Charge.

3.5.5 Revocation (withdrawal) of Material Approvals

Following approval of the job mixture (i.e. the job mix formula), the Material/QA Engineer, and all field support staff are to continue to monitor both the test results and the visual characteristics of the approved mix as placed to identify at an early stage any significant change in the mix design that may adversely influence the adherence of the approved mix design to the Specifications. A new mix design (or adjustment of the plant proportioning of materials to re-establish the approved job mix formula) will be required when it is observed that significant changes in the mix design properties are causing the mixture to no longer meet all Specification requirements. In addition, a new mix design will be required when either the approval of a material source or approval of one of the materials is revoked (i.e. withdrawn).

3.5.6 Reporting and Recording Material Approvals

The QA Engineer is to notify in writing to the Engineer-in-Charge each time a new source, material and /or mix design is either approved or the approval is revoked. This information is to be included in the Monthly Quality Progress Report.

Records are to be kept by the Engineer-in-Charge giving current approvals of all Borrow Areas, Quarries (all types) and Mix Designs for all BOQ items. These approvals are to be included as part of the Monthly Quality progress Report.

3.6 Sampling of Materials

3.6.1 Sampling Requirements

All construction materials to be used in the permanent works are to be sampled jointly by the QA engineers deployed by the Contractor and witnessed by the field officers/ Engineer-in-Charge before commencement of the Works. This includes sampling for materials to be tested for proposing approval of the material source as well as sampling of materials for approval of the individual construction materials. In both cases, and for each instance, the Contractor must give notification of a request for such sampling to the Engineer-in-Charge in advance. All assistance (e.g. sampling instruments and equipment, sample bags, and labor etc.) facilities and safety that is required for carrying out the sampling activities are to be provided by the Contractor. For sampling activities, the Engineer-in-Charge is to be represented by his authorized subordinate or his appointee.

3.6.2 Sampling Guidelines

All sampling is to be carried out in accordance with instructions to be given by the Executive Engineer or his representative. Sampling procedures are to follow recognized guidelines of sound engineering practice. These include:

(a) Obtaining samples from at least three areas.
(b) Ensuring that the sampled materials and locations are “typical” for the material to be tested.
(c) Ensuring that all overburden etc. is removed within the stockpiles rather than from the surface (top, side or base of the stockpile) in order to avoid the collection of segregated materials.
(d) Ensure that sufficient quantities are sampled to enable all tests to the conducted, plus additional material, to be stored for subsequent testing if required.
(e) Ensure that each sample bag is marked/labeled both inside and outside, giving the sample number, material type, sample location, date and number of the bag, as well as any additional information instructed by the Executive Engineer or his representative.

3.6.3 Preparation and Storage of Samples

Samples collected are reduced and prepared as per standard methods (Indian Standards), with an additional sufficient quantity retained in appropriately sealed bag(s) or container(s) and separately kept in the sample storage room of the laboratory for additional testing and/

or future reference as required. Concrete samples in particular are to be carefully cured and kept in the curing tank of the laboratory. Access to stored samples is under the strict direct control of the QA Engineer. Details of all samples stored are to be kept in a register to be administered by the QA Engineer.

3.7 Field Testing Laboratory

The Field-Testing Laboratory, including all furniture, testing equipment and apparatus as required by the Specifications is to be provided and maintained by the Contractor together with the provision of all necessary utilities (e.g. electricity, water, sewerage and drainage). The design and layout of the laboratory is to be decided in consultation with the Engineer-in-Charge. It is the responsibility of the Contractor to ensure that the laboratory is proficiently guarded at all times of the day and night (i.e. to control access and maintain security), is cleaned daily and is properly maintained.

Testing equipment and apparatus are to be initially approved, and subsequently periodically checked, by the QA Engineer to assure proper operation, accuracy, correct calibration and complete conformance to all Specifications requirements. Likewise, all testing procedures detailed in the Specifications and procedures instructed by the QA Engineer as part of his Quality Assurance Plan are to be strictly adhered to by the Contractor. The QA Engineer is to supervise, monitor and check all aspects of the testing procedures, including sample storage, preparation, testing and analysis and reporting of testing results. All material testing details relating to sample preparation, test procedure and analysis of results are to the recorded on the relevant standard testing formats as per QAP. Some sample formats are given in the Annexure(s).

3.8 Acceptance Testing

3.8.1 General

All material included in the construction works for which quality control tests are specified, and for which approval by the Engineer-in-Charge has been previously given, are to be inspected and checked for acceptability in accordance with the Specification requirements.

Any of the completed construction works in which unapproved and/or untested and/or unaccepted materials are used without approval or written permission from the Engineer-in-Charge are deemed to be performed at the Contractor's risk and are considered as unacceptable and unauthorized.

3.8.2 Routine Acceptance Tests

All sampling and quality control testing, as well as check tests to verify quality of materials, are to be conducted by the Contractor at his own expense under the direct supervision of the Engineer-in-Charge. The kind(s) of test(s) and frequency of testing should conform to the Minimum Quality Control Testing Requirements as specified in the contract. Sampling and Testing should be in accordance with the relevant IS methods. Tests are to be reported on proper forms, samples of which should be part of approved Quality Assurance Plan.

3.8.3 Special Tests

Special tests are generally ordered by the Engineer-in-Charge when there is some concern with some aspect of the routine acceptance tests (e.g. sampling technique, sample contamination, testing equipment problem, operator error, etc.). Based on the above, the following procedure is to be adopted for special testing:

(a) Identify what/how/where/when the special test is to be conducted.
   (i) By the Contractor within the Field Laboratory
   (ii) By the internal independent testing (i.e. by the consultant within the field Laboratory).
   (iii) By external independent testing.

(b) Obtain approval of the Engineer-in-Charge for conducting the special test, if needed as per the contract provisions.

(c) Following the implementation of any necessary actions indicated based on the results of the special test, test results are recorded , and also included as part of the “Quality Control Test Statement” to be submitted with, and as part of, the Monthly Quality Progress Reports. Records and videos of testing may be included in the test statement.

3.9 Documentation

3.9.1 Monthly Quality Progress Report

The contractor shall submit monthly quality progress report on implementation of the provisions of Quality Assurance Plan in the approved format to the Engineer-in-Charge in the first week of the following month. A model contents list for monthly Quality Report is given in Annexure-11.

The contractor is required to submit QC test statements showing the summary of laboratory test results, its statistical interpretations etc. in the approved format along with each running account bill. The Quality Control test statement shall include:

(a) Item description and kind of test.

(b) Numbers of tests complete passed and failed.
(c) Analysis of test results and establishment of trends.
(d) Any appropriate remarks or comments, based on trend detected and any corrective action needed.

3.9.2 On Completion of Section/ Project

Upon completion of each Contract Section, and the completion of the Project, there are several documents to be prepared and submitted by the contractor. These documents may include the following:

(a) As-built drawings/Completion plans
(b) Quality Assurance Records
(c) Final quantities and Final bill amounts
(d) Contract Documentation

Although final documentation is to be submitted at the end of Contract Section/Project is completed but they have to be prepared as work progresses, and finalized when works are nearing completion.

3.9.3 As-built Drawings

The conditions of Contract provide all information as to the required content of "As-built Drawings", and responsibilities for their completion. It is the Contractor's responsibility to prepare the As-built Drawings. The contractor shall submit As-built Drawings i.e., completion plans for Internal and External Civil, Electrical and Mechanical Services within thirty days of the completion of the work. The Contractor must supervise, monitor, and check the preparation of the As-built Drawings. The preparation of these drawings must be performed during the course of the works and must not be left until "substantial completion" to commence. As the works are completed, they are to be surveyed and the drawings prepared.

3.10 Forms for Testing

Recommended forms for testing of materials etc. are given in the annexure(s) and illustrative acceptance criteria are given in the Testing plan Section 8.1.

3.11 Non-Conformance Works, Procedure and Report

Non-Conformance works, Reporting and its procedure are detailed separately in chapter 5.

3.12 MODEL QUALITY ASSURANCE PLAN FOR CONSTRUCTION:

QAP is a tool that ensures that construction of the Building Project is done in such a manner that quality standards of the project are duly achieved. It covers both process and end control and acts as a precursor to cost and time control such that value for money is achieved. A Quality Assurance Plan for the Contractor shall typically cover but not limited to the following as given below. For easiness in preparing QAP an Illustrative Content List of QAP for construction is given at Annexure -4. QAP shall include the following features: -

(a) Brief particulars of project

- Name of Client organization including units/offices associated with project implementation.
- Name of the Engineer-in-Charge & his subordinates; project Consultants, Third Party Quality Audit Organization, etc.
- Name of Contractor
- Brief description of location, terrain, topography, climate, socio-economic characteristics of the project area.
- Geo Technical report in brief.
- Encumbrances, if any and other important point(s)

(b) Detailed Scope of project

(i) List the scope of civil works such as Foundation system, Structural system, number of story, Blocks, associated development works etc.
(ii) Scope of Electro mechanical& Horticulture works
(iii) Scope of works should indicate use of site and factory manufactured materials in particular items.

(c) Applicable documents and references

List all the applicable documents such as contract agreement, CPWD Specifications, relevant IRC/BIS/other codes of practice.

(d) Quality Policy

Contractor's own quality policy as per their own charter and necessary references to such documents.

(e) Contractor's organization and structure

(i) Indicate organizational chart of the project implementation team of the contractor.

(ii) Chart shall show the QA and other Engineers of the contractor/project management consultants as applicable in more detail.

(iii) Chart shall show interface with top management of the contractor.

(f) Responsibility matrix among the contractor's key personnel

(i) All the major tasks in project implementation including pre-construction/preparatory works shall be identified.

(ii) The role and responsibility of key personnel of contractor for different assigned tasks shall be established.

(g) Control of sub-contracting(Wherever provided for in contract document)

(i) Sometimes sub- contracting of a specialized nature of work is a genuine necessity. While finalizing a sub-contractor, qualification criteria as stipulated in contract agreement shall be followed. QAP shall provide the following details as regards sub-contracting:-

(ii) Works/items to be sub contracted in the project as a whole.

(iii) Plan as to how the works/items to be sub contracted will match the works program of the contractor for the whole project.

(iv) Plan as to how the role of QA&QC personnel of contractor shall be enforceable to the works/items to be sub contracted.

(h) Control of documentation and communication

Procedure for filing, indexing and maintenance of records in a manner that provides for ready access to documents and prevents loss, damage or deterioration.

(i) Control of methodology

Contractor is required to submit methodology as per the provisions of the agreement. QAP shall indicate a plan of approach as to how approved methodology shall be followed diligently during execution.

(j) Human resources and training

Skill, knowledge and expertise of contractor's personnel responsible for various activities such as plant/machinery operation and maintenance, laboratory /field testing etc. are extremely important to ensure quality of the project. QAP shall deal with contractor's plan and program to train its own personnel and skilling of workers.

(k) Key Parameters of quality system

The Quality Assurance System is prepared and implemented to provide confidence in fulfilling all the requirements as per the contract specifications. The Quality System shall comprise of the following basic parameters: -

(i) Site document formats.

(ii) Materials test plan (MTP)

(iii) Inspection test plan (ITP)

(iv) Site inspection & records.
(v) Report generation and documentation.
(vi) Check list for various items

(l) Control of materials including traceability and product identification

QAP will contain two different protocols to be followed by the Contractor to procure naturally occurring minerals and manufactured materials. There will be a separate protocol to control mix materials at Contractor's plant site. The protocol will list the responsibility of Contractor's key personnel and sub professional as regards to control of materials. The protocols will contain a system for maintaining product identification. A sample protocol is given below: -

(i) Estimate material quantities with reference to drawings and specifications.
(ii) Prepare requirement plan.
(iii) Float enquiries enclosing specifications.
(iv) Assign the responsibility of testing and obtaining approval among Contractor's personnel.
(v) Collect samples, test independently;
(vi) Seek/obtain approval of the source, if required.
(vii) Place order, receive materials, test samples.
(viii) Assign suitable identification number to each lot/stack and maintain record of the same;
(ix) Allow for usage if test reports are satisfactory.
(x) Untested materials to be stacked at locations designated for that purpose.
(xi) Where routine tests are not conforming to requirements, materials are to be segregated at locations designated for rejected materials and quickly removed from site.
(xii) If materials from a particular source continue to fail in the tests, discard the source.

(m) Control of Machinery, Plant & Equipment

Any equipment arriving at the site will be approved after proper inspection / testing. Proper records of inspection, approval and acceptance of material/equipment shall be maintained at the site in the prescribed format by respective department.

(i) Plan for selection of machinery (Number type and capacity) keeping in view production rate.
(ii) Plan for training of operators as per manufacture's requirement.
(iii) Plan for calibration, routine checking and upkeep of machinery including all relevant parts responsible for different controls.
(iv) Important materials/equipment & inspections can be jointly conducted by Quality Personnel and Engineer-in-Charge or his authorized representatives for checking the conformance of the material to specifications.

(n) Control of laboratory and field testing facility

(i) Plan for laboratory infrastructure such as location, space size, personnel, equipment, accessories, consumables, general facilities commensurate with work requirements.
(ii) Plan for calibration of equipment.
(iii) Plan for upkeep of equipment.
(iv) Plan for identification of samples and documentation of test results;
(v) Sample formats for collection of samples recording of test (field and laboratory) observations and analysis/calculation of test results;
(vi) Sample formats for statistical analysis;
(vii) Sample formats for checking of levels and profiles.

All the sample formats mentioned above shall be included in QAP.

(o) Calibration, Validation, Certification & Testing/ Measuring plants/ Equipment

Plan for calibration and certification of various testing equipment and plants & machinery shall be provided in QAP

(p) Protocol for control of Non-Conformance and Corrective action

The protocol for retesting and acceptance mechanism is as given below: -
(i) Marking of non-conformance and observations.
(ii) Recording of non -conformances.
(iii) Disposition of non-conformance.
(iv) Corrective and remedial action and Non-conformance preventive action.

Protocol for identifying non-conformities and corrective action shall be included in QAP.

(q) Control of Safety, Health and Environment (SHE) and Traffic management

Traffic management, Safety, health and environment are growing concerns in a construction project during both construction and operation. As soon as the work is awarded, the contractor shall submit a detailed and comprehensive contract specific SHE plan. The SHE plan shall include detailed policies, procedure and regulations etc. Reference of SHE Plan shall be part of QAP. For guidance CPWD Handbook on Safety, Health and Environment may be referred.

(r) Format for Monthly Quality Assurance Report

The requirements of Monthly Quality Report are explained in Para3.9.1. For easiness in preparing reports a model content list for Monthly Quality Report is given at Annexure- 11

CHAPTER 4

FIELD/ PLANT LABORATORY

4.1 Introduction

The quality of the work depends on the materials used and workmanship in construction. All materials and workmanship shall be as per Specifications described in the Contract document/ Agreement and shall be subjected from time to time to tests. The contractor shall be responsible to setup and maintain an adequately equipped Field Laboratory (based on type of work) for routine test on every material that is being used in the project including raw materials, processed materials, manufactured materials, proprietary materials etc. for quality control required to be conducted on a day to day basis. Establishing a Field Laboratory for construction material testing shall be an essential part of the QAP. Field laboratory will be manned by suitably trained personnel trained in material testing and quality control works.

Certain tests may be outsourced, to approved National Accreditation Board for laboratories (NABL) accredited test laboratories or by any other accreditation body which operates in accordance with ISO/IEC 17011 and accredits lab as per ISO/IEC 17025 for testing and calibration scopes or Higher Technical (academic) Institutes or Research Laboratories. Plant laboratory shall also be established by the contractor as per the site requirement i.e. wherever a Batching /RMC plant or group of plants are established or as specified in the Contract/ Agreement

The essentials of an ideal Field laboratory can therefore, be summarized as:

(i) Layout plan is such that it accommodates all the equipment in proper manner and provides good and efficient working environment.
(ii) Intended equipment and accessories are available and properly maintained.
(iii) Intended consumables are available and properly stored.
(iv) Documentation management system is efficient.

A list of field equipment / instruments for typical field laboratory is given in **Annexure-35.** However it may vary depending on the actual test facility envisaged at that location. All the materials/ items, testing equipment, relevant & applicable codes, specifications &standards, procedure for testing as well as the acceptance criteria for various items of works, should be available in field laboratory to conduct the tests and check their conformity.

4.2 QA/QC Personnel

Deployment of QA/QC personnel depends on the size of the laboratory, the test facilities planned and volume of work. The main /central laboratory shall be headed by Assistant QA/ QC Engineer; each plant lab shall be manned by at least one trained lab technician. QA/QC

in charge should be qualified and experienced in handling similar works; specific requirements e.g. number, experience etc. can be mentioned in the contract document based on the size and complexities of the project.

4.3 Documentation and Records

All the formats to be used for recording the results of various tests shall be included in the Quality Assurance Plan. A copy of QAP shall be made available in the field and plant laboratories. Test results shall be promptly entered in suitable register and / or form (paper / electronic) soon after conducting the tests. All the linked test reports, if applicable, shall be filed in a single location so that the records can be effectively retrieved at the time of future investigations. Quality records should be properly indexed and linked to suitable strip maps for traceability. They should be stored in an orderly manner in the safe custody of the Laboratory –in-Charge.

4.4 Upkeep and Maintenance of Field Laboratory

The laboratories shall be adequately lit, ventilated and well maintained with proper water supply and sanitary arrangements. The equipment / apparatus requiring temperature-controlled environment shall be housed in air-conditioned rooms. The tests that use inflammable substances shall be conducted in separate room having adequate ventilation/ windows. The laboratory shall have all the necessary equipment in good working condition with proper calibration as required for conducting materials test at site of work. Internal testing spaces within the laboratory should be properly demarked. The laboratory shall be kept clean at all times.

All the equipment/instruments provided in the field as well as the plant laboratories shall be checked periodically for their functioning and serving the intended purpose. To ensure this, maintenance for all the equipment and instruments shall be carried out at fixed intervals through authenticated service provider and also as and when the equipment warrants repair or maintenance. Calibration of measuring equipment shall be carried out as per specified frequency or whenever the equipment undergoes repair. Thus, all the time, all the equipment in the laboratory shall be in working condition within the tolerance limits.

Any inspection, measurement and testing equipment that undergoes excessive wear and tear and requires calibration more frequently than the frequency recommended by the manufacturer shall be replaced. Similarly, all the dial gauges, pressure gauges and similar equipment whose actual readings vary by more than 25% of the indicated readings shall be replaced. Equipment which may be more than 15 years of manufacturing also may be considered for replacement unless it is certified by the accredited laboratories to be fit for use.

4.5 Calibration of Measuring and Testing Equipment/Instruments

Calibration is a comparison between a known measurement (the standard) and the measurement using the instruments to be calibrated. Purpose of calibration is to check and ensure that the measurements made by the equipment/Instruments have the same accuracy as specified by the equipment manufacturer. In practice, calibration also includes repair of the device/equipment. Therefore, it is absolutely essential that the equipment / measuring devices are calibrated regularly, to ensure that errors associated with the measurements are in the acceptable range. The production unit such as concrete batching plant, crusher etc. also needs to be calibrated time to time more frequently than equipment calibration.

To ensure valid results the measuring equipment shall be calibrated or verified prior to use and also at specific intervals normally as specified by the equipment manufacturer, against measurement standards traceable to national or international measuring standards and where such standard do not exist, the basis for calibration or verification needs to be documented.

4.5.1 Frequency of Calibration

As a general rule, the equipment/measuring devices shall be calibrated at the frequency specified by the manufacturer of the specific equipment. Calibration shall also be done invariably after repair or mechanical maintenance of the equipment. Details of calibration requirements and interval are listed in the following table. Wherever time interval for calibration specified by the manufacturer is smaller than the time interval indicated in the table, the manufacturer's recommendation shall be followed.

Calibration Requirements and Frequency

S. no.	Category	Testing Equipment	Calibration/ Check	Frequency
1	Load Measuring Devices	Compression Testing Machine, Proving Rings	Check rate of loading, calibrate in accordance with ISO 7500: Part 1	Should not exceed 01 year. (External)
2	Length Measuring Devices	Micrometers, Vernier Callipers, Steel rules, Dial gauges	Calibrate in accordance with BS EN 10002:Part 4, over the entire extension range or working range Check for readability and wear	Should not exceed 01 year (External) Every 3 months (In house)

3	Temperature Measuring Instruments	Thermometers, Oven, Water baths	Calibrate for precision in the range of measurement required with calibrated reference thermometer Check at ice point	Annual (External) Before use (Internal or In house)
4	Time Measuring Devices	Stop watches	Check against BT speaking clock	Annual (Check)
5	Weighing machines	Physical, Electronic and common Balances, Weights	To be calibrated in accordance with the procedures of weight under measures	Annual/Biannual based on the use (External)
6	Plants	Cement Concrete Batching Plant /RMC Plant	Calibration of individual gate openings and the batching unit	Every 3 months (In house)

4.5.2 Calibration Records

Calibration records shall be maintained which shall include the following:-

(i) Identify of item of equipment
(ii) Name of the manufacturer
(iii) Serial number
(iv) Date of calibration
(v) Current location
(vi) Manufacturer's instructions
(vii) Reference standard, and reference used for calibration
(viii) Copies of all report's result of calibration and certificate of calibration
(ix) Maintenance plan and due date of next calibration
(x) Identity of the individual performing the calibration

Status of calibration and the calibration certificate shall be displayed near the respective testing equipment.

4.5.3 List of Documents

Each Field Laboratory should hold the following document:

(i) Quality manual.
(ii) List of approved external laboratories.
(iii) Approved Quality Assurance Plan (QAP)
(iv) Technical Records: Specification, Contract document, Inspection and test procedures, relevant Standards/ Code of practice.

(v) Material test reports, test reports of cores.
(vi) Inspection reports.
(vii) Photographic / Video film records of construction which may not remain accessible after commissioning of the project.
(viii) Non-conformance reports.
(ix) Statistical evaluation reports.
(x) Technical literature.
(xi) Standardization of records.

Quality Assurance personnel should hold the following Documents:

(i) Data of test.
(ii) Area where material is used.
(iii) Test method with reference to standards.
(iv) Testing results, including those of cores of concrete.
(v) Acceptance criteria.
(vi) Remarks.
(vii) Test personnel signature.

Site in-charge should always have a kit consisting of equipment measuring tapes scale, Vernier-calipers, plumb rule & bob, spirit level, square Gunia, (small) hammer, measuring glass etc. to facilitate quality checking at site. A comprehensive list of such instruments is given at annexure-36.

CHAPTER 5

Non-Conforming Works and Procedures

5.1 Introduction

In broad terms, for the Quality Assurance of the finished works, it is necessary for the materials and workmanship to comply with the Contract requirements. Non-complying works shall be rejected. The statement above is true in general terms but special difficulties arise in the case of concrete, where the non-compliance may only be known after 28 days cube test results. In these cases, removal, re-execution or rectification of the work is usually difficult. Therefore, separate procedures are laid out below for non-complying items like concrete. A similar situation may also arise when test results of some materials arrive after the same has already been used in the work.

In some of the situations, acceptance after repair/ review for adequacy is feasible. Therefore, separate procedures are laid out for some of the non-conforming situations. In case the feasible items do not meet the requirements after such repair/ review, the non-conforming item should be rejected.

Many a times test results may get delayed accidentally and the material may have been incorporated in the project. All such situations need to be dealt with in a careful manner. This section describes procedures for the same.

5.2 Acceptance Criteria

Once the test result on the sample of a particular material/ products / works is obtained for a particular Quality Characteristics, the following procedure shall be followed to check its acceptance or otherwise.

Wherever multiple Quality Characteristics are specified in the CPWD Specifications or particular specifications of the contract for a particular material / product / work, acceptance against each Quality Characteristic shall be established for final acceptance of the material/ work. If the value of the test results of the samples is more than the specified value/ less than the specified value than within tolerance limits of the specified value as applicable to the given Quality Characteristics(s) particular material / product / work may be accepted. Acceptance of additional Quality Characteristics for factory manufactured materials, products and specialized items shall be established if the value of the test result is more than the specified value/ less than the specified value within tolerance limits of the specified value as applicable to the given Quality Characteristics based on relevant code of Practice.

5.3 Non-conformance of works

The primary means by which Quality Assurance shall be achieved is by the procedures described in relevant specifications and method statement. The non-conforming particular material/ products / works shall be further reviewed as given below:

5.4 Non-Conformance

In the event that any requirement is not met, then the following procedure shall be followed:

(a) The Contractor shall be notified in the Non-Conformance Note (NCN) without delay verbally, and in writing by site inspection report or site order book or letter stating the facts and confirming that the works are 'not approved' with the reason for rejection stated. Sample Performa for Non-Conformance Note (NCN) is given in the annexure-37.

(b) Approval to carry out items/ works of a similar nature shall be withheld.

(c) All aspects of works and method statement shall be reviewed.

(d) The cause of non-conformance e.g., failure/ poor finish shall be identified.

(e) The Contractor shall be asked for his proposals to rectify the non-compliance, which may involve re-submission of materials, new trial mixes, and revised method statements.

(f) Where the required strength/finish is not attained then the nonconformance procedure for repair/rectification specified in the contract or specifications shall be followed. The Contractor shall furnish his exact proposals for rectification under consideration.

(g) When satisfied with the measures taken to ensure future compliance, the Engineer-in-Charge shall confirm approval to continue with execution of items.

5.5 Non-Conformance of strength in Concrete or similar other items

(a) The specification strength/density for items like concrete, bituminous works recognizes statistical possibility of specimen failure and thus limits of means, standard deviation, and minimum values of strength are specified. The rejection criteria are set out in the agreement.

(b) Materials that are stored for a long time shall be retested at regular intervals before use. Any deterioration in the quality shall be detected and defective material rejected and removed from site.

(c) The fact of non-conformance and the proposed rectification procedure is conveyed to the design consultant for review and opinion about:

  (i) Acceptability of Contractor's Proposal,

  (ii) Further non-destructive testing, if any

  (iii) Acceptability in case strength is achieved at a later age (e.g. 90 days)

  (iv) Acceptability at the level of strength achieved for the stress levels in concerned members.

  (v) Rejection.

(d) Proposed rectified structure shall be always be subject to appropriate non-destructive testing, if felt necessary by the Engineer-in-charge. If no satisfactory method is found then the member/ structural members incorporating the non-compliant material shall be dismantled at no cost to the owner. In the case of proprietary materials such as Admixture, Bearings, Expansion joints etc. the respective manufacturer shall invariably be consulted for analysis of the problems and possible rectification measures

(e) Rejection in case the item does not pass modified acceptance limits after repairs.

(f) Revise specification/instructions to avoid further recurrence of non-conformance.

Non-conformance in case of other similar nature of works e.g. earthwork, formwork, base and other pavement course are treated as per above guidelines as applicable.

5.6 Non-Conformance Report (NCR)

The QA Engineer shall send a status report of Non-Conformance (NC), proposed rectification measures, rejection/ removal status and its rectification report in his Monthly Quality Reports. Sample format of NCR/NCN status report is given in annexure-19. The record of repair/ rectification, retesting, inspection & acceptance shall be kept as part of "as built" documentation.

It is mandatory that all instances of works not satisfying the Specifications are intimated in writing to the Contractor. This ensures that the Contractor is irrefutably informed and record of non-compliance is built up to give a general guide to the Contractor's performance.

CHAPTER 6

QUALITY AUDIT

6.1 Quality Audit- Objectives and Principles

Audit is defined in ISO 9000-2015 as "*Systematic, independent and documented process for obtaining objective evidence and evaluating it objectively to determine the extent to which audit criteria are fulfilled*". The fundamental elements of an audit include the **determination** of the **conformity** of an **object** according to a **procedure** carried out by personnel not being responsible for the object audited.

Audit criteria and audit evidence are defined as follows:

Audit criteria: Set of policies, procedures or requirements used as a reference against which the audit evidence is compared.

Audit evidence: Records, statements of fact or other information, which are relevant to the audit criteria and verifiable.

The principles of auditing should ensure that an audit is an effective and reliable tool in support of management policies and controls, by providing information on which an organization can act in order to improve its performance. The principles as outlined in ISO: 19011.2011 include the following:

(i) Integrity
(ii) Fair presentation
(iii) Due professional care
(iv) Confidentiality
(v) Independence
(vi) Evidence-based approach.

6.2 Quality Audit- Types

Quality Audit is required for detecting whether the procedures adopted ensuring the quality of works are at variance with those required by the contract and/or as set out in the NIT and/or the Quality Assurance Plan. There are basically two levels of Quality Audit, viz.

(a) Internal Audit: It is also known as first party audit here the organization audits its own systems to measure the strengths and weaknesses of the management system against the system requirements,

(b) External Audit: It consists of second party audit and third party audit. In second party audit, customer or client audits the facilities of the contractor/ supplier with which it has a contract for supply of goods & services. Third party audit is carried out by an independent organization generally for the purpose of certification.

6.3 Internal Quality Audit

The internal Quality Audit is performed by the various Quality Assurance & Technical Audit (QA&TA) units of the departments. The plans for Quality Audit by these individual units are to be implemented by the respective unit heads. The NIT Approving Authority has to ensure through contract conditions that the concept of Total Quality Management (TQM) is in-built in the work delivery system for which everyone shares well defined responsibilities.

The functions of the Quality Audit teams are to check the compliance of Quality Assurance system by the field units, to locate the lapse/deficiency in the implementation of the Quality Assurance Plan, and to guide the field engineers in quality related aspects of the work.

6.3.1 Internal Quality Auditing Procedures

(a) In order to achieve Total Quality in the work, the pre-requisites cover among other things, an inbuilt provision in the contract for a system of continuous check on quality by the field staff and the contractor, availability of adequately manned and equipped agency for overseeing the quality aspects, and periodical appraisal of quality and a system of feedback for effecting possible improvements.

(b) The Quality Audit Plan for the work will specify the scope, type and frequency of Quality Audits to be undertaken. Audits may be of the following types:
   (i) Comprehensive Technical and Quality Audit
   (ii) Process and System Audit
   An auditor will be nominated by the department for this purpose.

(c) The nominated auditor will give at least 7 days notice in writing to the representative of the intended audit and will specify which aspects of the works are to be audited.

(d) Prior to the audit being undertaken, the auditor will prepare checklists of specific details of procedures to be audited.

(e) At the start of the audit, the auditor will hold an audit opening meeting to explain the purpose and procedure to be adopted for the audit with the department and contractor's representative and any other persons involved in the audit. Attendees at the meeting will complete an attendance sheet.

(f) The Auditor will undertake the audit using the prepared checklists. Any non-conformance identified is to be recorded on the Notification and Corrective Action Request Form. A separate form will be completed for each non-conformance.

(g) At the completion of the audit, the auditor will hold a closing meeting with the department and contractor's representative and others to explain the results of the audit and to handover any Non-conformance Notification and Corrective Action Requests. The contractor's representatives will sign the request signifying that he understands the nature of the non-conformance.

(h) The auditor will forward an audit report to the department's representative within 14 days giving a full account of the audit undertaken. Originals of Non-conformance Notifications and Corrective Action Requests will be attached to the report for action by the contractor. The department's representative shall forward the audit report to the contractor for compliance.

(i) The contractor's representative will propose an action to correct the non-conformance and the department must concur with the proposed action for it to be considered acceptable. The contractor's representative will also undertake action to prevent a recurrence of any non-conformance.

(j) The department will follow up on any proposed action as a result of the audit and will so record in the form when satisfied that action has been undertaken in a satisfactory manner.

6.3.2 Auditing Responsibilities

The Unit responsible for Quality Audit will:

(a) Prepare a quality audit plan for the works/ project in progress, and

(b) Maintain records of quality audits undertaken

The Auditors will:

(a) Give notice of intended audits;

(b) Prepare checklists for use during an audit;

(c) Undertake the audit and report any Non- conformities along with proposed Corrective Action.

(d) Concur with proposed satisfactory dispositions and follow up on any dispositions or corrective actions to be undertaken; and

(e) Complete an audit report for each audit

The Contractor's representative will:

(a) Propose dispositions for non-conformance and propose corrective actions, and

(b) Undertake action to prevent recurrence of any non- conformance or to correct any non-conformance.

6.3.3 Auditing Documentation and Records

(c) Quality Audit Report by Internal Auditors/External Auditors.

(d) Non-conformance Notification and Corrective Action Report Forms.

The internal audit team shall submit an overall assessment report in the proforma at Annexure-38 to Regional/ Zone head/Circle Head. The Quality Audit Report shall be sent to the Engineer-in-Charge with copies to Regional head/Zone/Circle Head.

6.3.4 Organizational set-up of Internal Quality Audit

The implementation of Quality Assurance in the field will require close co-operation among the three agencies, namely (a) field engineers (b) the construction agency, and (c) the Quality Assurance team (internal Quality Audit Team) at Regional level and for strict compliance of Quality Assurance Procedure forming part of agreement.

6.3.5 Internal Quality Audit/Assurance team at Regional level

(a) The Quality Assurance team at Regional level can be setup for works, which is to be headed by an Executive Engineer (QA), whose main job is quality assurance.

(b) In order that the role of the internal audit team is effective in the process of Quality Assurance, the following points are essential:
   (i) Internal Audit teams shall comprise of the Civil engineers, E&M Engineers and Horticulturist as per requirement based on the items of the works in progress.
   (ii) The periodicity of visit of works is such that the process control at various stages is possible.
   (iii) Undertake the audit and complete any Non-conformance Notifications and Corrective Action Report, if any.
   (iv) There is minimum delay between inspection of work and communication of inspection report to the field formation.

(c) The internal audit team carries out his/her tasks in a work that relates operationally to the quality, specifications and standards lay down for the work, and to the control actions that can be applied to the construction process. Thus, the QA team assesses those aspects which are important to the overall quality of the finished work.

(d) The functions of the Internal Quality Assurance team are to check the compliance of Quality Assurance system by the field units, to locate the lapse/deficiency in the implementation of the Quality Assurance Plan, and to guide the field engineers in quality related aspects of the work. For this purpose:
   (i) The QA team prepares their program and takes approval of the head. The program is sent to site in advance of inspection.
   (ii) Such inspection by the QA team is, however, not to absolve the responsibility of the field engineers or Engineer-in-Charge for accepting only quality work from the contractor.
   (iii) To check the quality of materials accepted by the field units for use in the work and to see whether the laid down system of Quality Assurance Plan (QAP) has been followed.
   (iv) To check the overall quality of the finished items. Random checks is applied by the QA team with the help of handy instruments like rebound hammer for

determining the strength of concrete, portable penetrometer for testing strength of mortar of plaster, electronic moisture meter for testing moisture content of timber, etc.

(v) To randomly check the field tests carried out by the field staff during the progress of the work.

(vi) To provide guidance to the field staff in case of any problem relating to routine field tests.

6.4 External Quality Audit

Internal audits are performed by employees of the organization whereas External audits are performed by an outside agent. Second party audit and third party audit are categorized as external audit. Second party audit is carried out by the customer or client to audit the facilities of the contractor/ supplier with which it has a contract for supply of goods & services. Whereas, the third party audits are performed by an organization independent of the project implementation agencies i.e. Contractor, Consultant and departments.

6.4.1 Third Party Quality Assurance

Third Party Quality Audit (TPQA) is a review by an independent entity (A separate organization / group of experts) of how well the key areas of a project quality plan is being followed and whether it's effective in getting the quality results originally envisaged. It is a value addition to the project and not just fault finding with the contractor. Normally audit scope covers safety adherence, occupational health and environmental compliance of the project apart from quality of works.

6.4.2 Selection of Projects for TPQA

Department shall take a decision on case –to- case basis for Third Party Quality Assurance/ Audit of a project depending upon its size and complexity. However, projects fulfilling any or all of the following criteria may be considered for Third Party Quality Assurance. In CPWD, Third Party Quality Assurance is done for projects costing 20 Crores and above, executed by CPWD. Third Party Quality Assurance charge of 1% of cost of construction is generally considered in the estimate, whereby client agree for assessment of quality through third party quality assurance team.

6.4.3 Scope of Third-Party Quality Assurance

Scope of Third-Party Quality Assurance for a project is given in the Standard Terms of reference for TPQA in the following Paras. Scope may be modified considering complexity and special features of particular projects. Third Party Quality Assurance shall cover physical verification of all major items of work. Inspection Report shall list all such items. The Quality Characteristics

of particular items of work and sample size for physical verification shall also be identified in Inspection Report. TPQA Agency shall be engaged to check the work during execution for the following purposes:

(i) To ensure that the site is equipped with necessary documents like agreement, CPWD Specifications, BIS Codes, Guard file containing inspection reports, list of approved manufactures, tools for checking quality of work & testing facilities.

(ii) To ensure that site records like inspection register, cement register, test register & site order book etc. are being maintained in prescribed forms.

(iii) To ensure specific control on various process of execution by controlling various factors such as testing of material & developing check list of important items of work.

(iv) Inspection of work during execution shall be done for the following aspects:

(a) Material Aspect: Quality & Testing of material keeping in view the requirement of contract specifications, BIS marked/ CPWD approved products. The agency shall conduct independently at least 10% tests of the total tests as required as per mandatory tests/ contract specifications/ BIS/IRC/MORTH requirements.

(b) Workmanship Aspects:-To ensure execution of work with sound engineering practice and laid down procedures.

(v) The authority concerned shall ensure checking of observations of TPQA before making payment to the execution agencies.

6.4.4 Standard Terms of Reference for Third Party Quality Assurance of Projects

6.4.4.1 Brief overview of the Project

(Give brief features of the project such as location, terrain, scope, cost, mode of contract, particulars of Department, Contractor).

The Consultancy Services ("The Services") include conducting Third party Audit/Assurance as outlined hereafter.(Department) intends that periodic Quality Auditing are carried out by a third-party to enable the Employer/Authority assess critically the in-place quality of the project. Third Party Quality Audit is required to be carried out preferably once every three months. The audit will be comprehensive, and include examination of the quality of work executed and services carried out, compliance of works with the technical specifications and standards prescribed in the contract, compliance of social and environmental safeguards, compliance of safety requirements and furnishing of recommendations for improvements in quality of project and project implementation as a whole.

6.4.4.2 Department invites bid offers from consulting firms, Govt. Engineering College/ Engineering Organizations hereinafter to be called Third Party Quality Audit (TPQA) to assist it in auditing quality of the project. The TPQA shall include a team of qualified and experienced technical and other experts to be able to satisfactorily fulfill the objectives of the Audit.

6.4.4.3. Project Familiarization

The TPQA should clearly understand the scope and complexities of the project by studying all contract documents including drawing, specifications, materials reports and conditions of contract. The TPQA shall visit the project site to acquaint himself with the ground conditions. A report in the nature of a Project Familiarization shall be submitted within 21 days of commencing the assignment.

6.4.4.4 Scope of the TPQA Services

The objectives of the TPQA Services are to:

(i) Verify if the quality of the Works is consistent with contract conditions as well as technical specifications including compliance to the social and environmental safeguards, occupational health and safety requirements by independent assessment/audit of quality of works at various stages of construction, and

(ii) Identify and recommend improvements to achieve the quality.

6.4.4.5 Tasks to be performed by the TPQA

The TPQA will undertake the following tasks but not limited to it. TPQA may suggest improvements over the services mentioned here below, without any additional burden to Employer.

6.4.4.5.1 Task 1: Technical Examination of Works

(i) The TPQA shall verify the adequacy of the Contractor's field laboratories, plant, equipment and personnel and general fitness for purpose of such inputs, including the accuracy / calibration of testing equipment used for measurement.

(ii) The TPQA shall review the Contractor's working practices e.g. material receipt, storing, consumption procedures, material testing, construction methods, and documentation system to assess whether sound practices are being employed to achieve quality.

(iii) The TPQA shall review degree of quality control exercised during the construction by the Contractor (tests, number, frequency, approach & timing etc.) and documentation (QC registers, test reports, observations of supervisory staff, compliance etc.) to assess whether the same is compliant to specified technical specifications.

(iv) The TPQA shall review Contractor's plan and actual practices with respect to social and environmental safeguards, safety measures, working conditions, and employment legislation as stipulated under the contract and relevant national and state laws/ regulations.

(v) The TPQA shall verify whether the quality of work is in accordance with contract specifications. This verification is to be implemented through independent materials testing of at least 10% of mandatory tests requirement. The TPQA shall verity actual implementation of QAP and carry out safety audit for both design and construction stage.

(vi) The TPQA shall prepare Inspection Test Plans (ITPs), to be approved by the department that elaborates the frequency and method for performing field inspections. The formats to be used in this assessment shall be provided in the Inspection Report.

(vii) The TPQA shall audit and assess the quality control practices and documentation thereof.

(viii) The TPQA shall under take inspections on a sample basis with prior intimation and approval of the Engineer-in-Charge to verity actual compliance with previously identified quality enhancement measures and recommendations.

6.4.4.5.2 Task 2 :- Training

The TPA shall provide on the job training to QA staff of contractor on quality control procedure, safety and environmental management etc.

The above assessment/ information should be presented to the department as a summary report biannually highlighting the following:

(i) Quality enhancement measures,

(ii) Clear recommendations, if any work is to be rejected for use.

The final audit should commence at least six weeks before the expected date of completion of work.

6.4.4.6 Confidentiality

The TPQA by virtue of their scope of work will come in contact with several confidential documents and their recommendations may have financial and legal implications. It is therefore, essential that the TPQA and its experts will exhibit and ensure highest sense of probity and integrity apart from knowledge and experience and maintain strict confidentiality.

6.4.4.7 Time Frame

The TPQA consultancy services will begin from the start of work and complete with substantial completion of work. The expected date of commencement of Services and period of consultancy services should be clearly specified in the TPQA agreement.

6.4.4.8 Organization

Comprehensive Technical Audit may be conducted by a group of professors of nearby NIT/IIT or by Professional Bodies like CBRI, CRRI. The TQPA should have the capability to carry out the job on its own strengths (in terms of skilled manpower, equipment, technical skills etc.) with adequate logistical support at the project location. To ensure that TPQA objectives are duly met, the Organization should have carried out at least two assignments of similar nature in the last 7 years.

6.4.4.9 Reporting Requirements

The TPQA shall furnish its reports in soft and 3 hard copies. The TPQA shall submit the following documents in pursuance of its services.

(i) TPQA will develop minimum quality assurance plan considering all the relevant provisions of the agreement and get it approved from competent authority. They will ensure that all the provisions of QA plan are being observed at site. The TPQA shall make a presentation to the department and modify the contents, if suggested by the department.

(ii) Inspection Report (IR) should contain the approach, methodology, audit/ monitoring formats etc. required to be reported. The report should contain a flow chart indicating the inputs / outputs by stages and type of work. The IR shall be submitted within 3 (three) weeks from the date on commencing the services. The TPQA shall make a presentation to the department and modify the contents, if suggested by the department.

(iii) TPQA will ensure that all the tests should be conducted as detailed in QA plan.

(iv) TPQA will ensure that test should be carried out in field lab or outside lab as per provisions of the agreement.

(v) TPQA shall mention the details of defective work in inspection report, to be dismantled by execution agency.

(vi) TPQA shall mention details of defective material, brought at site, which is to be removed from the site immediately in inspection report.

(vii) A sample checklist for preparation of Quality audit report is given at annexure- 39.

(viii) TPQA Inspection Reports and draft Final Audit Report shall be submitted within 15 days from the date of inspections.

(ix) Final Audit Report shall be submitted within 21 days from the date of compliance of by the Contractor.

(x) TPQA shall make a presentation to the department in presence of Contractor and field staff.

6.4.4.10 Deliverable and Payment Schedule

The Payment schedule will be based on the outputs as shown in the following table:

S. No.	Deliverable	Schedule of submission from the start date	Payment schedule (in % to the total value)	Remarks
1.	First Inspection Reports	TPQA will inspect the work as and when required, at least once in three months.	Nil	Advance payment limiting to 20% of total fee in two or more installments on production of Bank Guarantee of equal amount may be made to the TPQA Govt. agencies.
2.	Subsequent Inspection Reports	Within 15 days from the date of completion of Inspection	Running payment shall be made on proportionate basis as per the progress of work limited to 85%.	The 2nd installment will be released considering the progress of TPQA agency. Running payment shall be made on proportionate basis.
3.	Final Audit Report	Within 15 days from the date of completion of final Inspection.	15 %	
	5% of the due amount of TPQA during the month shall be deducted from TPQA for not carrying out inspection and preparation of details, required for work, in Performa as per Annexure – 39 by TPQA.			

6.4.4.11 List of Key Experts

List of Experts required in the TPQA team are given below along with their indicative man month for a 24 months period contract. The requirement may be modified for a particular contract keeping in view contract period, size and nature of complexity of project.

Position/ Expert	Number	Period of Deployment (months)
Team Leader (Civil/Structural Engineer)	1	24
Geo-tech / Foundation Engineer	1	6
Electrical/ Mechanical Engineer	1	6
Environment, Construction Safety & Health Expert	1	6

6.4.4.12 Data, services, and facilities to be provided by Department to the TPQA:

Apart from quality control and quality assistance records maintained by the Contractor and Engineer-in-Charge, a copy of the contract agreement of the work is required to be made available to the TPQA.

CHAPTER 7

Chief Technical Examiners

7.1 Functions

The Chief Technical Examiner's Organisation is the technical wing of the Central Vigilance Commission. The Chief Technical Examiner's Organisation conducts inspections of works from the vigilance angle on its own or on a complaint being received by/ referred to them. The inspections can be carried out by them for works of any magnitude, both in respect of original and repair works.

7.2 Returns

Consolidated Quarterly return of the works in progress, as per CTE's circulars from time to time are required to be submitted to CTE. Statement showing the quarterly progress of original works for ending of each quarter shall be submitted to CTE.

(1) The work wise returns are required to be submitted for the quarters ending June, September, December and March of the financial year.

(2) Quarterly progress reports to be sent to CTE for:

Category I	Civil works, Turnkey works Contracts, Stores & Purchases, PPP- Public Private Partnership (Cost/Revenue Values), Sale of Goods/Scrap/Land	Rs. Five crore and above.
Category-II (a)	Electrical/Mechanical works/ Maintenance /Service contracts including Electronics / instrumentation / Telecommunication /Man power Supply/ Consultancy contracts:	Rs. One crore and above
Category-II (b)	Medical Equipment	Rs. Fifty lakh and above
Category-III	Horticulture works	Rs. Ten lakhs and above

(3) The work wise returns are to be submitted on separate sheets. Proforma is given in Annexure – 40 & 41.

7.3 Technical Audit by CTE: Inspections

Following action is to be taken by Executive Engineer and other field officers in case of CTE Inspections:

(1) Various documents relevant to the work generally asked for by the CTE are to be kept ready at site before CTE Inspection. A list of such documents is given in Para 7.4 below.

(2) To expedite replies and settle the points and to ensure timely action, the time limit fixed by the CTE is strictly adhered to by officers at all levels.
(3) To watch proper disposal of replies, the Engineer-in-Charge shall maintain a register in given proforma given in Annexure – 42.
(4) A Register of overpayments pointed out by the CTE Organization and subsequent recoveries affected, is to be maintained by the Engineer-in-charge in the proforma given in Annexure -43
(5) Timely notice for rectification of defects, recoveries to be made etc., is to be issued by the Executive Engineer to the contractor.
(6) No reference is to be made to CTE inspection/examination of works in any correspondence made with the contractor.

7.4 List of documents considered essential for inspections by CTE and which may be called for examination of work

(1) (a) Press Cuttings, NIT uploading details including extended dates, ifany
  (i) For pre-qualification of architects/consultants
  (ii) For pre-qualifications of contractors.
  (iii) Call of tenders.
  (b) Register of sale of tenders,
  (c) Register of opening of tender.
(2) File giving reference to financial sanction and approval of competent administrative authority - Preliminary estimate.
(3) Copy of detailed estimate and its technical sanction by competent authority.
(4) Approved N.I.T. (Notice Inviting Tenders) in Original.
(5) Rejected tenders and comparative statements for:
  (a) Selection of architects/ consultants.
  (b) Shot-listing or pre- qualification of tenders.
  (c) Others tenders.
(6) Justification statement and corresponding noting in support of tenders/offers accepted.
(7) Details of negotiations, if any, made before acceptance of tenders.
(8) Original contracts with consultant/contractor.
(9) Guarantee Bonds etc. towards security for work, machinery/mobilization advance etc. including extension of validity.
(10) Insurance policies for work, materials, equipment, men etc. including extension of validity.
(11) Guarantees for water tightness, termite proofing etc.
(12) Standard specifications.
(13) Standard Schedule of Rates.
(14) Drawings - architectural and structural.
(15) All connected Measurement Books, Level Books, field books and lead chart.

(16) All Running Account Bills with all connected statements/vouchers etc.
(17) Statement showing details of check of measurements by superior officers - copies of orders laying down such requirements.
(18) Materials at site accounts/dismantled materials record.
(19) Site Order Books/ Test records/Log Books.
(20) Details of extra/substituted items and of deviated quantities being executed/considered for execution in the work along with analysis of rates.
(21) Office correspondence files and inspection notes, if any, issued by inspecting officers.
(22) Complaint records, if any.
(23) Any other documents relevant to the works.

CHAPTER 8

Testing Plan, Checklist And Do's & Don't For Building works

8.1 Testing Plan

MORTARS

Material	Test	Field/ Lab. Test	Test Procedure	Frequency of testing for construction work and EPC Project Work	Frequency of testing for maintenance work
1	2	3	4	5	6
Water (Natural of Treated)	(i) pH value (ii) Limits of acidity (iii) Limits of alkalinity (iv) Percentage of solids (a) Chlorides (b) Suspended matter (c) Sulphates (d) Inorganic solids (e) Organic solids	Field / Lab Field / Lab Field / Lab Field / Lab Field / Lab Field / Lab Field / Lab Field / Lab	**IS: 3025** Part-11 Part-22 Part-23 Part-15 Part-32 Part-17 Part- 24 Part- 18 Part- 18	• *One test at commencement of work* for approval of each source and *there after* change of source and • Thereafter, water from each source shall be got tested during the dry season before monsoon and again after the monsoon. • Time period between two tests shall not exceed six months.	Water from each source shall be got tested before the commencement of work and thereafter once in every three months till the completion of the work. Water from municipal source need be tested only once in six months. Number of Tests for each source shall be 3
Cement	(a) Physical requirement (i) Fineness (ii) Soundness (iii) Setting time (initial & final) (iv) Compressive strength (v) Consistency of standard cement paste	Field / Lab Field / Lab Field / Lab Field / Lab Field / Lab	**IS: 4031** Part- 1 Part- 3 Part- 5 Part- 6 Part- 4	• Every 50 MT or part thereof. • 100 MT or part thereof if cement brought at site in a day from single source is more than 200 MT. • Each brand of cement brought to the site shall be tested as per this frequency. **(Minimum Quantity: Each lot).**	Every 50 MT or part thereof. Each brand of cement brought to site shall be tested as per this frequency. (**Minimum quantity :- Each lot)**

Fine aggre-gate	Deleterious materials & organic impurities	Field	**IS: 2386** Part-2	One test at commencement of work for approval of each source and change of source and thereafter, One test for 40 cum or part thereof. **(Minimum quantity: 20 cum).**	Every 20 cum or part thereof or more frequently as decided by Engineer-in-Charge (**Minimum quantity :- 20 cum)**
	Silt content	Field	**IS: 2386** Part-2	-------do------	--------do-----
	Practical size distribution	Field/ Lab	**IS: 2386** Part-1	One test at commencement of work for approval of each source and change of source and thereafter, One test for 40 cum or part thereof. (Minimum quantity: 40 cum).	40 cum or part thereof (**Minimum quantity :- 40 cum)**
Fine aggre-gate	Bulking of sand for volumetric mix/ Moisture content for design mix/ RMC	Field	**IS: 2386** Part-3	One test at commencement of work for approval of each source and change of source and thereafter, One test for 40 cum or part thereof or more frequently as decided by the Engineer-in-charge. **(Minimum quantity: 20 cum).**	Every 20 cum or part thereof or more frequently as decided by Engineer-in-Charge (**Minimum quantity :- 20 cum)**

Notes: Cement Testing

Material	Test	Field/ Laboratory Test	Test Procedure	Frequency of testing for construction work and EPC Project Work	Frequency of testing for maintenance work
1	2	3	4	5	6
Fly ash	Total chloride in percent by mass, max.	Lab	IS: 12423	One test at commencement of work for approval of each source and change of source and thereafter, One test for 10 cum or part thereof or more as decided by the Engineer-in-charge. **(Minimum quantity: 10 cum).**	Every 10 cum or part thereof or more (**Minimum quantity :- 10 cum)**
	Loss of ignition in percent by mass, max.	Lab	IS:1727	------do---	Frequency as decided by Engineer-in-charge
	Fineness, specific surface in m^2/kg	Field / Lab	Blaine's air permeability method IS-4031 part-2	------do---	-do-
	Compressive strength at 28 days in N/mm^2 Min.	Field / Lab	IS: 4031	One test at commencement of work for approval of each source and change of source and thereafter, Every 10 cum or part thereof. Only in cases when fly ash is used as pozzolana in cement**.** **(Minimum quantity: 10 cum).**	Only in cases when fly ash is used as pozzolana in cement. **(Minimum quantity: 10 cum).**

(i) In case cement has been stored for over Six (06) months from the date of manufacture or for any reason the stored cement shows sign of deterioration and contamination, it shall be tested prior to use in the work.

(ii) The sample shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling and not later than 03 months from the receipt of sample for testing.

(iii) After completion of previous test, if cement is stored more than 03 months, it shall be retested before use

1. PLAIN CEMENT CONCRETE WORKS

Material	Test	Field/ Lab Test	Test Procedure	Frequency of testing for construction work and EPC Project Work	Frequency of testing for maintenance work
1	2	3	4	5	6
Coarse Aggre-gate	Percentage of soft or deleterious materials	Field / Lab	**IS:2386** Part-2	One test at commencement of work for approval of each source and thereafter for every change of source	For all quantities
	Particle size distribution	Field / Lab	**IS:2386** Part-1	• Once at beginning for approval of each source and change of source • One test for 50 cum or part thereof for RCC works only. • For rest of items as decided by Engineer-in-charge	For every 45 cum or part thereof for RCC Work only. For rest of items as decided by Engineer-in Charge. **(Minimum quantity: 45 cum).**
	Estimation of organic impurities	Field / Lab	**IS:2386** Part-2	One test at commencement of work for approval of each source and change of source and thereafter, One test for 50 cum or part thereof. **(Minimum Quantity : 10 cum)**	For every 40 cum or part Thereof. **(Minimum Quantity : 10 cum)**
	Surface moisture	Field / Lab	**IS:2386** Part-3	-do-	-do-
	Determination of 10 % fine value	Field / Lab	**IS:2386** Part-4	-do-	-do-
	Specific gravity	Field / Lab	**IS:2386** Part-3	-do-	-do-

	Bulk density	Field / Lab	**IS:2386** Part-3	-do-	-do-
	Aggregate crushing strength	Field / Lab	**IS:2386** Part-4	-do-	-do-
	Aggregate impact value	Field / Lab	**IS:2386** Part-4	-do-	-do-
	Aggregate abrasion value	Field / Lab	**IS:2386** Part-4	-do-	
Concrete	Slump test	Field	**IS: 1199**	One test at commencement of work for approval of each source and change of source and thereafter, One test for 50 cum or part thereof. **(Minimum Quantity : 10 cum)** (Test procedure Appendix 'D')	15 cum or part thereof. (Test procedure Appendix 'D')

2. REINFORCED CEMENT CONCRETE WORKS

Material	**Test**	**Field/ Laboratory Test**	**Test Procedure**	**Frequency of testing for construction work and EPC Project Work**	**Frequency of testing for maintenance work**
1	**2**	**3**	**4**	**5**	**6**
Reinforced cement concrete (Nominal Mix)	(a) Slump Test(For workability of concrete)	Field / Lab	**IS:1199**	(i) One test for 10 cum of part thereof for columns. (ii) One test for 40 cum or part thereof for other R.C.C work. **Minimum Quantity:-** **(i) 5 cum in case of column.** **(ii) 20 cum for other RCC work.**	Every 5 cum or part thereof in case of column. (ii) Every 20 cum or part thereof in case of slab, beam and connected columns. (iii) One test for 20 cum for all other RCC work for all other small items and where RCC done in a day is less than 5 cum, tests may be carried out as required by Engineer-in- Charge. **Minimum Quantity:-** **(iii) 5 cum in case of column.** **20 cum for other RCC work.**

	(a) Cube Test (For compressive strength of concrete)	Field / Lab	**IS:516**	(i) One test for 10 cum of part thereof for columns. (ii) One test for 40 cum or part thereof for other R.C.C work. **Minimum Quantity: -** **(i) 5 cum in case of column.** **(ii) 20 cum for other RCC work.**	Every 5 cum or part thereof in case of column. (ii) Every 20 cum or part thereof in case of slab, beam and connected columns. (iii) One test for 20 cum for all other RCC work for all other small items and where RCC done in a day is less than 5 cum, tests may be carried out as required by Engineer-in- Charge. **Minimum Quantity: -** **(iii) 5 cum in case of column.** **20 cum for other RCC work**
Reinforced Cement Concrete (Design Mix)					
a) Coarse Aggregate	Same tests as SH: Plain cement concrete	Field / lab	**IS: 2386**	As prescribed in Concrete work.	Frequency as prescribed in concrete work.
b) Fine Aggregate	Same tests as SH: Mortar	Field	**IS: 2386**	As prescribed in Concrete work	Frequency as prescribed in concrete work.
c) Cement	Same tests as SH: Mortar	Field / Lab	**IS:4031**	As prescribed in Concrete work	As prescribed in Mortars section**.**

<table>
<tr><th>Material</th><th>Test</th><th>Field/ Labor-atory Test</th><th>Test Procedure</th><th colspan="2">Frequency of testing for construction work and EPC Project Work</th><th colspan="2">Frequency of testing for maintenance work</th></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td colspan="2">5</td><td colspan="2">6</td></tr>
<tr><td rowspan="11">a) Fresh Concrete</td><td>(a)Slump test (For workability of concrete)</td><td>Field / Lab</td><td>IS:1199</td><td colspan="2">As prescribed in Mortars section.</td><td colspan="2">50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge. (Minimum quantity:-10 cum)</td></tr>
<tr><td rowspan="10">(b) Cube test (For compressive strenght of concrete)</td><td rowspan="10">Field / Lab</td><td rowspan="10">IS:516</td><td>Quantity of concrete Delivered in a day / Lot (cum)</td><td>Number of samples</td><td>Quantity of concrete Delivered in a day / Lot (cum)</td><td>Number of samples</td></tr>
<tr><td>1 to 10</td><td>1</td><td>1 to 5</td><td>1</td></tr>
<tr><td>11 to 30</td><td>2</td><td>6 to 15</td><td>2</td></tr>
<tr><td>31 to 60</td><td>3</td><td>16 to 30</td><td>3</td></tr>
<tr><td>61 to 100</td><td>4</td><td>31 to 50</td><td>4</td></tr>
<tr><td>101 and above</td><td>4 plus one additional samples for each additional 50 cum or part thereof</td><td>51 and above</td><td>4 plus one additional samples for each additional 50 cum or part thereof</td></tr>
<tr><td colspan="2">Each sample shall be of adequate quantity so that a minimum of 3 specimen cubes can be made. Test of the sample is to be done in accordance with IS 516. (Minimum Quantity: 10 cum).</td><td colspan="2">Each sample shall be of adequate quantity so that a minimum of 3 specimen cubes can be made. Test of the sample is to be done in accordance with IS 516. (Minimum Quantity: 10 cum).</td></tr>
<tr><td colspan="4">Reinforcement Cement Concrete (Ready Mix)</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>a) Coarse Aggregates</td><td>Same tests as SH: Plain Cement Concrete</td><td>Field/ Lab</td><td>IS: 2386</td><td colspan="2">Test reports to be given by the RMC producer at every RMC supply of 100 cum or part thereof. (Minimum Quantity : 50 cum)</td><td colspan="2">As prescribed for RCC (Design Mix) for maintenance works.</td></tr>
<tr><td>b) Fine Aggre-gates</td><td>Same tests as SH: Mortar</td><td>Field</td><td>IS:2386</td><td colspan="2">-do-</td><td colspan="2">As prescribed for RCC (Design Mix) for maintenance works.</td></tr>
<tr><td>c) Cement</td><td>Same tests as SH: Mortar</td><td>Field/ Lab</td><td>IS: 4031</td><td colspan="2">-do-</td><td colspan="2">As prescribed for RCC (Design Mix) for maintenance works.</td></tr>
<tr><td>a) Fresh Concrete</td><td>(a)Slump test (For workability of concrete)</td><td>Field/ Lab</td><td>IS: 1199</td><td colspan="2">One test for 50 cum for R.C.C work including in all other small location. R.C.C done in a day is less than 50 cum, test may be carried out as required by Engineer-in-charge. (Minimum quantity :10 cum)</td><td colspan="2">As prescribed for RCC (Design Mix) for maintenance works.</td></tr>
</table>

<table>
<tr><td></td><td>(b) Cube test (For compressive strength of concrete</td><td>Field/ Lab</td><td>IS:516</td><td>Quantity of concrete Delivered (cum)</td><td>Number of samples</td><td colspan="2">As prescribed for RCC (Design Mix) for maintenance works.</td></tr>
<tr><td></td><td></td><td></td><td></td><td>1 to 100</td><td>1 test for every 25 cum or part thereof</td><td colspan="2"></td></tr>
<tr><td></td><td></td><td></td><td></td><td>101 and above</td><td>4 plus one additional samples for each additional 50 cum or part thereof</td><td colspan="2"></td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2">Each sample shall be of adequate quantity so that a minimum of 3 specimen cubes can be made. Test of the sample is to be done in accordance with IS 516. (Minimum 10 cum).</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Steel for Reinforced cement concrete</td><td rowspan="2">(a) Bend test
(b) Rebend test
(c) Per-centage Elongation test
(d) Ultim-ate tensile strength test
(e) 0.2% proof stress/Yield stress
(f) Che-mical test</td><td rowspan="2">Lab
Lab
Lab
Lab
Lab
Lab</td><td rowspan="2">IS: 1599
IS: 1786
IS: 1608
IS: 1608
IS: 1608
IS: 1786</td><td>Consignment* below 100 MT</td><td>Consign ment* over 100 MT</td><td>(a) For consignment below 100 MT</td><td>(b) For consign ment over 100 MT</td></tr>
<tr><td>(i) Under 10 mm dia, one sample for each 25MT or part thereof.
(ii) 10mm to 16 mm dia, one sample for each 45MT or part thereof.
(iii) over 16 mm dia, one sample for each 50 MT or part thereof</td><td>(i) Under 10 mm dia, one sample for each 40MT or part thereof.
(ii) 10mm to 16 mm dia, one sample for each 50 MT or part thereof.
(iii) over 16 mm dia, one sample for each 75MT or part thereof.</td><td>(i) under 10 mm dia, one Sample for each 25 MT or part thereof
(ii) 10 mm to 16 mm dia one sample for each 35 MT or part there of
(iii) over 16 mm dia one sample for each 45 MT or part thereof</td><td>(i) Under 10 mm dia, one sample for each 40 MT or part thereof
(ii) 10 mm to 16 mm, one sample for each 45 MT or part thereof
(iii) over 16 mm dia, one sample for each 50 MT or part thereof</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="4">Consignment shall be defined as quantity included in single purchase voucher.</td></tr>
</table>

3. MASONRY WORKS

Sl. No.	Material	Test	Field/ laboratory Test	Test Procedure	Frequency of testing for construction work and EPC Project Work	Frequency of testing for maintenance work
1	2	3	4	5	6	7
(i)	Bricks/ Brick Tiles	Testing of Bricks/Brick Tiles for dimensions Compressive strength, Water absorption and efflorescence	Lab	**IS:3495** Part-1 Part-2 Part-3 **IS:1077**	One test for 50,000 Nos. or part thereof **(Minimum Qty. 2000 nos.).**	As per Table 6.3 and 6.4 (page No. 238) of CPWD Specifications.
(ii)	Sewer Bricks	Dimensions, Compressive strength, Water absorption and Efflorescence	Lab	**IS:6441** (Part-1) (Part-5) **IS:3346** (Part-3) **IS:6441** (Part-3)	One test for 100 cum or part thereof. (**Minimum Qty. 5cum).**	As per Table 6.3 and 6.4 (page No. 238) of CPWD Specifications.
(iii)	Burnt clay perforated building bricks	-do-	Lab		-do-	-do-
(ii)	Fly Ash Lime (FALG) Bricks	(i) Compressive Strength (ii) Water absorption (iii) Efflorescence (iv) Dimensions	Field / Lab Field / Lab Field / Lab Field	**IS:3495** Part-1 Part-2 Part-3 **IS:1077**	One test for 50,000 Nos. or part thereof (Minimum 2000 nos. or less - The test may be carried out as per decision of the Engineer-in-Charge.	As per Table 6.3 and 6.4 (page No. 238) of CPWD Specifications.
(iii)	Burnt Clay, Fly Ash Bricks	(i) Compressive Strength (ii) Water absorption (iii) Efflorescence (iv) Dimensions	Field / Lab Field / Lab Field / Lab Field	**IS:3495** Part-1 Part-2 Part-3 **IS:1077**	One test for 50,000 Nos. or part thereof (Minimum 2000 nos. or less - The test may be carried out as per decision of the Engineer-in-Charge.	As per Table 6.3 and 6.4 (page No. 238) of CPWD Specifications.

(iv)	Burnt clay perforated building bricks	(i) Compressive Strength	Field / Lab	**IS:3495** Part-1	One test for 100 cum or part thereof. (**Minimum Qty. 5cum).**	-do-
		(ii) Water absorption	Field / Lab	Part-2		
		(iii) Efflorescence	Field / Lab	Part-3		
		(iv) Dimensions	Field	**IS:1077**		

4. STONE WORKS

Material	**Test**	**Field / laboratory Test**	**Test Procedure**	**Frequency of testing for construction work and EPC Project Work**	**Frequency of testing for maintenance work**
1	**2**	**3**	**4**	**5**	**6**
Natural building stone	(a) Water absorption	Field / Lab	**IS: 1124**	One test for 200 sqm / 40cum or part thereof or change of source as per direction of Engineer- in-Charge **(Minimum 50sqm. for slabs and 10 cum in stone masonry).**	100 sqm/20 cum or part thereof or change of source as per direction of Engineer- in-Charge **(Minimum 50sqm. for slabs and 10 cum in stone masonry).**
	(b) Transverse strength	Lab	**IS: 1121 Part-2**	-do-	-do-
	(c) Resistance to wear	Lab	**IS: 1706**	-do-	-do-
	(d) Durability	Lab	**IS: 1126**	-do-	-do-

5. CLADDING WORKS

Material	Test	Field/ Laboratory Test	Test Procedure	Frequency of testing for construction work and EPC Project Work	Frequency of testing for maintenance work
1	2	3	4	5	6
Marble	(i) Moisture	Field / Lab	IS: 1124	One test for 500 sqm.or part thereof. (Minimum quantity: 100 sqm)	100 sqm or part thereof. (**Minimum quantity: 100 sqm)**
	(ii) Hardness Test	-do-	Mohs Scale	-do-	-do-
	(iii) Specific Gravity	-do-	IS: 1122	-do-	-do-
Granite	(i) Moisture	-do-	IS: 1124	-do-	-do-
	(ii) Specific Gravity	-do-	IS: 1122	-do-	-do-

6. WOOD AND PVC WORKS

Material	Test		Field/ Laboratory Test	Test Proce-dure	Frequency of testing for construction work and EPC Project Work	Frequency of testing for maintenance work
1	2		3	4	5	6
Timber	Moisture content		Field test (by moisture meter) laboratory test as required by Engineer- in-Charge.	**IS: 1708 Part-1**	One test for one cum or part thereof. (**Minimum quantity for Testing:1 cum)**	Every one cum or part thereof. (**Minimum quantity for Testing:1 cum)**
Flush door	(i)	End immersion test	Field / Lab	**IS: 4020** Part-13	As per sampling and testing specified in clause 9.7.11 (**Minimum quantity for Testing: 26 shutters)**	As per sampling and testing specified in clause 9.7.11 (**Minimum quantity for Testing: 26 shutters)**
	(ii)	Knife test	Field / Lab	Part-14		
	(iii)	Glue adhesion test	Field / Lab	Part-15		
	(iv)	Screw withdrawal resistance test	Field / Lab	Part-16		

Wooden Paneled Door Shutter/ Flush door shutter /Laminated Veneer Lumber (LVL) door shutter/ PVC door shutters/ FRP door shutter	**TYPE TEST (as applicable for a particular type of door as per relevant IS code)** (i) Dimension and Squareness Test (ii) General Flatness Test (iii) Local Planeness Test (iv) Impact Indentation Test (v) Edge Loading Test (vi) Shock Resistance Test (vii) Buckling Test (viii) Slamming Test (ix) Misuse Test (x) Screw Holding Test (xi) End immersion Test (xii) Knife Test Glue Adhesion Test	Lab	**IS:4020** Part-2 Part-3 Part-4 Part-5 Part-7 Part-8 Part-9 Part-10 Part-11 Part-16 Part-13 Part-1 Part-15	Manufacturer type test report for at least 3 nos. door shutters to be obtained from contractor after supply of 5000 nos or part thereof or once in 12 months whichever is earlier. **(Manufacturer Type test Report is not mandatory in case total quantity of shutters to be supplied in the work is less than 50 nos.)**	As prescribed in relevant specification for the door shutters. (**Minimum Quantity:-50 nos**.)
Mortice Locks	Testing of spring	Lab	**IS:2209**	100 or part thereof **Minimum Quantity:- 50 Nos.)**	100 or part thereof (Minimum Quantity:- 50 Nos.)

7. STEEL WORKS

Material	Test	Field/ Laboratory Test	Test Proce-dure	Frequency of testing for construction work and EPC Project Work	Frequency of testing for maintenance work
1	2	3	4	5	6
Steel if arranged by the contractor	(a) Tensile strength (b) Bend test	Lab Lab	**IS: 1608** **IS:1599**	Every 40 MT or part thereof. **(Min. Quantity : 20 MT)**	Every 20 tonne or part thereof **(Min. Quantity : 20 MT)**
Steel tubular pipes	(a) Tensile Test (b) Bend Test (c) Flattening Test	Lab Lab Lab	**IS:1608** **IS:2329** **IS:2328**	Every 15MTor part thereof. **(Min. Quantity: 8 MT)**	Every 8 tonne or part thereof **(Min. Quantity: 8 MT)**

8. FLOORING WORK

Material	Test	Field/ laboratory Test	Test Proce-dure	Frequency of testing for construction work and EPC Project Work	Frequency of testing for maintenance work
1.	2.	3.	4.	5.	6
Terrazzo Tiles	1. Transverse Strength 2. Water Absorption 3. Abrasion test	Lab.	**IS:1237**	One test for every 10,000 Nos. or part thereof for each type and size from a single manufacturer. (One test to be done even if the number of terrazzo tiles of any type and size from a single manufacturer is less than 5000 Nos. provided the total number of terrazzo tiles of all types and sizes from all manufacturers used in work exceed 5000 Nos.)	One test for every 10,000 Nos. or part thereof for each type and size from a single manufacturer. (One test to be done even if the number of terrazzo tiles of any type and size from a single manufacturers is less than 5000 Nos. provided the total number of terrazzo tiles of all

				(**Minimum Qty. 5000 Nos. for all types of sizes from all manufacturers to be used in the work.)**	types and sizes from all manufacturers used in a work exceed 5000 Nos. (**Minimum Qty. 5000 Nos. for all types of sizes from all manufacturers to be used in the work.)**
Pressed ceramic tiles (for floor &wall)	1. Dimensions and surface quality 2. Physical properties 3. Chemical properties	Lab	**IS: 13630** Part-2 Part-3 Mohs scale Part-6 Part-7 Part-8	10,000 Nos. or part thereof (**Minimum Qty. 5000 nos. for each type and size from single manufacturer).**	*3000 Nos. or part thereof.* (**Minimum Qty. 5000 nos. for each type and size from single manufacturer).**

9. ROAD WORK

Material/ works	Test	Field/ Lab Test	Test Procedure	Frequency of Testing for construction/EPC Project/maintenance works
Embankment and Sub-grade under (O.M.C. conditions)	Gradation Test	Field/Lab	**IS 2720** (Part 4)	One test on receipt at site. One to two tests per 3000 cum of soil.
	Plasticity Test e.g. LL, PL,PI	Lab	**IS 2720** (Part 5)	-do-
	Density Test	Field/Lab	**IS 2720** (Part 8)	-do-
	Deleterious content Test	Field	**IS 2720** (Part 27)	As and when required by the Engineer-in-Charge.
	Moisture content Test	Field	**IS 2720** (Part 2)	One test for every 250 cum of soil.
	Compaction Control (Dry Density) Test	Field	**IS2720** (Part 28)	One test for each 1000 sqm of compacted area.
	CBR Test	Field/Lab	**IS 2720** (Part 16)	One test for every 3000 cum or closer as and when required by the Engineer-in-Charge.
Prime Coat / Tack Coat	(a) Quality of Binder	Field/Lab	**IS 1201-1220**	Number of samples per lot and tests as per IS:73, IS:217 and IS:8887 as applicable.
	(i) Ductility Test		**IS 1208**	

	(ii) Softening Point Test		**IS 1205**	Number of samples per lot and tests as per IS : 73, IS : 217 and IS : 887 as applicable
	(iii) Penetration Test		**IS 1203**	
	(iv) Viscosity Test		**IS 1206**	
	(v) Specific gravity Test		**IS 1202**	
	(vi) Float Test		**IS 1210**	
	(vii) Flash and Fire Point Test		**IS 1209**	
	(b) Temperature of the Binder for application	Field		At regular close interval.
	(c) Rate of spread of Binder	Field		Three tests per day.
Seal Coat / Surface Dressing	Quality of Binder - same tests as for Prime Coat / Tack Coat	Field/Lab	**IS:1201-1220**	Same as mentioned for Prime Coat / Tack Coat.
	Aggregate Impact value or Los Angeles Abrasion value	Field/Lab	**IS:2386** (Part IV)	One test per 200 cum of each source and whenever there is change in the quality of aggregates.
	Combined Flakiness Index and Elongation Indices	Field/Lab	**IS:2386** (Part I)	One test per 100 cum of aggregate for each source and whenever there is change in the quality of aggregates.
	Stripping value of aggregates (Immersion Tray Test)	Field/Lab	**IS:6241**	One test of each source and whenever there is change in the quality of aggregates.
	Water absorption of aggregates	Field	**IS:2386** (Part III)	-- do --
	Grading of aggregates	Field	**IS:2386** (Part I)	Two tests per day.
	Soundness test (Magnesium and Sodium Sulphate)	Lab	**IS:2386** (Part V)	One test for each source and whenever there is change in the quality of aggregates.
	Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	Field		At regular close intervals
	Rate of spread of materials	Field		Three tests per day.
	Percentage of fractured faces (When gravel is used)	Field		One test per 100 cum of aggregates.

Bitumen Macadam	Quality of Binder - same tests as for Prime Coat / Tack Coat	Field/Lab	**IS 1201-1220**	Same as mentioned for Prime Coat / Tack Coat
	Aggregate Impact Value or Los Angeles Abrasion Value	Field/Lab	**IS 2386** (Part IV)	Same as mentioned under Seal Coat / Surface Dressing
	Combined Flakiness Index and Elongation Indices	Field/Lab	**IS 2386** (Part I)	One test per 350 cum for each source.
	Stripping value of aggregates	Field/Lab	**IS 6241**	Same as mentioned under Seal Coat / Surface Dressing.
	Water absorption of aggregates	Field	**IS 2386** (Part III)	-do-
	Deleterious materials	Field	**IS:2386** (Part II)	Once in a month.
	Grading of aggregates	Field	**IS 2386** (Part I)	Same as mentioned under Seal Coat / Surface Dressing.
	Soundness test (Magnesium and Sodium Sulphate)	Lab	**IS:2386** (Part V)	-do-
	Binder content	Field/Lab		Two test per day per plant.
	Control of temperature of binder and aggregate for mix and of the mix at the time of laying and rolling	Field		Same as mentioned under Seal Coat / Surface Dressing.
	Density of Compacted layer	Field/Lab	**IS 2720** (Part 28)	One test per 700 sqm area.
	Rate of spread of mixed materials	Field		At regular intervals.
Dense Bituminous Macadam / Bituminous Concrete	Quality of Binder - same test as for Prime Coat / Tack Coat	Field/Lab	**IS 1201-1220**	Number of samples per lot and tests as per IS:73 or IRC:SP:53, IS:15462
	Aggregate Impact value / Los Angeles Abrasion value	Field/Lab	**IS:2386** (Part IV)	One test per 350 cum of aggregate for each source and whenever there is change in the quality of aggregate.
	Combined Flakiness and Elongation Indices	Field/Lab	**IS:2386** (Part I)	One test per 350 cum of aggregates for each source and whenever there is change in the quality of aggregates.
	Soundness test (Sodium or Magnesium Sulphate test)	Lab	**IS:2386** (Part V)	One test for each source and whenever there is change in the quality of aggregate

	Water absorption of aggregates	Field	**IS:2386** (Part III)	One test for each source and whenever there is change in the quality of aggregates.
	Plasticity Index	Lab	**IS:2386** (Part V)	One test for each source and whenever there is change in the quality of aggregate
	Mix grading	Lab		One set for individual constituent and mixed aggregate from dryer for each 400 tonnes of mix subject to minimum of two tests per day per plant
	Stability and voids analysis of mix including theoretical maximum specific of loose mix	Lab		Three tests for stability, flow value, density and void contents for each 400 tonnes of mix subject to minimum of two tests per day per plant.
	Water Sensitivity of mix	Lab	**AASHTO T 283**	One test for each mix type whenever there is change in the quality or source of coarse or fine aggregates.
	Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	Field		At regular intervals.
	Binder content	Field/Lab		One set for each 400 tonnes of mix subject to minimum of two tests per day per plant.
	Rate of spread of mix material	Field		After every 5th truck load.
	Density of compacted layer	Field/Lab	**IS 2720** (Part 28)	One test per 700 sqm area.
Modified Binder	Quality of Modified Binder	Field/Lab	**IS 1201-1220**	Number of samples per lot and tests as per IS:15462
Granular Sub Base (GSB)	Gradation	Field	**IS:2386** (Part I)	One test per 400 cum.
	Atterberg limits	Lab	**IS 2720** (Part 5)	-do-
	Moisture content prior to compaction	Field/Lab	**IS 2720** (Part 28)	-do-
	Water absorption	Field	**IS 2386** (Part III)	As required by the Engineer-in-Charge.
	Density of the compacted layer	Field/Lab	**IS 2720** (Part 28)	One test per 1000 sqm.

	Deleterious constituents	Field	**IS:2386** (Part II)	As required by the Engineer-in-Charge.
	Soundness test (test required if water absorption is greater than 2%)	Lab	**IS:2386** (Part V)	One test for each source and whenever there is change in the quality of aggregates.
	C.B.R	Lab	**IS 2720** (Part 16)	As required by the Engineer-in-Charge.
Water Bound Macadam (WBM)	Aggregate Impact Value	Field/Lab	**IS:2386** (Part IV)	One tests per 1000 cum of aggregates.
	Grading of aggregate	Field	**IS:2386** (Part I)	One test per 250 cum of aggregate.
	Combined Flakiness and Elongation Indices	Field/Lab	**IS:2386**(Part I)	One test per 500 cum of aggregates.
	Atterberg limits of binding material	Lab	**IS:2720** (Part 5)	One test per 50 cum of binding materials.
	Atterberg limits of screenings	Lab	**IS:2720** (Part 5)	One test per 100 cum of aggregates.
	Water absorption of aggregate	Field	**IS:2386** (Part III)	As required by the Engineer-in-Charge subject to a once in a month.
	Deleterious material	Field	**IS:2386** (Part II)	-do-
Wet Mix Macadam (WMM)	Aggregate Impact value or los Angeles Abrasion test	Field/Lab	**IS:2386** (Part IV)	One test per 1000 cum of aggregates.
	Grading of aggregate	Field	**IS:2386** (Part I)	One test per 200 cum of aggregates.
	Combined Flakiness and Elongation Indices	Field/Lab	**IS:2386** (Part I)	One test per 500 cum of aggregates.
	Atterberg limits of portion of aggregate passing 425 micron sieve	Lab	**IS:2720** (Part 5)	One test per 200 cum of aggregates.
	Density of compacted layer	Field/Lab	**IS 2720** (Part 28)	One set of three test per 1000 sqm.
	Water absorption of aggregates	Field	**IS:2386** (Part III)	As required by the Engineer-in-Charge, once in a month
	Soundness test	Lab	**IS:2386** (Part V)	One test for each source and whenever there is change in the quality of aggregates.
	Deleterious material	Field	**IS:2386** (Part II)	As required by the Engineer-in-Charge, once in a month.

Cement concrete pavement under controlled conditions				
(a) Cement Physical and Chemical Tests	Same tests as **SH:** Mortar	Lab /Field	**IS 4031**	Once at beginning for approval of each source and change of source and thereafter one test for 50 MT or part thereof. Each brand of cement brought at site shall be tested as per this frequency. Occasionally when called for in case of long/improper storage. Besides, the Contractor also will submit daily test data on cement released by the manufacturer.
(b) Water (Natural or Treated)	Same tests as **SH:** Mortar	Field /Lab	**IS 3025**	Once at beginning for approval of each source and change of source and thereafter once in every three months till the completion of the work. **Note:-** Water from each source shall be got tested during the dry season before monsoon and again after monsoon
(c) Coarse Aggregates	(i) Combined Flakiness and Elongation Indices	Field/Lab	**IS 2386** (Part I)	(i) Once at beginning for approval of each source and change of source. (ii) One test per 100 cum of aggregates.
	(ii) Los Angeles AbrasionValue or Aggregate Impact Value	Field/Lab	**IS 2386** (Part IV)	-do-
	(iii) Soundness	Lab	**IS 2386** (Part V)	Before approving the aggregates and every month subsequently.
	(iv) Alkali aggregate reactivity	Lab	**IS 2386** (Part VII) **IS 456**	-do-
(d) Coarse and Fine Aggregates	(i) Gradation test	Field	**IS 2386** (Part I)	Once at beginning for approval of each source and change of source. One test for every day's work of each fraction of coarse aggregate and fine aggregate, initially; (may be relaxed later at the discretion of the Engineer-in-Charge).

	(ii)Deleterious material	Field	**IS 2386** (Part II)	-do-
	(iii) Water absorption	Field	**IS 2386** (Part III)	Regularly as required by the Engineer-in-Charge subject to a minimum of one test a day for fine aggregate. This data shall be used for correcting the water demand of the mix on a daily basis.
(e) Concrete	i) Workability of fresh concrete Slump Test	Field	**IS 1199**	One test per each dumper load at both Batching plant site and paving site initially when work starts. Subsequently sampling may be done from alternate dumper.
	ii) Strength of concrete	Field	**IS 516**	2 cubes and 2 beams per 150 cum or part thereof (one for 7 day and other for 28-day strength) or minimum 6 cubes and 6 beams per day's work whichever is more.
	iii) Core strength on hardened concrete	Field/Lab	**IS 516**	As per the requirement of the Engineer-in-Charge, only in case of doubt.
	iv) Thickness determination	Field		From the level data of concrete pavement surface and sub-base at grid points of 5/6.25 m x 3.5 m.
	v) Thickness measurement for trial length	Field		3 cores per trial length.
	vi) Verification of level of string line in the case of slip form paving and steel forms in the case of fixed form paving	Field		String line or steel forms shall be checked for level at an interval of 5.0 m or 6.25 m. The level tolerance allowed shall be $\pm$2 mm. These shall be got approved 1-2 hours before the commencement of the concreting activity.

8.2 Check List for Examination of Building works/Products/ Items

CHECK LIST PROFORMAS

CHECK LIST OF COARSE AGGREGATE

Name of work
Name of Contractor / Agency
Agreement No.
Source
Lot No., Challan No. & Date
Date of Inspection
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1.	Is coarse aggregate received from approved source ?		
2.	Is the coarse aggregate (CA) of hard variety, cubical in shape and not flaky and conforms to the grading requirements of CA for concrete as per IS: 383 ?		
3.	Is the content of deleterious matter like coal & lignite, clay lumps, material finer than 75 micron IS sieve (dust), soft fragments, organic matter etc. Â5% as per IS: 383 ?		
4.	Is the % age water absorption Â2% for the CA for concrete ?		
5.	Has the aggregate been tested from the approved laboratory and conforms to relevant specifications / IS: 383 ?		

Signature of Contractor

Signature of JE/AE/EE

CHECK LIST OF FINE AGGREGATE

Name of work
Name of Contractor/ Agency
Agreement No.
Source
Lot No., Challan No. & Date
Date of Inspection
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1.	Is fine aggregate received from approved source ?		
2.	What is the type of fine aggregate? (i) Crushed stone sand (ii) Natural sand (iii) Crushed gravel sand		
3.	Whether fine aggregates(FA or sand) contains any deleterious material, silt, clay balls or pellets and harmful impurities eg. Iron pyrites, alkalis, salts, coal, mica, vegetable matter etc. which cause corrosion of metal or affect adversely the hardening, the strength and durability of mortar or concrete?		
4.	Has the fine aggregate (sand) been tested from the approved laboratory and does it conform to relevant specifications / IS: 383 ?		
5.	Has bulking of sand/ moisture content of sand been tested? and adjustment done accordingly?		

Signature of Contractor Signature of JE/AE/EE

CHECK LIST OF WATER (NATURAL OR TREATED)

Name of work
Name of Contractor/ Agency
Agreement No.
Lot No., Challan No. & Date
Date of Inspection
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1.	What is the source of supply? (i) Bore well (ii) Supply of local body (iii) Tankers (iv) Treated Water		
2.	Has the water been tested from approved laboratory and does it conform to relevant specifications / IS: 456?		
3.	Whether the water is clean and free from injurious amount of oils, acids, alkalis, salts, sugar, organic materials or other substances that may harm the quality of mortar or concrete?		

Signature of Contractor

Signature of JE/AE/EE

CHECK LIST OF CEMENT

Name of work
Name of Contractor/ Agency
Agreement No.
Source
Cement (OPC / PPC / other)
No. of cement bags in lot
Brand / Make of Cement
Lot No., Challan No. & Date
Date of Inspection
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1.	Whether the cement brought at site is as per contract approved make list and conforming to specifications and special condition of cement supply?		
2.	Whether cement is of required grade and not more than three months old from the date of manufacture? Is it free from lumps?		
3.	Whether the delivery of cement is accompanied by a Manufacturer Test Certificate (MTC) conforming that the supplied cement conform to relevant specifications?		
4.	Whether the supplied cement is stored and properly stacked and protected from damage / atmosphere?		
5.	Whether the date of manufacture & batch no. with month checked on the cement bags / drums and recorded in the cement register?		
6.	Whether the cement is tested and satisfies the test requirements as per contract specifications / relevant IS code of cement?		

Signature of Contractor Signature of JE/AE/EE

CHECK LIST OF REINFORCEMENT

Name of work
Name of Contractor/ Agency
Agreement No.
Source
Brand / Make
Lot No., Challan No. & Date
Dia of Reinforcement Steel (mm)
(i) (v)
(ii) (vi)
(iii)
(iv)
Date of Inspection
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1.	Whether the reinforcement steel brought at site is as per contract approved make list and conforming to specifications and special conditions of steel supply ?		
2.	Whether the delivery of Reinforcement Steel is accompanied by a Manufacturer's Test Certificate (MTC) conforming that the supplied Reinforcement Steel conform to relevant specifications ?		
3.	Whether the reinforcement steel is tested and conforms to the contract specifications / IS: 1786 ?		

Signature of Contractor

Signature of JE/AE/EE

CHECK LIST OF REINFORCEMENT CEMENT CONCRETE (RCC) WORK

(A) FORM WORK (SHUTTERING)

Name of work
Name of Contractor/ Agency
Agreement No.
Structural Drawing No.
Date of Inspection
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1.	Is the shuttering material (steel) as approved?		
2.	Is the thickness of shuttering plates as approved?		
3.	Whether structural drawing correlated with architectural drawing?		
4.	Is pre assembly of shuttering checked and elements of individual shuttering checked before use?		
5.	Is arrangement of the form work as per approved dimension drawings?		
6.	Is the alignment, levels and verticality of the shuttering / form work checked?		
7.	Is shuttering watertight and whether foam rubber sheet seal provided?		
8.	Are shuttering plates surface clean and suitable to give shutter finish of concrete, i.e. free from dents, without any bend, depression, scales or pitting etc.?		
9.	Is the shuttering adequately supported and braced?		
10.	Is the oiling of forms done with approved release (shuttering) oil?		

(B) REINFORCEMENT

Name of work
Name of Contractor/ Agency
Agreement No.
Structural Drawing No.
Shop Drawing No.
Date of Inspection
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1.	Is the drawing in use latest issued, checked and approved for construction purpose?		
2.	Is reinforcement used is as per approved make list of contract agreement?		
3.	Whether architectural and structural drawing correlated?		
4.	Is Bar Bending Schedule (BBS) approved?		
5.	Whether reinforcement is thoroughly cleaned and provided with protective coating of cement slurry?		
6.	Whether reinforcement detailing, there sizes and placement are as per the approved structural drawing and as per approved BBS?		
7.	Whether bar lap length and their location (staggered) correct as per approved structural drawings?		
8.	Are all joints tied properly with binders of 18 SWG GI wire using double knot?		
9.	Is bar assembly rigid and adequately supported (including spacers / chair supports)?		
10.	**Cover to reinforcement**		
10.1	Is the concrete for cover blocks of the same grade as the main concrete?		
10.2	Is the cover to bottom, top & side reinforcement correct?		
10.3	Are the cover blocks of proper size & adequately fixed at proper spacing and tied to reinforcement in sufficient nos.?		

(C) CONCRETE POUR

Name of work
Name of Contractor/ Agency
Agreement No.
Structural Drawing No.
Date of Inspection
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1.	**Reinforcement**		
1.1	Is the reinforcement approved as per checklist as given in (B) i.e. Reinforcement?		
2.	**Form Work**		
2.1	Is the form work approved as per checklist as given in (A) i.e. Form work?		
3.	**Embedded Parts**		
3.1	Are the embedded part provided as per the requirement?		
3.2	Is the alignment and fixing of inserts correct?		
4.	**Pre-Concreting Arrangement**		
4.1	Are construction joints provided as approved?		
4.2	Has the old concrete surface been roughened?		
4.3	Whether materials / ingredients use for concrete tested & conformed to the relevant specifications / IS course as well as approved by the competent authority?		
4.4	Whether batching plant / RMC plant approved? Is batching plant calibration checked?		
4.5	Whether grade of concrete as per approved drawing?		
4.6	Whether design mix approved from the competent authority?		
4.7	Whether sufficient quantity of materials / ingredients and admixture etc. are available at site of work?		

Sl. No.	Description	Yes/No/ NA	Remarks
4.8	Whether adequate number of concrete vibrators in working conditions is available?		
4.9	Has the concreting sequence been approved?		
4.10	Has arrangement for protection from extreme weather during and after concreting been made?		
4.11	Are the platforms and access for materials and labor movement provided?		
4.12	Is adequate illumination arrangement provided?		
4.13	Are safety measures as per safety Assurance Record taken?		
5.	**During Concreting**		
5.1	Whether cement slurry applied on construction joints before pouring of concrete?		
5.2	Whether Concreting to start from farthest point with respect of batching plant /RMC plant is placed in position?		
5.3	Whether plasticizer being used is approved from the Engineer-in-charge?		
5.4	Whether the slump of concrete checked and meets the required range for the nature of work being undertaken		
5.5	Whether Number of cube specimens taken as per contract specifications		
5.6	Is the previously placed layer of concrete green to receive the succeeding layer for amalgamation?		
5.7	Is vibration done to ensure compaction?		
5.8	Is shear key and roughening provided for next day concreting?		

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CHECKLIST FOR POST CONCRETING INSPECTION

Name of work: .....
Name of Contractor/ Agency: .....
Agreement No. .....
Date of Inspection
Drawing No.
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1	Whether shuttering stripped off as per specification, and laitance removed immediately thereafter?		
2	Whether arrangement of curing and date of work done written or marked on concrete work to keep watch on the curing period is maintained as per specifications?		
3	Whether hacking of RCC surface by proper hacking tool for subsequent plastering / finishing is carried out?		
4	**Alignment / Dimensions of the members**		
4.1	Is the alignment correct?		
4.2	Are the dimensions correct as per approved drawings?		
5	**Is any bulging noticed?**		
6	**Appearance of surface**		
6.1	Is there any honeycombing?		
6.2	Are there any bubbles?		
6.3	Are there any cold joints?		
6.4	Is shutter finish obtained?		
6.5	Are there any cracks noticed? If yes, nature of cracks (Depth & Width)?		
7	**Any other defects?**		
8	**Any non -confirmations?**		

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CHECK LIST FOR BRICK WORK

Name of Work
Name of Contractor/Agency
Agreement No.
Drawing No.
Date of Inspection.
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1	Whether material used has been tested and conforms to relevant Specifications?		
	(a) Sand		
	(b) Bricks		
	(c) Water		
2	Are the bricks well burnt without un-burnt portions, of rectangular shape, with sharp edge, free from cracks and of correct size as per relevant specifications? Are they properly stacked?		
3	Do the bricks give clear metallic sound when struck with a hammer or each other? Are they intact and do not break when dropped from a height of about 1 meter?		
4	Whether structural drawings co-related with architectural drawings?		
5	Whether the centre line of brick work checked with reference to grid lines as pre architectural drawings?		
6	Whether bricks soaked in water before being used for sufficient period as per relevant specifications?		
7	Whether all loose materials, dirt and set lumps of mortar which may be laying over the surface on which brick work is to be freshly started, has been removed and surface wetted?		
8	Whether the bricks laid on a full bed of mortar and their joints fully filled and packed with mortar?		

9	Whether queen closers are used at junction of walls?		
10	Whether brickwork is in true plumb and vertical and all layers truly horizontal?		
11	Whether graduated wooden straight edge storey rod being used for keeping height of brick courses uniform?		
12	Are the joints in each layer broken to prevent stress concentration?		
13	Whether wall height being constructed in a day is being restricted to 1 meter height?		
14	Whether parts of wall left at different levels are raked back at an angle of 45 degrees or less with the horizontal? (Toothing is not to be permitted) ?		
15	Whether top courses of all plinths, parapets, steps and top of walls below floor and roof slabs laid with brick on edge? Whether marucona provided at corners in such brickwork?		
16	Whether thickness of joints in brickwork is kept 10 mm as per relevant specifications?		
17	Whether mortar used as per specified proportion and within maximum permissible water cement ratio is used?		
18	Whether face of brick work raked according to finishing to be done i.e. plaster or pointing is as per relevant specifications.		
19	Whether arrangement of curing and curing period maintained as per specification?		
20	Whether date of work done written/marked on bricks work to keep watch on the curing period?		

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CHECK LIST FOR PLASTERING WORK

Name of Work
Name of Contractor/Agency
Agreement No.
Drawing No.
Date of Inspection.
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1	Whether material used i.e. sand and water has been tested and conform to relevant Specifications?		
2	Whether bricks / blocks masonry and concrete surface are found clean, free from dust, loose materials, oil, grease, mortar dropping, nails, steel patti, wooden pieces, wire etc. and efflorescence?		
3	Whether all conduiting and electrical piping done?		
4	Whether all doors, windows frame are fixed in plumb?		
5	Whether all defects of brickwork/CC/RCC rectified?		
6	Whether preparation of surface done?		
7	Whether joints in bricks/blocks masonry are raked to a depth of 10 mm?		
8	Whether surface to be plastered is made sufficiently damp?		
9	Whether unavoidable projections in masonry and concrete are chiseled?		
10	Whether hacking on concrete surface is sufficient deep and distance between hacking is not more than 25-40 mm?		
11	Any leakages observed before plastering? If Yes, whether leakages have been rectified?		
12	Whether 15 cm x 15 cm bunda at every 2 meter horizontally and vertically being provided to serve as gauges?		
13	Whether verticality and evenness of the surface checked?		

Sl. No.	Description	Yes/No/ NA	Remarks
14	Whether uniform groove provided at junctions of all plaster and ceiling plaster?		
15	Whether mortar of approved mix within maximum permissible water cement ratio is used?		
16	Whether arrangement of curing and curing period maintained as per specifications?		
17	Whether date of work done written / marked on plaster work surface to keep watch on the curing period?		

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CHECK LIST FOR WATER SUPPLY LINES

Name of Work
Name of Contractor/Agency
Agreement No.
Drawing No.
Date of Inspection.
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1	Whether material used have been tested and conform to relevant Specifications?		
2	Whether plumber employed is licensed plumber or not?		
3	Whether plan for piping system has been prepared and got approved?		
4	Whether all pipes and fittings are of approved make and as per approved make list of relevant agreement item?		
5	Whether a sample system has been prepared according to approved drawing and got approved?		
6	Whether clamps provided at specified spacing?		
7	Whether pipe lines checked at required pressure before covering?		
8	Whether weight of flushing pipe checked?		
9	Whether fittings like wash basin, sink, cistern, bib cock, stop cock, wheel valves, PVC storage tank etc. are of approved make and as per approved make list of relevant agreement. ?		

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CHECK LIST FOR TILE FLOORING AND DADO

Name of Work
Name of Contractor/Agency
Agreement No.
Drawing No.
Date of Inspection.
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1	Whether layout of floor checked and proper slopes for draining water are maintained specially in bathroom, toilet and verandah?		
2	Whether the tiles brought at site are as per contract approved make list and conforming to specifications and special condition of tiles supply?		
3	Whether tiles brought at site of required sizes as per Contract Agreement / Architectural drawings?		
4	Whether the tiles are tested and satisfy the test requirements as per contract specifications / relevant IS code of tiles?		
5	Whether tile flooring work is being carried out as per architectural drawing?		
6	Whether dado provided as per required height as per architectural drawing?		
7	Whether arrangement of curing and curing period maintained as per specifications?		

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CHECK LIST FOR WATER PROOFING WORK

Name of Work
Name of Contractor/Agency
Agreement No.
Drawing No.
Date of Inspection.
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1	Whether before taking up the water proofing treatment on roof slab, the construction of parapet walls including finishing completed or not?		
2	Whether all the ancillary items like haunches, khurras, fixing of all down take pipes, water pipes and electric conduits etc. completed or not ?		
3	Whether surface preparations for water proofing has been carried out?		
4	Whether all surface cracks and undulation on the surface has been filled before water proofing is commenced.		
5	Whether specialized agency has been engaged by the agency for waterproofing work?		
6	Whether the specified water proofing material brought at site as per contract approved make list?		
7	Whether water proofing material tested and satisfies the test requirements as per contract specifications / relevant code?		
8	Whether water proofing work is carried out as per specifications by the specialized agency?		

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CHECK LIST OF R.C.C WORKS IN FOUNDATION

Name of work: .....
Name of Contractor/ Agency: .....
Agreement No. .....
Date of Inspection
Drawing No.
Location

(A) PRE - CONCRETING

Sl. No.	Description	Yes/No/ NA	Remarks
1.	Material used for concreting whether tested and conforms to contract specifications?		
	(a) Fine aggregate (sand)		
	(b) Coarse aggregate		
	(c) Water (Natural or Treated)		
	(d) Reinforcement Steel		
	(e) Admixture, if any		
2	Raft top level, whether provided as per details?		
3	Whether architectural / structural drawing correlated?		
4	Whether location of construction joint has been discussed with Engineer-in-charge and approved by him?		
5	Whether cleaning over water proofing surface and construction joint done?		
6	**Form Work**		
6.1	Is the shuttering material (steel) as approved?		
6.2	Is pre-assembly of shuttering checked and elements of individual shuttering checked before use?		
6.3	Are the alignment, level and verticality of the shuttering checked?		

Sl. No.	Description	Yes/No/ NA	Remarks
6.4	Is the shuttering water tight and whether foam rubber sheet seal provided?		
6.5	Are shuttering plates surface cleaned and suitable to give shutter finish of concrete, i.e. free from dents scales or pitting, without any band, depression etc. ?		
6.6	Is the shuttering adequately supported and braced?		
6.7	Is the oiling of form done with approved release (shuttering) oil?		
7	**Reinforcement**		
7.1	Are the structural drawings in use latest issued for construction purpose?		
7.2	Is reinforcement material used as per approved make list of contract agreement?		
7.3	Is Bar Bending Schedule (BBS) approved?		
7.4	Has corrosion treatment of bars been carried out in case of scaling of bars?		
7.5	Whether reinforcement detailing, their sizes and placement are as per the latest approved structural drawing and as per approved BBS?		
7.6	Whether bar lap lengths and their location (Staggered) correct as per the approved structural drawing?		
7.7	Whether all bar joints tied properly with proper gauge binding wire (18 SWG GI Wire) is used and with full cross binding and tightening of reinforcement bars with stirrups?		
7.8	Is bar assembly rigid and adequately supported (including spacers / chair supports)?		
7.9	Are the concrete cover blocks of proper size & adequately fixed at proper spacing and tied to reinforcement in sufficient numbers as well as of same grade as the main concrete?		
7.10	Is the cover to bottom, top and side reinforcement, correct?		
7.11	Whether layout of columns as per relevant structural drawing checked?		

Sl. No.	Description	Yes/No/ NA	Remarks
8	**Pre- Concreting Arrangement**		
8.1	Is batching plant / RMC plant approved and its calibration checked?		
8.2	Has the concreting sequence been approved?		
8.3	Has arrangement for protection from extreme weather during and after concreting been made?		
8.4	Whether grade of concrete is as per approved drawing?		
8.5	Whether concrete of approved design mix with maximum permissible water cement ratio is used?		
8.6	Whether sufficient quantities of materials / ingredients and admixture etc. are available?		
8.7	Is adequate illumination arrangements provided?		
8.8	Are safety measures as per safety Assurance Record / Plan taken?		
8.9	Whether adequate number of concrete vibrators in working condition available		
9	**During Concreting**		
9.1	Whether cement slurry applied on construction joint before pouring of concrete?		
9.2	Whether concreting to start from farthest point to nearest point with respect of batching plant / RMC plant & properly placed in position?		
9.3	Whether plasticizer being used and is approved from the engineer-in-charge?		
9.4	Whether slump of concrete checked and meet the required range for the nature of work being undertaken?		
9.5	Whether numbers of cube specimens taken as per contract specifications?		
9.6	Is the previously placed layer of concrete green to receive the succeeding layer for amalgamation?		

Sl. No.	Description	Yes/No/ NA	Remarks
9.7	Is vibration done to ensure compaction?		
9.8	Is shear key and roughening provided for next concrete?		

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CHECK LIST FOR RCC IN COLUMNS/BEAMS/SLABS

Name of work: .....
Name of Contractor/ Agency: .....
Agreement No. .....
Date of Inspection
Drawing No.
Location

Sl. No.	Description	Yes/No/ NA	Remarks
1	Material used for concrete whether tested and conforms to contract specifications?		
	(a) Fine aggregate(Sand)		
	(b) Coarse aggregate		
	(c) Water (Natural or Treated)		
	(d) Reinforcement Steel		
	(e) Admixture, if any		
2	Whether the centre line of column/beams checked with reference to grid lines as pre architectural drawings?		
3	Whether location of construction joints has been discussed with Engineer-in-Charge and approved by him?		
4	Whether treatment of expansion joint, wherever required, is done?		
5	**Form work**		
5.1	Whether cleaning, repairing and approval of shuttering plate, application of quality shuttering oil is done ?		
5.2	Is the shuttering material (steel) as approved ?		
5.3	Is the shuttering water tight and whether foam rubber sheet seal provided ?		
5.4	Is the alignment, level and verticality of the shuttering checked ?		
5.5	Are shuttering plates surface clean and suitable to give shutter finish of concrete, i.e. free from dents scales or pitting , without any bend depression etc. ?		

Sl. No.	Description	Yes/No/ NA	Remarks
5.6	Is the shuttering adequately supported and braced?		
5.7	Is the oiling of form done with approved release (shuttering) oil?		
6	**Reinforcements**		
6.1	Are the structural drawings in use latest issued for construction purpose?		
6.2	Is reinforcement material used as per approved make list of contract agreement?		
6.3	Is Bar Bending Schedule (BBS) approved ?		
6.4	Has corrosion treatment of bars carried out in case of scaling of bars?		
6.5	Whether reinforcement detailing , their sizes and placement are as per the latest approved structural drawing and as per approved BBS ?		
6.6	Are bar lap lengths and their location (staggered) correct as per the approved structural drawing?		
6.7	Whether all bar joints tied properly with proper gauge binding wire (18 SWG GI Wire) is used and with full cross binding and tightening of reinforcement bars with stirrups ?		
6.8	Is bar assembly rigid and adequately supported (including spacers / chair supports)?		
6.9	Are the concrete cover blocks of proper size & adequately fixed at proper spacing and tied to reinforcement in sufficient numbers as well as of same grade as the main concrete?		
6.10	Whether required minimum cover to bottom, top and sides of reinforcement is maintained?		
7	**Pre Concreting Arrangement**		
7.1	Whether conduits for various electrical / mechanical / fire fighting / other service have been seen and approved by the Engineer-in-Charge?		
7.2	Whether grade of concrete as per approved drawing?		

Sl. No.	Description	Yes/No/ NA	Remarks
7.3	Whether concrete of approved design mix within maximum permissible water-cement ratio is used?		
7.4	Whether sufficient quantities of materials / ingredients and admixture etc. are available?		
7.5	Is batching plant / RMC plant approved and its calibration checked?		
7.6	Has the concreting sequence been approved?		
7.7	Has arrangement for protection from extreme weather during and after concreting been made?		
7.8	Is adequate illumination arrangements provided?		
7.9	Are safety measures as per safety Assurance Record / Plan taken?		
7.10	Whether adequate number of concrete vibrators in working condition available		
8	**During Concreting**		
8.1	Whether cement slurry applied on construction joint before pouring of concrete?		
8.2	Whether concreting to start from farthest point to nearest point with respect of batching plant / RMC plant & properly placed in position?		
8.3	Whether plasticizer being used and approved from the engineer-in-charge?		
8.4	Whether slump of concrete checked and meet the required range for the nature of work being undertaken?		
8.5	Whether the numbers of cube specimens taken are as per contract specifications?		
8.6	Whether compaction with vibrator is done ?		
8.7	Whether the concreting has been done in a lift not exceeding 1.5 m ?		
8.8	Is shear key and roughening provided for next day concreting?		

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8.3 Dos and Don't For Items of Construction works

(Instructions prescribed in this section may be modified as per the provisions contained in the contract specifications)

DO'S & DON'TS IN BUILDING CONSTRUCTION WORKS (CIVIL)

SUB HEAD	DO'S	DON'TS
1.0	**FOUNDATION AND EARTHWORK**	
1.1	Have a permanent Bench mark at site w.r.t. G.T.S.	
1.2	Record Initial Ground levels w.r.t. G.T.S.	
1.3	Level plan to be acknowledged by contractor and Engineer-in-Charge.	Do not test check levels jointly.
1.4	Stack of excavated earth minimum 1.0 m or ½ of depth of foundation, away from trench whichever is more.	
1.5	Before actual execution, make trial pits to ensure that roughly soil condition compares with soil investigation report.	
1.6	Check water table & compare with soil investigation report and in case of difference, take advice of Structural Engineer / Consultant.	
1.7.	Transfer level to trench bottom.	
1.8	Walk through trench before laying lean concrete to detect weak pockets.	
1.9	Do not change depth of excavation as shown in approved drawings on your own. In case of abnormal situation, refer to Structural Engineer / Consultant.	
1.10	Decide soil classification before measurement.	Do not allow contractor to take away ordinary rock from site of his own. Do not resort to blasting inhabited area. Do not do blasting without adequate permission.
1.11	Do prepare lead chart for borrowing/disposal of earth.	Do not forget to take levels of place where earth is disposed.
1.12	Payment for disposed earth to be made with levels only restricted to lower of the quantity as assessed from excavation and from place where earth is disposed.	Do not forget to deduct voids before making payment for supply of earth. Do not make payment for earth work by truck load measurements.

SUB HEAD	DO'S	DON'TS
1.13	Keep minimum depth of excavation from Ground level as per approved structural drawings.	
1.14	Filling inside and outside to be done simultaneously.	Do not fill plinth till outside filled up to finish ground level approximately.
1.15	Fill loose pocket/extra excavation done by mistake with lean concrete only.	
1.16	Do full course anti termite treatment, wherever applicable	Do not do part operation.
1.17	For deep excavation cutting slopes/benching to be got approved from Engineer-in-Charge.	
1.18	Record water table before dewatering and get acknowledgment from the contractor.	
1.19	For earth filling in pond, adopt only stack measurement with 20% void deduction.	
1.20	Maintain account of receipt and issue of the materials like hard rock.	
1.21	To ensure refilling of earth in layers, mark layers depth on foundation wall and ensure filling for full block up to one level. Mark first and then for 2nd, 3rd and so on after previous layer is properly watered and compacted.	Do not exceed earth filling layers from 200 mm in depth. Do not keep flooring over soft rock filling/or organic material, building rubbish filling.
1.22	In sloping ground, keep horizontal distance between two footings equal to twice the level difference.	
1.23	Test for quality of water available for building construction and curing. Take appropriate steps to make water fit for construction. Plan an industrial R.O. if needed.	
1.24	Check load bearing capacity of soil before planning for foundation of the building.	
	PILE FOUNDATION	
1.25	For pile work, do all work with reduced levels w.r.t. cut off level.	
1.26	Pile registers to give details of size, bulb, length, water table, mix, slump, actual cement consumption for each pile.	
1.27	In case of controlled concrete, get the mix design done from reputed approved lab.	Do not change pile length at site due to filling; Approved structural drawing must indicate final length below cut off level.

SUB HEAD	DO'S	DON'TS
1.28	Remove top loose concrete; Anchor 50 mm in the cap/grade beam.	
1.29	Take one cube set as per prescribed frequency of testing	
1.30	Have proper control on slump.	
1.31	Must use Tremie, if concreting done under sub-soil water.	
	RCC STRIP FOUNDATION	
1.32	Take care of proper cover and side shuttering.	
1.33	Wherever filling is to be done, the earth from excavation shall be directly used for filling and no payment for double handling of earth shall be admissible.	
2.0	**CONCRETE WORK**	
2.1	Stack OPC/PPC cement separately and maintain separate accounts.	
2.2	Check quality and grading of coarse aggregates after blending aggregates of different gauges in proper proportion.	
2.3	Check silt content and grading zone for fine aggregates (sand).	
2.4	Screen the sand for earth lump.	
2.5	Use only hopper mixture for proper mixing of concrete.	Do not use lean concrete with brick ballast in depressed portion of floors of upper floors.
2.6	Use only Standard measuring boxes of size 40 x 35 x 25 cm in case of volumetric mixing.	
2.7	Keep mixing time 1 ½ to 2 minutes	
2.8	Have container for measuring water.	
2.9	Flooring or masonry on concrete must be started only after 48 hours.	
2.10	Repair honey combing immediately when the concrete is green.	Do not use extra mortar on concrete surface.
2.11	Use rammer of proper weight (5 Kg.) for compaction of lean concrete.	

SUB HEAD	DO'S	DON'TS
3.0	**FORM WORK (Centering & Shuttering)**	
3.1	Check verticality of form work; form work must be so constructed as to be removable in sections in the desired sequence without damaging the surface of concrete or disturbing other sections, care shall be taken to see that no piece is keyed into the concrete.	
3.2	Check location of steel and cover for columns. Use 40 x 40 mm cover blocks of same mortar mix as concrete.	
3.3	Check Props spacing for 1.2 meter maximum.	Do not use inclined props.
3.4	Check form work for rigidity by providing/ using adequate number of ties and braces, screw jacks or hard board wedges where required to control false work settlement.	
3.5	Shuttering must be of sufficient stiffness to avoid excessive deflection and joints shall be tightly butted to avoid of leakage of slurry.	
3.6	The completed form work must be inspected and approved before reinforcement bars are placed.	Do not allow casting of floor slab without approval of Formwork. Form work and concreting of upper floor not to be done until concrete of lower floor has set for 14 days.
3.7	Brick pillars for supporting props to be in mud mortar.	Do not support props over dry brick pillar.
3.8	In case the height of centering exceeds 3.50 m, the props may be provided in multistage. Use double wedges below props.	
3.9	Double height centering/shuttering to be approved by Engineer-in-Charge.	
3.10	Check level of shuttering with leveling instrument. Poor lines & level of shuttering is bound to spoil RCC.	Do not cut bearing plaster to accommodate shuttering plate. The bearing plaster has to be in cement mortar 1:3, cured for 3 days and has to have thick coat of lime wash over neat cement punning. Do not remove shuttering before 7 days if slab span is up to 4.5 m and before 14 days if more than 4.5 m. In case of vertical form work of columns, walls and beams do not remove shuttering before 16-24 hours.

SUB HEAD	DO'S	DON'TS
3.11	Suitable camber must be provided in horizontal members of structure, especially in cantilever spans to counter the effect of deflection. Camber for beam and slab shall be 4mm per meter. (1 to 250).	
3.12	Ensure, drawing indicates depression for sunken portion.	Do not forget to provide level difference for depressed RCC portion.
3.13	For beam, support side shuttering on bottom place.	Do not remove shuttering before 14 days if span is up to 6m and after 21 days if span is up to 9m. Do not remove shuttering for cantilever before counter weight is there. (stripping time for OPC only)
3.14	Provide additional stripping time for shuttering if PPC Cement is used. The props must be provided immediately after stripping each shuttering panel and not after stripping all the panels.	
3.15	Steel shuttering must also be properly repaired before use and properly cleaned to avoid stains, honey combing, seepage of slurry through joints etc.	Do not use undulated/ damaged plates.
3.16	Support lower floor before concreting done on upper floor.	
3.17	For beams & cantilever, support lowers two floors.	
3.18	Check and then apply proper shuttering oil after cleaning the shuttering plate for each use.	
3.19	Take extra care for shutter finish shuttering in respect of water tightness, surface pattern and stiffness.	
4.0	**STEEL REINFORCEMENT**	
4.1	Ensure structural drawing approved as "Good for Construction" (GFC) and signed by competent authority.	Do not forget to provide proper chair especially for cantilever.
4.2	Check reinforcement bars as per approved structural drawing. The bars crossing one another must be tied together at every intersection with two strands of annealed steel wires 0.9 to 1.6 mm thick to twisted tight to make the skeleton of the steel work rigid so that the reinforcement does not set displaced during deposition of concrete.	Do not forget to check continuity of reinforcement at L&T sections as well as over opening for lintel bands.

<table>
<tr><th>SUB HEAD</th><th>DO'S</th><th>DON'TS</th></tr>
<tr><td>4.3</td><td>Use spacers where more than one-layer bars or where reinforcement is congested.</td><td>Do not leave reinforcement short of support.</td></tr>
<tr><td>4.4</td><td>The overlaps /splices must be staggered.</td><td>Do not forget to leave dowels for railing in balcony and waist slab/landing.</td></tr>
<tr><td>4.5</td><td>Place precast cover blocks of proper size to kept bars in correct position as well as of proper thickness of specified cover.</td><td>Do not provide stirrups/ rings of improper size reducing cover.</td></tr>
<tr><td>4.6.</td><td>Record measurements in MB before allowing concreting.</td><td></td></tr>
<tr><td>4.7</td><td>Check lap length which is different for different mix. The overlapping bars must not touch each other and these shall be kept apart with concrete between them by 25 mm or 1¼ times the maximum size of coarse aggregate, whichever is greater.</td><td>Do not forget to check that all column reinforcement bars are projecting at different level as required.</td></tr>
<tr><td>4.8</td><td>Bars to be cleaned of rust before putting in position.</td><td>No bar to be used if section reduced due to rust.</td></tr>
<tr><td>5.0</td><td>REINFORCED CEMENT CONCRETE (R.C.C)</td><td></td></tr>
<tr><td>5.1</td><td>For Materials- Refer to subhead "Concrete".</td><td>Do not use fine aggregate Grading Zone IV in RCC unless test has been made to ascertain the suitability of proposed mix proportions.
Do not use old cement.</td></tr>
<tr><td>5.2</td><td>Ensure (Latest) GFC structural drawing is available signed by competent authority and numbered.</td><td></td></tr>
<tr><td>5.3</td><td>Considering weather and nature of work, use minimum water.</td><td></td></tr>
<tr><td>5.4</td><td>Concrete to be properly vibrated.</td><td></td></tr>
<tr><td>5.5</td><td>Use slump:
<table>
<tr><td>(i)</td><td>Lightly reinforced sections in slabs, beams, walls, columns, hand placed pavements, strip footings</td><td>25 to 75 mm</td></tr>
<tr><td>(ii)</td><td>Heavily reinforced sections in slabs, beams, walls, columns</td><td>50 to 100 mm</td></tr>
<tr><td>(iii)</td><td>Slipform work:- Pumped concrete</td><td>75 to 100mm</td></tr>
<tr><td>(iv)</td><td>Trench fill; In-situ piling</td><td>100 to 150 mm</td></tr>
</table></td><td></td></tr>
</table>

SUB HEAD	DO'S	DON'TS
5.6	To have control on cement / water ratio, identity one person of the contractor to control mix permanently during concreting.	
5.7	Use water with pH value 6 to 8. In case of excessive alkalinity compare 28 days strength on cubes cast with distilled water & those cast with water used in the work and difference not to be more than 10%.	Do not use water having chloride and sulphates. Do not add acid to neutralize alkalinity of water for use in RCC work.
5.8.	To avoid labor movement directly over reinforcement, provide Chalies supported over angle iron chairs.	
5.9	Ensure depth of concrete with depth gauge.	
5.10	The progress of concreting in the vertical direction must be restricted to one metre per hour.	Do not allow vertical drop of concrete is more than 1.5 metre at a time in case of columns and walls.
5.11	Leave holes for services before casting of R.C.C. to avoid cutting of reinforcement and R.C.C.	Do not cast column up to beam level. Leave it 450 mm below soffit of beam and cast with the beam only.
5.12	Provide construction joint as per Contract Specifications & concreting must be carried out continuously up to construction joints.	Do not forget to ensure trowel finishing of RCC slab on top before the concrete begins to set.
5.13	Ensure compaction of concrete must be completed before the initial setting start i.e. 30 minutes.	Do not allow shaking of reinforcement for the purpose of compaction.
5.14	Put date of casting to ensure that the curing is started within 24 hours after casting of the slab and surface is kept wet at least 7/10 days.	Do not provide box type fan clamp for roof slab. Use M.S. fan hook and not Tor Steel hook.
5.15	Repair honey-combing immediately after removal of form Work.	
5.16	Ensure hacking (depth 3mm) immediately after removal of form work.	
5.17	Ensure after 24 hours of laying of concrete, the surface shall be cured by ponding with water for a minimum period of 7 days from the date of placing concrete in case OPC cement and at least 10 days where mineral admixtures or blended cements are used.	Do not forget that the period of curing not be less than 10 days for concrete exposed to dry and hot weather condition.
5.18	Ensure number of CC cubes are taken as required with reference to quantity of R.C.C. done.	28 days test to be got done from the same Lab where 7 days test got done.
5.19	Cubes must bear name of work, mix, date, work location and signature of the Engineer taking the cube sample.	

SUB HEAD	DO'S	DON'TS
5.20	Check bearing of lintels at ends.	Do not provide bearing of lintels less than 150 mm.
5.21	If sulphate is there in sub-soil water and earth, take specific design from Structural Engineer/ Consultant for the foundation.	
5.22	For precast members do mark top and bottom surface.	
5.23	For RMC, register should be maintained along with batch wise computerized voucher till finalization of the work.	
6.0	**BRICK WORK**	
6.1	Check, mandatory tests like compressive strength, water absorption, dimension and efflorescence done for bricks.	
6.2	Ensure mortar for brick work must be as specified and conform to accepted standards.	Do not forget lime shall not be used where reinforcement is provided in brick masonry work.
6.3	Ensure brick masonry wall must be taken up truly in plumb or true to required batter where specified as well as all courses must be laid truly horizontal and all vertical joints must be truly vertical.	Do not allow out of plumb Brick if more than 6mm in 3.0 meter height.
6.4	Do not forget bricks must be laid in English bond unless otherwise specified and brick work in half brick wall bricks must be laid in stretcher bond.	
6.5	Ensure bricks must be soaked in water before use for a period the water penetrates full thickness of brick.	Do not forget the bricks required for masonry work using mud mortar shall not be soaked.
6.6	Do check use of queen closer at junction of walls.	Do not allow toothing. Ensure brick work in full block at cut off levels like sill level and lintel level before further brick work is allowed. If necessary, provide stitching blocks at junctions at cut off levels during construction itself.
6.7	Check in brick masonry wall, the vertical joints in the alternate courses shall come directly one over the other and whether Queen Closer used near the ends of the wall to break the vertical joints in brick masonry of two consecutive courses and to complete the bond also.	Do not leave vertical construction joint. Always rake back at an angle of 45degree or less with the horizontal to have bond with subsequent brick work.

SUB HEAD	DO'S	DON'TS
6.8	Check the size of opening for doors and windows is not excessive.	Do not fill excessive gap around door/ window openings with cement mortar. Use micro concrete.
6.9	Put date on day masonry work done, to ensure the required curing period i.e. 7 days.	
6.10	Ensure that no part of the wall is raised more than one metre above the general construction level in a day.	
6.11	Do have brick on edge in top courses of all plinth, parapets, steps and top of wall below floor and roof slabs with Marucona.	Do not make cost adjustment of Marucona. Alternatively provide Cement Concrete blocks of mix 1:2:4 (1 cement: 2 coarse sand:4 graded stone aggregate 20mm nominal size).
6.12	Ensure that the half brick partitions must be keyed into main walls, indents must be left in the main walls.	
6.13	Fill vertical joints with trowel.	Do not believe in grouting of vertical joints.
6.14	Use bed block under beams.	
6.15	Check mortar strength and filling of joints by scratching with sharp instrument like screw driver. Top of the brickwork in coping & sill in external walls must be slightly tilted.	Do not allow mortar mixing without mechanical mixer and platform. Do not use tokries for measurement.
6.16	Ensure that drip course/ throating must be provided where brick coping and sills are projecting beyond the face of the wall	Do not forget to get joints raked for 10 mm depth for subsequently plastering and 15 mm depth in case of pointing to be done on both sides, when mortar is green.
6.17	Check specially cupboard openings for trueness at right angles.	
6.18	At the end of day check that frog in brick work in top layer are not filled with mortar.	Do not use fallen mortar for joint filling. Take it to mixer & use after mixing adequate quantity of cement. For balcony railing in half brick wall do not forget to provide vertical RCC posts with horizontal RCC band.
6.19	Check bearing plaster done or not, before centering & shuttering is started.	

SUB HEAD	DO'S	DON'TS
6.20	Height of brick masonry in foundation must be measured 150 mm for two bricks height and difference, if any; w.r.t. approved structural drawing must be accounted for in 230 mm brick wall (Top courses).	As far as possible do not cut horizontal chases in half brick thick wall to provide services
6.21	Check provision of expansion joint before start of brick work.	Do not provide expansion joint from lean concrete level. It is required from ground level.
6.22	Allow filling of scaffolding holes with properly soaked bricks buttered with mortar on all four faces only.	Do not leave scaffolding holes in stretcher courses. Keep their numbers minimum.
6.23	Ensure that when horizontal chases are unavoidable, no horizontal chase shall exceed one metre in length.	Do not allow vertical chases closer than two metre in any stretch of wall and kept away from bearing of beams and lintels.
6.24	Ensure that in half brick non load bearing wall services should be planned with the help of vertical chases.	Do not allow cutting of chases in half brick load bearing wall.
6.25	Boundary wall without plinth beams must be measured in foundation up to 1.20 m height above ground level.	
7.0	**STONE MASONARY WORK**	
7.1	Wet stone before use.	
7.2	Mark bond stone for identification.	Do not forget to provide bond stone whether it is R.R. masonry or Course Rubble Masonry.
7.3	Overlap bond stone by 150 mm if wall thickness is more than 600 mm and bond stone of full length is not available.	
7.4	Ensure proper curing of masonry for 7 days.	Do not forget to put date on Stone Masonry work done during the day.
7.5	Fill scaffolding holes with Cement Concrete 1:3:6.	
7.6	All joints must be checked and filled with flowing cement mortar before laying next layer of stone masonry work.	
7.7	Surface of stones must be cleaned when mortar is green both after masonry work and pointing work.	
7.8	Ensure overlapping of stones for breaking joints.	Do not raked joints, if pointing is not to be done and finish joints flush.

SUB HEAD	DO'S	DON'TS
7.9	Stone shall be laid on their natural bed and shall be solidly bedded full in mortar with close joints.	Do not allow use of more than 20% Stone Chipping.
7.10	Size of stone used must be with length not less than 3 times heights and breadth on base must not be more than 3/4th of wall thickness or less than 150 mm.	Do not allow use with bushing more than 40 mm.
7.11	Pointing must be along the mortar joint and not over the stone.	
8.0	**WOOD WORK**	
8.1	Check wood for sap, moisture content and excessive knots/ size of knots/quality of knots.	
8.2	Check joinery with reference to approved drawing for dimensions and joints.	Do not accept readymade shutters from other than approved make/ firm.
8.3	In toilet and bath, provide only one tower bolt at mid height of door on inside surface.	Do not provide tower bolt inside of kitchen door.
8.4	For aluminum fittings use C.P. brass screws and check fittings for anodizing.	Do not hammer the screws.
8.5	Check size of wire and mesh number for wire mesh shutters. It is galvanized 85G and of dia 0.56 mm as per contract.	
8.6.	Wire mesh to be folded under beading.	
8.7	Use only ISI marked door hinges.	
8.8	Mortice and tendon joints in wood work must fit in fully and accurately.	Do not allow painting on wood work till it is approved by the competent authority.
8.9	Tenon must pass at least three-fourth of the style.	Do not allow wedging or filling in joints.
8.10	Ensure that the joints are glued and put together and pinned with hard wood or bamboo pin.	Do not use nail for joints.
8.11	Members of doors and window shutters must be straight without any warp.	Do not allow use of unseasoned timber.
	FLUSH DOOR SHUTTERS	
8.12	Accept only approved make shutters.	Do not forget to take purchase vouchers (challans).
8.13	Collect samples for testing from the lots as per IS : 2202	
8.14	Hidden side of wooden door and window chawkhats should be painted with bitumen coating as specified, before use in building work during construction.	
8.15	Primer should be applied on all edges of doors before fixing.	

SUB HEAD	DO'S	DON'TS
9.0	**STEEL WORK**	
9.1	Prepare drawing for openings in brick work for doors/windows.	Do not fill excessive gap with mortar. Use micro concrete.
9.2	Ensure welding for full contact length	Do not forget to get grinded all excess welds including sharp edges projections of welding. Do not ignore line and levels of grill members.
9.3	Use of approved primer on steel work (red oxide zinc chromate).	Do not apply primer on rusted surface without cleaning.
9.4	Doors/Windows along column to be fixed with raw plugs.	Do not cut column/RCC member to accommodate hold fast
9.5	Check fixing of window/s/doors at top and bottom as required under specifications.	
9.6	Use only ISI marked sections for window and doors frames.	
9.7	Do check that doors and windows fabrication is at true right angles	Do not break tie bars of door frames to accommodate level.
9.8	Provide thickness of glass panes depending upon size of opening	
9.9	Ensure welding of hinges for full length unless specified otherwise.	
9.10	Ensure grill welding for full contact length	
9.11	Make payment for M.S. grill for lesser of the weights i.e. theoretical and actual.	
9.12	For running meter items of stair case/balcony railings do compare it with approved drawing/ nomenclature meticulously.	Do not use item of window grill for payment to Railing.
9.13	Ensure brass striking lock plate in window sections.	
9.14	Check for window shutters, if provided with projecting hinges or not. The hinge pin must be of galvanized steel	Do not accept work at reduced rates if hinge pin is not electro galvanized.
9.15	Check sizes and thickness of hold fast and their number required as per specifications.	
9.16	Check length, weight of stays and handles.	
9.17	Check all door and windows for proper closing and locking.	Do not assume that putty is substitute for fixing clips. Both are must.
9.18	Railing height of staircase must be one meter uniformly.	

SUB HEAD	DO'S	DON'TS
9.19	Ensure that steel sections sash bars are connected properly to the styles by making a slot and thereafter welding.	
	PRESSED STEEL DOOR FRAME	
9.20	Check thickness and quality of MS sheet conforming to IS 226.	Do not forget to provide base tie. Do not forget to check frame for trueness of right angles by diagonal measurements.
9.21	Ensure that mortar guards, lock strike plate and shock absorber are provided as per contract specification.	Do not make extra payment for mortar guards, lock strike place, shock absorber.
9.22	Ensure that surface is thoroughly cleaned before applying primer.	Do not forget concreting in frames in yards itself before fixing but after priming on all faces i/c internal face.
9.23	Check the filling of frames with concrete by tamping.	
	ROLLING SHTUTTERS	
9.24	Check the dimension of all components of rolling shutter conforming to ISI 6341.	Do not forget to ensure primer application before fixing of shutters
9.25	Check the quality of spring tested for tensile strength	Do not forget to check shutters for smooth closing/opening
9.26	Check the quality and make of Ball bearing	
	DOOR / WINDOW FITTINGS	
9.27	Use only ISI marked fittings.	
9.28	Ensure that all carbon has been removed and grinding has been done on welded portion before priming is done.	
9.29	Priming should be ensured before use of T-iron door and window frame in building work.	
9.30	Holes should be provided in side of steel window panels for fixing clips.	
9.31	Fixing clips should be checked before applying glass putty on glass panes for security.	
9.32	Lubrication must be provided in side channels and springs of rolling shutters for smooth working.	
10.0	**FLOORING**	
10.1	Check compaction of sub grade, sand filling and lean concrete.	Don't forget to depress plinth masonry off set so as to allow the base concrete to rest on it.

SUB HEAD	DO'S	DON'TS
10.2	Check slope and levels of sub grade of wet areas, balcony, verandah and courtyard to achieve tuck of 15mm after final finish. Slope ranging from 1:48 to 1:60 depending upon location and floor in water closet portion must have slope of 1:30 or as decided by Engineer-in-Charge.	Do not forget to provide necessary drop in flooring in bath, WC, kitchen near floor traps ranging from 6 mm to 10mm.
10.3	Provide vertical D.P.C. for excessive drops in floor finish.	Do not provide ground Floor flooring higher than D.P.C. level.
10.4	Check level of glass strips for proper floor levels and flooring must be commenced preferably within 48 hours of the base concrete.	Do not provide cross at junction of glass strips. Provide T junctions.
10.5	Before laying cement concrete flooring the base must be wetted and coat of cement slurry @ 2 kg per sqm spread on it to get a good bond between base and concrete floor after roughened the base concrete with wire brushes without disturbing the concrete.	Never put mortar to cover honey combing and to absorb excess moisture
10.6	Ensure curing for 10 days by ponding and curing should not be commenced until the top layer has hardened.	Do not start flooring till all traps are plugged.
10.7	Cement concrete flooring to be laid in alternate panel, if separating strips not allowed.	Do not exceed size of panel more than 2.0 sqm. And no dimension of panel should exceed 2.0 metre.
10.8	If CC flooring to be laid directly on the RCC slab spread cement slurry @ 2 kg per sqm on the RCC slab after cleaning the surface properly.	Do not forget to clean R.C.C. surface with wire brushes of all loose mortar/ dropping etc. Keep water cement ratio minimum to avoid shrinkage cracks and keep surface wet for 10 days minimum.
	TERRAZZO FLOORING	
10.9	Check for laying under layer i.e. cement concrete for specified mix & thickness.	
10.10	Under layer must be allowed to harden and roughened with wire brushes.	Do not delay lying of topping beyond 24 hrs after laying under layer.
10.11	Ensure that the proportion of the marble chips to binder mixes as specified. Wash marble chips before use.	Do not use marble chips of size more than 75% thickness of terrazzo topping.
10.12	Ensure mix of cement and marble powder in proportion of 3:1(3 part of cement to 1 part of marble powder) by weight.	
10.13	Flooring in WC and bathroom must be laid after fixing of water closest, squatting pans and floor traps.	

SUB HEAD	DO'S	DON'TS
10.14	Use minimum water for topping mix. For smooth surface have better tapping than adding more water	Do not exceed size of panel more than 2.0 sqm area or 2 metre in length for inside situations. In exposed situations, the length of any side of the panel should not be more than 1.25 metre. Do not use glass and metallic strips in areas exposed to sun.
10.15	Cement to be used for terrazzo flooring must be stacked separately for having uniform colour.	Do not cast part flooring of any room on a day to avoid colour change in flooring.
10.16	Ensure first grinding & polishing of floors with machine fitted with special rapid cutting grit blocks (Carborandum stone) of coarse grade (no. 60) till the marble chips are evenly exposed and the floor is smooth. Grinding & polishing of floors shall be commenced not before 7 days.	Don't keep the traps open; plug them while grinding is in progress and open the traps after the floor is cured and cleaned.
10.17	Start second grinding after curing of 4 days; with Carborandum stone no.120; cure again for 3 to 5 days after repairing.	Do not forget to do hand grinding of skirting just after 24 hours of laying. So put dates.
10.18	Do final grinding with No.320 Carborandum stone, and finally use oxalic acid @ 33 gm/ m2 diluted with water and rubbed hard with Nemdah blocks (pad of wooden rags).	Do not use more than 6mm terrazzo topping where hand grinding is to be done.
	TERRAZZO SKIRTING	
10.19	Ensure that skirting and dado properly finished with smooth surface and thickness of top coat shall not be less than the thickness specified.	Do not forget rounding of junction of floor and skirting.
10.20	The under layer must be made rough with a scratching tool to form a key for terrazzo layer which must be applied after 24 hours of first layer.	
	TERRAZZO TILE FLOORING	
10.21	Terrazzo tiles shall conform to IS: 1237 and its wearing layer must be free from projections, depressions, cracks, holes, cavities and other blemishes.	Do not forget to get tiles tested for water absorption, transverse strength and abrasion test.
10.22	Tiles fixed in floor adjoining the wall must enter 12 mm under the plaster, skirting or dado.	Do not break tiles, get them cut (sawn) from full tiles to the required size and their edges rubbed smooth to ensure a straight and true joints.

SUB HEAD	DO'S	DON'TS
10.23	Do clear joints of excess mortar/slurry after tiles are fixed	Do not keep thick joints. Keep it minimum but not more than 1.0 mm. Do not forget to lay honey like consistency cement slurry@ 4.4 kg per sqm over base mortar for fixing of Terrazzo tile and tamping it with wooden mallet.
	VETRIFIED CERAMIC/ PRESS CERAMIC TILE FLOORING	
10.24	Check quality of tile as per IS:15622 and thickness of tile as specified by the manufacturer as well as of approved make.	
10.25	Check that the tiles must be flat & true to shape and free from blisters, crazing, chips, welts, crawling or other imperfections.	Do not forget to soak tiles in water before use.
10.26	Ensure that the base concrete or the RCC slab on which tiles are to be laid must be cleaned, wetted and mopped.	
10.27	Check the bedding cement mortar mix and its thickness as specified.	Do not forget to spread neat cement slurry of honey like consistency over the tile bedding mortar & 3.3 kg per sqm.
10.28	Ensure that the joints thickness in flooring must not be more than 1mm.	Do not forget to keep joints as thin as possible and in straight line or to suit the required pattern.
10.29	Ensure that where full size tiles cannot be fixed, these must be cut (sawn) to the required size.	Do not forget to rub smooth the edges of tiles to ensure straight and true joints.
10.30	Ensure that the tiles which are fixed in the floor adjoining the wall must enter not less than 10mm under the plaster, skirting or dado.	Do not forget to clean surplus cement slurry after tiles have been laid.
10.31	Ensure the floor must be kept wet for 7 days.	Do not forget to check the finish floor, it should not be sound hollow when tapped with a wooden mallet.
	PRESSED CERAMIC (VETRIFIED)/ PRESSED CERAMIC GLAZED TILES IN SKIRTING AND DADO	
10.32	Check quality as per IS 15622 and thickness of tiles as specified by the manufacturer and of approved make.	
10.33	Ensure that joints of masonry wall are raked to a depth of 15mm while masonry is being laid. In case of concrete wall the surface shall be roughened with wire brushes.	

SUB HEAD	DO'S	DON'TS
10.34	Ensure that the surface on which the tiles to be fixed is thoroughly cleaned and washed with water and must be kept wet before commencing of skirting/ dado work.	Do not forget tiles must be soaked in water before use.
10.35	Provide under layer cement mortar plaster as specified which shall be roughened with wire brushes.	Time lag between under layer and tile laying must not be more than 24 hours.
10.36	Soak the tiles in water/ washed cleaned and coat of cement slurry applied liberally at the back of tiles and set in bedding mortar at the time of fixing.	Do not forget to use tiles with chamfered edges at all projecting concerns.
10.37	The tiles must be set in the required pattern. Top of skirting or dado must be truly horizontal and joined truly vertical except where otherwise indicated.	Don't provided thick joints. These should be as fine as possible.
10.38	Skirting and dodo shall rest on top of flooring.	Do not forget to machine cut (saw) tiles to the required size and their edges rubbed smooth.
10.39	Fill the joints with white cement with pigment as required.	Ensure that skirting / dado must not project from the finished "surface of wall" by more than the tile thickness.
10.40	Check if tiles fixed are in one plane or not ?	Don't forget to check the tiles for hollow sounding by tapping with wooden mallet.
	KOTA STONE FLOORING	
10.41	The thickness of stone shall be as specified	Don't accept stonewith tolerance beyond ± 2mm in thickness and ± 5mm (for hand cut) slabs and ± 2mm (for machine cut) slabs in respect of length and breadth.
10.42	Stones of varying thickness must not be put together	
10.43	Ensure chiseling is done in brick wall so the part of stone skirting is embedded under wall plaster.	
	RED SAND STONE FLOORING	
10.44	Thickness of slabs shall be as specified.	Don't accept stone with tolerance beyond ±2% in thickness.
10.45	Check quality and classification as per relevant Specifications.	Do not confuse Raj Nagar Stone with Makrana stone.

SUB HEAD	DO'S	DON'TS
	MARBLE STONE SLAB FLOORING	
10.46	Check quality and thickness of marble stone slab as specified. Tolerance of ± 3% may be allowed for the thickness and in respect of length & breadth of slab a tolerance of ± 2% may be allowed.	Do not forget to get the marble stone tested for moisture absorption, hardness and specific gravity.
10.47	Ensure that the marble stone slab should be uniform in color and free from stains, cracks, decay and weathering.	Do not forget to check that the top surface must be fine chisel dressed to remove all waviness.
10.48	Check all angles and edges of the marble slabs must be true, square and free from chippings as well as the surface must be true and plane.	
10.49	Ensure that the base concrete or the RCC slab on which the marble slabs are to be laid must be cleaned, wetted & mopped and bedding mortar mix must be as specified.	Do not forget to spread cement slurry of honey like consistency @ 4.4 kg per sqm on the base mortar over which the marble slabs flooring to be laid.
10.50	Ensure that the joints thickness must not be more than 1 mm and the surface of the flooring as laid must be true to levels and slope as instructed by the Engineer-in-Charge.	Do not forget to check the finished flooring. It should not sounding hollow.
10.51	Ensure that the flooring must be cured for a minimum period of 7 days.	
11.00	**ROOFING**	
11.1	Prepare mud phaska slope plan approved by Engineer-in-Charge (slope allowed 1:48).	Do not use soil having excessive clay or sand, stone, kanker, vegetable matter and other foreign matter.
11.2	After proper painting of roof with bitumen laid 400 micron PVC sheet of size1m x 1m (alternatively aluminum foil of 32 SWG) under the khurra and then cement concrete shall be laid over it to average thickness of 50mm with its top surface lower than the level of adjoining roof surface by not less than 50mm.	Do not raise parapet before laying khurra concrete. Do not accept P.V.C. sheet of lesser thickness. Do not accept 2 or 3 numbers of thinner P.V.C. sheet.
11.3	Provide Cement Concrete flooring under water tanks.	
11.4	Tile Must overlap khurra concrete coping over parapet. Keep coping sloping towards roof.	
11.5	Provide Cement Concrete coping over parapet. Keep coping sloping towards roof.	Do not provide thick mortar over cement concrete coping.
11.6	Check Rain Water Pipe (RWP) out let mouth level w.r.t. to khurra level.	

SUB HEAD	DO'S	DON'TS
11.7.	Keep brick tile joints thickness 6 mm to 12 mm. Thinner joints and wider joints both are unacceptable.	Avoid use of broken tiles and do not forget to mix 2% of integral water proofing compound in cement mortar used for grouting the brick tiles joints.
11.8	The brick tiles/Mud phuska must go right up to parapet wall and gola must come over that.	Do not forget to provide chopped straw (bhusa) @ 35 kg per m^3 of soil in mud plaster.
11.9	Provide mud phuska and gola in area around water tanks before casting tank beams/slab.	
11.10	Do rendering of tank supporting beams at bottom.	In case of precast beams do not forget to mark top and bottom of beam.
11.11	CI Rain water pipe shoe must not be left much above the pavement level. It must just touch it.	Do not render RCC water tank.
11.12	Check dimensions i.e. Dia, thickness ad weight of CI Rain water pipe should be as specified in contract specification and conformed to IS 1230.	
11.13	Plaster gola simultaneously with parapet plaster.	Do not forget to cut chase of proper size for gola. Do not forget to provide expansion joints in gola and parapet coping and is filling with bitumen filler.
11.14	Check hardness of brick tile grouted joints with screw driver	Do not forget to cure brick tile floor by frequent sprinkling of water for a minimum period of 7 days.
11.15	Check that all the brick tiles are fully clear of dead mortar etc.	
11.16	Priming and painting may be done before fixing corrugated sheet in steel truss & frames structures.	Do not put nuts and bolts in the valley portion of corrugated sheets.
12.0	**FINISHING WORKS**	
	PLASTERING	
12.1	Prepare the surface by brushing with wire brush to remove all dead and loose mortar after cutting superfluous projections. Remove all efflorescence by dry brushing and scrapping or proper treatment.	Do not plaster till all conduiting and electrical piping is done. Do not allow for plastering till all doors, windows R.C.C. jali ventilators are fixed
12.2	Do profuse watering of the surface after it is ensured that all defects of brick work and cement concrete/R.C.C. have been properly rectified	Do not forget that Pre-curing is as important as post curing

SUB HEAD	DO'S	DON'TS
12.3	Check line and levels of plaster. The plaster shall be finished to a true and plumb surface and to the degree of smoothness as required.	
12.4	Put (15cm x 15cm) bunda at every 2.0m (horizontally and vertically)over the entire surface to serve as gauges to ensure even thickness and a true surface	
12.5	Start with ceiling plaster first and shall be finished to chamfered edge at an angle at its junctions when plaster is being done.	Do not do ceiling plaster till next floors slab is cast.
12.6	Provide uniform groove at junctions of wall plaster and ceiling plaster.	Do not do ceiling of top roof till terracing is completed.
12.7.	Avoid excessive trowelling. Separate wall plaster from ceiling plaster by a thin straight groove not deeper than 6mm while the plaster is green.	Do not leave jambs, soffits for plaster, later on. These have to be plastered along with wall for curing and strength.
12.8.	At the end of days' work leave plaster on the body of wall and not on comers	
12.9	To avoid leakages do not leave horizontal joint on parapet wall tops	Do not leave plaster in patches. It creates weak spots/ shabby appearance
12.10	Provide and fix 150mm wide chicken wire mesh to prevent surface cracks and plastering of wall and beam/column carried out in one vertical plane or provide groove where R.C.C. column /wall about the Brick work.	
12.11	Use 2.5 m long aluminium straightedge and plumb bob to check verticality and evenness of surface frequently.	Do not forget to check soffit level of various doors and windows opening in a room These must be at same level.
12.12.	Put date of plastering to ensure 7 days curing	Do not forget to start curing just after 24 hours of hardening of plaster surface.
12.13	Check openings specially cupboards for finishing at right angles.	Do not allow plaster to get dry during curing period.
12.14	For R.C.C. Projections provide molding /drip.	Do not accept work with groove. Drip is must
12.15.	For rough cast plaster, the under layer must be kept rough for bonding and kept wet before top layer is applied	Do not give a gap of more than two days between under layer and top layer
12.16.	Sample of rough cast plaster must be approved by competent authority before further work is taken up	

SUB HEAD	DO'S	DON'TS
12.17	While doing external plaster ensure that upper and lower plaster at D.P.C. level is separated.	Do not plaster D.P.C. let it remain in groove or projected
12.18	Plaster below D.P.C. to be in cement mortar 1:4 (1 cement: 4 coarse sand).	Do not forget to take plaster 5cm. below plinth protection
12.19	Any plaster more than 15mm thick to be done in two layers	
12.20	When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When plastering the edge of the old work shall be scrapped cleaned and wetted with cement slurry before plaster is applied to the adjacent areas.	
	WHITEWASHING	
12.21	For white washing with lime, use 40 gm of gum dissolved in hot water for 10cudm'of the cream and Indigo(Neel) up to 3 gm per Kg. of lime dissolved in water. Approximately quantity of water to be added in making the cream will be 5 liter of water to one kg of lime.	Do not forget to screen the lime before use.
12.22	One coat means brush applied from top down wards, bottom up wards left to right and right to left.	Do not apply second coat till first coat is dry.
	CEMENT PAINT	
12.23	Use only ISI marked cement paint.	
12.24	Wet the surface after cleaning of any algae formation, grease, other foreign matters and loose mortar drippings dust etc.	
12.25	Mixing of cement paint to be done in two stages. First mix two parts of cement paint and one part of water.	Do not add water to cement paint but add cement paint to water
12.26	Stir thoroughly and allow to stand for 5 minutes. In 2nd stage add one part water & stir thoroughly to obtain the mix 1:1 (1 Cement paint: 1 Water).	Do not use mix after one hour of mixing.
12.27	Water the surface at the end of days work	Do not apply 2nd coat within 48 hours of 1st coat. Do not wet the previous surface for 2nd coat / 3rd coat.
12.28	Keep painted surface wet for 2-3 days. (1st coat only).	Do not forget to keep account of cement paint.
12.29	Ensure application of paint on surfaces which are normally off the view like soffits, behind SCI/GI/RWP etc.	Do not forget to clean glass panes on external faces of all paint drippings side by side otherwise jhulla/scaffolding will be needed again for that.

SUB HEAD	DO'S	DON'TS
12.30	All drips must be painted as per the colour scheme for vertical surface.	Do not agree for use for colour shades which are not in standard shade cards to avoid maintenance problems.
	PAINTS	
12.31	Before application of primer see that surface is properly prepared. Check that all holes, cracks or other defects are properly filled and smoothened. All dust, scales, oil grease, moisture and loose particle must be removed and surface cleaned before application of primer.	
12.32	Use only first quality paint as per approved brand and agreement item.	Do not forget to keep account of primer and paint, Do not remove empties from site without permission of Engineer-in-Charges. Do not forget that for steel work, zinc chromate red oxide primer is specified. Do not add thinner till prescribed by manufacturer.
12.33	Check application of each coat for uniformity of thickness.	No hair marks form brush or clogging of paints, puddles in corner of panels, angles of molding etc. must be left.
12.34	The painted surface must be free from paint drips, waves and must be uniform in colour, texture and finish.	Do not paint on humid or on rainy days or when it is too cold.
12.35	Check application of paint on places that are difficult to reach such as edges, corners, crevices, welds, bolts and nuts, top and bottom edges of shutters.	
12.36	Clean all fitting/glass panes of paint marks	
12.37	Primer and painting should be done before fixing glass panes in steel windows and final coat of paint should be applied after hardening of glass putty.	
12.38	Paint should be of approved make and checked by the competent authority and container should be serially numbered and signed by competent authority.	
12.39	Empty initialed containers should be received back daily.	
	STONE VENEERING (CLADDING)	
12.40	Check quality of stone. It should be free from cracks/decay, weathering defects etc.	

SUB HEAD	DO'S	DON'TS
12.41	Dressing of stone on exposed surface only. Stones shall be gang saw cut into slabs of required thickness.	Do not forget permissible tolerance is only ± 2mm in thickness.
12.42	Use cramps and pins as specified.	Do not use cramps and pins of metal prone to corrosion
12.43	Every stone must be cut to the required size shape and chisel dressed.	Do not forget wetting stones before lying in position.
12.44	Provide uniform staggered joints. Provide horizontal angle iron support at soffit of all openings and at interval of maximum 3.5m vertical. Backing of stone shall be carried out simultaneously with face work.	
	MISCELLANEOUS	
12.45	Ensure that the expansion joints are clean and free from malba /dead mortar.	
12.46	Expansion joint should be covered at top with precast cement concrete slab, freely kept	Do not forget to cover expansion joint with rope while executing brick work on expansion joint.
12.47	Vertical faces expansion joint should be covered with one end fixed screws and other end with oval shape cut fitted with screws. Screws should be staggered.	
12.48	To have control, sample of expansion joint must be got approved from competent authority before execution.	
13.0	**SANITARY WORK:**	
13.1	Get drawing for plumbing system approved from competent authority and keep a copy at site.	
13.2	Plaster shaft surfaces before starting plumbing work in shafts.	Do not forget to plan drainage arrangement for shaft. Storm water must not go in G.T. or manhole provided for sewerage
13.3	All sanitary and plumbing work must be carried out through licensed plumber.	
13.4	Use only ISI mark SCI pipes & fittings and must confirm to relevant IS code i.e. IS 3989	Do not use SCI pipes of dia less than 75 mm
13.5	Check weight and thickness of SCI pipe and compare with contract Specifications.	

SUB HEAD	DO'S	DON'TS
13.6	Depressions in W.C. and bath/ kitchen must be 500 and 300 mm respectively. All RCC work around depressed portion must be with RCC 1:1½:3. Depressions for EWC be kept 300 mm.	Treatment of depressed portion must be in two operations i.e. Ist for horizontal surface before piping and 2nd for vertical surface after piping and repairs of openings
13.7	Get pig lead tested from each lot for purity before use.	Do not use excess of yarn in joints to avoid use of lead in quantity.
13.8	Prefer single stack system for economy	Do not allow covering of joint under floors without smoke test
13.9	Ensure that access doors are so located that they can be easily opened and closed.	Do not forget to check quantity of lead used w.r.t. theoretical requirement daily.
13.10	SCI floor trap and Nahani trap must be of self-cleaning type and must have minimum 50mm water seal.	
13.11	Keep slope of 1 in 50 for "horizontal SCI pipes."	Top of floor trap must not be more than 10 mm below finished floor level.
13.12	The fittings shall be as close as possible to the vertical stack.	
13.13	Avoid collar joints under floors.	Do not use floor traps with water seal less than required even at reduced rate.
13.14	Fix levels and positions of floor traps/P traps by laying false pipe line first.	Do not forget to check that W.C. seat mouth has properly gone into P trap mouth and keep record also.
13.15	For vertical stacks prefer Y junctions to T or L junctions.	Do not fix holder bat clamps with brick bats/mortar.
13.16	For European seat socket of SCI bend Must be above final finished floor level by about 40 mm.	
13.17	Use S.W. pipes of ISI marked only.	Connecting SCI piece from trap to external shaft bed should be single one piece and at least 10mm outside the wall plaster.
13.18	Check weight of G.T. cover and frame.	Do not forget that cover and frame to have specified weight separately.
13.19	Check weight of manhole cover and frame.	
13.20	Provide access door fitting before connecting to main stack to facilitate cleaning	Do not forget to provide rubber insertion in access door.
13.21	All fittings, M.S. stays and clamps must be got painted before fixing in position.	Do not forget to check height of stay and its fixing in concrete block.

SUB HEAD	DO'S	DON'TS
13.22	The complete stack must be tested by smoke test and record to be kept.	
13.23	Overflow spout pipes must be provided at floor level of sunken portion under WC's for safe guard of RCC slab.	
14.0	**WATER SUPPLY LINES**	
14.1	All water supply line works must be carried out by a licensed plumber.	All water supply line works must be carried out by a licensed plumber.
14.2	Prepare plan for G.I. piping system and get it approved.	Do not forget to keep level of taps in W.C., bath and kitchen at specified height.
14.3	Check the dimensions and weight of pipes and sockets as well as their tolerances as per contract. Use only approved make fittings.	
14.4	Maintain line and levels for exposed G.I. pipe line work and also keep the pipes about 15mm clear of the wall.	Do not forget to paint fittings when used in painted lines. Do not cut horizontal chases in brick work to accommodate G.I. pipe lines at one level for more than 600 mm. No chase allowed in half brick work.
14.5	Provide clamps at spacing 2.5 m for vertical and at 2 m for horizontal for 15 mm dia G.I. piping on walls. For 20 mm dia G.I. pipes the spacing of clamps shall be 3 m and 2.5 m respectively.	Do not forget to fix clamps near the fittings as well as provide unions in pipe line to facilitate connections, addition and alteration in future.
14.6	Check the lines under required pressure before covering	Do not forget to maintain record of testing.
14.7	Avoid joints in under floor piping	
14.8	Check provision of G.I. nipples at the time of casting RCC storage tanks.	Do not keep tanks empty. Do not accept repaired water tanks. Do not render water tank.
14.9	Check size of brackets for washbasin, sink, and flushing Cistern.	Over flow of water directly at roof top should not be allowed at any cost.
14.10	Use only 1SI marked wash basin, sink, pan, cistern, bib cocks, stop cocks, wheel valves etc.	
14.11	Check lead connections pipes, PVC connections pipes for size and quality.	
14.12	Check weight and dimensions of Polyethylene water storage tanks conforming to IS 12701	
14.13	The overflow pipes of overhead tanks should be laid up to khurras and spouts at roof.	

SUB HEAD	DO'S	DON'TS
14.14	Water supply line should first fed into overhead water storage tanks for firefighting and then water should fill overhead tanks for water supply to building. So that firefighting overhead tank water is always circulated.	
14.15	Separate overhead tanks should be provided for kitchen and bathrooms.	
15.0	**EXTERNAL WATER SUPPLY WORK**	
15.1	Check if the WS scheme is approved by local body.	
15.2	Do keep a plan showing location of pipe to be laid w.r.t. its depth & distance from permanent feature.	Do not forget to cut sufficient offset in excavation to receive the sockets.
15.3	Check license of plumber.	
15.4	Check if suitable cushion available or not, (60 cm on road berms & 120 cm on road).	Do not pass Water supply line through drain or sewage manhole with joints in sewer storm water line.
15.5	Check if suitable distance available between water supply & sewer storm water lines.	For economy do not use CI pipe more than 450 mm dia, use Pre-Stress Concrete (PSC) pipes.
15.6	Use only ISI marked pipes and fittings.	Do not forget to keep record of weight and dimensions of fitting.
15.7	Take initial ground levels for execution control. Check pipes and fittings physically for visible defects, if any.	
15.8	Keep lead joints daily consumption record.	Do not forget to soak spun yarn in bitumen before use.
15.9	Check quality of lead as per IS: 782 for each lot.	Do not forget to make comparison with daily theoretical requirement.
15.10	Check depth of lead joint with Kenda (Gauge).	
15.11	Fittings/specials must be provided simultaneously with laying of pipes.	Do not forget to lay concrete below Sluice Valve/ Fire Hydrant (SV/FH) before their fixing.
15.12	Pipes to be laid in continuation, not in patch laying.	
15.13	Water supply pipes should not be just slided in trench but should be lifted and lowered.	Do not forget to keep socket against direction of flow (water enters pipe through socketed end and goes through spigot end).
15.14	For PSC pipes use hydraulic jack for pushing pipes into socket with good quality rubber rings.	Do not forget to test quality of rubber rings.

SUB HEAD	DO'S	DON'TS
15.15	Provided thrust blocks at bends.	Do not forget to close open end of pipe at the end of days work.
15.16	Take precautions as per Contract Specification and local body norms when pipes are laid below roads /culverts.	Do not forget to level the base when water supply line is laid in rocky strata.
15.17	Do check pipe lines under required pressure after back fill and leaving joints exposed.	Do not forget that pipe line has to be laid true to line.
15.18	Do provide scour valve for scouring of pipe where needed.	Do not forget to disinfect the line before actual supply of water for drinking.
15.19	For water supply line to be laid under foul conditions follow special precautions as per contract specifications and municipal norms.	
15.20	Change in dia of pipe must be gradual and not abrupt.	
15.21	To avoid accidents due to collapse of excavated tranches follow precautions as per Specifications.	
15.22	For underground tanks provide fittings along with casting of R.C.C.	Do not forget to clean underground tank from time to time.
15.23	Provide air valve at highest point when there is change in gradient.	
15.24	The ferrules must be tapped on top side of main water supply line with clamps.	
15.25	Gate valve and non-return valve should be provided in the ferrule pit itself.	
16.0	**SEWERAGE WORK:**	
16.1	Check if scheme approved by local body.	Do not forget to get the excavation plan approved from competent authority.
16.2	Check soil mechanics of the soil for deep sewers to decide mode of excavation.	Do not forget to excavate offsets to receive the sockets.
16.3	Use only ISI marked RCC pipes.	
16.4	Provide barricading during carrying out sewerage work to avoid accidents.	Do not forget to take up the work from downstream end.
16.5	Use S & S type RCC pipes only for sewerage system and ensure all pipes must be true to shape, straight, perfectly sound and free from cracks and flaws.	
16.6	Check all levels w.r.t. G.T.S. only.	

SUB HEAD	DO'S	DON'TS
16.7	Ensure all Precast cement concrete pipes (with or without reinforcement) conform and having marking as per IS-458.	
16.8	Construct masonry pillars away from the edge of excavation and parallel to the alignment as intervals of manholes with I.L. marked on their top.	
16.9	Ensure that the excavated earth is dumped away from the edge of the excavation (minimum half of the depth away from the edge).	
16.10	Ensure that record of sub-soil water levels is maintained for the purpose of making additional payments for executing work under water, it should be duly signed by the contractor.	
16.11	For bigger PCC pipes not bearing ISI marked, ensure tests as per IS-458.	
16.12	Decide use of Non-Pressure (NP-2/ NP-3) RCC pipes as per loading conditions and conform to IS-458. The pipes must be with reinforcement as required and must be of class not lesser than NP-2.	Do not provide concrete encasement. Provide concrete cradle as per local body norms.
16.13	Ensure that construction of manhole is taken up simultaneously with the laying of RCC pipes.	Do not forget to fix foot rests along with brick work of manhole and embedded in cement concrete block and painted.
16.14	Ensure that the pipe is provided up to full thickness of manhole wall.	Do not leave pipe projecting in the man hole.
16.15	Provide stone soling under bed concrete in poor soil conditions.	
16.16	Ensure that the distance between the supports in no case exceed the length of the pipe to retain the pipe line in the alignment.	Do not forget the pipe must be supported as far as possible close to the joints and no case the joints come in the center of the span.
16.17		Do not forget that before deciding size of manholes local Municipal bylaws must be consulted.
16.18	Test SFRC over to conform to IS- 12592 Part-1.	
16.19	Provide drop connection as per specification where the drop is more than 60 cm.	
16.20	Start back filling of the trenches as per contract specification, after inspection and approval by the competent authority.	

SUB HEAD	DO'S	DON'TS
16.21	Ensure testing of joints.	
16.22	Manholes of sewer line should be checked for joint fittings of bricks and rich plaster near a building.	Don't lay sewer lines close to the buildings.
16.23	Maintain record for disposal, of surplus excavated earth at specific disposal point (Lead chart and computation of quantities be done through levels).	Do not make payment of disposal of earth on truck basis. It has to be based on levels taken at the point of excavation and disposal, whichever is less.
17.0	**STORM WATER DRAIN:**	
17.1	Check if the scheme is approved from the local body.	
17.2	Check all levels w.r.t. G.T.S. only.	
17.3	Construct masonry pillars at an internal of 30 m or as required as per site condition with I.L. marked (written) on top parallel to the drain away from the edge of the excavation.	Do not make any change at site from approved plan.
17.4	Take necessary precautions if PNG Gas line, electric cables, water supply line, and sewer line passing through the drain.	
17.5	Ensure barricading during storm water drain construction to avoid accidents.	
17.6	Check that the section of drain wall & culvert as approved by the Engineer-in-Charge	Don't forget to start the work from downstream end.
17.7	Provide staggered weep holes in drain walls as per design.	
17.8	Provide expansion joint in RCC & brick work as per design.	
17.9	Ensure RCC slab is supported on minimum 34.5 cm brick wall.	Do not forget to render bottom of RCC slab.
17.10	Ensure brick on edge for top course of single brick wall.	
17.11	Provide footrest and manhole covers in covered drain as per local body norms.	
17.12	For storm water pipe drain work follow contract specification.	Don't forget to get the design of chamber approved by competent authority and local body. Don't forget that the minimum dia of R.C.C. pipe or S.W. drain is 300 mm or prescribed in local body norms.
17.13	Edges of concrete flooring should be rounded off with wall.	

SUB HEAD	DO'S	DON'TS
17.14	Provide bearing plaster where ever RCC slab is to be cast for covering of drain.	
17.15	Put separate item for flooring and not as "Concrete in foundation".	
18.0	**ROADS**	
18.1	**EMBANKMENT & SUB-GRADE**	
18.1.1	Record Initial G.L. with respect to G.T.S. and also duly test checked.	Do not forget to transfer B.M. with respect to G.T.S. at work site.
18.1.2	Get the Longitudinal Section/Cross Section of proposed road approved by Engineer-in-Charge.	
18.1.3	In case of road in embankment, fix pegs at 15-meter intervals to indicate the limits of side slope.	Where road is in cutting. Do not forget to construct side drain simultaneously.
18.1.4	Fill the earth in 20 cm. layers and consolidate with roller as per item.	Do not forget to compact each layers by rolling with 8 to 10 tonnes power road roller and a sheep foot roller if required. The required amount of water must be added during consolidation to keep the moisture content of the soil at the optimum level.
18.1.5	Ensure that material used for filling is earth, moorum and gravel or a mixture of these.	Avoid expansive clay in filling.
18.1.6	Soil shall have dry lab density under OMC not less than 1.44 gm/CC for embankment upto 3-meter ht. and 1.52 gm/cc for more than 3-meter height or as per approved specifications	
18.1.7	In case of earth-work under OMC condition, the density to be achieved must not be less than density to be achieved should not be less than 95% of the density obtained in the laboratory (Proctor method).	Do not forget to test and accept each compacted layer for field density with record location wise before the operations for next layers.
18.1.8	Ensure measurement of density for each compacted area of 500 sqm or as decided by Engineer-in-Charge.	
18.1.9	Wherever it is not convenient to take measurements at excavation, quantity shall be measured at filling. The quantity at filling shall be reduced by 10% in case of consolidated fill, by 5% in case of consolidation by mechanical machinery. No deduction where filling done under OMC.	

SUB HEAD	DO'S	DON'TS
18.1.10	Surface of formation for width of sub base, which shall be 150 mm more on either side of base course, shall first be cut to a depth equal to the combined depth of sub base and surface course below the finished level.	
18.1.11	The sub-grade must be consolidated with a power road roller of 8 to 10tonnes. The roller must run over the sub-grade till the soil is evenly and densely consolidated and behaves as an elastic mask (the roller must pass a minimum of 5 runs on the sub-grade).	Do not forget that subgrade is finished to the specified camber and super elevation at curves.
18.1.12	Check the levels of finished sub-grade. The finished surface must be uniform and conform to the lines, grades and typical cross section as shown in the related drawings, when tested with a template and straight edge.	Do not forget to check the surface evenness & permissible tolerances of sub-grade. Longitudinal profile permissible undulation when measured with a 3 meter straight edge shall not be more than 24 mm and Cross profile permissible variation from specified profile when measured with a camber template shall not exceed 15 mm.
18.1.13	Embankment should be made up to final formation level of road and then cutting for sub- grade should be made as said above.	Do not forget to check final sub-grade surface with template.
18.1.14	In slushy soils or in areas that are water logged sub-grade construction, special arrangements must be made to improve the sub-grade and the total pavement thickness must be designed after testing the properties of the sub-grade soil.	
18.1.15	Plinth protection all around the building walls must be provided for preventing seepage of water to the foundation. Slope of plinth protection should be away from the walls.	
18.2	**CARPETIING:**	
18.2.1	Clean the existing base course like WBM/ WMM surface with wire brushed to expose the metal about 10 mm depth and surface should be mode dust free.	Do not lay premix carpet during rainy whether or when the base course is damp or wet.
18.2.2	Stack the stone aggregate of required grade and physical requirement reach-wise as per theoretical requirement.	Do not forget to keep a record of the measurement of stone aggregate brought by the agency.
18.2.3	Stone aggregates must conform to contract specifications.	

SUB HEAD	DO'S	DON'TS
18.2.4	Use paving asphalt grade VG-10/VG-30. Heat the binder to required temperature 149°C to 177°C.	Do not forget to keep a thermometer at site to check the temperature at regular intervals.
18.2.5	Maintain account of binder /bitumen as per contact Specifications.	
18.2.6	The mixing of binder with chipping must be continued until the chippings are thoroughly coated with the binder and the mix must be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows.	
18.2.7	Tack coat to be spread by spraying machine.	
18.2.8	Just after rolling, check the longitudinal profile with straight edge and cross profile with a camber template and make good all deficiencies when carpet is green.	Do not forget to check longitudinal & cross profile. In longitudinal profile max. undulations permissible is 10 mm and in cross profile permissible variation shall not be more than 6 mm.
18.2.9	Normally provide 2% camber.	
18.3	**BITUMINIOUS MACADAM:**	
18.3.1	Stone Aggregate shall conform to contract specifications. Stone Aggregate must be clean, heard, durable, of cubical shape, free from dust and soft or friable matters, organic or other deleterious matters.	Do not forget to test aggregates for stripping before approval of the source.
18.3.2	Grading of stone aggregate to be used as per contract specifications.	
18.3.3	The binder content should be worked out by percentage weight of stone aggregate by job mix design in laboratory.	
18.3.4	The binder shall be straight run bitumen confirming to IS:73.	
18.3.5	The mix will be prepared in Hot mix plant and will be load by paver.	Do not forget to check aperture opening as required at plant for proportion of mixing.
18.3.6	The temperature of mix at laying should be between 121°C to 163°C.	
18.3.7	The field density shall not be less than 95% of lab density.	
18.3.8	Maintain daily out turn and bitumen consumption as per contact Specifications.	Do not lay Bituminous mixture when the air temperature at the surface on which it is to be laid is more than 10°C.

SUB HEAD	DO'S	DON'TS
18.3.9	Quantity Control tests shall be done as per contract Specifications except Marshal stability.	
18.3.10	Finished surface should not have undulation more than 6 mm in longitudinal direction and 4 mm in transverse direction when checked with 3 meter long straight edge and also make good when it is green.	
18.3.11	Provide 1.7 to 2% camber.	
18.3.12	Measure quantity for payment as per levels.	
18.3.13	One field density test for every 500 sqm or part shall be done.	Do not forget to keep record of weight of each truck load of the mix brought as site.
18.3.14	Speed breakers should be properly designed and located before carpeting as laid down by the Engineer-in-Charge as per guidelines.	
18.3.15	Cautionary and Informative signs must be placed at required places for smooth flow of traffic and livestock.	
18.4	**ASPHALT CONCRETE:**	
18.4.1	Stone aggregate shall conform contract Specifications.	
18.4.2	Gradation shall be as per contract Specifications.	
18.4.3	Binder shall be straight run bitumen of appropriate frade conforming to IS-73.	
18.4.4	Mix shall be designed as per Marshal job mix design.	
18.4.5	Mixing to be done in a plant and laid at side with paver.	Do not forget to check aperture opening at plant for proportion of mixing.
18.4.6	Temperature at the time of laying to be 121°C to 163°C.	
18.4.7	Quality Control tests as per contract Specifications.	
18.4.8	Surface correctness same as macadam.	
18.4.9	Camber same as macadam.	
18.4.10	Measure quantity for payment as per levels.	
18.4.11	Field density to be achieved 98% of lab density.	

SUB HEAD	DO'S	DON'TS
18.4.12	One field density test for every 500 sqm or part thereof as per contract Specifications must be done.	
18.5	**KERB STONE**	
18.5.1	Kerb stone to be of precast cement concrete.	
18.5.2	Kerb stones mortar joints must have grooves and check for straightness as well as must be cured for 7 days.	
18.5.3	The necessary drainage openings of specified sizes must be made through the Kerb as per drawing or as directed by the Engineer-in-Charge for connecting to storm water drains.	Do not forget that berms and road edges must be restored and all surplus earth including rubbish etc. to be disposed off as directed by the Engineer-in-Charge.

Annexure- 1
(Refer Chapter- 2)

Responsibility for Quality for Departmental Engineers

1. Civil Work

	Item of Work	Responsibility for Quality
A.	**Materials**	
	(a). Sand, stone, metal & chips, bricks, ordinary glass panes	JE & AE
	(b). Timber, paints, polish, door, shutters, windows, door/ window fittings, sanitary and water specials, glass panes	JE & AE
	(c). Marble, granite, kota stone and similar stone work items	AE & EE
	(d). Cement and Steel	AE & EE
	(e). Bitumen, Bitumen emulsion, mastic	AE & EE
B.	**Items of work**	
	(a). Foundation up to plinth	AE & EE
	(b). Brick/ Stone/ Block Masonry work	JE & AE
	(c). Centering and shuttering excluding sunshades/ shelves	AE & EE
	(d). Reinforcement and RCC	AE & EE
	(e). Structural steel work, Steel work, Aluminum Work, Wood Work.	AE & EE
	(f). Steel work	AE & EE
	(g). Aluminum Work	AE & EE
	(h). Wood work/ wood substitute work	AE & EE
	(i). Flooring- CC, Mosaic, Glazed/ Ceramic/ **Vitrified** tiles	AE & EE
	(j). Flooring & cladding- Marble, granite, kota, sand stone etc.	AE & EE
	(k). Plastering, Painting & Polishing	JE & AE
	(l). Joints in Pipes i/c testing, slopes in flooring i/c verandah, balcony, toilets, terrace.	AE & EE
	(m). Bitumen painting of roofs	JE & AE
	(n). Waterproofing treatment	AE
	(o). Fittings of doors/windows,	AE
	(p). False Ceiling work	AE & EE
	(q). (i) Storage tanks,	AE & EE
	(ii) Sluice valves, fire hydrants,	AE
	(iii) CI / Hume pipes & specials and their lead caulked joints	AE & EE

	Item of Work	Responsibility for Quality
	(r). (i) Manholes i/c covers &frames,	JE & AE
	(ii) CI Inspection bends &chambers	JE & AE
	(s). General quality of work and materials with particular reference to lines & levels/ adherence to drawings and specifications/ standards & functionality	AE & EE
	(t). Road Works	
	(i) Preparation of sub base	JE & AE
	(ii) Sub base / Base course	JE & AE
	(iii) Wearing Course	AE & EE
	Other important materials/items	To be decided by the tender accepting authority.

2. E&M Works

	Item of Work	Responsibility for Quality
A.	**Materials**	
	(a) Conduit wires, switches, accessories internal wiring, MCB's, MCBDB's	JE & AE
	(b) Finished goods of Internal El i.e. Fans, electrical fittings, exhaust fans, call bells etc.	AE & EE
	(c) L T / HT cables	AE & EE
	(d) S/STN equipment, L T Panel/HT Panel Elect. main boards, DG Sets, Bus trunking, rising mains	AE & EE
	(e) All the major equipment concerning wet riser/ sprinkler system, fire detection system etc. like pumps, DG Sets, pipes, valves. hoses, cabinets, panels, sprinklers, detectors, detecting panels, manual call boxes, PA system equipment etc.	AE & EE
	(f) Air conditioning equipment like chilling units, cooling towers, Pump AHU's, duct insulation, GI sheets, pipes, control instrument etc.	AE & EE
	(g) Major equipment of other special services like CCTV, BMS, EPABX, computer networking etc.	AE & EE
B.	**Items of Works**	
	(a) Internal El work i/c UG cabling etc.	JE & AE
	(b) Sub Station work	JE & AE
	(c) Fire fighting, fire detection work	JE & AE
	(d) A/C works & other specialized Services	JE & AE
C.	**Other important materials/items**	**To be decided by tender accepting authority**

Annexure- 2
(Refer Chapter-2)

Site Order Book

Name of Works
Name of Contractor

S. No.	Remarks of the Inspecting Officer or Contractor	Action taken and by whom	Remarks
1	2	3	4

Annexure- 3
(Refer Chapter-2)

Inspection Register

Name of Work
Name of Contractor

S. No.	Date and Time	Officer's Name and Designation	Items inspected and specific defects noticed & action to be taken	Signature	Defects taken to Site Order Book/Letter written			Final action/ result
					Site Order Book Page No./ letter No	Date	Sign of AE/EE	
1	2	3	4	5	6	7	8	9

Annexure- 4
(Refer Chapter -3)

Model Contents list of QAP for Construction
(Only for illustration)

INDEX

S.No.	Brief Description	Page nos
	Project Information	
1.	Contents	
2.	Glossary of Terms	
	1. Introduction	
3.	Detailed Scope of the Project work	
4.	Brief Geotechnical report & Foundation system	
	Site Lay out Plan	
	2. Organization	
5.	Quality Policy	
6.	Organizational roles, responsibilities and authorities	
7.	Quality Planning and Quality Objectives	
8.	Client Organizational structure	
9.	Client's QA Unit & Key personnel	
10.	TPQA Agency	
	3. Applicable Documents and References	
11.	Site Infrastructure & Site management Plan	
12.	Communication related to QA	
13.	Master list of Documents (Hard copy/ Soft copy)	
14.	Master List of Submittals	
15.	Master list of Specifications, Codes and Standards	

S.No.	Brief Description	Page nos
16.	Drawings Register	
17.	Master list of records (Hard Copy & Soft Copy)	
18.	Completion Certificate format	
19.	Completion Plans/ As built Drawings	
20.	Monthly Quality Report format	
21.	Quality Report & Records to be submitted on completion	
	4. Plant/Laboratory & Calibration	
22.	Laboratory & plant laboratory Infrastructure	
23.	List of instruments / equipment	
24.	List of equipment as per NIT	
25.	List of field testing Instruments	
26.	Batching Plan Calibration Summary	
27.	List of Instruments for calibration & calibration frequency	
28.	Monitoring and measuring resources	
29.	List of approved External Laboratories	
	5. Skilling & Training	
30.	Training plan for QC staff; Sub contractor Supervisor	
31.	Skilling plan of Workmen	
32.	Training & Evaluation record for Workmen	
33.	Training Resources	
	6. Execution of Work	
34.	Material at Site (MAS) Register	
35.	Cement Register	
36	Steel (Reinforcement) Register	
37.	Mandatory Test Performa/ Monthly Quality Test Summary	

S.No.	Brief Description	Page nos
38.	Checklist for examination of Product/Item/Works	
39.	Dos &Don't for items of construction works	
40.	Checklist for examination of Building works	
41.	Common Observation/ issues in Construction works	
42.	Method Statements	
43.	Frequency of Testing & Acceptance Criteria	
44.	Test Reports formats	
45.	Statistical Quality Control & Procedure	
46.	Design Mix Submission, Trial Mixes & Approval formats	
47.	Site Order Book	
48.	Inspection Register	
	7. Approval of Material, Source & Product	
49.	Requirement for product and services	
50.	Approved list of Materials and products	
51.	Forms for seeking approval of material source/ Product	
52.	Control on Production and service provision- Method statements	
53.	Identification and Traceability	
54.	Preservation of approved samples	
55.	Control of Non-conforming Items / works and Corrective action-Format	
56.	Approved materials/ Items/ Products	
57.	Approved Vendors list	
58.	Approved sub-contractors list	
59.	Inspection Test plan/QA Formats	

S.No.	Brief Description	Page nos
	8. Audit	
60.	Internal Quality Audit Plan by Contractor's Organization	
61.	Internal (Contractor)Audit Report Summary	
62.	External Quality Audit Conducted & dates/TPQA	
63.	External Quality Audit/TPQA Report summary	

Annexure- 5

Drawings Register

Name of Work
Name of Contractor

S. No.	Drawing No.	Details of Drawings	Date of Receipt	Date of Issue to Contractor	Sign. of JE	Sign. of Contractor	Sign. of AE/ EE	Remarks
1	2	3	4	5	6	7	8	9

Annexure- 6

Material at site register

Section/Sub-division
Name of work
Name of Article/item
Estimated Requirements
Issue Rate

S. No.	Date of Receipts (Details of Challans/ Bills, Vehicle No.	Received from/ Issued to	Quantity Received	Date of issue	Specific location where Plants & Materials Displayed/ issued	Quantity issued	Balance Quality	JE/ AE	Remarks
1	2	3	4	5	6	7	8	9	10

Annexure- 7

Cement Register

Name of Work
Name of Contractor

Date of receipt	Quantity received	Source of receipt	Progressive Total	Date of issue	Quantity issued	Items of work for which issued	Quantity returned at the end of the day	Total issue	Daily balance	Contractors' initial	JE's initial	AE/EE periodical check with dated signature	Remarks
1	2		3	4	5	6	7	8	9	10	11		12

Annexure- 8

Steel Reinforcement Issue Register
(Designation of Steel Bar……mm TMT)

Name of Work
Name of Contractor

S. No.	Date	Qty. Received in MT	Source	Challan No.	Qty issued	Item for which issued	Consumption of Steel as per measurement	Difference in measured & Issued quantity	Sign. Of Contractor	Sign of JE	Sign. of AE/EE	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13

Annexure- 9

Bitumen Issue Register

Name of Work
Name of Contractor

Particulars of Receipt			Progressive Total	Date of Issue	Particulars of issues		Daily Balance in hand	Contractor's initials	JE Initials	Daily comparison of issue with required			JE/ AE	EE	Remarks
Date of receipt	Qty. Received	Source of Receipt			Qty. of Bitumen issued	Total Issued				Items of work for which issued	Approx. Qty. of work done on each day	Theoretical require of bitumen for work done on each day			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Annexure- 10

PROFORMA FOR PAINTS/ CHEMICALS ISSUE REGISTER

Name of Work
Name of Contractor
Name of Paint/ Chemical

Particular of Receipt							Particular of issue										
																Periodical Check	
Date of receipt	Source of receipt with details if any	Batch No.	Dt. of manufacture	Dt. of expiry	Qty. received	Progressive Total	Dt. of Issue	Qty. Issued	Items of work for which issued	Qty. returned at the end of day's work	Net Qty. issued	Progressive Total	Daily Balance	Contractor's Initial	J.E's Initial	By AE	By EE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Annexure-11
(Refer Chapter-3)

Illustrative Monthly Quality Report
Table of Contents (Model)

Name of Work
Name of Contractor

S. No.	Description	Page No.
1	Project Information	
2	Scope of project work	
3	Progress of Work	
4	Organization chart for QA with names of the Quality persons	
5	Monthly Quality Test Summary	
6	List of Approved External Laboratory	
7	List of Quality Control Formats	
8	List of Field Laboratory Equipment	
9	Calibration Status of Measuring and Monitoring Equipment	
10	Approval Status of Construction Material/ Products/ Item and Source	
11	Batching Plant Calibration Status	
12	Concrete Mix Design Summary	
13	Method Statement Status	
14	Cement (or other key materials) consumption statement	
15	Material Test Reports conducted in reported month	
A	Cement Test Report	
B	Steel Test Report	
C	Fine Aggregate Test Reports	
D	Coarse Aggregate Test Report	
E	Water for Construction Test Report	
F	Admixture Test Report	
G	Concrete Test Report	
H	Fly ash Bricks/AAC Blocks Test Reports	

S. No.	Description	Page No.
I	Other Material Test Reports	
16	Other External Tests	
17	Internal Quality Audit Report (Monthly)	
18	External Quality Audit Report (Quarterly)(Include Inspection of Condition of Machinery Equipment)	
19	Status of Monthly Inspection Report	
20	Status of NCR/ NCN	

Annexure-12

Monthly Quality Tests Summary

Name of Work
Name of Contractor:

S. No.	Material	Brand/ Source	Reference of specification	Frequency of tests	Total test conducted up to previous month			Quantity executed		No. of tests required for this month	No. of tests conducted for this month			No. of tests cumulative			Remarks
					Tested	Passed	Failed	In this month	Cumulative Qty.		Tested	Passed	Failed	Tested	Passed	Failed	

Annexure-13

Approved External Testing laboratories

Name of Work
Name of Contractor

S. No.	Name of External testing laboratories	Submitted for Approval vide Contractor Lr. No.	Status of Approval (Approved /Not Approved)	If Approved Approval Lr. No. & Date	Remarks

Annexure-14

List of Field Laboratory Instruments

Name of Work
Name of Contractor

S. No.	Equipment Description	Equipment No.

Annexure-15

Master Calibration Status of Batch Plant/ Weighing Machine/ Field Testing Equipment

Name of Work
Name of Contractor

S. No.	Description of Equipment	Make	Frequency	Last date of Calibration	Next due date of Calibration	Calibration by	Remarks

Annexure-16

Mix-design and approval summary

Name of Work
Name of Contractor

S. No.	TM No.	Grade of Concrete	Mode of Placing	Structure	Brand Name of Cement	Cement Content (Kg)	Fly Ash (Kg)	WPC (Kg/ cum)	Admixture		CA 20 mm (Kg/ cum)	CA 10 mm (Kg/ cum	FA (Sand Content) (Kg/ cum)	Approval Status	Remarks
									Brand	% of Admixture by weight of Cement					

Annexure-17

Cement Consumption Statement of Different Items of Works (Theoretical & Actual)

Name of Work
Name of Contractor
Abstract for the month ending - (Indicate cement consumption)

S. No.	Name of Work	Quantity of work done		Coefficient MT per cum	Cement required to be consumed theoretically (Bags/ MT)	Actual Cement consumed (Bags /MT)	Sign. of Contractor	Sign. of Engineer	Remarks
		Quantity	Unit						

Annexure-18

Method Statement Approval Status

Name of Work
Name of Contractor

S. No.	Description of items of work	Method Statement No.	Submitted by	Date of Submission	Approved by	Date of Approval	Remarks

Annexure-19

NCN/NCR Status

Name of Work
Name of Contractor
Quality Team:
Date:

S. No.	NCR No.	Location	Issue Date	Description	Evidence (Photograph)	Closing Date	Suggested Corrective Action	Details of action taken with evidence	Status (Open/ Closed)

Annexure-20

SLUMP TEST

Name of Work
Name of Contractor
Grade of Concrete

S. No.	Date of testing	Item of work and location	Vibrators used Yes/No	Quantity of water added per bag of cement liter	Height specimen after removal mould in mm	Slump (mm)	Acceptability action taken	Sign. of JE	Sign. of Contractor	Checked by AE / EE
1	2	3	4	5	6	7	8	9	10	11

Annexure-21

Performa for concrete delivery and pour record

Name of Work
Name of Contractor

	Location of Site Grade of Concrete Mix. Date Max. Aggregate Size	Ticket ref No. Truck No	
S. No.	**Concrete batching delivery**		**Remarks**
1.	Nomenclature of item (in brief)		
2.	Type of Cement & Grade		
3.	Water Cement Ratio		
4.	Workability /Slumps at Loading Time mm		
5.	Cement Contents		
6.	Admixture (Type & Dosage)		
7.	Mineral Additives (Pulverized fuel ash/Slag/Others)		
8.	Time of Loading Hrs.		
9.	Mix Temperature during Loading		
10.	Quantity of Batched Cum		
11.	Number of Cubes Taken during loading		
12.	Signature of Contractor during Loading		
13.	Signature of Govt. Site Engineer during Loading TM/Truck arrived on site		
14.	Name of items and placement location		
15.	Pouring Started Hrs		
16.	Slump at Site during placing - mm		

S. No.	Concrete batching delivery		Remarks
17.	Quantity of water added during curing (if required)		
18.	Time of end of pour - Hrs.		
19.	Mix Temperature during Placing		
20.	Method of Placing concrete		
21.	Weather condition and Temperature		
22.	Numbers of Cubes Taken at Site during placing		
23.	Place Where Cube Taken		
24.	Method of compaction		
25.	Signature of Contractor during placing		
26.	Signature of Govt. Site Engineer during placing		

Annexure-22

Test for Compressive Strength of Cement Concrete Cube (Design Mix)

Name of Work
Name of Contractor

(a)	Name of Work	
(b)	Name of Agency/Contractor	
(c)	Agreement No.	
(d)	Sample No.	
(e)	Date of Casting cubes	
(f)	Whether admixture used (Y/N)	
(g)	Cement (OPC/PPC/Slag)	

7 Day and 28 Days Test
Clause (5.8.3)

S. No.		1	
Shift		2	
Date of taking sample		3	
Brief location of work and Quantity represented by sample		4	
Grade of mix		5	
Cube identification mark		6	
Sample taken in presence of	Sign. of Cont.	7	
	Sign of JE/AE	8	
	Sign of EE	9	
Date of Testing		10	
Wt.of Cube(gms)		11	
Density(kg/m^3)		12	
Crushing Load(KN)		13	
Compressive strength at age	7 Days	14	
(N/mm^2)	28 Days	15	
Average compressive strength of	7 Days	16	
three specimens (A) N/mm^2	28 Days	17	

0.85 of (A) N/mm^2		18	
1.15 of (A) N/mm^2		19	
Validity of sample (Yes/No)		20	
Note : invalid if individual specimen strength variation more than ±15% of (A)			
ACCEPTANCE (a) Mean of the group of 4 Non-Overlapping consecutive Test Results in N/mm^2 (Min.) $\geq f_{ck}$ + 0.825 x established standard Deviation (rounded off to nearest 0.5 N/mm^2 Or Individual Test Results in N/mm^2 (Min.) $\geq f_{ck}$-3 N.mm^2		21	
Tested in presence of	Sign. of Cont.	22	
	Sign. of JE/AE	23	
	Sign. of EE/SE/CE	24	
Remarks		25	

Acceptance Criteria:-

(1) Check whether individual cube compressive strength is within ± 15% of the average compressive strength. If more the test results of the sample are invalid.

(2) Check compressive strength requirement as per Table-11 of IS:456 (Amendment No.4) for means of group/shift test results and individual test results.

Notes:-

(1) In the absence of established value of standard deviation, the values given in Table-8 of IS : 456 (Amendment No.4) may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

(2) For concrete or quantity up to 30m^3 (where the numbers of samples to be taken is less than four as per the frequency of sampling given in clause 15.2.2 of IS : 456), the mean of test result of all such samples shall be f_{ck} + 4 N/mm^2 (minimum) and the requirement of minimum individual test results shall be f_{ck} - 2 N/mm^2 (minimum). However, when the number of sample is only as per clause 15.2.2 of IS : 456 the requirement shall be f_{ck} + 4 N/mm^2 (minimum)f_{ck} + 4 N/mm^2 (minimum).

Annexure-23

Test for Particle Size Distribution of Coarse /Fine Sand

Name of Work
Name of Contractor

Zone of Coarse/Fine Sand:

S. No.	Date of testing	Weight of	I.S. Sieve Designation	Weight retained (in grams)	% retained	% cumulative retained	% cumulative passing	Acceptability against each sieve designation according to zone specified	Sign. of JE	Sign. of Contractor	Checked by AE/EE	Remarks (Action Taken)
1	2	3	4	5	6	7	8	9	10	11	12	13
			10 mm									
			4.75 mm									
			236 mm									
			1.18 mm									
			600 microns									
			300 microns									
			150 microns									
			75 microns									
			Pan									
			Total									

Annexure-24

10% FINES VALUE TEST OF COARSE AGGREGATE

Name of Work
Name of Contractor

S. No.	Location		Date of Sampling	Source of Material	Test Results							Sign. of Contractor	Sign. of JE/AE/EE	Remarks
	Lab	Site			Weight of Saturated surface dry Sample passing IS-Sieve 14mm and retained on IS Sieve 10mm (A) g	Oven dried weight of fraction retained on IS Sieve 2.36 mm after the test(g)	Oven dried weight of fraction passing IS Sieve 2.36mm after the test (B) g	The maximum force "X" (Tonne)	Y=% of materials passing IS Sieve 2.36 mm at the maximum force (B/A)x100)	10% Fines Value (TFV) =14 * X/(Y+4)kN	Average Value of 10% Fines Value (kN)			

Annexure-25

Test for Particle Size Distribution of 12.5/20mm/40mm graded stone aggregate

Name of Work
Name of Contractor

S. No.	Date of testing	Weight of	I.S. Sieve Designation	Weight retained (in grams)	% retained	% cumulative retained	% cumulative passing	Acceptability against each sieve designation	Sign. of JE	Sign. of Contractor	Checked by AE/EE	Remarks (Action Taken)
1	2	3	4	5	6	7	8	9	10	11	12	13

Annexure-26

FLAKINESS INDEX AND ELONGATION INDEX

Name of Work
Name of Contractor
Description of material

Source of Materials	Sampling Location	Date of Sampling	Date of Testing	IS-Sieve Size mm		Total Weight of Aggregate retained (g)	Weight of Aggregate retained on Flakiness gauge (g)= C	Weight of Aggregate passing through Flakiness gauge (g)=A	Weight of Aggregate retained on elongation gauge after retained on Thickness gauge(g)= D	Weight of Aggregate passing on elongation gauge after retained on Thickness gauge(g)= B	Flakiness Index = (C/A)*	Elongation Index (D/B)*	Combined Flakiness and Elongation Indices= {(C/A)+D/B)}x100=	Sign. of Contr.	Sign. of JE/AE/EE	Remarks
				Passing	Retained											
				63	50											
				50	40											
				40	31.5											
				31.5	25											
				25	20											
				20	16											
				16	12.5											
				12.5	10											
				10	6.3											

Annexure- 27

Test for Silt Content in Coarse/Fine Sand

Name of Work
Name of Contractor

S. No.	Date of Testing	Height of silt above sand layer (ml)	Height of sand below silt layer in (ml)	% age silt = column 3x100 Column (4)	Acceptance limit	Sign. of JE	Sign. of Contr.	Checked by AE/EE	Remarks
1	2	3	4	5	6	7	8	9	10

Annexure- 28

Fineness Modulus of Coarse/Fine Sand

Name of Work
Name of Contractor

S. No.	Date	Weight of sample	Size of Sieves	Wt. Retained on each sieve	% age of Wt. Retained on each sieve	Cumulative % age retained	Fineness modulus	Sign.of JE	Sign. Of Contractor	Sign. of AE/EE	Remarks

Annexure- 29

Water Test for construction use

Name of Work
Name of Contractor

S. No.	Sample from where collected	Date of sampling	Description	Test Result	I.S. Requirements	Sign. of Contr	Sign. of Govt. Engineer	Remarks
1			Volume of O-IN-HCl required to neutralize 200 ml. sample using methyl orange as indicator		10 ml max.			
2			To neutralize 200 ml. sample of water using Phenolphthalein as indicator O.I.N. NAOH is required		2 ml max.			
3			SULPHAE as SOH		500 max.			
4			Chloride as Cl		1000 max. for RCC			
5			Organic Solids		200 max			
6			Inorganic solids		3000 max			
7			Suspended solids		2000 max.			
8			PH value		Not less than 6			

Annexure- 30

Test for compressive strength of / bricks/ bricks tiles/ Fly Ash Bricks/AAC Block etc.

Name of Work
Name of Contractor

S. No.	Date of taking sample of 5 bricks for each test	Identification mark filling frog	Sample taken in presence of			Date of testing	Compressive strength for individual bricks kg/cm^2	80% of specified compressive strength kg/cm^2	Average strength kg/cm^2	Acceptability		Tested in presence of		Remarks (i/c ref. No. of the laboratory result)
			Sign. of JE	Sign of AE/EE	Sign of Contractor					Individual strength	Average strength	Sign. of JE/AE/EE	Sign. of Contractor	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Annexure- 31

Test for bricks/ bricks tiles for water absorption

Name of Work
Name of Contractor

S. No.	Date of taking sample of 5 bricks for each test	Sample taken in presence of			Date of testing	% water absorbed in individual bricks / tiles	Average % water absorbed	Acceptability	Tested in presence of			Remarks (i/c ref. No. of the laboratory result)
		Sign. of JE	Sign of AE/EE	Sign of Contractor					Sign of JE	Sign of AE/EE	Sign. of Contractor	
1	2	4	5	6	9	8	9	10	11	12	13	14

Annexure- 32

Test for bricks/bricks tiles for Efflorescence

Name of Work
Name of Contractor

S. No.	Date of taking sample of 5 bricks for each test	Sample taken in presence of			Date of testing	Result i.e nil/ slight / moderate/ heavy serious	Acceptability	Tested in presence of			Remarks (i/c ref. No. of the laboratory result)
		Sign. of JE	Sign of AE/EE	Sign of Contract-or				Sign of JE	Sign of AE/EE	Sign. of Contractor	
1	2	4	5	6	9	8	9	10	11	12	13

Annexure- 33

Test of brick/ tiles for dimensions

Name of Work
Name of Contractor

S. No.	Date of testing	Identification marks of brick	Dimensions obtained for twenty bricks	Acceptability	Signature of JE	Signature of AE/EE	Signature of Contractor	Action taken if any
1	2	3	4	5	6	7	8	9

Annexure- 34

Check list for seeking approval of Source /Product/Agency

Name of Material/ Product/ Source- ……..

Name of Work
Name of Contractor

S. No.	Particulars	Sign. of Contractor	Sign. of JE/AE/EE	Remarks
1	Name and address of the manufacturer/ supplier			
2	Whether the supplier/manufacturer included in the preferred make list ?			
3	Whether the material satisfies the test requirements specified in the BOQ item?			
4	Whether the supplier can supply the material in desired quantity/ lot size as per the site schedule?			
5	Whether the manufacturer has given the method statement for its application? (attach a copy of the method statement)			

Annexure -35
(Refer Chapter-4)

LIST OF EQUIPMENT FOR FIELD TESTING LABORATORY
(Illustrative List)

1. Weighing Balance
   (i) 50 kg capacity electronic type - accuracy 2 gm
   (ii) 5 to 20 kg capacity electronic type - accuracy 1 gm
   (iii) 5 kg capacity electronic type - accuracy 0.5 gm
   (iv) 2 kg capacity electronic type - accuracy 0.1 gm
   (v) 500 kg capacity electronic type - accuracy 0.01 gm
   (vi) Chemical Balance 100 gm capacity – accuracy 0.001 gm
2. Oven Electrically operated, thermostatically controlled (including thermometer) StainlessSteel interiors from 0^0 C to 220^0 C
3. G.I IS Sieves : as per IS 460 (Part-I)
   (i) I.S. Sieves- 450 mm internal dia, of size sieve sets – 100mm, 80mm, 63mm, 40mm, 20mm, 16mm, 12.5mm, 10mm, 4.75mm, 2.36mm complete with lid and pan.
   (ii) I.S. Sieves- 200mm internal dia (brass frame and steel/ or brass wire cloth mesh) consisting of sieve sets - 10mm, 4.75mm, 2.36mm, 1.18mm, 600 micron, 300micron, 150 micron, 75 micron with lid and pan.
4. Sieve shaker capable of shaking 200mm and 300mm, 450mm dia sieves, electrically operated with timer (time switch) assembly.
5. Stop watches 1/5 sec accuracy
6. Dial gauges, 25 mm travel - 0.01 mm / division least count
7. Graduated measuring cylinders
   (i) Glass (100 ml)
   (ii) Glass (200 ml)
   (iii) Glass (250 ml)
   (iv) Plastic (500 ml)
8. Gauging Trowel
9. Enamel Trays
   (i) 600 mm x 450mm x 50mm
   (ii) 450mm x 300mm x 40mm.

(iii) 300mm x 250mm x 40mm

(iv) Circular plates of 250 mm dia

10. High frequency mortar cube Vibrator for cement testing
11. Cement mortar moulds sizes (70.6 x 70.6 x 70.6 mm)
12. Soundness testing apparatus for cement (Le-Chatelier)
13. Vicat needle apparatus with plunger for cement setting time testing as per IS 269
14. Mortar cube testing machine
15. Flakiness and Elongation index test apparatus (for stone aggregate testing as per IS 2386 (Part-4)
16. Aggregate impact test apparatus as per IS 2386 (Part-4)
17. Apparatus for determination of specific gravity of fine and coarse aggregate as per IS 2386 (Part-3)
18. 3 liter, 15 liter and 30 litercylinder as per IS 2386 (Part-3) for checking bulk density of aggregate with tamping rod.
19. Apparatus for slump test - Slump cone, Steel plate, Tamping rod, Steel scale and Scoop.
20. 1000 – 2000 KN capacity Compression and Flexural strength testing machine, electrically cum manually operated with additional dial for Flexural strength testing.
21. Concrete mixer power driven – 1 cuft capacity
22. Steel cubes / molds
    (i) 150mm x 300mm height cylinder with capping components along with the capping set.
    (ii) Cube 150 mm and 100mm (each size)
23. Core cutting machine with 10cm dia diamond cutting edge.
24. Le-Chatelier flask
25. Variable frequency and amplitude Vibrating table size 1meter x 1meter as per relevant Standard.
26. Thermometers
27. Digital Moisture meter

Annexure- 36
(Refer Chapter-4)

FIELD TESTING INSTRUMENTS

1. Steel Tape of 3 meter
2. Vernier Calliper
3. Micrometer screw 25 mm gauge
4. A good quality plumb bob
5. Spirit level, minimum 30 cms long with 3 bubbles for horizontal vertical
6. Wire gauge (circular type) disc
7. Foot rule
8. Long nylon thread
9. Rebound hammer for testing concrete
10. Dynamic penetrometer
11. Magnifying glass
12. Screw driver 300 mm long
13. Ball pin hammer, 100gms
14. Plastic bags for taking samples
15. Moisture meter for timber.
16. Earth resistances tests (for Electrical Divisions)
17. Meggar (for Electrical Divisions)
18. Depth Gauge
19. Straight edge

Annexure- 37
(Refer Chapter-5)

NON-CONFORMANCE REPORT
Conformance/Non-Conformance Report

Ref: Date: .....

To

(Contractor)

Agreement No. ..... Name of Contractor .....

Name of Work: .....

Conformance/Non-Conformance Notification No. .....

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

Inspection Report	Date	Inspection Laboratory	Material/ Product item of work	Comments (Conforms/ Does not conform/ reject/ rework/ desired corrective action instructions as below)

Instructions: (Rejection /Corrective Action to be taken by Contractor): .....

.....

.....

.....

.....

Engineer-in-Charge

.

Annexure- 38
(Refer Chapter-6)

Format for Quality Audit by Internal QA/Regional QA unit

1.0	**Particulars of work**	
1.1	(a) Name of work	
	(b) Description of work	
1.2	(a) Sub-Division and name of Assistant Engineer	
	(b) Division and name of Executive Engineer	
	(c) Circle and name of Superintending Engineer	
	(d) Zone and name of Chief Engineer	
1.3	Agency/Contractor	
	(a) Name	
	(b) Registration Class	
1.4	Agreement No.	
1.5	Stipulated time and date of start	
1.6	Stipulated time and date of completion	
1.7	(a) Estimated cost put to tender	
	(b) Schedule of rates applicable	
1.8	Accepted tendered cost with overall percentage	
1.9	Percentage progress at time of inspection vis a vis expected as per contract and reasons for delay, if any:	
1.10	Inspecting officers (Name & Designation)	
1.11	Officers and contractor present during inspection (Name & Designation)	
1.12	Date of Inspection	
2.0	Quality Control aids:	

2.1	Is site equipped with	
	(a) Copy of agreement	
	(b) Applicable relevant Specification/ along with (up to date) correction slips:	
	(c) List of ISI marked/approved materials to be used:	
	(d) Guard File containing inspection reports of CTE/ QCTA/AE/QC)/CE/SE etc.	
	(e) Testing facilities to check conformations to acceptance criteria	
	(f) Relevant Circulars on Quality Control	
2.2	Is field laboratory existing and well equipped?	
3.0	Departmental procedure aspects:	
3.1	Maintenance of Inspection register.	
3.2	Highlights of inspection by senior officers requiring compliance.	
3.3	Are Test Registers maintained in standard forms?	
3.4	Are Test Register reviewed by EE/SE with dates?	
3.5	Cement Register:	
	(a) Is cement store checked by AE/EE periodically as stipulated?	
	(b) Comment on cement stock with reference to cement register:	
3.6	Site Order Book and Schedule of defects:	
	(a) Is Site Order Book Properly maintained?	
	(b) Is the Site Order Book reviewed by EE? (Mention details)	
	(c) Have timely notices been issued to the contractor with the schedule of defects/damages and date of compliance?	
	In case of failure to rectify defects/damages whether action under relevant clause of contract initiated?	

4.0	Process control aspects:	
4.1	Is soil investigation done? (give brief details)	
4.2	Suitability of water for construction	
	(a) What is the source of water?	
	(b) Has water been tested and approved by Engineer-in-charge before construction?	
	(c) Has water been tested subsequently (i.e. after every 3 months) and found fit for use in works?	
4.3	Are 10% (25% for concrete) of all samples for testing taken in presence of EE.	
4.4	Are all mandatory tests carried out at stipulated frequency?	
4.5	Are materials approved by Engineer-in-charge? If so, are samples available at site?	
4.6	Are sample units/items completed and approved by EE before start of mass finishing work?	
4.7	Specific control on RCC work like centering /shuttering, proportioning with boxes: mixing by full bag capacity hopper fed mixer: control of slump: placing/compaction with vibrator:	
4.8	Any other particular comments on adequacy of process control:	
5.0	Site Inspection for observation and comments on Quality Control system in place:	
5.1	Non-Conformities details	
5.2	Observation on floors slope (especially in Bath, WC, Kitchen, Terrace, Balcony etc.)	
5.3	Observation on QC for dampness/ leakages prevention. If dampness /leakages noticed, then state locations and probable reasons.	
5.4	Samples collected by QC Core/Cell	
6.0	Observations on site material QC aspects. (Keeping in view the requirement of contract specifications: BIS marked/ CPWD approved products etc.) (Attached separate sheet, if required)	

7.0	Observations on workmanship QC aspects. (Attached separate sheet, if required)	
8.0	Test audit of R/A bill: (Indicate RA bill no., gross amount, Vr. No. and date)	
8.1	Deviation in Quantities.	
	(a) Whether deviation in quantities noticed?	
	(b) If so, the reason there of and whether prior approval of competent authority has been obtained before allowing deviations?	
	(c) Whether revised T/S is required due to this deviation? If yes, the action taken	
8.2	Items not conforming to specifications:	
	(a) Whether notice was issued as specified in contact?	
	(b) Whether approval in principle was obtained from competent authority before acceptance of sub-standard work?	
8.3	Extra/substitute items:	
	(a) Are justification of item in remark column of EI/SI proper?	
	(b) Whether prior approval of competent authority for execution of EI/SI has been obtained before execution?	
	(c) Whether sanction of competent authority issued?	
8.4	Part Rates- whether rates held back are adequate?	
8.5	Comments on secured advance paid with reference to materials lying at site.	
8.6	Test check by AE/EE	
	(a) Critical item:	
	(b) Hidden items:	
	(c) Extent (whether satisfactory?)	

8.7	Any other observation? (The observation made about quality of material and workmanship relate to only what could be randomly seen at locations specified. Executive Engineer and supervisory staff shall thoroughly inspect the entire work for such defects as observed as well as for other remedial measures properly. The Executive Engineer shall be responsible for accepting any defective work that went unnoticed but pointed out during such inspection.	
8.8	Progress of work and programme chart :	
	(a) Whether progress of work is as per stipulated milestone/approved revised milestone? If no action taken by EE.	
	(b) Whether contractor has submitted the programme to complete various activities of work within stipulated date of completion as per contract condition duly accepted byEE?	
	(c) Whether monthly progress report submitted by contractor as per programme submitted has been certified by JE/AE and reviewed by EE?	
	(d) Any notice under relevant clause of contract for inordinate delays has been issued or not. If yes. Then the action taken by EE.	

Annexure- 39
(Refer Chapter-6)

TPQA CHECKLIST PROFORMA

1.0	**Particulars of Work**	
1.1	(a) Name of work	
	(b) Description of work	
1.2	(a) Sub-Division and name of Assistant Engineer	
	(b) Division and name of Executive Engineer	
	(c) Circle and name of SE / SE and PD.	
	(d) Zone and name of CE / CE and ED.	
1.3	Agency/Contractor	
	(a) Name	
	(b) Registration Class	
1.4	Agreement No.	
1.5	Stipulated time and date of start	
1.6	Stipulated time and date of completion	
1.7	(a) Estimated cost put to tender	
	(b) Schedule of rates applicable	
1.8	Accepted tendered cost with overall percentage of ECPT	
1.9	Percentage progress at time of inspection vis-a-vis expected as per contract and reasons for delay, if any:	
1.10	Inspecting officers (Name & Designation)	
1.11	Officers and contractor present during inspection (Name & Designation)	
1.12	Date of Inspection and Number	
2.0	**Quality Control aids:**	
2.1	Is site equipped with	
	(a) Copy of agreement	

	(b) Applicable CPWD Specification/ along with (up to date) correction slips:	
	(c) Provision of QAP in agreement? Whether approved QAP is available on site?	
	(d) List of ISI marked /approved materials to be used:	
	(e) Guard File containing inspection reports of CTE/ QCTA/AE/QC/ CE/SE etc.	
	(f) Testing facilities to check conformations to acceptance criteria	
	(f) Relevant Circulars on Quality Control.	
2.2	Is field laboratory existing and well equipped?	
3.0	**Departmental procedure aspects:**	
3.1	Maintenance of Inspection register.	
3.2	Highlights of inspection by Senior officers requiring compliance.	
3.3	Are Test Registers maintained in standard forms?	
3.4	Are test Register reviewed by Senior officers with dates?	
3.5	Cement Register:	
	(a) Is cement store checked by AE/EE periodically as stipulated?	
	(b) Comment on cement stock with reference to cement register:	
3.6	Site Order Book and Schedule of defects:	
	(a) Is Site Order Book Properly maintained?	
	(b) Is the Site Order Book reviewed by EE. (Mention details)	
	(c) Have timely notices been issued to the contractor with the schedule of defects/damages and date of compliance? In case of failure to rectify defects/ damages whether action under relevant clause of agreement initiated?	

4.0	**Process control aspects:**	
4.1	Is soil investigation done? (give brief details)	
4.2	Suitability of water for construction	
	(a) What is the source of water?	
	(b) Has water been tested and approved by Engineer-in-charge before construction?	
	(c) Has water been tested subsequently (i.e after every 3 months) and found fit for use in works?	
4.3	Are 10% (25% for concrete) of all samples for testing taken in presence of EE.	
4.4	Are all mandatory tests carried out at stipulated frequency?	
4.5	Are materials approved by Engineer-in-charge? If so, are samples available at site?	
4.6	Are sample units/items completed and approved by EE before start of mass finishing work?	
4.7	Specific control on RCC work like centering /shuttering, design mix concrete/RMC, checking of slump and filling of cubs, placing/compaction with vibrators:	
4.8	Any other particular comments on adequacy of process control:	
5.0	**Site Inspection**	
5.1	Observations and comments on QAP (Quality Assurance Plan) Quality Control system in place: Attached separate sheet, if required	
5.2	Observations on floors slope (especially in Bath, WC, Kitchen, Terrace, Balcony etc.)	
5.3	Observation on QC for dampness/ leakages prevention. If dampness /leakages noticed, then state locations and probable reasons.	
5.4	Samples collected by QC Core/Cell	
6.0	Observations on site material QC aspects. (Keeping in view the requirement of contract specifications, BIS marked / CPWD approved products etc.) (Attached separate sheet, if required)	
6.1	Observations	
7.0	Observations on workmanship QC aspects. (Attached separate sheet for each non-compliance, if required)	

Annexure- 40
(Refer Chapter-7)

PROFORMA FOR STATEMENT SHOWING THE QUARTERLY PROGRESS OF ORIGINAL WORKS FOR THE QUARTER ENDING.....

Civil Works costing Rs. Five crore and above.

Electrical Works costing Rs. 100 lakhs and above.

Medical equipment costing Rs. 50 lakhs and above.

Horticulture Works costing Rs. 10 lakhs and above.

S. No.	Name of work & location	Est. cost in lakhs Rs.	Tendered cost in lakhs Rs.	% above/ below schedule of Rates applicable	Agreement no.	Agency	Date of Commencement	Stipulated Date of completion	Physical progress of work	Name of Engineer-in-Charge and Address	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Annexure- 41
(Refer Chapter-7)

PROFORMA FOR STATEMENT SHOWING THE QUARTERLY PROGRESS OF SUPPLY/ PURCHASE CONTRACTS FOR THE QUARTER ENDING.....

S. No.	Name of the organization with location	Contract no.	Brief details of the materials required	Value of the contract	Mode of tendering	Scheduled delivery period	Present status	Remarks
1	2	3	4	5	6	7	8	9

Annexure- 42
(Refer Chapter-7)

PROFORMA FOR REGISTER OF OBSERVATION MEMOS RECEIVED FROM THE CHIEF TECHNICAL EXAMINER

S. No.	No. & date of Observation Memo	Name of work	Name of contractor	Remarks regarding subsequent settlement of observations
1	2	3	4	5

Annexure- 43
(Refer Chapter-7)

PROFORMA FOR REGISTER SHOWING OVER PAYMENT ASSESSED/POINTED OUT BY C.T.E ORGANISATION AND SUBSEQUENT RECOVERIES EFFECTED

S. No.	Reference no. and date	Name of work and agreement no.	Name of contractor	Amount of over payment assessed/ pointed out by CTE	Amount of over payment finally accepted by EE for recovery	Actual date of recovery of over-payment	Remarks
1	2	3	4	5	6	7	8

CPWD TEAM

1. Sh. D.C.Goel, ADG, Tech.
2. Sh. Vinayak Rai, Chief Engineer, CSQ (Civil)
3. Sh. Divakar Agrawal, SE, TLQA (Civil)
4. Sh. Anil Kumar Gupta, SE, DC-1
5. Ms. Bhumika Mishra, EE (TLC)
6. Sh. Udai Veer, AE(Civil)
7. Sh. Chander Vikas Gerangal, AE (Civil)
8. Sh. Onkar Mal Meena, AE(Civil)
9. Sh. Sanjiv Kumar, AE (Civil)
10. Smt. Sunita Bangla, Steno

CPWD



OTM Complex for Indian Coast Guard
at Visakhapatnam

Central Public Works Department

168 Years of Engineering Excellence