# PMAY-AHP(URBAN) HOUSING PROJECTS IN ANDHRA PRADESH

# QUALITY ASSURANCE MANUAL


**By**

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# CHAPTER 1

## Introduction to Quality Assurance Manual for PMAY – AHP (Urban Housing) Projects

- "Pradhan Mantri Awas Yojana- Housing for All (Urban)" is a flagship programme of Government of India as well as Government of Andhra Pradesh (GoAP) and is aimed at addressing the housing requirement of the urban poor including slum dwellers.
- For the year 2015-16 1,20,106 AHP houses were sanctioned under PMAY urban.
- For the year 2017-18 2,43,162 AHP houses were sanctioned under PMAY urban.
- Another 4lakhs AHP houses are going to be sanctioned within the next 3 months and will be grounded before March 2018.

**Financial assistance for the PMAY- AHP houses are as follows**

- Central Share – Rs 1.50 Lakhs/ unit
- State share – Rs 1.50 Lakhs/unit (in addition External Infrastructure and Land Cost will be borne by the State Govt. of AP.)

The remaining balance cost will be arranged through Bank loans and will be borne by beneficiary.

**The Highlights of PMAY- NTR Urban housing are as follows**

- Mostly G+3 pattern units with vitrified flooring, bathroom with ceramic flooring, ceramic dadooing in kitchen and booth room, wall putty & Emulsion paints.
- The Andhra Pradesh is first State in the entire world to adopt Monolithic Technology for housing meant for urban poor.
- Govt. of AP is first state in India to implement entire EWS housing through Shear wall Technology.
- The Completion period of all Housing Projects is fixed as **15 Months** so as to deliver the houses to the needy urban poor without any delay

This Quality Assurance Manual (QAM) has been prepared with the objective of putting in place a comprehensive, consistent and common system through Testing and Inspections for quality assurance to address specific need of the project to be taken up for implementation of Pradhan Mantri Awas Yojana (PMAY) – AHP(Urban) Housing projects with the focus on the activities primarily on supervision and quality control of construction works of the project after award of contract.

The QA manual shall be used for day-to-day reference of the Engineers in the field and the Contractors engaged in the construction works of PMAY Housing, Social Amenities & basic Civic Infrastructure. This manual will also help the implementing agencies to set the procedures to be adopted by the contractor for Quality Control. The manual contains checklists and quality control tests & their frequency related to various civil works primarily with Housing construction proposed under PMAY.

The quality control requirements prescribed in this Manual will be mandatory for all PMAY works.

This QA Manual focuses on the implementation activities of the project following contract award and primarily on supervision and quality control of construction works.

Its aim is to ensure that the works are executed as per specifications. Quality Assurance and test results shall be interpreted as applicable for different contracts in accordance with contractual provisions.

The Manual covers the overall quality assurance system and the field level quality control procedures for different types house construction works, based on IS codes. This Quality Assurance manual has been prepared referring following sources:

a. Relevant IS Codes
b. CPWD Specifications
c. National Building Code.
d. MoRTH Specifications

## CHAPTER 2

**Quality Control & Quality Assurance Concepts**

### Quality definition as per ISO : 8402 of 1994

The totality of features and characteristics of a product or services that bear on its ability to satisfy stated or implied needs.

- In the contractual environments needs/ requirements are specified.
- As such quality is generally understood to mean compliance with specified requirements, i.e., fulfillment of material specification, process specification, equipment specification and end specifications.

**QC Definition :** The operational techniques or activities (eg. Inspection or test) that are used to verify fulfillment of quality requirements for services and or products.

- QC normally refers to those tests necessary to control a product and to determine the quality of the product being produced.
- Quality control is a means to control the quality i.e., to verify the compliance of materials, equipment, process and final product to pre-determined requirements.
- Quality control in Building construction typically involves ensuring compliance with specified standards for the materials, workmanship and finished building in order to ensure the performance of the building according to the design.
- The specified standards are contained in the Agreements, IS codes etc. For the purpose of ensuring compliance of specified standards, random samples and statistical methods are commonly used as the basis for accepting or rejecting the batches of materials and the work completed.
- Defects or failures in constructed facilities can result in very large costs. Even with minor defects, re-construction may be required and facility operations impaired. Increased costs and delays are the result. In the worst case, failures may cause personal injuries or fatalities
- During the past, quality was often considered as conformance to specifications and was based on detection at the end of production stage, thus, ensuring conformance to specified requirements entirely through inspection and testing of product at the end. This is the quality control phase.
- In order to maintain or enhance the quality of the offerings, manufacturers use two techniques, quality control and quality assurance. These two practices make sure

that the end product or the service meets the quality requirements and standards defined for the product or the service

- If one looks around in the corporate sector, it is revealed that mere conformity to specifications is no longer considered as a measure of quality and the major corporate organizations have switched to a quality assurance (QA) phase.

## QUALITY ASSURANCE

- All those planned and systematic actions necessary to provide adequate confidence that a product or service / facility will satisfy given requirements for quality and also to perform satisfactorily in service.
- QA addresses the overall problem of obtaining the quality of a service, product, or facility in the most efficient, economical, and satisfactory manner possible.
- QA involves continued evaluation of the activities of planning, design, development of plans and specifications, advertising and awarding of contracts, construction, and maintenance, and the interactions of these activities

## QA Vs QC

- Many people get confused between quality control (QC) and quality assurance (QA).
- The process of making sure that the stakeholders are adhered to the defined standards and procedures is called quality control. In quality control, a verification process takes place. Certain activities and products are verified against a defined set of standards
- The QA stresses on planned and systematic working with a view to eliminate non-conformities. Statistical process control techniques are employed to assure that the product meets specified requirements, rather than achieving through detection and rejection of detectives at the end of production.

| Quality Assurance (QA) | Quality Control (QC) |
|---|---|
| Making sure the quality of a product is what it should be | Making the quality of product what it should be |
| Implementing agency responsibility | A producer / contractor responsibility |
| Includes QC<br>Doing the right things | A part of QA<br>Doing things right |
| Motivates good QC practices | Motivated by QA and acceptance producers |

## Quality Control (QC) Vs QUALITY ASSURANCE (QA)

**Definition of Quality control with reference to QA:** Those QA actions and considerations necessary to assess and adjust production and construction processes so as to control the level of quality being produced in the end product.
QA refers to those tests necessary to make a decision on acceptance of a project and hence to ensure that the product being evaluated is indeed what the client specified. These QA tests are normally performed by the implementing agency.

**QUALITY ASSURANCE**

- In quality assurance, a constant effort is made to enhance the quality practices in the organization. Therefore, continuous improvements are expected in quality functions in the company. For this, there is a dedicated quality assurance team commissioned. Sometimes, in larger organizations, a 'Process' team is also allocated for enhancing the processes and procedures in addition to the quality assurance team. Quality assurance team of the organization has many responsibilities. First and foremost responsibility is to define a process for achieving and improving quality. Some organizations come up with their own process and others adopt a standard processes such as ISO.

**Quality Assurance covers much larger area in comparison to Quality control functions.**

- Right design.
- Right materials of Construction.
- Right way of Construction.
- Right way of maintenance

The quality of materials and work shall meet the requirements specified in the agreement & relevant IS codes. The decision with regard to the relevance and applicability of the Clause shall rest with the Inchare Engineer. The quality of materials and work that are not relevant to the building specifications further shall meet the requirements of other relevant standards that are required to be followed. The manufacturer’s testing and certification shall be essential for the manufactured materials.

## QUALITY MANAGEMENT MECHANISM

- A three tire quality management mechanism has been practiced for ensuring the quality in PMAY- AHP housing projects.

- ✓ **In House QMM**: In-house quality control by the contractor with the approval of Engineer.

- ✓ **First tier QMM:** The executive agency has the primary function of quality control through enforcement of technical standards and quality control requirements through regular testing, close supervision and inspection.

- ✓ **Second tier QMM:** The quality control wing plays an important roll to ensure that the quality management system at the site is functioning satisfactorily and suggest possible improvements where required and thus conducts quality audit.

# In house QMM by the contractor

- First and foremost responsibility is to define a process for achieving and improving quality.

- In order to complete the Buildings so as to meet the specified requirements, contractors have to produce a quality control plan. These quality control plans have to include all certified material deliveries, component manufacturing steps, material acceptance tests and site acceptance tests

- This quality system is described (by the contractor) in a specific "Project Quality Plan", which should include subjects such as project organization, procedures to be applied during investigation, design & drawings preparation, procurement, fabrication, construction and commissioning and a summary of quality control plans.

- Contractors are responsible for the execution and completion of the work(s) inaccordance with the contractual provisions, specified standards & specifications and with in the contractual time and contract price for the work(s).

- For the E.P.C (turnkey) contracts, contractors are also responsible for preparing design, drawings, quantity surveying, cost estimation etc. and obtaining their approval.

- All test samples should be preserved, with proper identification numbers, test log reference, test date, and other applicable information. These samples must be stored at contractor's office/laboratory by the contractor.

- The Contractor Shall Establish field laboratory of 40 Sq meter area in the project site and establish all testing equipments to conduct the required tests on materials, workman ship and finished items of work.
- The Contractor Shall Submit Quality Management Plan (QMP) duly indicating the test procedures, frequency of testing and formats for recording test results, and get approval for QMP before proceeding with execution of the project.
- The contractor shall submit the detailed designs, all drawing and get approval from the competent authority and based on the above the contractor shall submit the detailed estimate with BOQ (Bill of Quantities) which will be basis for making payments.
- **Quality Control Tests on Materials before incorporation in the Works:**
- All materials before incorporation in the work shall be tested by the Contractor for the tests indicated "under 'Tests to be carried out prior to Construction'.
- The tests shall be carried out from each source identified by the Contractor.
- The test samples shall be representative of the material available from the source.
- Any change/variation in the quality of material with depth of strata shall be reported.
- Important tests like sieve analysis for particle size and gradation, flakiness index, Elongation Index, deleterious materials, aggregate crushing value, silt content, Aggregate Impact Value and any other tests specified by the Engineer shall invariable carried out in the presence of a representative of the Engineer.
- The test results shall form the basis for approval of the source and the material for incorporation in the work.
- For manufactured items, however, such as concrete pipes, doors & windows, water supply and sanitary items, flooring tiles, dadooing tiles etc, a test certificate obtained by the Manufacturer from an approved Test House shall be accepted

**Quality Control Tests during Construction**

- During execution of the work, quality control for workmanship and ensuring conformance to specifications shall be exercised on the basis of the tests indicated under 'Field Quality Control Tests during Construction'.
- The tests shall be carried out by the Contractor independently or in the presence of Employer's representative.

- The Contractor shall be fully responsible for all the tests carried out for the work.
- The First tier of quality management at project site has the primary function of quality control through enforcement of technical standards and quality control requirements through, regular testing, close supervision and inspection. The quality management functions of Implementation team shall include the following:
- Preparation of realistic detailed project report(DPR) with adequate attention to investigations and pre-construction activities which are essential for proper design and estimation of the project following relevant specifications.
- Preparation of bid documents and effective selection process for procurement of works, based on proven capacity and ability of the contractors.
- Supervising Site Quality Control arrangements including materials and workmanship, primarily through testing as per provisions of this manual.
- Ensuring that: Contractors have brought the necessary machinery and equipment to site.
- (ii) Field laboratory has been established.
- (iii) Key engineering personnel have been deployed by the Contractor.
- (iv) The work programme has been approved.
- Taking timely action to ensure replacement of defective material and rectification of defective workmanship.
- The Field engineers shall record the results in their own handwriting.
- The Senior Engineers during their site visits shall have a few tests carried out in their presence and sign in the Quality Control Register.
- Submission of monthly tests reports.
- Verification of Non Conformance Reports(NCR)when ever non-conformance occurs and the action taken by the Contractor on the NCR.
- Payment to the Contractor shall be regulated as per the Quality Control tests.

## First tier QC Testing

- The following frequency of visits to projects sites by the below mentioned implementation officials to extract good quality is much essential, while the work is in progress:
  - ATO–Daily
  - Dy. Technical Officer–Twice a week
  - Technical Officer–Once a week
  - Photographs at each stage of work with reinforcement must be taken and field officers must maintain a photo showing all components of work.
- **Stage Passing:**
- The responsibility at different levels of the executing agencies have been prescribed and made mandatory through the introduction of stage passing
- Supervisory officers at the level of ATO/ and Dy. TO shall exercise quality control checks and certify the work of various stages on the basis of tests and their frequencies indicated under 'Quality Control Checks'.
- The officer certifying the work at various stages as prescribed shall be responsible for the quality and quantity of the work certified by him.
- The prescribed tests, frequencies and the procedure for stage passing by Supervisory Officers shall be mandatory and shall form part of the Contract.
- **Non-conformance reports**
- When the test results do not confirm to the prescribed limits, NCR will be issued to the Contractors.
- The contractors should rectify the defects and intimate to the engineer in charge and again test should be conducted to ascertain that work has been rectified to meet the standards.
- **Remedying the defects and deficiencies shall be carried out in the following manner**:
- (1) Replacing the non-conforming material by materials conforming to the standards by changing the material source, material processing, construction equipment or technique before incorporation of the material in work.

- (2) In case a non-conforming material has been incorporated in the work, by removing the work to the extent of non-conformities and replacing it by a work meeting the requirements of the quality.
- (3) In case a work or any of its component exceeds the limits of tolerances specified in the quality standards, by rectifying the work and bringing it within the limits of tolerance

## Second tier QC Testing

- **Quality Monitoring:**
- The Quality Control Officers shall check the proper functioning of the Executive agencies by verifying the quality of completed works executed by the executive agencies and to see whether the executive agencies are effectively exercising quality control checks and reaching the intended objective.
- **The AIMS of the Quality Control**
- QC aim is to identify defects both in materials and finished product.
- The goal of QC is to identify defects after a product is developed and before it is released
- The actives or techniques used to achieve and maintain the product quality, process and service comes under QC.
- Quality control Team has to continuously inspect the work in progress to ensure that it is in line with the project scope and with an effective quality control programme which includes specified standards and service requirements. This QC team shall be responsible for overall quality of works to be implemented through contractor.
- The Concerned QC team member(s) shall record their observations, in the QC registers. Daily work record / Site order book as prescribed in this Quality Assurance manual shall also be maintained at project site
- The QC Team should also be ensured that Quality control lab has been established by the contractor and qualified personal as per provisions of contract have been deployed. It is also be ensured that records and registers of quality control have been maintained properly and observations are being recorded.
- They will also verify that the Non-Conformance Reports are issued in time and action is being taken by Contractor promptly. They will prepare Inspection Reports which shall be sent to the Implementation team for taking remedial action.

**Quality Audit**

- All the test results registers maintained by the field officers and contractors will be compared with reference to the number of tests specified in the codes. Further, obtained strength will be compared with required strength specified in the Codes / Agreement

The observed deficiencies in both quality and quantity will be quantified and compared with acceptable limits. The deficiencies beyond tolerable limits will be brought to the notice of the Chief Engineer concerned, for taking further necessary action.

**INTIMATION TO QUALITY CONTROL WING**

Agreement Authority shall forward copy of contract documents to the concerned Technical Officer and Chief Technical officers of QC wing within 10 days of executing agreement. The Dy. Technical Officer in charge of the work shall intimate the date of carrying out of concrete works or any item of work which requires sampling during the course of construction, well in advance to the Technical Officer, QC wing. The Technical Officer in charge of the work shall ensure that the date of commencement of each item of work is intimated in a timely manner to the concerned Technical Officer & Chief technical officer of the QC wing for arranging second-tier QC testing.

**MANUFACTURER'S CERTIFICATE**

The Contractor shall produce Manufacturer's certificate wherever required as per the guidelines in this Manual. The Contractor shall record the following statement in the Manufacturer's certificate before submission to the Dy.Technical Officer. "This Manufacturer's Certificate for the supply of ……. (Name of material with item number in Schedule) has been obtained by me from the manufacturer/dealer M/s ……. (Enter name and address of dealer/manufacturer) on ……., for the actual Material supplied at Site". He shall sign below the statement with date and name seal. The Contractor shall be responsible for the genuineness of the certificate submitted by him.

**PROCEDURE FOR TAKING SAMPLES AT SITE**

Samples for all tests in the first-tier QC testing shall be taken in the presence of an officer not below the rank of the Engineer-Incharge in charge. Photographs in which departmental officers and Contractor's representative are present may be taken during sampling of items and kept as a record. There shall be a separate module for Quality Control in the online for recording the photographs and test results. The photographs shall be uploaded on the very next day of sampling. After sampling, the Engineer-Incharge in charge shall make entries regarding the samples taken in the QC register at the earliest. The entries in the QC register shall be duly checked and attested by the Dy.Technical Officer.

Samples taken shall be kept in sealed bags and these bags shall be opened only at the time of testing. The samples which require curing shall be kept for curing at the site itself. The responsibility for sealing the bags shall vest with the Dy.Technical Officer/Engineer-Incharge. The responsibility for keeping the sealed samples under safe custody and curing shall vest with the Contractor. The Engineer-Incharge shall ensure that the curing of the sample is done properly.

Samples for second-tier testing shall be taken from site by an officer not below the rank of an Assistant Technical Officer of the QC wing. If samples taken are kept at the site for curing, the same procedure detailed for first-tier testing shall be followed. An acknowledgement for receipt of the sample shall be obtained by the QC wing from the Contractor or his representative, to ensure that he will keep the sample under safe custody. Photographs of sampling shall be taken by the officer entrusted to take the sample. The photograph shall be uploaded in the online by the Technical Officer of the concerned QC laboratory on the very next day.

**RECTIFICATION OF DEFECTIVE WORK**

The Contractor is bound to carry out the rectification works at his own cost, if results obtained during quality control tests either in the first-tier or second-tier do not comply with the requirements. He shall also carry out rectification works, if any pointed out during technical audit done after completion of work.

The Dy.Chief Technical Officer/ Technical Officer shall initiate action, if required based on the test results obtained from first-tier and second-tier testing and the technical audit. On receipt of the test reports, the Dy.Chief Technical Officer shall compare the results obtained in the tests with the values specified. If the result of any test falls outside the requirement, he shall issue notice to the Contractor forthwith, pointing out the nature and extent of defects and directing to rectify the defects by suitable methods. The Dy.Chief Technical Officer shall inspect site after rectification is completed and issue approval in writing if he is satisfied with the rectification work carried out.

If a Contractor does not comply with the direction to carry out rectification work, his contract shall be terminated at his risk and cost and penal action as per registration rules shall be initiated against him.

**CHECKLISTS**

There shall be a quality verification of the work at the time of submission of each bill by the Contractor. For this, checklists are to be filled up by the Engineer-Incharge concerned during the execution. It shall be verified and attested by the Dy.Technical Officer and reviewed by the Technical Officer before submission to the Dy.Chief Technical Officer along with the bill for payment. The entire monitoring process shall be done through online. Specimen checklists for quality assurance are given in Appendices of this Manual.

# CHAPTER 3

# Quality Assurance plans for materials & Civil Works of PMAY-AHP (Urban) Housing Projects.

## Quality Assurance Plan for basic construction materials

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

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

1. Test reports for materials tested at site, such as cement, sand, water, aggregates, bitumen etc.
2. Manufacturer's certificates and IS mark for manufactured items.
3. Third party inspection for various items as per contract documents.

**Q.A P for Basic Materials**

The first step towards ensuring good quality construction is to get good quality basic materials required to be used in the construction activities. These materials may be raw materials like Aggregates, Sand, Earth or Water, processed materials like Cement, Bitumen, and Geo textile. Sealant etc. or processed and assembled materials like Bearings and Expansion Joints. This shall also require prior approval of the source or supplier for the individual material or product.

In order to ensure that material used in construction is of high quality and meets the codal requirements of BIS, IRC or MORTH as applicable, a series of tests have to be carried out at regular frequencies. The testing has to be done first at the level of the supplier *I* manufacturer or the contractor. This forms the first level check. The testing may be done jointly with the client or the client may do the testing independently in the site laboratory. This forms the second level check. The material is also got tested from reputed independent laboratories. This forms the third level check.

### Materials Tested at Project Site:

The materials to be tested at project site include cement, water, aggregates for concrete, bricks and stones, soil for embankments, and aggregates and bituminous materials for road works. For aggregates and soil, the contractor shall obtain the approval of the borrow source or quarry before extracting material. The list of materials to be tested on site is given below. Test procedures are presented in under the referenced procedures described. Test report formats are included in Annexure A-Z. The reports are to be maintained in a bound register, where in 3 copies of report will be prepared, two copies are to be submitted with monthly report and third copy to be retained by contractor.

**TESTS TO BE CONDUCTED ON THE CEMENT**

**a)** Cement:- The following tests should be conducted on the cement duly obtaining one bag from the each consignment received at site.

1) Normal consistency

2) Initial setting time/Final setting time

3) Fineness

4) Soundness

5) Compressive strength - 3/7/28 days

Test certificates shall be produced to the field engineers and shall obtain approval before use on the work**.**

**TESTS TO BE CONDUCTED ON THE STEEL**

**b) Steel:-** HYSD Fe 415/Fe500 conforming to IS: 1786 should be used. The following tests are to be conducted on all diameters for each consignment.

- 1) Tensile Stress
- 2) Modulus of Elasticity
- 3) Weight Kg/Mt.
- 4) Percentage Elongation.

5) Rebend Test

**TESTS TO BE CONDUCTED ON THE COURSE AGGREGATE**

**c) Coarse Aggregate:-**The following tests to be conducted on the Coarse aggregate.

1) Grading Test

2) Aggregate impact Value or los angles abrasion value

3) Deleterious material

4) Flakiness Index

5) Elongation Index

6) Soundness

7) Alkalinity and acidity as per IS-3025

8) Solids

## Materials and Equipment certified by Manufacturer

Apart from tests conducted on field, acceptance of certain manufactured materials and equipment components, as stipulated in the contract, shall be based on test certificate(s) from the manufacturer conforming to BIS and on visual inspection. These items shall bear the ISI mark. Implementing agency shall review the manufacturers' certificates for conformance to contract requirements before these items are delivered to the site, installed or otherwise incorporation in the works. Materials and equipment subject to manufacturer's certification are as under:

1. Cement
2. Steel/Reinforcing Steel
3. Paint, Primers and Protective Coatings
4. Water Proofing Compound
5. Metal Works such as windows, barbed wire, MS ladder, footrest, rolling shutters etc,.

## Materials and Equipment Inspected By Third Party

Materials and equipment are to be inspected by a third party as stipulated in the contract documents. Third party inspection would normally take place at the factory during or upon completion of manufacture. Before delivery on site, Third Party Inspection (TPI) certificates shall be reviewed for conformance to requirements. Inspection criteria should be stipulated in the contract document.

## Quality Assurance of General Civil and Structural Works

The subject covers materials to be used for building works, the testing of works and the inspection of workmanship for general civil and structural works. The key elements to be inspected in these works are concreting, stone masonry, brick masonry and finishes. The requirements for testing and control of materials for these works are outlined in the previous paras.

## Q.A.P for Site Activities

While executing important activities like Piling, Casting of Reinforced Cement concrete elements, construction of Embankment, Road works like WBM, road surfacing activities etc. it has to be ensured that the completed work satisfied the required of Q-4 level of Quality Assurance as per the RC: SP-47. In addition to the checks and tests on the quality of the materials to be used as enumerated in the previous chapter, it shall be necessary to carry out certain tests during the construction process itself at the various stages of construction. These tests for various activities comprise its QAP.

The results of these tests shall be reported as per the proformas given in the subsequent paras and the various checks required to be made at different stages have also, been given in the previous paras. A standardized procedure for carrying out the activities has to be viewed as a whole in order to ensure the complete QAP of any particular activity.

## Testing of Works

The works to be tested on site include excavation, cement concreting and stone & brick masonry. All the materials proposed to be used in these works shall be tested by the contractor and get these approved well in advance of execution of these works.

Tests for general civil and structural works are listed in below. Test procedures are presented in the below paras**,** under the referenced test numbers. Required materials tests are also indicated materials testing procedures are presented in previous section. Test report formats are included in Annexure A-Z. The contractor shall conduct tests as stipulated.

**Tests to be Conducted on the Concrete**

1) Slump test as per IS-1199

2) Cube Strength (Compressive Strength)

Concrete cubes of 150 mm X 150 mm X 150 mm should be cast and tested at different levels of structure for 7 days and 28 days for compressive strength and the frequency of sampling should be as follows.

- One test for 1-5 cum of concrete
- Two tests for 6-15 cum of concrete
- Three tests for 16-30 cum of concrete
- Four tests for 31-50 cum of concrete
- + one set for every 50 cum of additional concrete work.

  Note: One sample will have 3 specimens

**Tests to be Conducted on the Self Compaction Concrete**

1) Flow ability – Slump Flow Test

2) Passing ability – L Box Test

3) Viscosity - T500 Slump, Flow Test or V-Funnel Test

4) Segregation - Segregation Resistance (Sieve) Test

5) Compressive Strength - Cube Strength

Concrete cubes of 150mm X 150mm X 150mm should be cast and tested at different levels of structure for 7 days and 28 days for compressive strength and the frequency of sampling should be as prescribed in the previous slide.

**Other Tests**

- The standard procedure is adopted for the assessment of quality of foundations, walls, slabs, doors & windows, flooring items, Electrification, water supply & Sanitary fittings, etc....

- Further, The permeability test will be conducted on roof slab, toilet slabs and water tanks to assess the leakages

**Foundations:-**

- Before starting the work the safe bearing capacity of soil must be tested in the approved/authorized laboratory for adopting suitable designs.

**P.C.C: Plain Cement Concrete:**

- Plain cement concrete (PCC) is used to provide rigid impervious bed to RCC in foundation. PCC can be used over compacted ground Plain cement concrete can also called only "cement concrete (CC)" or "binding concrete"
- Check the dimensions of form work of PCC before mixing concrete.
- Check polythene sheet is laid over PCC bed.
- Check the concrete slump (maximum slump should be 75mm)
- Check the thickness level of PCC before casting by putting steel pegs in concreting area or putting level pillar of fresh concrete at suitable distance.
- Check the finish level of PCC by thread fixing with nails in form work.
- Inspect if the concrete is placing gently

**Reinforced Cement Concrete Footings**

- **Reinforced Cement Concrete** Footings**:** RCC Footings are structural elements that transmit column or wall loads to the underlying soil below the structure. Footings are designed to transmit these loads to the soil without exceeding its safe bearing capacity, to prevent excessive settlement of the structure to a tolerable limit, to minimize differential settlement, and to prevent sliding and overturning. Footings are laid above the PCC to support the structure according to the dimensions given in the plan with Reinforcement

- Marking of Footings

- Laying of footings

- Checking of Footings

- Marking of footing: According to the grid lines marked on the site the PCC is laid, that grids are transferred to the PCC and by that reference the marking of the footing is done

- Laying of Footing: Laying of footing is done on PCC, it required all the shuttering works and the reinforcement works

**Checking of Footings**:

1. Reinforcement check
2. Shuttering checks

**Reinforcement Checks:**

1. Steel Placing: The steel has to be placed in a proper way as per the drawings

2. Spacing: After placing the steel the spacing should be checked properly with the reference of the markings and whether they are as per the drawings or not

3. Number of Bars: Check whether the given number of bars is placed or not

4. Diameter of Bars: This is the important factor that will consider mainly while laying of the reinforcement. The diameter of the bars has to be placed in the same direction as given in the drawings.

5. Chair height calculations: Mainly chairs are provided to avoid the contact of the top mat to the bottom mat. The height of the chairs is dependent on the depth of footing

6. Alignments: In this reinforcement checks the alignments are checked by considering the covers on the all sides of the footing

## 3 Shuttering Checks:

1. Profile (level): Whether the top of the footing is level or not has to be checked in these checks.

2. Alignments: The footings are to be laid in the same alignments; if not there may be chances of changing the position of the footing

3. Plumb: The vertical of the footing is checked by using the plump

4. Dimensions: The dimension of footing has to be laid same in the site as per the drawings given. For that, the dimensions of the footings can be accurately checked.

5. Diagonal: After marking the footing dimensions on the PCC it has to be checked diagonally.

6. Supports: After providing the shuttering works it has to support by some supports, so that can avoid the leakage of the concrete when it is poured. For providing this supports the excavations has to be done 1 feet extra excluding the dimension of the footing not in the depth.

7. Gaps: The gaps between the shuttering works has to be avoided, so when the concrete is poured the leakage can be arrested

8. Covers: After laying of the reinforcement the covers has to be checked. If it is not, there may be chances of increasing the cover at one side and decreasing at other side.

**RCC PLINTHBEAM, SHEARWALL AND SLAB**

- **Plinth BEAMS**: A beam is a structural member which spans horizontally between supports and carries loads which act at right angles to the length of the beam. Furthermore, the width and depth of the beam are "small" compared with the span. Typically, the width and depth are less than span/10 the cover at other side.

- **Shear walls**: Shear walls are vertical elements of the horizontal force resisting system shear wall in structural engineering is a structural element that transmits, through compression, the weight of the structure above to other structural elements below.

- **SLAB:** A concrete slab is a common structural element of modern buildings. Horizontal slabs of steel reinforced concrete, typically between 100 and 500 millimeters thick, are most often used to construct floors and ceilings, while thinner slabs are also used for exterior paving.

    - Checks conducted for the beams walls and slabs

    - Reinforcement Checks

    - Shuttering Checks

**Reinforcement Checks**

1 Steel Placing: The steel has to be placed in a proper way as per the drawings

2 Spacing: After placing the steel the spacing should be checked properly with the reference of the markings and whether there are as per the drawings or not.

3 Number of Bars Check whether the given numbers of bars are placed or not.

4 Diameter of Bars: This is the important factor that will consider mainly while lying of the reinforcement. The diameter of the bars has to be placed in the same direction as given in the drawings

**Lapping:**

- Steel reinforcement usually comes in 6m (200 ft) and 12m (40ft) lengths. In such cases where the steel reinforcement is required to exceed these lengths, or other cut lengths then a splice is required. This lap length as we would discuss varies depending on the bars sizes as there are various bar sizes and where the bars are lapped and/or which structural member or element the lapping occurs.

**Shuttering Checks**

- **Alignments**: The footings are to be laid in the same alignments; if not there may be chances of changing the position of the footing

- **Plumb:** The vertical of the item is checked by using the plumb

- **Dimensions**: The dimension of items has to be laid same in the site as per the drawings given. For that, the dimensions of the items can be accurately checked
- **Diagonal**: After marking the footing dimensions on the PCC it has to be checked diagonally.
- **Supports**: After providing the shuttering works it has to supported by some supports, so that can avoid the leakage of the concrete when it is poured. For providing this supports the excavations has to be done 1 feet extra excluding the dimension of the footing not in the depth

- **Gaps**: The gaps between the shuttering works has to be avoided, so when the concrete is poured the leakage can be arrestees
- **Covers**: After laying of the reinforcement the covers has to be checked. If it is not, there may be chances of increasing the cover at one side and decreasing the cover at other side.

## Control of electromechanical works

The subject gives an overview of the quality control requirements for electromechanical works, such as water treatment and supply systems, sewage treatment plants, compost plants, pumping systems, and power supply and distribution systems. The requirements for testing and control of input materials and components, including manufacturers' certification and third party inspections, are outlined in the previous chapter.

Materials and components to be incorporated into electromechanical works shall be inspected as soon as they are delivered, to ensure that they meet the specifications and design requirements, are in agreement with shipping documentation, and are accompanied by manufacturer's certifications or third party inspection certificates, as applicable. Accepted materials and equipment shall be properly stored by the contractor until needed. If manufacturer's installation instructions conflict with design or contract requirements, these shall be notified immediately. Installation shall proceed only after the materials and components are approved.

A series of inspections and tests during installation and completion of electromechanical works shall be performed by the contractor or the equipment manufacturer and witnessed by Engineer-in-charge, as follows:

- Preparatory Inspections: Prior to installation, the civil and structural works where electromechanical equipment is to be installed shall be inspected to ensure conformance with designs and equipment installation requirements.
- Installation Inspections and Tests: A system of inspections and tests, as specified in the contract or recommended by the equipment manufacturer, shall be employed throughout movement to position and installation of equipment and systems. Inspections shall be performed at critical points during installation. Surveillance shall be provided throughout

the progress of work to ensure that installation is performed in accordance with the contract requirements, approved drawings, acceptable workmanship standards and configuration control requirements. All field modifications and retrofit work shall be performed under the surveillance of the installation inspector.

- Installation Verification Inspections: Prior to all mechanical and electrical testing, verification inspections shall be performed to ensure that equipment has been satisfactorily installed.
- System Tests: These tests shall be conducted as appropriate to demonstrate that the installed systems are free from damage due to shipment and installation, and that equipment performs in accordance with specifications.
- Integrated Tests: After completion of system tests, integrated tests shall be performed to demonstrate that the system performs satisfactorily when connected to its interfacing systems or sub-systems. These tests will be followed up by commissioning tests.
- Commissioning Tests: These consist of a series of tests performed under service operating procedures to demonstrate compatibility of the physical plant with operating procedures.
- Final Inspections: Final inspections shall be performed to ensure that the completed work is in accordance with the contract and that all previously identified discrepancies have been resolved satisfactorily.

## External Electrification:

All supply and installation work shall be carried out as per specification and in accordance with the construction drawings and shall conform to requirements called for in the Indian Electricity Rules 1956 with its latest amendment, Indian Electricity Acts and all relevant codes and practices issued by the Bureau of Indian Standard as amended up-to-date. The work shall also comply with the provisions of the general or local set of legislatures and regulations of any local or other statutory authority which may be applicable.

Contractor shall obtain approval of the layout at site from the Engineer-in-Charge before commencement of the work. Contractor shall furnish samples of materials at site for approval including arranging necessary tests on samples, as directed by the Engineer-in-Charge in an approved Laboratory.

Contractor shall employ a full time experienced supervisor having electrical supervisor's certificate of competency endorsed by the Licensing Board, Directorate of Electricity of concerned State to supervise the work.

Contractor shall keep the appropriate Electrical Inspector & supply authority be informed from time to time as per the execution programme of the work shall be the responsibility of the contractor and he shall be responsible to ensuring that all work passes their approval.

# CHAPTER 4

## Documentation on Quality Assurance

Proper check lists and test preformed play a vital role in not only ensuring the quality control but also for proper documentation of the project. At the end of the project, will he only the documents which will help in knowing the quality assurance system adopted in that project. In order to maintain the uniformity in the documentation of the total project, some checklists have been given in this manual along with the testing proformas. Check lists are framed for the selection of the best material and workman ship etc. and also for ensuring the specifications to be followed in the execution of the work. While the test proformas are to be used while conducting any test at site.

Proper check lists and tests preformed play a vital role in not only ensuring the quality control but also for proper documentation of the project.

The supplier should also have the capacity to supply the required volumes of material while maintaining consistence in quality. Certain checks shall have to be carried out in order to select and approve one more suppliers or manufacturers for the material to be used in the construction.

The quality control however does not end with the approval of the source. The material procured from the approved sources needs to be checked frequently for its quality carrying out certain tests. These tests and their testing frequency have been mentioned in the previous chapter. The formats for reporting the results of the tests are given below. While framing the test profomas for the material testing, the emphasis has been given in the BIS codes which are applicable for the acceptance of the material in the work before the selection as well as during the execution of the work

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

The flow of test report documentation shall generally be as follows:

i) Test reports shall be submitted by the contractor to the Engineer – in-charge.

ii) Engineer – in -charge representative shall issue a Conformance/Non-Conformance Report (CNC Report) to the contractor after review of test results using Format **QF-1.** The CNC reports will have a running serial number for each contract package.

iii) The CNC report shall be entered in the Test Report Log by the contractor at the site, using Format of **QF-2**. The details of input materials will be recorded in the Material

Register, using **QF-3.** The contractor shall maintain all test records properly.

iv) Other approvals given to the contractor will be recorded in the daily logs of the contractor which should form part of the contractor's monthly report. A recommended format for Daily Work Record/Site Order Book is illustrated in Format **QF-4.**

v) Hindrance during execution if any shall be recorded in Hindrance register as per QF-5.

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

## Tracking of Instructions

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

All the instructions to the contractor shall flow through the Engineer in charge of the Implementing Agency. The instructions are of the following types:

1. All instructions related to the contract administration including approval of the contract variation orders, time extensions, notices related to rate of progress etc. to be issued by implementing agency.
2. The instructions regarding quality, testing, monitoring and work scheduling can be issued by the CMA, State quality monitors and representatives of implementing agencies also. In case of conflict of instructions of the in these matters, the instructions of the Implementing Agency would prevail.
3. Instructions issued during site visits or inspections of the various agencies, which are normally recorded in the contractor's Site Order Book, shown in QF-4.
4. Instructions issued during review meetings in the form of minutes, letters, etc.

All instructions noted above are to be recorded by the contractor in the instruction log. Instructions also include notices of rejection of work inspected because it was found to be non-conforming to requirements and which has to be redone or rectified.

### Site Order Book

The Contractor shall be responsible to maintain a Site Order Book, in triplicate, at the site of the works at all times, and this shall be open for inspection by authorized representatives of Central, State and Implementing agencies.

The Site Order Book has two primary purposes – to record the day-to-day instructions to the Contractor and the Contractor's compliance with these instructions, and to record the inspection and acceptance of work completion stages along with issuing approvals to the Contractor to proceed with the next stage of construction.

As noted above, the status of the Contractor's compliance with instructions issued is to be summarized in the Instruction Log and reviewed monthly by the implementing agency and during the periodic inspections by supervising agencies. In cases where the Contractor has failed to comply with the instructions, the reasons therefore shall be determined and necessary remedial actions taken. The implementing agency will maintain a file of site orders issued to contractor for record and compliance.

**Non Conforming Products and Procedures**

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 day cube test results. In these cases removal, re-execution or rectification of the work is usually difficult. Therefore separate procedures are laid cut below for non-complying concretes. A similar situation may also arise when test results of some materials arrive after the same has already been incorporated in the project. This happens when certain materials like Admixture which require long term tests, such as development of compressive and flexural strength over 1 year and length changeover 1year, to be performed and the construction cannot wait for them. Other such example is long term corrosion resistance test on coatings. 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 chapter describes procedures for the same.

**Non-Compliance other than Strength or Finish for Concrete Works**

In the event that any requirement other than strength and standard of finish is not met then the following procedure shall be followed:-

The Contractor shall be notified without delay verbally and in writing by the following means.

Return of the Request for Inspection form signed "not approved" with the reasons for rejection stated.

Issue of a Site Instruction or Site works order or letter stating the facts and confirming that the works are not approved.

Approval to carry out concreting of a similar nature shall be withheld. The Contractor shall be asked for his proposals to rectify the non-compliance which may involve resubmission of materials, new trial mixes, and revised method statement.

The acceptance or rejection of any unapproved concrete work shall be referred to the Engineer. When satisfied with the measures taken to ensure future compliance the Engineer shall confirm approval to continue concrete for - permanent works.

**Non-Compliance with Strength requirements**

The Specifications for concrete recognizes the statistical possibility of cube failures and thus limits of mean, standard deviations, and minimum values of strength are specified. A single isolated unsatisfactory cube result is not usually cause for rejection. The rejection criteria are as set out in the Contract agreement.

In order to provide assurance against strength failures the procedures described in Chapter 4 shall be observed.

In the event of cube failures outside the provision of the Contract then the non-compliance procedures described in the specifications shall be followed.

**In addition the following procedures shall be followed:-**

- **a)** Approval of concrete of similar works shall be withheld.
- **b)** All aspects of concreting shall be reviewed.
- **c)** The cause of failure shall be identified and measures taken to remedy the problem.
- **d)** The repair/ rectification procedures for commonly arising defects should be covered by tender specifications, from which the contractor shall be asked to state his exact proposals for rectification. It shall be ensured that the faulty work is made good following approved method and retested and/or inspected.

The fact of non-compliance & rectification means as proposed should be conveyed to the Engineer and for review & opinion about

- **a)** Acceptability of Contractor's proposal.
- **b)** Further non-destructive testing, if any.
- **c)** Acceptability in case strength is achieved at a later age (e.g. 90days).
- **d)** Acceptability at the level of strength achieved for the stress levels in concerned members.
- **e)** Rejection of concrete.

**Non-Compliance with Finish Requirements**

In order to prevent occurrence of unacceptable standard of finish the procedures for formwork and trial panels described in shall be followed. This will involve preparation of scaled Mock up trials if provided for in the contract or ordered by the Engineer in case of specific doubts,

Where the required finish is not attained then the non- compliance procedure described in the Specifications shall be followed.

In addition the following procedures shall be followed

- Approval of similar formwork shall be withheld.
- All aspects of formwork shall be reviewed.
- The cause of poor finish shall be identified.

Works other than concrete the procedure for acceptance of finish works for earthworks, formwork, reinforcement, coatings on reinforcement, materials for concrete, pre stressing and bridge finishing works are straightforward and shall be as follows:-

1. Regular special testing, logging of results and inspections shall determine compliance or non-compliance.
2. Any non-compliance shall without delay be notified to the Contractor.
   This shall be done both verbally and in writing by the following means:-
   - Return of the Request for Inspection form signed "not approved" with the reasons for rejection stated.
   - Issue of a Site Inspection or Site Work Order or letter stating the facts and confining that the works are not acceptable for inclusion in the pertinent works.
3. The Contractor shall be asked to state his exact proposals for rectification and it shall be ensured that the faulty work is made good and retested or inspected as decided by the Engineer.

It is mandatory that all instances of works outside the Specifications are recorded in writing to the Contractor. This ensures that:-
The Contractor is compulsory informed. A record of non-compliance is built up to give a general guide to the Contractor's performance.

The Quality Assurance Manager shall summaries the following information for each category of work:-

**The total number of inspections and tests.**

- The number first time approvals i.e. the number of times the material or workman ship is approved on the inspection.
- The number of second; third; fourth etc. inspections or tests of i. e same work required before final approval.
- The first time approvals, second, third, etc. over suitable time intervals.

From the above in action, the Engineer shall review the Contractor's superintendence and take action where necessary to improve matters. From increases or decreases in the number of first time the improvement or deterioration in Contractor's performance can be monitored. Record of repair/rectification, retesting, inspection & acceptance shall be kept as part of "as built" documentation. Record of all references to designers for opinion/rectification and approvals given by them. Record of compliance to the modifications in procedures, testing etc., if any, shall be properly maintained.

**ADMIXTURES**

In case the material test show non compliance prior to its use the complete material lot shall be removed from the site at once and the procedure stated above shall be followed. But, in case results arrive after the particular Admixture has been used in the concrete then the contractor shall be required to give his methodology of rectification, strengthening and get it approved by the Engineer before execution. Such a rectified structure shall be subject to appropriate non destructive test in, if felt necessary by the Engineer. If no satisfactory method is found then the structural members incorporating the non compliance material shall be dismantled at no cost to the owner/client 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.

**The following forms & Certificates are to be submitted for taking up QC inspection.**

Annexure-I

# Work memo for QC inspection

| | | |
|---|---|---|
| 1.0 | **PARTICULARS OF PROJECT:** | |
| 1.1(a) | Name of the Project | |
| 1.1(b) | Name of the **CITY /ULB** | |
| 1.2(a) | Description of work (Please mention the Foundation & Basement details, Dimensions of the Walls, Slabs etc,.) | |
| 1.2(b) | Agreement No. | |
| 1.2(c) | Name of Agency/Contractor | |
| 1.3(a) | Scheduled date of commencement | |
| 1.3(b) | Actual date of commencement | |
| 1.4(a) | Scheduled date of completion | |
| 1.4(b) | Expected/ Actual date of completion | |
| 1.5(a) | Stage of work as on date of inspections (Please enclose as many Photographs as possible) | |
| 1.5(b) | Percentage progress at the time of inspection vis a-vis expected as per contract and reasons for delay, if any | |
| 1.5(c) | Details of mile stones as per contract vis-à-vis their achievement | |
| 1.5(d) | **Name of the officers in execution Wing**<br>**1. ATO**<br>**2. DTO**<br>**3. TO**<br>**4. Dy.CTO** | |

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# Annexure-II

# Lab Tests Conducted by Other Agency

**Name of the Work:**

| Sl.No. | Material | No.of Tests done | Whether Results are within limits (YES/NO) |
|---|---|---|---|
| 1 | **Water:** Asper Clause 5.4 of ISI 456-2000 | | |
| 2 | **Design Mix** M30: | | |
| 3 | **Cement:** 43 Grade (IS:8112-1989)/6 Grade (IS:12269-1989) | | |
| 4 | **Steel:** Fe 415/Fe 500 (IS:1786-1985) | | |
| 5 | **Sand:** (IS 383) | | |
| 6 | Coarse Aggregate | | |
| | a) 20m Metal (IS 383) | | |
| | b)12.5mm Metal | | |
| | c) Single Size : | | |
| | d)Graded Size: | | |
| 7 | **40mm Metal (single Size):** (IS 383) | | |
| 8 | **CC Cubes for VRCC/SCC Members (7 & 28Days)** | | |
| 9 | **Tiles** (IS:13712:2006) | | |
| | 1) **For Flooring** | | |
| | a)Vitrified tiles : | | |
| | b)Ceramic tiles: | | |
| | **Vitrified /Ceramic tiles for Dadooing:** | | |
| 10 | Door Frames: | | |
| 11 | Window frames & Shutters: | | |
| 12 | **Flush door Shutters** as per IS 2202 | | |

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# Annexure-III

## FIELD TESTS CONDUCTED AND REGISTERS MAINTAINED AT SITE

**Name of the Work:**

| Sl.No | Material | Quantity Of Item | Frequency of Tests to be done as per Agreement/IS codes | | No.of Tests Required | No.of Tests done | Whether results are within limits (Yes/No) |
|---|---|---|---|---|---|---|---|
| 1 | 20mm HBG Metal (Single size): | | | | | | |
| | a)Gradation | | One Test for 15 cum | | | | |
| | b)Flakiness index | | One Test for 15 cum | | | | |
| | c)Aggregate Impact value | | | | | | |
| 2 | 20mm HBG Metal (Granded): | | | | | | |
| | a)Gradation | | One Test for 15 cum | | | | |
| | b)Flakiness index | | One Test for 30 cum | | | | |
| | c)Aggregate Impact value | | | | | | |
| 3 | Sand for concrete: | | | | | | |
| | a)Gradation:Zone I to III of table 110-D of APSS No.110 | | One Test for 15 cum | | | | |
| | b)Silt content. | | At least Once on the day of work: Yes/No | | | | |
| | Bulking of sand | | Three per each day of work.i.e. Morning, Noon and Evening: Yes/No | | | | |
| 4 | VRC Concrete (IS 456-2000) & SCC | | | | | | |
| | Grade of Concrete. M20/M25/M30 | | | | | | |
| | a) Slump of Concrete. | | Thrice in a day of concrete in Morning, Noon and Evening: Yes/No | | | | |
| | b)No.of C.C. Cubes casted and Tested as per required frequency as per Table IS:15.2.2 of IS 456-2000 | | QTY | No.of samples (1set =6cubes) | | | |
| | | | 1 to 5 | 1 set | | | |
| | | | 6 to 15 | 2 set | | | |
| | | | 16 to 30 | 3 set | | | |
| | | | 31 to 50 | 4 set | | | |
| | | | 51 and above 4 plus one additional sample for each additional 50 cum of part there off : Yes/No | | | | |
| 5 | 40mm HBG Metal (single size): | | | | | | |
| | a)Gradation | | One Test for 15 cum | | | | |
| | b)Flakiness index | | One Test for 30 cum | | | | |
| | c)Aggregate Impact value | | | | | | |
| 6 | Sand of Masonry: | | | | | | |
| | a)Grandation as per table 110-A of APSS No.110 | | At least Once on the day of work: Yes/No | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 | Sand for Finishing's: | | | | | |
| | a)Gradation as per table 110-B&110-c of APSS No.110 | | At least Once on the day of work: Yes/No | | | |
| | | | | | | |

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# Annexure-IV

**MAKES & BRAND NAME OF Building Materials used on the work**

| Sl.No | Item Name | Variety | Brand Name | Whether ISI/ ISO Certified | Quality (Premium/first Class/ Standard |
|---|---|---|---|---|---|
| 1 | Cement | 43 grade | | | |
| 2 | Steel | F 500 | | | |
| 3 | Flooring tiles | Vitrified | | | |
| | | Ceramic | | | |
| 4 | Dadooing Tiles | Ceramic / Vitrified | | | |
| 5 | Door Frames | Wood/Steel/PVC | | | |
| 6 | Window frame & shutter | Prepainted/Steel | | | |
| 7 | Flush Door Shutters | 35mm/30mm thick | | | |
| 8 | Fixture for Door | Aluminum | | | |
| 9 | Wash Basin | | | | |
| 10 | Water Closet | European | | | |
| 11 | Water Closet | Indian | | | |
| 12 | Flush Tank | | | | |
| 13 | Taps | | | | |
| 14 | SWR PVC Pipes | | | | |
| 16 | PVC rain water down take pipes | | | | |
| 16 | GI Pipes | | | | |
| 17 | CPVC Pipes | | | | |

Certified that all the Items are executed as per the Agreement Specifications

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# Annexure-V

Check List – 4 Makes/Brands of Materials: Electrical

Name of the Work:

| Sl.No. | Item Name | Brand Name | Whether ISI (Yes/No) |
|---|---|---|---|
| 1 | PVC Conduit Pipes | | |
| 2 | Switches/Switch board | | |
| 3 | 6 amps 2/3 pin sockets | | |
| 4 | 16 Amps 5 in 1 sockets | | |
| 5 | Tube light fittings | | |
| 6 | LED Lights | | |
| 7 | Ceiling Fans | | |
| 8 | Exhaust fans | | |
| 9 | Air Conditiners | | |
| 10 | Distribution Boards | | |
| 11 | MCB'S | | |
| 12 | PVC flexible copper cables | | |
| 13 | Aluminium UG Cables | | |
| 14 | Pumps & Motors | | |

Certified that all the items are executed as per the Agreement specifications.

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# Annexure-VI

**Check List – 6 Electrical Annexure – B : Form of completion Certificate**

I/We verify that the installation detailed below has been inspected and tested and that to the best of my/our knowledge and belief, it complies with Indian Electricity Rules, 1956 as well as IS 732 – 1966.

Electric Installation at Voltage and system of supply

| | | No. | Total | Types or System of Wiring | | |
|---|---|---|---|---|---|---|
| a)1 | Light Points | | | | | |
| 2 | Ceiling fan points | | | | | |
| 3 | 6A 3Pin socket outlet points | | | | | |
| 4 | 16A 3 Pin socket outlet points | | | | | |
| 5 | AC points | | | | | |
| 6 | Exhaust Fan points | | | | | |
| 7 | a)3 Phase DB's | | | | | |
| | b)Single Phase DB's | | | | | |
| b) | Length and Size of underground main cable laid | | | | | |
| c) | a)No.of Pipe earth electrodes size | | | | | |
| | b)No. Of coppe plates earthing | | | | | |

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# Annexure-VII

## Certificates

**Name of the work:**

1. **Foundation and Basement filling Certificate**

It is certified that filling in the above work is done with useful excavated earth (exuding rock)/Carted earth/Gavel/Sand in trenches, sides of foundations and basement in layers not exceeding 150 mm thick, consolidating each deposited layer duly watering and ramming as per Agreement and APSS No.309 & 310.

2. **No Cracks Certificate**

This is to certify that no cracks were seen in the walls and slab for the above work.

3. **No Dampness Certificate**

It is certified that ponding test is conducted as per agreement and there is no dampness /leakages observed either on walls or cellings for the above work.

4. **Wood Certificate**

It is certified that wood used for doors / windows / ventilators / cub boards etc, for the above work is well seasoned and as per agreement specification.

5. **Certificate on Maintenance of Registers**

It is certified that site Order Book, Daily Event Register, Field tests Registers and Lab test reports for the above work are maintained as per agreement conditions

6. **Expansion Joint Certificate**

It is certified that the expansion joints provided in the work to line and level as shown in approved drawing and ponding test is conducted in and around expansion joint portions and no dampness and no leakages are observed and treatment to expansion joint portions are executed as per agreement specifications/ approved drawings.

7. **Expansion Joint Certificate**

It is certified that the above work is competed satisfactory in all respect as per agreement specifications, approved drawings and circular instructions issued from time to time.

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## Format QF-1 : Conformance/ Non-Conformance Report

Ref: Date: _____

To
[Contractor]

Package No. : _____;Contract No.: _____

Title of Work : _____

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

| **Test Report No.** | **Date** | **Test Labo-ratory** | **Material** | **Comments** ***(Conforms/ Does not conform. See instructions below)*** |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

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

_____

Engineer – in - Charge

## Format QF-2 : Test Report Log

Contract Package No. : _____; Title of Work: _____

Contract No. : _____; Contractor: _____

| Date of Sample | Lab Name | Material / Process | Test Report No. | Date of TR | CNC Report No. | Date | C / NC | Action to be Taken by Contractor | Inspecting Authority Sign |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**Note:** C – Conformance; NC - Non-Conformance

_____

Engineer – in - Charge

## Format QF-3: Material Register

Contract Package No. : _____; Title of Work: _____

Contract No. : _____; Contractor: _____

Name of Material : _____; Unit of Measurement: MT/Bags/Drums/$M^3$/$M^2$

| Inward Date | Inward No. | Source of Supply | Qty | Test Report No. | CNC Report No. | Date of Issue | Quantity Issued | Quantity Balance | Inspecting Authority Sign |
|---|---|---|---|---|---|---|---|---|---|
| Cumulative Inward including this | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Cumulative Inward including this | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

_____

_____

## Format QF-4: Daily Work Record/Site Order Book

**Name of Work ……**

**Date of commencement / period for completion ……**

| Sl. No | Remarks of Inspecting Officer or Contractor | Action taken and by Whom | Remarks |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

(3 copies per set – one copy each to be sent to Engineer in charge, Implementing Agency records by the Contractor; one copy to be retained at site)

## Format QF-5: Inspection Register

**Name of Work** ……

| S.No | Date and Time | Officers 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 Engineer – in - charge | |
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## Format QF-6: Instruction Log

Contract Package No. :____

Title of Work : _____

Contract No. : _____

Contractor : _____

| Date of Instruction | Instruction | Mode of Transmittal | | | | Compliance Action by Contractor | Inspecting Authority Sign |
|---|---|---|---|---|---|---|---|
| | | Charge Order | Site Instruction | Letter | Minutes | | |
| | | | | | | | |
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## Format QF-8 : Review Meetings

Meeting Conducted on:_____Previous Meeting on: _____

| | |
|---|---|
| **Contract No.** | |
| **Name of the Work** | |
| **Contract Amount** | |
| **Name of Contractor** | |
| **Notice to Proceed** | |
| **Contract Duration** | |
| **Completion Date** | |
| **Elapsed Time:** | _____mos._____% |
| **Scheduled Work Completion:** | _____% |
| **Actual Work Completed:** | _____% |

***Compliance with commitments made during last review meeting***

| Sr. No | Commitments by Contractor / IA During Last Review Meeting | Whether Complied | If Not, Why & When Will Be Complied |
|---|---|---|---|
| | | | |
| | | | |

***Review of Progress, Quality and Coordination during this Period***

| **Sr. No** | **Problems, Issues, Actions to be Taken** | **Action By** | **Due Date** |
|---|---|---|---|
| | | | |

Any Other Business / General Comments:

[Affix Dated Signatures]

_____ _____

## Format GC – 1: General Check list for Works

| Sl.No | Item to be checked | Yes / No/ Remarks |
|---|---|---|
| 1. | Is the Community Information (Display) Board installed at the entry to site is it useful in knowing the details of works? | |
| 2. | Is the People's Estimate (pamphlet) also distributed to the community? | |
| 3. | Is there a Community Monitoring Committee in the site | |
| 4. | Is it able to monitor the Progress and Quality of work effectively? | |
| 5. | **AVAILABILITY OF DOCUMENTS:**<br>Are copies of following available at site<br>i) Contract documents incl. contract drawings,<br>ii) Construction (working) drawings,<br>iii) Estimates and designs ?<br>iv) Are the Site Order Book and Quality Control Test Registers properly maintained and available at contractor's site office? | |
| 6. | Is there a Work Plan of the contractor? | |
| 7. | Are the TBMs set up & verified by Engineer – in - charge? | |
| 8. | Are the underground works commenced / done first i.e., sewerage, water supply, drains, street lighting, roads in that sequence? | |
| 9. | Are the construction of sewerage & drainage commenced from down-stream end? | |
| 10. | Are the Drain top levels below the road edge levels and also below the Courtyard Levels of houses in general? | |
| 11. | Are there any encroachments to be removed? | |
| 12. | Is there any delay in progress of work with reference to work plan? | |
| 13. | Is there any deviation in work or field conditions with reference to design? Does any technical / financial problem need to be addressed? | |
| 14. | Is the construction as per construction drawings? | |
| 15. | Is the Contactor conducting quality control tests?<br>Is the Quality control test register being maintained properly and endorsed by the Engineer – in -charge? | |
| 16. | Is proper barricading provided where necessary to ensure safety of residents? | |
| 17. | Are drains and sewers properly connected to their disposal points? | |
| 18. | Is there free flow of drainage? | |
| 19. | What is the feedback of community on:<br>i) quality of work &<br>ii) functional aspects of works? | |
| 20. | Specific remarks on performance of consultant (where mobilized).<br>Is there a Resident Engineer stationed for the site for supervision? | |

| Sl.No | Item to be checked | Yes / No/ Remarks |
|---|---|---|
| 21. | Whether regular site visits are done by Engineer – in – charge? | |
| 22. | **CONCRETE WORK:**<br>**CEMENT:**<br>Is the manufacturer's test certificate for cement produced?<br>Is it fresh (<1 month from date of manufacture), free from lumps?<br>Is it stacked properly in stacks less than 10 bags height over a raised wooden platform to prevent contact with moisture?<br>Is air entry into the store room prevented to prevent formation of lumps? | |
| 23. | **AGGREGATES**:<br>Is the fine aggregate (FA or sand) of good quality coarse river sand and conform to the grading requirements of mortar / concrete (as applicable) as per IS: 383? | |
| 24. | Has bulking of sand been tested? If there is bulking, has the volume of sand been adjusted accordingly? | |
| 25. | 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? | |
| 26. | Is the content of deleterious matter like coal & lignite, clay lumps, material finer than 75 micron IS sieve (dust), soft fragments, organic matter etc. <5% as per IS: 383? | |
| 27. | Is the Maximum Size of Aggregate maintained as specified?<br>(For RCC, it should not be more than 20 mm; for PCC, it should not be more than ¼ of the minimum thickness of the member subject to a maximum of 50 mm). For pavement concrete, it should not be more than 25 mm as per MORTH. | |
| 28. | Is the % water absorption <2% for the CA for concrete? | |
| 29. | Has the concrete mix design been done by a designated laboratory and approved by the Engineer-in-Charge? | |
| 30. | Is the CA being wetted before being used for concrete? | |
| 31. | Is the concrete being mixed in a btching plant? | |
| 32. | Is the minimum cement content not less than that specified as per Table 5 of IS: 456 based on exposure conditions and the type of work? | |
| 33. | Is the water / cement ratio properly adhered to as per mix design? | |
| 34. | Are the concrete cube samples taken for compressive strength testing in accordance with sampling criteria in IS: 456? | |
| 35. | Is the concrete properly placed in position from a height of less than 0.5 m? | |
| 36. | Is the workability as per slump test in the required range for the nature of work being undertaken? | |

| Sl.No | Item to be checked | Yes / No/ Remarks |
|---|---|---|
| 37. | Is vibrator being used on the work? Is there a spare vibrator? | |
| 38. | Is the form work strong enough to prevent bulging when vibrated? Is it free from holes etc. to prevent loss of cement slurry? | |
| 39. | Is the concrete being cured adequately as per requirements? | |
| 40. | Is the form work removed only after the expiry of prescribed period for the type of structural element? | |
| 41. | Is the acceptance criteria being followed as per IS: 456? | |
| 42. | Are manufacturer's test certificate produced for conformance to IS: 1786 for Tor steel and to IS 432 for mild steel (as applicable) from manufactures? | |
| 43. | Have the i) yield strength test, ii) % elongation test, iii) rebend test been conducted for the steel being used on major / important works?<br>Does it meet the specifications? | |
| 44. | Is there any coating of earth or dirt etc. for the steel which prevents formation of proper bond with the concrete? | |
| 45. | Is the steel of adequate anchorage length, with proper cover (higher specified cover for water retaining structures as per IS: 3370) with chairs and placed in forms and properly tied with GI binding wire? | |
| 46. | Are the overlaps of required bond / anchorage?<br>Ie Minimum 50 times dia. of bar for tension<br>Ie. Minimum 40 times dia. of bar for compression<br>Whether overlaps are staggered? | |
| 47. | Is proper detailing of reinforcement done as per SP 34, particularly at **joints**? | |
| 48. | Has the reinforcement assembly been checked by the Engineer – in - charge prior to laying of concrete w.r.t. approved designs? | |
| 49. | Is necessary provision / arrangement for services like water supply, electrical fixtures etc. made in the form work prior to laying of concrete (for buildings)? | |
| 50. | Is sampling of concrete cubes and compressive strength testing done as per the sampling criteria in IS: 456-2000? | |
| 51. | **BRICK WORK:**<br>Are the bricks well burnt without un burnt portions, of rectangular shape, with sharp edges, free from cracks and of correct size? Are they properly stacked in stacks not more than 20 courses? | |
| 52. | Do they give clear metallic sound when struck with a hammer? Are they intact and do not break when dropped from a height of about 2m? | |

| Sl.No | Item to be checked | Yes / No/ Re-marks |
|---|---|---|
| 53 | Are the bricks soaked in water for 2 hours before being used? | |
| 54. | Have the bricks been tested for compressive strength? Do they satisfy 50 $kg/cm^2$ for 1st class bricks (for sewer man holes) and 35 $kg/cm^2$ for 2nd class bricks for other works? | |
| 55. | Is the % water absorption after 24 hours not more than 20%? | |
| 56. | Does the sand fall in the grading as prescribed? Is the mortar used as per specified mix proportions? | |
| 57. | Is the frog (manufacturer's mark) kept on the top of the brick while laying the brickwork? | |
| 58. | Are the joints in each layer broken to prevent stress concentration? | |
| 59. | Is the thickness of mortar joint as per specification?<br>(Not more than 12 mm for 2nd class brickwork and 10 mm for 1st class brickwork) | |
| 60. | Are the joints raked when mortar is green for at least 7.5 mm before plastering? | |
| 61. | Is the brickwork cured for at least 14 days after construction? | |
| 62. | Any constraints to speedy progress of work? | |
| 63. | Any constraints to maintaining quality of work? | |
| 64. | Any other remarks of the Inspecting Officer | |

Signature of Inspecting officer

## Format– IC – 1: Checklists for Building Works

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| **1)** | **EXCAVATION & PCC** | | |
| **A. Pre Excavation** | | | |
| 1 | Construction Drawings indicating levels available at Site | | |
| 2 | Proper safety precautions taken for site and public | | |
| 3 | Precautions taken for dewatering and protecting site from flooding | | |
| 4 | Dumping ground established | | |
| 5 | Setting out and levels as per drawings | | |
| 6 | Intermediate levels checked | | |
| | **B. Post Excavation** | | |
| 1 | Characteristics of excavated strata noted and deviations informed | | |
| 2 | Appropriate shoring and shuttering done | | |
| 3 | Final excavation levels, surface inspected and approved | | |
| 4 | Anti-Termite Treatment has been done post excavation | | |
| **2)** | **PLAIN CEMENT CONCRETE WORKS** | | |
| **A . Pre-concreting** | | | |
| 1 | All levels and dimensions checked for correctness | | |
| 2 | Shuttering is as per plan and has no gaps in between | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 3 | All materials are of specified brand and grade | | |
| **B. During Concreting** | | | |
| 1 | Mixing of concrete has been done as specified | | |
| 2 | Slump and other tests carried out as specified | | |
| 3 | Honeycombing removed | | |
| 4 | Required number of Samples have been taken for carrying out slump tests, cube tests etc | | |
| **C. Post Concreting** | | | |
| 1 | Concreting has been done as per specified line and level | | |
| 2 | Curing has been done as specified | | |
| 3 | Compaction has been done properly | | |
| 4 | Remedial measures taken for removal of defects | | |
| **3)** | **ANTI TERMITE TREATMENT (ATT)** | | |
| 1 | Chemicals for ATT are as per specifications | | |
| 2 | Chemicals in use are within the expiry date. | | |
| 3 | Sufficient quantities of chemicals are available at site for ATT. | | |
| 4 | Safety precautions have been taken for carrying out ATT and storage of Chemicals. | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 5 | Record of consumption Maintained at site. | | |
| **4)** | **BACKFILLING** | | |
| 1 | Filling material/ earth is as per specification | | |
| 2 | Anti-termite treatment has been carried out before commencement of backfilling | | |
| 3 | Filling has been done in layers of 150 mm, watered and compacted as per specifications | | |
| 4 | Proper compaction method has been adopted | | |
| 5 | Filling has been done to the required levels | | |
| **5)** | **REINFORCED CEMENT CONCRETE SELF COMPACTION COMCRETE WORKS** | | |
| **A. Pre-concreting** | | | |
| 1 | All specified materials available at site | | |
| 2 | Cement is of the required grade and not more than three months old. | | |
| 3 | Shuttering checked for Staging & Propping, line & level, dimensions cleaning etc and its quality approved | | |
| 4 | Application of oil & grease carried out | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 5 | Mixer/Vibrator as specified available at site with adequate means to run them during concreting | | |
| 6 | Cut-out & Sleeves/Inserted | | |
| 7 | Surface of reinforcement is clean and free from rust | | |
| 8 | Bars have been provided as per structural drawings | | |
| 9 | Lap length & dowels provided as per codal provisions | | |
| 10 | Pin bars & chairs/cover blocks provided as per requirements | | |
| 11 | Tying of bars has been done correctly | | |
| 12 | Service lines(Electrical, Plumbing, Others) if any, provided before commencement of concrete | | |
| **B. General Arrangement** | | | |
| 1 | Availability/ Arrangement of pumps etc, proper access & walkway checked | | |
| 2 | Adequacy of vibrators/ needle including diesel vibrator | | |
| 3 | Slump cone & test cubes made | | |
| 4 | Safety and health measures taken before commencement | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| **C. During Concreting** | | | |
| 1 | All necessary precautions taken before commencement of concreting | | |
| 2 | Samples of taken for slump, cube tests etc for each batch | | |
| 3 | Proper Compaction done and checks on Staging & Scaffolding carried out | | |
| 4 | Covering of green concrete carried out | | |
| 5 | Surface finish checked | | |
| 6 | Construction joints provided | | |
| **D. Post Concreting** | | | |
| 1 | De-shuttering started on Vertical faces / Other faces carried out as per codal provisions | | |
| 2 | Proper curing of concrete carried out | | |
| 3 | Line& Level of surface checked for correctness | | |
| 4 | Defects, notified and removed | | |
| 5 | Cube and other test results will be intimated to the engineer in charge for further action | | |
| **6) MASONRY, MORTAR AND PLASTER** | | | |
| **A. Pre-Masonry Work** | | | |
| 1 | Availability of material as per daily requirement checked | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 2 | Quality check for bricks/ blocks/ sand/ cement carried out | | |
| 3 | Provisions kept for electrical and other services | | |
| **B. During masonry work** | | | |
| 1 | Checking for line/ level/ right angle carried out | | |
| 2 | Mortar checked for mix proportion | | |
| 3 | Proper raking of joints | | |
| 4 | Seismic bands provided as per zonal requirements | | |
| **C. Post masonry** | | | |
| 1 | Check cleaning of dead mortar and broken bricks/ blocks etc. | | |
| 2 | Curing carried out as per requirements | | |
| **D. Plastering/Pointing** | | | |
| 1 | Mortar for plastering as specified for each side of wall | | |
| 2 | Quality of cement and sand checked | | |
| 3 | Curing work done as per requirement | | |
| 4 | Preparation of surface | | |
| **E. During Plastering** | | | |
| 1 | Mortar mixing in tray | | |
| 2 | Addition of water proofing compound | | |
| 3 | Proper roughing of first coat | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 4 | Check for collection of mortar spills | | |
| 5 | Cleaning of dead mortar | | |
| 6 | Check of waviness | | |
| 7 | Check for grooves/ drip moulds | | |
| 8 | Application of cement slurry on concrete surface | | |
| **F. After Plastering** | | | |
| 1 | Curing | | |
| 2 | Check for hollowness | | |
| 3 | Check for cracks | | |
| 4 | Check for diagonal | | |
| 5 | Lime wash after 3 days (within5 days in case of neeru application) | | |
| 6 | Safety and health measures | | |
| **7)** | **WATER PROOFING** | | |
| 1 | Surface for waterproofing has been prepared and cleaned | | |
| 2 | Safety measures/ precautions taken before commencement of works | | |
| 3 | Specified type of water proofing used | | |
| 4 | Specified material used for waterproofing | | |
| 5 | The material used was as per specification | | |
| 6 | Work has been carried out as per specifications by the department/ specialized agency | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| **8)** | **IPS/TILE FLOORING AND DADO** | | |
| 1 | Layout of floor checked and proper slopes for draining water are maintained specially in bath room and toilet. | | |
| 2 | Thickness bases at GL checked of different floor | | |
| 3 | Check for proper back filling under floor done | | |
| 4 | Metal/glass strips laid properly in IPS flooring | | |
| 5 | Curing of IPS Flooring done as per requirements | | |
| 6 | Dado provided as per required height | | |
| 7 | Cleaning and finishing done | | |
| **9)** | **PLUMBING & WATER SUPPLY** | | |
| 1 | GI/CI/HDPE/CPVC/SWR pipes etc. confirms | | |
| 2 | Pipes of required diameter and their fittings used | | |
| 3 | Plumbing and Water Supply work carried out through a licensed plumber | | |
| 4 | Works done as per specification | | |
| 5 | Plumbing and Water Supply works tested on completion - | | |
| 6 | Defects rectified | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| **10) INTERNAL ELECTRICAL WORKS** | | | |
| **A.GENERAL** | | | |
| 1 | Layout plans: showing the position of L.T Panels/ distribution board, lighting fixtures, lighting distribution, scheme, receptacles, etc available before commencement of work | | |
| 2 | All the following items are as per specification and of approved makes<br>L T Panels/ Distribution Boards<br>Lighting Fixtures<br>Conduits, including accessories Receptacles<br>Junction Boxes<br>Cables/Wires<br>Any other item | | |
| **B. SURFACE CONDUIT WIRING / CONCEALED CONDUIT WIRING** | | | |
| 1 | Conduit and accessories are of specified make, gauge and diameter | | |
| 2 | Proper installation of all conduit wiring and concealed wiring. | | |
| **C. CHECK LIST FOR EARTHING** | | | |
| 1 | Earth electrode provided as specified. | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 2 | Types and size of main/sub main and circuit earthing conductors provided as specified | | |
| **D. MAIN AND DISTRIBUTION BOARDS** | | | |
| 1 | Main switch board is fabricated based on approved shop drawings and the entire material used is as per BIS Code. | | |
| 2 | Make of switches and other items as specified. | | |
| | **CHECK LIST FOR EXTERNAL ELECTRICAL WORKS** | | |
| **A. CHECK LIST FOR O.H. LINES** | | | |
| 1 | Poles used are of approved make as specified and conform to relevant BIS codes. | | |
| 2 | Test certificate as applicable. | | |
| 3 | Pole embedded below ground level as specified. | | |
| 4 | Metallic poles are adequately earthed with specified size of earth conductor. | | |
| 5 | Strays struts, insulators, conductors used conform to relevant BIS Code., | | |
| 6 | Earth wire conductor used as specified. | | |
| 7 | Lightning arrestors used as specified | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 8 | Spacing of poles, spans and clearance between, conductors and, surroundings kept as specified. | | |
| 9 | Insulators used for specified grade. | | |
| **B. CABLE LAYING** | | | |
| 1 | Trenches of specified dimensions excavated and prepared | | |
| 2 | Required quantity of sand cushioning provided; cable laid; another layer of sand and brick protective covering provided. Refilling done earth ramming and dressing done. | | |
| 3 | Cables entry point in building or crossing roads path protected by providing Hume pipes or PVC pipe | | |
| 4 | Cable tested before and after laying and before emerging | | |
| **C. CHECK LIST FOR EARTHING** | | | |
| 1 | Earth electrode provided as specified | | |
| 2 | Types and size of main/ sub main and circuit earthing conductors provided as specified. | | |
| **11) DRAINAGE WORKS** | | | |
| 1 | Excavation for drains carried out as per the approved lay-out | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 2 | Bed Concrete laid as per specifications with proper slopes and cuttings | | |
| 3 | All pipes procured and laid as per requirement | | |
| 4 | Jointing of pipes done as per specifications | | |
| 5 | Manholes provided as per design | | |
| 6 | Materials for construction of manhole as specified | | |
| 7 | End of the pipes plugged | | |
| 8 | Drainage line tested before putting to use | | |
| **12)** | **CEMENT CONCRETE ROADS** | | |
| 1 | Materials used for construction of sub base, base and cement concreting is as specified | | |
| 2 | Grading of Aggregates is as per specifications | | |
| 3 | Right of Way Maintained as per drawings | | |
| 4 | Aggregates spread uniformly to proper profile | | |
| 5 | Centre line, gradient and camber maintained as specified - | | |
| 6 | Cross section levels of precedent layer recorded | | |
| 7 | Tests of aggregates carried out as specified and record | | |

| Sr. No. | Items | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 8 | Top concrete surface is of required grade and mix | | |
| 9 | All tests carried out as per the relevant BIS Codes | | |
| **13)** | **OTHERS** | | |
| 1 | Whether the provision for adequate ventilation and natural lighting has been made as per National Building code? | | |
| 2 | Whether facility for storage in terms of Almirah/ Shelves / Lofts / Platform has been made ? | | |
| 3 | Whether Sanitary fittings have been provided? | | |

Signature of inspecting officer

## Format– IC – 3 : Inspection checklists for Drains

| Sl.No. | Item to be checked | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 1. | Is the construction as per approved construction drawings? | | |
| 2. | Are the Drain Top Levels below the Road Edge Levels and Courtyard Levels for onsite drains? | | |
| 3. | Is Proper alignment and gradient maintained for the drains? | | |
| 4. | Are the dimensions correct? | | |
| 5. | Is proper granular bedding provided under the bed concrete after removing loose, slushy soil? Is the bed concrete of Good quality? | | |
| 6. | Is the construction done to the required gradient? | | |
| 7. | Are the CA, FA and water of good quality & free from deleterious material? | | |
| 8. | Are the concrete cube samples taken by Engineer – in -charge and tested? If so, do they satisfy compressive strength requirements? | | |
| 9. | Is Vibrator being used? | | |
| 10. | Is Curing done properly for the specified period? | | |
| 11. | Is the internal drainage properly connected to the outfall drain? | | |
| 12. | Are the Road side drain walls raised to just below road level?<br>Are the dimensions of these walls adequate? | | |
| 13. | Is the finishing of the drain good? | | |
| 14. | Are the culverts adequate to discharge the drainage? If not, do they need widening? | | |
| 15. | Are the water pipe lines across the drain or beside the drain being shifted /realigned/encased to prevent pollution of water? | | |
| 16. | Is there any need to rehabilitate existing damaged drain section if any, which inhibits the efficiency of functioning of the drain? | | |

Signature of inspecting officer

## Format– IC – 4 : Inspection checklists for Water Supply

| Sl.No. | Item to be checked | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 1 | Is the construction as per approved construction drawings? | | |
| 2 | Is the trench to proper i) alignment?<br>ii) depth conforming to minimum cover, and<br>iii) width? | | |
| 3 | Is proper bedding provided under (& around if necessary) the pipe with granular material like sand or crusher dust? | | |
| 4 | Are the manufacturer's test certificates for raw material made available?<br>Has the pipe testing been witnessed by Engineer – in -charge? Do the results satisfy the requirements of IS: 4984? Is the % of reprocessed HDPE material maintained less than 10%? | | |
| 5 | Are there any cracks in the DI/CI in the pipes or the lining? | | |
| 6 | Whether specials like bends, tees etc. conform to the material and pressure of the relevant pipe line? | | |
| 7 | Is the jointing of pipes good, particularly at junctions and while giving house service connections?<br>Have good quality jointing materials (like solvent cement for PVC; butt welding using welding machine for HDPE; Jiffy joints with Rubber rings and gaskets for DI/CI been used?<br>Are the rubber rings and gaskets field tested and are positioned properly with jointing material? | | |
| 8 | Are thrust blocks provided at bends as per requirements of BIS? | | |
| 9 | Is the backfilling done properly by watering and ramming in layers duly removing boulders etc. and slightly higher than GL? | | |
| 10 | Are the house connections of GI or MDPE? Is the quality of GI/MDPE pipes as per standards? | | |

| Sl.No. | Item to be checked | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 11 | Are the<br>i) valves, ii) valve chambers, covers and iii) specials of good quality? iv) are they properly and safely located to prevent their breaking due to traffic? v) do they conform to the relevant pipe line requirements? | | |
| 12 | Whether air valves conform to the pipe line requirements? | | |
| 13 | Whether non-return valves conform to the pipe line requirements? | | |
| 14 | Whether pressure release valves conform to the pipe line requirements? | | |
| 15 | Are horizontal stretches in the pipe line avoided to prevent air accumulation? | | |
| 16 | Have proper Arrangements for Interconnection with Source of supply done? Are concrete / RCC thrust blocks provided at bends as applicable? | | |
| 17 | Has the Hydraulic test on pipeline/s been conducted? Is it witnessed by the Engineer – in -charge & community? | | |
| 18 | Is the test pressure adequate and as per specifications? | | |
| 19 | Is there any leaks/cracks/damages observed in the pipes or joints? | | |
| 20 | Have all Households taken House Service Connections? | | |
| 21 | Are the pressures adequate? Have all pit taps, if any, been removed after laying new distribution lines/ replacing old lines? | | |
| 22 | Are there any un served Households? | | |
| 23 | Is there any pollution or scope for pollution of drinking water? If so, are necessary precautions taken **or** planned? | | |
| 24 | Is water **actually** reaching the consumer's house with adequate pressure? | | |

| Sl.No. | Item to be checked | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 25 | **PUMP SETS:**<br>**i)** Are the pumps procured as per specifications of duty and head? Has testing of pump set been conducted in the presence of Engineer – in -charge?<br>ii) Have the pump sets passed the tests and satisfy the duty and head requirements?<br>iii) Have all accessories like panel board, switch gear of the pump sets been supplied and are they suitable and satisfy the quality requirements?<br>iv) Is the starter provided appropriate to the KW of the pump set?<br>iv) Has Trial run been conducted and is it successful?<br>v) Have single phasing preventor, over load relay & capacitors been provided? | | |
| 26 | Are the cable sizes provided as per design and operating conditions? | | |
| 27 | Is positive suction condition ensured for centrifugal pump sets? | | |
| 28 | Has an eccentric taper been provided on the suction side? | | |
| 29 | Have the required sluice valves and non-return valve on delivery side been provided?<br>Is the piping devoid of unnecessary bends etc. to reduce friction losses? | | |
| 30 | Have proper earthing, lightning arrestors and safety controls been provided? | | |
| 31 | Have dismantling joints been provided for the valves at the pump house? | | |
| 32 | Has the electrical connection been given to the pump sets? | | |
| 33 | Has the correct Contracted Maximum Demand (CMD) been agreed with the State Electricity Board ? | | |
| 34 | For a tube well, has the capacity (KW) of the submersible pump set been fixed based on the depth and yield of water after conducting yield test? | | |
| 35 | **SUMP / OHSR / GLSR**<br>Is the safe bearing capacity (SBC) of soil for foundation of Sump / OHSR been tested? | | |

| Sl.No. | Item to be checked | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 36 | Does the design of foundation for the Sump / OHSR need any revision based on the SBC? | | |
| 37 | Have necessary strengthening of foundation done for poor soils like BC soil and / or high water table, if met? | | |
| 38 | Has the reinforcement assembly at each stage been checked by the Engineer – in - charge? | | |
| 39 | Is the form work for floor slab/ roof slab / dome adequate and safe? | | |
| 40 | Is the steel being used comply with the relevant specifications? Are the manufacturer's test certificates available on site? | | |
| 41 | Has the steel been tested for tensile strength, % elongation and rebend test? If so, do the results satisfy the requirements of the code? | | |
| 42 | Has the minimum cover in accordance with IS: 3370 provided for RCC water retaining structures? | | |
| 43 | Is the detailing at joints properly done as per SP: 34? | | |
| 44 | Have puddle pipes been provided in the floor slab of OHSR? | | |
| 45 | Has the SUMP / OHSR /GLSR been tested for water tightness in accordance with IS: 3370? | | |
| 46 | Is there any leakage through the Sump / OHSR / GLSR? | | |
| 47 | Is the scour of OHSR/GLSR connected to natural drain? | | |
| 48 | Have the inlet and outlet been inter connected (bye pass)? | | |
| 49 | Has the overflow pipe been connected to the outlet pipe? | | |
| 50 | Have proper lightning arrestor, water level indicators, ventilators, ladders, staircase, railing been provided? | | |
| 51 | Has the ground below the ELSR been raised to prevent stagnation of water? | | |

Signature of inspecting officer

## Format– IC – 5 : Inspection checklists for Sewerage

| Sl.No. | Item to be checked | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 1 | Is the sewer construction done from the downstream (D/S) end considering the Invert Levels of Manhole (MH )on out fall sewer / Inlet of Septic Tank? | | |
| 2 | Has TBM been established in the poor settlement and have the invert levels been established based on this TBM from the d/s end? | | |
| 3 | Have the invert levels been checked through the LF book by the Engineer – in - Charge? | | |
| 4 | Are sight rails and boning rods used in aligning and fixing the invert levels of sewer? | | |
| 5 | Are the i) Invert Levels of inlet and outlet of septic tank and ii) invert levels of sewers fixed as per construction (working) drawings? | | |
| 6 | Is the sewer construction done from the d/s end?<br>Is the direction of socket facing the upstream end? | | |
| 7 | Is proper granular bedding provided under the sewer for the required depth? | | |
| 8 | Is the sewer jointing done properly using solvent cement for UPVC pipes and Hessian/jute yarn soaked in cement mortar 1:1 ½ and cocked with a cocking tool into the socket end? | | |
| 9 | Are the manufacturer's test certificates available at the site? Have the pipe testing been witnessed by Engineer – in –charge ? Do the test results satisfy the requirements? | | |
| 10 | Is the sewer trench to proper<br>i) Alignment?<br>ii) Gradient?<br>iii) Depth? and<br>iv) Width? | | |
| 11 | Is the sewer jointing properly done as per specification? | | |
| 12 | Is the backfilling done properly by watering and ramming in layers, removing boulders etc. and slightly higher than GL? | | |

| Sl.No. | Item to be checked | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 13 | Are the 'Y's & 'Tee's of good quality? | | |
| 14 | Is the connection to trunk main/septic tank properly planned /given? | | |
| 15 | If the main sewer is to be joined to the outfall (trunk) sewer, is the crown level of the main sewer higher than the crown level of the outfall (trunk) sewer to prevent back flow? | | |
| 16 | Has the Hydraulic Testing of sewer lines witnessed by the, Engineer & the community? If there is any leakage etc., has it been rectified? | | |
| 17 | Have all Households taken House Connections? | | |
| 18 | Are the Manholes (MH) properly constructed as per design and drawings and to proper spacing, to the correct invert level using first class bricks? Are they properly cured?<br>Are the sewers properly aligned and joined at the MH? - | | |
| 19 | Are the top of Man Holes provided flush with the road level? | | |
| 20 | Are Man Hole frames and covers of appropriate strength provided i.e., LD / MD / HD / EHD considering the type of traffic to take care of traffic loads? Are they of good quality? | | |
| 21 | Has proper channelling (benching) been provided at the invert of the Man Hole? | | |
| 22 | Are there any un-served Households? | | |
| 23 | **SEPTIC TANK:**<br>Has the effect of GWT been considered in the design of floor slab?<br>Has necessary strengthening of foundation done for poor soils like BC soil, if met with? | | |
| 24 | Have the baffle walls been provided properly at the right place? | | |
| 25 | Have the Invert Levels for inlet and outlet properly adhered to and the influent enters the septic tank and leaves it satisfactorily? | | |
| 26 | Has free board of 0.30 m been provided for the septic tank? | | |

| Sl.No. | Item to be checked | Remarks by Implementation agency / Authorised representative | Compliance by Contractor |
|---|---|---|---|
| 27 | Has slope towards the inlet been given at the bottom to enable proper sludge removal? | | |
| 28 | Is the septic tank outlet properly connected to either dispersion trenches or to storm water drain? | | |
| 29 | Has the reinforcement assembly at each stage been checked by the Engineer – in - charge? | | |
| 30 | Is the form work for floor slab/ roof slab / dome adequate and safe? | | |
| 31 | Is the steel being used comply with the relevant specifications? Are the manufacturer's test certificates available on site? | | |
| 32 | Has the steel been tested for tensile strength, % elongation and rebend test?<br>If so, do the results satisfy the requirements of the code? | | |
| 33 | Has the minimum cover in accordance with IS: 3370 provided for RCC water retaining structures? | | |
| 34 | Is the detailing at joints properly done as per SP: 34? | | |
| | Have man holes been provided at the inlet and outlet? | | |
| 35 | Has the septic tank been tested for water tightness in accordance with IS: 3370? | | |
| 36 | Is there any leakage through the septic tank? | | |

Signature of inspecting officer

## Format– IC – 6 Community Monitoring Committee - Checklist

| Sl. No | Item to be checked | Yes / No / Remark | Remarks by Implementation agency / Authorized representative | Compliance by Contractor if any |
|---|---|---|---|---|
| 1. | Is the Community Information (Display) Board installed near the entry to the site is it useful in knowing the details of works? | | | |
| 2. | Is the People's Estimate (pamphlet) distributed to the community? | | | |
| 3. | Does the Contractor / Engineer enable proper Community Monitoring of the works? How can it be made more effective? | | | |
| 4. | Are the underground works commenced / done first i.e., sewerage, water supply, drains, street lighting, roads in that sequence? | | | |
| 5. | Are the construction of sewerage & drainage commenced from downstream end? | | | |
| 6. | Does it seem the waste water will enter their houses when the drains and roads are completed? | | | |
| 7. | Is adequate Gradient maintained for drains and sewers to enable free flow of waste water? | | | |
| 8. | Are the water pipelines and sewers constructed to proper i) alignment, ii) depth and iii) is the jointing good? | | | |
| 9. | Has the Testing of i) water pipe line and ii) sewers been witnessed by the Engineer – in – charge and community? | | | |
| 10. | Is drinking water reaching the houses with adequate pressure? | | | |
| 11. | Are there any encroachments to be removed? | | | |
| 12. | Is there any delay in progress of work? What are the constraints? | | | |
| 13. | Community's perception of the general quality of work? Satisfactory or not? | | | |
| 15. | Are the materials / equipment of the contractor safe? | | | |
| 17. | What is the Frequency of visits of Engineer – in – charge | | | |

| | | | | |
|---|---|---|---|---|
| 18. | Have ALL Households taken i) water connections and ii) sewer connections? | | | |
| 19. | Any other remarks of the Community Monitoring committee | | | |

Signature of Community Monitoring
Committee Members

| STATEMENT SHOWING QUALITY CONTROL TESTS TO BE DONE ALONG WITH FREQUENCY AND STANDARD VALUES | | | |
|---|---|---|---|
| **Type of Test** | **Frequency of tests** | **Test procedure and report format** | **Standard Requirement** |
| **QC Tests on Cement** | | | |
| **Fineness of Cement by Dry Sieving** | One for each source of supply in a month | IS 4031(Part-1) | <10% |
| **Consistency of Cement** | One for each source | IS 4031 (Part-4) | - |
| **Initial & Final setting time of Cement** | One for each source | IS 4031 (part-5) | Initial setting time Shall not be less than 30 Min (minimum), Final time shall not be more than 600 Max (Maximum). |
| **Soundness of cement** | One for each source | IS 4031(part 3) | Expansion shall not be more than 10mm by Le Chatelier method |
| **Compressive strength - 72 hrs, 168 hrs, 672 hrs** | One for each source | IS 4031 (part 6) | 72 ± 1h. Min =23mpa<br>168 ± 2h Min = 33mpa<br>672 ± 4h Min = 43mpa |
| **Test on steel (FE-500 D)** | | | |
| **a) 0.2% Proof stress** | One for each source of supply and once in Six months for fresh supply | IS 1786 | 500 $N/mm^2$ for Minimum |
| **b) Elongation** | One for each source of supply and once in Six months for fresh supply | IS 1786 | Percentage of elongation16% minimum |
| **c) Tensile strenght** | One for each source of supply and once in Six months for fresh supply | IS 1786 | 10% more than Actual |
| **d) Re bend test** | As per B.I.S | IS 1786 | |
| **e) Weight /RM** | As per B.I.S | IS 1786 | |
| **f) Chemical composition of Steel** | As per B.I.S | IS 1786 | |
| | | | |

| | | | |
|---|---|---|---|
| **Tests for Coarse Aggregate** | | | |
| Sieve anaalysis | One test for every 15 cum | IS 2386 (part 1) - 1963 | |
| Bulk density of Aggregate(Loose & Roded) | One test for every 15 cum | IS 2386 (part 1) - 1963 | Varies according to source |
| Flaki ness index test for Aggregate | One test for every 15 cum | IS 2386 (part 1) - 1963 | |
| Elongation index test for Aggregate | One test for every 15 cum | IS 2386 (part 1) - 1963 | |
| Combined | One test for every 15 cum | IS 2386 (part 1) - 1963 | <40% |
| Water absorption | | IS 2386 (part III)- 1963 | |
| Aggregate Abrasion value | One for each source | IS 2386 (part IV) - 1963 | |
| Aggregate Impact value test for Aggregate | One for each source | IS 2386 (Part IV)1963 | <45% |
| Aggregate Crushing value | One for each source | IS 2386 (Part IV) 1963 | |
| **Tests for Fine Aggregate** | | | |
| Silt content of Sand | At least once on the day of work | IS 383 | Silt Content shell be less than 3% by weight |
| Gradation & Fineness Modulus of Sand | One test for every 15 cum | IS 383 | FM= 2.2 to 3.2 |
| Bulking of Sand | Three per each day of work i.e Morning, noon, and evening | | Varies according to source |
| Deleterious Constituents | One test for 20 cum | IS 383 | |
| **Test on Water** | | | |
| Alkalinity and Acidity | One for each source of supply before use on work | IS 456- 2000 | The PH Value of water shell not be <6. |
| Solids | One for each source of supply before use on work | | |
| | | | |

| | | | |
|---|---|---|---|
| **Test on Fresh Concrete** Slump for ordinary concrete | Thrice in a day of concrete in morning, noon and evening. | IS 516 | a) Foundation footing 10mm to 25mm<br>b) Column beams and slabs - 25mm to 40mm(with normal reinforcement) slabs - 40mm to 50mm . |
| **Test on hardened Concrete** | | | |
| Rebound hammer | As per Requirement | IS13311 (part2) | |
| ULTRASONIC pulse velocity | As per Requirement | IS 13311 (part 1) | |
| Compression Test in cubes | QTY No of samples (1 set = 6 cubes) | IS 516 -2002 | As per IS 456 |
| | 1 to 5 - 1 set | | |
| | 6 to 15 - 2 set | | |
| | 16 to 30 - 3 set | | |
| | 31 to 50 -4 set | | |
| | 51 AND ABOVE 4 PLUS ONE ADDITIONAL SAMPLE FOR EASH ADDITIONAL 50 cum of part there off | | |
| | | | |
| **<u>Tests for Self Compacting Concrete</u>** | | | |
| Slump Flow test | Visual inspection of every batch and periodic tests as directed by the Engineer incharge. | | >600 mm <800 mm |
| Sieve Segregation resistance test | | | >5% AND <15% |
| L BOX Test | | | 0.8-1.00 |
| V Funnel test | | | 8-12 Sec |
| u - Box test | | | <30 mm |
| | | | |
| **Tiles** | | | |
| Vitrified / Ceramic Tiles | | | |
| Water Absorption | | IS-13006 | >3% & <=6% |
| Bending Strength | | IS-10545-3 | >22N/MM2 |

## FREQUENCY AND ACCEPTENCE CRITERIA FOR COMPRESSIVE STRENGTH OF CONCRETE

Strength of concrete is commonly considered its most valuable property, although in many practical cases, other characteristics, such as durability and permeability, may in fact be more important. However, the strength of concrete is almost invariably a vital element of structural design and is specified for compliance purposes.

**Table 1: Frequency (IS:456-2000clause 15.2.2)**

The minimum frequency of sampling of concrete of each grade shall be in accordance with the following:

| Quantity of concrete in the work,$m^3$ | Number of samples |
|---|---|
| 1-5 | 1 |
| 6-15 | 2 |
| 16-30 | 3 |
| 31—50 | 4 |
| 51 above | 4 Plus one additional sample for each additional 50M3 are part thereof |

NOTE: At least one sample shall be taken from each shift where concrete is produced at continuous production unit, such as ready-mixed concrete plant, frequency of sampling may be agreed upon mutually by suppliers and purchasers.

## ACCEPTANCE CRITERIA

(A) Compressive strength

The concrete shall be deemed to comply with the strength requirement when both the following conditions are met:

a) The mean strength determined from any group of four non-overlapping consecutive test results, complies with the appropriate limits col. 2 of Table 2.

b) Any individual test result complies with the appropriate limits in col. 3 Table 2.

**(B) Flexural strength**

When both the following conditions are met, the concrete complies with the specified flexural strength.

a) The mean strength determine from any group of four consecutive test results exceed the specified characteristic strength by at least 0.3 $N/mm^2$

b) The strength determined from any test result is not less than specified characteristic strength less 0.3 $N/mm^2$

The quantity of concrete represented by a group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches.

Three test specimens shall be made for each sample for testing at 28 days. Additional specimens may be required for 7 days strength. In all the cases 28 days strength shall alone be the criterion for acceptance or rejection of the concrete.

The test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than $\pm$15 percent of the average. If more, the test results of the sample are invalid.

**Table 2 : Characteristic compressive strength compliance requirement**

**IS: 456-2000 with amendments Table 11 (Clause 16.1 and 16.3)**

| Specified Grade | Mean of Group of 4 Non-Overlapping Consecutive test results in $N/mm^2$ Minimum | Individual Test Results in $N/mm^2$ Minimum |
|---|---|---|
| (1) | (2) | (3) |
| M15 and above | $f_{ck}$ + 0.825 X established Standard deviation (round off to nearest 0.5 $N/mm^2$<br>or<br>$f_{ck}$ + 3 $N/mm^2$ whichever is greater | $f_{ck}$ – 3 $N/mm^2$ |

NOTE 1: In the absence of established value of standard deviation, the values given in Table 8 (IS: 456-2000) may be assumed, and attempt should be made to obtained results of 30 samples as early as possible to establish the value of standard deviation.

NOTE 2: For concrete quantity up to 30 $m^3$ (where the number of samples to be taken is less than four) as per frequency of sampling given in 15.2.2, the mean of test results 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 samples is only one as per 15.2.2, the requirement shall be $f_{ck}$ + 4 $N/mm^2$, minimum.

(Values of column 2 and 3 are equal to or more than)

The acceptance criteria are best illustrated by the following examples:

Grade of concrete: M25

Laboratory design means target strength for

good quality control: 25 + (1.65 x 4)= 31.6 $N/mm^2$ at 28 days age

In all the case average of three 150 mm cubes shall be taken.

**Table 3: Site concrete acceptance.**

In one shifts 4 $m^3$ foundation concrete was done.

| Shift | Cube test results $N/mm^2$ | Average fav $N/mm^2$ | 0.85 fav $N/mm^2$ | 1.15 fav $N/mm^2$ | Acceptance 25+4 = 29 $N/mm^2$(Min) |
|---|---|---|---|---|---|
| 1. | 19, 26, 16 | 20.3 | 17.3 | 23.3 | Rejected due to:<br>a) Minimum strength of 29 $N/mm^2$ not achieved<br>b) Variation in strength cubes 26 and 16 are out of range +/-15% of average |

NOTE: Due to doubtful concrete the work was stopped. Concrete was tested by rebound hammer and drilled cores. From test results the foundation concrete found to be of M25 grade.

The work was started only when new cube moulds, properly calibrated compression testing machine was purchased and laboratory staff was trained in all the site testing work.

Table 4: Site concrete acceptance. In 3 shifts 27 $m^3$ foundation concrete was done.

| Shift | Cube test results $N/mm^2$ | Average fav $N/mm^2$ | 0.85 fav $N/mm^2$ | 1.15 fav $N/mm^2$ | Acceptance $f_{ck}$ + 4 $N/mm^2$ 25+4 = 29 Min Individual $f_{ck}$ – 2 $N/mm^2$ 25 – 2 = 23 $N/mm^2$(Min) |
|---|---|---|---|---|---|
| 1. | 33, 29, 32 | 31.3 | 26.6 | 36.0 | Av = 31.3 |
| 2. | 24, 32, 28 | 28.0 | 23.8 | 32.2 | Av = 28.0 |
| 3. | 25, 29, 32 | 28.7 | 24.4 | 33.0 | Av = 28.7 |
| | | | | | Average = 29.3 $N/mm^2$ |

Remarks

(1) All the cubes strength are within $\pm$15% of average

(2) From shifts 1, 2 and 3 all cubes strength are $\geq$ 23 $N/mm^2$.

(3) Average cubes strength of shift 1, 2 and 3 is 29.3 $N/mm^2$ which is $\geq$ 29 $N/mm^2$.

Foundation concrete is accepted as M25 grade.

**Table 5: Site concrete acceptance. In 6 shifts 75 $m^3$ roof slab concrete was done.**

| Shift | Cube test results $N/mm^2$ | Average fav $N/mm^2$ | 0.85 fav $N/mm^2$ | 1.15 fav $N/mm^2$ | Acceptance 25+0.825×4 = 28.3 $N/mm^2$ Rounded of 28.0 $N/mm^2$ Individual 25 – 3 = 22 $N/mm^2$ |
|---|---|---|---|---|---|
| 1. | 22, 28, 26 | 25.3 | 21.5 | 29.1 | Av = 25.3 |
| 2. | 26, 24, 28 | 26.0 | 22.1 | 29.9 | Av = 26.0 |
| 3. | 31, 35, 33 | 33.0 | 28.1 | 38.0 | Av = 33.0 |
| 4. | 32, 31, 33 | 32.0 | 27.2 | 36.8 | Av = 32.0 |
| 5. | 31, 32, 33 | 32.0 | 27.2 | 36.8 | Av = 32.0 |
| 6. | 26, 25, 24 | 25.0 | 21.3 | 28.0 | Av = 25.0 |

Remarks:

(1) All the cubes strength are within $\pm$15% of average

(2) Average of shift 1, 2, 3, 4 cubes is 29.1 $N/mm^2$ which is $\geq$ 28.0 $N/mm^2$.

(3) Average of shift 2, 3, 4, 5 cubes is 30.8 $N/mm^2$ which is $\geq$ 28.0 $N/mm^2$.

(4) Average of shift 3,4, 5, 6 cubes is 30.5 $N/mm^2$ which is $\geq$ 28.0 $N/mm^2$.

(5) All the cubes strength are $\geq$ 22 $N/mm^2$

It is concluded that the roof slab concrete comply with compressive strength requirements of M25 grade

A sample consists of three cubes/specimens. It is better for the same concrete sample cast more than three cubes, so that any defective cube should not be tested or any doubt full test result due to testing may be rejected and not included in the average of three cubes.

REFERENCES

1. IS: 456-2000 (Fourth Revision) with amendments plain and reinforced concrete – Code of Practice, BIS, New Delhi.

2. Kishore Kaushal, "Quality Control of Construction – Testing of Concrete Cubes", Indian Construction, Apr. 2010 pp. 21-24.

# CHAPTER 5

## Quality Control Test Procedures

## 1. TESTS ON CEMENT

### *1.1 FINENESS*

**AIM**

To determine the fineness of cement by dry sieving as per IS: 4031 (Part 1) - 1996.

***PRINCIPLE***

The fineness of cement is measured by sieving it through a standard sieve. The proportion of cement, the grain sizes of which, is larger than the specified mesh size is thus determined.

***APPARATUS***

**FIG. 1 : IS SIEVE**

i) 90□ m IS Sieve

ii) Balance capable of weighing 10g to the nearest 10mg

iii) A nylon or pure bristle brush, preferably with 25 to 40mm bristle, for cleaning the sieve

***PROCEDURE***

i) Weigh approximately 10g of cement to the nearest 0.01g and place it on the sieve.

ii) Agitate the sieve by swirling, planetary and linear movements, until no more fine material passes through it.

iii) Weigh the residue and express its mass as a percentage $R_1$, of the quantity first placed on the sieve to the nearest 0.1 percent.

iv) Gently brush all the fine material off the base of the sieve.

v) Repeat the whole procedure using a fresh 10g sample to obtain $R_2$. Then calculate R as the mean of $R_1$ and $R_2$ as a

percentage, expressed to the nearest 0.1 percent. When the results differ by more than 1 percent absolute, carry out a third sieving and calculate the mean of the three values.

### *REPORTING OF RESULTS*

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

## *1.2 CONSISTENCY*

### *AIM*

To determine the quantity of water required to produce a cement paste of standard consistency as per IS: 4031 (Part 4) - 1988.

### *PRINCIPLE*

The standard consistency of a cement paste is defined as that consistency which will permit the Vicat plunger to penetrate to a point 5 to 7mm from the bottom of the Vicat mould.

### *APPARATUS*

**FIG. 2 : VICAT APPARATUS**

i) Vicat apparatus conforming to IS: 5513 - 1976

ii) Balance, whose permissible variation at a load of 1000g should be ±1.0g

iii) Gauging trowel conforming to IS: 10086 – 1982

### *PROCEDURE*

i) Weigh approximately 400g of cement and mix it with a weighed quantity of water. The time of gauging should be between 3 to 5 minutes.

ii) Fill the Vicat mould with paste and level it with a trowel.

iii) Lower the plunger gently till it touches the cement surface.

iv) Release the plunger allowing it to sink into the paste.

v) Note the reading on the gauge.

vi) Repeat the above procedure taking fresh samples of cement and different quantities of water until the reading on the gauge is 5 to 7mm.

### *REPORTING OF RESULTS*

Express the amount of water as a percentage of the weight of dry cement to the first place of decimal.

## 1.3 INITIAL AND FINAL SETTING TIME

### *AIM*

To determine the initial and the final setting time of cement as per IS: 4031 (Part 5) - 1988.

### *APPARATUS*

i) Vicat apparatus conforming to IS: 5513 - 1976

ii) Balance, whose permissible variation at a load of 1000g should be ±1.0g

iii) Gauging trowel conforming to IS: 10086 - 1982

### *PROCEDURE*

i) Prepare a cement paste by gauging the cement with 0.85 times the water required to give a paste of standard consistency (see Para 1.2).

ii) Start a stop-watch, the moment water is added to the cement.

iii) Fill the Vicat mould completely with the cement paste gauged as above, the mould resting on a non-porous plate and smooth off the surface of the paste making it level with the top of the mould. The cement block thus prepared in the mould is the test block.

A) INITIAL SETTING TIME

Place the test block under the rod bearing the needle. Lower the needle gently in order to make contact with the surface of the cement paste and release quickly, allowing it to penetrate the test block. Repeat the procedure till the needle fails to pierce the test block to a point 5.0 ± 0.5mm measured from the bottom of the mould.

The time period elapsing between the time, water is added to the cement and the time, the needle fails to pierce the test block by 5.0 ± 0.5mm measured from the bottom of the mould, is the initial setting time.

B) FINAL SETTING TIME

Replace the above needle by the one with an annular attachment.

The cement should be considered as finally set when, upon applying the needle gently to the surface of the test block, the needle makes an impression therein, while the attachment fails to do so. The period elapsing between the time, water is added to the cement and the time, the needle makes an impression on the surface of the test block, while the attachment fails to do so, is the final setting time.

### *REPORTING OF RESULTS*

The results of the initial and the final setting time should be reported to the nearest five minutes.

## *1.4 SOUNDNESS*

### *AIM*

To determine the soundness of cement by Le-Chatelier method as per IS: 4031 (Part 3) – 1988.

APPARATUS

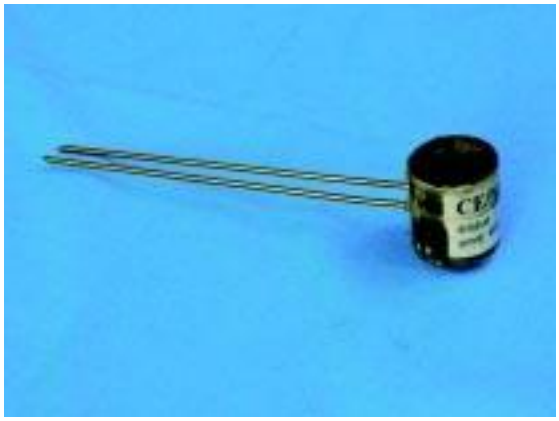

**FIG. 3 : LE-CHATELIER'S TEST APPARATUS**

i) The apparatus for conducting the Le-Chatelier test should conform to IS: 5514 - 1969

ii) Balance, whose pemissible variation at a load of 1000g should be $\pm$1.0g

iii) Water bath

### *PROCEDURE*

i) Place the mould on a glass sheet and fill it with the cement paste formed by gauging cement with 0.78 times the water required to give a paste of standard consistency (see Para 1.2).

ii) Cover the mould with another piece of glass sheet, place a small weight on this covering glass sheet and immediately submerge the whole assembly in water at a temperature of 27 ± 2$^{o}$C and keep it there for 24hrs.

iii) Measure the distance separating the indicator points to the nearest 0.5mm (say $d_1$).

iv) Submerge the mould again in water at the temperature prescribed above. Bring the water to boiling point in 25 to 30 minutes and keep it boiling for 3hrs.

v) Remove the mould from the water, allow it to cool and measure the distance between the indicator points (say $d_2$).

vi) $(d_2 - d_1)$ represents the expansion of cement.

### *REPORTING OF RESULTS*

Calculate the mean of the two values to the nearest 0.5mm to represent the expansion of cement.

## 2. TESTS ON AGGREGATES

### *2.1 SIEVE ANALYSIS*

### *AIM*

To determine the particle size distribution of fine and coarse aggregates by sieving as per IS: 2386 (Part I) - 1963.

### *PRINCIPLE*

By passing the sample downward through a series of standard sieves, each of decreasing size openings, the aggregates are separated into several groups, each of which contains aggregates in a particular size range.

### *APPARATUS*

**FIG. 4 : A SET OF IS SIEVES**

i) A set of IS Sieves of sizes - 80mm, 63mm, 50mm, 40mm, 31.5mm, 25mm, 20mm, 16mm, 12.5mm, 10mm, 6.3mm, 4.75mm, 3.35mm, 2.36mm, 1.18mm, 600□ m, 300□ m,150□ mand 75□ m

ii) Balance or scale with an accuracy to measure 0.1 percent of the weight of the test sample

### *SAMPLE*

The weight of sample available should not be less than the weight given below:-

| Maximum size present in substantial proportions (mm) | Minimum weight of sample despatched for testing (kg) |
|---|---|
| 63 | 100 |
| 50 | 100 |
| 40 | 50 |
| 25 | 50 |
| 20 | 25 |
| 16 | 25 |
| 12.5 | 12 |
| 10.0 | 6 |
| 6.3 | 3 |

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The sample for sieving should be prepared from the larger sample either by quartering or by means of a sample divider.

### *PROCEDURE*

i) The test sample is dried to a constant weight at a temperature of 110 $\pm$ 5 $^{o}$C and weighed.

ii) The sample is sieved by using a set of IS Sieves.

iii) On completion of sieving, the material on each sieve is weighed.

iv) Cumulative weight passing through each sieve is calculated as a percentage of the total sample weight.

v) Fineness modulus is obtained by adding cumulative percentage of aggregates retained on each sieve and dividing the sum by 100.

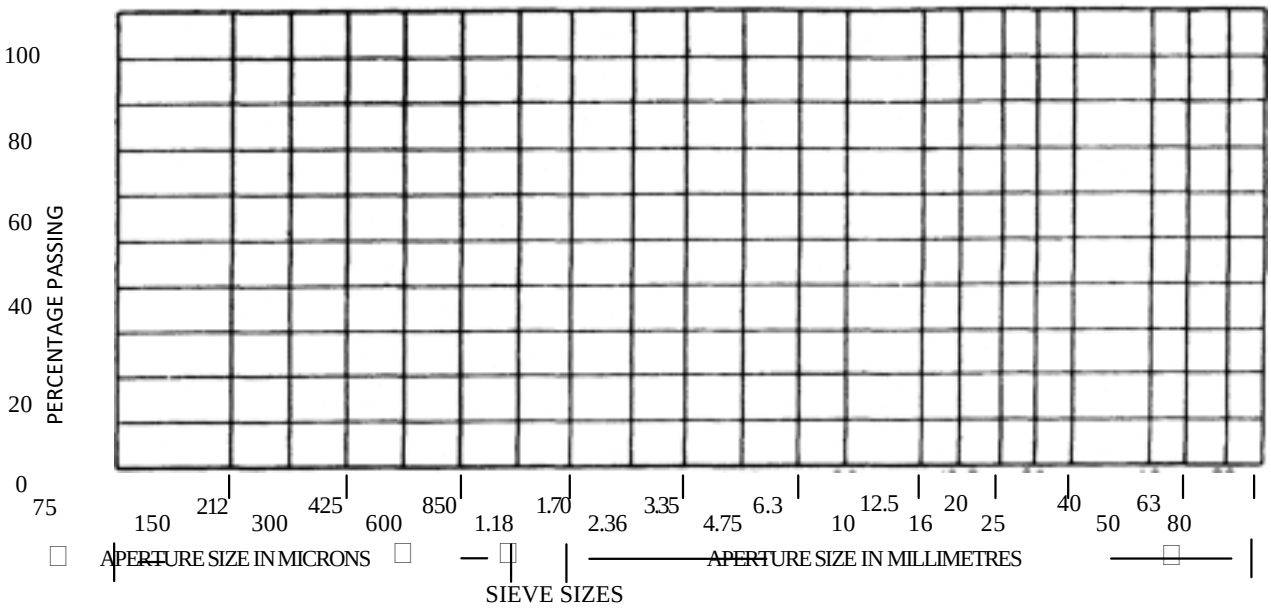
### *REPORTING OF RESULTS*

The results should be calculated and reported as:

i) the cumulative percentage by weight of the total sample

ii) the percentage by weight of the total sample passing through one sieve and retained on the next smaller sieve, to the nearest 0.1 percent.

The results of the sieve analysis may be recorded graphically on a semi-log graph with particle size as abscissa (log scale) and the percentage smaller than the specified diameter as ordinate. A sample chart is provided on page 12.




*Note - The vertical scale of this chart is an arithmetic scale and the horizontal scale is logarithmic.*

***CHART FOR RECORDING SIEVE ANALYSIS RESULTS***

## *2.2 WATER ABSORPTION*

**AIM**

To determine the water absorption of coarse aggregates as per IS: 2386 (Part III) - 1963.

### *APPARATUS*

i) Wire basket - perforated, electroplated or plastic coated with wire hangers for suspending it from the balance

ii) Water-tight container for suspending the basket

iii) Dry soft absorbent cloth - 75cm x 45cm (2 nos.)

iv) Shallow tray of minimum 650 sq.cm area

v) Air-tight container of a capacity similar to the basket

vi) Oven

### *SAMPLE*

A sample not less than 2000g should be used.

### *PROCEDURE*

i) The sample should be thoroughly washed to remove finer particles and dust, drained and then placed in the wire basket and immersed in distilled water at a temperature between 22 and 32 °C.

ii) After immersion, the entrapped air should be removed by lifting the basket and allowing it to drop 25 times in 25 seconds. The basket and sample should remain immersed for a period of 24 ± ½ hrs. afterwards.

iii) The basket and aggregates should then be removed from the water, allowed to drain for a few minutes, after which the aggregates should be gently emptied from the basket on to one of the dry clothes and gently surface-dried with the cloth, transferring it to a second dry cloth when the first would remove no further moisture. The aggregates should be spread on the second cloth and exposed to the atmosphere away from direct sunlight till it appears to be completely surface-dry. The aggregates should be weighed (Weight 'A').

iv) The aggregates should then be placed in an oven at a temperature of 100 to 110 C for 24hrs. It should then be removed from the oven, cooled and weighed (Weight 'B').

### *REPORTING OF RESULTS*

$$\text{Water absorption} = \frac{A - B}{B} \times 100\%$$

Two such tests should be done and the individual and mean results should be reported.

A sample proforma for the record of the test results is given in Annexure-I.

## *2.3 AGGREGATE ABRASION VALUE*

### *AIM*

To determine the abrasion value of coarse aggregates as per IS: 2386 (Part IV) - 1963.

### *APPARATUS*

Los Angles abrasion testing machine

IS Sieve of size - 1.7mm

**FIG. 5: LOS ANGLES MACHINE**

i) Abrasive charge-12nos. cast iron or steel spheres approximately 48mm dia. and each weighing between 390 and 445g ensuring that the total weight of charge is 5000 ±25g

ii) Oven

### *PREPARATION OF SAMPLE*

The test sample should consist of clean aggregates which has been dried in an oven at 105 to 110 °C to a substantially constant weight and should conform to one of the gradings shown in the table below:

### *PROCEDURE*

The test sample and the abrasive charge should be placed in the Los Angles abrasion testing machine and the machine rotated at a speed of 20 to 33 revolutions/minute for 1000 revolutions. At the completion of the test, the material should be discharged and sieved through 1.70mm IS Sieve.

**Grading of test samples**

| **Sieve size** (Square hole) | | **Weight in g of test sample for grade** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F | G |
| Passing through (mm) | Retained on (mm) | | | | | | | |
| 80 | 63 | - | - | - | - | 2500* | - | - |
| 63 | 50 | - | - | - | - | 2500* | - | - |
| 50 | 40 | - | - | - | - | 5000* | 5000* | - |
| 40 | 25 | 1250 | - | - | - | - | 5000* | 5000* |
| 25 | 20 | 1250 | - | - | - | - | - | 5000* |
| 20 | 12.5 | 1250 | 2500 | - | - | - | - | - |
| 12.5 | 10 | 1250 | 2500 | - | - | - | - | - |
| 10 | 6.3 | - | - | 2500 | - | - | - | - |
| 6.3 | 4.75 | - | - | 2500 | - | - | - | - |
| 4.75 | 2.36 | - | - | - | 5000 | - | - | - |

* Tolerance of ±2 percent permitted.

### *REPORTING OF RESULTS*

i) The material coarser than 1.70mm IS Sieve should be washed, dried in an oven at a temperature of 100 to 110 °C to a constant weight and weighed (Weight 'B').

ii) The proportion of loss between weight 'A' and weight 'B' of the test sample should be expressed as a percentage of the original weight of the test sample. This value should be reported as,

$$\text{Aggregate abrasion value} = \frac{A - B}{A} \times 100\%$$

A sample proforma for the record of the test results is given in Annexure-II.

## 2.4 AGGREGATE IMPACT VALUE

### AIM

To determine the aggregate impact value of coarse aggregates as per IS: 2386 (Part IV) - 1963.

### APPARATUS

**FIG. 6 : AGGREGATE IMPACT TEST MACHINE**

i) Impact testing machine conforming to IS: 2386 (Part IV) - 1963

ii) IS Sieves of sizes - 12.5mm, 10mm and 2.36mm

iii) A cylindrical metal measure of 75mm dia. and 50mm depth

iv) A tamping rod of 10mm circular cross section and 230mm length, rounded at one end

v) Oven

### PREPARATION OF SAMPLE

i) The test sample should conform to the following grading:

- Passing through 12.5mm IS Sieve 100%
- Retention on 10mm IS Sieve 100%

ii) The sample should be oven-dried for 4hrs. at a temperature of 100 to 110 C and cooled.

iii) The measure should be about one-third full with the prepared aggregates and tamped with 25 strokes of the tamping rod. A further similar quantity of aggregates should be added and a further tamping of 25 strokes given. The measure should finally be filled to overflow, tamped 25 times and the surplus aggregates struck off, using a tamping rod as a straight edge. The net weight of the aggregates in the measure should be determined to the nearest gram (Weight 'A').

### *PROCEDURE*

i) The cup of the impact testing machine should be fixed firmly in position on the base of the machine and the whole of the test sample placed in it and compacted by 25 strokes of the tamping rod.

ii) The hammer should be raised to 380mm above the upper surface of the aggregates in the cup and allowed to fall freely onto the aggregates. The test sample should be subjected to a total of 15 such blows, each being delivered at an interval of not less than one second.

### *REPORTING OF RESULTS*

i) The sample should be removed and sieved through a 2.36mm IS Sieve. The fraction passing through should be weighed (Weight 'B'). The fraction retained on the sieve should also be weighed (Weight 'C') and if the total weight (B+C) is less than the initial weight (A) by more than one gram, the result should be discarded and a fresh test done.

ii) The ratio of the weight of the fines formed to the total sample weight should be expressed as a percentage.

$$\text{Aggregate impact value} = \frac{B}{A} \times 100\%$$

iii) Two such tests should be carried out and the mean of the results should be reported.

A sample proforma for the record of the test results is given in Annexure-III.

## *2.5 AGGREGATE CRUSHING VALUE*

### *AIM*

To determine the aggregate crushing value of coarse aggregates as per IS: 2386 (Part IV) - 1963.

### *APPARATUS*

**FIG. 7 : CYLINDRICAL MEASURE AND PLUNGER**

i) Cylindrical measure and plunger

ii) Compression testing machine

iii) IS Sieves of sizes - 12.5mm, 10mm and 2.36mm

### *PROCEDURE*

i) The aggregates passing through 12.5mm and retained on 10mm IS Sieve are oven-dried at a temperature of 100 to 110 C for 3 to 4hrs.

ii) The cylinder of the apparatus is filled in 3 layers, each layer tamped with 25 strokes of a tamping rod.

iii) The weight of aggregates is measured (Weight 'A').

iv) The surface of the aggregates is then leveled and the plunger inserted. The apparatus is then placed in the compression testing machine and loaded at a uniform rate so as to achieve 40t load in 10 minutes. After this, the load is released.

v) The sample is then sieved through a 2.36mm IS Sieve and the fraction passing through the sieve is weighed (Weight 'B').

vi) Two tests should be conducted.

### *REPORTING OF RESULTS*

$$\text{Aggregate crushing value} = \frac{B}{A} \times 100\%$$

The result should be recorded to the first decimal place and the mean of the two results reported.

## 3. TESTS ON FRESH CONCRETE

### *3.1 WORKABILITY*

#### *3.1.1 SLUMP AIM*

To determine the workability of fresh concrete by slump test as per IS: 1199 - 1959.

### *APPARATUS*

**FIG. 8 : SLUMP CONE**

i) Slump cone

ii) Tamping rod

### *PROCEDURE*

i) The internal surface of the mould is thoroughly cleaned and applied with a light coat of oil.

ii) The mould is placed on a smooth, horizontal, rigid and non- absorbent surface.

iii) The mould is then filled in four layers with freshly mixed concrete, each approximately to one-fourth of the height of the mould.

iv) Each layer is tamped 25 times by the rounded end of the tamping rod (strokes are distributed evenly over the cross- section).

v) After the top layer is rodded, the concrete is struck off the level with a trowel.

vi) The mould is removed from the concrete immediately by raising it slowly in the vertical direction.

vii) The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured.

viii) This difference in height in mm is the slump of the concrete.

### *REPORTING OF RESULTS*

The slump measured should be recorded in mm of subsidence of the specimen during the test. Any slump specimen, which collapses or shears off laterally gives incorrect result and if this occurs, the test should be repeated with another sample. If, in the repeat test also, the specimen shears, the slump should be measured and the fact that the specimen sheared, should be recorded.

# 4. TESTS ON HARDENED CONCRETE

## *4.1 NON-DESTRUCTIVE TESTS*

### *4.1.1 REBOUND HAMMER AIM*

To assess the likely compressive strength of concrete by using rebound hammer as per IS: 13311 (Part 2) - 1992.

### *PRINCIPLE*

The rebound of an elastic mass depends on the hardness of the surface against which its mass strikes. When the plunger of the rebound hammer is pressed against the surface of the concrete, the spring-controlled mass rebounds and the extent of such a rebound depends upon the surface hardness of the concrete. The surface hardness and therefore the rebound is taken to be related to

the compressive strength of the concrete. The rebound value is read from a graduated scale and is designated as the rebound number or rebound index. The compressive strength can be read directly from the graph provided on the body of the hammer.

### *APPARATUS*

**FIG. 11 : REBOUND HAMMER**

### *PROCEDURE*

i) Before commencement of a test, the rebound hammer should be tested against the test anvil, to get reliable results, for which the manufacturer of the rebound hammer indicates the range of readings on the anvil suitable for different types of rebound hammer.

ii) Apply light pressure on the plunger - it will release it from the locked position and allow it to extend to the ready position for the test.

iii) Press the plunger against the surface of the concrete, keeping the instrument perpendicular to the test surface. Apply a gradual increase in pressure until the hammer impacts. (Do not touch the button while depressing the plunger. Press the button after impact, in case it is not convenient to note the rebound reading in that position.)

iv) Take the average of about 15 readings.

### *INTERPRETATION OF RESULTS*

The rebound reading on the indicator scale has been calibrated by the manufacturer of the rebound hammer for horizontal impact, that is, on a vertical surface, to indicate the compressive strength. When used in any other position, appropriate correction as given by the manufacturer is to be taken into account.

### *4.1.2 ULTRASONIC PULSE VELOCITY AIM*

To assess the quality of concrete by ultrasonic pulse velocity method as per IS: 13311 (Part 1) - 1992.

### *PRINCIPLE*

The method consists of measuring the time of travel of an ultrasonic pulse passing through the concrete being tested. Comparatively higher velocity is obtained when concrete quality is good in terms of density, uniformity, homogeneity etc.

## *APPARATUS*

**FIG. 12 : ULTRASONIC PULSE VELOCITY METER**

i) Ultrasonic pulse velocity meter

## *PROCEDURE*

i) *Preparing for use:* Before switching on the 'V' meter, the transducers should be connected to the sockets marked "TRAN" and " REC".

The 'V' meter may be operated with either:

a) the internal battery,

b) an external battery or

c) the A.C line.

ii) *Set reference:* A reference bar is provided to check the instrument zero. The pulse time for the bar is engraved on it. Apply a smear of grease to the transducer faces before placing it on the opposite ends of the bar. Adjust the 'SET REF' control until the reference bar transit time is obtained on the instrument read-out.

iii) *Range selection:* For maximum accuracy, it is recommended that the 0.1 microsecond range be selected for path length upto 400mm.

iv) *Pulse velocity:* Having determined the most suitable test points on the material to be tested, make careful measurement of the path length 'L'. Apply couplant to the surfaces of the transducers and press it hard onto the surface of the material. Do not move the transducers while a reading is being taken, as this can generate noise signals and errors in measurements. Continue holding the transducers onto the surface of the material until a consistent reading appears on the display, which is the time in microsecond for the ultrasonic pulse to travel the distance 'L'.

The mean value of the display readings should be taken when the units digit hunts between two values.

$$\text{Pulse velocity} = \frac{\text{Path length}}{\text{Travel time}}$$

v) *Separation of transducer leads:* It is advisable to prevent the two transducer leads from coming into close contact with each other when the transit time measurements are being taken. If this is not done, the receiver lead might pick-up unwanted signals from the transmitter lead and this would result in an incorrect display of the transit time.

### *INTERPRETATION OF RESULTS*

The quality of concrete in terms of uniformity, incidence or absence of internal flaws, cracks and segregation, etc., indicative of the level of workmanship employed, can thus be assessed using the guidelines given below, which have been evolved for characterizing the quality of concrete in structures in terms of the ultrasonic pulse velocity.

| Pulse Velocity (km/second) | Concrete Quality (Grading) |
|---|---|
| Above 4.5 | Excellent |
| 3.5 to 4.5 | Good |
| 3.0 to 3.5 | Medium |
| Below 3.0 | Doubtful |

## *4.2 COMPRESSION TEST*

### *AIM*

To determine the compressive strength of concrete specimens as per IS: 516 - 1959.

### *APPARATUS*

**FIG. 13 : COMPRESSION TESTING MACHINE**

i) Compression testing machine conforming to IS: 516 - 1959

### *AGE AT TEST*

Tests should be done at recognized ages of the test specimens, usually being 7 and 28 days. The ages should be calculated from the time of the addition of water to the drying of ingredients.

### *NUMBER OF SPECIMENS*

At least three specimens, preferably from different batches, should be taken for testing at each selected age.

### *PROCEDURE*

i) The specimens, prepared according to IS: 516 - 1959 and stored in water, should be tested immediately on removal from the water and while still in wet condition. Specimens when received dry should be kept in water for 24hrs. before they are taken for testing. The dimensions of the specimens, to the nearest 0.2mm and their weight should be noted before testing.

ii) The bearing surfaces of the compression testing machine should be wiped clean and any loose sand or other material removed from the surfaces of the specimen, which would be in contact with the compression platens.

iii) In the case a of cubical specimen, the specimen should be placed in the machine in such a manner that the load could be applied to the opposite sides of the cubes, not to the top and the bottom. The axis of the specimen should be carefully aligned with the centre of thrust of the spherically seated

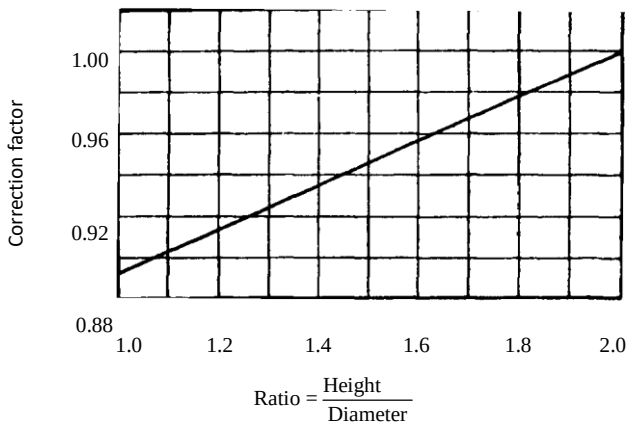
platen. No packing should be used between the faces of the test specimen and the steel platen of the testing machine. As the spherically seated block is brought to rest on the specimen, the movable portion should be rotated gently by hand so that uniform seating is obtained.

iv) The load should be applied without shock and increased continuosly at a rate of approximately 140kg/sq.cm/minute until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen should then be recorded and the appearance of the concrete and any unusual features in the type of failure should be noted.

## *CALCULATION*

The measured compressive strength of the specimen should be calculated by dividing the maximum load applied to the specimen during the test by the cross - sectional area, calculated from the mean dimensions of the section and should be expressed to the nearest kg/sq.cm. An average of three values should be taken as the representative of the batch, provided the individual variation is not more than □ 15% of the average. Otherwise repeat tests should be done.

A correction factor according to the height/diameter ratio of the specimen after capping should be obtained from the curve given below:-



**Correction factor for height-diameter ratio of a core**

The product of this correction factor and the measured compressive strength is known as the corrected compressive strength, this being the equivalent strength of a cylinder having a height/diameter ratio of two. The equivalent cube strength of the concrete should be determined by multiplying the corrected cylinder strength by 1.25.

## *REPORTING OF RESULTS*

The following information should be included in the report on each test specimen:

i) identification mark
ii) date of test
iii) age of specimen
iv) curing conditions, including date of manufacture of specimen
v) weight of specimen
vi) dimensions of specimen
vii) cross-sectional area
viii) maximum load
ix) compressive strength
x) appearance fractured faces of concrete of and type of fracture, if unusual
xi) date of test
xii) age of specimen
xiii) curing conditions, including date of manufacture of specimen
xiv) weight of specimen
xv) dimensions of specimen
xvi) cross-sectional area
xvii) maximum load
xviii) compressive strength
xix) appearance fractured faces of concrete of and type of fracture, if unusual

## Self-compacting concrete (SCC)

**Definition**

Self-compacting concrete (SCC) is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. The hardened concrete is dense, homogeneous and has the same engineering properties and durability as traditional vibrated concrete.

- It's very flowable concrete with high workability that has ability to flow under it's own weight with no need of vibration and no segregation and without the separation of the constituent materials until it sets

**Passing ability**

Ability of fresh concrete to flow through tight openings such as spaces between steel reinforcing bars.

**Segregation resistance**

The ability of concrete to remain homogeneous in composition while in its fresh state.

**Slump flow**

The mean diameter of the spread of fresh concrete using conventional slump cone.

**Slump-flow Test and T500mm Test**

This test specifies the procedure for determining the slump-flow and t500 time for self-compacting concrete. The test is not suitable when the maximum size of the aggregate exceeds 40 mm.

**Principle**

The slump-flow test is an indication of the flow ability of self-compacting concrete in the absence of obstructions. It is based on the slump test described in IS 1199 (Part 2). The flow ability is evaluated by measuring the maximum spreading diameter (d max) and the time it reaches the spreading diameter of 500 mm (t500). The d max of spreading is a measure of the self-compacting concrete flow range when subjected to load from its own weight. It is an indication of the yield stress of the self compacting concrete. The t500 time is a measure of the speed of flow and an indication of the relative viscosity of the self-compacting concrete. The result is an indication of the filling ability of self-compacting concrete. The fresh concrete is poured into a cone as used for the IS 1199 (Part 2) slump test. When the cone is withdrawn upwards the time from commencing upward movement of the cone to when the concrete has flowed to a diameter of 500 mm is measured; this is the t500 time. The largest diameter of the flow spread of the concrete and the diameter of the spread at right angles to it are then measured and the mean is the slump-flow.

**Apparatus**

The apparatus shall be in accordance with IS 1199 (Part 2) except as detailed below.

Base plate, made from a flat steel plate, with a plan area of at least 900 mm × 900 mm on which concrete can be placed.

The plate shall have a flat, smooth surface. The surface shall not be readily attacked by cement paste or be liable to rusting. The construction of the plate shall be such as to prevent distortion. The deviation from flatness shall not exceed 3 mm at any point when a straight edge is placed between opposing sides and corners.

The center of the plate shall be scribed with a cross, the lines of which run parallel to the edges of the plate and with circles of (210 ± 1) mm diameter and (500 ± 1) mm diameter having their centers coincident with the center point of the plate. See Figure 1. All lines to be a maximum of 2,0 mm wide and 1,0 mm deep.

Rule or measuring tape, of minimum length 1000 mm and having subdivisions not greater than 5 mm along its entire length.
Stop watch, capable of measuring to 0.1 s.
Spirit level, for checking horizontality of base plate prior to commencing the test.
Container, to hold the test sample and having a volume of at least 10 l.

**Test sample**
About 6 litres of concrete is needed to perform the test. The sample shall be obtained in accordance with IS 1199 (Part 1)

**Procedure**
Place the base plate on a flat and horizontal surface free from external vibration or shock. Check the top surface for horizontality using the spirit level. Clean the table and the cone and dampen immediately prior to testing, but keep free from excess moisture. Place the cone centrally within the 210 mm circle on the base plate and hold in position by standing on the foot pieces, ensuring that no concrete can leak from under the cone.

Fill the cone in one operation without any agitation or mechanical compaction, and strike off surplus from the top of the cone. Allow the filled cone to stand for not more than 30s; during this time remove any spilled concrete from the base plate.

Lift the cone vertically in 1s to 3s in one movement without interfering with the flow of concrete. If the t500 time has been requested, start the stop watch immediately the cone ceases to be in contact with the base plate and record the time taken to the nearest 0.1 s for the concrete to first touch the 500 mm circle

After the flow of concrete has stabilized without disturbing the base plate or concrete, measure the largest diameter of the flow spread and record as d1 to the nearest 10 mm. Then measure the diameter of the flow spread at right angles to d1 to the nearest 10 mm and record as d2 to the nearest 10 mm. If the difference between d1 and d2 is greater than 50 mm another sample shall be taken and the procedure repeated.

If two consecutive tests show the difference between d1 and d2 to be greater than 50 mm, the concrete lacks the necessary flowability for the slump-flow test to be suitable. Check the concrete spread for signs of segregation and report under cl. 9g in a qualitative way, e.g. no indication of segregation, strong indication of segregation.

NOTE: Signs of segregation include a ring of cement paste/mortar and segregated coarse aggregate in the central area.

**Test result**

The slump-flow SF is the mean of d1 and d2, expressed to the nearest 10 mm, given by the following equation.

SF = (d1+d2)/2,

Where,

SF is the slump-flow, in millimeters; d1 is the largest diameter of flow spread, in millimeters; d2 is the flow spread at 90° to d1, in millimeters.

The t500 time is reported to the nearest 0.1 s.

**Test report**

The test report shall include: a) Identification of the test sample; b) Location where the test was performed; c) Date and time of test; d) Ambient temperature, e) Slump-flow, SF, to the nearest 10 mm; f) t500 time, to the nearest 0.1 s (when requested); g) Any indication of segregation of the concrete, no indication of segregation or strong indication of segregation; (see NOTE under 7) h) Any deviation from the standard test method; j) Declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted in item h).

The report may include: k) Temperature of the concrete at the time of test; m) Time between completion of mixing and performance of the tests.

**V-Funnel Test**

**Introduction**

This test specifies the procedure for determining the V-funnel flow time for self compacting concrete. The test is not suitable when the maximum size of the aggregate exceeds 20 mm. The V-funnel test is used to assess the viscosity and filling ability of self-compacting concrete.

**Principle**

A V shaped funnel is filled with fresh concrete and the time taken for the concrete to flow out of the funnel is measured and recorded as the V-funnel flow time.

**Apparatus**

V-funnel, made to the internal dimensions and tolerances in Figure 2, fitted with a quick release, watertight hinged or sliding gate at its base and supported by a frame so that the top of the funnel is horizontal with sufficient clearance beneath the gate to place the container underneath. The V-funnel shall be made from metal or fibre glass; the surfaces shall be smooth, and not be readily attacked by cement paste or be liable to rusting.

Container, to hold the test sample and having a volume larger than the volume of the funnel and not less than 12 liters.

Stop watch, capable of measuring to 0.1 s.

Straight edge, for striking off concrete level with the top of the funnel.

**Test sample**

A sample of at least 12 litres shall be obtained in accordance with IS 1199 (Part 1).

**Procedure**

Clean the funnel and bottom gate, then dampen all the inside surface including the gate. Close the gate and pour the sample of concrete into the funnel in one operation, without any agitation or mechanical compaction, then strike off the top with the straight edge so that the concrete is level with the top of the funnel. Place the container under the funnel in order to collect the concrete. After a delay of (10 ± 2) s from filling the funnel, open the gate quickly and measure the time tv, to 0.1 s, from opening the gate to when it is possible to see vertically through the funnel into the container below for the first time. The time tv is the V-funnel flow time. The flow of concrete from the funnel shall be continuous. If a blockage occurs the test shall be repeated. If a second blockage occurs the concrete lacks the necessary viscosity. Report if a blockage has occurred.

**Test report**

The test report shall include:

a) Identification of the test sample;
b) location where the test was performed;
c) date when test performed;
d) Ambient temperature;
e) V-funnel flow time (tv) to the nearest 0.1s;
f) Any deviation from the standard test method; Declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted in item.
g) The report may include:
h) Temperature of the concrete at the time of test;
i) Time between completion of mixing and performance of the tests.

**L Box Test**

**Introduction**

The L-box test is used to assess the passing ability of self-compacting concrete to flow through tight openings including spaces between reinforcing bars and other obstructions without segregation or blocking.

**Principle**

The L box test is used to assess the passing ability of self-compacting concrete to flow through tight openings including spaces between reinforcing bars and other obstructions without segregation or blocking. There are two variations; the two bar test and the three bar test. The three bar test simulates more congested reinforcement. A measured volume of fresh concrete is allowed to flow horizontally through the gaps between vertical, smooth reinforcing bars. The heights of the concrete in the vertical section (H1) and at the end of the horizontal section (H2), see Figure 3, are measured and the ratio H2/H1 determined. This ratio is a measure of the passing or blocking behaviour of self-compacting concrete.

**Apparatus**

L box, having the general arrangement and internal dimensions as shown in Fig. 3.

The L box shall be of rigid construction with surfaces that are smooth, flat and not readily attacked by cement paste or be liable to rusting. The vertical hopper may be removable for ease of cleaning.

The bar positioning system shall be such that two smooth steel bars of (12 ± 0,2) mm diameter will provide a gap of (59 ± 1) mm for the two bar test and three smooth steel bars of (12 ± 0,2) mm diameter will provide a gap of (41 ± 1) mm for the three bar test. The system shall locate the bars in the L box so that they are vertical and equidistant across the width of the box.

The surface of any material used in the assemblies shall not be readily attacked by cement paste or be liable to rusting.

Rule or measuring tape, of minimum length 500 mm and graduated at intervals not exceeding 1 mm, the zero mark being at the extreme end of the rule or measuring tape.

Containers, to hold the sample and having a total volume not less than 14 l. Spirit level, for checking horizontality of base of L box base prior to commencing the test.

Straight edge, for striking off concrete level with the top of the L box.

**Test sample A sample of at least 12 liters shall be obtained in accordance with IS 1199 Part 1.**

Test procedure Support the L box on a level base and check for horizontality using the spirit level. Clean the L box and dampen immediately prior to testing, but keep free from excess moisture. Close the gate between the vertical and horizontal sections. Pour the concrete from the container(s) into the filling hopper of the L box, without any agitation or mechanical compaction, then strike off the top with the straight edge so that the concrete is level with the top of the vertical section of the L box and allow to stand for (60 ± 10) s. Check the concrete for signs of segregation before and after filling of the L box and report under cl. 22d) in a qualitative way, e.g. no indication of segregation, strong indication of segregation.

NOTE: Signs of segregation include a layer of cement paste/mortar and segregated coarse. Fully open the sliding gate in a smooth continuous action to allow the concrete to flow into the horizontal section. When movement has ceased, measure the drop in height of the level of concrete ΔH1 to the nearest 1 mm in the vertical section on the gate side of the box at three positions equally spaced across the width of the box. The mean depth of the concrete H1 is the difference between the height of vertical section and the average of the three readings of ΔH1. Record H1 to the nearest 1 mm. The same procedure is used to calculate the mean depth of the concrete at the end of the horizontal section of the L box H2 from the difference with the height of the horizontal section and the average of the three readings of ΔH2. Record H2 to the nearest 1 mm.

**Test result**

The passing ability ratio PL, as measured by the L box test, is calculated to the nearest 0.01 from the following equation:

Where, PL is the passing ability ratio measured by the L box test; H1 is the mean depth of concrete in the vertical section of the box, in millimeters; H2 is the mean depth of concrete at the end of the horizontal section of the box, in millimeters.

**Test report the test report shall include:**
a) Identification of the test sample;
b) Location where the test was performed;
c) Date and time of test;
d) Ambient temperature,
e) Whether two bar or three bar test was carried out;
f) Passing ability ratio, PL, to the nearest 0.05;
g) Any segregation or bleeding observed during filling of the L box, no indication of segregation/bleeding or strong indication of segregation/bleeding; (see NOTE under 20)
h) Any deviation from the standard test method;
j) Declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted in item
The report may include:
k) Temperature of the concrete at the time of test;
m) Time between completion of mixing and performance of the tests

**Sieve Segregation Resistance Test**
**Introduction**
This test specifies the procedure for determining the sieve segregation resistance of self-compacting concrete.

**Principle**
The sieve segregation resistance test is used to assess the resistance of self compacting concrete to segregation. After sampling, the fresh concrete is allowed to stand for 15 min and any separation of bleed water is noted. A known weight of the sample is then poured into a sieve with 4.75 mm square apertures. After 2 min the weight of material which has passed through the sieve is recorded. The segregation ratio is then calculated as the proportion of the sample passing through the sieve.

**Apparatus**
Perforated plate sieve, having 4.75 mm square apertures, frame diameter 300 mm andheight 40 mm, conforming to IS: 460 (Part 2) complete with a receiver from which thesieve can be easily removed by lifting vertically.

Weighing machine, having a flat platform which can accommodate the sieve receiver and having a capacity of at least 10 kg, calibrated in increments of ≤ 20 g. Sample container, a rigid container made from a non-absorbent material and having a minimum internal diameter of 200 mm and a capacity of at least 11 l with a 10 l point indicated on the inside of the container.

Timer, capable of measuring to 1 s.
Thermometer, capable of measuring to 1 °C.
Test sample A sample which fills the sample container to be obtained in accordance with IS 1199 -1

**Procedure**
Take and record the temperature of the concrete to the nearest 1 °C by using the thermometer. Place (10 ± 0.5) litres of concrete in the sample container and cover to prevent evaporation.
Allow to stand in a level position, without disturbance, for (15 ± 0.5) min.

Ensure the balance is level and free from vibration. Place the sieve receiver on the balance and record its mass, mp in gm. Then place the dry sieve on the receiver and again record the mass or zero the balance.

At the end of the standing period remove the cover from the sample container and record whether any bleed water has appeared on the surface of the concrete.
With the sieve and receiver still on the balance, and with the top of the sample container (500 ± 50) mm above the sieve, steadily and carefully pour (4.8 ± 0.2) kg of concrete (including any bleed water) onto the center of the sieve (see Figure 6) in one operation. Record the actual mass of concrete mc in gm on the sieve.

Allow the concrete to stand in the sieve for (120 ± 5)s and then remove the sieve vertically without agitation.
Record the mass of the receiver, including the material that has passed through the sieve, mps in grams.

**Test result**
The segregated portion SR is calculated from the following equation and reported to the nearest 1 percent.
Where,
SR is the segregated portion in percent; mps is the mass of sieve receiver plus passed material, in grams;
mp is the mass of the sieve receiver, in grams;
mc is the initial mass of concrete placed onto the sieve, in grams

**Test report**
The test report shall include: a) Identification of the test sample; b) Location where the test was performed; c) Date and time of test; d) Ambient temperature; e) Segregated portion SR, to the nearest 1 %; f) Presence of bleed water, if any, after standing for 15 min; g) Any deviation from the standard test method; h) Declaration by the person technically responsible for the test that it was carried out in accordance with this standard, except as noted in item g).
The report may include: j) Temperature of the concrete at the time of test; k) Time between completion of mixing and performance of the tests.

**METHOD STATEMENT FOR INSTALLATION OF BORED CAST-IN-SITU PILES.**

1. Pile point will be marked on the ground with Total Survey Station.
2. The Rotary boring machine will be moved to pile location and positioned w.r.t pile center pile ensuring verticality of mast with in-built indicator Panel facility or with spirit level.
3. After boring of about 5 to 6mtrs. Temporary steel casing or approx. Some depth will be placed in plumb position and checked with help of Spirit level.
4. Boring shall be carried out using rotary auger/bucket up to the tip of Pile. The depth of the bore shall be checked with a steel wire and tape.
5. The side of bore hole shall be stabilized even during boring by use of Betonies slurry through its length. The level of betonies suspension shall be maintained up to approx. 10M above the bottom level of temporary Casting at the top.
6. The bottom of bore hole shall be cleaned thoroughly using bucket.
7. Full length of steel reinforcement cage with spacer blocks will be lowered into the borehole.
8. 8”/10” dia tremmie pipe shall be lowered into bore hole keeping the bottom of termite approximately 300mm above pile bottom level.
9. The bore hole shall again be cleaned by betonies circulation by pumping Fresh betonies solution of a specific gravity of at least 1,025. The adequacy of pump for flushing piles more than 20mtr deep will be ensured.
10. After ensuring that the out coming betonies slurry is clean and consistency of the same is almost equal, (density to be measured & maintained) as that of fresh betonies slurry, the betonies circulation will be stopped.
11. If bore is left without concreting for more than two hours, it shall be flushed again.
12. Hopper wills he placed on termite pipe.
13. Ready mix concrete of required grade with 150 to I80mm slump shall be brought by transit mixers.
14. Concrete shall be poured through tremmie pipe (directly from transit Mixer in the hopper).
15. Concreting shall generally be poured with minimum interruption. However, under unavoidable circumstance if the operation has to be suspended temporarily, then the termite pipe shall be raised and lowered slowly from the time to time to avoid setting of concrete around it.
16. Sacrificial concrete at top will be cast for at least 1m.

17. The termite pipe shall be removed in stage during pouring of concrete ensuring that the termite bottom is always within the concrete. The operation shall be continued till the entire length of pile is cast.
18. The boring machine shall be brought back to location and temporary casing shall be removed using casing adapter.
19. Bore soil betonies mud shall be removed with the help of loader and tippers.

**METHOD STATEMENT- LOAD TEST ON PILES**

The initial load test to be carried out as per IS-2911 Part-4- 1985.
The Kent ledge structure shall be designed according to the applicable loads.
A pit of l2Mxl2M shall be excavated up to 2m below the ground level.
Further, pit about 3 M x: 3 M shall be excavated around the test pile up to about l below the test level of 1.40 M height below the bottom level of previous pit.
The pile shall be chipped off in order to remove the weak concrete and finished smooth at the test level with the same grade of concrete as in the pile.

The supports for the main girders shall be made of RCC and the top level shall be maintained at a pre-determined level, so that there is a gap of about 50mm between the jack assembly and the soffit of the main girders at the zero-load position. Sketch is shown in the drawing.

The jacks shall be placed over M.S. Plates on the pile, so that the center of gravity of the jacks is over the center of the M.S. Plates and over the center of the pi le.

The Kent ledge structure be placed in position as per design. The girders shall be tack-welded with reinforcement bars so as to keep them in position during the loading. The Kent ledge shall be covered with M.S. plates of 4mm thickness.

It is to be ensured throughout the process of loading that the kent ledge load shall be concentric with the center of the pile. The Kent ledge shall be loaded with sand bags/precast concrete blocks/sand.

Datum bars shall be provided with its supports at a distance of 5M from the edge of the piles. The supports shall be embedded in concrete into the ground. The datum bars shall be made of rigid structure steel material. The datum bars shall be so arranged as to accommodate dial gauges at three edges of the pile, the edges making apex points of an equilateral triangle.

Three numbers of magnetic stands shall be placed on the pile at the apex: points as mentioned above. The magnetic stands shall be placed on M.S. Plates fixed to the pile surface with some adhesive material. The dial gauges to be used for the test shall be of

sensitivity.

The dial gauges shall be fixed with the arms of the magnetic stands and shall be adjusted ‘0” reading. The test shall be carried out by applying series of vertical downward increment loads, each increment being of about 20% of the test load on the pile.

Taking of measurement or displacement in each stage of loading shall be maintained till rate of displacement of the pile top is either 0.1 mm in first 30 minutes or 0.2mm in first one hour or till 2 hours whichever occurs first.

The load shall be applied until the maximum test load is reached or the settlement exceeds 10% of the pile dia, whichever occurs earlier. The test load shall be maintained for 24 hours and hour readings shall be taken.

The load shall be started to be released in the reverse order of the increment applied. Each load stage shall be maintained for 30 minutes and the readings shall be recorded.
A graph shall be plotted showing loads on X-axis and corresponding displacements on Y-axis and the same shall be presented along with the load test Record Form1 A sample pro-forma for recording of observation is given.

Pressure shall be applied through 2 Nos. Electrically operated hydraulic jacks, each of 500MT capacity which are synchronized to work together.

Pressure gauge and dial gauges shall be got calibrated prior to testing from a reputed laboratory approved Engineer-in-Charge

## METHOD STATEMENT FOR CASTING OF PILE CAPS

The casting of pile caps will be taken up for pile groups cleared from all the routine tests i.e. Integrity Tests, Vertical Load Tests & Lateral Load Tests if the piles of that pile group are to be tested for any one of more of this tests. Before that the verticality and shift of the individual pile will be checked and recorded in the test given.

**SHUTTERING MATERIAL**: Pre-fabricated standard steel plate (1200 x 500 or 600 x 900 mm) will be joined with the help of bolts. Suitable packing to be provided to prevent leakage between successive plates.

**INSPECTION AND INSTALLATION OF SHUTTERING**: The shuttering will

then be supported by struts at suitable intervals to render the whole arrangement rigid. The straightness, line and level will be checked as per drawing. Before fixing of shuttering, it would be properly cleaned and the surfaces shall be treated with shuttering oil. Final cleaning of the enclosure will be done with compressor just before the casting of concrete. The position of reinforcement of pile cap and pier dowels will be checked with respect to the centerline of the bridge and the centerline of shuttering as well. To support the dowels of piers, staging shall be erected with scaffolding pipes to the full height at the opposite sides of the pile cap along the major axis of pier. This staging will be done at a suitable location outside the pile cap shuttering at for placing reinforcement of piers, one full set of links will be placed each, at the base (on the bottom layer reinforcement of Pile Cap), inside the template of the starter & at one place for the whole height of pier. A coat of cement will be applied on these dowels.

**POURING AND COMPACTION**: Casting will be done with crane & bucket arrangement or directly by transit mixer and chute. Pouring of concrete will be done in inclined layers. Concrete shall be deposited just on top of the top reinforcement layer. Compaction will be carried out by needle vibrators. The concreting shall be continued from one end and laid at such a speed that the unfinished face remains plastic. If under any circumstances concrete of the preceding layer looses its plasticity, a coat of cement slurry will be applied on this concrete surface to start further concreting. Small pieces of reinforcement would be inserted party inside the concrete top surface so that protruded portion may be used for proper supporting of the props/turn buckle of the pier. These shall be cut up to one inch below the concrete, painted with epoxy paint and surface repaired with epoxy mortar afterwards.

**PIER DOWEL AND CASTING OF STARTER**: The checking of pier Dowel Casting of starter will be done With a template (350mm or so high). The template will be in accurate lines, placed on chairs and well supported. These chairs will be welded to the top layer reinforcement of pile cap. The starter will be poured in the same operation of pile cap casting. The alignment and location of starter will be checked again before casting of starter.

**DESHUTTERING AND INSPECTION**: De-shuttering will be done after 24 hours and inspection of the de-shuttered surface shall be carried out immediately and remedial action of the surfaces, if any, shall be done with the concurrence of the department.

**CURING**: After de-shuttering, the vertical surfaces shall be wrapped with Hessian cloth and curing will be done by water spraying. The top surface will be inundated for 14 days by making a bund of 50mm height in cement mortar all round its periphery.

## CHAPTER 6
## FORMATES FOR RECORDING FOR QC TEST RESULTS

# ANNEXURE- A

**Name of Project :**

## STANDARD CONSISTANCY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Date of testing** | :- | | | | | |
| | **Location** | :- | | | | | |
| | **Agency** | :- | | | | | |
| | **Brand** | :- | | | | | |
| | **Wt of sample** | :- | | | | | |
| **Sl.No** | **Weight of Cement** | **Weight of Water** | **Percentage of Water** | **Penetration** | **Consistancy (P)** | **Standard as per IS Code** | **Remarks** |
| | **(Gms)** | **(Gms)** | **(%)** | **(mm)** | **(%)** | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
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**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- B

**Name of Project :**

## INITIAL SETTING TIME & FINAL SETTING TIME

| | | | |
|---|---|---|---|
| | **Date of testing** | **:-** | |
| | **Location** | **:-** | |
| | **Agency** | **:-** | |
| | **Brand** | **:-** | |
| | **Wt of sample** | **:-** | **400 gms** |
| | **Wt of Water** | **:-** | **0.85*(Water for normal consistancy)** |

| **Sl.No** | **Weight of Cement** | **Weight of Water** | **TIME (min)** (meaured from the instant of adding water to cement) | **Depthh of Penetration** | **Standard as per IS Code** | **Remarks** |
|---|---|---|---|---|---|---|
| | **(mm)** | **(mm)** | | **(mm)** | | |
| | | | | | | |
| | | | | | **Initial setting time:>30 Min** | |
| | | | | | **Final setting time:<600 Min** | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | The period elapsing between the same time when water is added to the cement and the time at which the needle fails to make an impression on the surface of the test block shall be the final setting time. | | | | | |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- C

**Name of Project :**

## FINENESS OF CEMENT

| | | | | | |
|---|---|---|---|---|---|
| | **Date of testing** | :- | | | |
| | **Location** | :- | | | |
| | **Agency** | :- | | | |
| | **Brand** | :- | | | |
| | **Wt of sample** | :- | **100Gms** | | |
| **Sl.No** | **Weight of Sample taken** | **Weight of Residue on 90 mm IS Sieve** | **Fineness (percentage retained)** | **Standard as per IS Code** | **Remarks** |
| | **(Gms)** | **(Gms)** | **(%)** | | |
| 1 | | | | **Fineness <10%** | |
| 2 | | | | | |
| 3 | | | | | |
| | **Average value** | | | | |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- D

**Name of Project :**

## COMPRESSIVE STRENGTH

| Room Temp | Date of | | Age of specimen | Crushing load (T) | Crushing Strength kg/cm2 | Remarks |
|---|---|---|---|---|---|---|
| | Casting | Testing | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

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

Comments of Laboratory In-Charge

Signed & Sealed by Laboratory In-Charge

Witnessed by: Name Designation Signature

# ANNEXURE-E

**Name of Project :**

## GRADATION OF FINE AGGEREGATE

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Date of testing** | :- | | | | | | | | |
| | **Location** | :- | | | | | | | | |
| | **Agency** | :- | | | | | | | | |
| | **Source of material** | :- | | | | | | | | |
| **Sl.No** | **Is Seive designation** | **Weight of Sample retained** | **% of Weight retained** | **Cumulative % of Weight retained** | **% of weight passing** | **Gradation limits** | | | | **Remarks** |
| | | | | | | **Grading Zone I** | **Grading Zone II** | **Grading Zone III** | **Grading Zone IV** | |
| | **(MM)** | **(GMS)** | **(GMS)** | **(%)** | **(%)** | | | | | |
| | | | | | | | | | | |
| 1 | **10** | | | | | **100** | **100** | **100** | **100** | |
| 2 | **4.75** | | | | | **90-100** | **90-100** | **90-100** | **95-100** | |
| 3 | **2.36** | | | | | **60-95** | **75-100** | **85-100** | **95-100** | |
| 4 | **1.18** | | | | | **30-70** | **55-90** | **75-100** | **90-100** | |
| 5 | **600 MIC** | | | | | **15-34** | **35-59** | **60-79** | **80-100** | |
| 6 | **300 MIC** | | | | | **5-20** | **8-30** | **12-40** | **15-50** | |
| 7 | **150 MIC** | | | | | **0-10** | **0-10** | **0-10** | **0-15** | |
| | **Pan** | | | | | | | | | |
| | | | | | | | | | | |
| | | | **FM=** | | | | | | | |
| | | | | | | | | | | |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE-F

| Name of Project : | |
|---|---|

## BULK DENSITY OF FINE AGGREGATE

| | | | |
|---|---|---|---|
| | **Date of testing** | :- | |
| | **Location** | :- | |
| | **Agency** | :- | |
| | **Source of Material** | :- | |

| | Description | Sample-1 | Sample-2 | Units | Standard as per IS Code | Remarks |
|---|---|---|---|---|---|---|
| | Capacity of Measure | | | Lts | | |
| | Empty Weight of Measure | | | Kgs | | |
| | Empty Weight of Measure + Sand (loose) | | | Kgs | | |
| | Weight of loose sand | | | Kgs | | |
| | Bulk Density (loose) | | | Kgs/Lts | | |
| | Avg value of Bulk Density | | | Kgs/Lts | | |
| | Empty Weight of Measure + Sand (Roded) | | | Kgs | | |
| | Weight of Roded sand | | | Kgs | | |
| | Bulk Density (Roded) | | | Kgs/Lts | | |
| | Avg value of Bulk Density | | | Kgs/Lts | | |

**Tested by**

**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE-G

**Name of Project :**

## DETERMINATION OF SILT CONTENT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Date of testing** | :- | | | | |
| | **Location** | **:-** | | | | |
| | **Agency** | **:-** | | | | |
| | **Source of Material** | **:-** | | | | |
| **Sl.No** | **Description** | **Sample-1** | **Sample-2** | **Sample-3** | **Standard as per IS Code** | **Remarks** |
| 1 | Volume of Sample (V1) ml | | | | **Silt Content <3%** | |
| 2 | Volume of Silt (V2) ml | | | | | |
| 3 | Percentage of silt | | | | | |
| | (V2/V1)*100 | | | | | |
| | Average | | | | | |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE-H

**Name of Project :**

## TEST CERTIFICATE FOR WATER FOR CONSTRUCTION WORK

| | |
|---|---|
| Package Name: | Package No.: |
| Contractor Name: | Contract No.: |
| Source of Supply: | |

| | No. of Samples Tested:<br>Tested as per IS- | | | Date | | Sample Collected:<br>Tested : | |
|---|---|---|---|---|---|---|---|
| *S. No* | *Color* | *pH Value* | *Organic Solids (mg/l)* | *Inorganic Solids (mg/l)* | *Sulphates (as $SO_4$) (mg/l)* | *Chlorides (as Cl) (mg/l)* | *Suspended Matter (mg/l)* |
| *Limits* | | *>6 <200* | | *<3000* | *<500* | *PCC <2000 RCC <1000* | *<2000* |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Traces of Oil & Grease

Average Hardness as CaCO3

Comments of Laboratory In-Charge

Signed & Sealed by Laboratory In-Charge

Witnessed by: Name Designation Signature

# ANNEXURE-I

**Name of Project :**

## AGGREGATE IMPACT VALUE TEST

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

| | | |
|---|---|---|
| **Material Name :** | **No. of Std. Blows : 15** | **Height of Fall : 380 mm** |

| No. | Detail | Unit | Trial | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 |
| 1 | Wt. of dry aggregate passing 12.5 mm and retained on 10 mm sieve + cylinder measure | Gms | | | | | |
| 2 | Wt. of cylindrical measure | Gms | | | | | |
| 3 | Wt. of dry aggregate taken (1)-(2) | Gms | | | | | |
| 4 | Wt. of crushed aggregate passing 2.36 mm sieve after subjecting the test specimen to 15 blows | Gms | | | | | |
| 5 | Aggregate Impact Value 100*(4)/(3) | % | | | | | |

Comments of Laboratory In-Charge

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name
Designation

Signature

# ANNEXURE-J

**Name of Project :**

## LOS ANGELES ABRASION TEST

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

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

Average Value

Comments of Laboratory In-Charge

Signed & Sealed by Laboratory In-Charge

Witnessed by: Name Designation Signature

# ANNEXURE- K1

**Name of Project :**

## GRADATION OF COARSE AGGEREGATE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Date of testing** | :- | | | | | |
| | **Location** | **:-** | | | | | |
| | **Agency** | **:-** | | | | | |
| | **Source of material** | **:-** | | | | | |
| | **MSA** | **:-** | **20 MM** | | | | |
| **Sl.No** | **Is Seive designation** | **Weight of Sample retained** | **% of Weight retained** | **Cumulative % of Weight retained** | **% of weight passing** | **Standard for Graded Aggregate** | **Standard for single size Aggregate** |
| | **(MM)** | **(GMS)** | **(GMS)** | **(%)** | **(%)** | | |
| | | | | | | | |
| 1 | **40** | | | | | **100** | 100 |
| 2 | **20** | | | | | **90-100** | 85-100 |
| 3 | **10** | | | | | **25-55** | 0-20 |
| 4 | **4.75** | | | | | **0-10** | 0-5 |
| | **Pan** | | | | | | |

**FM=**

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- K2

**Name of Project :**

## GRADATION OF COARSE AGGEREGATE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Date of testing** | :- | | | | | |
| | **Location** | **:-** | | | | | |
| | **Agency** | **:-** | | | | | |
| | **Source of material** | **:-** | | | | | |
| | **MSA** | **:-** | **12.5 MM** | | | | |
| **Sl.No** | **Is Seive designation** | **Weight of Sample retained** | **% of Weight retained** | **Cumulative % of Weight retained** | **% of weight passing** | **Standard for Graded Aggregate** | **Standard for single size Aggregate** |
| | **(MM)** | **(GMS)** | **(GMS)** | **(%)** | **(%)** | | |
| 1 | **20** | | | | | 100 | -- |
| 2 | **16** | | | | | **--** | 100 |
| 3 | **12.5** | | | | | **90-100** | 85-100 |
| 4 | **10** | | | | | **40-85** | 0-45 |
| 5 | **4.75** | | | | | **0-10** | 0-10 |
| | **Pan** | | | | | | |

**FM=**

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- L

**Name of Project :**

## BULK DENSITY OF COARSE AGGREGATE

| | | | |
|---|---|---|---|
| | **Date of testing** | :- | |
| | **Location** | :- | |
| | **Agency** | :- | |
| | **Source of Material** | :- | |
| | **MSA** | :- | **20 mm** |

| | Description | Sample -1 | Sample-2 | Units | Standard as per IS Code | Remarks |
|---|---|---|---|---|---|---|
| | Capacity of Measure | | | Lts | | |
| | Empty Weight of Measure | | | Kgs | | |
| | Empty Weight of Measure + Aggregate (loose) | | | Kgs | | |
| | Weight of loose Aggregate | | | Kgs | | |
| | Bulk Density (loose) | | | Kgs/Lts | | |
| | Avg value of Bulk Density | | | Kgs/Lts | | |
| | Empty Weight of Measure + Aggregate (Roded) | | | Kgs | | |
| | Weight of Roded Aggregate | | | Kgs | | |
| | Bulk Density (Roded) | | | Kgs/Lts | | |
| | Avg value of Bulk Density | | | Kgs/Lts | | |

**Tested by** **Checked by**

**Lab Assistant** **Field Incharge**

# ANNEXURE- M

**Name of Project :**

## FLAKINESS INDEX & ELONGATION INDEX

**(As part IS 2386 Part 1)**

| | | | |
|---|---|---|---|
| | **Date of testing** | :- | |
| | **Location** | :- | |
| | **Agency** | :- | |
| | **Source of materials** | :- | |
| | **MSA** | :- | **20mm** |

| **Sl. No** | **Pass through guage** | **Retained on gauge** | **Weight** | **Specified thickness guage** | **Weight of fraction passing through gauge** | **Retained on thickness gauge** | **Specified length gauge** | **Elongated Aggregate weight** | **Standard as per IS Code** | **Rem arks** |
|---|---|---|---|---|---|---|---|---|---|---|
| | **(mm)** | **(mm)** | **(G ms)** | | **(Gm s)** | **(Gms)** | | **(G ms)** | | |
| | **25** | **20** | | **25-20** | | | **25-20** | | **FLAKINESS % =** | |
| | **20** | **16** | | **20-16** | | | **20-16** | | **ELONGATED % =** | |
| | **16** | **12.5** | | **16-12.5** | | | **16-12.5** | | **COMBINED % =<40%** | |
| | **12.5** | **10** | | **12.5-10** | | | **12.5-10** | | | |
| | **10** | **6.3** | | **10-6.3** | | | **10-6.3** | | | |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- N

**Name of Project :**

## CUBE STRENGTH OF CONCRETE

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Date of testing** | | | **:-** | | | | **Agency :-** | |
| **Location** | | | **:-** | | | | **Source of Material :-** | |
| **Source of Material** | | | **:-** | | | | | |
| **Sl.No (1)** | **Grade of Concrete (2)** | **Date of Casting (3)** | **Date of Testing (4)** | **Age of Specimen Days (5)** | **Size of Specimen in mm (6)** | **Weight of Specimen in kgs (7)** | **Density (8)** | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | **Area of Loading (9)** | **Maximum Load (10)** | **Compressive Strength (11)** | **Avg Compressive Strength (12)** | **0.85*Avg $F_{av}$ (13)** | **1.15*Avg $Fa_v$ (14)** | **Acceptance 30+4=34 $N/mm^2$(Min) & for Individual Cube 30-2=28 or 30-3=27 (15)** | **Remarks (16)** |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- O

**Name of Project :**

## concrete slump test

| | | | | | |
|---|---|---|---|---|---|
| Package Name: | | | Package No.: | | |
| Contractor Name: | | | Contract No.: | | |
| Pour Card No: | | Pour Card Date: | Quantity : T/M3 | | |
| Daily Log Ref.<br>Date | | No. of Samples Tested:<br>Tested as per IS- | Date | Sample Collected :<br>Tested : | |
| S. No. | Particulars | Unit | Test no. | | |
| | | | 1 | 2 | 3 |
| | Wt. of cement | kg | | | |
| | Wt. of fine aggregate | kg | | | |
| | Wt. of coarse aggregate | kg | | | |
| | Water/cement ratio | | | | |
| | Wt. of water | kg | | | |
| | Slump | mm | | | |

Average slump of concrete = mm

Comments of Laboratory In-Charge

Signed & Sealed by Laboratory In-Charge

Witnessed by:

Name Designation Signature

# ANNEXURE-P

**Name of Project :**

## SLUMP FLOW METHOD

| | | |
|---|---|---|
| **Date of testing** | :- | |
| **Location** | :- | |
| **Agency** | :- | |
| **Source of Material** | :- | |
| **Time between completion of mixing and performance of the tests** | :- | |

| | Description | SET-1 | SET-2 | Specified value | Remarks |
|---|---|---|---|---|---|
| 1 | **Max coarse aggregate Size** | | | | |
| 2 | **Concrete Temperature** | | | | |
| 3 | **Slump flow** | | | | |
| | **d1** | | | | |
| | **d2** | | | | |
| | **SF= (d1+d2)** | | | >600 | |
| 4 | **Time to 500mm flow** | | | | |
| 5 | **Time to end of the flow slump** | | | | |
| 6 | **Visually detectable segregation** | | | | |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE-Q

**Name of Project :**

## L -Box Test

| | | | | | |
|---|---|---|---|---|---|
| | **Date of testing** | :- | | | |
| | **Location** | :- | | | |
| | **Agency** | :- | | | |
| | **Description** | **SET-1** | **SET-2** | **Specified value** | **Remarks** |
| 1 | **Mixture proportion of concrete** | | | | |
| 2 | **Concrete temperature** | | | | |
| 3 | **Minumum L-flow** | | | | |
| | **H1** | | | | |
| | **H2** | | | | |
| | **H2/H1** | | | **0.8-1.00** | |
| 4 | **Flow Speed** | | | | |
| | **1)time to reach an arbitrary L-flow distance during flowing as well as the L-flow distance** | | | | |
| | **2)Time to the end of the flow** | | | | |
| 5 | **Visually detectable segregation** | | | | |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- R

**Name of Project :**

## V-Funnel Test

| | | | | | |
|---|---|---|---|---|---|
| | **Date of testing** | :- | | | |
| | **Location** | **:-** | | | |
| | **Agency** | **:-** | | | |
| | **Description** | **SET-1** | **SET-2** | **Specified value** | **Remarks** |
| 1 | **Type of Funnel** | | | | |
| 2 | **Mixture proportions of concrete** | | | | |
| 3 | **Concrete Temperature** | | | | |
| 4 | **Flow through time** | | | | |
| 5 | **Average flow through speed** | | | | |
| 6 | **Relative flow through speed** | | | **0.8-1.00** | |
| 7 | **Flow through index** | | | | |
| 8 | **State of flow /Blockage** | | | | |

**Tested by**

**Lab Assistant**

**Checked by**
**Field**
**Incharge**

# ANNEXURE-S

**Name of Project :**

## U-Box Test

| | | | | | |
|---|---|---|---|---|---|
| | **Date of testing** | :- | | | |
| | **Location** | **:-** | | | |
| | **Agency** | **:-** | | | |
| | **Description** | **SET-1** | **SET-2** | **Specified value** | **Remarks** |
| 1 | **Mixture proportions of concrete** | | | | |
| 2 | **Concrete Temperature** | | | | |
| 3 | **H1** | | | | |
| 4 | **H2** | | | | |
| 5 | **H1+H2** | | | **<30 MM** | |
| 6 | **Visually detectable segregation** | | | | |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- T

**Name of Project :**

## SIEVE SEGREGATION RESISTANCE TEST

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Date of testing** | :- | | | | | |
| | **Location** | :- | | | | | |
| | **Agency** | :- | | | | | |
| | **Time between completion of mixing and performance of the tests** | :- | | | | | |
| | **The temperature of the concrete at the time of tests** | :- | | | | | |
| | **Description** | | | **SET-1** | **SET-2** | **Specified value** | **Rem arks** |
| | **Weight of seive receiver** | $W_p$ | = | | | | |
| | **weight of Seive receiver + Sieve (make balance zero)** | | = | | | | |
| | **Presence of bleed water if any,after standing for 15 min** | | = | | | | |
| | **Actual Weight of concrete pored in sieve** | $m_c$ | = | | | | |
| | **Weight of mass of concrete on receiver after allowing 2min** | $m_{ps}$ | = | | | | |
| | **SR =($m_{ps}$ -$m_p$)*100/$m_c$** | **SR** | = | | | **< 15 %** | |
| | **Average value** | **SR** | = | | | | |

**Tested by**
**Lab Assistant**

**Checked by**
**Field Incharge**

# ANNEXURE- U

**Name of Project :**

## Hydrostatic test for Pressure Pipes

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Package Name: | | | Package No.: | | | | | | |
| Contractor Name: | | | Contract No.: | | | | | | |
| Daily Log Ref.<br>Date | | Tested as per CPHEEO | Date Tested | | | | | | |
| S. No | Material of pipe | ID (mm) | Stretch | Length (m) | Applied test pressure ($kg/cm^2$) | Time in hrs) | | | Observations |
| | | | | | | 1 | 2 | 3 | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Comments of the Engineer in charge

Any rectification to be done by the contractor

Signature of the Engineer in charge

Signature of the Contractor

Witnessed by:

Name Designation Signature

| ANNEXURE- V | |
|---|---|
| **Name of Project :** | |
| **Leak test for elevated RCC structures** | |
| Package Name: | Package No.: |
| Contractor Name: | Contract No.: |
| Name of Structure: | Size: |

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

Comments of the Engineer in charge

Any rectification to be done by the contractor

Signature of the Engineer in charge  Signature of the Contractor

Witnessed by:

Name  Designation  Signature

| ANNEXURE- W | |
|---|---|
| **Name of Project :** | |
| **Leak test for underground RCC structures** | |
| Package Name: | Package No.: |
| Contractor Name: | Contract No.: |
| Name of Structure: | Size: |

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

Comments of the Engineer in charge

Any rectification to be done by the contractor

Signature of the Engineer in charge

Signature of the Contractor

Witnessed by:

Name Designation Signature

| ANNEXURE- X |
|---|
| **Name of Project :** |
| **Permit format for concreting** |

**Date of Concreting**

**This Permit Format must be presented to Employer's Representative at least one day advance of proposed concreting. Concreting can be done only if Permit Format is duly signed by authorized representative of implementing agency.**

| | | | |
|---|---|---|---|
| Package Name: | | Package No.: | |
| Contractor Name: | | Contract No.: | |
| Where the concrete used: | | | |
| Supervised By: | | Quantity :_T/M3 | |
| Daily Log Ref.<br>Date | Mix Grade:<br>Time Start<br>Finish | Date | Sample Collected :<br>Tested : |

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

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

| ANNEXURE- Y |
| --- |
| **Name of Project :** |
| **Centering & Shuttering** |

**Centering & Shuttering**

- IS formwork plan submitted and approved.
- IS formwork checked by Engineer in Charge

**Reinforcement**

**IS reinforcement placed as per approved drawings and design and checked by Engineer in charge.**

**Plasticizers**

1. **Is use of plasticizers approved.**

2. **Name and make of plasticizer**

3. **Type of plasticizer**

**Labor Amenities**

**Approved for concreting**

**Signature of authorized representative of implementing agency**

# ANNEXURE- Z1

**Name of Project :**

## Daily Concrete Report

| | | | |
|---|---|---|---|
| Package Name: | | Package No.: | |
| Contractor Name: | | Contract No.: | |
| Where the concrete used: | | | |
| Supervised By: | | Quantity : T/M3 | |
| Daily Log Ref.<br>Date | Mix<br>Grade:<br>Time Start<br>Finish | Date | Sample Collected :<br>Tested : |

| **Concrete materials per bag of cement** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Material | Material | Material | Material | Material | Material | Material | Material |
| Cement | Cement | Cement | Cement | Cement | Cement | Cement | Cement |
| Coarse Aggregate 1 CA1 | Coarse Aggregate1 CA1 | Coarse Aggregate1 CA1 | Coarse Aggregate 1 CA1 | Coarse Aggregate 1 CA1 | Coarse Aggregate 1 CA1 | Coarse Aggregate 1 CA1 | Coarse Aggregate1 CA1 |
| Coarse Aggregate 2 CA2 | Coarse Aggregate2 CA2 | Coarse Aggregate2 CA2 | Coarse Aggregate 2 CA2 | Coarse Aggregate 2 CA2 | Coarse Aggregate 2 CA2 | Coarse Aggregate 2 CA2 | Coarse Aggregate2 CA2 |
| Fine Aggregate | Fine Aggregate | Fine Aggregate | Fine Aggregate | Fine Aggregate | Fine Aggregate | Fine Aggregate | Fine Aggregate |
| Water | Water | Water | Water | Water | Water | Water | Water |

# ANNEXURE- Z2

| **Name of Project :** | |
|---|---|

## CONCRETE CUBES FOR TESTING REPORT

| Sieve Size mm | **Gradation** % Finer | | | **No. of Concrete Cubes for Testing** | | | |
|---|---|---|---|---|---|---|---|
| | CA1 | CA2 | FA | | | | |
| 40 | | | | Cube No | | | |
| 20 | | | | | | | |
| 4.75 | | | | Time | | | |
| 2.36 | | | | | | | |
| 1.18 | | | | Cube No | | | |
| 0.6 | | | | | | | |
| 0.3 | | | | Time | | | |
| 0.15 | | | | | | | |

| Slump Test | | | | | Temperature Test | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Sl.No | Time | Value | Sl.No | Time | Value | Time | Air Tempera-ture | Concrete Temperature |
| 1 | | | 5 | | | | | |
| 2 | | | 6 | | | | | |
| 3 | | | 7 | | | | | |
| 4 | | | 8 | | | | | |

## CHAPTER 7

## E.P.C. Contracts G.Os & QC Instructions.

# Code for E.P.C. Contracts

(Engineering, Procurement and construction)

G.O.Ms. No. 50, Dated: 2nd March, 2009

& ANNEXURES

# GOVERNMENT OF ANDHRA PRADESH

## ABSTRACT

Irrigation & CAD Dept., – Guidelines of EPC system through Appendix to the relevant codes of APPW "D" Code, APPW "A" Code, A.P.Financial Code vol.I, APDSS and PWD Codes for executing public works in all Engineering/Public works Department and other organizations – Orders – Issued.

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### Irrigation & CAD (PW-REFORMS) Department

G.O.Ms.No.50 Dated: 2nd March, 2009.

Read The Following

1. G.O.Rt.No.1652 Gen.Administration (GPM&AR) Dept. Dt: 7.4.04.
2. D.O.Lr.No. 69984/KPS/GPM&AR/04-9 from Spl.Cs to Govt.Gen.Admn. (GPM&AR) Dept. Dt.18.10.2004.
3. D.O.Lr.No. 60445/KPS/GPM&AR/05-1 from Spl.Cs to Govt. Co ordination, GPM&AR (GAD). Dt.17.5.05.
4. D.O.Lr.No. 11252/Reforms/2004-9 I & CAD (PW Reforms) Dt: 04.02.06.
5. D.O.Lr.No.CGG/EPC-Turnkey/2006, from Director General CGG Dt: 27.5.06.
6. U.O.Note.No.5292/R.I(2)/05-3, Dt:27.5.06. From Prl. Secy to Govt. Transport, Roads & Buil. Dept.
7. D.O.Lr.No.1405/ F3(2)/2006-3, from Dy. Fin. Advisor to Govt.,fin.(W&P) Dt: 11.8.2006.
8. D.O.Lr.No. 11252/Reforms/2004, I & CAD (Reforms) Dt: 14.11.2006.
9. Lr.No.14571/T4/EG/2006 from Eng.Chief (Public Health) Dt: 8.12.2006.
10. Lr.No. 231206/AEE1/DEE2/MC/2006 from the E-in-C, R&B Admn&Roads, Dt: 30.12.2006.
11. Lr.No.ENC(I)/DCE.1/OT.8/EPC/2006 From the E-in-C(Irr) Dt: 7.3.2007.
12. Memo.No. 11252/Reforms/2004, I & CAD Dept., Dt: 05.10.2007.
13. Memo.No. 11252/Reforms/2004, I & CAD Dept., Dt: 07.02.2009.

ORDER

1. Government, keeping in view the available human resources in the Irrigation & CAD Dept., as well as complex technical nature of works in terms of design and introduction of latest technology, took a decision to introduce internationally recognized and proven EPC methodology for execution of projects of such large size and technical complexities. Further Government of India and other organizations have been successfully executing projects through EPC methodology in various sectors such as National Highways, Power etc. Including sardar sarovar projects in Gujarat. The adoption of EPC methodology is likely to ensure involvement of major construction companies/firms with latest technical know how. In view of the introduction of EPC System for executing woks, the need to append relevant rules governing EPC Procedure for procurement to the existing Codes arose.

2. The Government vide G.O.Rt.No. 1652 GA (GMR&AR) Dept. Dt: 7-4-2004, have constituted a High Power Committee, to examine among other issues, the recommendations of Center for Good Governance on "The Accountability in Public Works". The committee has recommended to introduce fresh chapter in the APPWD Code at its first meeting held on 14-6-2004 and the work was entrusted to the centre for Good Governance (CGG), Hyderabad for working out details.

3. The Centre for Good Governance has taken up the introduction of relevant chapters in the APPW "D" code by conducting number of consultative workshops with the Engineer-in-Chiefs of the respective Engineering Departments and the Board of Chief Engineers have given their consent to the Revised Draft of the APPW "D" Code. Similarly, the CGG has taken up the revision of APPW "A" Code and revised the Draft Accounts Code duly incorporating the remarks and contributions made by the Director of Accounts, and duly obtaining the concurrence of Board of Chief Engineers. The revision incorporated the provisions available in various orders issued by the Government on works and also relevant provisions available in AP Financial Code, AP Accounts Code, AP Fundamental Rules, CPWD Code, CPW "A" Code and Govt. of India Accounting Rules 1990. The issue has also been discussed with all the works department viz, R&B, MA & UD, PR & RD etc., and the Finance Department.

4. The Finance ( W&P) Dept, accepted the recommendations in pursuance of the discussions held in wrap up Workshop on 19-8-2006 and 22-1-2007 in the Dr.MCR HRD Institute involving representatives of all the works departments, Finance, A.G., T and R & B, MA & UD, PR & RD etc., on the proposed additions to the PWD Codes i.e., (1) AP Detailed Standard Specifications (2) APPW "D" Code (3). A.P.Financial Code Volume -1 (4) APPW Accounts Code.

5. After detailed deliberations and discussion on the above issue, the Government accept the recommendations of the High Level Committee, Board of Chief Engineers and The Finance Department and accordingly issue the orders for appending to the existing relevant codes the Guidelines on EPC contract system applicable in all Engineering/Public Works Department and other organizations. The following four parts as Appendix to the relevant Codes related to EPC System of procurement are enclosed herewith in Annexure I , II III and IV as indicated below.

   1. Code for EPC Works
      (Appendix to A.P.Detailed Standard Specifications) --- Annexure – I
   2. Code for EPC Works (Appendix to "D" Code) – Annexure – II
   3. Code for EPC Works (Appendix to Financial Code Vol.I) – Annexure – III
   4. Code for EPC Works
      (Appendix to A.P.Public Works Accounts Code) --- Annexure – IV

   These are appended to the relevant codes to accommodate EPC Procedure of Procurement while leaving the original provisions in the code as they are.

6. This order issues with the concurrence of Finance (W&P) Department vide their U.O.No. 3347/F3 (2)/2007-1, dated: 13-4-2007.

(BY ORDER AND IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

RAJIV RANJAN MISHRA
SECRETARY TO GOVERNMENT

To

All the Engineer-in-Chief of Irrigation & CAD Department.

All the Chief Engineers of Irrigation & CAD Department.

The Commissioner, Commissioner of Tenders,

The Engineer-in-Chief, PR & RD Department, Hyderabad.

The Engineer-in-Chief (R & B) Admn.,Dept.,Hyderabad.

The Engineer-in-Chief (PH), Hyderabad.

Copy to

All the Collectors & Dist. Magistrate of A.P.,

All Sections in Irrign & CAD (PW/Irrgn.) Dept.

The A.G., A.P.Hyderabad.

The G.A. (Cabinet) Dept. w.r.t.U.O.No. 122/2009, dt: 24-2-2009.

The G.A. (GPM&AR) Dept.

The Finance (W&P) Dept.

The P.S. to Ministers (PR & RD/MA & UD/T.R. & B/Housing)

The P.S. to Prl. Secy. (SKJ)/P.S.to Secretary (AD)/P.S. to Secretary (RRM)

The P.S. to Prl. Secretary, Housing/P.S. to Prl. Secy, M.A. & U.D. / P.S. to Secretary,T.R. & B / P.S. to Prl. Secretary, PR & RD./P.S. to Secretary, Housing.

All the Advisors of Irrgn & CAD Dept.

SF/SC.

//FORWARDED :: BY ORDER//

J.NARAKANTEERAVA
SECTION OFFICER

**GOVERNMENT OF ANDHRA PRADESH**
**IRRIGATION & CAD (PW - REFORMS) DEPARTMENT**

# ANNEXURE – I

(Enclosure to G.O.Ms. No. 50,
Irrigation & CAD Department dt. 2-3-2009)

## Code for E.P.C. Contracts

(Engineering, Procurement and construction)

## Appendix to A.P.

## Detailed Standard Specifications

# GOVERNMENT OF ANDHRA PRADESH
# IRRIGATION & CAD
# (PW-REFORMS) DEPARTMENT

## ANNEXURE – I

(Enclosure to G.O.Ms. No. 50, Irrigation & CAD Department dt. 2-3-2009)

P. Detailed Standard Specifications

Provisions for EPC Works

P.S.8

Note .2 under P.S. 8

The 'employer' is the Superintending Engineer, i.e. the agreement concluding authority.
'Engineer-In-Charge' is The Executive Engineer in charge of execution.

P.S.11

Note.1 under P.S.11:

In respect of EPC works the conventional Schedule.A giving the quantities against each item of work is dispensed with. Only project information regarding project features, major components as available are given in project profile of bid documents. Scope of work and basic project parameters of the project shall be defined in the bid documents. The bidders shall review the data / information provided in bid documents and satisfy themselves. Any doubts shall be got cleared in pre bid meeting.The contractor shall quote the bid price in lumpsum after careful analysis of cost involved for the performance work considering all basic parameters, specifications and conditions of contract. The bid offer shall be for the whole work and not for individual item / part of work. The bidder shall quote for the entire work on a single source responsibility basis. The cost of all items of work necessary to achieve the objective as setout in the basic parameters shall be included in the bid price. The total cost of work shall be mentioned.

P.S.12

Note.1 under P.S. 12:

In respect of EPC works the execution shall be strictly in accordance with bid conditions. Contractors shall not deviate from basic parameters of the project to reduce his costs. EPC being a turnkey system extra items / financial claims on the department contingent to the work other than price adjustments shall not be considered.

P.S.13

Note.1 under P.S.13:

In respect of EPC the Estimated Contract Value excluding reimbursible items put to tender value shall be the basis for comparison of tenders.
The agency shall furnish the detailed estimates prepared based on approved drawings as per provisions of agreement.

P.S.14

Note.1 under P.S. 14:

In respect of EPC works drawings given, listed and indexed in bid documents are indicative. The above drawings show the system as a whole .The contractor shall carry out investigation to prepare detailed layout, designs and drawings of all components of the work within the stipulated time period, to be approved by competent departmental authority. The contractor shall follow all relevant BIS codes / circulars issued by the department from time to time for various components of the works. In case of difference of opinion on technical matters between the contractor and the Engineer-in-charge , the decision of the appellate authority shall be final and binding on the contractor.

The appellate authority is Superintending Engineer in respect of designs and drawings approved by Engineer-in-charge.

The appellate authority is Chief Engineer/ Chief Engineer (Designs) in respect of designs and drawings approved by Superintending Engineer.

The appellate authority is the Committee constituted by the Government in respect of designs and drawings approved by Chief Engineer/ Chief Engineer (Designs).

P.S.54 Note.1 under P.S. 54:

In case of EPC works, if the prime contractor desires to sublet a part of the work, he should submit the same at the time of filing bids (itself) or during execution, giving the name of the proposed sub contractor, along with details of his qualification and experience. The bid accepting authority should verify the experience of the sub contractor and if the sub contractor satisfies the qualification criteria in proportion to the value of work proposed to be sub let, including his past track record of completion and quality of work, he may permit the same. The aggregate value of works to be awarded on sub letting shall not exceed 50% of contract value. The extent of sub letting shall be added to the experience of the sub contractor and to that extent deducted from that of the main contractor.

P.S.59 Note.1 under P.S. 59

In respect of EPC works the Chief Engineer shall permit grant of extension of time up to six months and by the Govt. beyond six months based on the recommendations of State Level Standing Committee constituted by the Govt. and the Superintending Engineer conveys the same to the agency.

P.S.60 Note to P.S 60(a)

In respect of EPC works.

Termination of contract shall also be as per condition No.55 of General Conditions of EPC contract.

Note to P.S 60(b)

Extension of Time in EPC contracts shall be granted.

In respect of EPC works EOT with liquidated damages shall be granted by CE concerned upto six months and by the Govt. beyond six months based on the recommendations of State Level Standing Committee constituted by Government and the Superintending Engineer will convey with the same to the agency.

In respect of EPC contract, payments are made as per payment schedule given in Annexure.II. The payment schedule can be sub divided into sub components. Quantities are not indicated in the agreement or bill. In case of execution of unfinished work of agency the quantities have to be worked out by the department. The following is to be adopted:

I. The deletion shall be in conformity with the sub components already fixed.

   i. If the new agency is willing to carry out work at the amount not exceeding the sub component percentage of original agency ie., where there is no extra liability to government the same can be approved by the employer, irrespective of monetary value.

   ii. If the new agency is willing to carry out the work and the amount exceed the sub component percentage of original agency, if the difference is within 5% of agreement value the same may be entrusted by the Committee constituted for fixing I.B.M. The difference of 5% is to be made good from original agency.

   iii. If the agency is willing to carry out the work and the amount exceed the sub component percentage by 5% of agreement value, all such cases require prior approval of Government.

P.S.62 Note.1 under P.S. 62

In respect of EPC works the measurements shall be recorded by EPC agency in M.Books and LF Books issued by the Engineer-in-charge duly certified and numbered which shall be checked by the departmental officers as detailed in departmental codes.

P.S.63 Note.1 under P.S. 63

In respect of EPC works the quantities are not shown as in conventional Schedule.A. As such payment for any extra work shall be regulated as under

1 Entrustment of the additional items contingent to the main work and within the scope of contract will be authorised by the employer and the contractor shall be bound to execute such additional items at no extra cost to the employer and the cost of such items shall be deemed to have been included in the contract price quoted.

2 Entrustment of additional items of work contingent to main work and outside the scope of the contract will be authorised by the employer with the prior approval of the Government and the contractor shall be bound to execute such additional items and shall be compensated at the price decided by the Government.

3 Whenever additional items not contingent on the main work and outside the scope of original contract are entrusted to the contractor, entrustment of such items and the price to be paid shall be referred to the Government for final decision.

P.S.68

Note.1 under P.S. 68

In respect of EPC works the amount recovered from the final bills will be retained under deposits and paid together with the EMD retained, after defect liability period as stipulated in the agreement

In case of Irrigation Department works the defect liability period is to be taken as 2 working khariff seasons or 24 months whichever is higher.

P.S.69

Note .1 under P.S. 69

In respect of EPC works the retention amount in excess of 2.5 % of value of work done shall be released against unconditional BG in multiples of Rs. 25 lakhs(in respect of contracts of Rs.100 crores and below) / Rs.50 lakhs(in respect of contracts of above Rs.100 Crores), if the rate of progress is maintained. The unconditional irrevocable BG shall be for the period till the final bill is paid. In the final bill 2.5 % of value of work done is to be retained and kept under deposits. The same shall be paid after defect liability period.

**GOVERNMENT OF ANDHRA PRADESH**
**IRRIGATION & CAD (PW - REFORMS) DEPARTMENT**

# ANNEXURE – II

(Enclosure to G.O.Ms. No. 50,
Irrigation & CAD Department dt. 2-3-2009)

# Code for E.P.C. Contracts

(Engineering, Procurement and construction)

## Appendix to A.P.
## Public Works "D" Code

# GOVERNMENT OF ANDHRA PRADESH
# IRRIGATION & CAD
# (PW-REFORMS) DEPARTMENT

## ANNEXURE – II

(Enclosure to G.O.Ms. No. 50, Irrigation & CAD Department dt. 2-3-2009)

| | |
|---|---|
| "D" Code | Provisions for EPC Works |
| Para No.20 | Note.1 under Para 20.<br>Superintending Engineer should prepare project profile and basic project parameters with project cost under EPC Agency. The same shall be approved by<br>i) Superintending Engineer - upto Rs.50 Lakhs<br>ii) Chief Engineer - More than Rs.50 Lakhsand equal to Rs.200 Lakhs<br>iii) Committee constituted by Government for works costing more than Rs.200 lakhs. |
| Para No.99 | Note .1 under Para 99<br>The estimate shall be prepared based on available preliminary data, the scope of works and project parameters taking into consideration the points mentioned in Para 390 and duly furnishing approximate financial break up of component parts as envisaged in Para 101 of A.P.P.W "D" Code and submitted in case of works to be taken up under EPC for according Administrative approval. |
| Para No.102 | Note.1 under Para 102<br>On receipt of Administrative Approval for EPC works the department should verify the estimate prepared as envisaged in Note.1 under para 99 and if satisfied Technical sanction be accorded by the competent authority.<br>In case the department has any new facts which will materially affect the cost of the project they shall be taken into consideration for arriving at the estimate for according Technical sanction.<br>If that cost of estimate is found to exceed the Administrative approval, Revised administrative approval must be obtained before according Technical sanction. |
| Para No.112 | Note.1<br>In case of works taken up under EPC estimate shall be prepared as envisaged in Note.1 under para 102 of "D" Code. |
| Para No.117 | In respect of EPC works provision towards contingencies may be made as under subject to the ceilings indicated there in<br>Estimates upto Rs.1.00 crore @ 0.25% maximum Rs. 20,000/-<br>Estimates above1.00 crore and upto Rs. 10.00 crore @0.20% maximum Rs. 1.00 Lakh.<br>Estimates above Rs.10.00 Crores and upto Rs. 100.00 Crores @0.10% Maximum Rs.5.00 lakh.<br>Estimates above Rs.100.00 Crores @0.05% maximum Rs.10.00 lakhs. |
| Para No.120 | Note.1<br>In case of EPC works the designs are to be submitted by the executing agency which shall be approved by the competent authority. The EPC agency is responsible for the technical features of designs. The competent authority approving the designs is accountable to the department. |

Note.2

The Competent authority for approval of designs /HPs is Chief Engineer/Central Designs Organisation or any other authority as specified by Govt.

Para No.150 In addition to the three methods of execution fourth method is introduced for execution of EPC works.
(iv) By an agreement in the form approved by Government for EPC.

In regard to method (iv) the details are set forth clearly in the form of articles of agreement, tender notice and bid documents approved by Government.

Para No.151 Note1 under Para 151:

Contract documents approved by the Government for EPC works in terms of Para 153 of "D" Code shall be followed whenever tenders are invited for EPC works.

Para No.154 The following shall be added under Para 154 before sub para (1):

In respect of EPC works limited/ open tender system shall be followed.

The following shall be added under Para 154 (iii).

In case of EPC works the bidder shall furnish EMD at 1% of the value put to tender at the time of bid submission. EMD @ 2.5% of bid amount shall be paid at the time of concluding contract by successful bidder. EMD shall be in the form of DD / BG from any Nationalized /Scheduled bank.

The following shall be added as 4 under Note.6 of Para 154.

In case of EPC works

a) Entrustment of the additional items contingent to the main work and within the scope of contract will be authorised by the employer and the contractor shall be bound to execute such additional items at no extra cost to the employer and the cost of such items shall be deemed to have been included in the contract price quoted.

b) Entrustment of additional items of work contingent to main work and outside the scope of the contract will be authorised by the employer with the prior approval of the Government and the contractor shall be bound to execute such additional items and shall be compensated at the price decided by the Government.

c) Whenever additional items not contingent on the main work and outside the scope of original contract are entrusted to the contractor, entrustment of such items and the price to be paid shall be referred to the Government for final decision

Para No.174 Method (iv) to be inserted after method (iii)

Para No.197

1. (i) In EPC contracts, Mobilisation advance not exceeding 5% of the contract value is payable at the prescribed stages of execution.

   (ii) Mobilisation advance on new machinery at the prescribed percentage of the value of new machinery not exceeding 5% of contract value is payable against production of original invoices in proof of purchase of the machinery by the contractor/firm/joint venture.

2. The invoices should be in the name of the contractor/firm/joint venture only and the new machinery should have been purchased only after the date of conclusion of the agreement for the work.

3. No mobilisation advance is payable on machinery purchased by an individual firm in respect of joint ventures though that individual firm is a partner in the joint venture.

4. The contractor /firm/joint venture should submit an undertaking to the effect that they have not obtained any mobilisation advance from the government against the machinery for which they are presently claiming payment of mobilisation advance. This is to ensure that mobilisation advance is paid only once against one purchase. Any wrong declaration, when comes to light, entails recovery of the entire amount

paid with penal interest in a lump sum from their immediate next work bill apart from instituting other prescribed penal actions.

5. Payment of mobilisation advance is also permissible on ordered machinery with approval of Government.
6. Recovery of mobilisation advance along with interest shall be made as per provisions of the contract.

Para No.292

Note.4 under para 292 of "D" Code :

1. In case of EPC works, measurements shall be recorded by EPC agency in M.Books and L.F.Books issued by the concerned EE duly numbered and certified. The M.Books and L.F.Books have to be maintained by the EPC agency through authorized graduate engineers as per procedure prescribed in Code and finally to be handed over to the department (Engineer-in-charge).
2. In Earth Work Excavation and embankment AE/AEEs have to verify and record
   a. 1/3rd of prelevels taken by EPC agency
   b. 100% levels in case of cut off and foundations
   c. 25% of intermediate work done levels
   d. 100% for final levels recorded by EPC Agency.
   e. All measurements recorded by the EPC agency in the M-Books issued by the EE shall be checked to 100% extent by AEs/AEEs
   f. DEEs., EEs and SEs have to check the above levels and measurements as per standing codal provisions and orders.
3. Wherever Quality Control agencies are in existence, such agency has to record its findings in M Books/LF Books besides furnishing certificates as prescribed separately.

The Engineer-in-charge has to approve the cut-off trench and other foundation in consultation with the authorized geologist.

Para No.416. IV Contracts

Note.1 under Article 193

The procedure prescribed by Government for acceptance of tenders in respect of EPC shall be followed.

# GOVERNMENT OF ANDHRA PRADESH
# IRRIGATION & CAD
# (PW-REFORMS) DEPARTMENT

## ANNEXURE – III

(Enclosure to G.O.Ms. No. 50, Irrigation & CAD Department dt. 2-3-2009)

**Financial Code** — Provisions for EPC Works

**Article 51** — Note under Article 51(a)

For entrustment of EPC contracts the Government may approve a panel of firms/agencies based on certain prescribed eligibility criteria. This empanelment shall be reviewed at a periodicity of not more than 2 years.

In respect of EPC works, limited tender system inviting bids from the approved panel of firms/agencies under each category or open tender system shall be followed. The form of bid documents and contract format approved specially for EPC mode of works shall be used.

In respect of pre-qualified agencies, financial bid evaluation shall be done.
In respect of open category tenders, technical evaluation shall be done first following the criteria specified in the bid document and financial bid evaluation shall be done in respect of those who are qualified in technical bid evaluation.

**Article 163** — In addition to the four methods of execution fifth method is introduced for execution of EPC works.

(v) By an agreement in the form approved by Government for EPC works.

In regard to method (v) the details are set forth clearly in the form of articles of agreement, tender notice and tender documents approved by Government.

**Article 175** — Note 1 under Article 175:

1. In case of EPC works, measurements shall be recorded by EPC agency in M.Books and L.F.Books issued by the concerned Engineer-in-Charge duly numbered and certified. The M.Books and L.F.Books have to be maintained by the EPC agency through authorized graduate engineers as per procedure prescribed in Code and finally to be handed over to the department (Engineer-in-charge).
2. In Earth Work Excavation and embankment AE/AEEs have to verify and record
   a. 1/3rd of prelevels taken by EPC agency
   b. 100% levels in case of cut off and foundations
   c. 25% of intermediate work done levels.
   d. 100% for final levels recorded by EPC Agency.
   e. All measurements recorded by the EPC agency in the M-Books issued by the EE shall be checked to 100% extent by AEs/AEEs
   f. DEEs., EEs and SEs have to check the above levels and measurements as per standing codal provisions and orders.
3. Wherever Quality Control agencies are in existence, such agency has to record its findings in M Books/LF Books besides furnishing certificates as prescribed separately.

**Article 177** — Note under Article 177
Method (v) to be inserted

1. In EPC contracts, Mobilisation advance not exceeding 5% of the contract value is payable at the prescribed stages of execution. Mobilisation advance on new machinery at the prescribed percentage of the value of new machinery not exceeding 5% of contract value is payable against production of original invoices in proof of purchase of the machinery by the contractor/firm/joint venture.

2. The invoices should be in the name of the contractor/firm/joint venture only and the new machinery should have been purchased only after the date of conclusion of the agreement for the work.
3. No mobilisation advance is payable on machinery purchased by an individual firm in respect of joint ventures though that individual firm is a partner in the joint venture.
4. The contractor /firm/joint venture should submit an undertaking to the effect that they have not obtained any mobilisation advance from the government against the machinery for which they are presently claiming payment of mobilisation advance. This is to ensure that mobilisation advance is paid only once against one purchase. Any wrong declaration, when comes to light, entails recovery of the entire amount paid with penal interest in a lump from their immediate next work bill apart from instituting other prescribed penal actions.
5. Payment of mobilisation advance is also permissible on ordered machinery with approval of Government.
6. Recovery of mobilisation advance along with interest shall be made as per provisions of the contract.

Article 185 Note (2) under Article 185

The estimate shall be prepared based on available preliminary data, the scope of works and project parameters taking into consideration the points mentioned in Para 390 and duly furnishing approximate financial break up of component parts as envisaged in Para 101 of A.P.P.W "D" Code and submitted in case of works to be taken up under EPC for according Administrative approval.

Article 190 The following para to be added

In respect of EPC works the method of execution shall be as per the provisions of agreement.

Article 192 Note.4 under Article 192

In respect of EPC works bid documents approved by Government shall be adopted for inviting tenders.

Article 193 Note.1 under Article 193

The procedure prescribed by Government for acceptance of tenders in respect of EPC shall be followed.

Article 195 The following shall be added below 'f'

1. Entrustment of the additional items contingent to the main work and within the scope of contract will be authorised by the employer and the contractor shall be bound to execute such additional items at no extra cost to the employer and the cost of such items shall be deemed to have been included in the contract price quoted.
2. Entrustment of additional items of work contingent to main work and outside the scope of the contract will be authorised by the employer with the prior approval of the Government and the contractor shall be bound to execute such additional items and shall be compensated at the price decided by the Government.
3. Whenever additional items not contingent on the main work and outside the scope of original contract are entrusted to the contractor, entrustment of such items and the price to be paid shall be referred to the Government for final decision.

**GOVERNMENT OF ANDHRA PRADESH**
**IRRIGATION & CAD (PW - REFORMS) DEPARTMENT**

# ANNEXURE – IV

(Enclosure to G.O.Ms. No. 50,
Irrigation & CAD Department dt. 2-3-2009)

## Code for E.P.C. Contracts

(Engineering, Procurement and construction)

## Appendix to A.P Public Works Accounts Code

# GOVERNMENT OF ANDHRA PRADESH
# IRRIGATION & CAD
# (PW-REFORMS) DEPARTMENT

## ANNEXURE – IV

(Enclosure to G.O.Ms. No. 50, Irrigation & CAD Department dt. 2-3-2009)

A.P.Public Works Accounts Code

Provisions for EPC Works

Para 293

**Note 4 under Para 293**

In respect of EPC works, M.Books and L.F.Books have to be issued by the Executive Engineer to EPC agency duly certified and numbered for recording measurements and levels. The M.Books and L.F. Books shall be maintained by EPC Agency and bills are to be submitted to the **Engineer in Charge** by the EPC agency along with a true extract of the entire set for checking and making payment. The Engineer-in-charge has to keep the full set of true extract with him and return the originals to the agency for further use. The entire original record shall be finally handed over for record to the Engineer-in-charge by the EPC Agency.

Para 294

**Note.6 under para 294 of "A" Code:**

1. In case of EPC works, measurements shall be recorded by EPC agency in M.Books and L.F.Books issued by the concerned EE duly numbered and certified. The M.Books and L.F.Books have to be maintained by the EPC agency through authorized graduate engineers as per procedure prescribed in Code and finally to be handed over to the department (Engineer-in-charge).
2. In Earth Work Excavation and embankment AE/AEEs have to verify and record
   a. 1/3rd of prelevels taken by EPC agency
   b. 100% levels in case of cut off and foundations
   c. 25% of intermediate work done levels
   d. 100% for final levels recorded by EPC Agency.
   e. All measurements recorded by the EPC agency in the M-Books issued by the EE shall be checked to 100% extent byAEs/AEEs.
   f. DEEs., EEs and SEs have to check the above levels and measurements as per standing codal provisions and orders.
3. Wherever Quality Control agencies are in existence, such agency has to record its findings in M Books/LF Books besides furnishing certificates as prescribed separately

Para 297

**The following shall be added as:**
**Note.3.**

1. In Earth Work Excavation and embankment AE/AEEs have to verify and record
   a. 1/3rd of prelevels taken by EPC agency
   b. 100% levels in case of cut off and foundations
   c. 25% of intermediate work done levels
   d. 100% for final levels recorded by EPC Agency.
   e. All measurements recorded by the EPC agency in the M-Books issued by the EE shall be checked to 100% extent by AEs/AEEs
   f. DEEs., EEs and SEs have to check the above levels and measurements as per standing codal provisions and orders.
2. Wherever Quality Control agencies are in existence, such agency has to record its findings in M Books/LF Books besides furnishing certificates as prescribed separately.

Para 306 The following shall be added as :

306 (7) -

In respect of EPC works, EPC Agency shall prepare monthly work bills based on measurements of work done and submit to Engineer – in-charge.

In respect of EPC works, payments shall be regulated in accordance with Annexure.II- Schedule of Payments component wise.

The components may be further divided into appropriate sub components and stages. The payment of each stage of sub component shall be expressed as percentage of total cost of approved bid which shall also be approved by the Superintending Engineer or Executive Engineer, if the acceptance of tenders falls within his purview and shall form part of contract. Sum of all such stages of particular component shall be equal to the percentage of that component shown in Annexure.II of Schedule of Payments.

The percentage fixed for sub component shall be correlated to the main component and volume of the work.

The eligibility for payment shall be limited to completed portions of works, subject to other conditions envisaged in the agreement and executive instructions from time to time.

In EPC System, Schedule-A indicates only firm lumpsum amount of the contract., but does not firm the basis for payments.

Bidder shall quote lump sum amount for the work as a whole.

Percentages of components shall be indicated by the department in Annexure-II to Schedule .A

The Chief Engineer is empowered to modify the percentage of components; stage wise based on the detailed investigation, detailed drawings, and detailed estimation done by the EPC agency keeping the total price bid unaltered, in respect of works accepted by authorities above the level of CE. In respect of other works, the respective authorities to accept tenders have the powers to do so.

The Superintending Engineer is empowered to modify the sub-components reach-wise /stage-wise keeping the percentages of component unaltered., if the acceptance of the tender is EE he has the power to do so.

Para 309 **The following shall be added under Para 309:**

The Sub Divisional Officer and Engineer-in-charge shall exercise check to see that the bill submitted by EPC agency is in accordance with agreement conditions and certified by the departmental Quality Control Authorities (or) 3rd Party Quality Control Agency (or) by both if both are deployed on the work.

Engineer-in-charge (EE) should check the claim with reference to the measurements recorded to see that the percentage at which the bill is claimed is clearly traceable into the documents on which payments are to be made. Payments shall be adjusted for recovery of advance payments, liquidated damages in terms of agreement conditions, security deposit for due fulfillment of the contract. Recoveries shall be affected towards seignorage charges on the materials used and VAT and other statutory recoveries as per State and Central Government Rules and Acts.

Para 457 **The following shall be added to the exemption (1) under Note:**

In respect of EPC works the retention amount in excess of 2.5% of total value of work billed for shall be released against BG in multiples of amounts specified in the agreement, if the rate of progress is maintained.

# INSTRUCTION RELATING TO QUALITY ASSURANCE AS PER APDSS.

## As per Govt. MEMO No. 5217/ Reforms/06 Dated 23-02-2006)

## Sub: I & CAD- Quality Control – Roles and responsibilities of Construction Staff, Quality Control Wing and Third Party Quality Control Agency in execution of projects taken up under EPC Turnkey system – Reporting Procedure –Reg.

ORDER: - The Government of Andhra Pradesh on top priority has taken up large number of Major and Medium Irrigation projects under EPC turnkey system and almost all the prioritized projects are grounded and are at various stages of execution. Quality Control/Quality Assurance in execution is a prime requisite to ensure the longevity and performance of any Engineering System. In order to ensure the Quality Control/ Quality Assurance, Government have introduced 3rd party Quality Control/ Quality Assurance agencies to ascertain the Quality Control/ Quality Assurance in construction of Irrigation Projects in addition to Department construction staff and Departmental Quality Control organization.

In order to define the activities to be carried out by construction staff, Departmental Quality control staff and 3rd party Quality Control/Quality Assurance agencies, guidelines are prepared and herewith enclosed for following the same in discharging the duties by the above –mentioned agencies. All Quality Control Units including 3rd party Quality Control Agencies will function under Technical Control of Engineer –in-chief (Irrigation). Enclosed Guidelines.

Roles and responsibilities of Construction Staff, Quality Control Wing and Third Party Quality Control Agency in execution of projects taken up under E.P.C Turnkey System

The Government of Andhra Pradesh has taken up large number of Major and Medium Irrigation Projects to bring an additional Ayacut of about 645 lakhs of acres in a span 2 to 5 years. Most of the Projects are grounded and are at a various stages of progress. As the projects are to sustain for number of decades, Quality Control assumes an important role. Maintenance of Quality of irrigation Projects is a continuous process and has to be ensured and assured by the executing agency under EPC system, construction staff, Department Quality Control Staff and the third party Quality Control agencies wherever appointed.

For exercising the quality control check and maintaining proper record at the site of work for offering the remarks to inspecting officers, a study was made.

(a) To define the roles and responsibilities of field staff, quality control staff and 3rd party quality control agencies. In this, the essential items shall be identified which must be inspected and cleared by the quality wing and/ or 3rd party quality control agencies before crucial items of civil and mechanical work like embankments, foundations of large structures, fabrications of steel/PSC pipes, embedding of EM Parts etc. to be taken up.

(b) The procedure for recording of work executed in M Books for making payments to the contractors for the work executed every month including maintenance of records and certification of quality of work executed.

(c) Reporting procedure for adverse remarks of 3rd party QC agencies to field staff, CEs, Commissioner (Krishna Basin) & Ex-Officio secretary to Government and Director (Godavari Basin) & Ex-official Additional Secretary to Government and remedial action by field staff and reporting procedure.

The following guidelines are drafted with reference to the above three aspects and the same may be followed to have a uniform procedure in maintaining the quality control/assurance in the project taken up under EPC turnkey system.

(A) The roles and responsibilities of field staff, Quality Control staff and 3rd party Quality control Agencies.

(I) FIELD STAFF

(1) The field staff (construction staff) has to associate with the EPC agency while conducting the tests. In case of necessity they may conduct tests independently whenever required. Under E.P.C. system the field staff plays a vital role in quality assurance of the works.

(2) The field staff shall invariably check and produce all the following records and O.K. Cards maintained by E.P.C. Agency at the site to the Inspecting Officers.

**A) Registers:-**

1) Site order.
2) Register of Bench Marks.
3) Material O.K. Register.
4) Register of foundations.
5) Register of placement for concrete, Embankment, Reinforcement and other test reports.
6) Register of test reports of compressive strength of concrete specimens.
7) Cement day Book.

**B) O.K. Cards for big Structures and Heavy Embankments:**

1) O.K. Cards for cast-in-situ concrete lining.
2) O.K. Cards for Earthwork Embankment.
3) O.K. Cards for grouting.
4) O.K. Cards for structural concrete work.

3) The inspecting officers should verify the above records with their observations and sign in the Registers maintained at site during their inspections.

4) In case of Earthwork excavation embankment, the field staffs have to check and record the pre levels 25% of the pre levels taken by the E.P.C. Agency. In case of cut-off and foundations the field's staff has to check and record 100% levels.

**II) Department quality control Staff**

1) The Department Quality control staff shall verify the records maintained at site by E.P.C. agency and the third party quality control agency. The field quality control staff has to check 25% of the final levels of Earthwork, revetment, lining, concrete, linear dimensions of important structures; gates etc., and recede independently.
2) Regarding the tests and frequency of tests, the field quality control staffs have to conduct/associate with construction staff as mentioned in Annexure 'D'. In case of ambiguity, they shall conduct tests in A.P.E.R.L. independently.
3) Where the Third party quality control agency is not appointed, the Department quality control staff have to issue the quality certificates for releasing payment to the E.P.C. agency during construction and after completion.

**III) Third Party Quality Control Agency**

1) The third party quality control agency should posses all the testing facilities as per agreement and conduct independent testing to assure the quality of work. They should also verify 10% of the tests being done by the E.P.C agency independently.
2) The third party quality control agency has to submit the reports and records to the Engineer-in-charge vide appendix XE' (enclosed)

3) The Third party quality control agency shall give Quality control certificate for each work bill executed by the EPC agency.

C) Reporting procedure for adverse remarks of 3rd – party quality control agency and departmental quality control staff.

1. Reporting procedure shall be followed as per appendix VE.
2. The third party quality control agency shall submit reports in four sets for specific cases of deficiencies for connective action to the Engineer-in-charge soon after verification. The substandard material shall be rejected and got them removed from the site. In case of necessity, engineer-in-charge shall arrange to stop the work till the deficiencies are rectified to the satisfaction of the 3rd party quality control agency/departmental quality staff.
3. The Engineer-in-charge shall communicate the above remarks of 3rd party quality control agency to the EPC agency for compliance of corrective action.
4. The EPC agency shall furnish compliance report to the Engineer-in-Charge, who in turn forward the same to the third party quality control agency/departmental quality control as the case may be for verification.
5. Soon after receipt of report on the compliance to the remarks of the third party quality control agency by the EPC agency, evidence of compliance of corrective action has to be furnished to the engineer-in-charge to proceed with further work.
6. In addition to the above, the observations made by third party quality control and the Department quality control staff have to be invariably complied with before the next bill is present for payment and certificate to that effect has to be recorded in bills presented by the EPC agency duly countersigned by their field construction staff before making payments.

7. Engineer-in-Charge shall conduct meeting with the EPC agency and 3rd party quality control agency once in a fortnight to review the adverse remarks, compliance reports, verification report etc. Any non compliance of the adverse remarks within reasonable time shall be brought to the specific notice of superintending Engineer, Chief Engineer (HOD) and the concerned Secretary (Project / Commissioner (Krishna Basis) / Director, Godavari Basin.
8. On completion of the works, the third party quality control Agency and Department Quality control staff have to certify that the work has been executed as per design and specification satisfying intended scope of project as indicated in the agreement before making final payments to the E.P.C. agency
9. Mechanical Division shall do all Quality Control Checks of Mechanical works under the control of Engineer-in-Chief (Irrigation).
11. In respect of CM and CD works (structures) the intermediate payments will be in three stages i.e., at (a) completion of foundation including earth work (b) completion of substructure and (c) completion of super structure including miscellaneous items. The mode of payment will be 30 % after completion of foundation. 30 % after completion of sub- structure and balance 40 % after completion of individual structure.
12. The cost of earth work excavation and structure (on percentage basis with respect to whole work ) mentioned in Schedule ”A”
13. Intermediate payment for each structure (in 3 stages) shall be for canals and distributaries (up to 10 cusecs discharges) only. For minor and sub-minor (below 10 cusecs discharges) no separate intermediate payment to the structures shall be considered. For minor and sub minor payment shall be released when earth work excavation of canal and all structures (CM& CD works) are completed in full shape for a length of 5 Kms.
14. For other work like spillway, earth dam, pressure main, gates etc. The agreement clause for payment shall be followed keeping in view the agreement condition.
15. The Engineer-in-Charge shall recommend for release of payment duly ensuring quality certificate by the third party quality control agency /Department Quality control staff (in absence of third party quality control).

**Quality Control – Roles and responsibilities of Construction staff, Quality control Wing and 3rd Q.C. Agency in Execution of Project – Further Instructruction / Guideline Issued – Reg**

1. The agreement copy, the approved drawings are to be communicated to the 3rd party agency so as to enable them to verify the ongoing execution with respects to the conditions stipulated therein.
2. Further, if any changes /deviations with respect to the already approved ones, are also to be immediately communicated to the 3rd party agency without fail.
3. All the registers needed to be maintained by the EPC Agency shall have to be made available to the inspecting officers and the 3rd party Quality Control agency. The departmental staff has to ensure the same.
4. The EPC agencies are also to establish their own full-fledged laboratories in accordance with the agreement and codal provisions. The department staff shall have to ensure the same and see that the equipment is got calibrated from time to time by 3rd party Quality Control agency and the reports be obtained and recorded.
5. All the above records / registers being maintained shall invariably be authenticated by the Executive Engineer / Superintending Engineer whenever they inspect the site of work.
6. The Superintending engineer shall inspect the works frequently duly issuing the inspection notes discussing the progress, quality of the work and lapses / deviations if any.
7. It is to be ensured that whenever Executive Engineer / Superintending Engineer inspect the site, he shall insist for testing of materials etc. In their presence on critical points if any, and shall endorse the test proceedings and results of the test conducted.
8. It is being noticed that the EPC agency is conducting the test in his laboratory or in same private laboratories. It is to be ensured that at least 10 % of tests shall be got done at APERL / NITS or in the colleges run by Government or universities or other reputed institutes like NCCMB. Hyderabad. Tor steel, Hyderabad etc. Having ISO certificate for carrying out the tests.
9. The Engineer in charges shall furnished the M Book and LF books along with the invoice for payment of the EPC Agency to the 3rd party Quality Control agency by 22nd of every month for certification and the PAD officer for making arrangement for payments.
10. The Engineer in charges shall ensure that the 3rd party agency team during its visit to the site of work daily, gives the observations sheet to the DEE / AEE at the site itself and that the adverse remarks if any shall have to be attended to immediately and got cleared by them.
11. The superintending Engineer shall conduct fortnightly review meeting with the EPC agency and 3rd party Quality Control agency combinedly for reviewing the compliance of the observations being made.
12. The mix designs of concrete obtained from the laboratories are not being approved by the Superintending Engineers or Chief Engineers. They may be approved by the Superintending Engineers / Chief Engineers before adopting in the works.
13. The cement and steel have to be got tested invariably for each stock brought to work site and test reports are to be made available during inspection also
14. As per agreement OK cards are to be maintained but it is observed that at many places they are not seen. The Superintending Engineers / Chief Engineers may ensure that ok cards are mentioned at each work place.
15. It has been observed that EPC Agencies have not submitted proper quality management plans. They have to also with 3rd party quality management staff. All Chief Engineers / Superintending Engineers must insist for QMP and report compliance. The concerned Superintending Engineer should see that all agencies deploy the quality management staff as per agreement within next two weeks and obtain their particulars. If they are not deployed as per agreement, it may be notified to the agencies proposing suitable recovery from work bills.

16. Superintending Engineers shall invariably conduct fortnightly management meeting with EPC Agency along with 3rd party QA / QC Agencies and departmental officials and discuss in detail the quality assurance aspects. The minutes of such meetings shall be sent by SE to the undersigned without fail.
17. As per agreement, OK cards are to be maintained, but it has been noticed that OK cards system is not being maintained properly in many packages. Similarly, Guidelines provide for certain records to be maintained at site. Superintending Engineers must ensure that all OK cards and other documents / plans to be maintained at site should be invariably made available at site only. Certain documents and registers may also be kept available at the laboratory established by the EPC Agencies.
18. For all the lining works in different projects, curing is a critical process and due attention has to be paid by the executing agencies to ensure proper curing. This is also to ensured for all other concrete works. All Superintending Engineers should critically review the performance of EPC agencies on this and ensure quality standards.
19. The cement and steel have to be got tested invariably for each stock brought to the site and test reports are to be made available during inspection.
20. Quality Management Plan.

    i) The Quality Management plan for the contract work has to be obtained from the contractors indicating the following.
        a) The quantum of work to be done quantities of various materials required the electrical and mechanical equipment to be installed.
        b) The number of tests to be conducted for various materials, electrical and mechanical equipment and also for finished items of work as per IS codes and other Codes.
        c) The details of field laboratories and testing facilities available for conducting the above tests.
        d) M.O.U with external laboratories approved by the Government for conducting required tests on equipment and materials.
        e) The personnel of Contractor in-charge of Quality Management with their names, duties and authority. The qualifications of the persons in- charge of collecting samples, testing materials, testing equipment and finished items work, persons in-charge of quality assurance with power to reject the defective work, the process of rectification of o be recurrence of defects.

    ii) Copies of the quality management plan have to be furnished to the concerned field officers and also to the third party Quality Control team.

    iii) The Quality Management plan of the contractors for the work is to be reviewed with the contractors Quality control team and modifications or improvements, if any, have to be got incorporated.

    iv) Approved designs with plans have to be reviewed with the contractor's Managements staff and third party Control Team before commencement of work on all the structure, the quality and safety plans have to be obtained from the Contractors and approved.

    v) The test reports of all the work done quantities, materials, equipment and finished items of work are to be obtained from the Contractor along with the bill for payment. The Chief Engineer and Superintending Engineers are requested to specifically note that no bill payment should be accepted if it is not accompanied by the test reports

    vi) The test reports of all the tests conducted by the third party also may be obtained for every month.

vii) Whenever a bill is received from the contractor in full shape for payment a certificate of verification of Quality and conformity of work to the required specifications is to be obtained from the third party quality control team

viii) The chief Engineers / Superintending Engineers may submit the list of defects and rectifications attended by the Contractor with each payment.

ix) In addition to the communication of deficiencies separately by the Quality control agency, they must be allowed to record the same in the placement Register to draw immediate attention of the construction staff and to take prompt action to rectify the same.

x) The reinforcement details must invariably be got checked by the Quality control agency

xi) The construction staff should insist on establishing the laboratories by the EPC agency (Wherever they are not established) to enable the quality control agency to associate with them while conducting tests.

xii) Engineer incharge of the project (superintending engineer in most cases) is responsible for quality assurance of the project.

The Construction staff must ensure compliance report on the rectification of defects pointed out by the Quality control agency before proceeding with further work. These reports shall be available at site for inspection by any authority concerned.

If the contractor is not promptly complying with, the report of the departmental officers, the Superintending Engineer concerned should take immediate necessary action to withhold the payments till required rectifications are carried out.

**21. Recovery of Mobilization Advance:**

Dedication of the advance commences in the next interim payment following that in which total of such payments to the contractor reached 10% of contract value. The deduction will be made at the rate of 20% of the amount of all the interim payment together with interest/ The exclusion of amounts paid till the stage of recovery is reached is not correct. Government reiterates the clarification issued in Government Memo. No 1938-F8 (1)99-9 F&) (FW) Department, Dated 17-01-2000.

**22. Seigniorage Charge:**

Seigniorage Charges shall be recovered from the bills on the quantities used and measured at the rates mentioned in the agreement and a per the conditions of the agreement. All material including ordinary earth used on the work will attract seigniorage changes even if they are supplied free of cost as per agreement conditions.

**23. Liquidated Damages:**

Liquidated charges shall be recovered as per the conditions of the agreement and Executive Engineer is responsible for effecting recovery. For fixing revised milestones the competency is vested with Chief Engineer.