



2007-08

Field Training Report



Report submitted to-
Superintending Engineer
Quality Control Circle,
Aurangabad,
(26/11/2007-07/12/2007)

अधीक्षक अभियंता, गुणनियंत्रण मंडळ, औरंगाबाद.
कार्यकारी अभियंता, गुणनियंत्रण विभाग, धुळे
उप-विभागिय अभियंता, गुणनियंत्रण उप-विभाग, जळगाव

Superintending Engineer, QC Circle, Aurangabad
Executive Engineer, QC Division, Dhule,
Sub-Divisional Engineer, QC Sub-Division, Jalgaon.

सरळ सेवा भरतीने सहाय्यक कार्यकारी अभियंता या पदावर नियुक्ती दिलेल्या अधिकाऱ्यांसाठी क्षेत्रीय
प्रशिक्षण कार्यक्रम, जलसंपदा विभाग
Field Training for Direct Recruits as Assistant Executive Engineer of Water
Resource Department.

कालावधी: २६ नोव्हेंबर - ७ डिसेंबर २००७
Duration: 26 November - 7 December 2007

“क्षेत्रीय प्रशिक्षण अहवाल” “FIELD TRAINING REPORT”

सादरकर्ता-

Submitted by-

प्रविण कोल्हे, बी.ई.(सिव्हिल), एम.टेक.

(सहाय्यक कार्यकारी अभियंता)

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(Assistant Executive Engineer)



Tapi Irrigation Development Corporation, Jalgaon.

Executive Summary

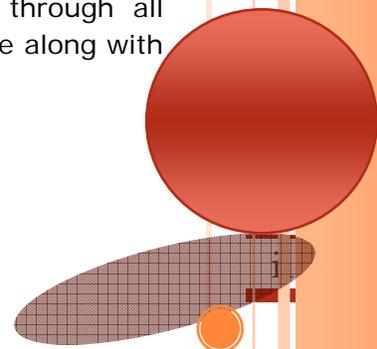
Maharashtra Engineering Training Academy (META), Nashik organized training program for direct recruits - Assistant Executive Engineer of Water Resource Department (WRD), in accordance with Maharashtra Engineering Service Examination-2004. As per schedule of training program, group of Assistant Executive Engineer's was directed to undergo field training under the guidance of Superintending Engineer- **Shri Bhure saheb** Quality Control Circle, Aurangabad to learn about the Quality Control testing and procedures. As per the instructions of Superintending Engineer- Shri. Bhure saheb, we joined for training at Jalgaon Sub division headed by SDE- Shri. Kale saheb on 26th November 2007. Jalgaon subdivision is under the jurisdiction of Dhule QC division, headed by Shri. Rajole saheb.

Change is a keyword that is only a constant word today. Everything is subjected to change. The origin of the concept of quality assurance is also the result of such a change and this change, as is known, has arisen from the need of customer satisfaction on quality and conformance to expected stipulations. As the need for Quality assurance was felt for irrigation works, the Government in Irrigation Department issued a technical circular on 1st January, 1998, which makes QC functioning more effective.

Quality is never an accident. It is always the result of intelligent efforts. There must be will to produce a superior thing. Also, Quality is not a destination; rather it is journey leading to success. Quality control is achieved in three stages- starting from selection of materials, Processing of material till obtaining final product. It is the combined responsibility of each and every person involved in planning, construction and maintenance. From a daily labour to the highest officer of Execution and QC division are responsible for achieving best quality.

During our training session, we visited several sites including- Waghur Project, Shelgaon Barrage Project, Padmalya II, Gul project etc. We observed several field and laboratory tests which are performed to ensure the quality of construction. We performed Slump test for concrete, Field density test by Core utter method and sand replacement method, moisture content test for hearting and casing materials, sieve analysis test, and proctor test.

This report includes the details of our training program at Jalgaon QC Sub division and also includes the study and observations performed by me. It was nice experience since I could realize the importance of QC during the construction. I learned valuable information regarding various tests and collected reference materials and hand books from the sub-division office. After going through all details, am able to conclude that the contribution of Quality Control Circle along with the executing authorities results a successful projects in this region.



Acknowledgement

This report will be incomplete without a proper acknowledgment of the debt to many persons, who made it possible. It is my great pleasure to acknowledge those whose active help and support make this report possible in the present form. First of all I express my sincere gratitude to **Shri. Bhure Saheb**, Superintending Engineer, Quality Control Circle, Aurangabad and **Shri. Rajole saheb**, Executive Engineer, Dhule Quality Control Division for their guidance during field training.

It is the endless guidance and constant encouragement of Sub-Divisional Engineer- **Shri. Kale saheb**, and I would like to express my heartfelt gratitude to him for providing us necessary technical information along with field visits.

I am deeply indebted to Sectional engineers- **Shri. A.J. Chaudhari, Shri. Shaikh, Shri. R.B. Patil and Shri. H.P. Joshi** and all technical and non-technical staff of office for insisting in me the drive to work hard and for inculcating in me the discipline to think clearly. Definitely the knowledge, I received during this training session was a lifetime experience and it will serve as a foundation for my career.

Last, but not least, I wish to express my gratitude towards my parents- Shivaji and Rohini, my grandparents- Rangnath and Sitabai, my uncle Raosaheb and aunty Radhika who sacrificed a lot to give me a good education.

- Pravin Kolhe BE (Civil), MTech (IITK)
(Assistant Executive Engineer)

Chapter 1 Nature of Work in Quality Control Organization

1.1 Introduction

“Quality is not a destination...It is journey...!”

The Public Works Department (PWD) of the Government of Maharashtra (GoM) was entrusted with the execution of the infrastructure works since British regime. The departments are now divided in three parts viz. Irrigation (now, Water Resource Department-WRD), PWD and Water supply (now, Maharashtra Jeevan Pradhikaran) and are functioning in a well-established fashion. The Maharashtra Public Works Manual, Maharashtra PW Accounts Code, Standard Specifications (Red Book) and the Maharashtra PW Handbook are the best documents the system had produced. These are modified to account for the changes that are necessary due to changes in material, material properties, methods of construction and availability of new equipments. The construction infrastructure works are carried out with reference to the guidelines prescribed in the above documents. The MPW Handbook has a chapter on Quality Control of works which serves as a good tool to achieve a good quality product. The first edition of MPW Handbook was published in 1876 and currently the 10th edition is in use.

1.2 Quality assurance and recent trends

Change is a keyword that is only a constant word today. Everything is subjected to change. The origin of the concept of quality assurance is also the result of such a change and this change, as is known, has arisen from the need of customer satisfaction on quality and conformance to expected stipulations. As the need for Quality assurance was felt for irrigation works, the Government in Irrigation Department issued a technical circular on 1st January, 1998, which makes QC functioning more effective. The circular states that any work which costs more than Rs.3 crore or any work of canal costing more than Rs.1 crore and any embankment which is more than 3 m in height can be started only after receiving "a go ahead" in the form of a Green card/OK card from QC Wing. The format of cards is different for earthwork and concrete.

1.3 Testing-Laboratory and Field

The following Laboratory Tests are carried out by the QC Organization as per the nature of work-

- **Embankment-** Hearting and Casing: Field Density, Moisture content, specific gravity, Grain size analysis, Compaction, Consolidation, Permeability Atterberg Limits, shrinkage limits, Direct Shear, Sieve Analysis, Swelling pressure of soil etc.
- **Cement:** Fineness, Soundness, Setting time, and compressive strength.
- **Fine Aggregate (Sand):** Mechanical Analysis Silt bulkage, filter criteria tests.
- **Coarse Aggregate (Metal):** Mechanical Analysis, Flakiness index, Water absorption
- **Cement Mortar:** Fluidity by flow table, compressive strength
- **Cement concrete:** Slump, compressive strength.
- **Testing of Steel:** Elongation, Tensile Strength

The field tests and laboratory tests are mainly conducted by the JE¹ and laboratory assistant. Checking of tests to the extent of 15% and 5% is done by SDE² and Executive Engineers respectively. In order to have better co-ordination and understanding between Construction Organization and Quality Control Organization, joint inspections are prescribed and visits are carried out accordingly.

¹ Junior Engineer

² Sub-Divisional Engineer

1.4 MPW Handbook Chapter 33: Quality Control

Part-I on Cement Concrete and part II on Earthwork constituting 519 pages is available as 10th revision (1990). Both the volumes are detailed documents and deal with the tests to be conducted in laboratory and in field, how the results should be entered in prescribed formats and are based in a way to meet the requirements of Bureau of Indian Standards. These documents are useful in guiding the field engineers to assess the quality of work in the light of design assumptions. In addition technical circulars are issued by Government in Irrigation Department (Water Resources) from time to time to add or modify the earlier provisions. Both the Quality Control and constructions organization use these handbooks and Circulars/standing instructions of Govt. The basic responsibility of maintaining good quality of works rests with the construction organization and the role of quality control is complimentary one. QC as a third party has the objective of pointing out deficiencies in construction materials, execution procedures and suggesting appropriate measures to achieve desired quality of the work. This is achieved through testing of materials as well as finished products. Thus QC¹ organization renders all necessary guidance to the construction organization for achieving good quality works.

1.5 Supervision

Constant supervision is carried out by the construction wing and also by QC organization on the works to ensure that work is being carried out as per the specifications. However it becomes difficult to attend the works when staff becomes short in a particular case.

1.6 Inspection slips

During inspections, two types of inspection slips are used by QC wing on the site of works viz., Green and Red. Green inspection slip is used for pointing out minor defects in the work and to communicate routine remarks. While Red inspection slip is used for serious discrepancies in the work, where stoppage of works to improve/rectify construction material/procedure is mandatory. Thus whenever the Red slip is issued the work is stopped for rectification. In actual procedure, JE visits the site of work he issues the Green slips every day which includes conducting field tests. When there are minor deficiencies in the work, the same are written in the inspection slip along with test results if any and inspection slip is handed over to his construction counterpart on which construction in-charge has to take action ,if needed. When there are serious deficiencies, bad workmanship. Violation of specifications etc. the Red slip is issued to construction organization for stoppage of work by the officers not below the rank of Dy. Engineer or Executive Engineer of QC organization. Compliance of the Yellow/Green Inspection slips is to be done by construction organization quickly and work is continued without stoppage. When Red slip is issued the work is to be stopped and can be resumed only after complying the deficiency duly accepted by the QC wing.

1.7 Inspection Notes

Whenever the works are visited by Dy. Engineer, Executive Engineer and by Superintending Engineer of QC organization, the inspection Notes are issued which are based on inspection details and deficiencies / corrections suggested are to be complied with by the construction organization. The visits are of informed as well as surprise type.

¹ Quality Control

1.8 Co-ordination Meetings

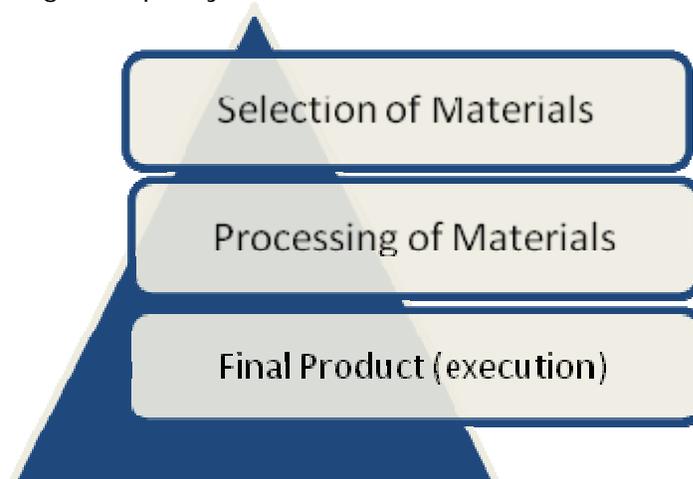
Meetings of the construction Executive Engineers are arranged by the respective Quality Control Division. Executive Engineer to sort out quality issues and maintain the cordial relation with construction wing. These meetings help very much in solving many routine and specific problems from the both the wings.

1.9 Reporting and monitoring

The reporting of QC work is as explained here. QC Jr. Engineer sends Daily placement reports of the works to Quality Control Sub Division. The Executive Engineer, Quality Control Division prepares and submits work wise reports in three types. i.e. Monthly, Quarterly and Annual. These reports are sent to construction Superintending Engineers/Executive Engineers and to Superintending Engineer Quality Control Circle. The monthly, Quarterly and Annual Q.C. reports include number of various laboratory /Field/record tests conducted for concrete/masonry/earth work along with actual frequency achieved, achievement of criteria, statistical analysis of tests, results of compressive strength of cubes for concrete/masonry work, graphs of statistical analysis of earth work. The Quarterly statistical data for concrete/masonry work include the number of tests actually conducted, percentage of tests achieving specified strength, Standard Deviation and co-efficient of variation etc. This report is scrutinized in the Quality Control Circle, and details of works which do not satisfy the specified criteria are reported to the Executive Director, Superintending Engineer and Chief Engineer of construction wing to improve the quality of these works. The copy of the report is given to Govt. also.

1.10 Stages of Quality control

There are three stages of quality control-



Chapter 2. Quality Control Organization

2.1 Organizational setup

The organization setup of QC organization is presented below-

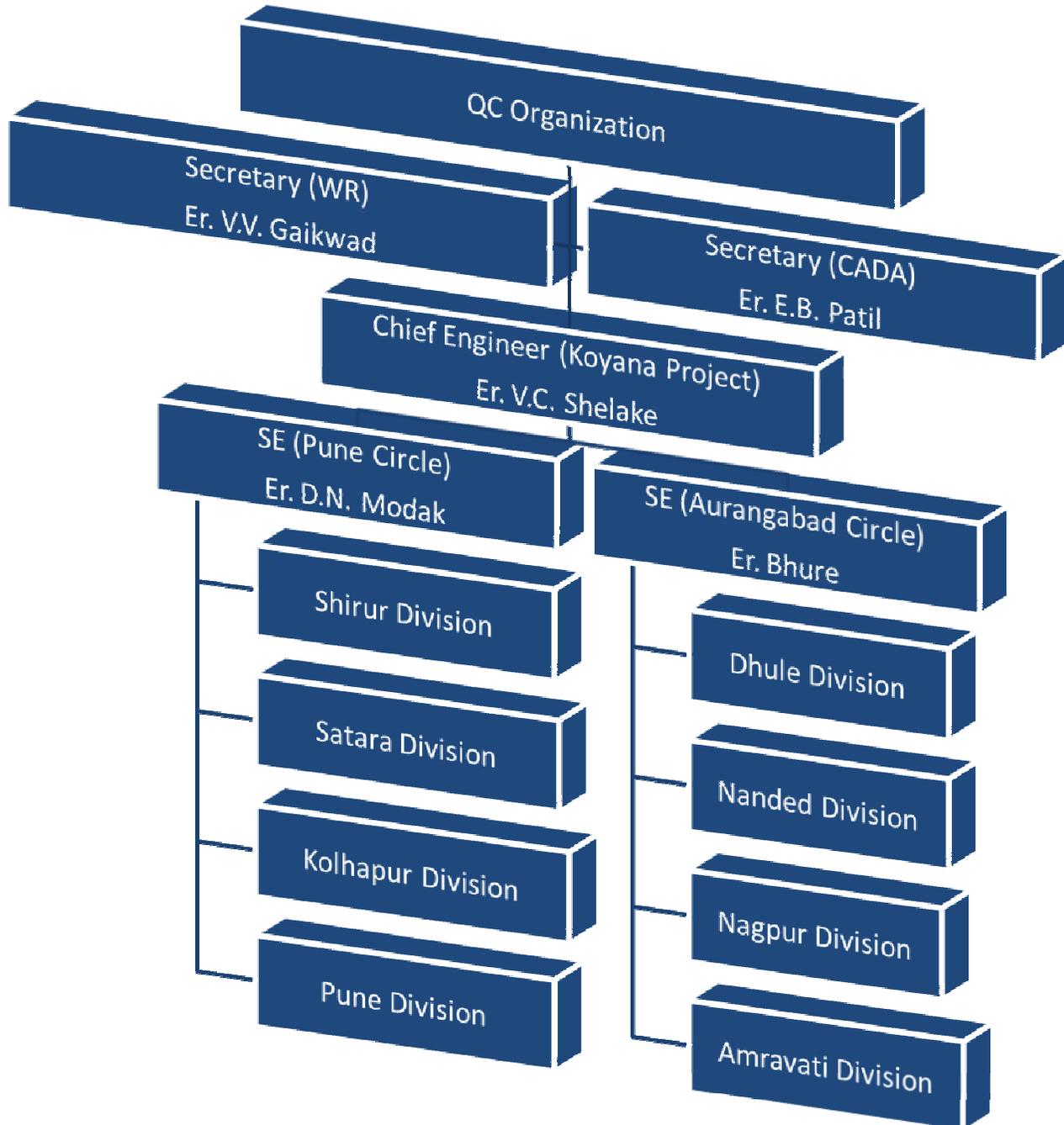


Fig. Organizational setup of QC organization

The QC organization is headed by Chief Engineer, Koyana Project. There are two circles at Pune and Aurangabad. The Pune circle consist of four divisions at Shirur, Satara, Kolhapur and Pune; while Auragabad circle consists four divisions located at Dhule, Nanded, Nagpur and Amaravati.

2.2 Dhule Division

Quality Control Circle, Aurangabad is headed by Superintending Engineer- Er. Bhure saheb and there are four divisions, among which we joined Dhule Division, headed by Executive Engineer- Shri. Rajole. The QC Division, Dhule has Sub-divisions at Jalgaon, Prakasha, Nashik and Dhule. As per order of Superintending Engineer-QC Circle, Aurangabad, we joined Jalgaon Subdivision for field training under the guidance of Shri. Kale saheb- SDE. The work load of Jalgaon subdivision is successfully handled by Sub-Divisional Engineer- Shri. Kale saheb along with Sectional Engineers- Shri. A.J. Chaudhari, Shri. Shaikh, Shri. R.B. Patil and Shri. H.P. Joshi along with other staff.

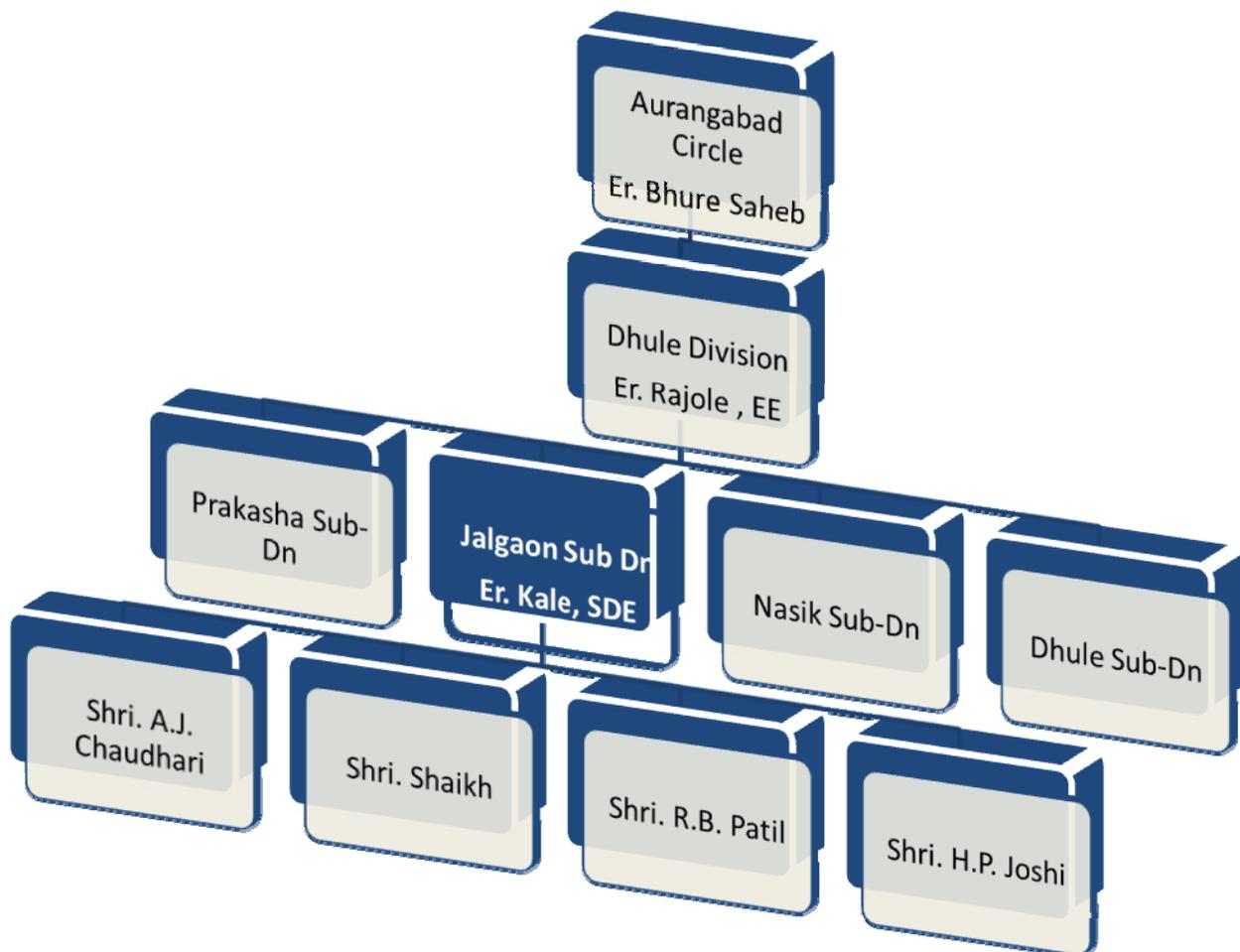


Fig. Organizational Setup of Aurangabad Circle of Quality Control

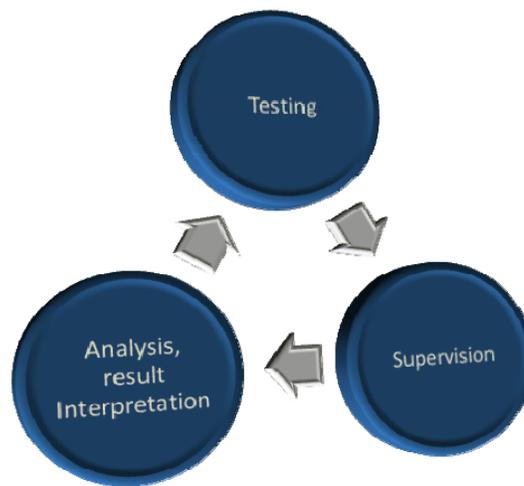
Chapter 3. Earthwork Quality Control

3.1. Means of Quality Control

“Quality is never an accident. It is always the result of intelligent efforts. There must be will to produce a superior thing”

- *John Ruskin.*

There are three means of QC, which are shown in the figure below-



Quality at the cost of quantity cannot be thought of. These two aspects are essentially complimentary and not contradictory.

3.2. Organization for control: Staff for QC (Lab) sub-division

Sr. No.	Name of post	Class A ¹	Class B ²	Class C ³
1	Deputy Engineer	1	1	1
2	Overseers or JE	4	3	2
3	Research Assistant	1	---	---
4	Head Lab Assistant	1	---	---
5	Lab Assistant	3	2	2
6	Senior Clerk	1	1	1
7	Junior Clerk	1	1	1
8	Tracer	1	1	1
9	Peons	3	3	2

3.3. Items on which QC is to be exercised for Earth Embankment

¹ For Class A: Earthwork > 2.5 Mm³

² For Class B: 1 < Earthwork < 2.5 Mm³

³ For Class C: Earthwork < 1 Mm³

Ref: *‘Handbook on Quality Control, Volume I- Earthwork’* by R.I. Kapadia, Superintending Engineer, Central Quality Control Organization.

1. All zones of embankment (including filling in Cut Off Trench) in layers of specified thickness, including flevelling, watering, compaction etc.
2. Filters in the embankment
3. Filling with drainage media all types of drains in embankment
4. Base below pitching for u/s or d/s slope protection arrangement.

3.4 Laboratory testing

Laboratory testings are performed at preliminary and design stage during the entire stages of QC, i.e. during ...

- (1) Selction of materials
- (2) Processing of materials
- (3) Final Execution

3.4.1 Laboratory Testing During Selection of Materials-

(a) At Preliminary stage

Sr. No.	Test	Form No.
1	Grain Size Analysis	SM-5 ¹
2	Atterberg Limits	SM-6
3	Compaction	SM-8
4	Specific Gravity	SM-4 ¹
5	Direst Shear	SM-9
6	Permeability	SM-12

(b) At Design stage

Sr. No.	Test	Form No.
1	Grain Size Analysis	SM-5 ¹
2	Atterberg Limits	SM-6
3	Compaction	SM-8
4	Specific Gravity	SM-4 ¹
5	Direst Shear	SM-9
6	Permeability	SM-12
7	Shrinkage Limit	SM-7
8	Consoldation	SM-11 ²

3.4.2 Laboratory Testing During Processing of Materials

No laboratory tests are necessary at this stage. However, there might be occassions requiring the use of combination of different soils in certain proportions determned from either tests. The embankment inspector should have such informaion with him.

3.4.2 Laboratory Testing During Final Product (Execution)

The laboratory tests during Final Product (execution) are performed for following components- Hearting Zone (including Filling of COT), Casing Zone, Semi-Pervious zone.

¹ Only for Filters

² If Asked

1. Hearting Zone (including Filling of COT)

Sr. No.	Test	Form No.
1	Moisture Content	SM-3
2	Placement Moisture	SM-15
3	Needle-Density	SM-16
4	Field Density	SM-13 and SM-14
5	Periodical Record	RSM-9
6	Record Test at Instrument Installation	RSM-9
7	In-Place permeability Test	Vide Appendix E

2. Casing Zone

Sr. No.	Test	Form No.
1	Moisture Content	SM-3
2	Field Density	SM-13 and SM-14
3	Periodical Record	RSM-9
4	Record Test at Instrument Installation	RSM-9
5	In-Place permeability Test	Vide Appendix E

3. Semi-Pervious zone

Sr. No.	Test	Form No.
1	Moisture Content	SM-3
2	Placement Moisture	SM-15
3	Needle-Density	SM-16
4	Field Density	SM-13 and SM-14
5	Periodical Record	RSM-9
6	Record Test at Instrument Installation	RSM-9
7	In-Place permeability Test	Vide Appendix E

Chapter 4. Concrete Quality Control

4.1 Introduction

“The quality of an organization can never exceed the quality of the minds that make it up.”

Cement is an important ingredient of concrete and mortar. As quality of concrete and mortar depends on cement, testing of cement is essential for determining its physical properties which would decide its quality and suitability. The Handbook on Quality Control-Vol. II- Concrete/Masonry¹ provides detailed information regarding various important aspects in concrete/masonry construction.

4.2. Laboratory Testing During Selection of Materials-

(a) Cement: Tests mentioned at Sr. No. 1 in chapter IV and appendices M, N, P and Q shall be carried out. However all physical and chemical tests, if needed be carried out in Central Laboratory and results should be entered in the test register Form No. RCM-1.

(b) Fine aggregates

Sr. No.	Test	Test No.
1	Particle Size analysis and Fineness Modulus	2
2	Clay, Fine Silt and Fine Dust	9
3	Organic Impurities	IS 2386 (Part II) 1963
4	Moisture Content, Specific Gravity and Absorption	8 and 6
5	Bulk density	IS 2386 (Part III) 1963
6	Soundness (Na ₂ SO ₄ test)	IS 2386 (Part V) 1963
7	Loss on Ignition	
8	Alkali Aggregate Reactivity	IS 2386 (Part VII) 1963

(c) Coarse aggregates

Sr. No.	Test	Test No.
1	Particle Size analysis and Fineness Modulus	2
2	Clay, Fine Silt and Fine Dust	9
3	Absorption (Loss Angles)	IS 2386 (Part IV) 1963
4	Moisture Content, Specific Gravity and Absorption	8 and 6
5	Soundness (Na ₂ SO ₄ test)	IS 2386 (Part V) 1963
6	Alkali Aggregate Reactivity ²	IS 2386 (Part VII) 1963

(d) Water: No testing is advocated for water, as water suitable for drinking will be suitable for mixing.

(e) Air Entraining Agents: These are the products of fatty acids or resins and are considered as admixtures.

¹ *Handbook on Quality Control-Volume II, Concrete/Masonry*, by Shri. R.I. Kapadia, Superintending Engineer, Central Quality Control Organization.

² Optional

4.3. Laboratory Testing During Proportioning

(I) In Laboratory:

After selection of materials the next stage is to proportion the various ingredients in the laboratory to form concrete. This is being done by the Central Laboratory, taking weights of aggregates on SSD¹ basis and batching the ingredients by weight while designing the mix, recorded in Form No. **RCM-4**

(II) At Field: Once the mix design is approved, field officer should observe the moisture conditions and grading of aggregates from time to time the first one with a view to see that the total weight of water does not exceed the design mix and the water cement ratio is not initiated.

4.3. Laboratory Testing During Product (Concrete)

Concrete as a whole when produced should satisfy certain tests when wet as also after it is hardened. After carrying out tests on materials of ingredients of concrete, it is essential to conduct tests on finished product, which are listed in following table-

Sr. No.	Test	Form No.
1	Slump of cement concrete	CM-16
2	Density and Air Contents of Fresh Concrete	CM-17
3	Compressive Strength of Molded Cement Concrete/Mortar specimen	CM-18
4	Compressive strength of drilled cores	CM-19
5	Laboratory Permeability	CM-20
6	'In-situ' Permeability	CM-21

¹ Saturated Surface Dry

Chapter 5. Mortar Quality Control

5.1 Laboratory Testing during material selection for Lime Mortar

Following tests are considered essential for Class A and B limes-

Sr. No.	Test	Test No.
1	Chemical Analysis	IS 712-1964
2	Residue on Slaking	
3	Fineness	22
4	Setting Time	23
5	Soundness	24
6	Compressive Strength	25
7	Transverse Strength	26

5.2 Laboratory Testing During Product (Mortar)

Mortar as a whole is required to pass certain test when wet as also when hardened. The Quality Control Organization staff has to be vigilant during the manufacturing operations. The detailed tests to be required are listed below-

Sr. No.	Test	Form No.
1	Particle Size Analysis of Aggregates	CM-2
2	Silt Content in Fine Aggregates	CM-3
3	Bulking of Fine Aggregates	CM-4
4	Surface Moisture Content in Fine Aggregates (Lab Method)	CM-5
5	Specific Gravity and Water Absorption test for aggregates (upto & 10mm)	CM-6
6	Surface Moisture Content in Fine Aggregates (Hot Plate Method)	CM-8
7	Clay, Fine Silt and fine dust in aggregates	CM-9
8	Fineness of Surki by Dry sieving	CM-11
9	Compressive Strength of Cement Surki Mortar	CM-12
10	Specific gravity and Water Absorption of stone	CM-13
11	Compressive Strength of stones	CM-14
12	Fluidity of Mortar by Flow Table	CM-15
13	Fineness of Lime	CM-22
14	Soundness of Lime	CM-24
15	Setting Time of Lime	CM-23
16	Compressive Strength of Lime Mortar	CM-25
17	Transverse Strength of Lime Mortar	CM-26

Conclusion

We enjoyed and learned several important aspects regarding Quality Control during our field training session at QC Sub-division, Jalgaon. We completely realized the fact that 'Quality is not a destination...it is journey' and this is continuous process. Quality control is achieved in three stages- starting from selection of materials, Processing of material till obtaining final product. It is the combined responsibility of each and every person involved in planning, construction and maintenance. From a daily labour to the highest officer of Execution and QC division are responsible for achieving best quality.

We visited several sites under the jurisdiction of Jalgaon Sub division and it includes- Waghur Project, Shelgaon Barrage Project, Padmalya II, Gul project etc. We observed several field and laboratory tests which are performed to ensure the quality of construction. At Waghur Project, we observed Cross-drainage structures like siphon, aqueduct and canal structures like canal fall, head regulators, outlets etc. The Waghur dam was constructed with colgrout treatment and we observed fine quality of construction. Shelgaon barrage project includes construction of earthen dam with central gated spillway for grass gross capacity of 11.34 mm³.

We also visited Padmalaya II, which is an irrigation project with storage on Waghur River near village Raipur, Tal and Dist- Jalgaon with LBC for irrigation for cropped area 23,288 ha and RBC for irrigating cropped area 3,136 ha. It involves masonry gated spillway in gorge and NOF masonry dam between RD 293 to RD 360m and RD 657.25 to 719.7m. Earthen dam between RD 150 to RD 293m on left flank and between RD 719.7 to RD 1230m on right flank. We performed Slump test for concrete, Field density test by Core utter method and sand replacement method, moisture content test for hearting and casing materials, sieve analysis test, and proctor test.

It was nice experience for me since I could realize the importance of QC during the construction. I learned valuable information regarding various tests and collected reference materials and hand books from the sub-division office.

Last but not least, I am thankful to Superintending Engineer- Shri. Bhure saheb, Executive Engineer- Shri. Rajole saheb, SDE- Shri. Kale saheb and all the staff of Jalgaon sub-division for providing me an opportunity to enjoy the thrill of Quality Control and providing all the necessary documents and related procedure. I am sure that Quality Control Circle and their subordinate staff contributes major part in achieving Quality in construction

-Pravin Kolhe
(Assistant Executive Engineer)

Site Visits and Photo Gallery



View of Canal fall on Waghur Left Bank Canal @ 7630m



Crossing of Natural Drain and Canal



Spillway of Waghur Dam



Field Density Test



Density by Sand Replacement test



Compression Test on Concrete cube



Sieve Analysis



Proctor Mould



Slump Test



Outlet for Padmalaya Storage Scheme