IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Experimental Study on Quality Control Practices in Ready Mix Concrete Plants

Fulsunder Vivek[1], Prof. Kiran Sharikar[2]

[1]UG Student, Department of Civil Engineering, Vidya Prasarini Sabha's College of Engineering and Technology, Lonavala, Maharashtra, India

[2]Assistant Professor, Department of Civil Engineering, Vidya Prasarini Sabha's College of Engineering and Technology, Lonavala, Maharashtra, India

Abstract

Ready Mix Concrete (RMC) plays an important role in modern construction due to its superior quality, consistency, and faster construction process compared to conventional site-mixed concrete. Quality control in RMC plants is essential to ensure the strength, durability, workability, and reliability of concrete used in infrastructure projects. This paper presents an experimental study on quality control practices adopted in Ready Mix Concrete plants. The study focuses on testing of raw materials, batching operations, workability assessment, compressive strength evaluation, and quality assurance procedures. Laboratory and field tests such as slump test, compressive strength test, sieve analysis, water absorption test, and specific gravity test were conducted to evaluate concrete performance. The study also highlights the importance of automation, mix proportioning, and quality monitoring systems in maintaining consistency in concrete production. The results indicate that systematic quality control procedures significantly improve the performance and durability of concrete while reducing material wastage and construction defects.

Keywords: Ready Mix Concrete, Quality Control, Slump Test, Compressive Strength, Concrete Technology, Batching, Workability.

1. Introduction

Concrete is one of the most widely used construction materials in the world due to its versatility, durability, and economy. With the increasing demand for rapid infrastructure development, Ready Mix Concrete (RMC) has become a preferred alternative to conventional site-mixed concrete. RMC is produced in a controlled environment using automated batching systems and delivered to construction sites in transit mixers.

Quality control is one of the most critical aspects of RMC production. Variations in raw material properties, improper batching, environmental conditions, and inadequate supervision can significantly affect the quality of concrete. Therefore, systematic testing and monitoring are essential throughout the production process.

The present study focuses on quality control practices adopted in RMC plants, including testing of cement, aggregates, water, admixtures, and fresh and hardened concrete properties. The study also evaluates the role of automation and quality assurance systems in improving concrete performance.

2. Objectives of Study

The main objectives of the study are:

- To study quality control procedures in Ready Mix Concrete plants.
- To evaluate properties of raw materials used in concrete production.
- To conduct workability and compressive strength tests on concrete.
- To study batching and mixing operations in RMC plants.
- To analyze the importance of quality assurance systems in concrete production.
- To suggest methods for improving quality and efficiency in RMC plants.

3. Materials Used

3.1 Cement

Ordinary Portland Cement (OPC) 53 Grade was used for concrete production. Cement was tested for:

- Standard consistency
- Initial and final setting time
- Soundness
- Compressive strength

3.2 Fine Aggregate

River sand conforming to Zone II as per IS 383 was used as fine aggregate.

Tests conducted:

- Sieve analysis
- Specific gravity
- Water absorption

3.3 Coarse Aggregate

Crushed stone aggregates of 10 mm and 20 mm sizes were used.

Tests conducted:

- Impact value test
- Crushing value test
- Flakiness and elongation index
- Specific gravity test

3.4 Water

Potable water free from harmful impurities was used for mixing and curing purposes.

3.5 Chemical Admixture

Superplasticizer was used to improve workability without increasing water-cement ratio.

4. Methodology

The methodology adopted for the study included:

1. Collection and testing of raw materials.
2. Preparation of concrete mix design for M25 grade concrete.
3. Batching and mixing using RMC plant operations.
4. Conducting slump test on fresh concrete.
5. Casting concrete cubes for compressive strength testing.
6. Testing concrete cubes after 7 days and 28 days curing periods.
7. Analysis of test results and quality control procedures.

5. Mix Design for M25 Concrete

The mix proportion adopted for M25 grade concrete is given below:

Material	Quantity
Cement	400 kg/m³
Fine Aggregate	650 kg/m³
Coarse Aggregate	1200 kg/m³
Water	180 liters
Admixture	1% of cement content

Water-cement ratio adopted: 0.45

6. Quality Control Procedures in RMC Plant

Quality control in an RMC plant includes monitoring of raw materials, batching operations, mixing, transportation, and testing of concrete.

6.1 Forward Control

Forward control involves:

- Selection of suitable materials
- Mix design preparation
- Calibration of batching equipment
- Moisture correction in aggregates

6.2 Immediate Control

Immediate control includes:

- Slump testing
- Monitoring batching accuracy
- Checking transit mixer rotation

- Monitoring concrete temperature

6.3 Retrospective Control

Retrospective control involves:

- Analysis of compressive strength results
- Evaluation of quality records
- Review of rejected concrete batches

7. Testing on Fresh Concrete

7.1 Slump Test

The slump test was conducted to determine workability and consistency of fresh concrete as per IS 1199.

Apparatus Used

- Slump cone
- Tamping rod
- Base plate

Procedure

1. The slump cone was placed on a non-absorbent surface.
2. Concrete was filled in three equal layers.
3. Each layer was tamped 25 times.
4. The cone was lifted vertically.
5. Slump value was measured.

Observations

Trial	Slump Value (mm)
1	72
2	88
3	115

The slump values indicated medium to high workability suitable for RMC applications.

8. Testing on Hardened Concrete

8.1 Compressive Strength Test

Concrete cubes of size 150 mm × 150 mm × 150 mm were tested using Compression Testing Machine (CTM).

Test Results

Age of Concrete	Average Strength (N/mm^2)
7 Days	18.2
28 Days	29.6

The results satisfied the target strength requirements for M25 grade concrete.

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9. Results and Discussion

The study indicated that:

- Proper batching and quality control improve concrete consistency.
- Use of superplasticizers enhances workability without increasing water content.
- Automated batching systems reduce human error.
- Continuous testing ensures achievement of desired concrete strength.
- RMC production minimizes material wastage and improves efficiency.

The compressive strength results confirmed that quality control procedures adopted in the RMC plant were effective.

10. Advantages of Ready Mix Concrete

- Better quality control
- Faster construction
- Reduced material wastage
- Improved durability
- Lower labor requirement
- Environment-friendly production
- Consistent concrete quality

11. Challenges in RMC Quality Control

The following challenges were observed:

- Variability in aggregate moisture content
- Delays in transportation
- Equipment calibration issues
- Environmental conditions
- Maintaining uniformity in large-scale production

Proper supervision and automation can help overcome these challenges.

12. Conclusion

Quality control is an essential component in Ready Mix Concrete production. Proper testing of raw materials, systematic batching operations, workability assessment, and compressive strength evaluation ensure production of durable and high-performance concrete.

The study demonstrated that implementation of quality assurance procedures and automated batching systems significantly improves concrete consistency and construction efficiency. Compared to conventional site-mixed concrete, RMC offers better quality, reduced wastage, faster construction, and improved reliability.

The experimental observations and test results confirmed that effective quality control practices play a major role in ensuring structural safety and long-term durability of concrete structures.

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