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Experimental Study on Quality Control On RMC Plant

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ABSTRACT

This study focuses on the quality control procedures adopted in a Ready Mix Concrete (RMC) plant to ensure consistent production of high-quality concrete. Quality control in RMC involves monitoring raw materials, mix design, batching, transportation, and testing of fresh and hardened concrete. Various tests such as slump test, compressive strength test, and moisture content analysis were conducted. The results indicate that strict adherence to quality control practices improves concrete strength, workability, and durability. Proper QC practices also reduce material wastage and enhance overall efficiency of construction projects.

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

1. Introduction

Ready Mix Concrete (RMC) is widely used in modern construction due to its uniform quality, speed of construction, and reduced labour requirements. Unlike site-mixed concrete, RMC is manufactured in a controlled environment, making quality control a critical aspect of production.

Quality control plays a crucial role in the production of RMC. Unlike traditional concrete mixing methods, RMC requires strict monitoring at every stage including material selection, batching, mixing, transportation, and placement. The primary objective of quality control is to ensure that the concrete produced meets the required specifications in terms of strength, workability, durability, and performance.

In an RMC plant, quality control begins with testing of raw materials such as cement, fine aggregates, coarse aggregates, water, and chemical admixtures. Properties like grading of aggregates, moisture content, and specific gravity are checked regularly to maintain consistency in mix design

Quality control in an RMC plant ensures:

- Consistency in mix proportions
- Desired strength and durability
- Proper workability for placement The QC process includes:
- Testing of raw materials (cement, aggregates, water, admixtures)
- Monitoring batching and mixing
- Testing fresh concrete properties
- Testing hardened concrete strength Improper quality control can lead to defects such as:
- Low strength
- Segregation
- Poor durability

Table 1.1 Literature Review

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Material	**Research Findings**	**Research Gap**
RMC Quality Control	Ensures uniformity and reduces variability in concrete	Need for automation and real-time monitoring
Slump Test	Indicates workability of fresh concrete	Limited accuracy for high-performance concrete
Compressive Strength	Primary measure of concrete quality	Early-age prediction methods need improvement
Admixtures	Improve workability and strength	Optimization required for different climates

2. Methodology

2.1 Material used Materials Used: -

2.1 Materials Used

- **Cement** – OPC 53 Grade, tested as per IS standards
- **Fine Aggregate** – River sand, Zone II
- **Coarse Aggregate** – 10mm & 20mm aggregates
- **Water** – Potable water
- **Admixture** – Superplasticizer

2.2 Mix Proportions : -

2.2 Mix Proportion

Mix Design: M25 Grade Concrete Material	Quantity (kg/m³)
Cement	400
Fine Aggregate	650
Coarse Aggregate	1200
Water	180
Admixture	1% of cement

2.3 Batching and Mixing Process

1. Raw materials are stored in separate bins
2. Aggregates are weighed using batching plant
3. Cement is added through silos
4. Water and admixture are added automatically
5. Mixing is done in transit mixer

2.4 Testing on Fresh Concrete

2.4.1 Slump Test

- **Objective:-**

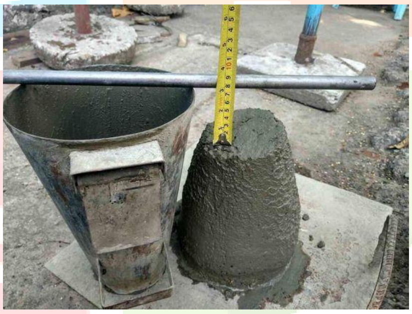
  To determine the workability and consistency of fresh concrete in the RMC plant.

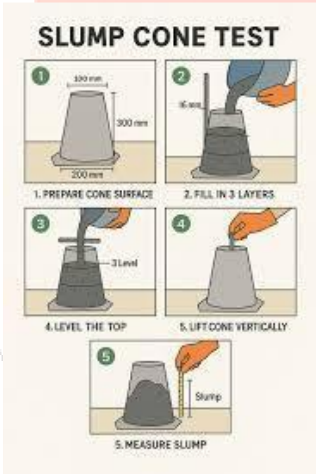
- **Standard Dimensions of Slump Cone:**

1. Height = 300 mm
2. Top diameter = 100 mm
3. Bottom diameter = 200 mm

- **Procedure:-**

1. Clean the slump cone and base plate and moisten them properly.
2. Place the cone on a level, rigid, and non-absorbent surface.
3. Hold the cone firmly in position using footrests.
4. Fill the cone with fresh concrete in **three equal layers**.
5. Each layer is tamped **25 times** using the tamping rod uniformly.
6. After the top layer, strike off excess concrete with a trowel.
7. Lift the cone slowly and vertically in **5–10 seconds** without any lateral movement.
8. Allow the concrete to subside.
9. Measure the **difference between original height (300 mm)** and the **final height of concrete**.
10. Record the slump value in mm.





Slump Test

2.5 Testing on Hardened Concrete

2.5.1 Compressive Strength Test

- **Objective**: -

  To determine the compressive strength of hardened concrete cubes and verify whether the concrete meets the required design strength.

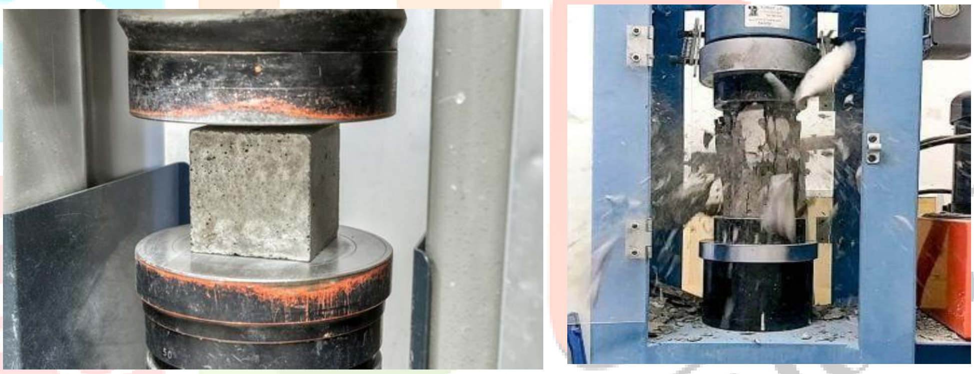
- **Standard Specifications:**

1. Cube size = 150 mm × 150 mm × 150 mm
2. Number of specimens = Minimum 3 per test
3. Testing ages = 7 days and 28 days

4. Loading rate = 140 kg/cm²/min (as per IS standards)

- **Procedure: -**

1. Prepare the concrete mix as per the required design (e.g., M25).
2. Fill the cube moulds in **three equal layers**.
3. Compact each layer by giving **25 blows** with a tamping rod or using a vibrator.
4. Level the top surface using a trowel.
5. Keep the moulds undisturbed for **24 hours** at room temperature.
6. After 24 hours, remove the cubes from moulds.
7. Cure the cubes in clean water for **7 days and 28 days**.
8. Remove the cubes from curing tank before testing and wipe off excess water.
9. Measure the dimensions of the cube accurately.
10. Place the cube in the CTM so that load is applied on opposite faces.
11. Apply load gradually and continuously without shock until failure occurs.
12. Record the maximum load at failure.



Compressive Strength Test

3. RESULT AND DISCUSSION

3.1 Result of Slump Test

Test on fresh concrete

Table no. 3.1 Slump Test Results

Trial	Slump (MM)	Type of slump
1	75	True Slump
2	90	True Slump
3	110	True Slump

- Workability increases with admixture dosage
- Suitable slump range for RMC: 75–125 mm

3.2 Result of Compressive Strength Test

7 Days Compressive Strength Test result on harden concrete

Table no. 3.2 Compressive Strength test Results

Sr.No.	**Age of concrete**	Load at Failure (kN)	Compressive Strength (N/mm^2)
1	7 Days	400	17.8
2	7 Days	420	18.7
3	7 Days	410	18.2
		Average	18.2 N/mm^2

- Strength meets M25 requirements
- Proper curing improves strength

3.3 Cost Analysis

Table no. 3.3 Cost Analysis

Sr.No.	**Description**	**Quantity**	**Unit**	**Rate (RS.)**	**Amount**
1	Cement	400	Kg	7/ kg	2800
2	Fine Aggregate	650	Kg	1.6/kg	975
3	Coarse Aggregate	1200	Kg	1.2/kg	1440
4	Water	180	Lit	0.05/lit	9
5	Admixture	4	Kg	80/kg	320
				Total	5544 Rs.

3.4 Discussion

• The results obtained from the slump test indicate that the workability of concrete increases with the use of admixtures and proper water-cement ratio. The slump values observed (75 mm, 90 mm, and 110 mm) fall within the acceptable range for Ready Mix Concrete, which ensures ease in placement and compaction without segregation.

• It is observed that as the dosage of superplasticizer increases, the workability improves significantly without increasing the water content. This helps in maintaining the strength of concrete while achieving better flow characteristics, which is essential in RMC operations.

• From the compressive strength test results, it is clear that the strength of concrete increases with curing time. The 7-day strength achieved is approximately 60–70% of the 28-day strength, which confirms the normal strength gain behavior of concrete.

• The 28-day compressive strength satisfies the requirements of M25 grade concrete, indicating that the mix design and quality control measures adopted in the RMC plant are effective.

• Proper batching and mixing in controlled conditions ensure uniform distribution of materials, which leads to consistent strength results. Any variation in batching can result in fluctuations in strength and workability.

• From the overall study, it is evident that maintaining proper quality control at every stage—from raw material testing to final strength testing—is essential to achieve desired performance of concrete.

4. CONCLUSIONS

• Quality control is a vital aspect in the production of Ready Mix Concrete (RMC), as it ensures that the concrete produced meets the required strength, durability, and workability standards.

• From the study, it is observed that proper selection and testing of raw materials such as cement, aggregates, water, and admixtures play a significant role in achieving consistent concrete quality.

• The use of automated batching systems in RMC plants helps in maintaining accurate proportions of materials, reducing human errors and improving overall efficiency.

• Workability of concrete, measured through slump test, was found to be within acceptable limits, indicating that the mix is suitable for placement and compaction without segregation.

• Compared to conventional site-mixed concrete, RMC provides better consistency, faster construction, reduced material wastage, and improved quality due to strict quality control measures.

• Overall, implementation of systematic quality control practices at every stage of RMC production ensures reliable, durable, and high-performance concrete for construction works.

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