Critical Study of Strength and Bonding Characteristics of Ready Mix Concrete

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Abstract— The outcome of study is over conventional concrete and RMC. Early studies show significant variations in strength, strength varies from 10 % to 25% in samples. Ready mixed concrete or RMC as it is popularly called, refers to concrete that is specially manufactured for delivery to the customer construction site in a freshly mixed and plastic or unhardened state. In this research 95% strength cover field, ready mix concrete over laboratory mix concrete. Ready mix concrete strength mainly depends on W/C ratio and quality control. Admixture affects the 28 days strength results. High strength is not workable more than 2 hours. Compressive strength is sufficient for structural requirements. IS CODE Method is best method for mix design.

Key words: RMC, Ready Mix Concrete

I. INTRODUCTION

Ready Mix Concrete (RMC) is concrete and it is a specified material in which the cement aggregates and other ingredients are weigh-batched as per mix design specifications at a plant in a central mixer or truck mixer, when it is transporting to the site it is ready for placing by the contractor. RMC is also known as fresh concrete Thus, `fresh' concrete is manufactured in a factory which is away from the construction site and transported within the requisite time.

II. CONSTRUCTION ISSUES

Since the development of the prototype of Ready mix concrete in 1988, the use of Ready mix concrete in actual structures has gradually increased. `The main reasons for the employment of Ready mix concrete can be summarized as follows:

1) Construction period
2) Compaction in the structure
3) Noise due to vibration - effective especially at concrete products plants by employing Ready mix concrete.

III. THESIS OBJECTIVES

A. *Principles of concrete mix design*

The basic steps involved are summarized as follows:

1) Arrive at the mean target strength from the characteristic strength specified and the level of quality control,
2) Arrive at the water content for the workability required,
3) Select the water-cement ratio for mean target strength and check for requirements of durability,
4) Analyze cement content and check for requirements of durability
5) Choose the relative proportion of the fine and coarse aggregates from the characteristics of coarse and fine aggregates,
6) Reach at the concrete mix proportions for the first trial mix, and
7) Conduct trial mixes with appropriate modifications till the final mix composition is arrived at.

IV. LITERATURE REVIEW

Prof.Aijaz Ahmad etal (2014) were concluded that "This Paper reviews the recent studies which were carried out on Self Compacting Concrete (SCC) and compare it with Normal Concrete (NC). Almost all countries in the world are facing an acute decline in the availability of skilled labor in the construction industry, and hence the need of Special Concretes becomes very essential in this world where the use of concrete is just next to the water. This paper discusses the various aspects of SCC including the materials and mix design, different test methods such as V funnel test, L- Box test etc., and also its performance characteristics and properties in the fresh and hardened state."

Kosmatka, S. etal (2002)were concluded that "It indicated that careful attention must be given to aggregate size, shape, surface texture, mineralogy, and cleanness. In high-strength concretes, the strength of the aggregate itself and the bond with the cement paste became very important factors. Tests have shown that crushed-stone aggregates produce higher compressive strength in concrete than gravel aggregate using the same size aggregate and the same cementing materials content. It has been assumed that the increase in strength was due to a superior aggregate-paste bond when using rough, angular, crushed material."

V. CEMENT SPECIFICATIONS

Indian Standard IS: 8112 – 1989 "Specification for High strength ordinary Portland cement"

– Physical Requirement for 43 grade cement
– Fineness

The specific surface of cement shall not be less than 350m^2/kg when fineness test done by Blaine's air permeability method as described in IS 4031 (Part 2): 1488.

A. *Setting Time*

The setting time of the cements, when tested by the Vicat apparatus process in IS 4931 (Part 5): 1988 shall conform to the following requirements:

B. *Compressive Strength*

For this test at least three mortar cubes (area of face 50 cm^2) composed of one part of cement and by mass three parts of standard sand (conforming to IS 650:1966) and $(\frac{P}{4} + 3.0)$ percent (of joined mass of cement and sand) water and prepared, stored and tested in the manner described in IS 4031 (Part 6): 1988 shall be as follows:

P = percentage of water required to produce a paste of standard consistency.

C. Material specification

1) Indian Standard IS: 383-1970

According to this Standard "Specification for coarse and fine aggregates from natural sources for concrete"

2) Fine aggregates

Aggregate most of which passes 4.75-mm IS Sieve.

- Natural Sand
- Crushed Stone Sand
- Crushed Gravel Sand

D. Factors to be considered for design mix

- The evaluation assignment giving the trademark quality necessity of cement.
- The sort of bond impacts the rate of improvement of compressive quality of cement.
- Maximum ostensible size of totals to be utilized as a part of cement might be as extensive as would be prudent inside the points of confinement endorsed by IS 456: 2000.
- The bond substance is to be restricted from shrinkage, splitting and crawl.
- The workability of cement for acceptable setting and compaction is identified with the size and state of segment, amount and dividing of support and strategy utilized for transportation, putting and compaction

VI. METHOD OF CONCRETE MIX DESIGN

- Indian Standard Recommended Method of Concrete Mix Design (IS:10262-2009)
- Mix Design for Pumpable Concrete
- DOE Method of Concrete Mix Design
- American Concrete Institute Method of Mix Design

A. Design of concrete mixes according to the Indian standards

Design of M30 concrete mix as per IS: 10262-2009, Concrete mix proportioning-guidelines (First revision)

1) Target Mean Strength from the Specified Characteristic Strength

Target mean strength = specified characteristic strength + standard deviation × risk factor

f_{ck} = 30 + 1.65 X 5 f_{ck} = 38.25 N/mm^2

a) Design mix

- Cement = 413 kg/m^3
- Water = 186 kg/m^3
- Fine aggregate = 706 kg/m^3
- Coarse aggregate = 1117 kg/m^3
- Water Cement proportion = 0.45
- Yield =2422 kg

B. Results of M-30 Grade Concrete with Different Method in Laboratory

Method	Materials (kg/m^3)							Cube Strength (N/mm^2)	
	W/C	Water	Admixer	Cement	Sand	20 mm	10 mm	7 Days	28 days
IS	0.42	180	1	428	542	711	474	32.59	43.41
DOE	0.48	190	1	275	690	677	450	32.59	43.41

Table 1: Comparison of Strength Results of M-30 Grade Concrete with Different Method in Laboratory

C. Results of M-30 Grade Concrete with Different Method in Field

Method	Materials (kg/m^3)							Cube Strength (N/mm^2)	
	W/C	Water	Admix	Cement	Sand	20 mm	10 mm	7 Days	28 days
IS	0.42	180	1	425	540	715	475	28.37	41.48
DOE	0.48	185	1	270+ 125	700	682	450	32.52	40.81

Table 2: Comparison of Strength Results of M-30 Grade Concrete with Different Method in Field

D. Comparison of Strength Results of M-30 Grade Concrete

Method	$= \frac{28 \text{ days field strength results}}{28 \text{ days laboratory strength results}} \times 100$
	Cube strength
IS	95%
DOE	94%

Table 3: Comparison of Strength Results of M-30 Grade Concrete between Field and Laboratory

VII. CONCLUSION

- 95% strength cover field, ready mix concrete over laboratory mix concrete.
- Ready mix concrete strength mainly depends on W/C ratio and quality control.
- Admixture affects the 28 days strength results.
- High strength is not workable more than 2 hours.
- Compressive strength is sufficient for structural requirements.
- IS CODE Method is best method for mix design.

A. Future Research Scope

The scope of this research included an examination of:

- The effect of water-cement ratio;
- The effect of materials standardization and
- Analysis of bonding between ingredients on tensile, compressive and flexural strengths of Ready mix concrete.

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