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Critical Analysis of Properties of Ready Mix Concrete with Site Mix Concrete of Smart Road Project

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Abstract - *Concrete is most extensively used constructional material. Depending upon the scope of the work and site conditions, the concrete can be in-situ (conventional mix/ manual mix) or Ready Mixed Concrete (RMC). Concrete being used for both major as well as minor constructional projects, it is necessary to maintain its properties and quality irrespective whether it is site mixed or Ready Mixed Concrete. It is of great concern to analyze the properties of both conventional mixed concrete and ready mixed concrete to assume quality control of concreting. In this research work, the main focus was to analyse important engineering properties of ready mixed concrete and site mixed concrete and deviation/ variation, if any, used at smart road construction project at Bhopal. The strength and workability parameter of concrete are essential to analyze with respect to the design of smart road project, The results of both ready mix concrete mix designs and site mixing are analysed and finding result are presented in finding of research*

Key Words: Ready Mix Concrete, Hand Mix Concrete, Concrete Properties, Workability, Compressive Strength & Smart Road Project.

1. INTRODUCTION

The material Concrete mainly contains fine aggregate (sand), coarse aggregate, cement and water. RMC (ready mix concrete) use is increasing due to its advantageous in comparison with traditional concrete mix. RMC is a type of concrete which is proposed under controlled conditions using consistent quality control of raw materials.

The properties of concrete like workability, compressive strength and other properties depends upon the properties of ingredients, process of preparing fresh concrete on the mix proportions, compaction method, curing and other controls.

The major projects require speed as well as quality of construction, compatible with the International standards. This is the cause of growing of ready mix concrete use to maintain the standard of construction. Concrete have typical characteristics and strength parameters.

The demand of concrete is fulfilled either by site mixed concrete or ready mixed concrete. Since the site mixed concrete is volumetrically batched, hence quality of the concrete is not as per with the standard ready mixed concrete, which is weighted. In contrast of this when the sample is collected from Ready Mixed Concrete plant then quality parameters are properly assessed. In view of this the research is proposed to critically analyze the properties of ready mixed concrete at the construction site of smart road project. A good quality of concrete is directly related to the high quality of material used in mixing process .In construction normally the workability and strength of concrete will be the first characteristics that will focus on to ensure the good result in construction.

1.1 CONVENTIONAL CONCRETE

Concrete when mixed manually at site is conventional concrete. Conventional concrete is prepared by approximate measurement of ingredients. Manual mixing of ingredients (cement, sand, aggregates and water) is done on site. The quality of conventional concrete depends on experience of workmanship. Since it is manually mixed, hence quality varies every time and it may affect the strength of structure and workability of concrete. Environmental factors such as humidity, temperature and type of mixing surface affect the quality of conventional concrete. Quality of site mix concrete is inconsistent because concrete is hand mixed and quality of raw material is manually checked.

For small scale projects quality of conventional concrete are sufficient. Hand mixed concrete is the only economical option for small scale projects. Conventional concrete needs high degree of supervision, otherwise the mix quality may degrade.

1.2 READY MIX CONCRETE

Ready mix concrete (RMC) is concrete in which cement, aggregate and other ingredients are weigh batched at a plant prior delivery to the construction site. IS: 4926-2003 defines ready mix concrete as concrete mixed in a stationary mixer in a central batching and mixing plant or in a truck mixer and supplied in a fresh condition to the purchaser either at site or into purchasers (vehicle).

In the present work the different grades (M15, M20, M25) of concrete mix are taken for the critical analysis of RMC. Being produced in Ready mix concrete plant under controlled super vision, the material properties are properly maintained.

Fig -1: Discharging of RMC at project Site

1.3 RESEARCH OBJECTIVE

Major objectives of Research were as follows;

1.) To analyze strength and workability parameter of Ready Mixed Concrete (RMC) used at smart road project.

2.) To test the properties of ingredients used for RMC and in-situ concrete.
3.) To analyze strength and workability parameter of in-situ concrete of smart road project.
4.) To establish the comparative results and deviation of RMC and site mixed concrete (in-situ) properties.

2. LITERATURE REVIEW

From the literature survey it is observed that substantial amount of work has been carried out by few researchers on assessment of compressive strength of concrete and workability by using waste products. However it is seen that there is no work carried on for the assessment of compressive strength and workability of concrete used for a particular project and its comparative analysis with hand mix and ready mix concrete.

3. MATERIAL DESCRIPTION

The material taken for study are-

a.) cement OPC43

Ordinary Portland cement of 43 Grade of Birla Uttam Brand Conforming to IS: 8112 is used in this study work. Table 1 shows the properties of cement.

Fig -2: Ordinary Portland cement

Table -1: Properties of OPC 43

Properties	Result
Fineness	7%
Specific gravity	3.15
Standard consistency	31.5
Initial setting time	35min
Final setting time	270min

b.) Fine aggregate the fine aggregates are defined as aggregate passing through an IS sieve that is less than 4.75mm sieve. Fine aggregate acts as filler material between the coarse aggregate.Wokability and uniformity in the concrete mix is most useful property of the fine aggregate. It enables cement paste to hold the coarse aggregate particle. Narmada rive sand of zone2 is used in the present research work. Table 2 shows the properties of fine aggregate.

Fig -3: Fine Aggregate

Table 2 Properties of fine aggregates

Properties	Result
Specific gravity	2.62
Water absorption	1%
Bulk density	1680
Fineness modulus	3
Type of sand	Narmada river sand

c.) Coarse aggregate Coarse aggregate are aggregate which are retained on 4.75mm IS sieve. These aggregates contain the major volume of concrete and contribute towards strength of concrete**.** Minimum 10 mm & maximum 20 mm size of coarse aggregate are used for this research work. Locally available coarse aggregate which is approved for the smart road project is used in present research work.

Fig -4: Coarse Aggregate

Table 3 Properties of coarse aggregates

Properties	Result
Specific gravity	2.86
Water absorption	0.81%
Impact value	*13.56%*
Los Angeles abrasion value	*22.04%*

3.1 QUANTITY PER CUBIC METER TAKEN FOR RESEARCH WORK

Table 4 Material Required For **M15** Grade Of Concrete per Cubic Meter

Material	Quantity	Proportion
Cement	300kg/m³	1
Sand	775kg/m³	2.58
Coarse Aggregate	1270kg/m³	4.23
Water	165lt/m³	0.55

Table 5 Material Required For **M20** Grade OfConcrete per Cubic Meter

Material	Quantity	Proportion
Cement	321kg/m³	1
Sand	742kg/m³	2.31
Coarse Aggregate	1270kg/m³	3.96
Water	170lt/m³	0.53

Table 6 Material Required For **M25** Grade Of Concrete per Cubic Meter

Material	Quantity	Proportion
Cement	344kg/M³	1
Sand	712kg/M³	2.06
Coarse Aggregate	1273kg/M³	3.70
Water	172lt/M³	0.50

Here table 4, table 5 & table 6 shows the quantity taken per cubic meter for different grades (M15, M20 & M25) of concrete in the present research work.

4. METHODOLOGY

- Project site description
- Collection of ingredients for
- RMC & IN-SITU Concrete
- Testing of materials
- Mix proportion
- Preparation of samples
- Testing of RMC samples
- Testing of HMC samples
- Critical analysis of results
- Conclusion

4.1 TESTING OF SAMPLES/ SPECIMEN

a.) Workability Test

Workability is the ease with which concrete flows. To handle the concrete without segregation, and without the loss of homogeneity, some lubrication is required. The water is required to lubricate the mix so that the concrete can be compacted with the required sufficient amount of effort Workable concrete is the concrete which exhibits little internal friction between particles and overcome the resistance due to friction. The workability test conducted as

per IS 1199-1959 for present research work. Factors affecting workability are:

- water content
- mix proportion

Fig -5: Slump cone for RMC & HMC

I. RMC- Ready Mix Concrete

II. HMC- Hand Mix Concrete

b.) Compressive strength Test

This test shows the measure of resistance of hardened concrete and it is reacquired to determine the strength of concrete. The compression test carried on sample shows the strength of that concrete structural component strength that's why it is the most significant property. The procedure followed for this test was as per IS: 516-1959.The test is carried out by preparing the cubical mould of size 150mm X 150mm X150mm.The 54 number of cube specimens were casted with different grades of mix and different w/c ratios for Hand Mixed Concrete. The cube samples were tested on Compression Testing Machine (CTM) in the well established site laboratory of **smart road project**, Bhopal. The 27 number of cubes were tested for hand mixed for **7days, 14days and 28days.**

Fig -6: Compression Test in CTM

5. RESULTS

5.1 RESULTS OF COMPRESSIVE STRENGTH

The results of different concrete mixes (M15, M20, M25)For compressive strength and workability are presented in the research work.

Table 7 Grade of Concrete: M15 Water Cement Ratio: 0.55
Size of Cube: (150mm*150mm*150mm)

Hand Mixed Concrete		**Ready Mixed Concrete**	
Samples	Compressive Strength N/mm²	Samples	Compressive Strength N/mm²
7 DAYS	12.44	7 DAYS	14.36
14 DAYS	15.25	14 DAYS	17.04
28 DAYS	17.78	28 DAYS	19.99

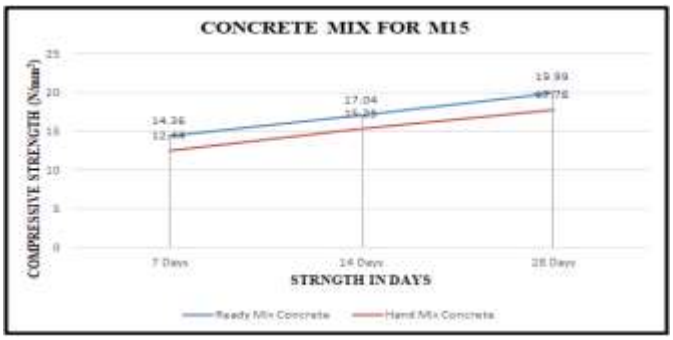

Fig -7: Graph showing comparison of RMC & HMC

Table 8 Grade of Concrete: M20 Water Cement Ratio: 0.53
Size of Cube: (150mm*150mm*150mm)

Hand Mixed Concrete		**Ready Mixed Concrete**	
Samples	Compressive Strength N/mm²	Samples	Compressive Strength N/mm²
7 Days	14.96	7 Days	17.04
14 Days	19.55	14 Days	21.18
28 Days	22.37	28 Days	26.55

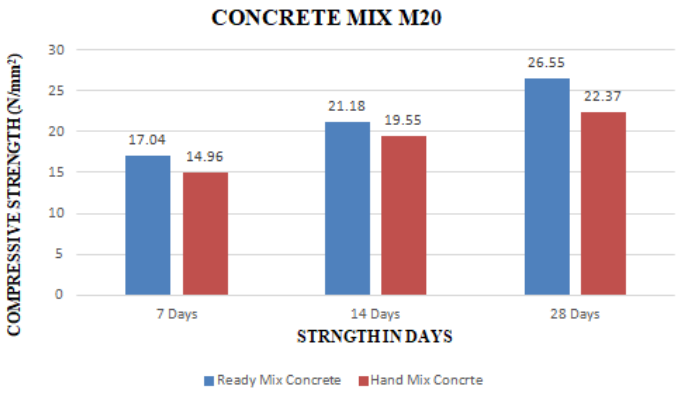

Fig -8: Bar chart showing comparison of RMC & HMC

Table 9 Grade of Concrete: M25 Water Cement Ratio: 0.50
Size of Cube: (150mm*150mm*150mm

Hand Mixed Concrete		Ready Mixed Concrete	
Samples	Compressive Strength N/mm²	Samples	Compressive Strength N/mm²
7 Days	14.96	7 Days	17.04
14 Days	19.55	14 Days	21.18
28 Days	22.37	28 Days	26.55

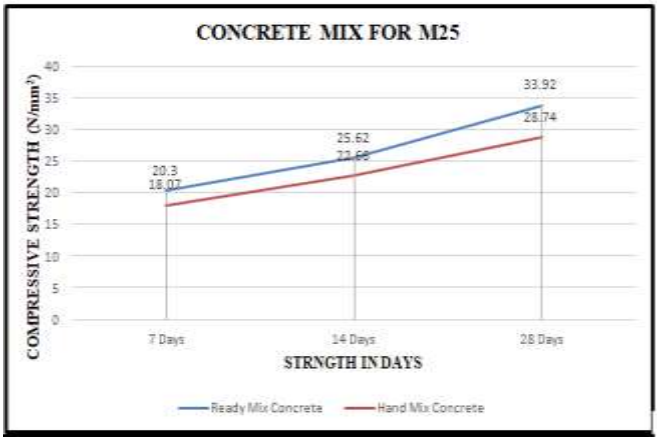

Fig -9: Graph showing comparison of RMC & HMC

5.2 RESULTS OF SLUMP CONE TESTS

Taken Grades of concretes are shown in figure 10.

Fig -10: Different Grades of concrete

Table 10 Slump value of Ready Mix Concrete

Grade Of Concrete	Slump Value
M15	65mm
M20	60mm
M25	75mm

Table 11 Slump value of Ready Mix Concrete

Grade Of Concrete	Slump Value
M15	65mm
M20	60mm
M25	75mm

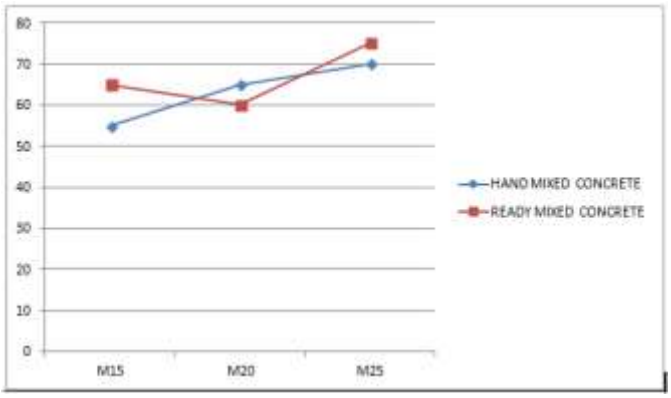

Fig -11: Slump value comparison of RMC & HMC

5.3 Deviation in compressive Strength

Deviation in the value of compressive strength and hand mixed concrete is calculated using the following formula:

Deviation = Ready Mixed Concrete Strength- Hand Mixed Concrete

Deviation Percentage

$$= \left(\frac{\text{Ready Mixed Concrete strength - Hand Mixed Concrete Strength}}{\text{Ready Mixed Concrete Strength}}\right) X\ 100$$

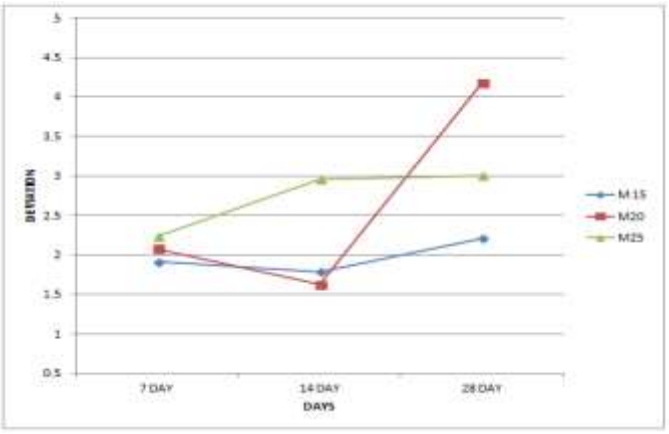

Fig -12: Deviation in compressive strength of different grades of concete

6. CONCLUSIONS

During the research study concrete as designed and proposed or typical concrete structures such as service ducts, drain, kerb, retaining wall are analyzed over the period of four months. The results and data obtained are realistic.

a) The results on strength parameters of RMC are found 11.64% for M15, 11.83% for M20 and 12.6% for M25 and for workability are found to be 7.69%, 8.33% and 6.66% are better as compared to in-situ concrete parameter, where as core or basic ingredients such as cement, sand, aggregate, water were remain same in both the cases of concrete preparation.

b) The properties of ingredients used for RMC and in-situ concretes are as per design requirement and within the permissible limits of BIS.

c) The slump value of few samples of RMC is deviated by 8.33_% that is because of other factors such as elongation and flakiness and quality control parameters which are beyond the scope of this research.

d) The comparative variation in results of RMC and in-situ concrete are about 1 to 5KN/mm^2, which is very very marginal.

e) The in-situ and RMC parameters if controlled as per the guide lines and engineering procedures of quality control. This deviation may be bridged by site engineers. The results of the study are in-line with the theoretical prospective of RMC and in-situ concrete which have been proved practically on the site of smart road project of Bhopal.

f) In few cases only in-situ concrete are used, since there is very nominal variation in the results of the parameter. Hence no negative effect is required to consider in contrast of RMC.

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BIOGRAPHIES

Rahul kumar has received his Bachelor of Engineering degree in Civil Engineering from RKDF Institute of Science and Technology Bhopal in the year 2016. At present he is pursuing M.Tech with the specialization of Construction Technology and Management in National Institute of Technical Teachers Training and Research, Bhopal. His area of interest is in the study of concrete strength, durability and workability of smart construction projects.

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