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Investigation of Factors Causing Poor Quality of Concrete in Terms of Strength and Durability

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Abstract: ***Considering modern era of globalization and highly competitive world market, quality plays key role in every field. Quality plays even more critical role in construction industry where wrong doings cannot be reversed at later stage. Modern construction industry all over the world hinges around "cement concrete construction" and hence quality management of cement concrete construction plays key role in every country's development.***
Quality management for concrete involves design of concrete mix for a specific situation and purpose, testing materials and controlling concrete operations so as to get Concrete of desire quality.
Keywords: Cement, Fine and Coarse Aggregates, Silt or dust, Compressive Strength, Durability, Workability, Quality.

I. INTRODUCTION

Because of rapid growth of infrastructure and due to space limitation, demand for high rise structures is increasing day by day. To meet that that demand and achieve desire quality of work, it is necessary to have a quality management system for concrete.
Quality of a project is usually depends on many factors, right from planning to completion of work, and every activity must be done with extreme care, otherwise it will result in failure of the structure.
Quality of concrete can be measured in terms of strength and durability, as these parameters are most significant for the safety of the structure. Quality of concrete depends upon material properties and their mix proportions that's why it becomes very essential to test material properties before designing the concrete mix.
After testing materials, mix design should be carried out by using building codes and care should be taken to implement that mix design proportions while making the fresh concrete. At many places, mix proportions are carried out by volume batching and workability is achieved by adding water till getting required workability as it becomes very easy to work with highly workable concrete, but this thing results in a reduction in strength of the concrete. Sometimes, reason for not getting require workability could be, presence of a high amount of cementitious material in fine aggregate or crushed sand, as finer the particles more surface area it has and eventually require more water to achieve the required workability. That's why it becomes very essential to test the material properties before designing the concrete mix to get concrete of desirable quality in terms of strength, workability, and durability.

II. PURPOSE AND SCOPE OF THE WORK

In this work we are trying to find out factors which causes variation in strength of concrete or factors which causes poor strength of concrete particularly effect of cementitious material present in fine aggregates (crushed sand) as it could affect strength and water requirement for concrete and it will ultimately affect strength and durability of concrete which are the very essential properties of concrete.

III. METHODOLOGY

In this work we designed concrete mix as per IS10262:2019 and then we casted 6 cubes of M25 and M35 grade of concrete with all fractions of Fine aggregates and 6 cubes of M25 and M35 without fraction smaller than 300microns. All the proportions were taken by weighing the materials with weighing machine and then mixing all the materials properly by hand mixing till concrete has got uniform color and then that concrete poured into cubical molds of size 15x15x15cm which were oiled properly. Concrete poured in three layers and each layer tamped 35 times with tamping rod of 16mm dia. All the cubes then cured for 28 days and then compressive strength test carried on each cube.

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IV. MATERIALS AND MIX PROPORTIONS

A. *Materials*

1) *Cement:* Ordinary Portland cement of grade 53 from local market had been used for this study.
2) *Aggregates:* Crushed sand from the local shop had been used in this study as a fine aggregates and angular coarse aggregates of size less 20mm had been used. Specific gravity of coarse aggregate and fine aggregates were 2.74 and 2.76 respectively.
3) *Water:* Water is necessary ingredient for hydration of cement and must be free from any impurities. Potable tap water which was free from any impurities had been used for the study.

B. *Mix Proportions of the Concrete*

Table 1: Mix proportions

Grade	Cement (kg/m^3)	Fine agg. (kg/m^3)	Coarse agg. (kg/m^3)	Water (kg/m^3)	W/C ratio
M25	438	666	1440	210	0.45
M35	493	631	1128	197.2	0.40

Table 2: Grading of Fine Aggregates

Size	Sample 1	Sample 2
4.75mm	20	17
2.36mm	185	190
1.18mm	268	263
600	248	265
300	89	90
150	55	60
Pan	101	107

Figure 1. Sieving of Fine Aggregates

Figure 2. Fractions smaller than 120microns.

V. TEST RESULTS

Figure 3. Compressive Strength Test

Table 3: Compressive Strength Test Results of M25 Grade Concrete.

Sr.	Strength of Concrete With all fractions of Fine Aggregates. (N/mm^2)	Strength of Concrete without Fractions of Fine Aggregates less than 300 microns.
1.	27.66	29.66
2.	26.52	28.52
3.	28.04	26.62
4.	26	27.14
5.	25.15	28.88
6.	26.12	27.34
	Avg =26.58	Avg=28.02

Table.4: Compressive Strength Test Results of M35 Grade concrete.

Sr.	Strength of Concrete With all fractions of Fine Aggregates. (N/mm^2)	Strength of Concrete without Fractions of Fine Aggregates less than 300 microns. (N/mm^2)
1.	35.46	37.46
2.	36.02	39.11
3.	36.81	38.27
4.	37.50	38.61
5.	35.28	37.44
6.	37	38
	Avg= 36.34	Avg= 38.14

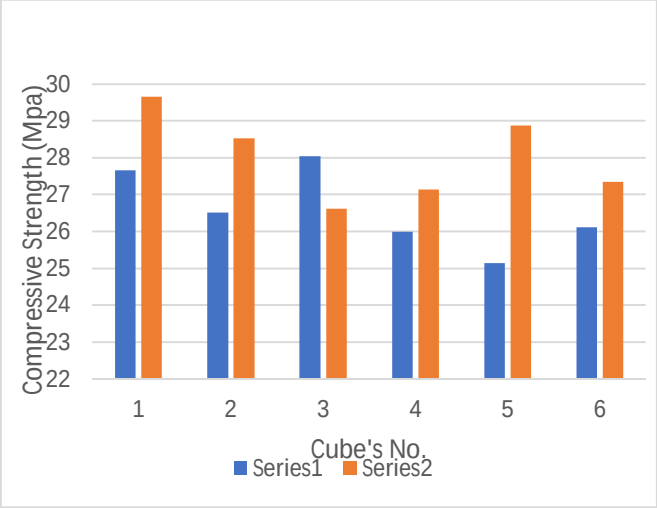

Figure 4. Compressive Strength Test of M25 Grade Concrete

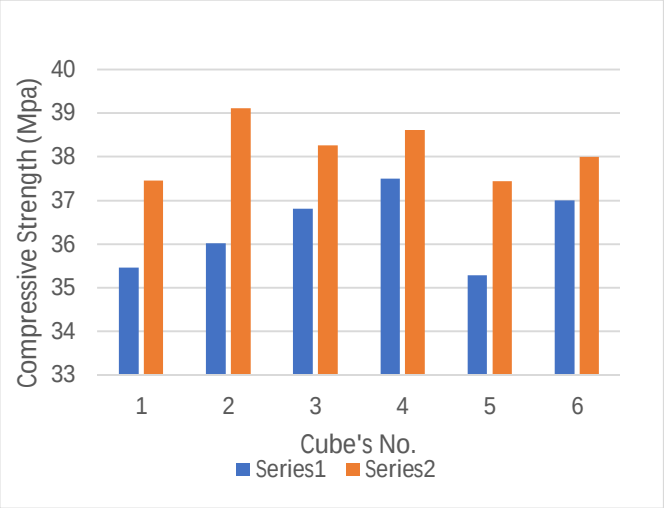

Figure 5. Compressive Strength Test Results of M35 Concrete.

VI. CONCLUSION

Concrete of grade M25 and M35 with all fractions of Fine Aggregates had achieved their respective design strength but cracking and spalling of concrete started at 30 % of design strength.

Concrete without contain fractions less than 300micron achieved its design strength and cracking had been observed from 70% of design strength.

Particles finer than 150 microns should not be more than 10% otherwise it could affect durability of concrete as spalling and cracking could lead towards corrosion of steel reinforcement.

Finer particles offer more surface area so water requirement will increase to attend workability and by doing this results in reduction in strength. So, it is very essential to study properties of materials before designing the concrete.

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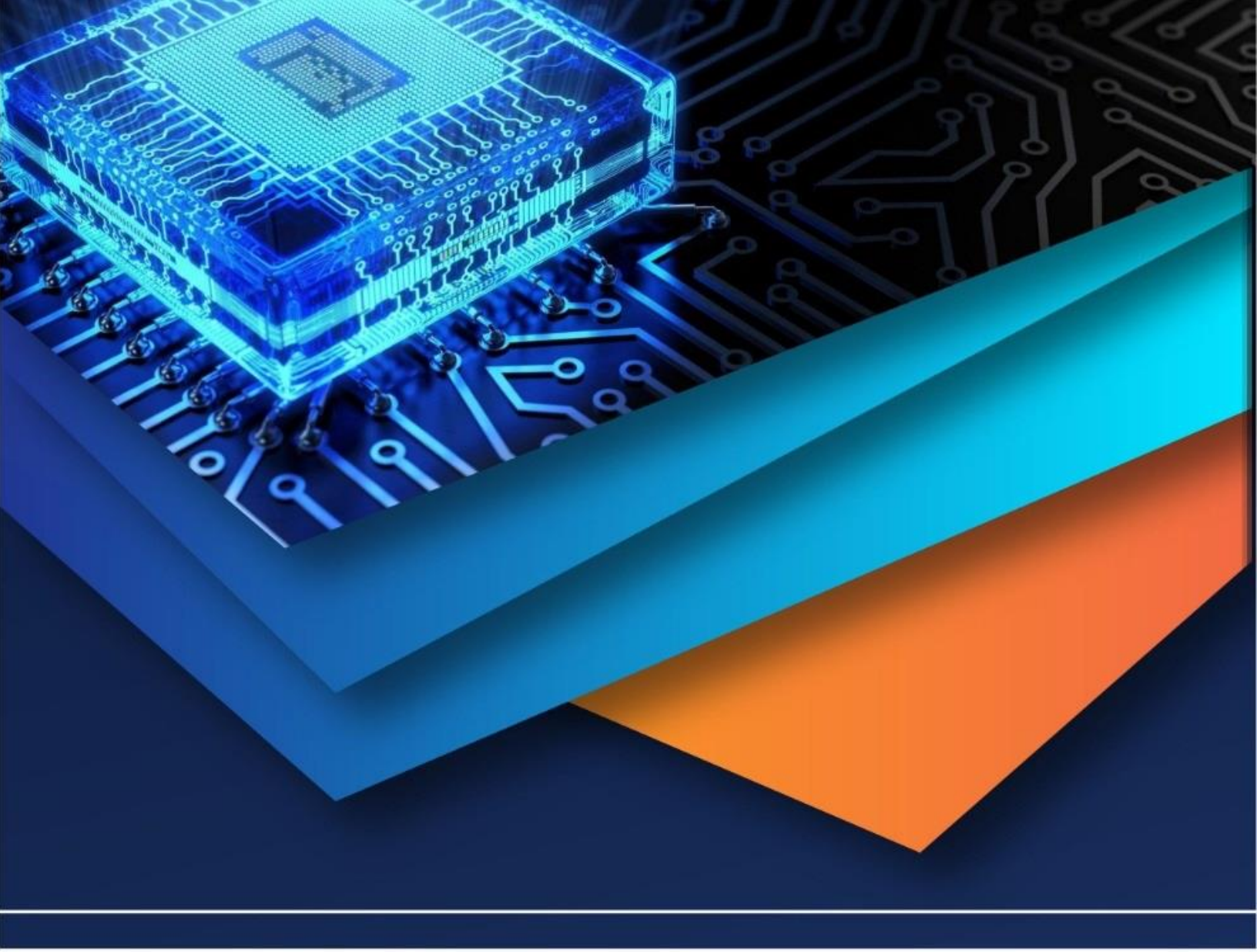

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