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Analysis on Mix Design of High Strength Concrete (M100)

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Abstract-*The compressive strength of concrete is its most important and useful properties and most easily determined. Research paper includes the mix design of high strength concrete with characteristic compressive strength of 111.8 N/mm2 according to IS 456:2000.The present experiment is based on the principle that fine aggregate should fill all the voids in the coarse aggregate and the cement paste should fill all the voids in the fine aggregate. The aggregate having less voids gives stronger concrete. such a combination of fine and coarse aggregate will require minimum amount of cement and will be most economical for a given water-cement ratio and slump. The proportion of fine to coarse aggregate which gives maximum weight of combined aggregate can be obtained by trial. Master glenium is used as super plasticizer in this research. High strength concrete can be made by using low water to cement ratio. This research is carried out to study the mix design of high strength concrete of grade M100*.

KEYWORDS-Accelerated steam curing, silica fume, silica fume, super plasticizer, compressive strength.

I. INTRODUCTION

Design of concrete mixes involves determination of the proportions of the given constituent namely, cement, fine aggregates, coarse aggregates, water and admixture, if any, which would produce concrete possessing specified proportions both in the fresh and hardened states with the maximum overall economy. Workability is specified as the important property of concrete in the fresh state and for hardened state compressive strength and durability is also important. The mix design is therefore generally carried out for a particular compressive strength of concrete with adequate workability so that fresh concrete can be properly placed and compacted to achieve the required durability. The proportioning of concrete mixes is accomplished by the use of certain relationships established from experimental data, which afford reasonably accurate guide to select the best combination of ingredients so as to achieve the desirable properties. Design of concrete mix requires complete knowledge of the various properties of these constituent materials, the implications in case of change on these conditions at the site, the impact of the properties of plastic concrete on the hardened concrete and the complicated inter-relationship between the variables.

PC (polycarboxylate ether) or naphthalene based super plasticizers are used because they will reduce more than 30% of mixing water than the normal super plasticizers.

High-strength concrete (HSC) has a compressive strength greater than 55MPa having water cement ratio (w/c) ranging from of 0.35 to 0.30 or even less. Due to low w/c ratio it requires super plasticizer to achieve required workability. For high strength concrete (M 60 and above) mixes, generally OPC 53-grade, a PC based super plasticizer (which can reduce 30% of the mixing water) and 5-10% silica fume will be required.

In this research, the concrete having grade M100 is mix designed.

II. LITERATURE REVIEW

There are various research reports available on the various properties of concrete.

1.Perumal& Sundararajan (2004)	They observe the effect of partial replacement of cement with silica fume on the durability and strength properties of high grade concrete, strength and durability properties for M60, M70 and M110 grades of HPC trial mixes and to arrive at the maximum levels of replacement of cement with silica fume, investigations were taken. The strength and durability characteristics of these mixes are compared with the mixes without silica fume. Compressive strengths of 60 N/mm2, 70 N/mm2 and 110 N/mm2 at 28days were obtained by using 10 percent replacement of cement with SF.

Oral Büyüköztürk and DenvidLau	According to them in manufacturing the material the use of densified small particle systems contribute to the high strength and low permeability of high strength concrete. Fly ash, silica fume and super plasticizer are important ingredients to manufacture high strength concrete. In order to create durable High strength concrete, it is necessary to use a proper mix design and apply an effective curing. It is suggested that three criteria should be considered to produce durable concrete. These criteria are strength, permeability and cracking resistance.

III MATERIALS USED

The ingredients of high strength concrete are: Cement, Fine aggregate, Coarse aggregate and water. Admixtures may be used to enhance some properties of the concrete.

1.Cement

Cement acts as a binder element in the concrete. In this research OPC 53 grade cement is used.

The colour of the cement is grey. It is confirms to IS-2015. Specific gravity of the cement is 3.15.

Initial setting time is 30 min and final setting time is 600min.

2. Fine aggregate

River sand is used as fine aggregate. Specific gravity of the fine aggregate is 2.16.Water absorption by fine aggregate is 1%. From sieve analysis fine aggregate is of zone II and fineness modulus of fine aggregate is 2.319.

3. Coarse aggregate

Stones made from Crushed rocks are used as coarse aggregate in this research work. Specific gravity of the fine aggregate is 2.74. Water absorption by them is 0.5% .Size of coarse aggregate is taken as 40% of 4mm to 10mm size aggregate and 60% of 10mm to 20mm.

4. Water

In concrete, the single most significant influence on most or all of the properties is the amount of water used in the mix. Water used in the preparation of concrete should be free from dirt and organic matters.

In concrete mix design, the ratio of the amount of water to the amount of cement used (both by weight) is called the water to cement ratio (w/c and water are responsible for binding everything together in concrete.

5. Admixture

Admixture are used enhance some properties like strength, durability, workability, to increase or decrease setting times etc. Here, silica fume is used as an admixture. It is grey in colour.

6. Super plasticizer

The new generation of this kind of admixtures represented by polycarboxylate ether-based super plasticizers. With a relatively low dosage (0.15–0.3% by cement weight) they allow a water reduction up to 40%, due to their chemical structure which enables good particle dispersion. In this research (*MASTER GLENIUM SKY 8765*) is used.

IV. MIX DESIGN

Mix Design is a process of selecting suitable ingredient materials of concrete and determining their relative proportions as economically as possible that would satisfy the desired properties of fresh and hardened concrete as well.

For mix design purpose, the complete knowledge of the various properties of the ingredient materials and the conditions at the site should be known beforehand.

In India, generally IS Codes are followed for designing a concrete mix.

1. Data used

The basic data required for design of concrete mix of grade M100 are given in the table below.

Data	**Value**
Degree of workability desired	**Good**
Standard deviation	**6**
Statistic, depending upon the accepted proportion of low results(t)	**1.65**

Target mean strength	**111.98 MPa**
Maximum size of aggregate Used	**20 mm**

2 .Water content

According to IS-10262:2009, for 20 mm size aggregate, water content and sand as percent of total aggregate by absolute volume is taken as 186 kg per cubic meter of concrete. We have used 140 liters water and with super plasticizer 1 % and expected that super plasticizer, silica fume will have high workability of 120 mm slump.

3. Air content estimation

According to IS-10262:1982, approximate amount of entrapped air to be expected in normal concrete is taken as 1%.

4. Casting of samples for mix design

The size of the cube Specimen is (150x150x150) mm. A total of 5 trials for mix design were casted. In each trial 6 cubes are casted. A total of 30 cubes are casted for the mix design of high strength concrete.

5. Curing of samples

In the next day of casting, cube samples were de-moulded from the moulds and placed in curing tanks until they are taken out from it for further tests. 3 and 3cubes - from each trial are taken out in 7 day and 28 day respectively for compression test. Accelerated steam curing also done on the trial no 5 in which predicted 28 days compressive strength = R28 = (8.09 + 1.64 Ra), where Ra is accelerated compressive strength and R28 is predicted compressive strength at 28 days.

6. Mix proportions

Table A: Mix Proportions

Trial mix no	Water to binder ratio	Cement: Fine aggregate: Coarse aggregate	super plasticizer
1	0.33	1:1.27:2.11	1.4% of cement
2	0.30	1:1.46:2.26	1% of cement
3	0.28	1:1.27:2.26	1% of cement
4	0.27	1:1.458:2.3	1% of binder
5	0.25	1:1.35:2.14	1% of binder

V. RESULTS

1. Trial 1(compressive test results)

The 7-day and 28-day compressive test result of Trial-1 are given in the following table.

Table B: Trial 1(compressive test results)

Age in days		**7**	**28**
No of Cubes		**3**	**3**
Cube Strength in MPa	**Cube 1**	**35**	**59**
	Cube 2	**37**	**62.5**
	Cube 3	**35**	**62**
Average Compressive Strength in MPa		**35.66**	**61.1**

2. Trial 2(compressive test results)

The 7-day and 28-day compressive test result of Trial-2 are given in the following table.

Table C: Trial 2(compressive test results)

Age in days		**7**	**28**
No of Cubes		**3**	**3**
Cube Strength in MPa	**Cube 1**	**34.4**	**63.55**
	Cube 2	**38**	**64.44**
	Cube 3	**36**	**66.62**

Average Compressive Strength in MPa	**35.66**	**61.1**

3. Trial 3(compressive test results)

The 7-day and 28-day compressive test result of Trial-3 are given in the following table.

Table D: Trial 3(compressive test results)

Age in days		7	28
No of Cubes		3	3
Cube Strength in MPa	**Cube 1**	37	66.34
	Cube 2	38	67.23
	Cube 3	36.50	68
Average Compressive Strength in MPa		37.16	67.19

4. Trial 4(compressive test results)

The 7-day and 28-day compressive test result of Trial-4 are given in the following table.

Table E: Trial 4(compressive test results)

Age in days		**7**	**28**
No of Cubes		**3**	**3**
Cube Strength in MPa	**Cube 1**	**48.89**	**78.20**
	Cube 2	**51.11**	**80.3**
	Cube 3	**50.12**	**77.64**
Average Compressive Strength in MPa		**50.04**	**78.71**

5. Trial 5(compressive test results)

The specimens are cured in accelerated steam curing(asc). Accelerated Curing Method is used to get early high compressive strength in concrete. This method is also used to find out 28 days compressive strength of concrete in 28 hours. (As per IS 9013-1978-Method of making, curing and determining compressive strength of accelerated cured concrete test specimens).

Predicted 28 days compressive strength = R28 = (8.09 + 1.64 Ra), where Ra is accelerated compressive strength and R28 is predicted compressive strength at 28 days.

Table F: Trial 5(compressive test results)

Age in hours		**28**	
No of Cubes		**3**	
Cube Strength in MPa	**Cube 1**	**Ra=66.2**	**R28=116.65**
	Cube 2	**Ra=62.4**	**R28=110.33**
	Cube 3	**Ra=61.2**	**R28=108.5**
Average Compressive Strength in MPa		**111.8**	

VI. CONCLUSION

The trial mix-5 having ingredients (cement: sand: coarse aggregate) and having ratio (1: 1.35: 2.14) with super-plasticizer (Polycarboxylate ether based) 1% of binder, 10% silica fume of cement and water-binder ratio 0.25 gives satisfactory result. This proportion gives predicted compressive strength of 111.8 MPa at 28days using accelerating curing method. This proportion can be used to produce concrete of grade M100. A slump of 120 mm is obtained. The high strength concrete can be achieved by using good qualities of materials, taking relatively low water cement ratio, using proper prescribed methods, proper proportion of materials and good supervision is necessary. The weather conditions should be taken into account while deciding the water quantity and for higher workability, the required water content may be established by trials. The super-plasticizer should be added carefully. Excess amount of super-plasticizer may result in segregation of the concrete and make concrete weaker. So the amount of super-plasticizer used should be between 0.8% to 1% of the quantity of binder (cement + silica fume).

VII. REFERENCES

[1] IS 456: 2000 code of practice for plain and reinforced concrete (third revision).

[2] Prof. (Dr.) D.K Sharma, HOD civil ABES engineering college, Ghaziabad.

[3] Dr. S.C. Maiti , Technical consultant Cement and Concrete.

[4] Civil faculty members, ABES engineering college Ghaziabad.

[5] Shetty. M.s, (2010) "concrete technology" S.Chand and company Ltd, Delhi.

[6] IS:10262-2009 Recommended Guidelines for Concrete mix design (Reaffirmed 2004).

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