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Improvement of Concrete Properties by Silica and Steel fiber

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Abstract *- The aim of this research is to improve properties of concrete by addition of silica and steel fiber. Samples of M30 grade concrete is tested in the laboratory for compressive and tensile Strength for different time periods (i.e. 7days,and 28days). It is cured for 28 days.*

Keywords- *concrete, silica, steel fiber, compressive strength, grade of concrete, water cement ratio, curing, admixture*.

I. INTRODUCTION

Concrete is second most consumed substance in the world. Cost of cement and reinforcement is mainly affecting the overall cost. Different materials have been added to concrete in order to improve or alter its properties and reduce cost of construction. Material such as steel fiber and silica slug has been added to fresh concrete to fresh concrete to improve specific characteristics such as compressive and tensile strength, hardness toughness.
Addition of steel fiber can increase compressive and tensile strength of concrete along with the post cracking ductility. Furthermore, the steel fibers raise the resistance of concrete to cracking. The use of steel fiber increases impacted resistance and provides ductile failure under compression, flexure and tension, besides increase in fatigue resistance.
Silica fume is by product in production of silicon matel, because of its chemical properties it is very reactive pozzolona. High strength and durability can be achieving by addition of silica fume in concrete. It is simply added as other admixture during concrete production. It is primary consists of non- crystalline silicon dioxide (SiO2). The individual particle of silica is extremely small. Approximately $1/100^{th}$ of the size of cement particle. Because of its small size particle and very large surface area silicon dioxide is very reactive pozzolona in concrete. It can be added as both slurry and powder form in concrete. Generally, 50:50 scenarios is preferred. Water demand is increase in production of concrete to amount of micro silica added. Increase in water demand in concrete containing micro silica will be 1% for every 1% replacement of cement contends. This demand can be reduced by using superplasticizer. Microsilica concrete generates more heat of hydration in initial stage then normal concrete. However, the total heat will be less than normal concrete.

II. METHODOLOGY

In order to check suitability of material, testing program was aimed to find the possibility of implementing destructive and non-destructive testing to evaluate strength and other effective factors such as durability and density.
Testing program consists of construction of concrete slab and blocks using two types of cement (i.e. Ordinary portend cement and portlend pozzolona cement). It is cured for 28 days and then samples are obtained for testing.
Beam and cube are tested for tensile and compressive strength. As properties of materials also affect characteristic of concrete, testing of materials also evaluated.

III. MATERIALS

3.1 Aggregates

Aggregates consists about 70 to 80% volume in concrete. Thus the nominal size of aggregates is 20mm.

3.2 Cementations Material

Cement used in this project was Ultratech cement.

3.4 Water

Water used in project was tap water obtained from vadodara area. It is also used for curing.

IV. MIX DESIGN

Special design mix is prepared for M30 grade concrete as per maximum dry density – optimum moisture content method.

4.1 Mixing

Mixing of concrete was done in mechanical mixer. Before mixing surface of mixer was washed by water. Concrete was

mixed for fifteen minutes.

4.2 Casting:

Cube mold size of 150*150*150 cm was casted in conventional method to know compressive strength of concrete. Beams were casted to know tensile strength of concrete. Moulds were cleaned and inside surface were oiled. Now moulds were placed on vibrator machine and filled with concrete in five layers by giving vibration to each layer for period of 2 minutes. After that compression is applied on concrete with help of hammer blows. Level the top surface and smoothen it with a trowel

4.3 Curing:

The molds filled with concrete are stored in moist air for 24 hours and let them settle. After this period the it is de-molded and kept submerged in clear fresh water until taken out prior to test.

Table 4.1 Mix design

Name	Quantity
Cement	380
Water	160
Fine AGG.	700
Corse AGG.	1308
Admixture	1.90
W/C ratio	0.42

V. TESTING METHODOLOGY

5.1 Slump test

Apparatus of slum test is first cleaned and then oil is applied on surface of it. Concrete is filled in slump cone in three equal layers. After placing of layers 25 blows of tamping road is applied to distribute concrete in cone. After placing all layers top surface is leveled. Then cone was smoothly lifted without disturbing concrete. Height of concrete slump is then measured. This height gives slump value in mm.

5.2 Compressive strength testing and tensile strength

M30 grade of concrete cubes of 15cm were used to determine the compressive strength. In total 16 cubes were casted. Results are as shown in below table.

Table 5.1 Compressive Strength.

% of Silica Fume added %	Compressive Strength (N/mm^2)	
	7 days	28 days
0	21.23	34.9
5	24.56	38.3
10	28.92	41.2
15	33.7	42.6
20	30.1	39.4

Table: 5.2- Compressive strength of M30 grade concrete cubes

Fiber content %	7th day Compressive Strength (N/mm^2)	28th day Compressive Strength (N/mm^2)
0%	30.73	38.95
0.25%	27.96	35.37
0.5%	29.53	37.39
0.75%	29.11	36.4

Table 5.3 Tensile strength

% of Silica Fume added %	Tensile Strength (N/mm^2)	
	7 days	28 days
0	2.7	4.02
5	2.82	4.31
10	3.55	4.47
15	3.21	4.06
20	2.9	3.52

Table: 5.4 - Tensile strength of M30 grade concrete cylinders

Fiber content %	7^{th} day Tensile Strength (N/mm^2)	28^{th} day Tensile Strength (N/mm^2)
0%	1.3	3.138
0.25%	2.21	3.351
0.5%	2.874	3.839
0.75%	2.149	3.637
1%	2.015	3.295

CONCLUSION

By adding silica fume compressive strength increases and tensile strength decreases whereas by adding steel fiber compressive strength decreases and tensile strength increases.

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