Study of Silica Fume Based Concrete Produced with Different Steel and Polypropylene Fibers

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Abstract - To upgrade the qualities of cement; half and half filaments are consolidated other than silica fume . In this exertion an assortment of fiber added substances can be joined with cement to plan for explicit applications and advance synthetic and strength properties. The blend of strands, regularly called hybridization, is presented by utilizing diverse fiber extents of steel and polypropylene. The silica fumes contributing 0 to 15 percentage were used in concrete mixes by volume of cement and poly-propylene fiber, steel (crimped) fibers and hybrid fiber (poly-propylene and steel (crimped) fibers) of various proportions i.e. 10% asadditives for each of the concrete mixes of M30 grade as perIS code method of mix design. Super plasticizer was also used in all mixes to make concrete better in workability. Besides cubes and beams of M30 grade concrete were cast 0 and 15 % silica fumes and different percentages of steel fiber and polypropylene fiber and hybrid fibers respectively, by volume of cement and identifies fiber combinations that demonstrate maximum compressive and flexural and shear strength of concrete. Finally we obtained that by addition of fiber and mineral admixture the concrete increase their properties as compare to normal concrete mass.

Keywords - fibrous concrete, hybridization, polypropylene fiber, steel fiber, hybrid fabric, orthodox- fiber, strength –properties, silica fumes.

I. INTRODUCTION

The framework needs of our nation is expanding step by step and with concrete is a fundamental constituent of development material in a huge bit of this infra-underlying framework, it is important to upgrade its qualities through strength and solidness[1]. Concrete is a moderately fragile material. Expansion of strands to substantial makes it a more pliable material[2]. Plain concrete cement has a few weaknesses like low elastic, restricted pliability, little protection from breaking, high fragility helpless sturdiness. The breaks by and large create with time and stress to enter the substantial, accordingly impeding the waterproofing properties and uncovering the inside of the substantial to the ruinous substances containing dampness, bromine, corrosive sulfate, and so forth The openness acts to crumble the substantial, with the building up steel consumption[5]. To balance the breaks, a battling methodology has come into utilization, which blends the substantial in with the expansion of discrete strands. Exploratory examinations have shown that strands improve the mechanical properties of cement, for example, flexural strength, compressive strength, rigidity, creep conduct, sway opposition and sturdiness. Among them, polymer filaments and the steel strands appreciate prevalence in the area of cement[3].Clearly the conduct of HFRC relies upon the viewpoint proportions, directions, mathematical shapes, circulations and mechanical properties of strands in substantial blends. from a fragile to a more flexible material[4].

II. OBJECTIVE OF THE STUDY

The fundamental goal of the examination is to research the adjustment of qualities strength properties and functionality of cement blended in with various level of silica vapor with strands. Following are destinations of the examination.

- To discover the impact of strands and silica fume on strength when blended in with substantial example.
- To study the usefulness of cement on variety in various fiber with various level of silica fume when blended in with concrete.
- To discuss the adjustment of variation of strength.
- To find out the strength examination and specific gravity of total utilized.

III. MATERIALS AND METHOLODOGY

Silica fume is a by- product of the smelting process in the production of silicon metal and ferrosilicon alloys. It has also been called silica fume, micro silica, amorphous silica and other similar names. These metals are used in many industrialapplications to include aluminum and steel production,computer chip fabrication, and production of silicones which are widely used in lubricants and sealants. While these are very valuable material, the by-product silica fume is of more importance to the concrete industry.

In general they have SiO_2 contents ranging from 85-96%. Silica fume is similar to fly ash but has a practical size 100 times smaller.

To fulfill our study, we adopted the research methodology are as follows:

We performed compressive, flexural and shear strength test to find out the increase in strength of concrete. To find the optimum value of the fiber added percentage we have read out many of the research papers. The cubes and beams are casted for finding out the strength of conventional concrete and fiber added concrete with M30, grade are as follows

- To determine the compression strength test we had casted the cubes of 100x100x100mm
- To determine the flexural strength test we had casted the beams of 500x100x100mm
- To determine the shear strength test we had casted the beams of 500x100x100mm.

IV. OBSERVATION AND CALCULATION

For M30 Grade Concrete

Ratio of the concrete = 1 : 2.21 : 3.09

Sum of the ratio of concrete =1+2.21 +3.09= 6.3

Weight of cement = (1/ Sum of the ratio of concrete) * Weight of concrete

=(1/6.3) * 20kg =3.174kg ≈ 3.2kg

Weight of sand = (2.21 / Sum of the ratio of concrete) * Weight of concrete

= (2.21 /6.3)*20kg = 7.01kg ≈ 7kg

Weight of crush = (3.09/ Sum of the ratio of concrete) * Weight of concrete

=(3.09/6.3)*20kg=9.81kg ≈ 10kg

Where,10 mm coarse aggregate:20mm coarse aggregate=9kg:1kg

water-cement ratio = w/c = 0.45

= 0.45 * 3.2kg = 1.44 kg ≈ 1.44kg

V. CASTING AND CURING

Standard sized cubes (150mm x 150mm x 150mm) are casted for compression test of concrete. However the beams are casted with dimension500mm x 100mm x 75mm.

A. Cubes

I. M30 grade conventional concrete quantity 9 numbers

II. M30 for 5%, 10% and 15% fiber introduced concrete quantity 9 numbers (3 each)

36 cubes are casted for compressive strength test. They cast and hold in the mould for 24 hours. Afterwards cubes were preserved in water for curing. After 28 days they are taken out from water, dried and then performed compressive strength test

Requirement of Dry Material

a. Volume of the cube = 150 mmx150 mmx 150mm

= 3375cm^3

= .003375 m^3

b. Specific weight of concrete = 2400kg/m^3

c. Weight of single concrete cube = Specific weight of concrete*Volume of the cube

= 2400kg/m^3*.0003375m^3

=8.1kg

d. Here,10% Wastage consider, therefore requirement of concrete for single cube = 8.1kg +. 81kg

= 8.91kg ≈ 9k

e. Total Concrete weight required for 54 cubes:= 9 * 54 = 324kg

B. Beams

I. M30 grade conventional concrete quantity 6 numbers

II. M30 for 5%, 10% and 15% fiber introduced concrete quantity 18 numbers (6 each)

24 beams are casted for flexural and shear strength test. They cast and hold in the mould for 24 hours. Afterwards cubes were preserved in water for curing. After 28 days they are taken out from water, dried and then performed flexural and shear strength test

Requirement of Dry Material

a. Volume of the cube = 500mmx100mmx 100mm

= 5000cm^3

= .005 m^3

b. Specific weight of concrete = 2400kg/m^3

c. Weight of concrete cube = Specific weight of concrete*Volume of the cone

= 2400kg/m^3*.0005m^3

=12 kg

d. 10% Wastage consider Required Weight of concrete for single beam =12 kg + 1.2 kg

= 13.2 kg

e. Total Concrete weight required for 108 beam:=13.2*72=950 kg

Total Concrete weight required for cubes and beam = 324 + 950 = 1274 kg

- For M30 grade Conventional concrete = 350 kg (approx)
- For M30 grade Fiber added concrete = 350 kg

(approx)

Table: 1 Compressive strength of conventional concrete silica fume and Fiber added concrete cubes after 28days for M30 grade

M30 Grade			
0% Fiber	**5% Fiber**	**10% Fiber**	**15% Fiber**
36.2	37.9	42.7	47.9
36.6	38.4	43.1	48.4
36.6	38.8	43.1	48.8

The results for 4-point bend test for conventional concrete cubes and fiber introduced concrete cubes are tabulated below.

The % gain in strength and % reduction of deflection due to incorporation of fibers in concrete is determined. The flexural strength increases from 7% to 30% and reduction in deflection of flexural strength from 11.9% to 20.7%

The shear strength is also one of the major important characteristic of concrete. Resistance offered by concrete towards force applied to it is called shear strength.

Table:2 Flexural strength of conventional concrete silica fume and Fiber added concrete cubes after 28days for M30 grade

silica fume %	Failure of load (KN)	Flexural strength (N/mm2)	Mean flexural strength (N/mm2)	Deflection (mm)	Mean deflection (mm)
Nil	14.97	5.98	5.99	0.085	0.085
	14.98	5.99		0.085	
	15.01	6.00		0.085	
5%	16.00	6.41	6.43	0.075	0.075
	16.10	6.44		0.075	
	16.13	6.45		0.075	
10%	18.00	7.21	7.23	0.071	0.071
	18.09	7.24		0.071	
	18.13	7.26		0.072	
15%	19.30	7.73	7.74	0.071	0.071
	19.36	7.74		0.071	
	19.38	7.76		0.071	

Table 8.9: Flexural strength of conventional concrete silica fume and Fiber added concrete cubes after 28days for M30 grade

Conventional concrete		5% silica fume introduced concrete	
Load (KN)	**Deflection (mm)**	**Load (KN)**	**Deflection (mm)**
0	0	0	0
2	0.006	2	0.006
4	0.018	4	0.018
7	0.034	7	0.034
10	0.056	10	0.056
13	0.072	13	0.072
15	0.085	15	0.08

10% silica fume introduced concrete		15% silica fume introduced concrete	
Load (KN)	**Deflection (mm)**	**Load (KN)**	**Deflection (mm)**
0	0	0	0
2	0.004	2	0.004
4	0.013	4	0.013
7	0.024	7	0.024
10	0.036	10	0.036
13	0.042	13	0.042
15	0.051	15	0.041
17	0.071	17	0.052
18.01	0.071	19.3	0.071

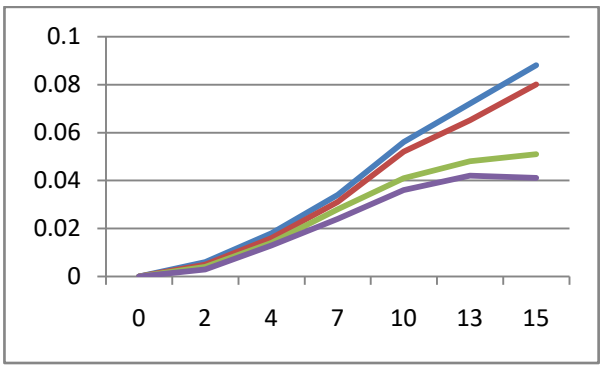

Figure-1 Comparison of Flexural strength deflection of conventional concrete silica fume and Fiber added concrete cubes after 28days for M30 grade

VI. CONCLUSION

The following conclusions have been observed from the above experiments done on concrete by adding polyethylene and tire fibers:

There is a gain of 5.20%, 17.91% and 32.71% in compressive strength after adding 5%, 10% and 15% fiber respectively of M30 grade concrete respectively after 28 days.

There is a gain of 6.43%, 7.23% and 7.74% in flexural strength and reduction in deflection 11.91%, 16.06%, 16.54%after adding 5%, 10% and 15% fiber respectively of M30 grade concrete respectively after 28 days.

There is a gain of 15.8%, 31.4% and 46.9% in shear strength and reduction in deflection 13.1%, 40.1%, 38.7% after adding 5%, 10% and 15% fiber respectively of M30 grade concrete respectively after 28 days.

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