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Experimental Study of Strength of Concrete Using Mineral Admixture Silica Fume and Added Fiber

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***Abstract*--In development industry concrete is significant material utilized these days. Concrete has better obstruction in pressure while steel has more opposition in strain. Ordinary cement has restricted malleability, low effect and scraped area opposition and little protection from breaking. To improve the pre breaking and post breaking conduct of short intermittent and discrete strands are added to the plain concrete to make it stringy cement. 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. 20% as additives for each of the concrete mixes of M30 grade as per IS 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.**

***Keywords* – Consolidated concrete, hybridization, polypropylene fiber, steel fiber, strength , characteristics, silica fumes.**

I. INTRODUCTION

Concrete is a pressure driven restricting specialist, which implies that it's a limiting specialist that solidifies when water is added. The concrete sort that is utilized today is called Portland concrete, on account of its shading which is like the shade of stone from the island of Portland[1]. The concrete is primarily comprising of four minerals which establish 90-95% of the mix. These are comprised of oxides of calcium (Ca), silicon (Si), aluminum (Al) and iron (Fe). Notwithstanding the "primary minerals" the concrete contains modest quantities of oxides of manganese (Mn), sulfur (S),potassium (K) and sodium (Na) The principle minerals in the mix impact its properties like warmth age, improvement of solidarity, the last strength and its toughness[2].. These properties might be constrained by changing the proportionality of the fundamental minerals[3].

Despite the fact that the remainder of the minerals make up a little piece of the concrete, these can effects affect the concrete's properties too. The potassium-and sodium oxides (the alkalis) are significant. They can cause the concrete to solidify quicker and make it extend[4]. At the point when the various minerals in the concrete respond with water there will be heat age. Because of this keep the substantial clammy while solidifying to stay away from drying out and breaking[5].

The aggregate is regularly assessed by its material evaluating, grain shape and shallow construction. The material evaluating implies the appropriation of various grain sizes in the total. It is alluring to have a decent dissemination of the grain estimates, that the measure of each size is roughly something very similar. This will prompt not many hollows and a low air content in the substantial which is a benefit as huge air substance will decrease the strength of the substantial. On the off chance that the hollows between the total particles are little the measure of concrete glue important to tie them together is little[6].

The grain shape and shallow construction implies how the states of the grains are. Normal total (sand, rock and rocks) is frequently adjusted and smooth, while human made total like squashed stone has sharp edges and harsh surface. Normally these boundaries are significant for filling compounds for street development, yet there are seldom necessities for these properties for concrete.

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.

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- 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 industrial applications 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:20 mm coarse aggregate=9kg:1kg

water-cement ratio = w/c = 0.45

= 0.45 * 3.2kg = 1.44 kg ≈ 1.44kg

V. Compressive Strength Test

The compressive strength test is the one of the important test performed on concrete, it determines characteristic resistance of concrete, which is the resistance of concrete against crush the load. The compressive strength of the filled cubes is tested on a compression test machine.

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	39.7	43.9	48.2
36.6	37.5	44.2	47.9
36.6	36.9	42.7	46.4

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%.

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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/mm 2)	Mean flexural strength (N/mm 2)	Deflection (mm)	Mean deflection (mm)
64.52	6.452	6.461	0.69	0.680	64.52
64.61	6.461	**5.99**	0.69	**0.085**	64.61
64.71	6.471	**6.00**	0.66	**0.085**	64.71
75.35	7.535	7.564	0.59	0.587	75.35
75.64	7.564	**6.44**	0.59	**0.075**	75.64
75.93	7.593	**6.45**	0.58	**0.075**	75.93
85.38	8.538	8.567	0.45	0.451	85.38
85.68	8.568	**7.24**	0.454	**0.071**	85.68
85.96	8.596	**7.26**	0.45	**0.072**	85.96
95.34	9.534	9.563	0.45	0.443	95.34
	19.36	7.74		0.071	
	19.38	7.76		0.071	

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 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
10	0.12	10	0.09
20	0.24	20	0.21
30	0.31	30	0.27
40	0.44	40	0.31
50	0.56	50	0.4
60	0.61	60	0.451

10% silica fume introduced concrete		15% silica fume introduced concrete	
Load (KN)	**Deflection (mm)**	**Load (KN)**	**Deflection (mm)**
0	0	0	0
10	0.06	10	0.05
20	0.11	20	0.09
30	0.17	30	0.15
40	0.21	40	0.18
50	0.29	50	0.26
60	0.36	60	0.31
70	0.39	70	0.36
80	0.43	80	0.41

VI. CONCLUSION

The theoretical values for deflection under given load are calculated for both 4-point bend test and double shear test for conventional concrete and polymer fiber reinforced concrete beams (5%,10% and 15%) for each grade and compared with the values of deflection obtained from respective experimentations when similar beam is loaded under same physical condition.

Use of non-biodegradable substance like waste polyethylene fiber is an economic and environment friendly approach to increase the strength of concrete. As we know steel fibers it is non-corrosive, light weight and has less cost. Similarly wasted tire fibers (with steel wires striped out) can be adopted efficiently in concrete effectively. These two materials together when incorporated with concrete fulfill two main requirement of cost effectiveness and reduced pollution.

It is also seen that the FRC made by using wasted materials like polyethylene and tire fiber significantly increase the strength of concrete.

The fiber introduced concrete exhibited good strength against compression, flexure and shear, three most important properties of concrete. It also made the concrete tougher and significantly reduced the deflection that it undergoes when subjected to any external loads.

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