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STRENGTH PROPERTIES OF STEEL FIBER CONCRETE BY PARTIAL REPLACEMENT OF SILICA FUME

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ABSTRACT- *Concrete mixes were prepared using M-50 grade of Portland Pozzolana Cement. Silica fume also known as micro silica is a byproduct of the reduction of high-purity quartz with coal in electric furnaces in the production of silicon and ferrosilicon alloys, which is being used as partial replacement of cement in concrete because it has more pozzolanic cementitious properties.*

The steel fibers are placed in concrete because they are used as resistance to cracking and strengthening of concrete. In this experimental work the compressive strength, split tensile strength tests were conducted by silica fume in various percentage of 5%, 7% ,10% and 15% to the weight of cement and 0.5%, 1%, 1.5% ,and 2% of steel fibers to the weight of concrete of round crimped type having aspect ratio 45.45 (length 25 & diameter 0.55) were used. Concrete cubes are tested at the age of 7, and 28 days of curing. Finally, the strength performance of steel fiber concrete is compared with the performance of conventional concrete.

Keywords— Silica fume, steel fibers, partial replacement, compressive strength.

I. INTRODUCTION

Concrete is the most widely used man-made construction material in the world. It is obtained by mixing cementitious materials, water, aggregate and sometimes admixtures in required proportions. Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape hardens into a rock-like mass known as concrete. The hardening is because of chemical reaction between water and cement, which continues for long period leading to stronger with age.

Silica fume is used in concrete because it significantly improves the properties of fresh and hardened concrete. The potential for the use of silica fume in concrete was known in the late 1940's, but the material did not become widely used until the development of another concrete technology. This parallel technology is the use of powerful dispersants known as high range-water reducing admixtures or super plasticizers. Once this chemical admixture became available and accepted, the use and development of silica fume in concrete became possible.

Concrete is most widely used construction material in the world due to its ability to get cast in any form and shape. Hence concrete is very well suitable for a wide range of applications. However concrete has some deficiencies as listed below:

1) Low tensile strength
2) Low post cracking capacity
3) Brittleness and low ductility
4) Limited fatigue life
5) Incapable of accommodating large deformations
6) Low impact strength

II. LITERATURE REVIEW

Palanisamay T and Meenambal T 2008) conducted experiment on Effect of Silica Fume on mechanical Properties of Concrete Composites. Carried out on 70 Mpa concrete with partial replacement of silica fume of 5, 10, 15, and 20% were investigated. The compressive strength, split tensile and Flexural Strength were carried out on 25 concrete mixes at the age of 28 days and compared with conventional concrete. The optimum replacement of silica fume was at 10 % that showed compressive, split tensile and Flexural Strength increased by 8%, 22% and 4.1% than control concrete.

H.Katkhuda, B.Hanaynehand, N.Shatarat conducted experiment on effect of silica fume on tensile, compressive and flexural strengths on high strength light

weight concrete. They carried out by replacing cement with different percentages of silica fume at different constant water-binder ratio keeping other mix design variables constant. The silica fume was replaced by 0%, 5%, 10%, 15%, 20%, and 25% for a water-binder ratios ranging from 0.26 to 0.42. For all mixes, split tensile, compressive and flexural strengths increased with silica fume incorporation but the optimum replacement percentage is not constant because it depends on the water- cementitious material (w/cm) ratio of the mix. Based on the result, a relationship between split tensile, compressive and flexural strengths of silica fume concrete was developed using statistical methods.

Pawadeprashant.y, et.al., studied the "influence of silica fume in enhancement of compressive strength, flexural strength of steel fibers concrete and their relationship" they investigated on concrete due to the effect of silica fume with and without steel fibers on Portland Pozzolana cement. In this study we used concrete mixes with silica fume of 0%, 4%, 8% and 12% with the addition of crimped steel fibers of two diameters 0.5mm Ø and 1.0 mm Ø with a constant aspect ratio of 60, at various percentages as 0%, 0.5%, 1% and 1.5% by the volume of concrete on M30 grade of concrete. In comparison, with control concrete the replacement of 4%,8%,12% and 16% cement by silica fume showed 7.46%, 11.17%, 11.91%, and 9.83%
increase in compressive strength at 28days of curing. The optimum combined effect at 8% silica fume and 1.5% steel fiber with normal concrete the maximum compressive strength increase at 0.5mm Ø and 1.0 mm Ø steel fiber at 28days of curing were 15.38% and 18.69%, the maximum flexural strength increase were 17.13% and 24.02%. The combined effect of silica fume at 4% & 12% with steel fiber at 0.5%, 1.0% & 1.5% of both diameters 0.5mm Ø and 1.0mm Ø at different ages of curing are presented.

III. SCOPE AND OBJECTIVE

The investigation is mainly focused to study the effect of same types of fibres with same aspect ratio on compressive strength, split tensile strength of HSC.

The content of silica fume varied from 5% to 15% by the weight of cementitiousmaterial .

Dosage of fibre was varied from 0.5% to 1.5% at an interval of 0.5% by the weight of concrete.

Type of cement, fine aggregate, coarse aggregate, type of super plasticizer are kept constant in every mix.

IV. EXPERIMENTAL INVESTIGATION

The present investigation is aimed at arriving the compressive strength of the steel fiber concrete with replacement of silica fume by considering M-50 grade after thoroughly understanding the parameters influencing the strength improvement which are designed with the help of IS: 10262-2009.

The experimental programme is divided in to three phases.

Phase I: Laboratory setup and procurement of materials.

Phase II: Replacement of silica fume to cement concrete, moulding and curing of cement concrete specimens.

Phase III: Testing procedure for evaluating the strength parameters of cement Concrete specimens

Experimental Programme

Materials Used:

The materials used in this investigation are…

- Cement
- Fine aggregate
- Coarse aggregate
- Water
- Steel fibers
- Silica fume
- Chemical Admixture

Cement:

Portland pozzolona cement

Properties of cement:

Specific gravity = 2.7

Consistency = 30%

Initial setting time = 30 min

Final setting time =10 Hours

Silica Fume:

Sl.No	property	Value
1	SiO2	99.5%
2	Al2O3	0.08%
3	TiO2	0.04%
4	CaO	0.01%
5	MgO	0.01%
6	L.O.I.	0.28%
7	ALKALIES	0.29%
8	PARTICLE SIZE	800 M

Chemical properties of silica fume

Properties of fine aggregate:

Bulk Density=1.49 g/cc

% of voids ratio=34.23%

Voids Ratio=0.58

Specific Gravity=2.28

Fineness modulus= 2.9

Properties of Coarse Aggregates:

20mm Aggregate

Bulk Density=1.44 g/cc

% of voids ratio=50.22%

Voids Ratio=1.0085

Specific Gravity=2.89

Mix proportions:

1: 1.762 : 2.377 : 0.38

Steel fibers:

Sl.No	Property	Value
1	Density of steel fiber	7850
2	Length (mm)	25
3	Diameter (mm)	0.55
4	Aspect ratio	45.45
5	Type of steel fiber	Carbon

Physical properties of steel fibers

V. RESULTS

- ***Compressive Strength of M50 grade at 7days curing***

S.No	% silica fume	% steel fiber	Avg compressive strength(Mpa)
1	5	0.5	37.77
		1	37.7
		1.5	38.29
		2	37.4
2	7	0.5	39.03
		1	38.81
		1.5	39.62
		2	37.99
3	10	0.5	37.1
		1	38.36
		1.5	38.07
		2	38.83
4	15	0.5	36.95
		1	36.1
		1.5	36.07
		2	36.43

Fig. Compressive strength of M50 grade after 7days curing

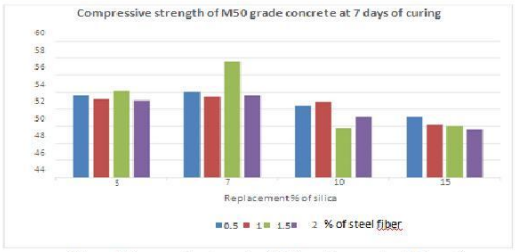

Figure 1 Compressive strength of M50 grade concrete at 7 days of curing

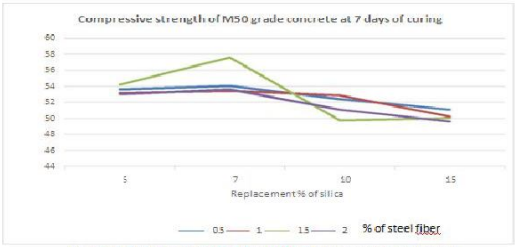

Figure 2 Compressive strength of M50 grade concrete at 7 days of curing

- ***Compressive Strength of M50 grade at 28days curing***

S.No	% silica fume	% steel fiber	Avg compressive strength(Mpa)
1	5	0.5	54.21
		1	53.18
		1.5	54.22
		2	53.03
2	7	0.5	54.07
		1	53.47
		1.5	57.62
		2	53.62
3	10	0.5	52.43
		1	52.88
		1.5	49.77
		2	51.10
4	15	0.5	51.10
		1	50.21
		1.5	50.06
		2	49.62

Fig. Compressive strength of M50 grade after 28days curing

Figure 3 Compressive strength of M50 grade concrete at 28 days of curing

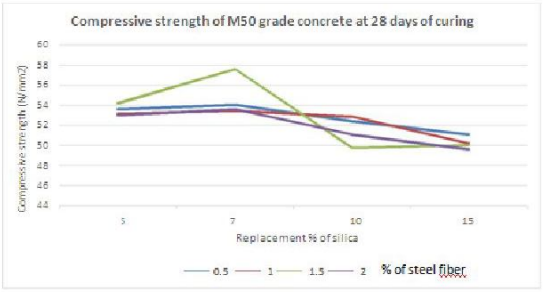

Figure 4 Compressive strength of M50 grade concrete at 28 days of curing

- ***Split tensile strength for M50 at 28 days***

S.No	% silica fume	% steel fiber	Split tensile strength
1	5	1.5	2.8
2	7	1.5	2.83

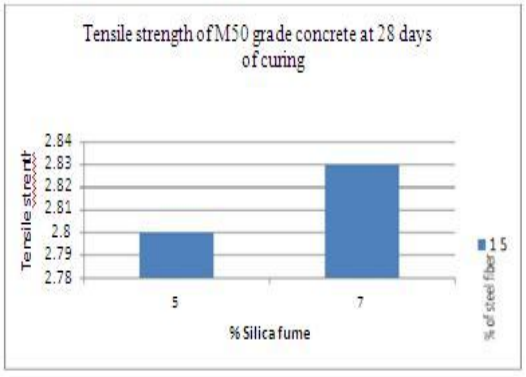

Figure 5 Tensile strength of M50 grade concrete at 28 days of curing

VI. CONCLUSIONS

When we added silica fume with steel fibers to the mixture it was observed that the weight density of the concrete is increased.

Super plasticizer with dosage range of 0.75 to 1.80% by weight of cementations materials (Cm = PPC + SF) has been used to maintain the adequate workability of silica fume with steel fiber concrete mixes.

The compressive strength increases with the increase of silica fume as compared to the normal concrete. Compressive strength get increased by addition of 7% of silica fume at 1.5% of steel fiber in normal concrete, also seen that, the increase of strength by 10% of silica fume to the replacement of cement has not much significant change on the development of compressive strength. So the maximum percentage of the silica fume on the replacement of cement should be 10% when ppc used.

There is an increase in splitting Tensile strength of cylinder concrete specimens up to 8% with the addition of silica fume and steel fibers to the concrete the flexural strength also increases with the addition of steel fibers as compared to conventional concrete.

The increases in flexural strength are directly proportional to the fiber content and also the flexural deflection decreases with increase in steel fiber as compared to the normal concrete.

Main purpose of using fibers in concrete is to eliminate or lower down the shrinkage cracks developed. It cannot be used as reinforcement but it can lower down the requirement of reinforcement.

VII. REERENCES

Concrete technology: Theory and Practice, By M.S.SHETTY, S.Chand publications.

IS: 2386-1963,"*Indian Standard Code of practice for methods of test forAggregates for Concrete*", Indian standard institution, new delhi

ACI committee, 544(2006), "*state-of-the-art report on fiber reinforcedconcrete*", *ACI 544*, 1R-82, American concrete institute, Detroit.

Balaguru P.N., and shah S.P.,(1992) "*Fiber Reinforced CementComposites*", McGraw-Hill: international Edition, New York.

Nataraja M.C., Dhang N. and Guptan A.P, (1998), "*steel fiber reinforcedconcrete under compression*", The Indian Concrete Journal, 26(3),pp353-356.

Nataraja M.C., Dhang N. and Guptan A.P, (1999),"*Stress-strain curve forsteel fiber reinforced concrete in compression*", cement and concretecomposites, 21(5/6), pp 383-390

Song P.S. and Hwang S (2004), "*Mechanical Properties of high-strengthsteel fiber-reinforced concrete" Construction and Building materials*, pp669-676