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An Experimental Investigation on Concrete by Influence of Silica Fume as Replacement and Using Admixture as Steel Fibers

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ABSTRACT: This paper shows the investigation on concrete due to the effect of silica fume with and without steel fibers on Ordinary Portland cement. In this study we used concrete mixes with Silica Fume of 10% , 15% with addition of steel hooke fibres of diameter 0.6 mm \varnothing and length 30mm with a aspect ratio of 50, at various percentages as 0%, 0.6 % , 0.8%,1.0 %1.2% and 1.5 % by the volume of concrete on M50 grade of concrete. The effect of mineral admixture as cement replacement material with and without steel fibers on mechanical properties were analyzed and compared with normal concrete as well as silica fume concrete. In comparison, with control concrete the replacement of 10%, 15% cement by silica fume showed 70.07 and 71.55 increase in compressive strength at 28 days of curing. The optimum combined effect at silica fume and 1.5% steel fiber with normal concrete the maximum compressive strength increase at 28 days of curing are 4.66.. As a result of the incorporation of steel hooke fibres, Silica fume and ordinary Portland cement has produced a strong composite with superior crack resistance, improved ductility and strength behavior prior to failure. On the basis of regression analysis of large number of experimental results, the statistical model has been developed. The proposed model was found to have good accuracy in estimating relationship at 28 days and 90 days Compressive strength with Flexural Strength.

KEYWORDS: Silica Fume, Steel fibers, steel fiber reinforced concrete (SFRC).

I. INTRODUCTION

Silica Fume is utilized as a part of cement to enhance its properties like compressive quality, bond quality, and scraped area resistance; lessens penetrability; and in this manner aides in shielding strengthening steel from erosion.



Fig: 1Silica Fume

A fiber is a small piece of reinforcing material posses certain properties by its own, where as comparing to different types of fibers, Steel fibres are most common used fiber.



Fig 2. Sample of Steel fiber used in this project

II. LITERATURE REVIEW

T.h. sadashiva murthy carried out an experimental study on the Split tensile strength of steel fibre reinforced concrete with fly ash and silica fume as binary. Test results of investigation on split tensile strength of steel fibre reinforced concrete with fly ash and silica fume as binary and ternary blend, cured up to 150 days under normal water and 5% sodium chloride solutions are presented.

Des King Hon carried out an experimental study on the effect of silica fume on the properties of concrete as defined in concrete society report 74, cementitious materials the new Concrete Society Publication, Cementitious Materials, CSTR74, covers the effects of cementitious materials - blast furnace slag (GGBS), fly ash (FA), limestone fines and silica fume (microsilica) on the properties of concrete. This paper focuses on the effects of silica fume on all the main properties of concrete in the fresh and hardened state as defined in the publication.

III. MATERIALS AND METHODOLOGY

SILICA FUME

The physical properties of Silica Fume are taken according to the **IS: 3812-part-1:2003**

Table 1 Properties of Silica Fume

Colours	Moisture content
particle size	<1µm
Specific surface	15,000 to 30,000 m ² /kg
Bulk density	695 g/cm ³
Specific gravity	2.2
Moisture content	0.78%
SiO ₂	92.83%
K ₂ O	0.26%

STEEL HOOK FIBERS

Steel hook fibers compliance to the requirements of **ASTM A 820** (type-1 cold drawn wire)

PROPERTIES OF STEEL HOOKE FIBRES

Type	:	Hooked End
Nominal Dimensions		
Diameter	:	0.60 mm
Length	:	30 mm
Aspect Ratio L/D		50
Tolerance for D/ L ± 10 %		
As per ASTM		
Yield Strength of Wire	:	> 1000 MPa
Wire Mechanical Properties		
Tensile strength of the wire	:	1450 Mpa
Strain at failure	:	< 4 %

Shape

The ending shapes of Hooked End Steel Fiber are very important to grant adhesion between fiber and concrete

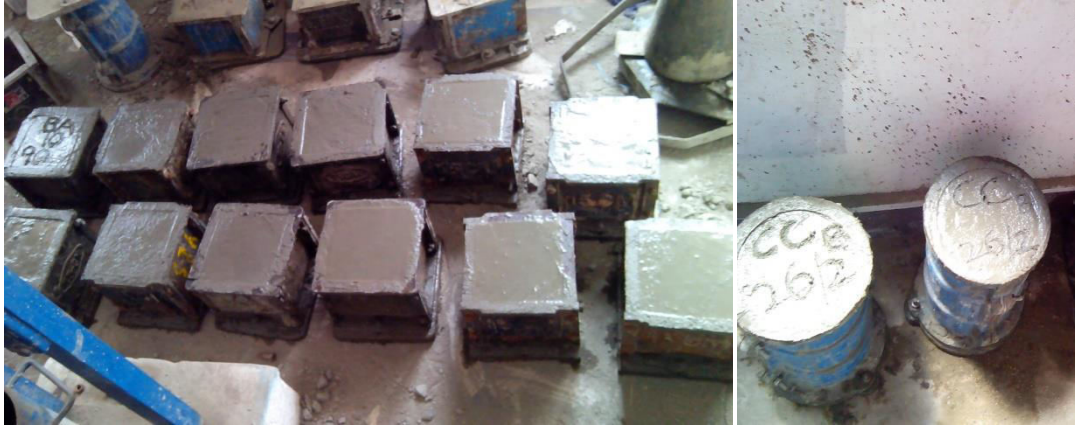


Fig 3: Sampling of concrete above figure shows casting of concrete cubes, cylinders and prisms.

Curing

Curing the concrete while hydrating, releasing high heat hydration. The heat is harmful from the point of view of volume stability. If the heat generated is removed by some means, the adverse effect due to the generation of heat can be reduced. This can be done by a through water curing. The influence of curing by bonding and wet converging



Fig4: Curing tank above figure shows a curing tank in which concrete is kept for 3, 7, 28, 56, 90 days for hydrating of concrete.

COMPRESSIVE STRENGTH TEST

Cubes with dimension of 150mm×150mm×150mm used for Compression test, durability test (acid). After 24 hours the specimens are removed from the moulds and immediately submerged in clean fresh water. After 3, 7, 28, 56 and 90 days the specimens are tested under the load in a compression testing machine.



Fig5: Cube compressive strength test the above figures shows a compressive testing machine in which compressive strength of cube is being tested.

SPLIT TENSILE TEST

As per IS specifications IS 5816:1999 Split tensile test is to be conducted. The cylinder of size is 150 mm diameter and 300 mm length are taken and cylinders were placed horizontally between the loading plate surfaces of a compression testing machine.

$$\text{Split Tensile Strength} = \text{LOAD} / \text{AREA} = 2P / \pi DL$$



Fig6: Split tensile test of cylinder

IV. EXPERIMENTAL RESULTS

Designed mixes are recommended by “the bureau of Indian standards (BIS)(IS10262-1982)”. IS-10262-2009 .

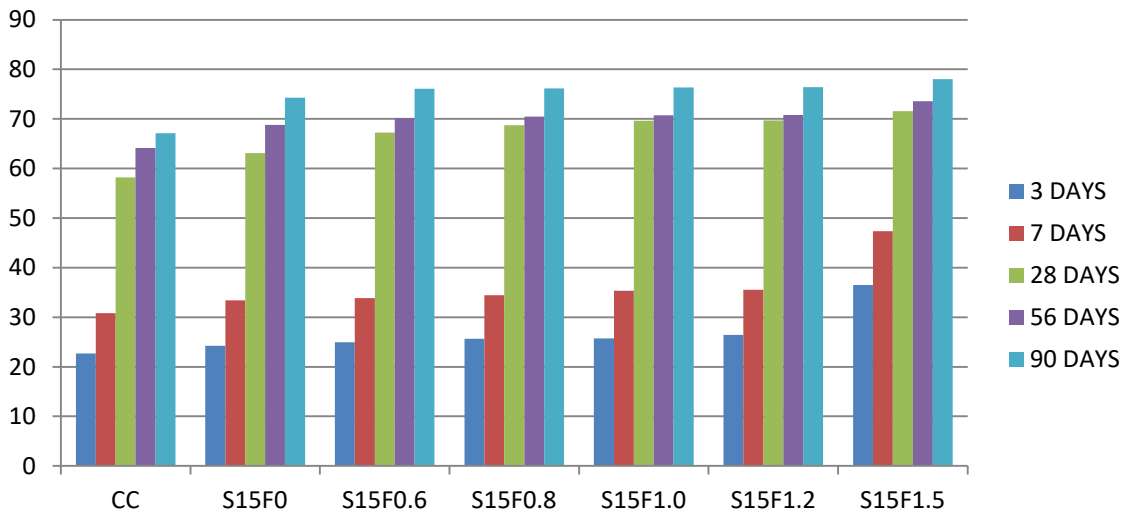
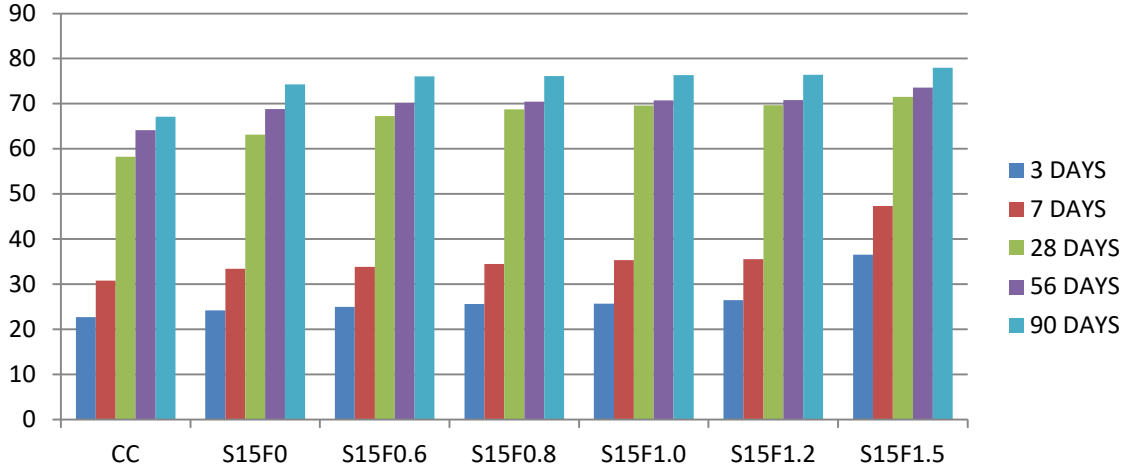
Mix Ratio : 1: 1.65: 3.05

Mix Proportion

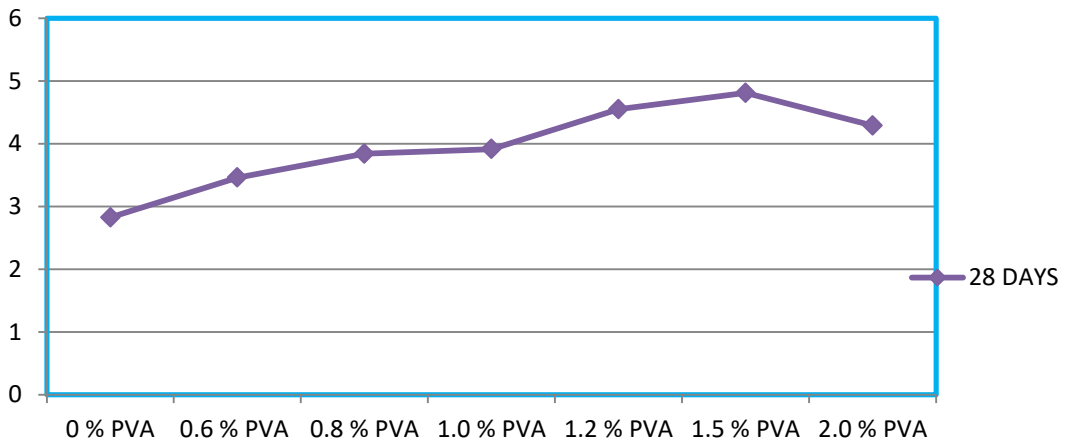
	Water	Cement	Fine aggregate	Coarse aggregate
Proportion by Weight	160kg	400	661.51	1220.19
Proportion by Ratio	0.4	1	1.65	3.05



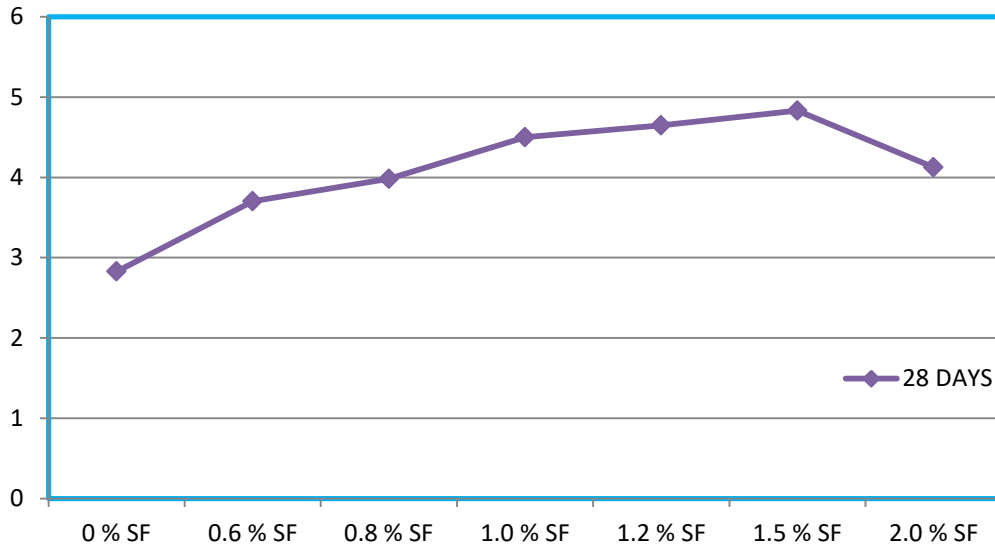
COMPRESSIVE STRENGTH



SPLIT TENSILE TEST

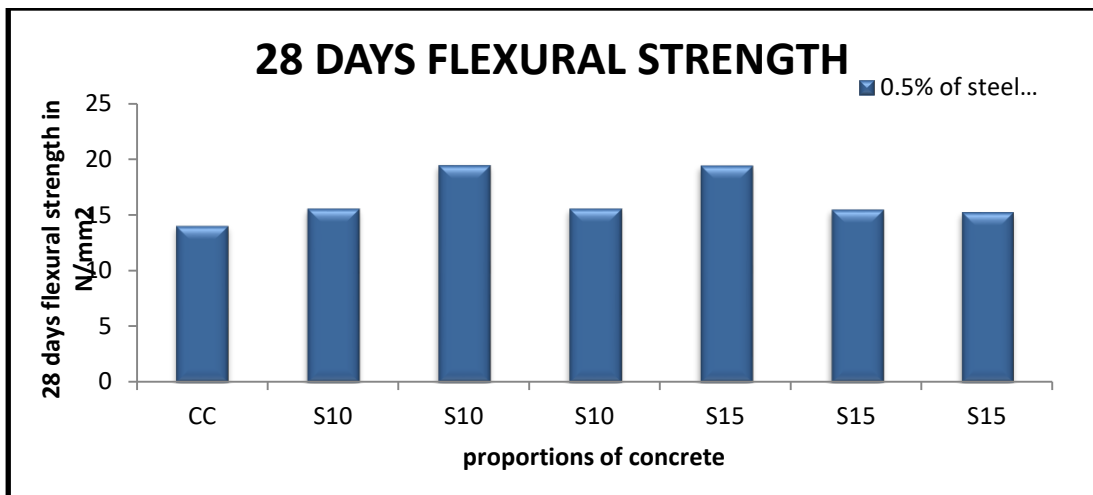


Tensile strength at 28 days for Silica fume 10 % using steel fibers



Tensile strength at 28 days for Silica fume 15 % using steel fibers

FLEXURAL STRENGTH TEST RESULTS



V. CONCLUSION

1. The weight density of concrete increase with increase in the steel fiber content.
2. The compressive strength increases with the increase in silica fume compared with normal concrete. The values that are obtained at 7 days, 28 days, 56 days and 90 days of curing for 10% of silica fume replaced by PPC cement.
3. The increase of replacement level of silica fume from 10% to 15% has much significant change on the development of compressive strength..
4. The compressive strength increases with the addition of steel fiber was marginal as compared with silica fume concrete.
6. Both the properties of concrete, compressive strength increases by addition of 0.6mm diameter steel fiber .
7. On the basis of regression analysis of large number of experimental results, the statistical model showed in figures has been developed. The proposed model was found to have good accuracy in estimating the 28 days and 90 days Compressive strength with their inter relationship at 10% , 15% Silica Fume & 0%,0.6%,0.8%,1.0%,1.2%,1.5% Steel Fibers.



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