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COMPARATIVE STUDY OF USE OF SILICA FUME AND FLY ASH ON PROPERTIES OF CONCRETE

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ABSTRACT

This paper investigates on analyzing the effects of the use of mineral admixtures such as silica fume and fly ash on the properties of concrete to get the benefit of advanced concrete technology to reduce cost. This study also includes an experimental investigation on strength characteristics of concrete mix such as compressive strength, split tensile strength and flexural strength by partial replacement of cement about 30% with silica fume and fly ash as per specified procedure of IS codes. In this experimental work M 40 grade of concrete and ordinary Portland cement was used. Concrete samples were prepared and cured for 28 days with water cement ratio of 0.4 for determination of basic properties of concrete such as split tensile strength, compressive strength and flexural strength. It also includes determination of mix proportioning with mineral admixtures (such as silica fume and fly ash). The experimental work investigates that, there is an increase in compressive strength, split tensile strength, and flexural strength, of concrete as compared to the strength of normal concrete.

Keywords: fly ash, silica fume, mix proportion, compressive strength, split tensile strength, and flexural strength.

I. INTRODUCTION

Concrete is the most widely used man-made construction material in the world, the worldwide production of cement has greatly increased since 1990, almost every civil structure includes use of concrete in it. It is obtained by mixing cementations materials, water, aggregate and sometimes admixtures in required proportions. Concrete is basically a brittle material having very low tensile strength as comparative its compressive strength. Also problems occur in bonding of old and new concrete structure. That is why most the concrete structure is reinforced with steel. Now a day's research is focused on improving the properties of concrete by using additives admixtures. Use of these make concrete improved material with certain changed physical and mechanical properties keeping its strength same. In this study concrete M40 was made using 43 grades OPC and the other mixes were prepared by replacing part of OPC with Silica Fume and fly ash. The replacement levels were 5%, 10%, 15%, 20%, 25% and 30% (by weight) for Silica Fume and 5%, 10%, 15%, 20%, 25% and 30%

(by weight) for Fly Ash.

II. OBJECTIVE

The main object of this study is to compare use of mineral mixtures of silica fume and fly ash on properties of concrete and comparing the results with usual concrete. This is aimed to find out the Compressive strength from cube, Split Tensile strength from cylinder and flexural strength from beam.

The goal of experimental work were to be developed methodology and evolve contributions with reference to following points

1. To compare the results between plain concrete and mineral admixture mixed concrete.
2. To find out compressive strength of concrete.
3. To find out split tensile and
4. To find out flexural strength of concrete.

In this experimental work for each mix of composite, a total 72 specimen of following type were prepared.

a) For compressive strength test, 3 cube of size 15X15X15 cm.

b) For split tensile test, 3 cylinders of 15 cm diameter and 30 cm length.

c) For flexural strength test, 3 beam of size 40X15X15 cm

III. MATERIALS

3.1 Cement

The cement (c) used in this experimental work is "Birala 43 grade Ordinary Portland cement" which meets the physical requirements in accordance with IS: 12269-1987 –specifications for 43 grade ordinary Portland cement was referred to test all properties of cement. The specific gravity of the cement is 3.15. The initial and final setting times were found as 78 minutes and 260 minutes respectively. Standard consistency of cement was 0.48.

3.2 Fine Aggregate (FA)

Locally available sand of Godavari river passed through 4.75 mm IS sieve is used. The bulk density of 1785 kg/m³, specific gravity of 2.6, and fineness modulus of 2.872 are determined.

3.3 Coarse Aggregate

Crushed granite aggregate available from local source of two different sizes has been used. One size 20mm (60%) and other size of 10 mm (40%) confirming to IS: 383-1970 was used. The coarse aggregates (CA) having the specific gravity value of 2.73 and fineness modulus of 20 mm is 6.97 and 10mm of 6.02 are used. Bulk density values of coarse aggregates for 20 mm and 10 mm are 1589 and 1612 kg/m^3 respectively.

3.4 Fly Ash

Fly ash (FA) is a fine powder which is a byproduct from burning pulverized coal in electric generation power plants. Fly ash is a pozzolan, a substance containing aluminous and siliceous material that forms cement in the presence of water. When mixed with lime and water it forms a compound similar to Portland cement.

3.5 Silica fume

Silica fume (SF), also known as microsilica, is an amorphus (non-crystalline) polymorph of silicon dioxide, silica. Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. It consists of spherical particles with an average particle diameter of 150 mm. Silica fume is added to Portland cement concrete to improve its strength and durability.

3.6 Water

Water fit for drinking is generally considered fit for making concrete. Drinking water has been used in this experiment.

IV. MIXTURE PROPORTION

Mix ID	C	FA	CA	w/c	Silica Fume %	Fly Ash %
Mix 1 Ordinary mortar	1	2.288	2.914	0.4	-	-
Mix 2	1	3.219	4.067	0.4	-	30
Mix 3	1	3.219	4.067	0.4	5	25
Mix 4	1	3.219	4.067	0.4	10	20
Mix 5	1	3.207	4.052	0.4	15	15
Mix 6	1	3.219	4.067	0.4	20	10
Mix 7	1	3.219	4.067	0.4	25	5
Mix 8	1	3.219	4.067	0.4	30	-

V. TESTING ON CONCRETE

Test is conducted on concrete to find out various strength characteristics at the age of 28 days. In this study, compressive test on cubes, split tensile test on cylinder and flexural test on beam were carried out on specimens. The maximum load applied to the sample was recorded on appearance of concrete and any unusual features in type of failure were noted.

5.1 Compressive Test

It was performed on cubical specimens of size 150mm X 150mm X 150mm, conforming to IS: 10086-1982.

5.2 Split Tensile Test

It was performed on cylindrical specimens of size 15 cm diameter and 30 cm length.

5.3 Flexural Test

It was performed on beam specimens of size 150mm X 150mm X 700mm.

VI. RESULT

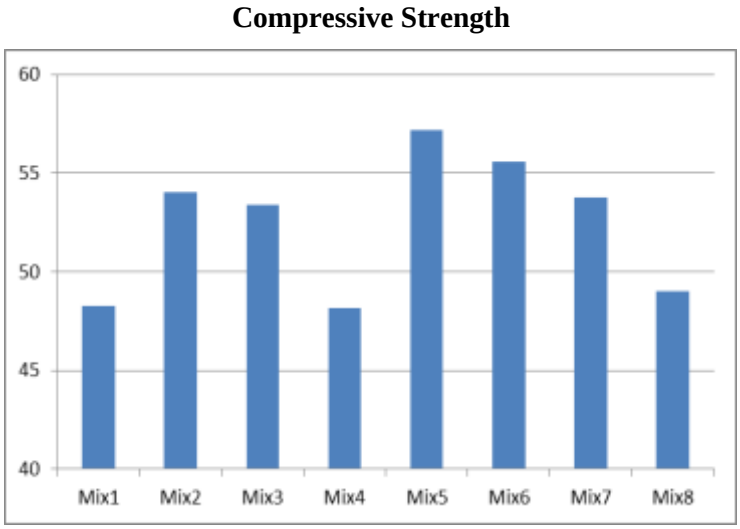

Figure 1: Compressive Strength with Mix

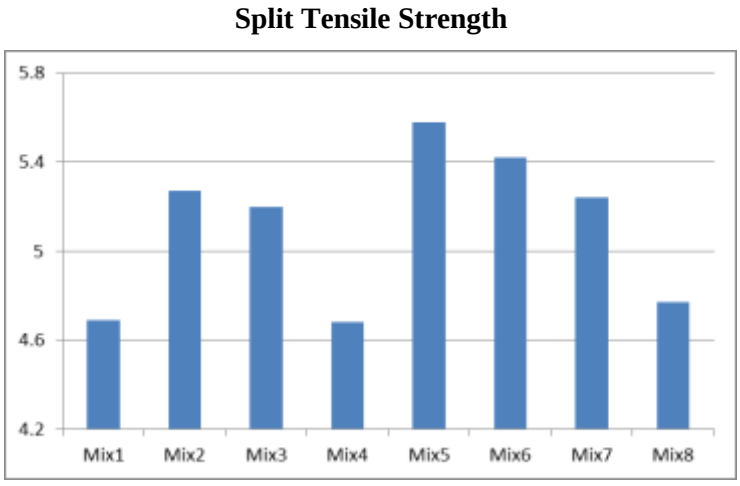

Figure 2: Split Tensile Strength with Mix

Flexural Strenth

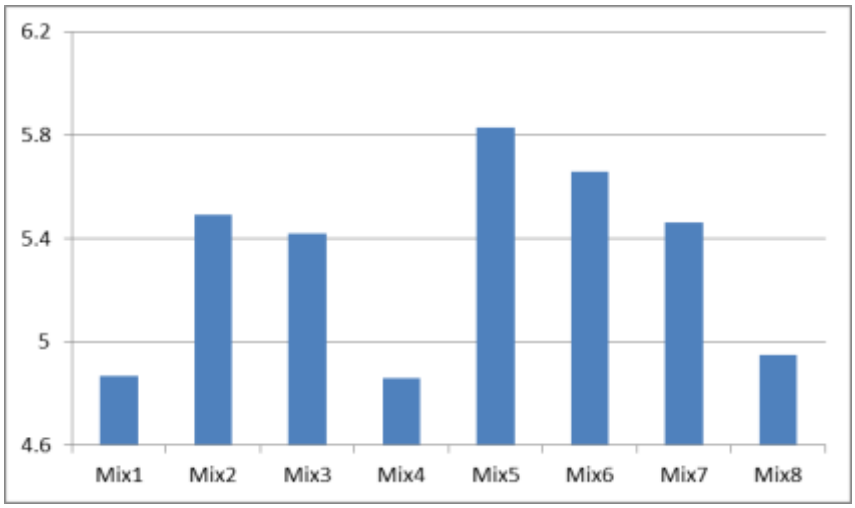

Figure 3: Flexural Strength with Mix

It is observed from the results shown in figure 1, 2 and 3 that, the compressive strength, Split Tensile Strength and Flexural Strength of the specimens at age of 28 days containing admixtures have increased for 15 % silica fume & 15% fly ash at 28 days content as compared to normal mix then it is reduced with decrease in silica fume and increase in fly ash content.

VII. CONCLUSION

From experimental results, the optimum percentage recommended as silica fume 15% and fly ash 15% (by weight) for achieving max benefits in compressive strength, split tensile strength, and flexural strength comparing to normal concrete.

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