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Investigation On Mechanical Properties of Silicafume Blended High Strength Concrete

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ABSTRACT

The study of the mechanical properties of high performance concrete mixed with silica fume aims to study the effect of adding silica fume as a partial replacement of cement on grades M60, M70 and M80 of high performance concrete.In this study, silica fume was the cement and the resulting concrete was tested for compressive strength and splitting tensile strength. The results show that the 15 percent substitution of silica fume significantly improved the mechanical properties of concrete.It is observed that as the curing time increased, the values for compressive strength and splitting tensile strength are increased. It is concluded that the optimal proportion of silica fume contributed significantly to the strength of high-strength concrete.

Keywords: Highstrength concrete, Mechanical properties, durability properties, silicafume blended HSC, split tensile strength, compressive strength

I. INTRODUCTION

A by-product of the manufacture of silicon and ferrosilicon manufacture of silicon and ferrosilicon improve the mechanical properties of concrete when used as a partial replacement improve the mechanical properties of concrete when used as a partial replacement. Combining silica fume with HSC can result in a concrete mix with significantly improved mechanical properties, including higher compressive and tensile strengths, improved durability and reduced permeability. This research aims to study the mechanical properties of high performance concrete mixed with silica research aims to study the mechanical properties of high performance concrete mixed with silica elasticity and fracture toughness of the concrete mix. In addition, the study will analyze

the microstructure of the blend, including pore size distribution, porosity and interfacial transition zone.

II. LITERATURE REVIEW

Piyush Kumar (2022), study shows that the cement has been replaced by fly ash accordingly in the range of 0%, 10%, 20%, 30%, 40%, 50%, and 60% by weight of cement and 10% of silica fume in common for M30 grade of Concrete. Concrete mixtures produced, tested and compared in terms of compressive strength and split tensile strength with the conventional concrete for 7, and 28 days. It is found that, 30% of fly ash and 10% of silica fume can be replaced and good strength obtained is comparable to the conventional concrete mix

Judita Gražulytė, Audrius Vaitkus et. al,. (2020) study reveals that Three, the same type, concrete mixtures with different amount of silica fume (0%, 7% and 10%), but the same water/cement ratio (0.4) were produced and tested in compression, tension, bending and cyclic loading. In addition to this, density was determined to identify the difference in concrete microstructure due to presence of silica fume.

Selva Priya R (2019), study shows that her research investigated the possibility of replacing part of the cement in concrete with silica fume. Tests were performed on the sample using 0%, 5%, 8%, 11% and 15% silica fume to replace cement in the composition. Concrete samples were poured and evaluated after 7 days, 14 days and 28 days of curing. The test samples were compared to a concrete control sample and statistical analysis was used to determine the ideal percentage that would provide maximum strength. The mechanical properties of concrete were improved when silica fume was used as a binder; the resulting concrete was also economical. The ideal silica fume content for concrete has been found to be 11%.

Dhanraj Wadekar, et al (2017), study reveals The main parameter examined in this study is M40 concrete with partial replacement of cement by silica fume at 0%, 3.5% and 5%. This paper presents a detailed experimental study of compressive strength at 7, 21 and 28 days of age. The effect of silica fume on various concrete properties is also tested. This paper provides a goal to understand the effect of silica fume on concrete for high strength mix design.

Overall, the literature review suggests that SF can be aneffective additive to enhance the mechanical properties ofHSC. However, further research is needed to investigate theoptimal SF content, as well as its long-term performance andsustainabilityaspects.

OBJECTIVES AND SCOPE OF INVESTIGATION

The aim of the study is to investigate the mechanical properties of high-strength concrete mixed with silica fume, a by-product of the production of silicon and ferrosilicon alloys. The study aims to analyze the effect of 15% silica fume on the mechanical properties of the concrete, such as compressive strength and cleavage strength. The research also aims to identify the optimal amount of silica fume that can be added to the concrete mix to increase its strength while ensuring its durability and workability. The results of this research can provide valuable insights into the use of silica fume as a sustainable and cost-effective alternative to traditional concrete admixtures for high-strength concrete applications.

III. EXPERIMENTAL INVESTIGATION

COMPRESSION TEST :

Compression testing is a widely used method of measuring the compressive strength of concrete. In this test, a cylindrical or cubic concrete specimen is placed between two steel bearing plates or blocks and an axial compressive load is applied along the length of the specimen until it fractures. The load is applied at a constant rate until the specimen fails, typically indicated by a sudden drop in the applied load. To perform the compression test, the concrete sample is placed horizontally between the two aligned steel

support plates or blocks to ensure that the load is applied axially along the length of the sample. The load is then applied at a constant rate until the specimen fails and the maximum load applied to the specimen is recorded. The compressive strength of the specimen is calculated using the following formula:

Compressive Strength = P/A

WherePisthemaximumloadappliedtothespecimen,and Aisthecross-sectional areaofthespecimen.

Fig1: Compression Test

SPLIT TENSILE STRENGTH TEST:

The split test is a common method for measuring the tensile strength of concrete specimens. In this test, a cylindrical or prismatic concrete body is subjected to an axial load over its length until it breaks. The load is applied through two steel bearing plates or blocks placed at the ends of the specimen. To carry out the splitting test, the concrete sample is placed horizontally between the two steel support plates. The load is applied at a constant rate until the sample breaks. During the test, tensile stress is distributed along a plane perpendicular to the applied load, dividing the specimen in half. The maximum load applied to the sample is recorded and the splitting tensile strength is calculated using the following formula:

Splitting tensile strength = $\frac{2P}{\pi DL}$,

where P is the maximum load applied to the sample, D is the diameter of the cylindrical sample or the shorter side of the prismatic sample, and L is the length of the sample.

Fig2: Split Tensile Test

IV. TEST RESULTS AND ANALYSIS

Compression Strength Test:

The compressive strength test is carried out on a sample with cube sizes of 10 cm x 10 cm x 10 cm. In this experiment we use a nominal size of aggregate of 10 mm. This test is performed to calculate the compressive strength of the hardened concrete. This is one of the destructive tests of hardened concrete. We test cubes after curing with a time interval of 7, 14, 28 and 56 days. The compressive strength test refers to the characteristic properties of the concrete.

Table 1: Compressive strength

Grade of Concrete used	Duration for Testing			
	7days (Mpa)	14days (Mpa)	28days (Mpa)	56days (Mpa)
M60	47.75	63.42	71.26	76.80
M70	53.94	71.37	79.32	85.42
M80	59.89	80.09	88.89	95.45

As we know, when the grade of concrete increases, the compressive strength also increases. Here M60

has 76.80 MPa compressive strength but M70 and M80 has 85.42 MPa and 95.45 MPa respectively. It is observed that increase of compressive strength is resulting when increasing the grade of concrete.

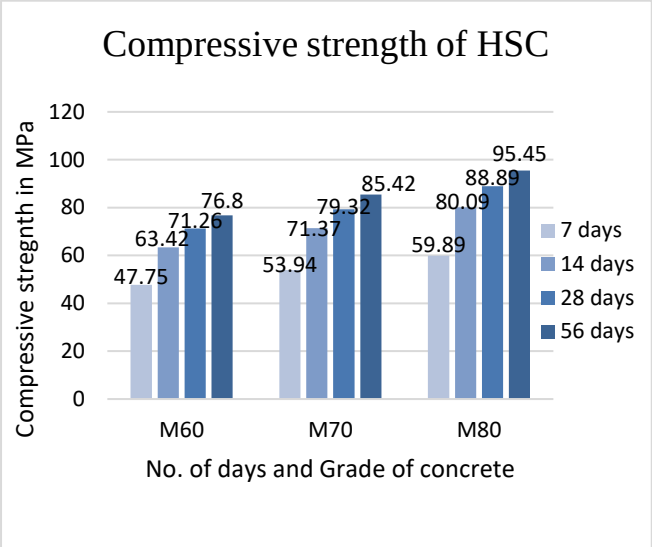

Fig3: Compressive strength

Split Tensile Strength Test:

The cylindrical concrete specimens are taken to test. The weights of specimens are to be noted. The metal strips are placed above and below the specimen while placing for testing at the testing machine. The loading is gradually applied. Table 2 shows the results of split tensile strength of cylindrical specimens for different curing periods of 7,14,28 and 56days.

Table2: Split Tensile Strength

Grade of Concrete used	Duration for Testing			
	7days (Mpa)	14days (Mpa)	28days (Mpa)	56days (Mpa)
M60	2.07	2.75	3.59	4.40
M70	2.07	3.43	4.21	5.01
M80	3.28	4.25	4.37	5.18

Here M60 has got 4.40 MPa for 56 days of curing but in the case of M70 and M80 the split values are increased when compared to M60 grade's split values. We can observe that the higher grade of concrete and more curing period are resulting high split tensile strength.

V. CONCLUSION

- It is clearly understanding that the compressive strength is increasing with respect to increasing of curing periods.
- We have clearly observed that M60, M70 and M80 grade mixes are resulting high compressive strength for 56days curing period i.e., for M60. M70 and M80 are 76.80MPa, 85.42MPa and 95.45 MPa respectively.
- Split tensile values are increasing with increasing of curing periods when grades of concrete are increasing.
- Split tensile strength for M60 is 4.4 MPa for 56days but incase of M70 and M80 are 5.01 MPa and 5.18 MPa respectively.

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