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Utilization of Steel Fibre in Corporation with Silica Fume in Concrete

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Abstract: Now a days, many investigations and experiments are currently going on to prepare a high strengthed and durable concrete by the addition of different types of materials. This research represents the influence of silica fume and steel fibers on normal concrete and will also help in achieving the outstanding results.
The concrete mix adopted were M35 with varying percentage of the silica fume ranging from 0%, 2.5%, 5%, 7.5% & 10% in the partial replacement of cement weight and stainless steel fibers of diameter and length 0.50 mm and 40 mm respectively at various percentages ranging from 0%, 0.5%, 1.5%, 2.5% & 3% by weight of the concrete. On the analysis of the test results the normal concrete with silica fume and straight steel fibers has enhanced the performance of composite mixture as compared to the ordinary concrete with conventional silica fume and steel fibers which were easily available in the market. These sustainable improvements or modifications could be easily adopted in the regular constructions.
Keywords: Silica Fume, Stainless Steel Fiber, Cement, Compressive Strength

I. INTRODUCTION

Plain concrete has two major deficiencies - a low tensile strength and allow strain at fracture. The tensile strength of concrete is very low because plain concrete normally contains numerous micro cracks. The rapid propagation of these micro cracks under applied stresses is responsible for the low tensile strength of material.BThese deficiencies have lead to considerable research aimed at developing new approaches to modifying the brittle properties of concrete. Current research has developed a new concept to increase its ductility and energy absorption capacity as well as to improve overall durability. The fibers are bonded to the material, and allow the fiber reinforced concrete to withstand considerable stresses during the post-cracking stage. The actual effort of the fibers is to increase the concrete toughness. In present study we use silica fume with fibre reinforcement concrete by replacing cement with silica fume for 2.5, 5, 7.5 and 10 % percentage for M35 mix design and various percentage of steel fibre like 0.5 %, 1.5 %, 2.5 % and 3 % but main focus on the study is to check the strength criteria by using steel fibre.
The uses of silica fume in the concrete have attracted the attention of researchers throughout the World .The following are the objectives of using silica fume in concrete:

1) To investigate the behavior of steel fibre reinforced with silica fume concrete under various loading conditions
2) To determine the effect of silica and steel fibre on the compressive strength of concrete.

II. LITERATURE REVIEW

(Kayali, 2004) showed that the Steel fibers at the rate of 1% by volume of concrete resulted in the highest gains in the strength of high volume fly ash concrete reported in these tests. The strength of the concrete in compression was more than double that without fibers. The tensile strength benefited in a similar manner especially when compared with the concrete that neither contained fly ash nor fibers.
(Koksal et al. 2008) showed that the compressive strengths of concretes produced by additions of both steel fiber and silica fume had higher than the ones containing only silica fume. A considerable increase in the splitting and flexural tensile strengths of the concretes was obtained by using silica fume and steel fibers together. There were no more changes on toughness of concretes containing 5% and 10% silica fume at 0.5% and 1% steel fiber volume fractions. However, a decrease in toughness of concrete with 15% silica fume content for each steel fiber volume fraction was seen in comparison with 5% and 10% silica fume contents.
(Rashad et al. 2014) showed that the Irrespective of Fly ash (Zero), incorporation 20 % of equally combination of Silica Fume and slag (i.e. 10 % SF and 10 % slag) in high volume fly ash concrete gave the highest compressive strength and abrasion resistance at 7 and 28 days.

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(Ghutke & Bhandari, 2014) concluded that Portland cement can be partially replaced by silica fume. The main objective of this research work is to determine the optimum replacement percentages which can be suitably used under the Indian conditions. It has been seen that when cement is replaced by silica fume compressive strength increases up to certain percentage (10% replacement of cement by silica fume).But higher replacement of cement by silica fume gives lower strength.

III. METHODOLOGY

A. *Materials Used & Its Properties*

1) *Cement:* Ordinary Portland cement (OPC) is by far the most important type of cement. Ordinary Portland cement of 43 grade of ultratech cement is used in this experimental work and collected from nearby market.
2) *Aggregates:* It should be passed through IS Sieve 4.75 mm. It should be hard, strong, dense, durable and clean. . It confirms to IS 383-1970 which comes under Zone I. Collected from nearby construction. It should confirm to IS 2838(I). Collected from nearby construction
3) *Water:* Water should be free from acids, oils, alkalies, vegetables or other organic impurities. It is collected from concrete lab.
4) *Silica Fume:* Silica fume or Micro silica is co-product of the ferrosilicon and silicon alloy industry which is very rich in amorphous silicon dioxide nearly 90%. It is collected from Buildcon Infra-Chemical Technology in Faridabad.
5) *Steel Fibers:* Fibers are generally utilized in concrete to manage the plastic shrink cracking and drying shrink cracking. Stainless steel wire of 0.5 mm diameter has been used in the preparation of SFRC. The fibre of 40mm in length has been used giving optimum aspect ratio of 80.

B. *Testing of Materials*

The properties of the different materials are to be used for making the specimens for the experimental studies. The data is useful to classify the cement, sand, coarse aggregate, silica fume and steel fiber. These values will be used for further studies for the calculation of mix design. These values also confirm the right type and quality of the materials used.

Testing of Specimens

1) Compressive strength test

Fig.1 Compressive Testing Machine

IV. RESULT AND ANALYSIS

A. *Compressive Strength*

The compressive strength was conducted on various specimens as per the guidelines given in IS 516-1959. The compressive strength of plane mortar has been obtained as 15.65Mpa for 7 days and 29.45 Mpa after 28 days. This strength has been obtained as 19.14 Mpa, 22.41 Mpa, 21.02 Mpa, 19.43 Mpa for 0.5, 1.5, 2.5 and 3.0 percent fibre contents respectively in the case of Steel fibre reinforced concrete (SFRC) for 7 days and 31.92 Mpa, 32.00 Mpa, 34.38 Mpa, 33.41 Mpa for 28 days . It has been observed that the compressive strength of SFRC is initially higher then plane concrete and decrease as the percentage of silica fume and steel fibre

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increases. This is due to the fact that the total length of fibre increases enormously with consequent improvements in crack control toughness and compressive strength.

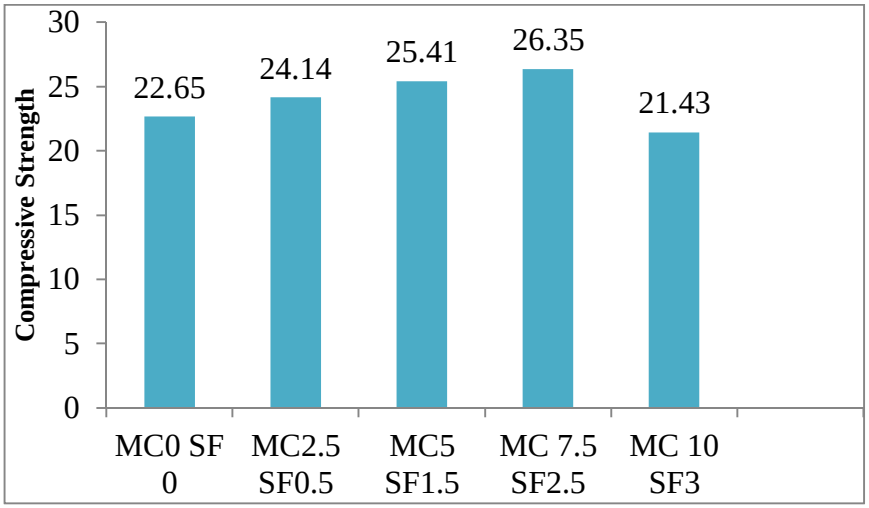

Fig. 2 Compressive Strength 7 Days

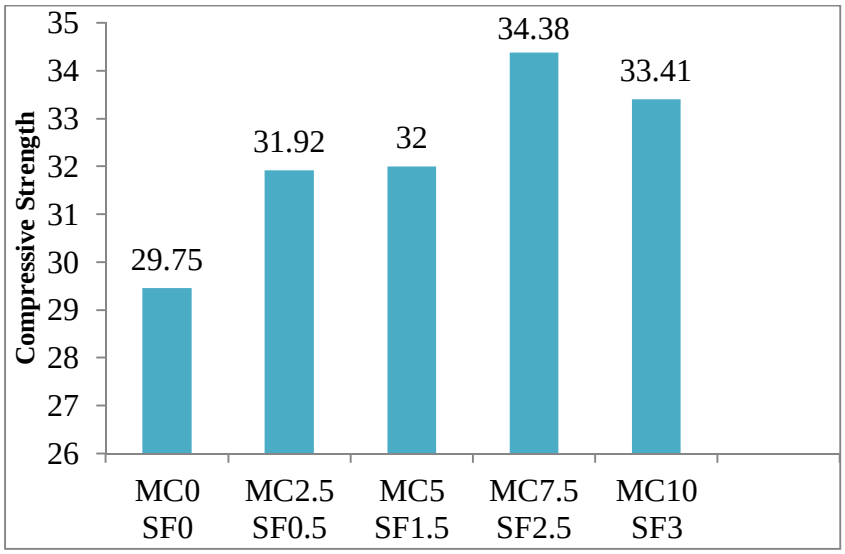

Fig. 3 Compressive Strength after 28 Days

These results show that Stainless Steel fibre possesses good compressive behavior with some amount of silica fume and helps in improving the properties of M35 concrete.

V. CONCLUSION

The present investigations have been undertaken to study the behavior of SFRC with silica fume under loading conditions. The results are compared with those obtained by other researchers and a good agreement between the two has been exhibited. From the results of the present investigation the following conclusion may be drawn:-

A. The Experimental work shows that properties of concrete M35 get improved due to incorporation of steel fibres with silica fume.

B. It can be concluded that the compressive strength after 7 days of SFRC gets increased up to 26.35 Mpa with 2.5 % addition steel fibres and 7.5 % of silica fume content as compared to plain concrete.

C. It can be concluded that the compressive strength after 28 days of SFRC gets increased up to 34.38 Mpa with 2.5 % addition steel fibres and 7.5 % addition of silica content as compared to plain concrete.

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D. While testing the specimens, the plain cement concrete specimens have shown a typical crack propagation pattern which leaded into splitting of beam in two-piece geometry. But due to addition of steel fibres and silica in concrete cracks gets ceased which results into the ductile behaviour of SFRC.

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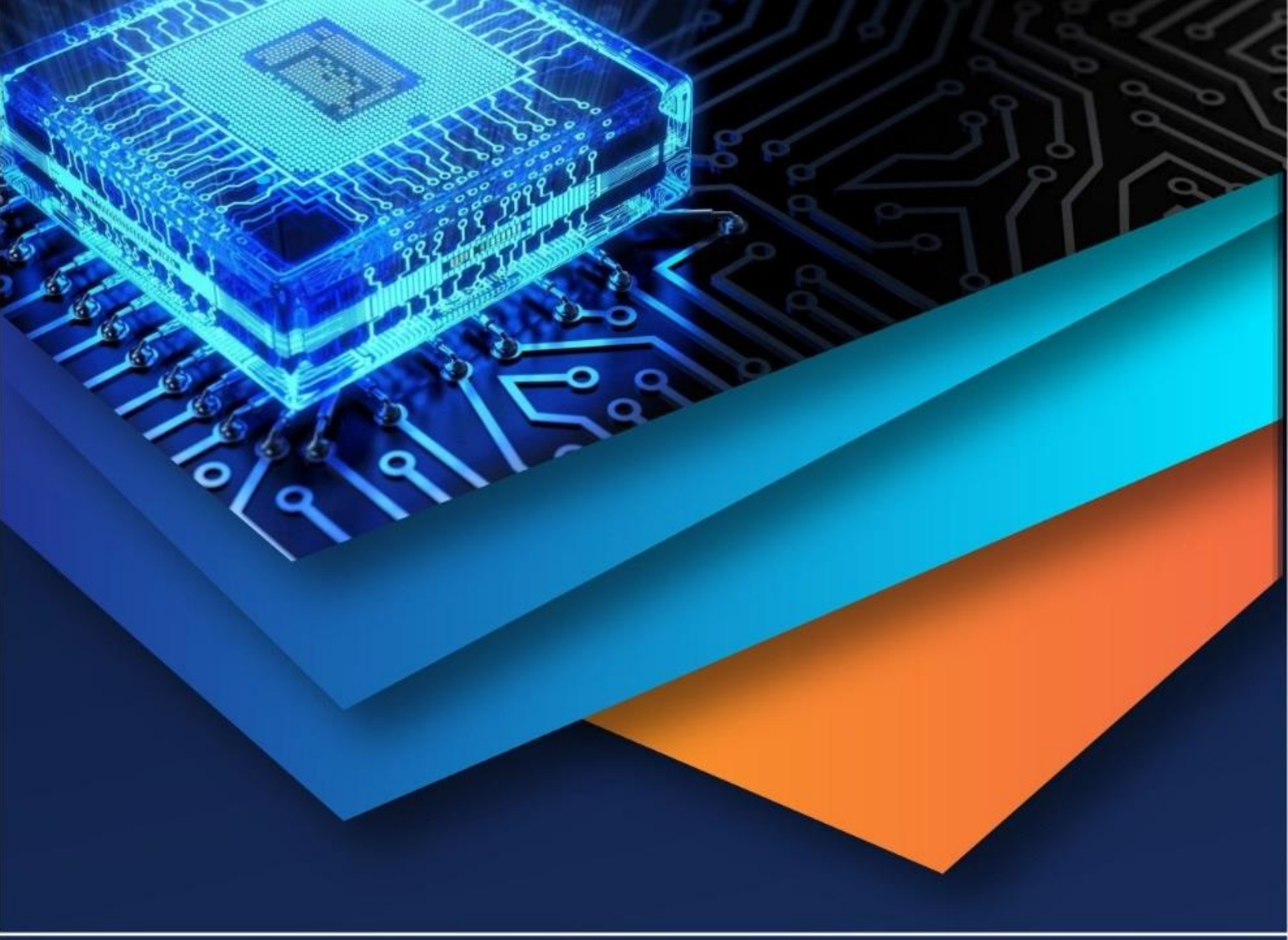

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