Behavior of Concrete using the Hybrid Fiber with and without Fly Ash

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Abstract

The effect of addition of mono fibers and hybrid fibers on the mechanical properties of concrete mixture is studied in the present investigation. Besides cubes and beams of M30 grade concrete were cast with 5 and 10 % of fly ash and different percentages of steel fiber and polypropylene fiber and hybrid fibers respectively, by volume of cement and identifies fiber combinations that demonstrate maximum compressive and flexural strength of concrete. Finally we obtained that by addition of fiber and mineral admixture the concrete increase their properties as compare to normal concrete mass. Super plasticizer was also used in all mixes to make concrete better in workability.

Keywords: Fibrous Concrete, Hybridization, Polypropylene Fiber, Steel Fiber, Hybrid Fabric, Orthodox- Fiber, Strength Properties, Fly-Ash

I. INTRODUCTION

To improve the pre cracking and post cracking behavior of concrete short discontinuous and discrete fibers are added to the plain concrete to make it fibrous concrete. The infrastructure needs of our country is increasing day by day and with concrete is a main constituent of construction material in a significant portion of this infra-structural system, it is necessary to enhance its characteristics by means of strength and durability. Concrete is a relatively brittle material. Addition of fibers to concrete makes it a more ductile material. It is obvious that the behavior of HFRC depends on the aspect ratios, orientations, geometrical shapes, distributions and mechanical properties of fibers in concrete mixtures. From a brittle to a more ductile material.

II. LITERATURE REVIEW

R.H. Mohankar et al. (2016) studied on hybrid fiber reinforced concrete and concluded that the addition of small closely spaced and uniformly dispersed fibers (steel and polypropylene) to concrete would act as crack resistor and would substantially improve its properties. HFRC can be used to resist seismic effects in structure, the floors additionally act as foundation slab that is bracing and carrying the entire building load.

M Vadivel and R Venkatasubramani (2016) researched on Robustness Study of Hybrid Fiber Reinforced Concrete with Steel and Synthetic Fiber and concluded that the strength of hybrid fibers reinforced concrete with a combination of steel and Polyester fiber. Mix design for M40 concrete was adopted and hybrid fibers were added at a volume fraction of 0.5%. Control specimen and three hybrid fiber composites were cast using various fiber proportions of steel and polyester.

S. Eswari (2015) researched on the strength and ductility performance of hybrid fiber reinforced concrete specimens having different proportions of steel (S) and polyester (P) fibers and concluded that the parameters of investigation included modulus of rupture, ultimate load, service load, ultimate and service load deflection, crack width, energy ductility and deflection ductility. The test results show that a proportion of S60P40 hybrid fibers improve the performances appreciably.

M Tamil Selvi and Dr. T S Thandavamoorthy (2013) researched on Studies on the Properties of Steel and Polypropylene Fiber Reinforced Concrete without any Admixture and concluded that the durability properties of M30 grade of concrete reinforced individually with 4% of steel and polypropylene fibers, respectively, as well as with hybrid fibers consisting of 2% steel and 2% polypropylene fibers, respectively, and to evaluate their strength at 7, 28, and 90 days.

Sayal Tarun et al. (2013) studied on workability and Compressive Strength of Steel Polypropylene Hybrid Fiber Reinforced Self-Compacting Concrete and they introduced Self compacting concrete (SCC) is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement.

S C Patodi and C V Kulkarni (2012) researched on Performance Evaluation Of Hybrid Fiber Reinforced Concrete Matrix concluded that to use different volume fractions of Recron 3S fibers (polyester fibers) and continuously crimped steel fibers to produce HFRC and thus to evaluate its performance under compression, tension, flexure, shear and impact types of loading.

III. OBJECTIVES

The main objective of the study is to investigate the change in characteristics strength properties and workability of concrete mixed with different percentage of fly ash with fibers proportions like mono fibers and hybrid fibers.

IV. MATERIALS

In this study, materials used are ordinary Portland cement, fine aggregate, coarse aggregate, steel fibers, polypropylene fibers and fly ash. The Ordinary Portland cement of 43 grade confirming to IS 8112-1989 manufactured by Ultra Tech Company was used in this experimental work. Cement with specific gravity 3.12 was used for the preparation of test specimens. There are different type of cement; out of that have used 43 grade ordinary Portland cement (OPC). Initial and Final setting time of cement respectively is 90 min and 360 min. Broken stone from the local quarry of size 20 mm and 10 mm in the ratio of 60:40 respectively confirming to IS: 383-1970 has been used as coarse aggregate. The specific gravity of 10 mm and 20 mm coarse aggregate were taken as 2.72 and 2.74 respectively. Water absorption for 10 mm and 20 mm aggregate were 0.17 and 0.15 % respectively. Fineness modulus of 10 mm and 20 mm were 2.31 and 2.65 respectively. Locally available river sand of zone II conforming to IS 383-1970 with specific gravity 2.69, water absorption 1.82 % and fineness modulus 2.86. Clean and portable water from tape was used for mixing of concrete and curing the concrete as per IS: 456-2000 in the entire experimental program. Fly ash is one of the most extensively used by-product materials in the construction field resembling Portland cement. It is an inorganic, non-combustible, finely divided residue collected or precipitated from the exhaust gases of any industrial furnace. Steel fibers with Hooked end & Flat crimped were used in the mixes. The steel fibers had a length of 50 mm and a diameter of 0.75mm (an aspect ratio of 100). The density of the fibers was 7.65 g/ cm3 and the young's modulus was 210 GPa. Fibrillated 20 mm cut length fibers were used. Polypropylene fiber had a length of 20 mm and a diameter of 1mm (an aspect ratio of 100). The specific gravity of polypropylene fiber is 0.9. Super plasticizer was also used in all mixes to make concrete better in workability.

V. METHODOLOGY

Following test were conducted on prepared samples as per relevant IS code of Practice and results are tabulated from Table- 5.1

- Slump cone Test - The slump test is prescribed by IS: 456 (2000), ASTM C 143 90A and BS 1881 Part 102:1983. This is a test used extensively in site work all over the work.
- Compressive Strength Test - Test for compressive strength is carried out either on cube or cylinder. Out of many test applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not.
- Flexural Strength Test - The flexural strength of concrete prism was determined based on IS: 516 –1959. Beam specimens of size 100 mm x 100 mm x 500 mm were casted. The samples were de-molded after 24 h from casting and kept in a water tank for7 days and 28 days curing. The specimens were placed in UTM and tested for flexural strength.
- The mix proportion of 1: 1.73: 2.72 using I.S. code method with water cement ratio .45 to get a characteristic strength of M30, was considered for this study. The parameters varied were fiber content vary 0-4% as additives and fly ash 5 to 10 % by weight of cement. The cement, fine aggregate, coarse aggregate, steel fiber and fly ash were tested prior to the experiments and checked for conformity with relevant Indian standards.

VI. RESULTS AND DISCUSSION

The results indicate that the variation of compressive strength of the concrete with various different mix samples. Compressive strength of the concrete is maximum in 4% of steel fiber reinforcement with 5 % of fly ash replace with cement and there is a slight decrease in 2% steel fiber reinforcement with 5 % of fly ash. The flexural strength of the concrete is maximum in 4% fiber reinforcement and there is a slight decrease in 2% fiber sample. The variation of strengths of the concrete with partial replacement of fly ash with different % of fiber is shown in figure 6.1.

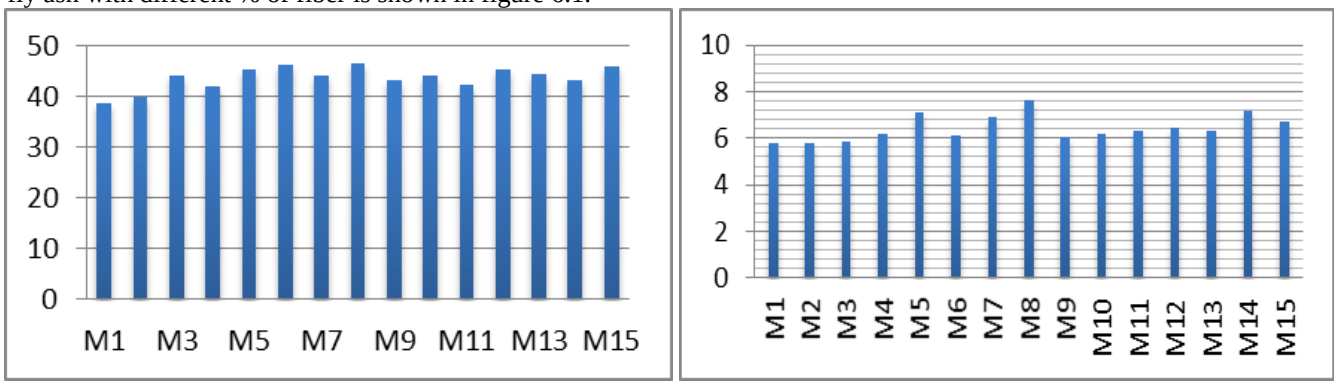

Fig. 6.1:

VII. CONCLUSIONS

From the above points it can be concluded that fiber reinforcement is very effective for improving the strength characteristics, cracking and workability of the concrete. Therefore the performance of the concrete will be improved if proper design and construction methodology is adopted.

The maximum compressive strength of specimen after 28 days is 46.44 N/mm² with 4% of hybrid fibers (polypropylene and steel) with 5% of fly ash with comparisons of normal concrete and other mix. It is 20.34 % increase overcome with normal concrete.

The maximum compressive strength of specimen after 28 days is 45.93 N/mm² with 4% of hybrid fibers (polypropylene and steel) with 10% of fly ash with comparisons of normal concrete and other mix. It is 19.02 % increase overcome with normal concrete.

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