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Strength Parameters of Hybrid Fibers with GGBS and Flyashusing Concrete

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Abstract—This paper was investigated on the feasibility and usage of hybrid fiberson concrete with partial replacement of GGBS and flyash and test its mechanical properties. Medium strength concrete was adopted and M40 grade was fixed. Cubes, Cylinders and prisms were cast and placed for curing and tested on their 28th day. Mechanical properties include Compression, Splitting tension and flexure. Hybrid fibers was replaced in percentages such as 0, 0.5%,1%,1.5% and Cement was partially replaced by Fly ash and Ground Granulated Blast furnace Slag (GGBS) varied up to 30% by weight of cement. . All tests and discussions are discussed better.

Key Words: Steel Fiber, Polypropyene Fiber, GGBS and Flyash

I. INTRODUCTION

Concrete is the most often used material by the community. It is obtained by mixing cementitious materials, water, aggregate and sometimes admixtures in required proportions.. Concrete is much stronger in compression than it is in tension. Concrete less brittle and prone to cracking is to add fibers. Because fibers are strong in tension, they help prevent crack growth and stabilize the concrete against shrinkage. They also increase the impact and abrasion resistance of the concrete. A variety of different types of fibers can be used in concrete, including steel, glass, plastic, and cellulose. Steel fiber offers good tensile strength, ultimate strength, flexural strength, ductility and crack arrest. Polypropylene fiber when added to concrete reduces the compressive strength, but increase both spilt tensile strength and flexural strength. They are more porous compared to the plain concrete. When fibers are added to concrete it becomes homogeneous, isotropic and transforms it to ductile material. The addition of pozzolanic materials along with super plasticizer in a fiber reinforced concrete. The materials like Fly ash and Ground Granulated Blast furnace Slag (GGBS) are used for the partial replacement of cement. Thus concrete becomes inexpensive and eco-friendly.

II. LITERATURE REIVEW

Patodi et .al.,[1] studied the mechanical properties of hybrid fiber reinforced concrete with recron 3s fibers and steel fiber with fiber content ranging from 0 to 1% by volume of concrete and thus to evaluate its performance under compression, tension, flexure, shear and impact types of loading.The improvement in mechanical properties of a matrix having volume fraction hybridization of 0.3% Recron and 0.7% of steel fibers was found to be the best. **Davidovits and Sawyer [2]** used ground blast furnace slag to produce geopolymer binders. This type of binders patented in the USA under the title 'Early High-Strength Mineral Polymer', was used as a supplementary cementing material in the production of precast concrete products .**Eswari et. al., [3]** present a study on ductility performance of hybrid reinforced concrete. The influence of fiber content on the ductility performance of hybrid reinforced concrete specimens having different volume of fractions was investigated. 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 the addition of fiber improves the ductility performance of concrete. **Mohammad Adnan Farooq**, **et. al., [4]** presents the work done to determine the influence of change in Fiber volume fraction and Fiber aspect ratio on workability property of green concrete as well as on the compressive, flexural and split tensile strength properties of hardened concrete. Fiber content were varied by 0.25%, 0.50%, 0.75%, 1%, 1.5%, 2%, 2.5% and 3% by volume of cement. Results showed that, as the fiber content in concrete increases, the strength also increases up to a certain extent. The optimum Fiber content is 1%.

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III. EXPERIMENTAL PROGRAM

The following materials are used for our experiment in M40 grade concrete:

A. ***Cement:***

Ordinary Portland cement of specific gravity equaling 3.145 was used as binder material. Cement qualifies the Indian specifications as per IS **12269:1987.**

B. ***Coarse Aggregate:***

Crushed angular granite material was used as coarse aggregate for our investigation. The sizes vary between 10mm and 20mm by the sieve analysis and fineness of 7.45. The specific gravity was found as 2.65 and bulk density of 1556Kg/m^3 by IS 383:1970.

C. ***Fine aggregate:***

Finely sieved river sand conforming to IS 383:1970 was used as fine aggregate with a specific gravity of 2.55 and fineness modulus of 2.95 and bulk density of 1717.64Kg/m^3.

D. ***Steel fibers***

steel fibers are using in constructions. Only straight and round cross sectional steel fibers were used in the beginning. Though remarkable improvements in toughness and ductility were obtained, problems in mixing and workability were encountered. These problems were overcome with the advent of deformed steel fibers and high range water reducers. Now a day's steel is the most commonly used fiber type for concrete reinforcement, with the exception of asbestos fibers.

E. ***Polypropylene fibers***

Synthetic fibers have attracted more attention for reinforcing cementitious materials in the recent years. In this part emphasis is given on polypropylene fibers, as they were used throughout the experimental program. Polypropylene fibers were suggested as an admixture to concrete in 1965 for construction of blast-resistant buildings for the U.S Corps of Engineers. Results of this research work showed that polypropylene fibers could be practical for reinforcing concrete, since polypropylene is cheap, abundantly available, and possess a consistent quality. Considerable improvements in strain capacity, toughness, impact resistance, and crack control of concrete can be obtained through the use of polypropylene fibers.

F. ***Ground Granular Blast furnace Slag(GGBS)***

The blast furnace slag is a by-product of the iron manufacturing industry. Iron ore, coke and limestone are fed into the furnace and the resulting molten slag floats above the molten iron at a temperature of about 1500^{o}C to 1600^{o}C. The molten slag has a composition of about 30% to 40% SiO_2 and about 40% CaO, which is close to the chemical composition of Portland cement. After the molten iron is tapped off, the remaining molten slag, which consists of mainly siliceous and aluminous residue is then water-quenched rapidly, resulting in the formation of a glassy granulate. This glassy granulate is dried and ground to the required size, which is known as Ground Granulated Blast furnace Slag (GGBS).

G. Fly ash is also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. Ash which does not rise is termed bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants and together with bottom ash removed from the bottom of the furnace is in this case jointly known as **coal ash**.

H. ***Water:***

Potable fresh water conforming to IS 456:2000 was used throughout the project.

I. ***Casting details:***

Casting was carried out with the selected materials in proper mix proportions. The Indian Standards IS 10262: 2009 was used as a guidelines for proportioning. Hybrid fibers was replaced for fine aggregate in percentages of 0, 0.5%, 1%,1.5% by weight of cement.The specimens were taken under the guide lines of IS 516:1999. Cylinders of 150mm diameter and 300mm height, prisms of size 100mm x 100mm x 500mm and Cubes of size 150mm x 150mm x 150mm were adopted. Concrete was prepared in proper proportions under clean dry environment. They are poured into the specimen in three layered compaction and demoulded 24 hours after casting. They are placed in curing tank undisturbed till the day of testing. The mix proportions are tabulated below in Table 1.

Table 1- Control Mix proportions

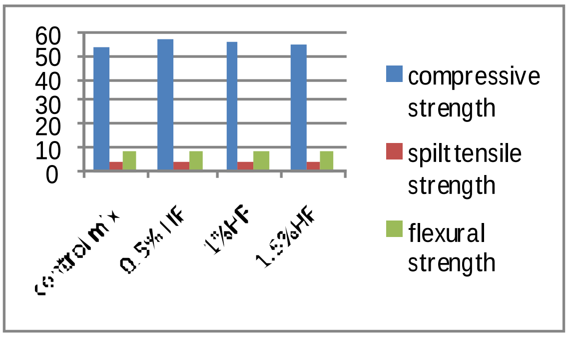
Cement (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)		Hybrid fibers (Kg/m^3)	Water (litre/m^3)+ Admixture (Kg/m^3)
		20mm	12mm		
420	716.51	566.61	552.02	-	168

G. ***Testing:***

Specimens were taken from the curing tank on their 28th day testing. They are taken and placed in a dry environment for 4 hours and wiped well. Cubes and cylinders were tested on Compression testing Machine. Prisms were tested in flexure Testing Machine with a simply supported end conditions and two-point loading setup. The various test results are tabulated below in Table 2.

Table2 – Strength characteristics of M40 concrete

Mix type	Compressive strength(N/mm^2)	Spilt tensile strength(N/mm^2)	Flexural strength(N/mm^2)
Control concrete	**53.7**	**4.02**	**8.9**
mix-1 0.5% hybrid fibers	**56.3**	**4.64**	**9.0**
mix-2 1% hybrid fibers	**55.7**	**4.8**	**9.3**
mix-3 1.5% hybrid fibers	**54.7**	**4.78**	**8.9**



IV. **DISCUSSIONS AND CONCLUSION**

Addition of Hybrid fibers has both positive and negative impacts on concrete. Initial addition of the above promotes good results in compression. The concrete was less workable since copper slag has a great demand for water. Hence, Admixtures are highly advisable. Further investigations may be done for 56 days and 90 days.

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