Behavior of Combined Effect on Natural and Artificial Fiber in Concrete

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Abstract- *Fibers are generally used as resistance of cracking and strengthening of concrete. In this project, I am going to carry out test on hybrid fiber reinforced polymer that is combination of Artificial fiber and Natural Fiber (Coconut fiber) to check the influence of fibers on strength of concrete and other mechanism. According to various research papers, it has been found that Hybrid fibers give the maximum strength in comparison to other fiber reinforced polymer. Hybrid fiber reinforced concrete with different proportions going test for compressive strength, split tensile and flexural strength . With the same grade of concrete hybrid fiber reinforced cubes, flexural beams specimens were cast in different proportions Hence, in this project I was interested in finding the effect of hybrid fibers in concrete. An experimental investigation on the behavior of concrete specimens reinforced with Asbestos fiber, Polypropylene fiber and Coconut fibers and subjected to Tensile ,compressive and flexural loading is presented.*

Keywords- Coconut Fiber, Asbestos Fiber, Polypropylene Fiber Compressive Test, Tensile Test, Flexural Test.

I. INTRODUCTION

Concrete is one of the most versatile building materials. The advantages of using concrete include high compressive strength. The strength, good fire resistance, high water resistance, low maintenance, and long service le disadvantages of using concrete include poor tensile strength, low strain of fracture and formwork requirement and the major disadvantage is that concrete develops micro cracks during curing. It is the rapid propagation of these micro cracks under applied stress that is responsible for the low tensile strength of the material and tend to reduce durability.

To overcome these limitations, fiber incorporation in concrete is preferable alternative. The addition of fibers dispersions to the concrete mix improves mechanical characteristics of concrete e.g., fracture strength, toughness, impact resistance, increase ductility, increase impermeability. And adhesion capacity of material. It is well established that the properties of fiber reinforced cement based composites are dependent on the characteristics of the fiber and fiber matrix. The interaction between the fiber and matrix is the fundamental property that affects the performance of cement-based composites. The fiber contributes to both composite strength and stiffness. The amount and nature of contribution depends on the fiber type, fiber volume and matrix properties.

A. Crushed Sand

Asbestos has a host of physical properties that make it almost a superstar in the world of industrial chemistry. Its tensile strength surpasses that of steel. It has tremendous thermal stability, thermal and electrical resistance and is non-flammable. It can be subdivided into fine fibers that are strong enough and flexible enough to be spun into material that is a flame retardant, chemically inert thermal and electrical insulator. Note that asbestos binds with better insulating materials to create the ultimate construction materials. Physical and chemical properties of asbestos (as with many other materials) can be altered; e.g., heat resistance of asbestos fiber is a very important characteristic; it can produce more interesting results, however, when it is combined with other types of materials. When asbestos fibers are subjected to a temperature of 1,200°F, their tensile strength values are extremely high. In comparison, tensile strength values of organic and inorganic fibers are complete destroyed or melt between 200 and 900°F

B. Coconut Fiber

Coconut fibre is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fibre is Coir, Cocosnucifera and Arecaceae (Palm), respectively. There are two types of coconut fibres, brown fibre extracted from matured coconuts and white fibres extracted from immature coconuts. Brown fibres are thick, strong and have high abrasion Although it is a cheap and efficient a major hindrance towards its wide scale use is the high rate of water absorption, which can be reduced by coating it with oil.The advantages of coconut fibre are :low cost, reasonable specific strength, low density, ease of availability, enhanced energy recovery, biodegradability, ability to be recycled in nature in a carbon neutral manner, resistance to fungi moth and rot, excellent insulation to sound, flame,

moisture and dampness, toughness, durability, resilience. There are many general advantages of coconut fibres.

C. Polypropylene Fiber

Polypropylene fibers were first suggested for use in 1965 as an admixture in concrete for construction of blast resistant buildings meant for the US Corps of Engineers. Sub-sequently, the polypropylene fiber has been improved further and is now used as short discontinuous fibrillated material for production of fiber reinforced concrete or as a continuous mat for production of thin sheet components. Further, the application of these fibers in construction increased largely because addition of fibers in concrete improves the tensile strength, flexural strength, toughness, impact strength and also failure mode of concrete.

II. EXPERIMENTAL DESIGN, MATERIALS AND TEST RESULTS

A. Experimental Design

A total of six concrete mixtures were investigated in this study. One mixture consisted of a plain that is commonly used in projects. The other five mixtures were made by modifying the control mixture with the addition of fibers to it. The materials used for this project was obtained from sources that are Reliable sources to the construction Industry. All concrete mixtures developed for this project were made with the consideration of I.S. 10262(2009). To Study the strength of concrete cube Containing hybrid fibers with fixed 1% (CF-AF) & 0.33% (PF-CF) proportions by weight of Cement.

B. Materials

The raw materials used in this project were obtained from sources and suppliers that are approved by various Bodies in India. Portland cement from a single source was used to eliminate discrepancies and variations in material properties. The fine and coarse aggregates were also obtained from a single supplier and obtained in one batch.. The fibers were obtained from a verified source. Tables 1,2 list the materials and fibers used in this project along with their suppliers.

Table 1

	Material	Supplier
Cement	OPC – 53 Grade	J.K laxmi Cement
Coarse Aggregate	10 mm, 20 mm	Local area bodies
Fine Aggregate	Crushed Sand	Local area bodies near Vadodara.
Water	Tube Well	-

Table 2

	Material	Supplier
Fiber	Polypropylene Fiber	Zeinth fiber co.pvt Ltd Vadodara
Fiber	Asbestos Fiber	Asbestos fiber supplier vadodara
Fiber	Coconut Fiber	Local area

C. Mixture Proportions

All mixtures were proportioned to comply with the I.S code provisions for minimum required workability and strength. It should be noted that no attempt was made to optimize the mixture containing fibers in order to isolate the fiber's effect on concrete properties. A Single dose of fibers were used, while it was further varied in proportions in this project. A dosage of 1% CF-AF and 0.33% PF-CF by weight of cement was used for mixtures. Mixture CC was a control mixture with no added fiber content. The general mixture proportion is given in Table 4 and 5.

Table 4

Mix	Proportion of fibers in total fiber content (1%) by weight of Cement.	
	Coconut Fiber.	Asbestos Fiber.
A1	100	0
A2	90	10
A3	80	20
A4	70	30
A5	60	40
A6	50	50

Table 5

Mix	Proportion of fibers in total fiber content (0.33%) by weight of Cement.	
	Polypropylene Fiber	Coconut Fiber.
M1	100	0
M2	75	25
M3	50	50
M4	25	75
M5	0	100

D. Specimens Fabrication

A set of three specimens per testing sequence was prepared for all tests and mixtures. A 150 x 150 x 150 mm specimen Cubical in shape complying with I.S Code 10086:1982 was used for measuring the compressive strength and 150mm x 300mm height cylinder in shape used for split tensile strength. A 500 x 100 x 100 mm specimen Rectangular in shape complying with I.S Code 10086:1982 was used for measuring the flexural strength.

E. Mix Design

The mix design is made in conformance to I.S. 10262:2009. The proportions of fiber being added in concrete are tabulated in table 6. As per the design a primary mix of plain concrete was prepared.

Table 6

Water	Cement	Proportions comes out as Coarse aggregate	Fine aggregate
197.16	438.13	1082.013	663.169
Ratio			
0.4	1	2.19	1.34

III. LABORATORY TESTS

Several laboratory tests were conducted to determine the mechanical properties and cracking performance, which are discussed in this section. The compressive strength and flexural strength were used to determine the mechanical properties.

A. Compressive Test

The compressive strength test for the different mixtures was carried out in accordance with I.S. 516:1959. A 150 X 1510 X 150 mm Cubical specimen was used for this test. The test was carried out at three ages, specifically at 7-days, 28-days. Three specimens were used for each test and the average value was calculated from the test results. The specimens were cured in a water bath until they were tested.

Table 7 Combination of CF-AF fibers

Sr.no	Sample no.	Compressive strength	
		7 days	28 Days
1	A0	16.78	28.68
2	A1	17.8	32.56
3	A2	17.6	33.68
4	A3	18.78	36.58
5	A4	18.92	37.58
6	A5	22.31	44.69
7	A6	20.36	42.45

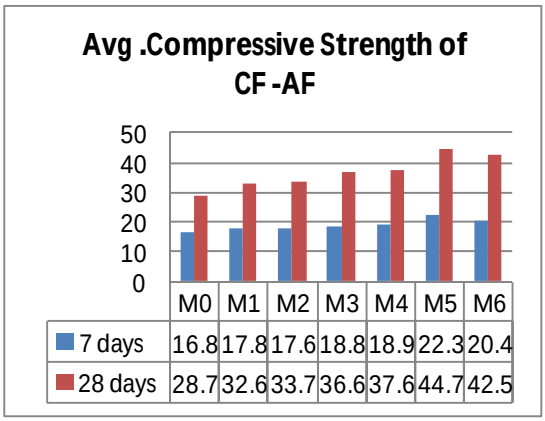
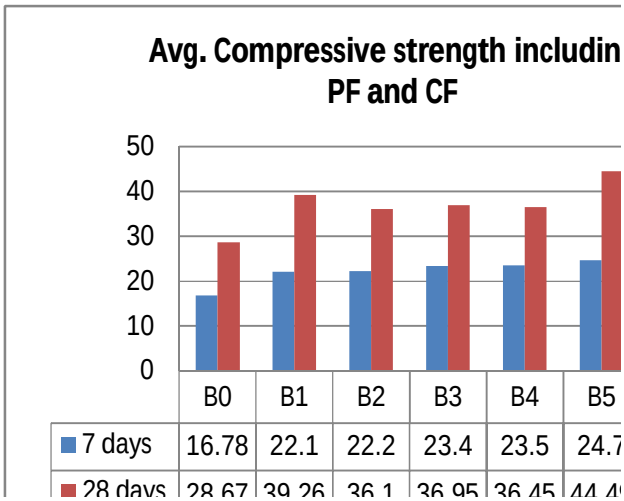


Table No: 8 Compressive strength including PF and CF

Sr.no	Sample no.	Compressive strength	
		7 days	28 Days
1	B0	16.78	28.69
2	B1	22.1	39.26
3	B2	22.2	36.1
4	B3	23.4	36.95
5	B4	23.5	36.45
6	B5	24.7	44.49



C. Split tensile strength of concrete

The split tensile strength of concrete is determined by casting cylinders of size 150 mm X 300 mm. The cylinders were tested by placing them uniformly. Specimens were taken out from curing tank at age of 7, 28 and 56 days of moist curing and tested after surface water dipped down from specimens. This test was performed on Universal Testing Machine (UTM). The magnitude of tensile stress (T) acting uniformly to the line of action of applied loading is given by formula

T= 0.637P/dl
Where,
T = Split Tensile Strength in MPa
P = Applied load,
D = Diameter of Concrete cylinder sample in mm.
L =Length of Concrete cylinder sample in mm.

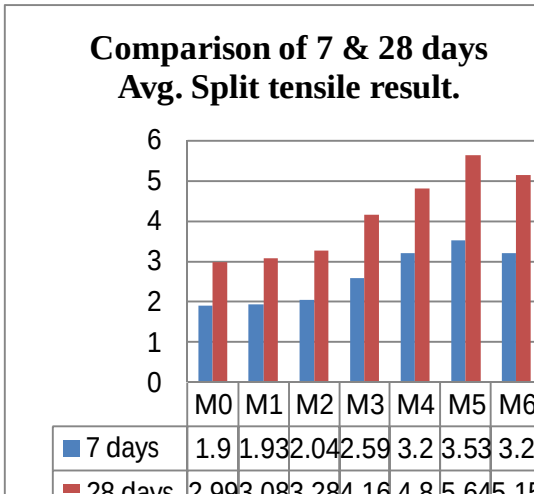
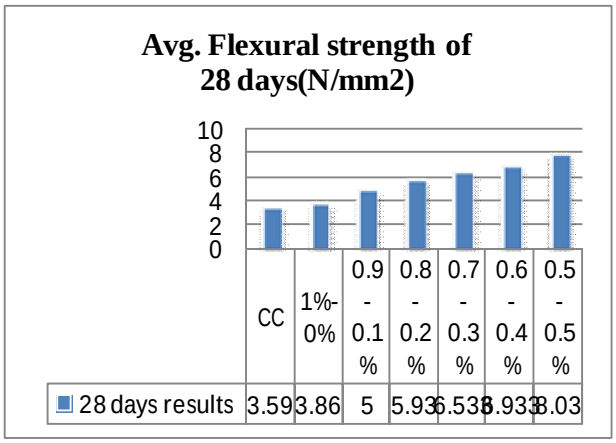


Fig.3 Split Tensile Strength of Concrete for Different Combination CF-AF

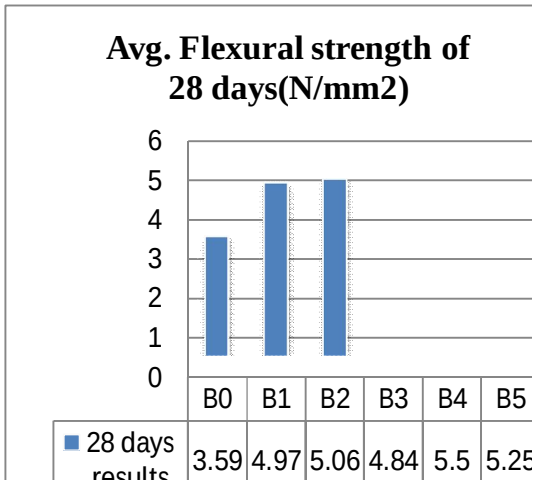
D. Flexural strength of concrete

The Flexural Test for the Beam specimens was carried out in accordance with I.S. 516:1959. One- point loading method was used, where the setup was made on the universal testing machine. Universal Testing Machine having capacity of 60 Tonnes with Micro Data Acquisition System was used. The test was carried out for two ages 7 and 28 Days

Flexural Strength of Concrete for Different Combination CF-AF



Flexural Strength of Concrete for Different Combination PF-CF



IV. CONCLUSIONS

1. At 0.6-0.4% (CF-AF) with a water cement ratio of 0.45, compressive strength tests yielded best results. However, the compressive strength decrease on further fibre addition with proportion . But there is increase in compressive strength with mix A5 with the increment of 55.18%. Hence there is an optimum value of fibre to

cement ratio, beyond which the compressive strength decreases.

2. In Addition of PF-CF fibers to concrete can increase the early age compressive strength by up to 48%. Furthermore the age at cracking can be more than doubled by just adding 0.3% volume of polypropylene fibers. Other fibers can also be used for intermediary effects. Coconut fibers are found to provide residual strength, however they are also prone to deterioration due to corrosion.
3. For coconut fiber as it can be susceptible to corrosion if water seeps through it, it was not seen during the 28 days test after the specimens were removed from water that coconut fiber has been deteriorated or corroded. But from safety point of view it must be used for less important works.
4. It is also seen that at this percentage of fiber (0.33%) the micro-structure cracking or shrinkage cracks are not seen/ rare as compared to conventional.

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