ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.5

Comparison of properties of Fiber Mix Reinforced Concrete & Conventional Concrete

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Abstract:
Fibres have played a dominant role for a long time in a variety of applications for their high specific strength and modulus. They can be effectively controlled cracking and use the concrete with crack free and also increase the overall properties like compressive, ductility, flexural, quality of the concrete. Fiber-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented, which are resistant to most chemical attacks. Hence in this project Polypropylene fibres, Polyester fibres and Natural fibre (Coir) were used which are cheap and easily available type of fibres. In this project the scope and objective of the work has been finalized, the properties of materials such as cement, fine aggregate, coarse aggregate and fibre that are going to be used in the specimen preparation were determined and the values have been tabulated. The concrete cubes and beams are prepared and the strength properties such as compression strength and flexural strength are to be determined and compared with the conventional concrete.

Keywords: Natural fibres, Polypropylene, Polyester, Fiber-reinforced concrete.

I. INTRODUCTION:

Concrete is a construction material composed of cement as well as other cementetious materials such as fly ash and slag content, aggregate (generally a coarse aggregate such as gravel, limestone, or granite, plus a fine aggregate such as river sand), water, and chemical admixtures. Fibers are usually used in concrete to control plastic shrinkage cracking and drying shrinkage cracking. They also lower the permeability of concrete and thus reduce bleeding of water. Some types of fibers produce greater impact, abrasion and shatter resistance in concrete. The promise of thinner and stronger elements reduced weight and controlled cracking by simply adding a small amount of fibres is an attractive feature of fibre-reinforced concrete. The quality of good and durable concrete does not depend only on the quality of raw materials but also on proper mix-design, use of admixtures, placement, vibration and efficient curing. A number of additives are being used with concrete to enhance structural properties. The amount of fibres added to a concrete mix is measured as a percentage of the Cement. Weight of fiber fraction typically ranges from 0.1 to 3% of cement weight. Fibres include steel fibres, glass fibres, synthetic fibres and natural fibres – each of which lends varying properties to the concrete. In addition, the character of fibre-reinforced concrete changes with varying concretes, fibre materials, geometries, distribution, orientation, and densities.

Natural fibres are low cost and abundant. They are no hazardous and renewable. In this project natural fibre is coconut husk (coir). It can be used in place of asbestos. It increases toughness and flexural strength. It also induces good durability in concrete.

Polypropylene is one of the cheapest and abundantly available polymers. Polypropylene fibres are resistant to most chemical attacks and increase the flexural strength, compression strength as well as reduce the creep in concrete.

Polyester is also one of the cheapest and abundantly available polymers. Polyester fibres are resistant to most chemical attacks and increase the flexural strength, compression strength and workability is also good as compare to polypropylene fibre.

II. PREPARATION OF CONCRETE MIX:

For **conventional concrete**: Proportioning of raw material was done for M20 concrete, produce of making concrete of desired quality and under assumed conditions of mixing, placing and curing.

For **Polyester Fiber concrete:** Proportioning of raw material was done for M20 concrete, produce of making concrete of desired quality and under assumed conditions of mixing, placing and curing. Weight of coir **is taken as 0.25% by weight of cement.**

For **Polypropylene Fiber concrete**: Proportioning of raw material was done for M20 concrete, produce of making concrete of desired quality and under assumed conditions of mixing, placing and curing. Weight of coir **is taken as 0.25% by weight of cement.**

For **Natural fiber concrete(coir):** Proportioning of raw material was done for M20 concrete, produce of making concrete of desired quality and under assumed conditions of mixing, placing and curing. Weight of coir **is taken as 2% by weight of cement.**

III. TESTS PERFORMED ON VARIOUS FRC:

Following tests were performed on concrete mix prepared by mixing different proportions of different fibers:

(1) Slump Test
(2) Compaction Factor Test
(3) Compressive strength Test
(4) Flexural strength Test

Workability Test for Concrete-

American Concrete Institute (ACI) Standard 116R-90 defines workability as "that property of freshly mixed concrete which determines the ease and homogeneity with which it can be mixed, placed, consolidated, and finished." [ACI 116R (1990)]

Slump Test

Workability is the measure of the ability of concrete to be mixed, handled, transported, placed, and consolidated. Slump test is used to determine the workability of fresh concrete. Slump test is performed per IS: 1199 – 1959 is shown in table no.1.

Table 1: Slump of different concrete type

S.NO.	Concrete Type	Slump
1.	Conventional Concrete	60mm
2.	Coir reinforced Concrete	10mm
3.	Polypropylene Reinforced Concrete	20mm
4.	Polyester Reinforced Concrete (Recron 3S)	45mm

Compaction Factor Test

Compacting factor of fresh concrete is done to determine the workability of fresh concrete by Compacting factor test as per IS: 1199 – 1959. From Compaction factor Apparatus specified in IS: 1199-1959, all four concrete mixes were tested for workability & results are shown in table no.2.

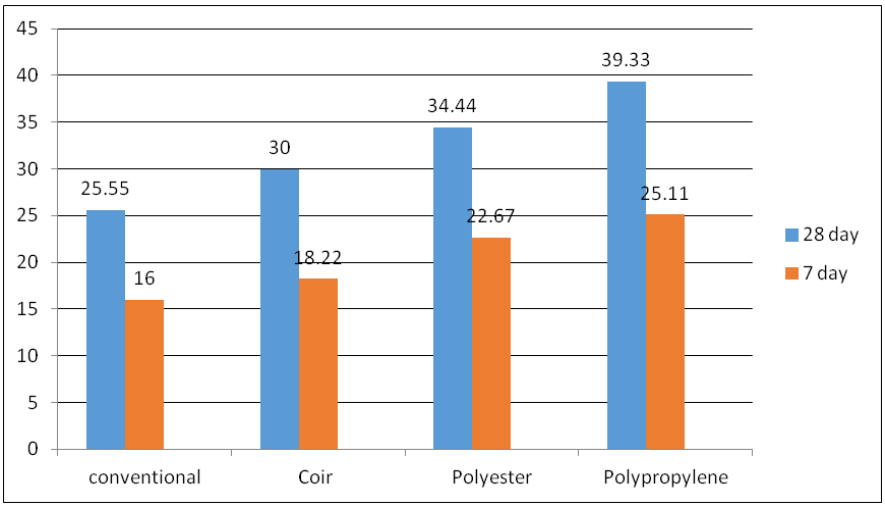
Table 2: Compaction Factor for different concrete type

S.NO.	Concrete Type	COMPACTION FACTOR
1.	Conventional Concrete	0.94
2.	Coir reinforced Concrete	0.84
3.	Polypropylene Reinforced Concrete	0.88
4.	Polyester Reinforced Concrete (Recron 3S)	0.84

Compressive Strength Test- Compressive strength of concrete depends on many factors such as water-cement ratio, admixture, cement strength, quality of concrete material, and quality control during production of concrete etc. The effect of fibres on the compressive strength of concrete has been discussed in many studies and resulted that these fibres either decrease or increase the compressive strength of concrete. For this, 24 cubes of different concrete of 15cm dimension was casted and tested in compression testing machine after curing of 7 & 28 days. From this results were obtained & tabulated in table no.3. Their comparison is also shown in Graph 1.

Table 3: Compressive Strength for different concrete

S. No.	Concrete type	Days	Compressive strength (N/mm^2)
1.	Conventional concrete	7 days	16.0
		28 days	25.11
2.	Coir Reinforced concrete	7 days	18.22
		28 days	30.0
3.	Polyester Reinforced Concrete	7 days	22.67
		28 days	34.44
4.	Polypropylene Reinforced Concrete	7 days	25.11
		28 days	39.33



Graph 1: Comparison of Compressive Strength of Different Fibres concrete

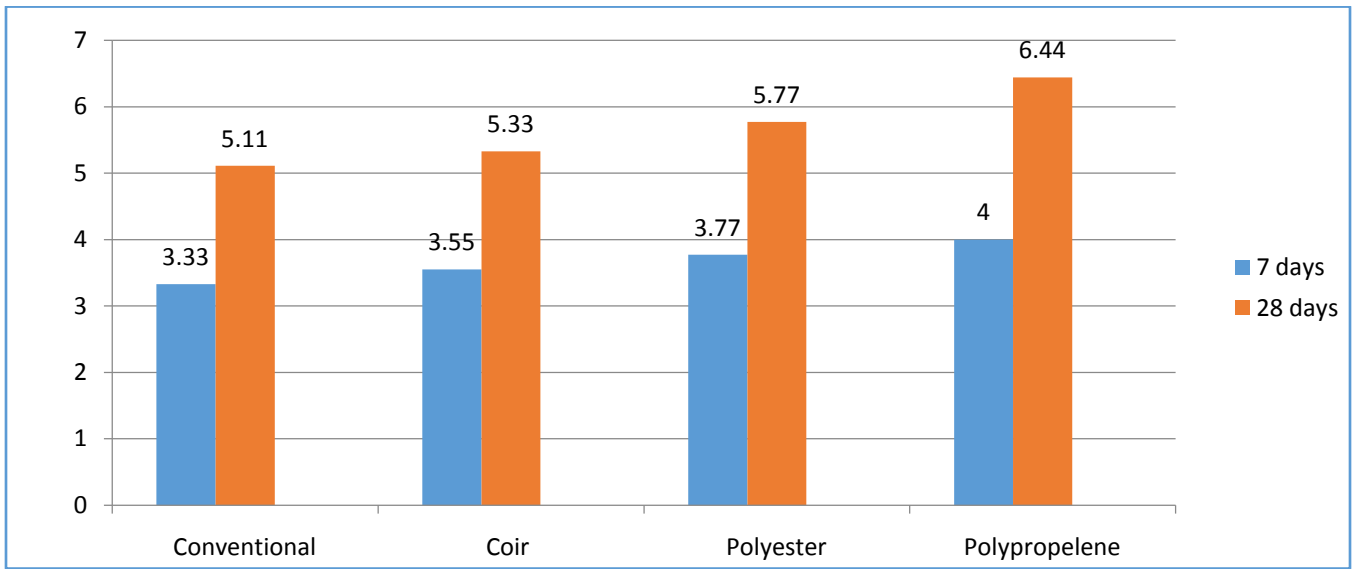
Flexural Test

Flexure strength is one of the measures of tensile strength of concrete. Flexural test provides values for the modulus of elasticity in bending , flexural stress , flexural strain and the flexural stress-strain response of the material. It is the ability of a beam or slab to resist failure in bending. It is measured by loading un-reinforced concrete beams with a span three times the depth. The flexural strength is expressed as "Modulus of Rupture" (MR) in psi. Flexural MR is about 12 to 20% of Compressive strength. However, the best correlation for specific materials is obtained by laboratory tests. (As per IS: 516-1959 – Methods of tests for strength of concrete)

Beam mould of size 15 x 15x 75 cm (when size of aggregate is less than 38 mm) or of size 10 x 10 x 50 cm (when size of aggregate is less than 19 mm) is used for the test. Results are shown in table no.4 & comparison is shown in graph 2.

Table 4: Flexural Strength for different concrete

S. No.	Concrete type	Days	Flexural strength (N/mm^2)
1.	Conventional Concrete	7 days	3.33
		28 days	5.11
2.	Coir Reinforced Concrete	7 days	3.55
		28 days	5.33
3.	Polyester Reinforced Concrete	7 days	3.77
		28 days	5.77
4.	Polypropylene Reinforced Concrete	7 days	4.0
		28 days	6.44



Graph 2: Comparison of Flexural Strength between Different Fibres Concrete

IV. CONCLUSION

Based on the objectives set in the present study and the experimental work carried out in the laboratory, the following conclusions are drawn. As the fiber content was increased, the mix became more cohesive. Workability decreased as the fiber content increased.

- At 7 days, As compared to conventional concrete, compressive strength increased 13.87% for 2% Coir fiber content , 56% for 0.25% of Polyester (Recron 3S) fiber content and 41.68 % for 0.25% of Polypropylene fiber content.
- At 28 days, As compared to conventional concrete, compressive strength increased 19.47 % for 2% Coir fiber content , 56.63% for 0.25% of Polyester (Recron 3S) fiber content and 37.15% for 0.25% of Polypropylene fiber content.
- At 7 days, As compared to conventional concrete, flexural strength increased 6.60 % for 2% Coir fiber content , 13.21% for 0.25% of Polyester (Recron 3S) fiber content and 20.12% for 0.25% of Polypropylene fiber content.
- At 28 days, As compared to conventional concrete, flexural strength increased 4.30 % for 2% Coir fiber content , 12.91% for 0.25% of Polyester (Recron 3S) fiber content and 26.02% for 0.25% of Polypropylene fiber content.

V. FUTURE SCOPE

- We can use these fibers at different percentage by weight of cement.
- Use of Coir fiber gives natural cooling effect due to it's near to zero thermal conductivity.
- Admixtures can also be used to reduce the number of voids which are formed to the present of fibres in the concrete.

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