An Experimental Study And Investigation on Strength Properties of Concrete With Fibres

S.Poorna Chandra[1], Thota Gireeshma[2]
[1, 2] Dept of Civil Engineering
[2]Asst.Proffessor, Dept of Civil Engineering
[1, 2] Sree Rama Engineering College, Tirupati, Andhra Pradesh, India.

Abstract- *Concrete will give better durability and also its costs during construction as well as maintenance are very low when compared to other construction materials. As we know that concrete is strong in construction and weak in tension and tends to fail because of its deficiencies such as low tensile strength, low strain at fracture. The weakness of concrete is due to the presence of micro cracks at mortar aggregate interface. In present experimental work forM25 grade of concrete can be designed according to IS 10262:2009 with four different proportions of hybrid fibers are added with concrete ingredients. The proportion of steel and polypropylene fibers are added by 50% each with different hybridization ration i.e. 0%,0.5%, 1.0 %, 1.5% and steel fibers are added by volume of concrete and polypropylene is added by weight of cement. For strength parameters compressive, tensile, flexural, impact strength specimens are casted and cured for 28 days and tested for hardened concrete and for fresh concrete slump and compaction factor test is carried to know the workability of hybrid fiber reinforced concrete. For durability study Sorptivity test is carried out to know the absorption of water by capillary. To evaluate the strength parameters different tests are conducted and results are tabulated.*

Keywords- Cement, Aggregate, Concrete, Fiber- reinforced Concrete.

I. INTRODUCTION

Fiber reinforced concrete (FRC) is concrete obtained by the addition of fibers to concrete (short discrete fibers that are uniformly distributed). Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers. Adding fibers to concrete greatly increases the toughness of the material. The use of fibers also alters the behavior of the fiber matrix composite after it has cracked, thereby improving its toughness. In the beginning, FRC was primarily used for pavements and industrial floors but currently, the FRC composite is being used for a wide variety of applications including bridges, tunnel and canal linings, hydraulic structures, pipes, explosion-resistant structures, safety vaults, cladding and roller compacted concrete.

II. DIFFERENT TYPES OF FIBRES:

Different type of fibers is manufactured with different technology. Every fiber has different properties with good strength parameters and most commonly used fibers in concrete are as follows.

1. Steel fiber.
2. Polypropylene fiber.
3. Nylons fiber.
4. Polyesters fiber.
5. Asbestos fiber.
6. Glass fiber.
7. Carbon fiber.

Steel fibers are probably the most widely used fibers for many applications, other types of fibers are more appropriate for special applications.

III. HYBRID FIBER REINFORCED CONCRETE

Every Fiber has different strength characteristic and gives strength to concrete. When two different fibers added to concrete to make the composite structure gives maximum strength to concrete that type of concrete is hybrid fiber reinforced concrete (HFRC). Addition of fibers like steel and polypropylene, steel and glass, glass and polypropylene, steel and polyester etc., these are hybrid ratio of HFRC with different mix proportion and variation of fibers in concrete. By using HFRC the concrete become stronger because of the fibers which we added they may have good in tensile strength, crack resistance, avoids initial cracks, shrinkage of concrete may be reduced.

IV. MATERIALS

Materials used in the project and the various tests conducted on them and also along with methodology of mix proportion with various proportions of addition of steel fibers in the concrete. In this chapter properties of the materials which are used for the project are discussed and also along with their permissible limits according to the standards. The place from where the materials are taken also mentioned.

The following are the materials used in the experimental work.

1. Cement.
2. Fine aggregate.
3. Coarse aggregate.
4. Water.
5. Steel fibers.
6. Polypropylene fibers.

Percentage variation of fibers in mix

The proportions of fibers used in concrete mix are at percentage of 0.5%, 1%, 1.5% and for each proportion equal quantity (50% of each) of fibers are added in the m.

Percentage of fiber added in overall concrete mix (%)	Steel Fibers by Volume of Concrete (%)	Polypropylene Fibers by Weight of Cement (%)
0	0	0
0.5	0.25	0.25
1	0.50	0.50
1.5	0.75	0.75

V. EXPERIMENTAL METHODLOGY

To study the strength parameters of concrete it's necessary to conduct the certain tests on concrete.

Concrete can be tested in fresh state as well as in hardened state with different mix proportion of fibers.

TESTS ON CONCRETE

HARDENED CONCRETE:

There are 5 types of tests on hardened concrete.
They are:

1. Compressive strength.
2. Split tensile strength.
3. Flexural strength.
4. Impact test.
5. Sorpativity test.

FRESH CONCRETE:

There are 5 types of tests on fresh concrete.

They are:

1. Slump cone test.
2. Compaction factor.

VI. RESULTS AND DISCUSSIONS

From the present work of experimentation results of all the parameters are calculated and tabulated
below.

COMPRESSIVE STRENGTH TEST RESULTS

Sl.no	Percentage of Steel fiber	Percentage of Polypropylene fiber	% Hybrid fibers	Compressive strength at 28 days (N/mm^2)	Percentage increase in strength
1.	0	0	0	29.56	0 %
2.	0.25	0.25	0.5	32.74	10.75%
3.	0.50	0.50	1	37.62	27.26%
4.	0.75	0.75	1.5	39.55	33.79%

Table 1 Test results of compressive strength

Figure 1 Graph showing the results of compressive strength of HFRC.

From the above fig 1 plainly at 0.5% expansion of filaments the compressive quality is 32.74 N/mm2.As the rate of strands is expanded to 1 % and to 1.5 % the compressive quality is 37.62 N/mm2, 39.55N/mm2 separately. At the point when contrasted and controlled cement the expansion in the compressive quality with fiber expansion in rates of 0.5%, 1%, 1.5% is 10.75%, 27.26%, 33.79% individually.

VII. TENSILE STRENGTH TEST RESULTS

Sl.no	Percentage of Steel fiber	Percentage of Polypropylene fiber	% Hybrid fibers	Split Tensile strength at 28days (N/mm^2)	Percentage increase in strength
1.	0	0	0	2.71	0
2.	0.25	0.25	0.5	2.46	9.22 %
3.	0.50	0.50	1	3.39	25.09 %
4.	0.75	0.75	1.5	3.96	46.12 %

Table 2 Test results of tensile strength.

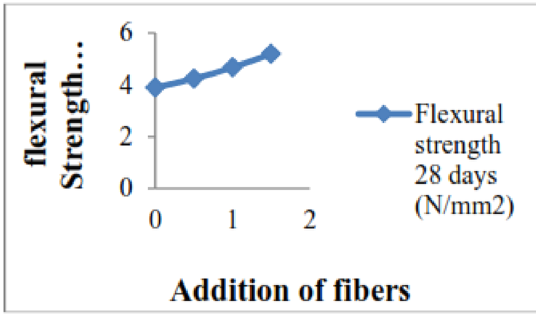


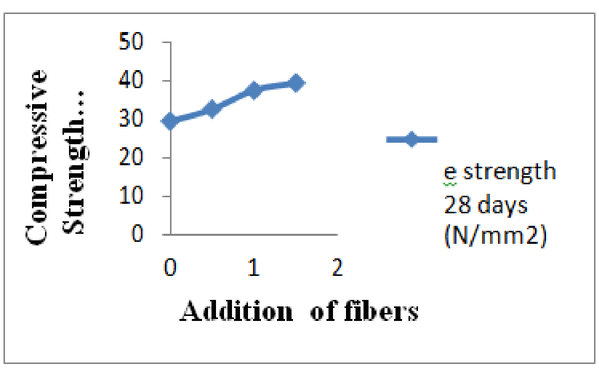
Fig 2 Graph shows results of split tensile strength of HFRC

From the above fig 2 plainly at 0.5% expansion of filaments the elasticity is 2.46 N/mm2 and at 0.5 % expansion of strands there is declarations in quality contrast with traditional cement i.e 2.71N/mm2.As the rate of strands is expanded to 1 % and to 1.5 % the split rigidity is 3.39 N/mm2, 3.96 N/mm2 individually. From this we can infer that for 0.5% expansion of filaments there is lessening in results from there on expansion of strands i.e 1%,1.5% there may increment in quality When contrasted and controlled cement the increment in the split elasticity with fiber expansion in rates of 0.5%, 1%, 1.5% is 9.22%, 25.09%, 46.12% individually.

FLEXURAL STRENGTH TEST RESULTS

Sl.no	Percentage of Steel fiber	Percentage of Polypropylene fiber	% Hybrid fibers	Flexural strength at 28 days (N/mm^2)	Percentage increase in strength
1.	0	0	0	3.90	0 %
2.	0.25	0.25	0.5	4.25	8.97 %
3.	0.50	0.50	1	4.68	20 %
4.	0.75	0.75	1.5	5.20	33.33%

Table 3 Test results of Flexural Strength



TEST RESULTS OF FLEXURAL STRENGTH

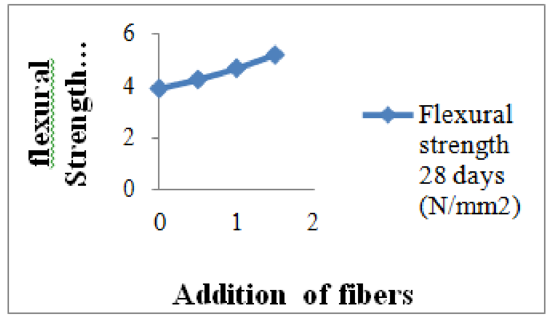


Figure 3 Graph showing the results of flexural strength of HFRC.

From the above fig 3 plainly at 0.5% expansion of strands the flexural quality is 4.25 N/mm2As the rate of filaments is expanded to 1 % and to 1.5 % the flexural quality is 4.68 N/mm2, 5.20 N/mm2 separately. From this we can presume that as there is an addition in the fiber content there is likewise an augmentation in the flexural quality. Hence flexural quality increments with the expansion of expansion of filaments in the blend. At the point when contrasted and controlled cement the expansion in the flexural quality with fiber expansion in rates of 0.5%, 1%, 1.5% is 8.97%, 20%, 33.33% individually.

IMPACT STRENGTH TEST RESULTS

Sl.no	Percentage of Steel fiber	Percentage of Polypropylene fiber	% Hybrid fibers	impact strength at first crack no of blows (28 days)	impact strength at failure no of blows (28 days
1.	0	0	0	10	34
2.	0.25	0.25	0.5	13	51
3.	0.50	0.50	1	19	87
4.	0.75	0.75	1.5	24	125

Table 4 test results of impact test.

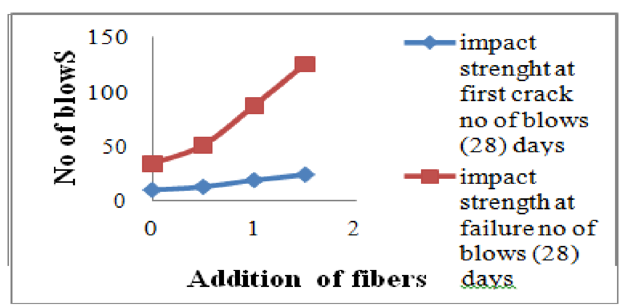


Figure 4 Graph showing the results of impact strength of HFRC.

From the above fig 4 obviously at as the rate of strands expands the no of blows required to disappointment the example additionally increments. From this we can infer that as there is an augmentation in the fiber content there is likewise an addition in the effect valve or quality. In this manner sway quality increments with the expansion of expansion of filaments in the blend. At the point when contrasted and controlled cement the expansion in the effect quality with fiber expansion in rates of 0.5%, 1%, 1.5% separately.

SORPTIVITY TEST RESULTS

Sl. No	Percentage of fibers (%)	Dry weight in grams	Wet weight in grams	Sorptivity value in 10^-7mm/min^0.5
1	0	8018	8023	4.016
2	0.5	8757	8762	4.0.16
3	1.0	8784	8794	8.033
4	1.5	8846	8856	9.676

Table 5 result of sorptivity test.

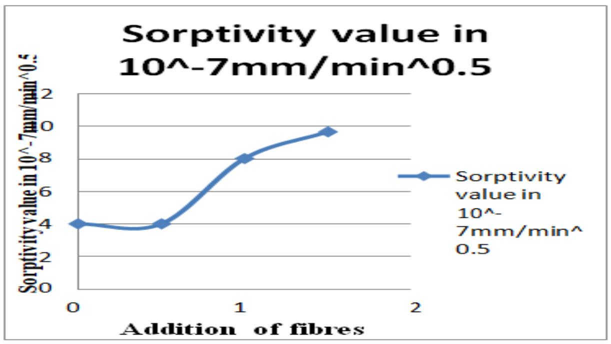


Figure 5 Graph showing the results of Sorptivity test of HFRC

In the above fig 5 as expansion of filaments is expanding there is a diminishing in the droop values. It is so in light of the fact that as the filaments are included the draining will be lessened and the blend will get to be cruel. From this we can infer that as the rate of fiber substance is expanded the workability will be diminished.

SLUMP AND COMPACTION FACTOR RESULTS

Sl.no	% of fibers	Slump values in mm	Compaction factor
1	0	96	0.95
2	0.5	92	0.92
3	1.0	87	0.90
4	1.5	80	0.89

Table 6 Results of slump and compaction factor tests.

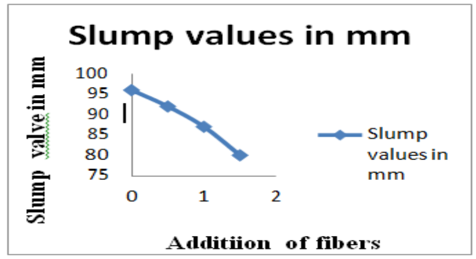


Figure 7Graph showing compaction factor results of HFRC

It is seen from the above chart that as the fiber content in the blend build compaction element values diminishes. From this we can reason that the workability of the blend diminishes as the fiber content in the solid increments.

VIII. CONCLUSIONS

From my experimental examination I finished up the accompanying focuses.

1. There is change in Compressive quality of HFRC contrast with traditional cement on account of expansion of strands. The greatest increment in compressive quality saw at having mixture proportion 1.5 % i.e. 0.75 % steel fiber and 0.75 % polypropylene fiber and When contrasted and controlled cement the expansion in the compressive quality with fiber expansion in rates of 0.5%, 1%, 1.5% is 10.75%, 27.26%, 33.79% separately.
2. Tensile quality might be abatement for the proportion 0.5 % of filaments contrast with ordinary cement, from that point it might increment in rigidity and half and half proportion having 1.5% gives greatest quality contrast with other extent. From this we can infer that for 0.5% expansion of strands there is decline in results from that point expansion of filaments i.e 1%,1.5% there may increment in quality When contrasted and controlled cement the expansion in the split elasticity with fiber expansion in rates of 0.5%, 1%, 1.5% is 9.22%, 25.09%, 46.12% separately.
3. Flexural quality might be most extreme for mixture proportion 1.5% thinks about to customary cement. From this we can reason that as there is an augmentation in the fiber content there is likewise an addition in the flexural quality. In this way flexural quality increments with the expansion of expansion of strands in the blend. At the point when contrasted and controlled cement the expansion in the flexural quality with fiber expansion in rates of 0.5%, 1%, 1.5% is 8.97%, 20%, 33.33% separately.

4. Impact quality of HFRC increments as the rate of strands expands the no of blows required to disappointment the example additionally increments. Along these lines sway quality increments with the expansion of expansion of filaments in the blend. At the point when contrasted and controlled cement the expansion in the effect quality with fiber expansion in rates of 0.5%, 1%, 1.5% separately
5. Slump cone valves is diminishing with Addition of filaments is expansions. It is so in light of the fact that as the strands are included the draining will be decreased and the blend will get to be unforgiving. From this we can reason that as the rate of fiber substance is expanded the workability will be diminished. As the rate increment in filaments the compaction variable qualities diminishes. From this we can infer that the workability of the blend diminishes as the fiber content in the solid increments.
6. Sorptivity will be more as the rate of strands expansion is increment. From results we can reason that 0.5% expansion of cross breed filaments gives same Sorptivity valve contrast with customary cement.
7. The ideal rate of filaments expansion is 1.5%. Expansion of strands up to 1.5% gives best results in all quality parameters contrast with other blend extent.

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