Experimental Study Of Strength And Durability Properties Of Hybrid Fiber Reinforced Concrete For M 25 Grade Concrete.

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Abstract:

Among all the construction materials that are available for construction, we know that concrete is a widely used construction material for building of various civil engineering structures. 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. To overcome the existing problems addition of fibers in the concrete has been come in to practice. In fiber reinforced concrete the fibers are added to the concrete mix so that those are discontinuous fibers will be uniformly distributed in the mix and improve the concrete properties in all directions. To get more improvement in the mechanical properties work has been done by combining two different types of fibers knows as hybridization. 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. From the present work results show that

1.5 % addition of hybrid fiber gives maximum results in all the strength parameters compare to other different hybrid ratios.

Keywords: *Durability, Aggregates, Compressive strength, Flexural strength, Sorpitivity test*

INTRODUCTION:

Conventional concrete have good compressive strength and it is poor in tension as well as in flexural strength. So forincreasing concrete tension as well as flexural strength it's required to add any innovative materials like fibers, admixture, and waste material having goodpozzolanas properties, construction chemical. Cement mortar and concrete made with Portland cement is akind of most commonly used construction material in the world. These materials have inherently brittle natureand have some dramatic disadvantages such as poor deformability and weak crack resistance in the practicalusage. Also their tensile strength and flexural strength is relatively low compared to their compressive strength.The weakness in tension can be overcome by the use of sufficient volume fraction of certain fibers like steel, polypropylene, nylon, polyester, glass; carbon fibers are used to increase the strength of normal concrete. Steel fibers are probably the most widely used fibers for many applications, other types of fibers are more appropriate for special applications. Fiber addition in the concrete brings a better control of its cracking and improves its mechanical properties. Particularly, it imparts to the material a post cracking load carrying capacity, ductility. The metal and, more particularly, steel fibers are most largely employed. Initially used in pavements and slabs on soil, their applicability is now extended to the case of structural elements such as piles, beams and self-supporting cladding elements (generally prefabricated), spread linings, and repairs or reinforcements of tunnels, walls, or floors. Polypropylene/Nylon Fiber are Suitable to increase impact strength of concrete. Possess high tensile strength but their low modulus of elasticity and higher elongation do not contribute to the flexural strength.

2. REVIEW OF LITERATURE :

The art and science of construction developed through the pre-historic ages itself. The unending quest for the better building materials and better construction practices lead to the discovery of many building composite. History envisages Romans as the first to recognize the pozzolanic action of certain volcanic ashes. The modern recognition of ash materials as a pozzolana and using various types of fibers in concrete had lead to revolutionary developments in the construction industry and research.

3.METHODOLOGY:

To study the different strength parameters like compressive strength, tensile strength, flexural strength of hybrid fiber reinforced concrete with different mix proportion of fibers forM25 grade concrete. To determine impact resistance properties on the hybrid

fiber reinforced concrete and comparing with the conventional concrete. To know the optimum percentage of addition of fibers to concrete and finding maximum hybrid ratio. To determine workability of hybrid fiber reinforced concrete by the addition of fibers in concrete mix. To study the durability properties of hybrid fiber reinforced concrete.

4. EXPERIMENTAL STUDY:

There are different tests which are conducted on the materials used for making of concrete. They are the fineness modulus test for OPC, PPC, coarse aggregate, sand,surkhi, coconut shells. Specific gravity tests for OPC, PPC, coarse aggregate, sand,surkhi, coconut shells water absorption test for coarse aggregate, coconut shells and bulking test for sand, surkhi, normal consistency test, initial and final setting time tests for OPC, PPC.

4.1Steel Fibers:

Steel fibers are short, discrete lengths of steel with different aspect ratio from about 30to 150 with different cross sections. Different types of Steelfibers are hookedends, crimped, glue hooked end etc these are most commonly used fibers. Their shape will be Round of diameter 0.25 to 0.75mm. They Enhances flexural, impact and fatigue strength of concrete. Thin shells and plates have also been constructed using steel fibers.In the present work crimped steel fiber with flat end used. These steel fibers are brought from Bharat Steel Chennai Pvt Ltd (BSC). The properties off steel fibers with their specifications are mentioned in the table below.

Table1 : properties of steel fibers.

Type of steel fiber	Crimped
Material	Low carbon drawn flat wire
Length of fiber	25mm
Diameter of fiber	0.5 mm
Aspect ratio	50
Tensile strength	500-750mpa
Appearance	Clear, bright, flat end crimped steel fiber
Applications	Tunnel shot create, industrial flooring, road and Pavement

4.2 Polypropylene fibers:

Polypropylene fiber is composed of crystalline and non-crystalline (amorphous) regions. The fiber range in size from fractions of a micrometer to centimeters in diameter. The manufacturing of this fiber have to two different types. First one is pulling wire procedure with circular cross section or by extruding the plastic film with rectangular cross section. And appearance of this fiber in fibrillated bundles, mono filament. These fibers have different length 12mm, 24mm; 40mm cut length is available.

In the present investigation the polypropylene fibers with 12mm cut length is used. These polypropylene fibers are brought fromBharat Steel Chennai Pvt Ltd (BSC). The properties off polypropylene fibers with their specifications are mentioned in the table below.

Table 2: properties of polypropylene fibers.

Geometry of fiber	Fibrillated
length of fiber	12mm
tensile strength	500-750 mpa

4.3 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 mix.

Table 3: Percentage variation of fibers in mix

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

5. RESULTS AND DISCUSSIONS:

There are number of tests conducted on concrete before and after the castinf of cubes, casted by using conventional cocncrete and replacement concrete, they are the slump cone test which is conducted to test the workability of fresh concrete and compressive tests and split tensile test are conducted after concrete.

5.1 COMPRESSIVE STRENGTH TEST RESULTS

Table 4: 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%

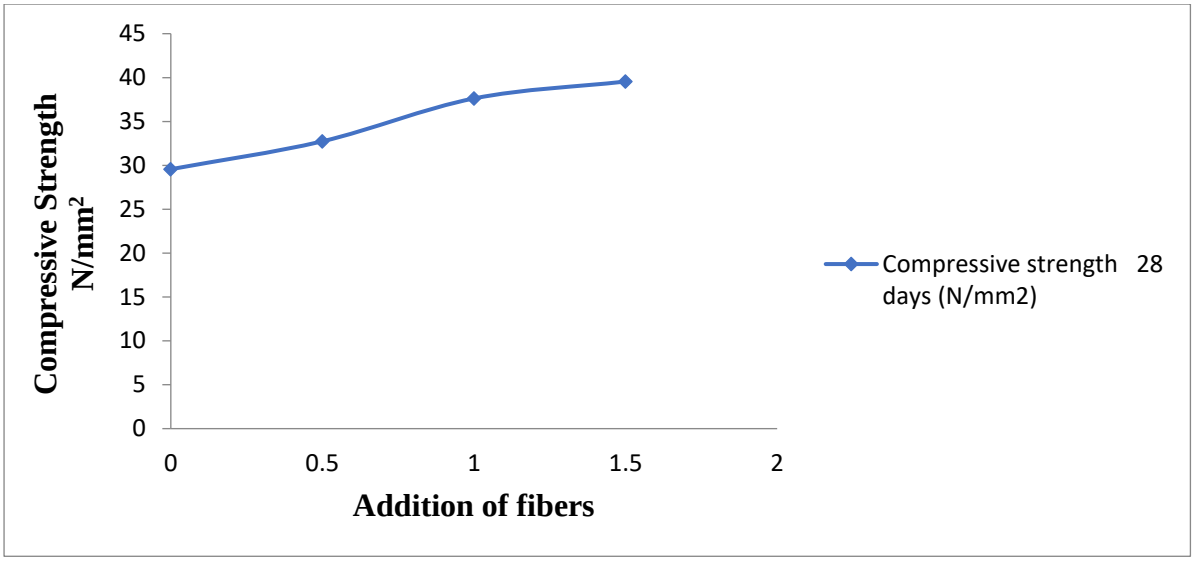

Figure: Graph showing the results of compressive strength of HFRC.

From the above fig 6.1 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, 39.55 N/mm2 separately. From this we can presume that as there is an augmentation in the fiber content there is additionally an addition in the compressive quality. In this way compressive quality increments with the expansion of expansion of filaments in the blend. 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.

TENSILE STRENGTH TEST RESULTS

Table 5: test results of tensile strength.

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 %

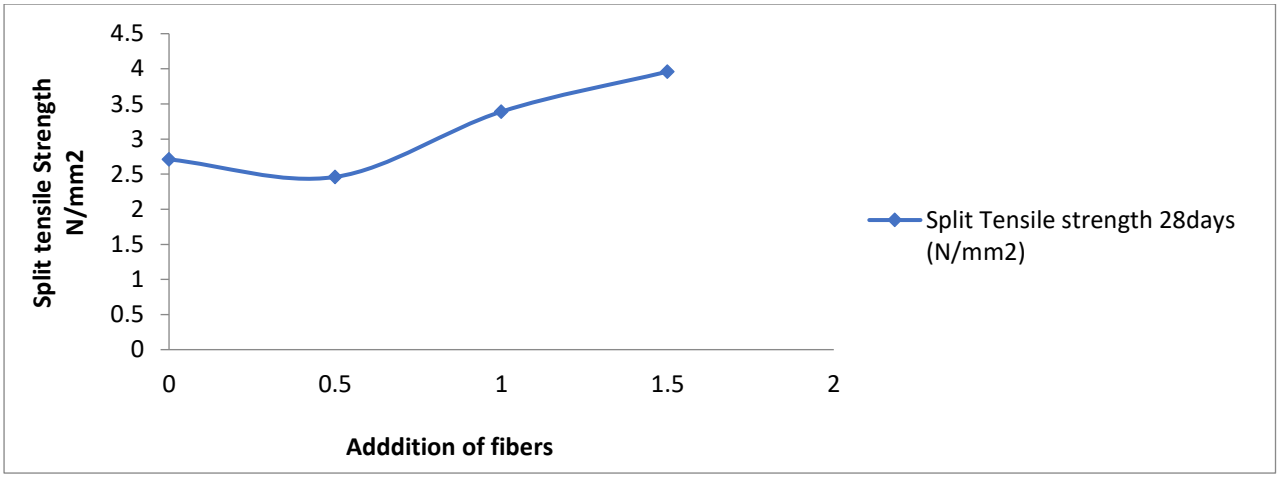

Figure 2:Graph showing the results of split tensile strength of HFRC.

From the above fig 6.2 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.

SPLIT TENSILE STRENGTH OF CONCRETE:

SPLIT TENSILE STRENGTH OF CONVENTIONAL AND REPLACEMAENT CONCRETE

S. No	Concrete mix type (or) Percentage	3 days (N/mm^2)	7 days (N/mm^2)	14 days (N/mm^2)	28 days (N/mm^2)	56 days (N/mm^2)
1	Convention al concrete	1.73	3.17	4.21	4.67	4.73
2	10%	1.81	3.23	4.29	4.72	4.76
3	20%	1.87	3.31	4.36	4.79	4.83
4	25%	1.98	3.42	4.52	4.93	5.01
5	30%	1.92	3.39	4.44	4.86	4.92
6	40%	1.85	3.35	4.35	4.75	4.87
7	50%	1.83	3.34	4.32	4.71	4.79

5.4 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

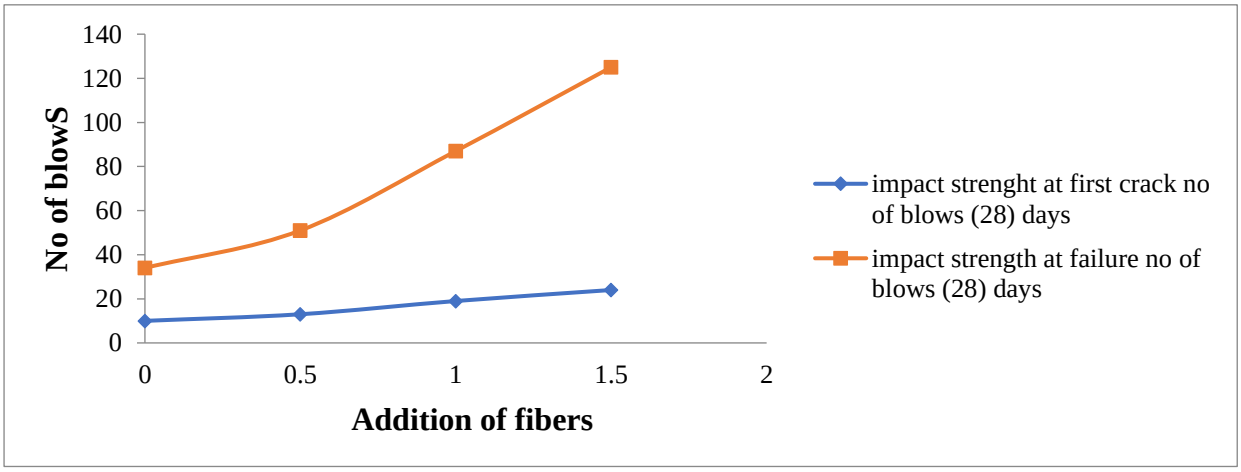

Figure Graph showing the results of impact strength of HFRC.

From the above fig 6.4 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.

6. 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**7.**

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