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EXPERIMENTAL INVESTIGATION ON STRENGTH PROPERTIES OF POLYPROPYLENE FIBER WITH FLY ASH IN CONCRETE

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Abstract : Concrete is a material which is made up of cement, water, fine aggregate and course aggregate that has excellent compressive strength and weak in tensile strength, In order to provide tensile strength usually we will provide steel reinforcement. There are many approaches to decrease the failure of concrete structures made up of steel reinforcement. The usual approach is to adhesively bond fiber polymer composites onto the structures. This further helps to increase the toughness and tensile strength and increase the cracking and deformation qualities of the resultant composite. The process involved in this project is to prepare mix design of M30 grade concrete, to conduct slump test, preparing samples with and without fiber, cubes, beams, cylinders were casted. Here we have added polypropylene fiber. It is a discontinuous short fiber that can be used in concrete to control and arrest cracks. And also we are replacing the cement by fly ash in certain percentage. The main objective is to increase the compressive strength, tensile strength by adding 0.25%, 0.5%, 0.75%, 1% and comparing with the conventional concrete. The test were conducted after 7days, 14 days and 28 days of curing.

***IndexTerms* - Concrete cubes, concrete cylinder, concrete beams, experiment and finite element analysis.**

I. INTRODUCTION

Normal reinforcing steel is designed to calculate all tensile and bending stresses in addition to temperature associated stresses in concrete structures. The design limits are well accepted in the indian standard code is 456 and are minimum structural necessity for design and construction. These necessary steel are described for this paper as primary steel. Use of secondary reinforcement does not alter the requirements of primary steel. But structural reinforcement does not determine its benefits until concrete hardens. Hence secondary reinforcement in form of fiber reinforcement should be added to concrete. Unlike structural reinforcement, artificial fires provides benefits while concrete is still in plastic stage. they improve few of the properties of hardened concrete also. hence it is confirmed that by adding of limited quantities of evenly distributed secondary fiber reinforcement increase the static and dynamic properties of concrete.as a whole fiber reinforced concrete has greater resistance to drying, shrinkage, cracking, compressive strength and tensile and flexural strength and water permeability Normal reinforcing steel is designed to calculate all tensile and bending stresses in addition to temperature associated stresses in concrete structures. The design limits are well accepted in the Indian standard code is 456 and are minimum structural necessity for design and construction. These necessary steel are described for this paper as primary steel. Use of secondary reinforcement does not alter the requirements of primary steel. But structural reinforcement does not determine its benefits until concrete hardens. Hence secondary reinforcement in form of fiber reinforcement should be added to concrete. Unlike structural reinforcement, artificial fires provides benefits while concrete is still in plastic stage. they improve few of the properties of hardened concrete also. hence it is confirmed that by adding of limited quantities of evenly distributed secondary fiber reinforcement increase the static and dynamic properties of concrete.as a whole fiber reinforced concrete has greater resistance to drying, shrinkage, cracking, compressive strength and tensile and flexural strength and water permeability.

II. LITERATURE REVIEW

[1]. preliminary study on the behaviour of fiber reinforced concrete under flexure is presented, place pre-cracked notched beams were certified under recurrent storing for concrete with various dosages of addicted-done fortify fibers. The fatigue crack tumor and stiffness shame all along the eras are argued in term of the rate of progress of crack opening, and the critical crack chance is recognized, further that the crack tumor enhances unstable. S–N curves have existed proposed respective the detracting crack chance as these hopeful more relevant to design preventing unexpected misstep. It is apparent that bigger dosages of fiber develop the fatigue life of fissured concrete only when the magnitudes of the recurrent stowing are high, what the effect of dosage is unimportant at lower magnitudes. For the fiber road considered present, the lastingness limit appears to be about 50% of the pre-crack load in the post-peak establishment. preliminary study on the behaviour of fiber reinforced concrete under flexure is

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[2]. Composites invented of fiber as reinforcement and a fine concrete as matrix are refer to fabric reinforced concrete that determines the moment to build thin and covering constructions and to repair and toughen concrete and masonry makeups. This paper proposed to exploit the repair potential of TRC through restriction of heat-broken hardened columns. For this purpose, a two-stage approach was conducted, in the first stage of that the effect of raised temperature on automatic properties of actual was checked. The main objective of the second chapter, however, search out evaluate the expertise of mirror fabric strengthened hardened (GTRC) in the confinement of heat-damaged concrete. Experimental results disclosed that the selected confinement order is an effective answer to enhance the load posture ability. Then an analytical imprisonment model was expected established best-fit analysis restricted to heat-damaged concrete confined by GTRC.

[3]. Fiber reinforced polymers (FRP) are used to wrap reinforced concrete (RC) components to increase their load giving capacity and, in a force mentioned requests, the fad of disappointment of the retrofitted aspect is commonly ruled for one rupture of the FRP when it reaches its final strain. This paper reports the split disc test reduced to typify the stress-strain behaviour of FRP utilizing a simple example preparation methods. The results obtained from the changed split-platter tests on bottle and element-FRP composites are compared accompanying those from uniaxial FRP certificate tests. It is raise that the elastic modulus acquired from both the designs are analogous but the last strains and the tensile substances from the split-plate tests are lower. To equate the split disk ultimate strains, FRP limited concrete cylinders of 150 mm in width and 300 mm in height were planned and certified under uniaxial compression, after wrapping with element and jar FRP sheets. The average last strains of FRP accompanying split-platter test are inferior the final hoop strains noticed in FRP-limited cylindrical samples. Consequently, strain productivity circumstances have happened resolute for application in design.

[4]. In this study, 24 concrete cylinders with a notch at the centre were prepared. Among them six cylinders were protected using single and double layers of texture reinforced polymer; six cylinders were coated with binding material paste; the surplus cylinders were used as a control. The cylinders were exposed to wet and dry moving and acid resolution between of 120 days. Two various factual substances M30 and M50 were deliberate for the study. It is raise that the substance, flexibility and collapse mode of protected cylinders believe number of tiers and the type of uncovering environments. It was seen that the damage on account of wet and dry controlling a vehicle and acid attack was difficult in control sample than the binding material laminated and covered cylinders.

[5].This paper reports the belongings of alternative in mass, concentration and type of cation guide sulphate on the growth, bulk and substance loss of foam actual presented accompanying two synthetic surfactants. Comparisons are made middle from two points practice of foam actual of various densities what of corresponding base mixes of mortar outside foam. The surveys pointed out that the expansion in sodium sulphate atmosphere be honest to 28% above that of magnesium sulphate surroundings that can be assign to better quantity of ettringite composition in sodium sulphate environment. The important decay system in magnesium sulfate atmosphere is disintegration of sealing material and this provided to deficit in mass of 1% and greater sulphate deterioration factor of 0.4 for examples under harsh magnesium sulphate atmosphere. Irrespective of the type of sulphate environment, the deterioration of foam concrete was inferior that of base mix.

III. METHODOLOGY

Before casting the concrete cubes, beams, and cylinders the moulds were cleaned thoroughly. The standard size of cube 150 mm × 150 mm × 150 mm, beams 100mm × 100mm × 500mm, cylinder 150mm × 300mm respectively (Figure 1). To cast 45 cubes, 45 beams, 45 cylinders the moulds were tighted with all nuts and bolts properly to avoid leakage. Oil is applied to all contact surfaces of moulds for easy removal of moulds.

Figure 1. Empty moulds of cube, beam, cylinder cylinder

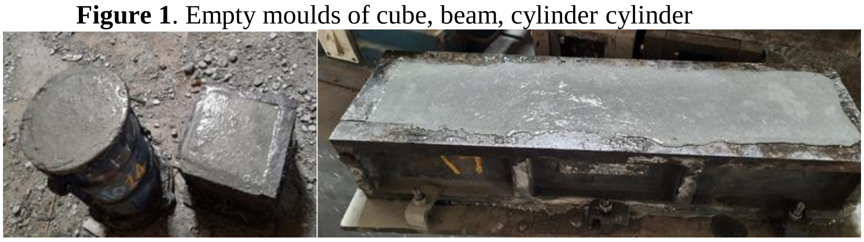

Figure 2.Cube, cylinder, beam mould is filled with concrete cylinder.

Figure 3.Curing of cubes, cylinder, beams

Concrete is filled in 3 layers, each layers of concrete has given 25 nos of strokes by using 25 mm diameter rod, tamping was done for better compaction and also to avoid air voids. After filling, the concrete up to top surface (Figure 2). Top surface layers were finished by trowel. The concrete cubes were allowed to dry for 24 hours. After demoulding the specimen, the care should be taken while removing to avoid the breaking of edges. Later the concrete cubes are left for curing in water tank. The specimens are submerged in fresh water for 7 days, 14 days and 28 days. later it is taken out and tested (Figure3).

IV. EXPERIMENTATION

4.1 Compressive strength test.

For conducting the compressive strength test for concrete cube specimen of dimension 150 mm × 150 mm × 150 mm were used. The moulds were prepared with 0%, 0.25%,0.5%,0.75%,1% of polypropylene fibers with 20% replacement of fly ash. Experiments were conducted by using a universal testing machine of capacity 2000 KN as shown in figure (Figure 4) compressive load was applied at center of the specimen with a loading rate of 10KN. The samples were tested for their compressive strength at 7, 14 and 28 days.

Figure 4. Compression testing machine

4.2 Split tensile test

For conducting the split tensile strength test for concrete cylinder specimen of dimension 150 mm diameter and 300 mm length were used. The moulds were prepared with 0%, 0.25%,0.5%,0.75%,1% of polypropylene fibers with 20% replacement of flyash..Experiments were conducted by using a universal testing machine of capacity 2000 KN as shown in figure (Figure 5) split tensile load was applied at center of the specimen with a loading rate of 10KN. The samples were tested for their split tensile strength at 7, 14 and 28 days.

4.3 Flexural strength test

For conducting the flexural strength test for concrete beam specimen of dimension 100mm × 100mm × 500mm were used. The moulds were prepared with 0%, 0.25%,0.5%,0.75%,1% of polypropylene fibers with 20% replacement of flyash. Experiments were conducted by using a universal testing machine of capacity 2000 KN as shown in figure (Figure 6) flexural strength load was applied at center of the specimen with a loading rate of 10KN. The samples were tested for their flexural strength at 7, 14 and 28.

Figure 6. Flexural testing machine

V. RESULTS AND DISCUSSION

Experiments were conducted on 45 concrete cubes, 45 concrete cylinder, 45 concrete beams for mix design of M30. These cubes, cylinders and beams were tested after 7 days, 14 days and 28 days. 15 samples were tested for every 7 days, 14 days , 28 days. The addition of fiber in improving the strength of cubes, cylinders and beams were studied. The results obtained for each models is given in table 1, 2 and 3.the results obtained were compared with the conventionally made concrete cube, concrete cylinders and concrete beams and the variations strength of cubes, cylinders, beams were compared with conventional concrete cubes, beams and cylinders for 7 days, 14 days and 28 days respectively. These variations showed in figure.

5.1 Compressive strength

The average compression strength of casted cubes was determined using 20% replacement fly ash and added polypropylene fibre at the age of 7, 14 and 28 days reported in table 1. Variation of compression strength of concrete mix cured at 7 days, 14 days and 28 days is shown in figure 7, 8, 9 ,10.

From the above experimental results, it is clear that the compressive strength of concrete increases when polypropylene fiber is added to it. It is found that the strength of concrete increases gradually from 0.25% and then decreases in 1% of polypropylene fiber in concrete. M30 grade of concrete showed better results for 0.75% of polypropylene fibrin concrete. Polypropylene fiber reinforced concrete gives better results when compared with conventional concrete.

Table 1: Compressive strength results of concrete cubes

SL NO.	Addition of polypropylene fiber %	Compressive strength (N/mm^2)		
		7 days	14 days	28 days
1	0	19.87	28.98	31.6
2	0.25	21.52	31.03	33.18
3	0.5	22.11	31.63	33.81
4	0.75	23.31	32.76	34.96
5	1	22.26	31.75	33.91

5.2 Split tensile strength

The average split tensile strength of casted cubes was determined using 20% replacement fly ash and added polypropylene fibre at the age of 7, 14 and 28 days reported in table 2. Variation of tensile strength of concrete mix cured at 7 days, 14 days and 28 days is shown in figure 11,12,13,14.

From the above experimental results, it is clear that the tensile strength of concrete increases when polypropylene fiber is added to it. It is found that the strength of concrete increases gradually from 0.25% and then decreases in 1% of polypropylene fiber in concrete. M30 grade of concrete showed better results for 0.75% of polypropylene fibrin concrete. Polypropylene fiber reinforced concrete gives better results when compared with conventional concrete.

Table 2: Split tensile strength results of concrete cubes

SL NO.	Addition of polypropylene fiber %	Split tensile strength (N/mm^2)		
		7 days	14 days	28 days
1	0	2.36	3.28	4.46
2	0.25	2.45	3.39	4.64
3	0.5	2.55	3.47	4.75
4	0.75	2.75	3.69	5.0
5	1	2.42	3.48	4.71

5.3 Flexural strength

The average flexural strength of casted cubes was determined using 20% replacement fly ash and added polypropylene fibre at the age of 7, 14 and 28 days reported in table 3. Variation of flexural strength of concrete mix cured at 7 days, 14 days and 28 days is shown in figure 15,16,17,18.

From the above experimental results, it is clear that the flexural strength of concrete increases when polypropylene fiber is added to it. It is found that the strength of concrete increases gradually from 0.25% and then decreases in 1% of polypropylene fiber in concrete. M30 grade of concrete showed better results for 0.75% of polypropylene fibrin concrete. Polypropylene fiber reinforced concrete gives better results when compared with conventional concrete.

Table 3: Flexural strength results of concrete cubes

SL NO.	Addition of polypropylene fiber %	Flexural strength (N/mm^2)		
		7 days	14 days	28 days
1	0	2.60	4.36	6.30
2	0.25	2.96	4.97	6.38
3	0.5	3.54	5.09	6.68
4	0.75	3.67	5.88	7.03
5	1	3.36	4.51	6.72

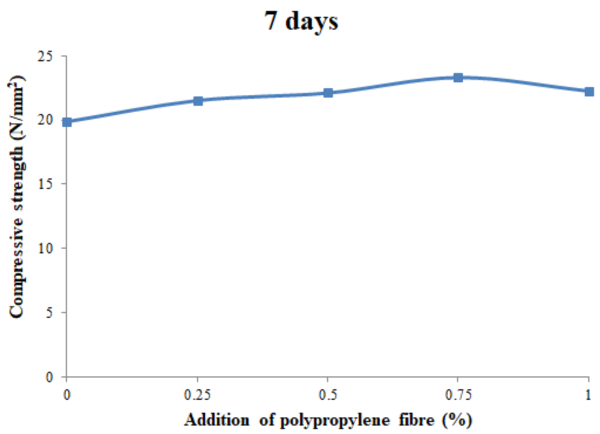

Figure 7. Compressive strength values of 7 days

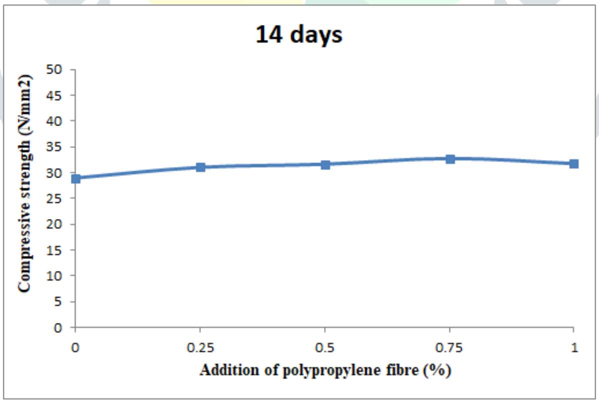

Figure 8. Compressive strength values of 14 days

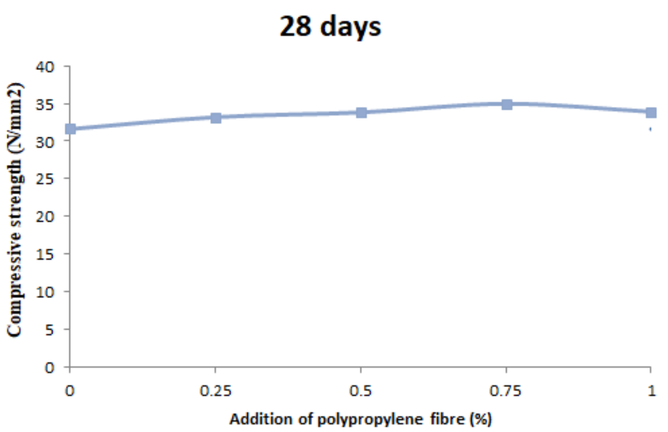

Figure 9. Compressive strength values of 28 days

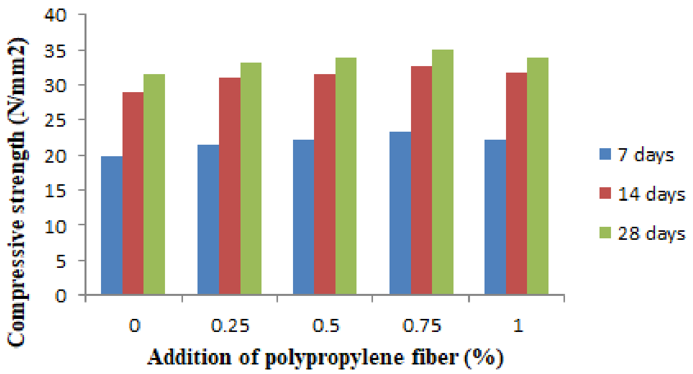

Figure 10. Comparative study on compressive strength values of concrete

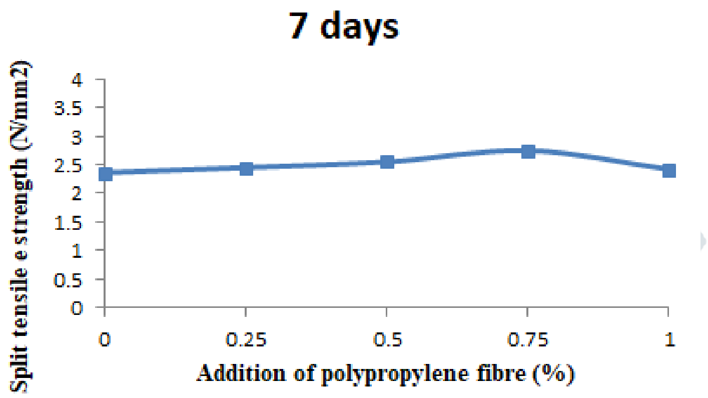

Figure 11. Split tensile strength values of 7 days

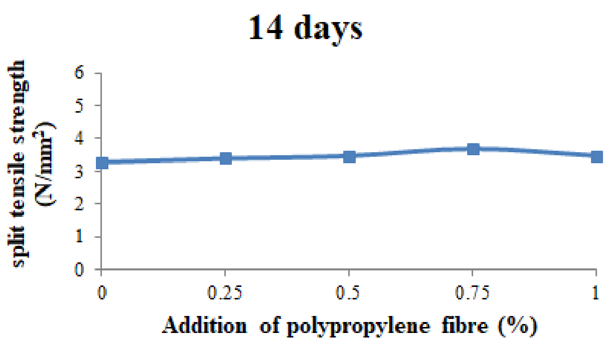

Figure 12. Split tensile strength values of 14 days

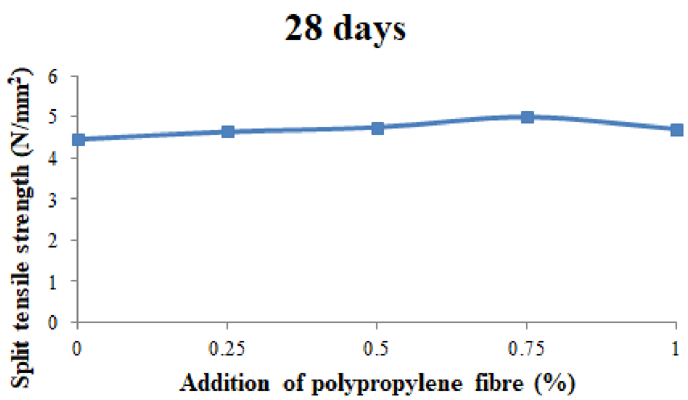

Figure 13. Split tensile strength values of 28 days

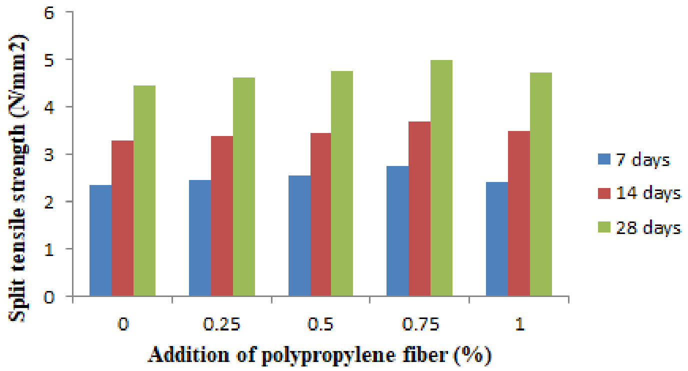

Figure 14. Comparative study on Split tensile strength values of concrete

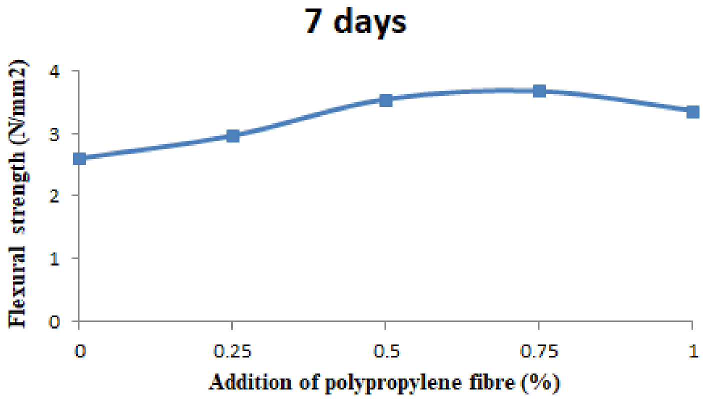

Figure 15. Flexural strength values of 7 days

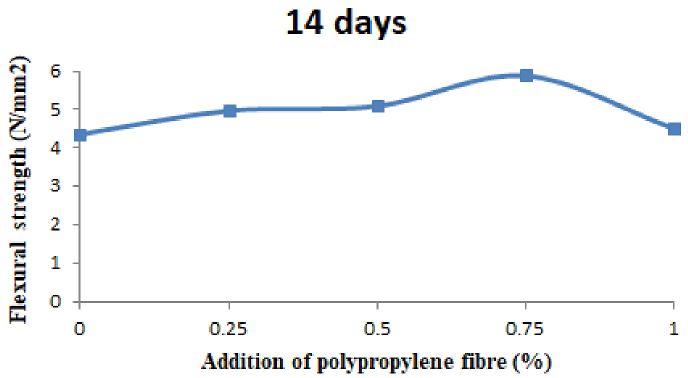

Figure 16. Flexural strength values of 14 days

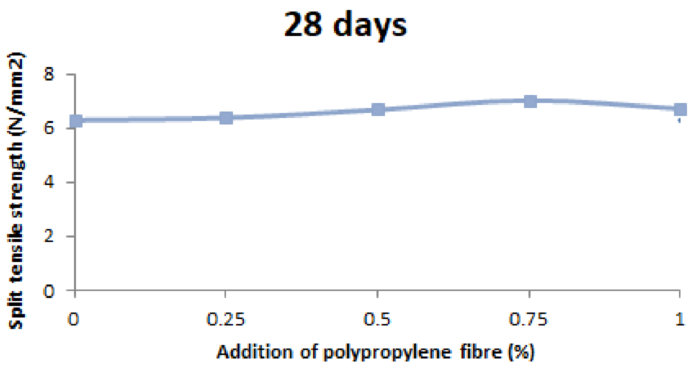

Figure 17. Flexural strength values of 28 days

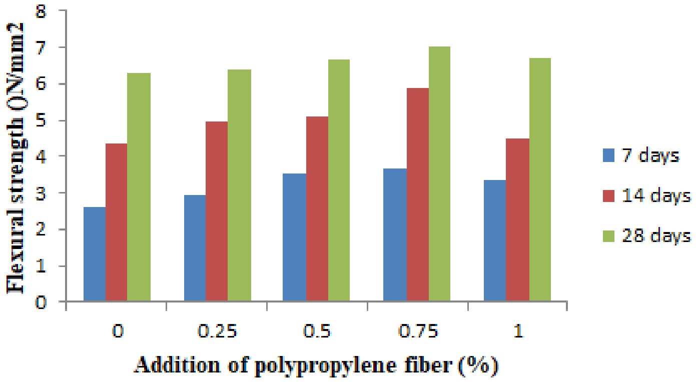

Figure 18. Comparative study on Flexural strength values of concrete

Conclusion

The workability of the fiber reinforced concrete, it was found that with increase in percentage of polypropylene fiber, there will be decrease in slump value of concrete mix. The strength of concrete increases gradually increases from 0.25% and then decreases in 1% of polypropylene fiber in concrete. It has showed better results for 0.75% of polypropylene fibre in concrete when compared with conventional concrete.

V. Acknowledgment

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