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Examining the Strength Characteristics of Fiber Rein Forced Concrete with Basalt and Coir Fibers

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Abstract- **According to earlier studies it was found that the concrete is good in the compression but weak in tension and flexural. Many of alternative materials were replaced or added in concrete to enhance the fresh and hardened properties of the concrete matrix. In this paper comparison of experimental results of coir and basalt fibers at different volume fractions i.e. 1% and 3% at different curing ages like 7 and 28 days were employed. The most appropriate mix combination from this study in terms compressive strength, split tensile strength and workability is having the volume fraction 3%.**

Keywords: **Compressive strength, Tensile strength, Workability, Coir fiber and Basalt fiber.**

I. INTRODUCTION

In construction industry the concrete is most widely used materials ingredients are cement, aggregates (fine and course) and water. Many of materials used as admixture and super plasticizers are used to enhance the properties of the concrete. Due to the brittle nature of the concrete it will break easily when tension load acts on it. To improve the properties of concrete under tension and flexure, steel reinforcing bars are used from a long time, but they were very expensive and having other complication too. Many researchers have been conducted around the world on the addition of various types of natural and synthetic fibers to improve the mechanical properties of concrete. The purpose of this study is to investigate the improvement in properties of concrete by reinforcing *it* with two different fiber i.e. coir and basalt fiber.

II.MATERIALS AND METHODLOGY

The main purpose of this investigation was to study strength characteristics like the compressive strength and tensile strength. This programme involved casting, curing and testing of plain concrete cubes and cylinders with different amounts of volume fractions of basalt fiber and coir fiber. The concrete mix depends on the properties of the material. Preliminary tests were carried out with cement, coarse and fine aggregates. Cube and cylindrical specimens were employed with different amounts of basalt and coir fibers. The specimens were remolded after 24 hours of casting to keep them in water for curing 7 and 28 days respectively. The specimen was tested on a compression testing machine for compression and split tensile test.

A. Cement

Portland cement used as a binder in concrete mixtures. The main objective was to create homogeneous properties in the mix to achieve good strength. OPC 43 grade cement was used for the design mix in the present study and its properties are as per table I. Various properties of the cement are tested, such the compressive strength after 7 days and 28 days, specific gravity, consistency and initial and final hardening of the cement.

TABLE I. CEMENT PROPERTIES

S. No	Properties	Experimental Value
1.	Specific gravity	3.15
2.	Setting time	55 min (Initial) 264 min (Final)
3.	Standard consistency	35%

B. Aggregates

Aggregates provide the volume and support to almost all properties of the concrete at fresh and harden state. As a result, aggregates are often used in two or more dimensions to increase the density of the mix. The main purpose of fine aggregate is to improve the workability and consistency of the mix, the test details if fine aggregates given in table II. Aggregates that pass through a large IS 4.75 mm sieve are called fine aggregate and retained are known as coarse aggregates. Aggregates were used by combining two closely spaced crushed stones of sizes 20 mm and 10 mm in the ratio of 60:40, table III describe properties of coarse aggregates. The aggregates were washed to remove dirt and dust and then dried on a dry surface.

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TABLE II. COURSE AGGREGATES PROPERTIES

S. No	*Properties*	*Description*
1.	Color	Grey
2.	Shape	Angular
3.	Specific gravity	2.71 (20 mm) 2.67 (10 mm)

TABLE III. FINE AGGREGATES PROPERTIES

S. No	*Properties*	*Description*
1.	Specific gravity	2.58
2.	Color	Brown
3.	Sieve Analysis	Zone-II

C. Water

Portable water is usually measured appropriately for mixing and curing concrete. Therefore, drinking water was used to extract the concrete in the material testing laboratory. It was free from harmful impurities.

D. Fiber

The two types of fibres were used in this present study like basalt and coir fibres. Moreover, the fiber were used in concrete as single nad combination of both to study the different objectives of the investigation. In experimental work figure 1 and 2 presents two different fiber coir and basalt fiber respectively. Average length of basalt fiber is 12 mm and coir fiber is 25 mm for compare the length property were cut the length of coir fiber about 12 mm. The physical properties of basalt and coir fibrs are presented in table IV ans V.

TABLE IV. BASALT FIBER PROPERTIES

S. No	*Properties*	*Description*
1.	Specific gravity	2.7
2.	Water absorption	25%
3.	Color	Golden Brown

TABLE V. COIR FIBER PROPERTIES

S. No	*Properties*	*Description*
1.	Specific gravity	0.9
2.	Water absorption	12%
3.	Color	Golden

Fig.1 Basalt fibers

Fig.2 Coir fibers

III. EXPERIMENTAL WORK

The experimental setup arranged to perform different tests on plain mix and fiber reinforced concrete by addition of basalt and two coir fibers. Total 30 cubes and 30 cylinders were employed in all mix combination. The concrete mix used is M20 for present investigation. Figure 3 presents the concrete cubes moulds having size 150mm X150mm X150 mm and cylinder having size of 100 mm in diameter and 200 mm long.

Fig.3 Concrete cubes and cylindrical moulds

TABLE VI: MIX PROPORTIONS.

Mix	**Fiber (kg)**	**Cement (Kg)**	**Fine aggregates (Kg)**	**Coarse aggregates (kg/m3)**	**Water (kg/m3)**
Mix proportion	-	1	1.64	2.92	0.5
M20	0	395	648.3	1154.3	198
M20+1% BF fiber	3.95				
M20+3% CF fiber					
M20+3% BF fiber	11.85				
M20+3% CF fiber					

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A. Mixing of normal concrete and fiber reinforced concrete.

First, carefully mix the cement, fine aggregates and course aggregates as per mix design with right amount of fiber before adding the water. The coir fiber must be dipped in water for 24hrs due to high water absorption property. Fibers were added after 2 to 3 minutes mixing of the concrete, while being stirred to ensure that coir fiber is uniformly mixed. When concrete is homogenous, add the necessary amount of water and mix for 2-3 minutes before casting into cylinders and cubes moulds. The mould has been positioned correctly on a level surface, the moulds with fresh concrete is put on the vibrate machine to compact the concrete and removal of air voids in it. The table VI provides the basic information about mixes and material proportions.

Fig 4. Casted cubes and cylinder

B. Slump cone test

On fresh concrete the slump cone test as per figure 5 has performed to determine the workability of the concrete.

Fig 5. Slump test

IV.RESULTS AND DISCUSSIONS

A. Slump cone Test

TABLE VII SLUMP CONE TEST

S No.	*Fiber content*	*Name of Mix*	*Slump Value(mm)*
1.	0%	Plain Concrete	96
2.	1%	12mm long BF	73
		12mm long CF	59
3.	3%	12mm long BF	69
		12mm long CF	32

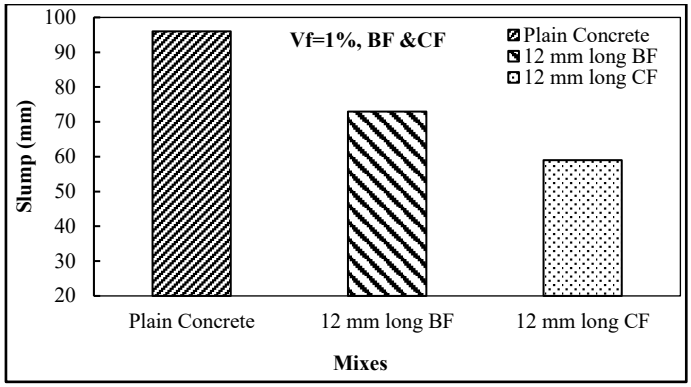

Fig.6 Slump test results (Vf=1%)

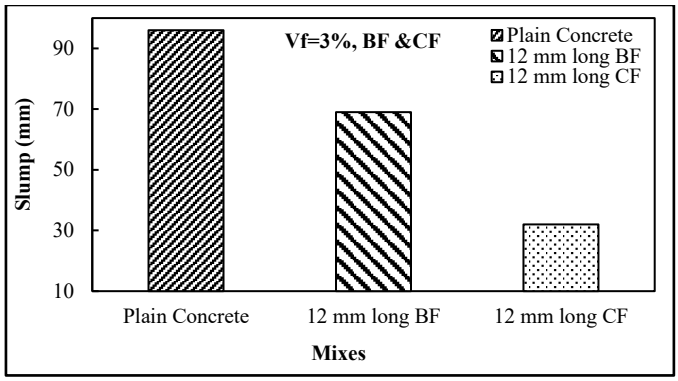

Fig.7 Slump test results (Vf=3%)

Due to the high water absorption properties of the coir fiber the workability of the concrete mixes has reduced as the fiber content increased from 1% to 3% as shown in fig 6 and fig 7 for both type of fibers. As the fiber content increased the concrete losses cohesiveness nature which also reduced its workability.

B. Compressive strength.

After a day of casting, the specimen was remolded cubes and cylinders placed them in water to cure for 7 and 28 days. The table VIII presents the compressive strength results for both 1% and 3% volume fractions. But the figures 8 present 1% and figure 9 shows 3% volume fraction for discussion propose.

TABLE.VIII COMPRESSIVE STRENGTH

S. No	*Fiber content*	*Name of Mix*	*Compressive Strength (MPa)*	
			7days	*28 days*
1.	0%	Plain Concrete	22.5	24.4
2.	1%	12mm long BF	16.96	30.85
		12mm long CF	22.9	25.8
3.	3%	12mm long BF	18.05	34.54
		12mm long CF	24.1	25.7

For more clearly the compressive strength results were discussed only for 28 day of curing. Figure 8 represents the compressive strength results at a volume fraction 1% of basalt and coir fiber. There is a significant increase in compressive strength by 26% on addition of basalt fibers as compare to the plain concrete. There is a slight increase in compressive strength by 6% on addition of coir fibers with reference to the plain mix.

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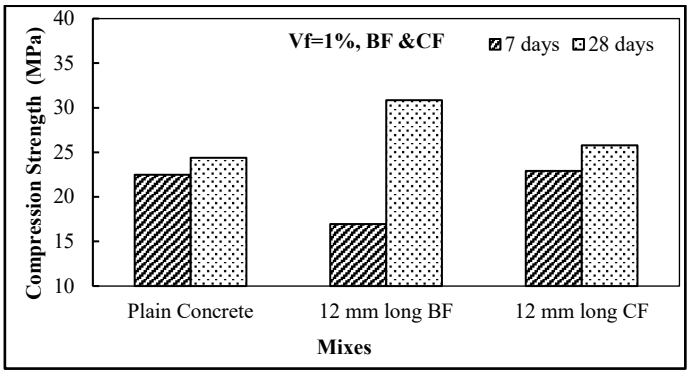

Fig.8 Compressive strength test results (Vf=1%)

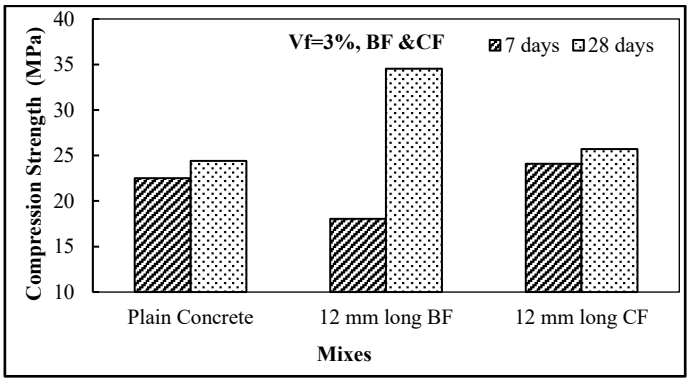

Fig.9 Compressive strength test results (Vf=3%)

Compressive strength results at a volume fraction 3% of basalt and coir fiber are presented in figure 9. There is a considerable increase in compressive strength by 42% on addition of basalt fibers with compare to the plain concrete mix. There is a minor increase in compressive strength by 5% on addition of coir fibers with reference to the plain mix.

C. Split tensile strength

TABLE.IX SPLIT TENSILE STRENGTH

S. No	*Fiber content*	*Name of Mix*	*Split Tensile Strength (MPa)*	
			7days	*28 days*
1.	0%	Plain Concrete	1.25	4.8
2.	1%	12mm long BF	2.09	5.7
		12mm long CF	2.6	6.4
3.	3%	12mm long BF	2.13	6.04
		12mm long CF	2.9	6.8

Only 28 days results of split tensile strength are discussed. The table IX presents the split tensile strength results for both 1% and 3% volume fractions. However the figures 10 present 1% and figure 11 shows 3% volume fraction for discussion propose. Split tensile strength results at a volume fraction 1% of basalt and coir fiber are presented in figure 10. There is a considerable increase in split tensile strength by 19% on addition of basalt fibers with compare to the plain concrete mix. It is observed that noticeable increase in split tensile strength by 33% on addition of coir fibers with reference to the plain mix.

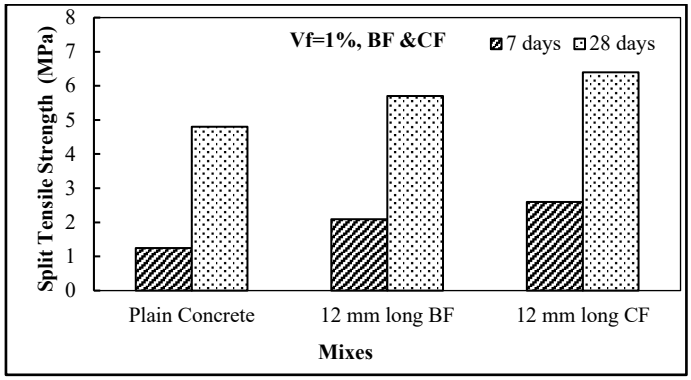

Fig.10 Split tensile strength test results (Vf=1%)

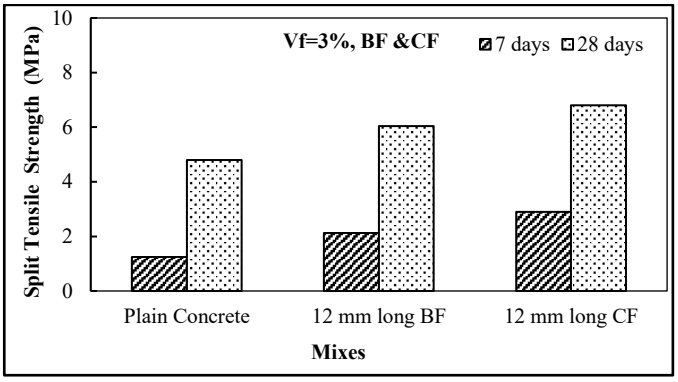

Fig.11 Split tensile strength test results (Vf=3%)

Figure 11 provides the split tensile strength results at a volume fraction 3% of basalt and coir fiber. There is a significant increase in split tensile strength by 26% on addition of basalt fibers as compare to the plain concrete. There is a drastically increase in split tensile strength by 42% on addition of coir fibers with reference to the plain mix.

V. CONCLUSIONS

The workability of the mixes containing the basalt and coir fibers is decreased due to the fiber volume effect. The coir fibers absorbed the water from the mix which leads to low workability as compared to basalt fiber.

There is a significant increase was observed in compressive strength on addition of basalt fibers at volume fraction 1% and 3% by 26% and 42% respectively.

The performance of the coir fibers was on the lower side. The increase was 6% and 5% at the volume fraction 1% and 3% respectively.

The performance of the basalt fibers in terms of increase in split tensile strength from 1% to 3% volume fraction was in a order of 19% and 26% respectively at 28 days of curing.

The coir fibers plays the noticeable elevate role in increase of split tensile strength as 33% and 42% for the addition of volume fraction 1% and 3% respectively.

The most appropriate mix combination from this study in terms compressive strength, split tensile strength and workability is having the volume fraction 3%.

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REFERENCES

[1] Jaysingh G.P and Joshi D.A, "Performance of Basalt Fiber in Concrete," International Journal of Science and Research (IJSR), (2014), pp 1372-1373.
[2] Singha K, "A short review on basalt fiber," International Journal of Textile Science, (2012), pp 166-180.
[3] Kirthika S.K and Singh S.K, "Experimental Investigations on Basalt Fiber-Reinforced concrete" J.Inst. Eng. India Ser. (2018): pp 661-670.
[4] Sinha D, Mishra C.B, and Solanki R.V, "Comparison of Normal Concrete Pavement with steel Fiber Reinforced Concrete Pavement," Indian Journal of Applied Research, Vol.4, Issue 8, (2014), pp 233-235.
[5] Jayaprada,"Behaviour of concrete by adding coir fibre", International Journal of Applied Engineering Research, (2014).
[6] Majid Ali, "Versatile Material and its application in Engineering," Journal of Civil Engg & Const. Tech vol.2 (9), (2011), pp.189-197.
[7] Noor Md, SadiqulHasan, Habiburrahman, Mdshiblee and MdSaifulIslam, "The use of Coconut Fibre in the production of Structural Lightweight Concrete" Journal of Applied Sciences vol 12(9), 2012.
[8] Maninder Kaur and Manpreet Kaur,"A review of utilization of Coconut coir as coarse aggregate in concrete," International Journal of Applied Engineering Research, vol (7) 2012,pp 0509.
[9] Pravin V Domke,"Improvement in the strength of concrete by using Industrial and Agricultural waste," Iosr Journal of Engineering, vol 2(4), (2012),pp 755-759.
[10] Anthony Nakem Ede and Joshua OlaoluwaAgbede,"Use of coconut husk fibre for improvement compressive and flexural strength of concrete,"International Journal of Applied Engineering Research, 2014.
[11] Ankit Sharma, "The study of strength characteristics of concrete by adding coir fibre and replacement of steel slag," International Journal of Mechanical Engineering and Technology, vol8 (2017), ISSN 0976-6359.
[12] Othumal,"Effect on the properties of concrete by adding coir fibre,"Journal of Applied Sciences 12(9), 2015.
[13] Das Gupta, N. C, Paramsivam, P,.and Lee S. L, "Coir reinforced cement pastes composites,". Conference Proceedings of Our World in Concrete and Structure,1979.
[14] Yaw Osei, , "Experimental Assessment on coconut coir as aggregate in concrete,"International Journal of Engineering Science Research, 05, 2013, pp 07-11.
[15] Harish S, Michael D. P, Bansely A, Mohan Lal D and Rajadurai A, "Mechanical property evaluation of natural fiber coir composite," Materials Characterization, (2009),pp. 44-49.
[16] I.S 10262-2019, "Recommended guidelines for concrete mix design," 2019.
[17] I.S 383-1970, "Specifications for coarse and fine aggregates",1970.
[18] I.S 8112-2013,"Specifications for 53 grade Ordinary Portland Cement", 2013.
[19] I.S 456-2000 "Indian Standard: Plain and Reinforced Cement Concrete" Code of practice.
[20] I.S. 5816-1999, "Methods of test for splitting tensile strength of concrete," Bureau of Indian standard, New Delhi 1999.