Evaluation of Strength Properties of Hybrid Fiber (Plastic + Coir + Areca nut Husk) Reinforced Concrete

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Abstract- In construction industry, concrete is used entirely in the world. The production of waste increases as the development of infrastructure increases. The waste disposal is becoming waste management problem. This targets to promote recycling of waste and energy recover is one of the significant applications of the work in the construction industry. In the present investigation, the influence of plastic + Coir + Areca nut husk fibers are studied. the fiber varying percentages are 0.5% to 3.0% at interval of 0.5% by weight of cement. M-20 fiber reinforced concrete is studied for various strength like flexural, compressive and split tensile strengths. Tests are determined as per Indian Standard codes. The tested results are compared with normal concrete. From the results, it is observed that strength of concrete increases due to addition of fibers. Addition of Fiber of 1.5% shows the best increase in strength. It was found that the proposed waste plastic + Coir + Areca nut husk fiber can be used in construction industry leading to safe and economical disposal of the wastes.

Keywords: Plastic + Coir + Areca nut husk fiber, Hybrid fiber reinforced concrete (HFRC), Flexural, Compressive and split Tensile strengths

I. INTRODUCTION

In developing and developed countries, concrete is used entirely in the world. The ingredients of concrete are important for its performance in the mix. We knew that concrete is brittle in nature. Addition of fibers controls cracks in concrete. The fibers were cheap and waste material, which can be used in concrete to develop strength. The organic and in organic fibers are added in concrete and its different strengths are determined by many researchers in the world. The present investigation, an attempt has been put in this paper is to control the cracks due to addition of plastic and natural fibers in normal concrete

Scope and objective of work

1. To introduce plastic + Coir + Arecanut husk fiber in conventional concrete.
2. To vary the percentage of plastic + Coir + Arecanut husk fiber in conventional concrete
3. To compare conventional concrete with plastic + Coir + Arecanut husk fiber reinforced concrete in terms of different strengths of concrete.
4. To find out optimum % of fiber content Description of concrete specimen is presented in

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Table 1 Description of concrete specim

Description of concrete	Designation	% of fiber	No. of specimen		
			cubes	prism	cylinder
Conventional Concrete	CC	0	3	3	3
concrete with plastic + Coir + Arecanut husk fiber for varying % of fiber (0.5% to 3.0%)		0.5	3	3	3
		1	3	3	3
		1.5	3	3	3
		2	3	3	3
		2.5	3	3	3
	HFRC	3	3	3	3

II. EXPERIMENTAL INVESTIGATION MATERIALS

Cement

The character of concrete depends the quality and quantity of cement. In this paper, Birla super cement 53 grade was used for the present research. Tests are carried out according to IS- 12269:1987. Cement properties are as tabulated in Table 2.

Table 2 Cement Properties

Sl. No.	Test	Results	Requirements as per IS 12269 : 1987
1	Specific Gravity	3.10	3.15
2	Fineness of cement	6.15%	Less than 10%
3	Standard Consistency	29%	Not Specified

Fine aggregate

The character of concrete depends the quality and quantity of M-sand. In this paper, locally available M- sand was used for the present research. Tests are conducted according to IS. M-sand properties are presented in Table 3.

Table 3 Fine Aggregate Properties

Sl. No.	Physical properties	Results
1	Specific Gravity	2.65
2	Fineness Modulus	2.73
3	Bulk density (kg/m^3)	1445

Coarse aggregate

The character of concrete depends the quality and quantity of coarse aggregate. In this paper, coarse aggregate was used and tests are conducted according to IS - 23861963. Coarse aggregates properties are tabulated in Table 4.

Table 4 Coarse Aggregates Properties (12.5mm down size)

Sl.No	Particulars	Results
1	Fineness Modulus	4.2
2	Specific Gravity	2.67

Water

Clean potable water was used for mixing and curing of concrete

Plastic fiber

The waste plastic fiber is obtained from LM Wind Power Blades (India) Pvt. Ltd Bangalore- 562111,

Coir fiber

The fiber is obtained from coir industry.

Arecanut husk fiber

The fiber is obtained from areca nut industry. Fiber properties are tabulated in Table 5.

Table 5 Fiber Properties

Properties	Plastic fiber	Coir fiber	Arecanut husk fiber
Length(mm)	25	25	25
Diameter(mm)	0.234	O.240	- 0.017 To 0.394
Tensile Strength(N/mm^2)	226	189	--

Fig 1 Plastic fiber

Fig 2 Coir fiber

Fig 3 Arecanut husk fiber

Design Mix

M-20 was designed according to IS-10262-2009.The concrete mix ratio obtained is 1:2.12:2.15.

Fig 4 Concrete with fibers (HFRC)

III EXPERIMENTAL PROGRAMME

M-20 mix design is prepared by addition of plastic fibers. The cube size 100*100*100mm, cylindrical size length-300 and dia-150mm and prism size 100*100*500mm specimens were casted with Plastic fiber(FRCP) of 0.5%, 1.0%, 1.5%,2%,2.5% and 3.0% and without fibers

Testing of specimen

Concrete specimens were tested for different fibers and various strengths like compression, split and flexural strengths respectively according to IS specification after curing 28 days

Compressive strength

Compressive test is conducted according to IS – 516:1959 .

Flexural strength

Flexure test conducted according to IS – 516:1959.

Split tensile strength

Compression test conducted according to IS – 5816:1999.

IV RESULTS AND DISCUSSIONS

Strength of cubes

The figure 3 inferrance that compressive strength increases compared to conventional concrete upto 2.5% fiber content of concrete with addition of Plastic + Coir + Arecanut husk fiber(HFRC) with further increase in fibre decreases the compressive strength. For an addition of fibre of 0.5% TO 2.5% with an interval of 0.5%, the increase in strength compared to conventional concrete is observed to be 10%, 14%, 20% , 23.5% and 15% respectively , for an addition of 3% of fiber the strength decreases by 2.5%.

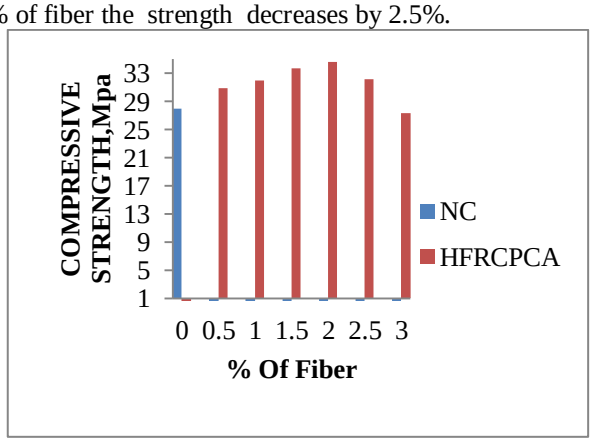

Fig 3 Comparison of cube strength of concrete for various % of fiber

Strength of prisms

The figure 4 explains that with the addition of Plastic + Coir + Arecanut husk fiber(HFRC) the flexural strength increases compared to conventional concrete. However increase in prism strength is higher than cube strength.

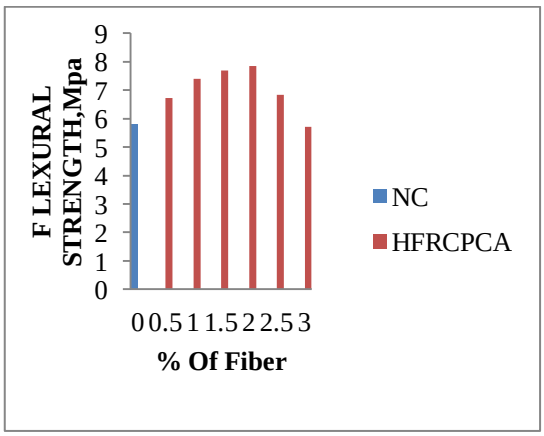

Fig.4: Comparison of prism strength of concrete for various % of fiber

Strength of cylinders

The figure 5 inference that with the addition of fibers the cylinder strength increases compared to conventional concrete. For concrete due addition of Plastic + Coir + Arecanut husk fiber (HFRC) of 0.5% to 2.5% the increase in strength compared to conventional concrete is observed to be 22%,25%, 29% , 30.7% and 17% respectively, for addition of 3% of fiber strength decreases by 1.8%.

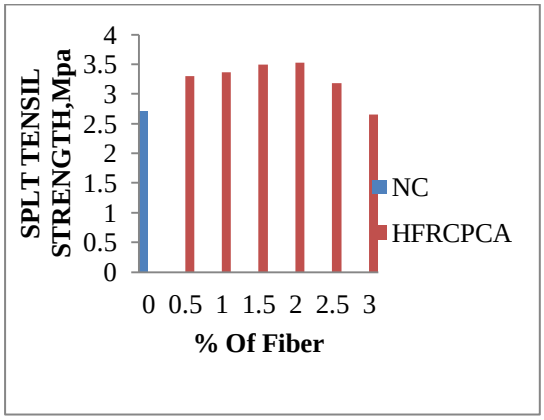

Fig 5 Comparison of cylinder strength of concrete for various % of Fiber

The addition of Plastic + Coir + Arecanut husk fiber (HFRC) in concrete has more influence on prism strength and cylinder strength rather than the Cube strength. For an optimum Percentage of 2% of fiber the Cube strength, prism strength and cylinder strengths compare to normal concrete increased by 23.5%, 35% and 30.7% respectively, as presented in fig6

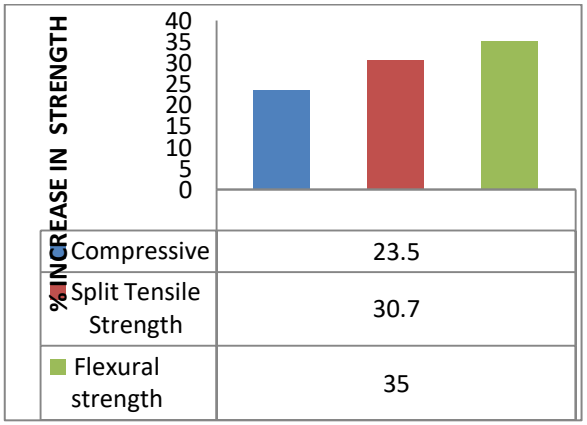

Fig 6: Comparison of cube, prism and cylinder strengths of 1.5% Fiber content.

V CONCLUSIONS

- With the addition of Plastic + Coir + Arecanut husk fiber in the concrete (HFRC) compare to conventional concrete (CC) the cube, prism and cylinder strengths increases.
- The strength of (HFRC) increases upto 2% of fiber which is optimum further increase in percentage of fiber (up to 3%) decreases the strength. however the strength is higher than CC upto 2.5% of fiber content.
- The presence of fiber increases the prism strength of concrete than the cube and cylinder strengths.
- Wastes can be effectively utilized in increasing the strength of concrete efficiently, instead of destroying its useful inherent properties. Also in turn reducing the problem of disposal.

REERENCES

1. Libo Yan andNawawiChouw, "Experimental study of flax FRP tube encased coir fibre reinforced concrete composite column", Construction and Building Materials 40 (2013), pp.1118–1127
2. Li Z, Wang L, Wang X (2007). Cement composites reinforced with surface modified coir fibers. J. Comp. Mat., 41(12), pp.1445-1457.
3. J.M.L. Reis, "Fracture and flexural characterization of natural fiber-reinforced polymer concrete", Construction and Building Materials 20 (2006), pp. 673–678
4. Majid Ali , Anthony Liu, HouSou, and NawawiChouw, "Mechanical and dynamic properties of coconut fibre reinforced concrete", Construction and Building Materials 30 (2012), pp 814–825
5. AnoopsinghChandel, Tanmay Shah, Tarak Shah, and Dixit Varde, "A Comparative Strength Study of Coir Fibre Reinforced Concrete (CFRC) Over Plain Cement Concrete (PCC)", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 13, Issue 2 Ver. I (Mar. - Apr. 2016), pp.95-97
6. Chao-Lung Hwang, Vu-An Tran, Jhih-Wei Hong and You-Chuan Hsieh, "Effects of short coconut fiber on the mechanical properties, plastic cracking behavior, and impact resistance of cementitious composites", Construction and Building Materials 127 (2016), pp.984–992
7. Shreeshail. B.H, JaydeepChougale,andDhanraj Pimple,. "Effects of coconut fibres on properties of concrete", International journal of research in engineering and technology. 2014 ; 03(12), PP.5-11.
8. R. N. Nibudey, Dr. P. B. Nagarnaik,Dr. D. K. Parbat and, Dr. A. M.Pande, "Strengths Prediction of Plastic fiber Reinforced concrete (M30)", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 3, Issue 1, January - February 2013, pp.1818-18

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