Experimental Enhancement On Strength Properties Of Coconut Fibre Concrete (CFC) And Polypropylene Fibre Concrete (PFC)

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Abstract- *Concrete is a cozy blend of binding material, fine aggregate, coarse aggregate and water. It is strong in compression yet exceptionally feeble in tension. The tensile property is presented in concrete by drafting diverse materials and this endeavor has offered ascend to reinforced cement concrete, reinforced brick concrete, prestressed concrete, fibre-reinforced concrete, cell cement and Ferro cement. For this study, coconut fibres will be used, as they are freely available in large quantities and will enhance the properties of concrete. The study comprises of comparative statement of properties of coconut fibre reinforced concrete with conventional concrete based on experiments that will be performed in the laboratory. The use of coconut fibres will also lead to better management of these waste fibres. The present day world is witnessing the construction of very challenging and difficult civil engineering structures. Concrete is the most important and widely used material for its high strength and sufficient workability properties. In order to find the optimum quantity of Polypropylene fibers required to achieve the maximum compressive strength for M25 grade concrete, various experimental work will be performed. We are using both polypropylene fibre and coconut fibre to increase the strength of concrete.*

Keywords- Coconut Fibre Concrete, Polypropylene Fibre Concrete, Setcrete RMW Concrete

I. INTRODUCTION

Concrete is a composite material composed of fine aggregate bonded together with fluid cement that hardens over time. Portland cement is the commonly used type of cement for production of concrete. It is used for the construction of foundations, columns, beams, slabs and other load bearing elements. Concrete can be cast in any shape since it is a plastic material in fresh state. Concrete is generally in two types of construction, i.e. plain concrete construction and reinforced concrete construction. In PCC, it is poured out and casted without use of reinforcement. This is used when the structural member is subjected only to the compressive forces and bending. Concrete is one of the most durable building materials. It provides superior fire resistance compared with wooden construction and gains strength over time. Concrete is used in large quantities almost everywhere there is a need for infrastructure.

Cement is a binder, a substance used for construction that sets, hardens and adheres to other materials to bind them together. Cement is a seldom used on its own but rather to bind sand and gravel (aggregate) together.

Fine aggregates are usually sand or crushed stone that are less than 9.55 mm. There are two types i.e. scrabbled stone and Gravel. It includes the particles that passes through 4.25 mm and retained on 0.075 mm sieve.

Uncrushed gravel or stone which is the result of natural disintegration and crushed gravel or stone are usually called the coarse aggregates. Coarse aggregates are stones that are retained on 4.5mm sieve. Nearly all natural aggregates originate from bed rock.

Fibres can be in form of coconut fibre, banana fibre, steel fibre, glass fibre, natural fibre, synthetic fibre, etc. The fibres are used to reduce shrinkage cracking. Even though the market for fibre reinforced concrete is still small compared to the overall production of concrete, the worldwide yearly consumption of fibres used in concrete is 300,000 tons. Concrete containing hydraulic cement, water, aggregate, and discontinuous discrete fibers is called fibre reinforced concrete. Main role of fibres is to bridge the cracks that develop in concrete and increase the ductility of concrete elements, improvement on post cracking behavior of concrete.

Coconut fibre reinforced concrete has been used for making roof tiles, corrugated sheets, pipes, silos and tanks. Concrete without any fibers will develop cracks due to plastic shrinkage, drying shrinkage and changes in volume of

concrete. To overcome the brittle response of the concrete, Micro structural properties of natural fibers as composites in terms of flexibility, ductility and energy absorption improves seismic resistance.

Polypropylene fibers are new generation chemical fibers. They are manufactured in large scale and have fourth largest volume in production after polyesters, polyamides and acrylics. Polypropylene Fibers are one of the main types of Fiber used in the market, apart from steel Fibers. However, both types of Fibers vary significantly in their elastic and strength properties. For 40 years, steel Fibers have been commonly used in concrete flatwork and sprayed concrete applications. The emergence of polypropylene Fibers has introduced to the world the possibility of having a high-performance and more cost-effective product in the market place.

Polypropylene fiber is a synthetic fiber with low density, fine diameter and low modulus of elasticity. It has some special characteristics such as high strength, ductility and durability, abundant resources, low cost and easily physical and chemical reformations according to certain demands. Thus it can be widely utilized in the field of concrete products. In this study the influence of different amount of polypropylene fibers content on concrete properties were investigated by measuring compressive strength.

Investigated that PFRC does provide improve impact resistance with increasing volumes of fibres. A PFRC mixture does provide reductions in permeability provided that the water-cement ratio remains below 0.5. Increased percentages of fibre further decreased the permeability provided the mixture remained workable **(James E. Shoenberger, Joe G. Tom et al)**

Polypropylene fibers enhance the strength of concrete, without causing the well known problems, normally associated with steel fibers. The problem of low tensile strength of concrete can be overcome by addition of polypropylene fibers to concrete. Notable increase in compressive strength is reported with addition of polypropylene fibers. The failure is gradual and ductile in polypropylene fiber reinforced concrete. **(Dr.T.Ch.Madhavi, L.Swamy Raju, Deepak Mathur, 2014).**

The percentage increase in the compressive strength for the cubes with polypropylene fiber 1%, 1.5% and 2% compared to the cubes without polypropylene fiber are 4%, 5.6% and 12 % respectively. Thus it is recommended to use polypropylene fiber 2% to get the maximum benefit in improving compressive strength. In a nutshell it can be concluded that the use of polypropylene fiber is an effective method to improve the compressive strength of concrete **(Salahaldein Alsadey, Muhsen Salem, 2016).**

The addition of coconut fibres significantly improved many of the engineering properties of the concrete, notably compression, and tensile strength. The ability to resist cracking and spalling also enhanced. Despite its excellent properties, coconut fibre as an enhancement of concrete is unlikely to replace steel for the vast majority of structures **(Raphael Chacko, S Hema and M Vadivel, 2016).**

The compressive strength, Split tensile strength and Flexural strength has an increasing trend upto 2%. Later, strength decreased with the increase in fiber content. CFRC with 2% fiber content has higher compressive strength, Split tensile strength and Flexural strength as compared to that of PC **(Shreeshail.B.H, Jaydeep Chougale, Dhanraj Pimple, Amar kulkarni).**

By reinforcing the concrete with coconut fibres which are freely available, we can reduce the environmental waste. Flexural strength increases in case of 3% fibre mix. Thus, economy can be achieved in construction. Since, 5% & 7% fibres do not show favorable results, it can be concluded that fibre content should not be used beyond 3% **(Kshitija Nadgouda, 2015).**

Compressive strength of material increases with increasing fibre content. The durability of concrete improves and addition of polypropylene fibers greatly improves the fracture parameters of concrete. Polypropylene fibre is a reduce number of joints and reduce repair due to subsequent damage. The compressive strength and split tensile strength increase with the addition of fiber content as compared with conventional concrete. The workability of Polypropylene fibre concrete has been found to decrease with increase in Polypropylene fibre content replacement **(A. P. Sathe, A. V. Patil).**

The aim of this experimental study is to compare the basic properties of control concrete such as compressive strength, tensile strength at 7 days, 14 days and 28 days with the properties of concrete made using polypropylene fibre and coconut fibre. Also focused on improving the strength and stiffness of concrete by the use of these fibres and it will also lead to better management of waste fibres.

II. MATERIALS

1. Cement

Ordinary Portland cement 53grade which is available in the market is used.

Fig: 1 Cement

2. Coarse aggregate

Locally available crushed stone, sieved with a 20 mm sieve, was used as coarse aggregate.

Fig:2 Coarse aggregate

3. Fine aggregate

M Sand which is locally available was used as fine aggregate.

Fig:3 Fine aggregate

4. Coconut fiber

Coconut Fibres are strong, light in weight. The addition of coconut fiber can reduce the thermal conductivity of the composite specimens. Cement used- Ordinary Portland cement of 53 Grade.

Sand- passing through 4.75mm sieve.
Coarse aggregate- 20mm and downsize.

Fig: 4 Coconut fibre

5. Polypropylene fiber

Polypropylene fiber, a synthetic carbon polymer, is produced as continuous mono-filaments, with circular cross section. Polypropylene fibres are tough but with low tensile strength and modulus of elasticity. They have plastic stress-strain characteristics.

Fig:5 Fine aggregate

6. Admixture

Setcrete RMW is a Liquid Waterproofing admixture for use in all cement based mortars, screeds and concrete formulated from selected polymers specially designed to reduce water permeability.

Fig: 6 Setcrete RMW

III. METHODOLOGY

Mix design:

Mix design is a process of selecting suitable ingredients and determining their relative proportions with the objective of producing concrete of having minimum

workability, strength and durability as economically as possible. M25 grade was used in this study.

Table1. Mix proportions

SI NO	GRADE OF CONCRETE	MIX PROPORTIONS
1	M25	1:1:2

Casting of concrete:

Quantity of materials for:

1. Conventional Concrete:

Table 2 Quantities Of Conventional Concrete

S.No	Description	Cement (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)	w/c ratio
1	Cube(3nos)	6.075	6.075	12.15	0.50
2	Cylinder (3 nos)	10.189	10.189	20.379	0.50
3	Beam (1 no)	3	3	6	0.50

2. Polypropylene Fibre:

Table 3 Quantities Of Polypropylene Fibre

Sl.no	Description	Cement (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)	w/c ratio	Super Plastic izer (ml)		Coconut Fibre	
						0.01%	0.03%	0.01%	0.03%
1	Cube (3 nos)	6.075	6.075	12.15	0.50	30	60	60.75	182.16
2	Cylinder (3 nos)	10.189	10.189	20.379	0.50	30	60	101.88	305.685
3	Beam (1 no)	3	3	6	0.50	30	60	90	270

3. Coconut fibre:

Table 4 Quantities Of Coconut Fibre

Sl.no	Description	Cement (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)	w/c ratio	Super Plastic izer (ml)	Polypropylene fibre	
							0.01%	0.03%
1	Cube (3 nos)	6.075	6.075	12.15	0.50	30	60.75	200
2	Cylinder (3 nos)	10.18	10.189	20.379	0.50	30	101.89	305.68
3	Beam (1 no)	3	3	6	0.50	30	30	90

Fig:7 Casting of mould

IV. RESULT

1. Compression test:

Table 5. Compression Test Result

Sl. no	Description	%of fibre	7 Days N/mm2	14Days N/mm2	28Days N/mm2
1	Cube(CRC)	0	19	23.2	25
2	Cube (PFC)	0.01%	13.77	20.31	24
		0.03%	10.4	12	13.95
3	Cube (CFC)	0.01%	11.77	17.68	23.4
		0.03%	6.48	14.84	20.2

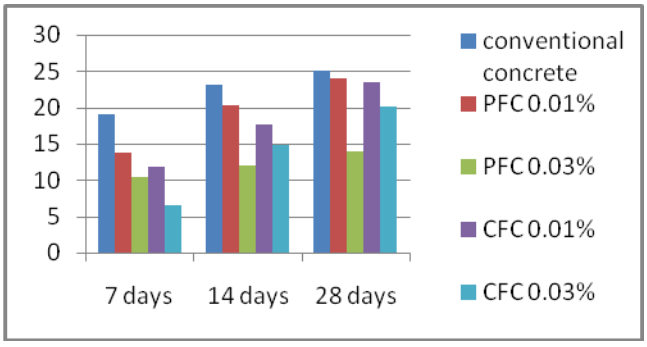

Fig:8 Compression test

In the above figure 8, the 14 days compressive strength of PFC-Polypropylene Fibre Concrete (0.01%) is equal to the 14 days compressive strength of conventional

concrete. The 28 days compressive strength of PFC-Polypropylene Fibre Concrete (0.01%) is equal to the 14 days compressive strength of conventional concrete. In 28 days of PFC-Polypropylene Fibre Concrete (0.03%) and CFC-Coconut Fibre Concrete (0.01%, 0.03%) gives lesser strength than Conventional Concrete.

2. Split tensile strength:

Table 6 Split Tensile Result

Sl. No	Description	%of fibre	7 Days N/mm²	14 Days N/mm²	28 Days N/mm²
1	Cylinder(CC)	0	1.129	2.861	6.65
2	Cylinder (PFC)	0.01%	2.136	2.8	3.0
		0.03%	1.733	2.16	2.77
3	Cylinder (CFC)	0.01%	2.107	2.68	2.9
		0.03%	1.952	2.15	2.5

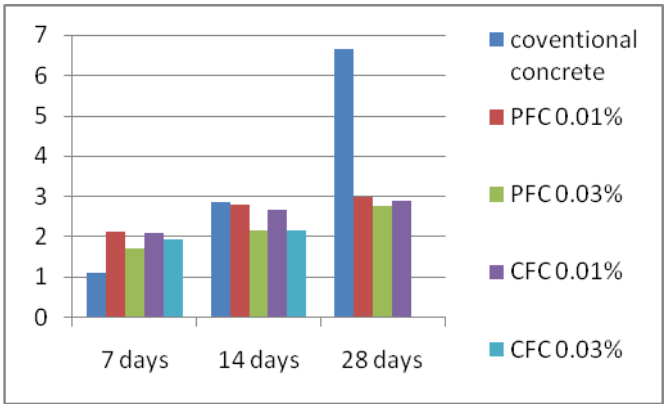

Fig:9 Split tensile test

In the above figure 9, the 14 days split tensile test of PFC-Polypropylene Fibre Concrete (0.01%) and coconut fibre (0.01%) is almost equal to the 14 days split tensile strength of conventional concrete. In 28 days of PFC-Polypropylene Fibre Concrete (0.01%,0.03%) and CFC- Coconut Fibre Concrete (0.01%,0.03%) gives lesser strength.

3. Flexural strength test:

Table 7 Flexural Strength Test

Sl. No	Description	% of fibre	28 Days N/mm2
1	Beam (CRC)	0	3.85
1	Beam (PFC)	0.01%	4.2
		0.03%	3.5
2	Beam (CFC)	0.01%	4.5
		0.03%	4.1

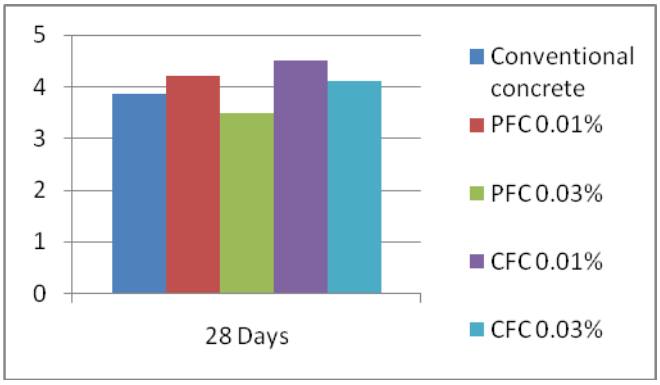

Fig 10 Flexural strength test

From the figure 10, we can conclude that the flexural strength of polypropylene fibre (0.01%,0.03%) and coconut fibre (0.01%,0.03%) gives more strength.

V. CONCLUSION

The findings of experimental investigations on the strength characteristics of concrete enhanced with polypropylene fibre and coconut fibres are reported. The following conclusions can be derived.

- The polypropylene fibre concrete (0.01%) gives compressive strength which is almost equal to the conventional concrete. So it is applicable for construction field.
- The polypropylene fibre concrete (0.03%) gives compressive strength less than the conventional concrete. So it is not advisable.
- The coconut fibre concrete (0.01%) gives compressive strength almost equal to conventional concrete. But the compressive strength decreases as the percentage of fibre increases.
- From the above we can conclude that coconut fibre concrete gives higher strength when compared to polypropylene fibre concrete.

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