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Evaluation of Strength of Fibre Reinforced Concrete Using Plastic Fibres

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Abstract— Now-a-days, environmental problem is faced all over the world. The things which are invented and used for our luxurious life are responsible for environmental pollution. Due to improper waste management, we facing land pollution. Land pollution is mainly due to waste plastic. This plastic can be reused or recycled to maintain the beauty of nature. To address this issue, in this paper, the waste plastic is used to make fibres. These plastic fibres were added in various percentages in the M25 grade concrete. This paper describes the performance of plastic fiber reinforced concrete (M25). The experiments were carried out on the specimens like cubes and cylinders which were casted in the laboratory and their behavior under the test was observed. The plastic fibers were added from 0.0 % to 0.8 %. The compressive strengths of concrete were determined after 7, 14 28 and 56 days of curing period. The test results were compared and the relationships between the standard concrete and Fibre reinforced concrete are presented.

Keywords ---Cement Concrete Composites, Plastic Fibers, Fibre Reinforced Concrete, And Compressive Strength.

I. INTRODUCTION

The most widely used construction material is concrete. The performance of concrete after construction depends on its ingredients. It is well known that plain concrete is brittle but strong in compression. But at the same time, it is weak in tension. The fiber reinforcement concrete transform a brittle concrete into a pseudo ductile material and very advantageous to concrete. Fibres addition in concrete can arrest micro cracks causing gradual failure. The fibers made from cheap or waste materials like plastic, glass etc., may be used for manufacture a wide range of structural units with cement mortar composites and has a great potential for developing countries like India. Mechanical properties of concrete has been studied by many researchers to enhance the properties of concrete using different fibers like glass, steel, carbon, synthetic organic and natural fibers. The present paper studies the effect of addition of various percentage of plastic fibers on mechanical property and behavior of concrete. Effect of plastic fibers in concrete under compression strength are discussed.

The fibre-reinforced polymer (FRP) composite is a combination of :

- A polymer (plastic) matrix (either a thermoplastic or thermoset resin such as polyester,vinyl ester, epoxy).
- A reinforcing agent such as glass, carbon, aramid or other reinforcing material.

The resin is used to coheres and gives shape to the element while fibres reinforce it. Tis combination results in light weight and strong composite material. The FRP composites have high strength to weight ratio which provides discernible reinforcing function.

II. MATERIALS

Two types of materials are used in FRP:

- A polymer (plastic) matrix and
- Fibre.

A. Resins Used In Frp

Some of the most important material characteristics to consider in selecting a matrix for structural FRP are: stiffness, strength, thermal and electrical conductivity, ability to impregnate and bond to fibres.

ISSN No: - 2456 – 2165

a). Epoxy Resin

Epoxy resins are the most versatile matrices for FRP's. They have an exceptionally broad range of physical properties, mechanical capabilities. The most important and major advantage of epoxy resin for manufacture of FRP laminates is that the exothermic polymerization process can be slowed down by lowering the temperature of resin after the fibres have been infiltrated. Epoxy resin are known for their excellent strength and creep resistance, strong adhesion to fibres, chemical and solvent resistance, good electrical properties.

b). Polyester Resin

Commercial thermo set polymers consists of an unsaturated ester polymer dissolved in a cross linking monomer such as styrene. The principal advantages of polyster for FRP's are its low viscosity, dimensional stability, fast cure time and excellent chemical resistance.

B. Pultrusion Method of Producing FRP

Pultrusion is a process for molding continuous lengths of constant or nearly constant profiles. The FRP roads are produced by pultrusion method. After traveling through the continuous traction pulling device, the profiles are cut to the desired length with an abrasive wheel. Longitudinal roving are necessary are necessary to provide sufficient strength for pulling the material through the die, although mats and fabrics with fibre angles between 0 deg. To 90 deg. are frequently added to obtain some transverse stiffness and strength.

In the construction industry, much attention has been focused on pultruded rods with " deformed " or sand-coated surfaces which promote better mechanical bonding in reinforcement rod application. Hybrid fibre FRPs can also be made easily by the pultrusion process since any mix of fibres can be selected at the time of manufacture. While circular rods are most common, flat bars and another shape have been manufactured.

III. SCOPE AND OBJECTIVE OF WORK

Based on the previous discussions, the objective of the present study has been identified as follows:

1. To introduce plastic fibre in conventional concrete.
2. To vary the percentage of plastic fiber in conventional concrete
3. To compare conventional concrete with plastic fibre reinforced concrete with respect to the compressive strength of concrete
4. To find out the optimum percentage of plastic fibre in conventional concrete.

IV. EXPERIMENTAL WORK

The ingredients used in the experimental work are Ordinary Prtland Cement, 20mm and 10 mm size Aggregates, potable water, plastic fibre of 4 mm diameter (refer fig. 1)

Fig. 1: Plastic Fibre

The properties of aggregates are as follows;

Sieve Size	Mass of Retained Fraction on sieve in gm.	Mass of no. of pieces Retained on guage in gm.	x	y	ἐ
	(w)	(n)	n/w	w/W	xy
63-50	0.00	0.00	0.00	0.00	0.00
50-40	0.00	0.00	0.00	0.00	0.00
40-31.5	0.00	0.00	0.00	0.00	0.00
31.5-25	0.00	0.00	0.00	0.00	0.00
25-20	0.00	0.00	0.00	0.00	0.00
20-16	0.00	0.00	0.00	0.00	0.00
16-12.5	0.00	0.00	0.00	0.00	0.00
12.5-10	361.00	57.00	0.16	0.68	0.11
10-6.3	168.00	11.00	0.07	0.32	0.02
Total Wt. (W)	529.00				12.85%
			Flakiness index =		12.85%

Table 1: Flakiness Index of Coarse Aggregate of 20mm Size

Sieve Size	Mass of Retained Fraction on sieve in gm.	Mass of no. of pieces Retained on guage in gm.	x	y	ε
	(w)	(n)	n/w	w/W	xy
63-50	0.00	0.00	0.00	0.00	0.00
50-40	0.00	0.00	0.00	0.00	0.00
40-31.5	0.00	0.00	0.00	0.00	0.00
31.5-25	0.00	0.00	0.00	0.00	0.00
25-20	1705.00	142.00	0.08	0.31	0.03
20-16	2011.00	213.00	0.11	0.37	0.04
16-12.5	942.00	110.00	0.12	0.17	0.02
12.5-10	523.00	98.00	0.19	0.10	0.02
10-6.3	319.00	53.00	0.17	0.06	0.01
Total Wt. (W)	5500.00				11.20%
			Flakiness index =		11.20%

Table 2: Flakiness Index of Coarse Aggregate of 10mm Size

IS Sieve sizes (mm)	Analysis of coarse aggregate fraction		Percentage of different fraction		Combined	Limits as per IS 383 - 1970
	20 mm Agg. % passing	10 mm Agg. % passing	20 mm	10 mm	100	
			33	22		
40 mm	100	100	33	22	100	100
20 mm	89.83	100	29.64	22	96.64	95 to 100
4.75 mm	0.2	4.07	0.07	0.9	43.92	30 to 50
0.6mm	0	0	0	0	18.6	10 to 35
0.150 mm	0	0	0	0	0.87	0 to 06

Table 3: Combined Grading

Description	Specific Gravity	Water Absorption
20 mm Coarse Aggregate	2.84	2.04%
10 mm Coarse Aggregate	2.82	1.83%
Natural Sand fine aggregate	2.73	2.25%
Crushed Sand Fine Aggregate	2.68	3.09%

Table 4 Specific Gravity & Water Absorption

a) Grade of designation	M - 25 Grade
b) Type of cement	OPC 53 grade
c) Maximum nominal size of agg.	20 mm
d) Minimum cement content	320 Kg/Cum
e) Maximum water - cement ratio	0.50
f) Workability	100-120mm
g) Exposure condition	Mild
h) Method of concrete placing	Conventional
i) Type of aggregate	Fine and Coarse Aggregate
j) Maximum cement content	450 /Cum

Table 5: Data For Mixed Design

V. RESULTS AND DISCUSSION

The compressive strength test over Conventional concrete and fibre reinforced concrete are conducted and following results are extracted. The concrete is replaced by plastic fibre 0.2%, 0.4%, 0.6% and 0.8% by weight of concrete. Compressive strength at 7 days, 14 day, 28days and 56 days are determined.

The experimental study over conventional concrete and plastic fibre reinforced concrete shows that the compressive strength of concrete after adding plastic fibre increases. The compressive strength at 28 days of 0.6% by weight replacement of plastic fibre increased by 13.1%. But further addition of plastic fibre in concrete reduces the compressive strength at 28 days by 8.06%.

Days	0.0%	0.2%	0.4%	0.6%	0.8%
7	18.99	20.41	21.06	21.37	20.32
14	23.29	24.82	25.63	26.23	25.46
28	28.45	30.21	31.80	32.74	30.10
56	30.06	31.61	33.46	35.59	33.52

(Compressive Strength in Mpa)

Table 6: Compressive Strength

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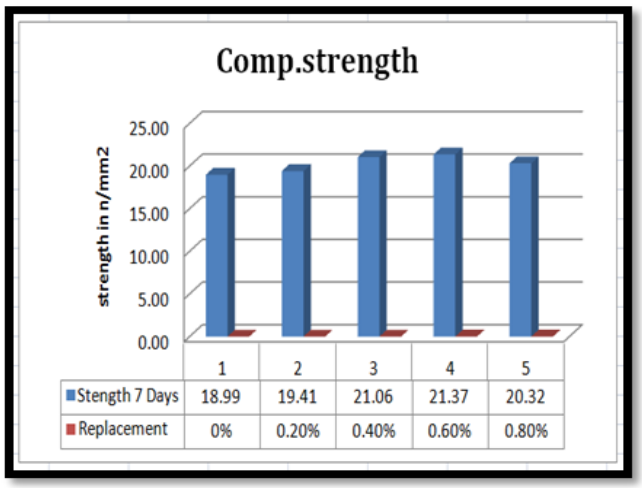

Fig.2: Compressive Strength at 7 Days

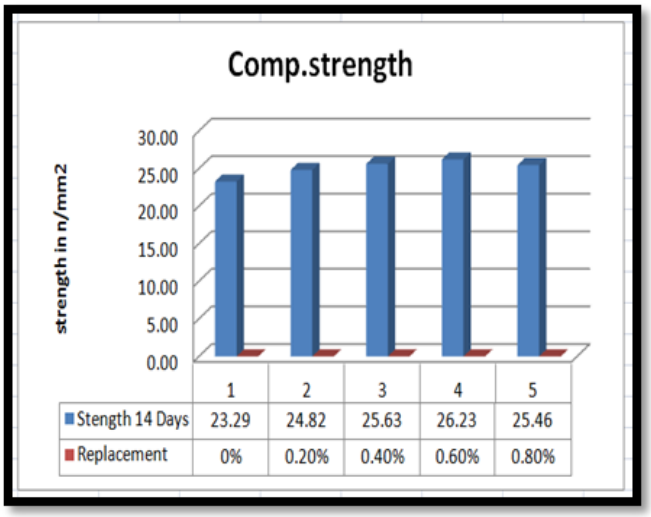

Fig.3: Compressive Strength at 14 Days

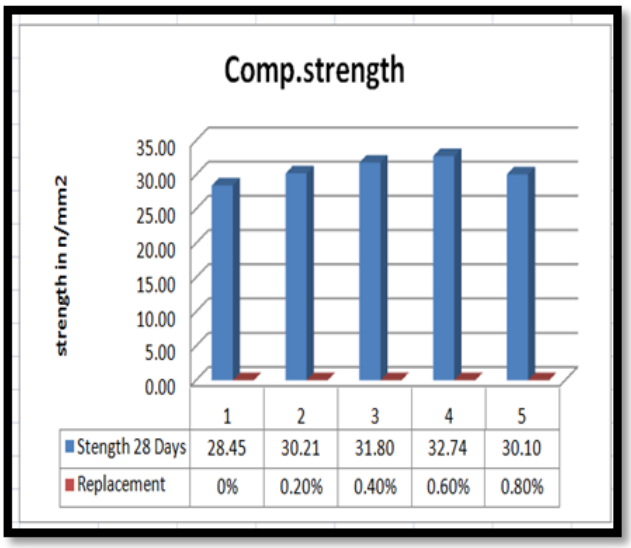

Fig. 4: Compressive Strength at 28 Days

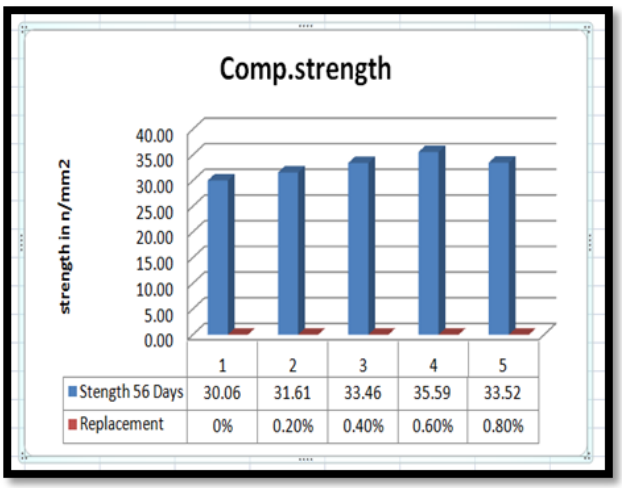

Fig. 5: Compressive Strength at 56 Days

VI. CONCLUSION

The test results concludes that addition of plastic fibre in concrete increases compressive strength of concrete. It has been observed that addition of plastic fibre upto 0.6% by weight of concrete increases the compressive strength by 13.1%, But further increasing the percentage upto 0.8% again reduces the compressive strength of concrete by 8.06%. Hence, it can be concluded that, the optimum percentage of plastic fibre is 0.6% by weight of concrete. Plastic fibred ores not affect the workability of concrete.

Plastic fibre is a good alternative to conventional concrete as it increases the compressive strength more than the expected value. Moreover, plastic waste is used as the fibre in conventional concrete. This reduces the plastic waste in environment and helps to maintain the clean environment. Hence, Plastic fibre reinforced concrete is an environmental friendly option in a construction industry.

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