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INVESTIGATION OF REINFORCED CONCRETE BEAMS BY INCORPORATING POLYPROPYLENE FIBRE REINFORCED POLYMER COMPOSITES

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ABSTRACT

Worldwide, massive research is currently conducted concerning to exploit the fibre reinforced sheets and laminates in the strengthening and repair of Reinforced Concrete members. Fiber-reinforced polymers (FRP is a beneficial way to strengthening and repair structures for those which have become structurally frail over their lifespan. In this project, the experimental investigation conducted on polypropylene fibre of length 12mm and 24mm, having an aspect ratio of around 800 was employed in an equal percentage of 0.5% by weight in cast concrete and tests like compressive strength on cubes, flexural strength on beams and split tensile strength on cylinders conducted. Moreover, the outcome shows the ordinary concrete has the deficient tensile strength and a small resistance to cracking. Internal cracks were primarily present in concrete, and its weak tensile strength is due to the propagation of such microcracks. Fibers added to a certain percentage of concrete improves strain value and also crack resistance and flexure strength.

Key words: polypropylene fibre reinforced polymer (PFRP), Compressive strength flexural strength and split tensile strength.

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1. INTRODUCTION

Historically, much attempt has been spending improving the behaviour of concrete structures. Compressive, flexural, ductility, shear strength, and durability properties are presently focused by many researchers who have tested concretes with the addition of steel and other materials to develop the behaviour of concrete. Nowadays, fibres created from different materials knowingly as glass, steel, carbon, and synthetic material. Every fibre has its specific benefits. However, steel fibre is the most familiar one. However, it was not there until 1963[1] when significant experiments were carried to improve particular characteristics using real steel fibres. A typical length of steel fibres ranges from 0.24 to 2.4 in (6 to 62 mm), and its diameter ranges from 0.025 to 0.044 in (0.5mm to 1.0mm). Earlier studies [1] showed that these fibres were not successful like steel and glass.

According to the researchers, bending strength and formability are the additional advantages of accumulating the fibres to the concrete. Various kinds of fibre that frequently used in the concrete are steel and polypropylene fibre [2]. The desertion of concrete surface moist is a factor in creating the paste fracture in concrete which leads to the development of tension stress since the concrete start to strengthen[3]. The fractures which form the acceleration of water disappearance is more than the movement of the concrete emulsion to the surface [4]. Here, the harmful stress generated in the capillary suction through which the concrete stick flows and proportionately the tensile stress will form. Such stress enveloped during the concrete strengthening and the cracks caused by paste constricting in the concrete forms at the early hours after transferring of concrete in the frames and before the concrete reaches its early strength.

The contribution of fibres in concrete towards flexural strength is smaller compared to the strength given by the rebar. In present work, fibres are replaced to Study the flexural behaviour of PFRC with different tests such as compressive strength of the cube and the split tensile strength of the cylinder.

2. MATERIALS

2.1. Cement

In the present work, Ordinary Portland cement (OPC) 53-grade sample was tested to obtain the following characteristics of the Specific Gravity 3.14 and Standard consistency 32%. The cement bag should not keep open so as not to lose the properties of cement.

2.2. Coarse Aggregate

In the present research, the locally available trampled stone aggregate of size 20 mm and down, was used and various tests carried out on the aggregates such as Specific gravity, fineness modulus and water absorption are recorded as 2.754, 2.263, and 1.23%.

2.3. Fine Aggregate

In the present research, the river sand, which was available at Vellore, was used as fine aggregate and the test value on Specific gravity 2.641, Fineness modulus 3.652 and Water absorption 1.84%

2.4. Polypropylene Fiber

Polypropylene fibre is a synthetic hydrocarbon polymer. According to ACI 544R-2003, synthetic fibres are fibres made and developed using textile and petrochemical industries. Monofilament form of polypropylene fibres made through an extrusion process. The length of the fibre is 12, and 24mm with elongation 1.1, the tensile strength, specific gravity and water absorption recorded as 1500Mpa, 0.91 and 3%.

Figure 1 Polypropylene Fiber

3. EXPERIMENTAL PROCEDURE

3.1. Mix Proportioning of Concrete

The Mix design for M25- grade of concrete done with cement replaced with fibres as per the Indian Standard Code IS 10262:2009. Table 1 shows the proportioning of the various mixes.

Table 1 Mix proportions of blended concrete

Mix	C:S: A	w/c	% Fiber Added	Cement (Kg/m^3)	Sand (Kg/m^3)	Aggregate (Kg/m^3)
M25	1:1.42:2.56	0.5	(0-3)	350	497	896

Cube moulds of size 0.15 x 0.15 x 0.15 cm were cast and were demoulded after 24hrs later immersed in water for 28days. Next, to that, the specimens should take out from water and dried for 24hrs.

3.2. Compression Test

The compression test was done for the cubes of size 0.15 x 0.15 x 0.15cm after preparing the specimens these specimens were kept in the testing machine and slowly the load was increased untill the failure of cube happened .The cubes tested on compression testing machine was done as per I.S.516-1959.

Figure 2 Compressive Strength Test Setup

3.3. Split Tensile Strength

For tensile strength test, cylinder specimens of dimension 0.15cm diameter and 0.30cm length have taken. The specimens were demoulded after 24 hours of casting and later taken to curing tank to cure for 28 days. The specimens tested as per IS: 5816-1999.

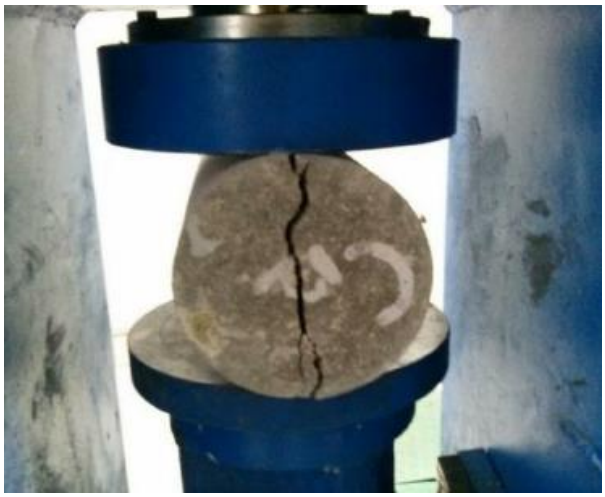

Figure 3 Split Tensile Strength test Setup

3.4. Flexural Strength Test

The flexural strength of concrete beam was determined based on IS: 516 –1959.Beam specimens of size 0.5cm x 0.10cm x 0.10cm are selected. After preparing the specimens, they were placed in loading frame and tested for flexural strength. The load increased until the maximum load applied to the specimen which tends to break the specimen during the test. The flexural test was performed on beams on the universal testing machine according to IS: 516-1959. The failure load to each beam was noted for finding flexural strength.

Figure 4 Flexural strength test Setup

4. RESULTS & DISCUSSIONS

4.1. Compressive strength of Cube Polypropylene Fiber Reinforcement concrete

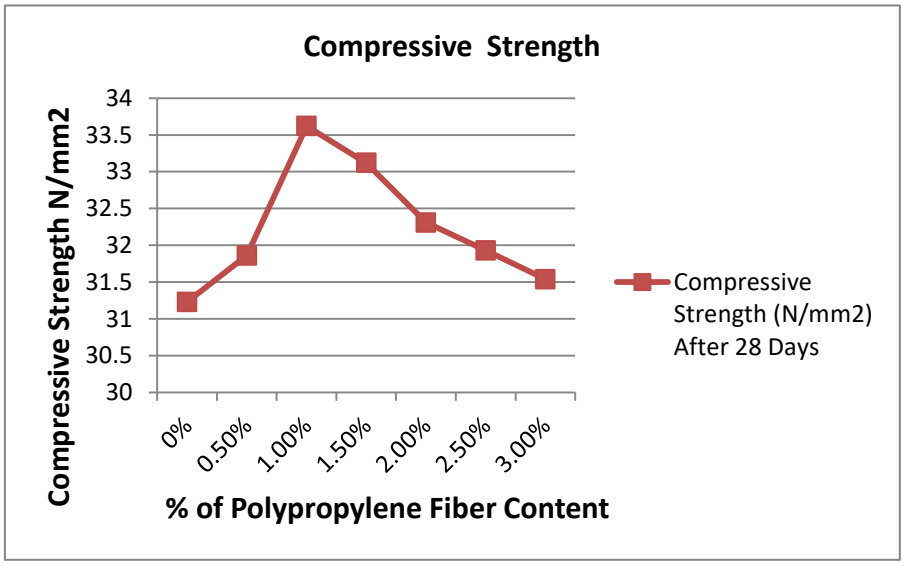

Figure 5 Compressive Strength plot

From the above figure, it concluded that the compressive strength of the cube increased 0.5 % to 1% of Polypropylene fibre by weight of the cement. Fiber with the addition of more than 1% decreased. Compared to the Nominal concrete mix the addition of polypropylene fibre achieves better compressive strength.

4.2. Split Tensile strength of Polypropylene Fiber Reinforcement concrete

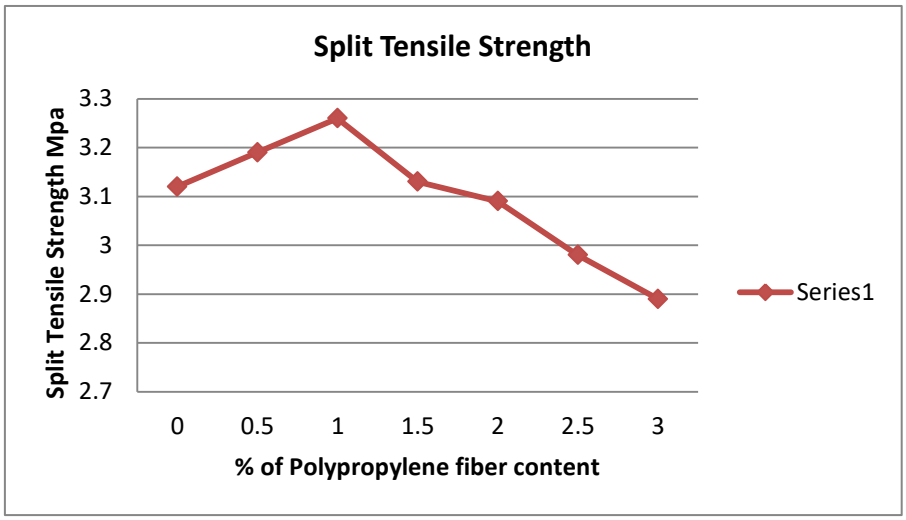

Figure 6 Split Tensile Strength plot

From the above figure, it shows that the split tensile strength increased with an increased percentage from 0.5% to 1% of Polypropylene fibre by weight of the cement. After 1 % the strength tends to decrease. When compared to Nominal concrete mix the polypropylene fibre achieves good split tensile strength.

4.3. Flexural Strength Test of Polypropylene Fiber Reinforcement concrete

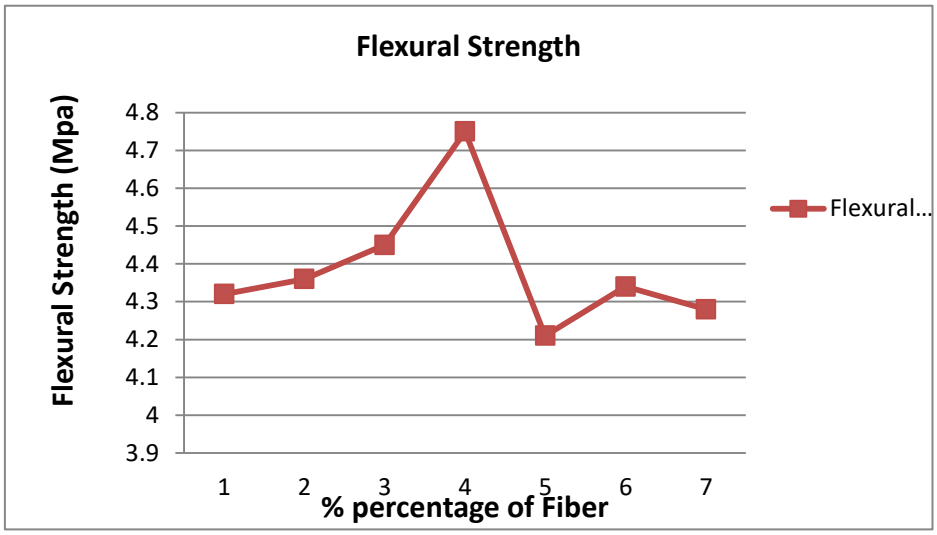

Figure 7 Flexural Strength test plot

From the above figure, it shows that the flexural strength increased with increase in percentage from 0.5 % to 1.5 % of Polypropylene fibre by weight of the cement. After 1.5% the strength tends to decrease. When compared to Nominal concrete mix the polypropylene fibre achieves good flexural strength.

5. CONCLUSIONS

- Compared to ordinary concrete fibre reinforced concrete achieves more strength. The following quantity of fibre 0.5% to 1 % added in concrete, and their strength compared with normal mix concrete and hence found that the concrete with polypropylene added is stronger than normal mix concrete.

- The addition of fibres improved the flexural strength of concrete significantly. The fibre reinforced concrete can hold the crack of the concrete and resist the concrete beams from falling apart.
- So on an average to achieve maximum compressive and tensile strength with mono-filament fibre the best possible dosage restricted at 1% to 1.5%, which further increase these strength properties decrease.

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