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Experimental Study on Polypropylene Fiber in Concrete

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ABSTRACT: The aim of this project is to inject polypropylene fibers into the concrete in a particular ratio and showing the strength of the concrete for using for building construction purposes. For this project various materials used such as water, coarse aggregate, fine aggregate, cement, cand, polypropylene fibersnad its properties are discussed. Instrtuctions of forming a concrete is also discussed in this project. Testing of the concrete is also seriously discussed in this project.
KEYWORDS: Polypropylene Fibers, Compressive strength, Tensile strength

I. INTRODUCTION

Concrete develops micro cracks with curing and these cracks propagate rapidly under applied stress resulting in low tensile strength of concrete. Hence addition of fibers improves the strength of concrete and these problems can be overcome by use of Polypropylene fibers in concrete. Application of polypropylene fibers provides strength to the concrete while the matrix protects the fibers. The primary role of fibres in a cementitious composite is to control cracks, increase the tensile strength, toughness and to improve the deformation characteristics of the composite. The performance of FRC depends on the type of the fibers used. Inclusion of polypropylene fibers reduces the water permeability, increases the flexural strength due to its high modulus of elasticity. In the post cracking stage, as the fibers are pulled out, energy is absorbed and cracking is reduced.

II. OBJECTIVE OF PRESENT STUDY

1. To determine the optimum percentage of polypropylene fiber.
2. The main objective of present investigation is to study the properties of concrete with addition of polypropylene fibres. The study was carried out on M30 grade concrete.
3. To compare the strength of concrete cube containing polypropylene fiber with 1.5% proportions of volume of the cement and normal concrete.

III. LITERATURE REVIEW

An Experimental Study On Fibre Reinforced Concrete Using Polypropylene Fibre And Partial Replacement Of Coarse Aggregate By Weld Slag Material By Nivedhan , Nivedhitha , Rifakkathullah , Sowmiya,Mr . P. Gopalsamy Normal or conventional concrete uses more of the raw material like sand,gravels, fly ash etc. its usage has been increased to an enormous amount where there are likely chances of meeting with the demand of such construction materials. It may also lead to increase the cost of the materials drastically. To overcome such situations, alternate building materials were emerging now-a-days. This study has been made as an attempt in improving the technological ailment by usingrecycled materials for construction. Weld Slag and Fibres, the abundantly available materials were selected for partially replacement in concrete. Weld Slag being a residual content is used in concrete with various proportions as a partial replacement of coarse aggregate in the proportion of 10%, 20% and 30% by weight. Polypropylene fibre being used for the post cracking purpose in concrete is used here for increasing the mechanical properties of the concrete along with the addition of Weld Slag. The fibre is added at the proportion of 0.2% of total volume of the concrete. This experimental investigation is carried out to evaluate the ability to increase the mechanical properties of the concrete by using Weld Slag and polypropylene fibre and to determine the optimum dosage of those ingredients.

IV. MATERIAL PROPERTIES

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CEMENT

The cement used was ordinary Portland cement 53 (OPC 53).All properties of cement were determined by referring IS 12269 - 1987. The specific gravity of cement is 3.15. The initial and final setting times were found as 55 minutes and 258 minutes respectively. Standard consistency of cement was 30%. Cement is one of the binding materials in this project. Cement is the important building material in today's construction world. 53 grade Ordinary Portland Cement (OPC) conforming to IS: 8112-1989.

COARSE AGGREGATE

20mm size aggregates-The coarse aggregates with size of 20mm were tested and the specific gravity value of 2.78 and fineness modulus of 7 was found out. Aggregates were available from local sources. Locally available crushed blue granite stones conforming to graded aggregate of nominal size 20 mm as per IS: 383 – 1970.Crushed granite aggregate with specific gravity of 2.77 and passingthrough 4.75 mm sieve and will be used for casting all specimens. Several investigations concluded that maximum size of coarse aggregate should be restricted in strength of the composite. In addition to cement paste – aggregate, aggregate type has great influence on dimensional stability.

FINE AGGREGATE

The sand which was locally available and passing through 4.75mm IS sieve is used. The specific gravity of fine aggregate was 2.60. Locally available river sand conforming to Grading zone I of IS: 383 –1970.Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm Sieve will be used for casting all the specimens.Fine aggregate is defined as material that will pass a No. 4 sieve and will, for the most part, be retained on a No. 200 sieve. For increased workability and for economy as reflected by use of less cement, the fine aggregate should have a rounded shape. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.

WATER

The water used for experiments was potable water. Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. It should be free from organic matter and the pH value should be between 6 to 7.

V. PROPERTIES OF POLYPROPYLENE FIBERS

Properties	**Test Data**
Diameter(mm)	**0.045**
Length(mm)	**6.2**
Aspect Ratio	**139.33**
Tensile Strength	**308**
Specific Gravity	**1.33**

VI. TESTING PROCEDURE

Flexural Strength Test

During the testing, the beam specimens of size 7000mmx150mmx150mm were used. Specimens were dried in open air after 7 days of curing and subjected to flexural strength test under flexural testing assembly. Apply the load at a rate that constantly increases the maximum stress until rupture occurs. The fracture indicates in the tension surface within the middle third of span length. The flexural strength was obtained using the formula (R)

$R = Pl/bd^2$

Where,

R = Modulus of rupture (N/mm^2)

P = Maximum applied load (N/mm^2)

l = Length of specimen (mm) b = Width of specimen (mm)

d = Depth of specimen (mm)

Flexural strength, also known as modulus of rupture, bending strength, or fracture strength, [a mechanical parameter for brittle material, is defined as a material& ability to resist deformation under load. The flexural strength represents the highest stress experienced within the material at its moment of rupture. The flexural strength would be the same as the tensile strength if the material were homogeneous. In fact, most materials have small or large defects in them which act to concentrate the stresses locally, effectively causing a localized weakness. When a material is bent only the extreme fibers are at the largest stress so, if those fiber.

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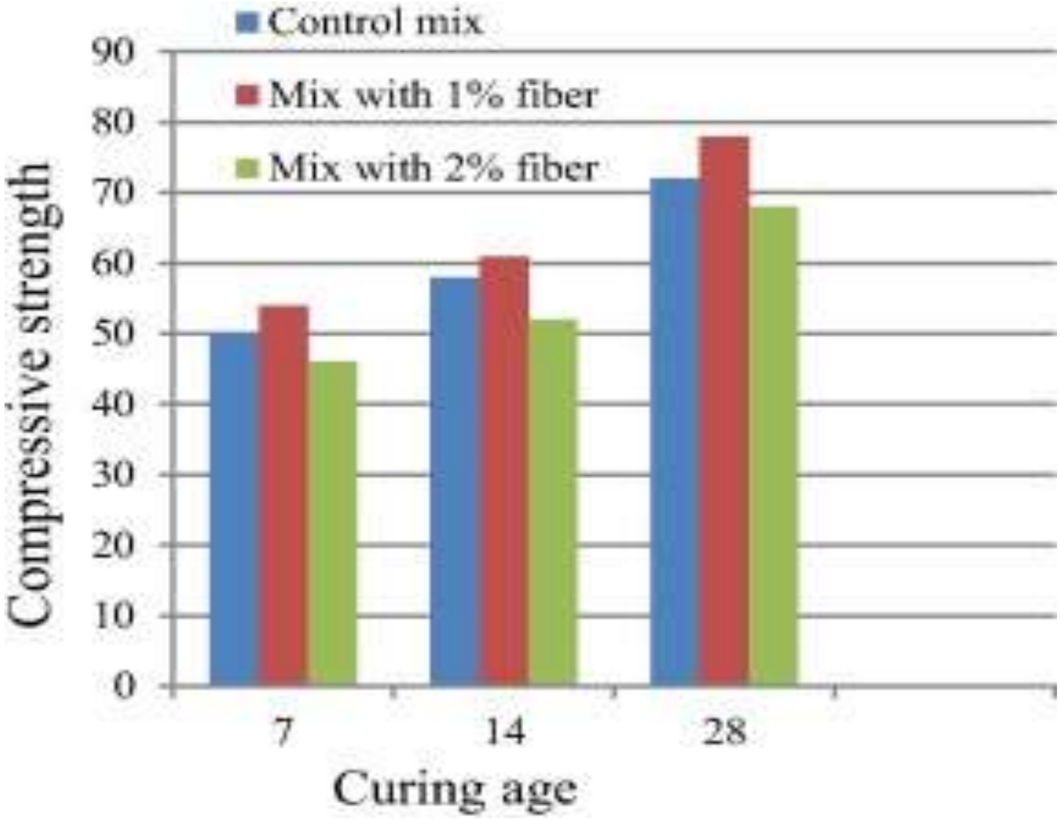
VII. TESTING RESULTS:

RATIOS FOR SPECIAL CONCRETE (EXTRA INGREDIENTS)
RATIO –I
Conventional concrete (Normal concrete)
RATIO - II
Adding 0.75 % of polypropylene fiber in weight of cement
RATIO - III
Adding 1.5% of polypropylene fiber in weight of cement

7.2) COMPRESSIVE STRENGTH TEST RESULT

Mix Design	Curing Days	%replace ment t	Compressive Strength in N/mm2			Average Strength
			S1	S2	S3	
		0	17.50	17.40	17.3	17.4
	7	0.75	18.50	18.60	18.70	18.6
		1.50	20.20	20.40	20.50	20.3
M25						
		0	24.5	24.2	23.8	24.2
	28	0.75	26.2	25.8	26.5	26.2
		1.5	28.3	27.9	28.6	28.3

MODEL CALCULATION
STRENGTH = Load/Area N/mm 2
= 393.75 x 10 3 / 150 x 150
= 17.5 N/mm2



COMPRESSION TEST GRAPH RESULT

7.3) SPLIT TENSILE TEST FOR CYLINDER:

Mix Design	Curing daysment	%replace	Split Tensile Strength in N/mm2	Average Strength

			S1	S2	S3	
M25	7	0	2.92	2.91	2.91	2.91
		0.75	3.01	3.01	3.02	3.01
		1.5	3.14	3.16	3.16	3.15
	28	0	3.52	3.48	3.5	3.5
		0.75	3.78	3.68	3.7	3.72
		1.5	4.4	4.2	4.15	4.25

MODEL CALCULATION
STRENGTH =Load/Area N/mm ^{2}
= 2 x 206.20 x 10 ^{3} / (150 x 300)
= 2.92 N/mm ^{2}
Split Tensile Graph Result

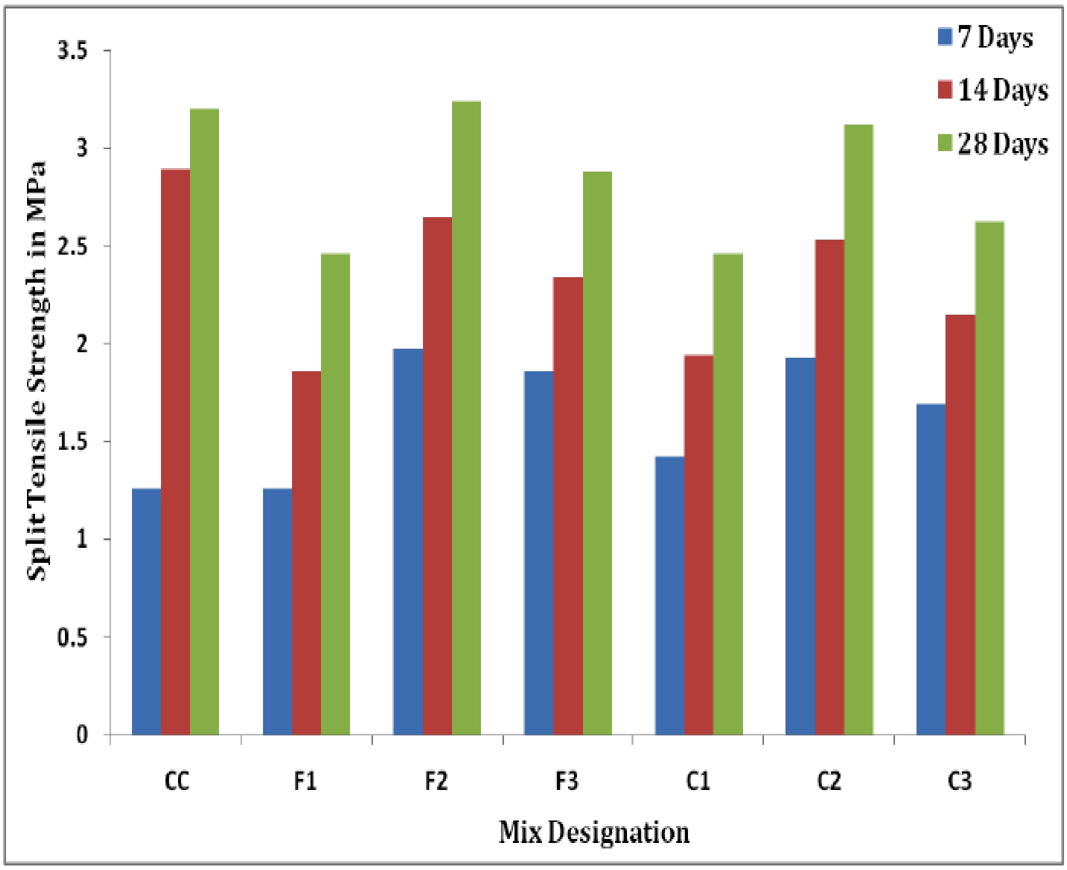


FIG. 3. **Split tensile strength results of the concrete mixes.**

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7.3)FLEXURAL STRENGTH TEST FOR BEAM

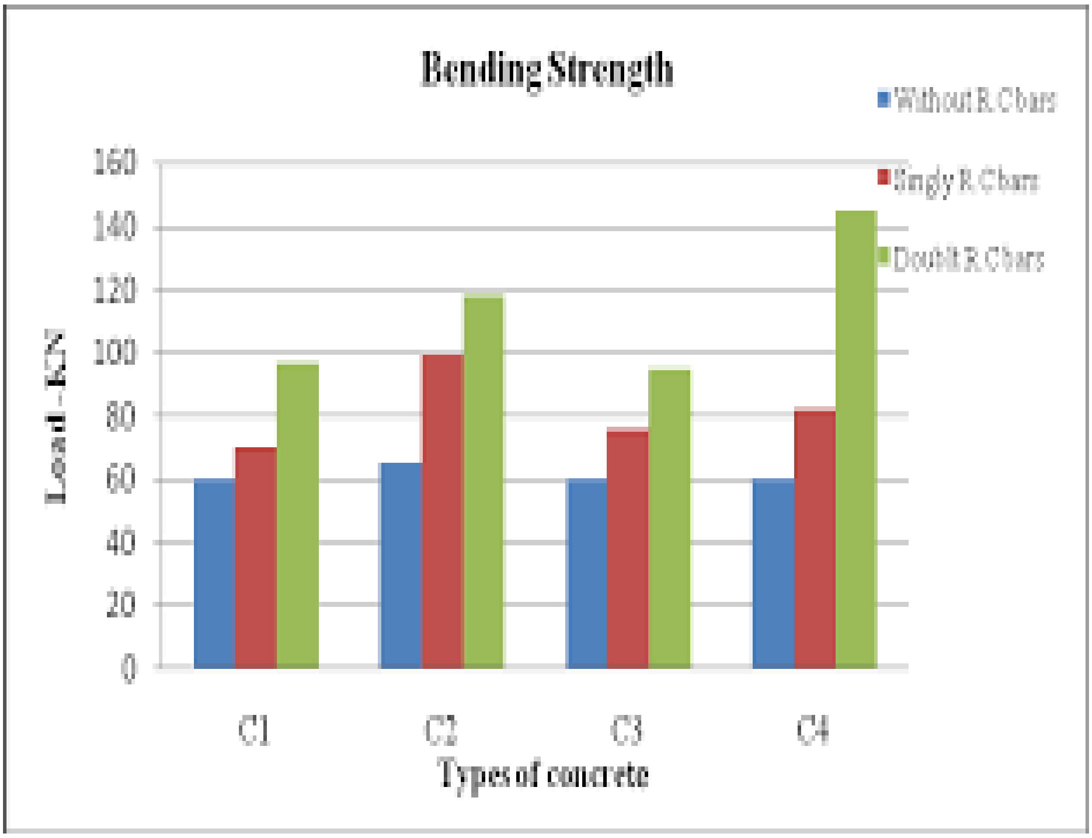
Mix Design	Curing Days	%Replacement	Flexural Strength in N/mm 2			Average Strength
			S1	S2	S3	
M25	7	0	2.45	2.43	2.42	2.43
		0.75	2.77	2.79	2.80	2.78
		1.5	2.82	2.85	2.87	2.84
	28	0	3.8	3.75	3.86	3.80
		0.75	4.2	4.26	4.3	4.25
		1.5	4.85	4.9	4.82	4.85

MODEL CALCULATION

Flexural strength R = Pl/bd 2

= 11800 x 700 / (150 x 150 2)

= 2.45 N/mm 2.



FLEXURAL STRENGTH GRAPH RESULT

VIII. CONCLUSION

From the above investigations, the following conclusions are made from the experimental results indicated following: By using of polypropylene fibre the specimens will be cast in different volume i.e. 0%, 0.75% and 1.5% in concrete.

- The compressive strength is increases with increase in quantity of polypropylene fibre.
- The compressive strength of the concrete with 1.5% polypropylene fibre is attaining 28.3N/mm 2 at 28 days curing.
- The split tensile strength of the concrete with polypropylene fibre is high when compared to conventional concrete.
- The flexural strength of conventional concrete is 4.85 N/mm 2 . It is high when comparing to conventional concrete.

- Addition of polypropylene fibre increases the split tensile strength increasing when comparing to conventional concrete results.
- Therefore the PP 1.5% gives maximum compressive strength, split tensile strength and flexural strength.

Finally conclude the result of experimental work proves that addition of polypropylene fibres to increase the strength and mechanical characteristics of Concrete.

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