Evaluation of The Strength of Polypropylene Fiber Reinforced Concrete With Artificial & Natural Sand

Priyanka sudhkar Tandre[1], Shete Gunderao N.[2]
[1]Dept of Civil Engineering
[2]Assistant professor, Dept of Civil Engineering
[1, 2] M.S.Bidve Engineering College Latur, Maharshtra,India

Abstract- *This paper presents the experimental result of Compressive and Tensile Strength of polypropylene fiber in concrete with 40% natural sand and 60% artificial sand.different volume fraction of polypropylene fiber 0., 0.5, 1.0 and 1..5% by weight of cement are used. Concrete mix prepared with 100% Natural sand as a normal mix and also mix with optimum percentage of Natural sand & Artificial sand ie. 40% Natural sand and 60% artificial sand is used. For the purpose of experimentation concrete mixes are designed for M30 grades of concrete.In this program we are going to construct 48 cube samples of size 150mm x150mm x150mm for different percentages of polypropylene fiber with 60% Artificial sand & 40% natural sand. so as to determine the best proportion, which would give maximum compressive strength. It reveals that with 1% polypropylene fiber with natural and artificial sand were found to be most favorable combinations for casting of concrete flexural members.*

Keywords- Polypropylene fiber, Concrete, Artificial sand, Natural sand, Flexure, Compressive, Tensile Strength

I. INTRODUCTION

The concrete is one of the most widely used construction material in developed and developing countries. The performance of concrete depends on its ingredients. It is well known that plain concrete is brittle and weak in tension. One of the objectionable characteristics of the concrete as a brittle material is its low tensile strength, and strain capacity. One of the objectionable characteristics of the concrete as a brittle material is its low tensile strength, and strain capacity.
Due to shortage of natural sand, artificial sand is one of the suitable substitutes. Partial replacement of 60% artificial sand and 40% natural sand will give betterresults. Theaddition of polypropylene fiber improves the post cracking response of the concrete and also improves crack resistance& crack control.

II. REASEARCH SIGNIIFICANCE

This research is aimed at studying the improvement in properties of concrete like compressive strength and flexural strength which increases with adding polypropylene fiber and Artifical & natural sand with different percentage in concrete. The optimum % of Polypropylene fiber by weight of cement determined at which it gives more compressive and flexural strength. The study also aims is to determining the flexural strength of the concrete beam based on the cross section dimension, span and amount of polypropylene with Natural & Artifical sand used and compared with actual strength obtained on experimental result.

III. EXPRIMENTAL PROGRAM & SETUP

In this Chapter, the test results are presented and discussed. The test results cover the compressive strength, flexural strength, workability of concrete and compaction factor.The main aim of this experimentation is to study the effect of polypropylene fiber with Artificial& Natural sand on the properties of concrete.

The experimental programme is divided in four phases.

a) Concrete mix design as per IS 10262-2009 for M30 grade of concrete.
b) Casting of cubes and beams
c) Curing of cubes and beams for 7 days and 28 days
d) Testing of all beam specimens with two points loading for flexural strength and compressive strength for all cubes. Each test result plotted in the Figures or given in the Tables is the mean value of results obtained from at least three specimens.

IV. MATERAL AND METHOD

4.1 Cement

Ordinary Portland cement conforming to IS 8112 was used. The different laboratory tests will be conducted on cement to determine standard consistency, initial and final setting time, and specific gravity as per IS 4031 and IS 269-

1989. Locally available cement is used. Like ACC , Birla cement etc.

Table -1 Physical properties cement

S. No	Property	Test results
1	Normal consistency	28.25%
2	Specific gravity	3.15
3	Initial setting time	170 minutes
4	Final setting time	250 minutes
5	Soundness (mm) -Le Chatelier test	0.5

4.2 Water

Ordinary potable water free from organic content, turbidity and salts was used for mixing and for curing throughout the investigation

4.3. Fine Aggregate

The sand used was having a specific gravity of 2.62 and confirmed to grading zone-II as per IS: 383-1970 specification. Size: <4.75 mm; >75 µm (0.003 in.).

Table -2: proprieties of FA

properties	Fine Aggregate (River sand)
Specific Gravity	2.62
Fineness Modulus	3.75
Loose Bulk Density (Kg/m^3)	1450
Compacted Bulk Density(Kg/m^3)	1700

4.4 Coarse Aggregate

The crushed granite aggregate will collected from the local quarry. The coarse aggregate will be used in the experimentation will be of 20mm and down size aggregate and tested as per IS: 2386-1963.

Table -3: properties of CA

Properties	Fine Aggregate (River sand)
Specific Gravity	2.68
Fineness Modulus	7.13
Loose Bulk Density (Kg/m^3)	1350
Compacted Bulk Density(Kg/m^3)	1610

4.5 Artificial Sand (MFA Sand)

Manufactured sand or manufactured fine aggregate (MFA) is produced by reducing larger pieces of aggregate into sand-sized aggregate particles**.**

Properties of Artificial sand

1. Artificial sand contains no organic impurities hence it gives increased strength of Concrete with same cement content.
2. No wastage in crush sand since Sand is already sieved in the required size (below 4.75 mm).
3. Manufactured to conform to Grading zone (II)
4. Bulk density1.75 Kg/m^3Approximate 2.73

4.5 Polypropylene fiber

Polypropylene is a 100% synthetic fiber which is transformed from 85% propylene. The monomer of polypropylene is propylene. Polypropylene is a by-product of petroleum. Polypropylene chips can be converted to fiber/filament by traditional melt spinning.polypropylene fiber is generally superior in elasticity but it has lower wear resistances. It displays good heat insulating proprieties and is highly resistant to acids &, alkalis.

Chemical and physical properties:

Polypropylene is in many aspects similar to polyethylene, especially in solution behaviour and electrical properties. The methyl groupimproves mechanical properties and thermal resistance, although the chemical resistance decreases. The properties of polypropylene depend on the molecular weight and molecular weight distribution, crystallinity, type and proportion of commoner (if used) and the isotacticity. In isotactic polypropylene, for example, the methyl groups are oriented on one side of the carbon backbone. This arrangementcreates a greater degree of crystallinity and results in a stiffer material that is more

resistant to creep than both astatic polypropylene and polyethylene.

Table no-4properties of polypropylene fiber

Properties	Testdata
Diameter(D),mm	0.0445
Length(l),mm	6.20
AspectRatio(l/D)	139.33
TensilestrengthMpa	308
Specificgravity	1.33

4.6 Concrete

A control concrete mix of M30 grade was mix proportioned. The mix design procedure was according to guidelines of IS 10262-2009.The fine aggregate confirming to zone II of IS383:1970 and coarse aggregate of nominal size 20mm was used in the study. The cement used was 43 grade OPCwith W/C ratio 0.45 .Specific gravity of fine aggregate and coarse aggregate are 2.63 and 2.68 respectively

Table -5

Water	Cement	Fine aggregate	Coarse aggregate
186	414	614	1163
0.45	01	1.48	2.81

V. RESULTS AND DISCUSSION

5.1 Compressive Strength test

The cube specimens of the size 150 x 150 x 150 mm were tested after curing for period of 7 and 28 days for different combinations. The cube compressive strength for different mixes at period of 7 days and 28 days curing was calculated by following formula:

Compressive strength (N/mm)=P/A

P: Failure load
A: cross sectional area of cube

Table-6: Compressive Strength at 7days & 28 days

Sr. no	Fiber %	Compressive strength (N/mm) 7 day	Average	Compressive strength (N/mm) 28 day	average
1	0	16.66	19.53	31.12	31.75
2	0	20.15		34.00	
3	0	21.78		30.26	
4	0.5	16	20	32.40	32.42
5	0.5	20.44		33.00	
6	0.5	23.55		31.88	
7	1	16.92	21	31.66	33.69
8	1	20.66		33.77	
9	1	23.77		35.64	
10	1.5	16.08	18	29.88	29.81
11	1.5	17.77		30.66	
12	1.5	22.66		27.00	

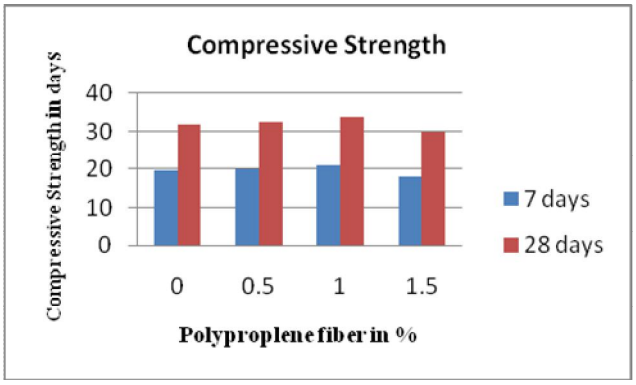

Chart:1 Compressive strength at 7 days and 28 days

5.2 Tensile Strength Test

The 150mm X 150mm X 150mm size cubes are casted and curing is done for 7 days and 28 days. They were tested for tensile strength in compression testing machine.
Tensile strength = 0.642 P/S^2

Table -7: Tensile Strength at 7 days & 28 days

Sr.no	Fiber %	Tensile strength(7day)	Average	Tensile strength (28 day)	Average
1	0	13.52	13.59	21.93	20.97
2	0	14.28		20.42	
3	0	12.98		20.57	
4	0.5	14.52	15.01	21.52	22.20
5	0.5	15.10		23.87	
6	0.5	15.42		21.21	
7	1	18.40	17.04	23.20	24.22
8	1	16.20		24.28	
9	1	16.52		25.20	
10	1.5	13.20	12.72	18.40	18.01
11	1.5	12.40		17.20	
12	1.5	12.58		18.45	

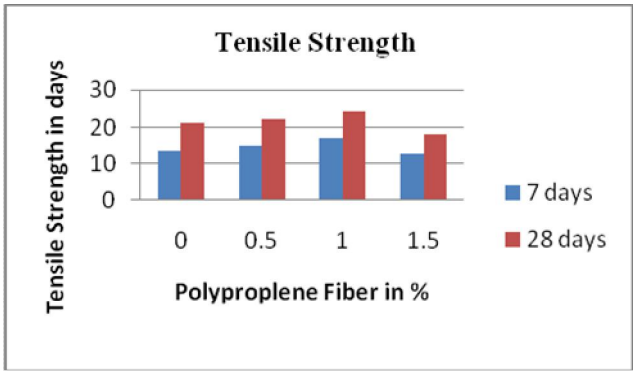

Chart:3 Tensile strength at 7 days and 28 days

5.3 Flexural strength

Standardcube specimens of 150mm X 150mm X 750mm size were casted.The cube compressive strength for different mixes at period of 28 days curing was calculate by following formula:

$$\text{Flexural strength } (N/mm^2) = PL/bd^2$$

Where,

P:Failure load,
L:center to center distance between support,
b:Width of specimen,
d:depth of specimen

Table-8: Flexural Strength at 28 days

Sr.no	Fiber(%)	Flexural strength(28 day) (N/mm^2)	Average
1	0	3.73	3.90
2	0	4.13	
3	0	3.86	
4	0.5	4	4.46
5	0.5	4.60	
6	0.5	4.80	
7	1	4.05	4.58
8	1	4.50	
9	1	5.20	
10	1.5	4.20	3.80
11	1.5	3.50	
12	1.5	3.70	

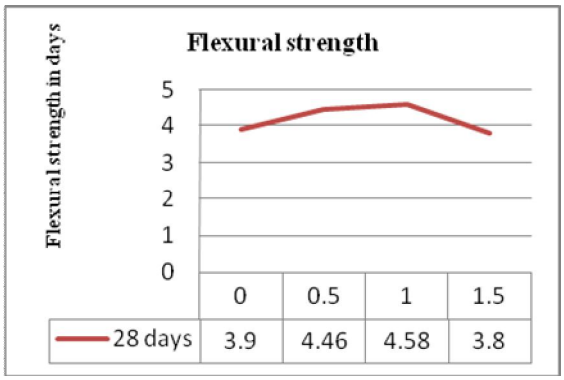

Chart-5: Flexuralstrength at 28 days

VI. CONCLUSION

1. The experimental study has proved to be better method in providing strong and durable concrete it also gives solution shortage of natural sand.
2. After conducting all the tests on the specimen, it has observed that up to 1% polypropylene fiber replacement of cement with 60% Artificial sand & 40% Natural sand to be good in compression, as well as Split tensile strength.
3. 12.42% and 3.80% increment in the compressive strength is found for 0.5% to 1% replacement of polypropylene fiber by wt. of cement with 60% Artificial sand & 40% Natural sand respectively and the strength decreases by 4.20% when the 1.5 % polypropylene fiber replace by wt. of cement, by using aggregate cement ratio (A/C) is 4.2 and water cement ratio (W/C) is 0.45.
4. 12.40 and 3.80 % increment in the tensile strength is found for for 0.5% to 1% replacement of polypropylene fiber by wt. of cement with 60% Artificial sand & 40% Natural sand respectively and the strength decreases by

5% when the 1.5 % polypropylene fiber replace by wt. of cement.

5. 15.7% and 7.8% increment in the flexural strength is found for 0.5% to 1% replacement of polypropylene fiber by wt. of cement with 60% Artificial sand & 40% Natural sand respectively and the strength decreases by 5% when the 1.5 % polypropylene fiber replace by wt. of cement .

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