Experimental study on high strength concrete by using steel fiber & polypropylene fiber

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Abstract - High performance concrete (HPC) has been a promising material for many decades. Development of new high performance concrete types has a great success within the last few years. The experimental results of testing mechanical and durability properties of different high performance concrete types with steel fiber & Polypropylene fiber are presented. Advantage and disadvantage of these concrete types are critically commented with the aim to find the optimum practical application of different high performance concrete types. Concrete is one of the most extensively used construction material in the world. It is attractive in many applications because it offers considerable strength at a tentatively low cost. When the general performance of concrete is substantially higher than that of normal type concrete, such concrete is regarded as high performance concrete (HPC).

The mix design of M40 was prepared that characteristic strength is 40N/mm^2.Prepare the concrete with the help of Polypropylene fiber, steel fiber, Polypropylene Fiber +Fly Ash, Steel Fiber+ Fly-Ash. Four values of volume fraction of steel fibers, Polypropylene Fiber namely 0.6%, 0.9%, 1.5% and 1.8% were used& Fly Ash was replaced with cement in proportion 15%. Results indicate that introduction of steel fibers significantly improves the cracking behavior in terms of significant increase in first crack load and the formation of large number of finer cracks. Addition of steel fibers to HPC imparted high ductility to structural members which is essential for seismic force resisting structures.

Fly Ash (FA) is the organic, non - combustible residue of powdered coal offer burning in power plant. This paper format states a simplified mix design procedure for HPC by IS method. The HPC mixes are tested experimentally for compression, split tension, flexure &workability. The performances of the design are very good & the results are reported

Key Words: (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)…

1. INTRODUCTION

HPC is a construction material which is being used in increasing volumes in recent years due to its long term performance & better rheological, mechanical & durability properties than cement concrete. HPC possess invariably high strength, reasonable workability & negligible permeability compared to CC., preparation of HPC requires lower water binder ratio (w/b) & higher cement content. The HPC permits the use of reduced sizes of structural member, increased building height in congested areas & early removal of formwork.

Fiber Reinforced Concrete:-Fiber Reinforced Concrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete and discontinuous, discrete, uniformly dispersed suitable fibers. Continuous meshes, woven fabrics and long wires or rods are not considered to be discrete fibers.

Steel Fiber (1): - Steel fibers are available unperforated, corrugated or with wide end for better bending. The fibers can placed single or in the form of mats. The main fields of application of steel fibers are gunned concrete, tunnel constructions & high loaded industrial floors. The addition of steel fiber increases the tensile strength of normal & high strength concrete. It also has positive effects on the tension stiffening behavior, the formation of cracks the tightness & long -term deformations.

1.1 SALIENT FEATURES OF HPC (2)

- Compressive strength > 80 Mpa , even up to 800 Mpa
- Water binder ratio=0.25-0.35, therefore very little free water
- Reduced Flocculation of cement grains
- Wide range of grain size
- Densified cement paste
- No bleeding homogeneous mix
- Less capillary porosity
- Discontinuous pores
- Stronger transition zone at the interface between cement paste & aggregate
- Low free lime content
- Endogenous shrinkage
- Powerful confinement of aggregate
- Little micro-cracking until about 65-75% of f_{ck}
- Smooth fracture surface
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1.2 POLYPROPYLENE FIBER (3)

In the past several years, an increasing number of contractors have placed concrete containing polypropylene fibres. Fibre manufacturers have promoted the material as a practical alternative to the use of welded wire fabric for control of shrinkage and temperature cracking. They cite the ease with which fibres' can be added to concrete and also state that adding fibres reduces shrinkage, inhibits shrinkage cracking, reduces permeability and improves impact and abrasion resistance. There is, however, conflicting data concerning the effects of polypropylene fibres' on the properties of concrete. This article reviews some of the suggested applications for concrete reinforced with fibres and surveys recent studies concerning properties of the fibre- reinforced concrete.

1.3 Effects of Fibres on Fresh Concrete [3]

Slump effects

Table 1.1 Effect of polypropylene fibres on concrete slump

Initial Slump (mm)	Final Slump (mm)	Fiber Length (mm)
87.5	75	50
131.50	68.75	250
168.75	118.75	37.5
125	47.5	50
118.75	52.5	50
112.5	62.5	18.75

Table1.2. Effect of polypropylene fibres on concrete compressive strength

Plain Concrete Strength (N/mm2)	Fibre Reinforced Concrete Strength (N/mm2)	Fibre Length (mm)
38.79	44.57	50
33.62	36.99	50
50.22	49.81	37.5
19.36	18.53	50
32.72	33.62	50
39.27	40.30	18.75
39.27	36.31	25
29.28	31.90	56.25
40.85	43.13	50

Table 1.3. Effect of polypropylene fibres on concrete flexural strength

Plain Concrete Strength (N/mm2)	Fiber Reinforced Concrete Strength (N/mm2)	Fiber Length (mm)
4.6852	4.823	50
4.6852	4.9952	50
3.65	3.8239	50
5.61535	5.512	50
5.9598	5.9943	18.75
5.9598	6.1321	25
3.9273	4.5818	56.25
5.1675	5.2019	50

1.4 SCPOE & OBJECTVE:

The objectives of the present investigation are too developed a simply mix design procedure, especially for HPC by varying the percentage replacement of cement by poly propylene fiber, steel fiber& fly Ash. The objective of the present work is to developed concrete with good strength, less porous, less capillarity so that durability will be reached. The design is based on IS method & available literature on HPC. Investigation were carried out on the above procedure to produce HPC in Mix M40 grade using 20mm maximum size of aggregate to ascertain workability & the mechanical properties of the design mix. High-performance concrete has been primarily used in tunnels, bridges, and tall buildings for its strength, durability, and high modulus of elasticity (Fig.1) [4]. It has also been used in shotcrete repair, poles, parking garages, and agricultural applications.

1.5 NECESSITY OF HPC

2. It increases the tensile strength of the concrete.
3. It reduces the air voids and water voids the inherent porosity of gel.
4. It increases the durability of the concrete.
5. Fibers such as graphite and glass have excellent resistance to creep, while the same is not true for most resins. Therefore, the orientation and volume of fibers have a significant influence on the creep performance of rebar/tendons.

Table 1.4: Quantity of Materials per Cubic meter of concrete: Grade M-40

Sr. No.	Material	Weight in Kg/m³
1	W/C	0.38
2	CEMENT	440
3	FLY – ASH	00
5	RIVER SAND	405
6	CRUSHED SAND	400
7	(CA)10MM	392
8	(CA)20MM	705
9	WATER	167
10	ADMIXURES	4.4

The final mix design for M40

grade of concrete with fibers

are as follows:

Table 1.5: Quantity of Materials per Cubic meter of concrete: Grade M-40 with Polypropylene Synthetic fiber

TRIAL-1, 2, 3, 4

Sr. No.	Material	Weight in Kg/m³
1	W/C	0.38
2	CEMENT	440
3	FLY – ASH	00
5	RIVER SAND	405
6	CRUSHED SAND	400
7	(CA)10MM	392
8	(CA)20MM	705
9	WATER	167
10	ADMIXURES	4.4
11	FIBERS (%)	0.60,0.90,1.5,1.8

Table 1.6: Quantity of Materials per Cubic meter of concrete: Grade M-40 with Polypropylene Fiber Fly-Ash TRIAL-5, 6, 7, 8

Sr. No.	Material	Weight in Kg/m³
1	**W/C**	0.38
2	CEMENT	374
3	**FLY – ASH (15%)**	66
5	RIVER SAND	405
6	CRUSHED SAND	400
7	(CA)10MM	392
8	(CA)20MM	705
9	WATER	167
10	ADMIXURES	4.4
11	FIBERS (%)	0.60,0.90,1.5,1.8

Table 1.7: Quantity of Materials per Cubic meter of concrete: Grade M-40 with Steel Fiber TRIAL-9, 10, 11, 12

Sr. No.	Material	Weight in Kg/m³
1	**W/C**	0.38
2	CEMENT	440
3	**FLY – ASH**	00
5	RIVER SAND	405
6	CRUSHED SAND	400
7	(CA)10MM	392
8	(CA)20MM	705
9	WATER	167
10	ADMIXURES	4.4
11	STEEL FIBERS (%)	0.60,0.90,1.5,1.8

Table 1.8: Quantity of Materials per Cubic meter of concrete: Grade M-40 with Steel Fiber + Fly-Ash TRIAL-13, 14, 15, 16

Sr. No.	Material	Weight in Kg/m³
1	**W/C**	0.38
2	CEMENT	374

3	**FLY – ASH (15%)**	66
5	RIVER SAND	405
6	CRUSHED SAND	400
7	(CA)10MM	392
8	(CA)20MM	705
9	WATER	167
10	ADMIXURES	4.4
11	STEEL FIBERS (%)	0.60,0.90,1.5,1.8

1. CEMENT: OPC Ambuja 53 GRADE

3. COARSE AGGREGATE: LALING

4. ADMIXTURE-1: Indura-28(H.R.Johnson)

5. WATER: POTABLE WATER

6. Fly ash: - Nashik.

Fig.1 Mixing o concrete

1.6 PREPARATIONS OF SPECIMEN

1.6.1 Measurement of Ingredients: All cement, sand, coarse aggregate (20mm, 10mm), fibers measured with Digital balance.

1.7 Mixing of concrete

No change in conventional method of mixing of concrete. Mixing is done using conventional trial mixer. Sand, cement and aggregate are measured accurately and were mixed in dry state for normal concrete. Fibers were added in dry state before mixing of water .After that water is mixed slowly. Admixture dosage is given during mixing. Concrete mix containing CA, FA, cement and fibers hence known as fiber reinforced concrete. Fiber dosage is taken as 1% by volume cement i.e. 4.4 kg/m^3.

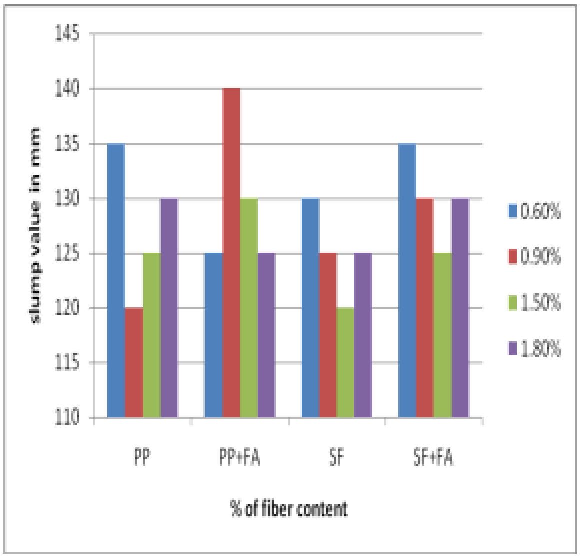
Fig.2 Photograph of dry mixture with fibers

1.8 Slump Test

Table 1.9: Slump Value

Sr. No	**Grade**	**ID Mark**	**Time (min)**	**Slump (mm)**
1	M40	T-1(0.6%PP)	0	135
2	M40	T-1(0.9%PP)	0	120
3	M40	T-1(1.5%PP)	0	125
4	M40	T-1(1.8%PP)	0	130
5	M40	T-2(0.6%PP+FA)	0	125
6	M40	T-2(0.9%PP+FA)	0	140
7	M40	T-2(1.5%PP+FA)	0	130
8	M40	T-2(1.8%PP+FA)	0	125
9	M40	T-3(0.6%SF)	0	130
10	M40	T-3(0.9%SF)	0	125
11	M40	T-3(1.5%SF)	0	120
12	M40	T-3(1.8%SF)	0	125
13	M40	T-4(0.6%SF+FA)	0	135
14	M40	T-4(0.9%SF+FA)	0	130
15	M40	T-4(1.5%SF+FA)	0	125
16	M40	T-4(1.8%SF+FA)	0	130

Graph-1 % Fiber Content Vs Slump Value



1.9 Compressive Strength for Plain Concrete Grade:-M40

Curing days	Plain concrete (N/mm^2)
7	35.35
28	50.05

1 Trial-1 for 0.6% Polypropylene Fiber

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	**2**	**3**	**4**	**5**	**6**
Date of Testing :-08/1/2017					
1	8.782	7 Days	900	40.00	
2	8.920	7 Days	970	43.21	**41.82**
3	8.837	7 Days	950	42.26	
Date of Testing :- 29/1/2017					
1	8.867	28 Days	1240	55.24	
2	8.842	28 Days	1190	52.90	**53.96**
3	8.858	28 Days	1210	53.76	

Trial-2 for 0.9% Polypropylene Fiber

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	**2**	**3**	**4**	**5**	**6**
Date of Testing :-08/1/2017					
1	8.955	7 Days	960	42.77	
2	8.974	7 Days	950	42.23	**44.48**
3	8.880	7 Days	1090	48.44	
Date of Testing :- 4/2/2017					
1	8.920	28 Days	1200	53.30	
2	9.020	28 Days	1440	64.00	**59.11**
3	8.914	28 Days	1350	60.03	

Trial-3 for 1.5% Polypropylene Fiber

Sr. No. 1	Wt. of Specimen (kg) 2	Age At Testing 3	Crushing Load observed on Machine (KN) 4	Compressive Strength (N/mm^2) 6	Average Compressive Strength (N/mm^2) 7
Date of Testing :-13/01/2017					
1	8.780	7 Days	1010	44.90	
2	8.864	7 Days	1020	45.36	**44.62**
3	8.910	7 Days	980	43.60	
Date of Testing :- 03/2/2017					
	8.982	28 Days	**1550**	68.88	
2	8.892	28 Days	1560	69.34	**67.26**
3	8.808	28 Days	1430	63.57	

Trial-5 for 0.6% Polypropylene Fiber + Fly-ash

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1	2	3	4	5	6
Date of Testing :-08/1/2017					
1	8.782	7 Days	900	40.00	
2	8.920	7 Days	970	43.21	**41.82**
3	8.837	7 Days	950	42.26	
Date of Testing :- 29/1/2017					
1	8.867	28 Days	1240	55.24	
2	8.842	28 Days	1190	52.90	**53.96**
3	8.858	28 Days	1210	53.76	

Trial-6 for 0.9% Polypropylene Fiber + Fly-ash

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine(KN)	Compressive Strength	Average Compressive
1	2	3	4	(N/mm) 5	Strength (N/mm) 6
Date of Testing :-27/2/2017					
1	8.936	7 Days	880	39.14	
2	8.790	7 Days	950	42.23	**40.76**
3	8.867	7 Days	920	40.90	
Date of Testing :- 21/3/2017					
1	8.842	28 Days	1260	56.05	
2	8.814	28 Days	1240	55.10	**56.61**
3	8.870	28 Days	1320	58.68	

Trial-7 for 1.5 %Polypropylene Fiber + Fly-ash

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm2)
1	2	3	4	5	6
Date of Testing :-28/2/2017					
1	8.660	7 Days	920	40.90	
2	8.840	7 Days	900	40.00	**39.72**
3	8.745	7 Days	860	38.22	
Date of Testing :- 22/3/2017					
1	8.845	28 Days	1180	52.43	
2	8.883	28 Days	1210	53.79	**53.20**
3	8.880	28 Days	1200	53.43	

Trial-8 for 1.8 %Polypropylene Fiber + Fly-ash

Sr. No	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm) ²
1	2	3	4	5	6
Date of Testing :-06/3/2017					
1	8.840	7 Days	810	36.00	
2	8.870	7 Days	790	35.10	**36.00**
3	8.825	7 Days	830	36.88	
Date of Testing :- 27/3/2017					
1	8.844	28 Days	1350	60.20	
2	8.770	28 Days	1230	54.68	**58.54**
3	8.900	28 Days	1370	60.89	

Trial-9 for 0.6 % Steel Fiber

Sr. No	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm)²
1	2	3	4	5	6
Date of Testing :-10/3/2017					
1	8.652	7 Days	990	44.20	44.51
2	8.654	7 Days	1000	44.44	
3	8.701	7 Days	1010	44.89	
Date of Testing :- 01/04/2017					
1	8.860	28 Days	1280	56.90	55.25
2	8.763	28 Days	1230	54.68	
3	8.905	28 Days	1220	54.20	

Trial-10 for 0.9 %Steel Fiber

r. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1	2	3	4	5	6
Date of Testing :-16/3/2017					
1	8.683	7 Days	1030	45.80	45.05
2	8.640	7 Days	1000	44.44	
3	8.742	7 Days	1010	44.93	
Date of Testing :- 06/4/2017					
1	8.880	28 Days	1250	55.58	56.45
2	8.874	28 Days	1190	52.90	
3	8.920	28 Days	1370	60.88	

Trial-11 for 1.5 %Steel Fiber

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm)²
1	2	3	4	5	6
Date of Testing :-18/3/2017					
1	8.852	7 Days	1000	44.44	44.60
2	8.830	7 Days	1000	44.44	
3	8.700	7 Days	1010	44.92	
Date of Testing :- 8/4/2017					
1	8.963	28 Days	1150	51.11	53.05
2	8.900	28 Days	1230	54.68	
3	8.885	28 Days	1200	53.35	

Trial-12 for 1.8 %Steel Fiber

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1	2	3	4	5	6
Date of Testing :-09/4/2017					
1	8.788	7 Days	1010	44.89	44.75
2	8.670	7 Days	980	43.66	
3	8.840	7 Days	1030	45.78	
Date of Testing :- 07/5/2017					
1	8.844	28 Days	1110	49.36	47.55
2	8.886	28 Days	1000	44.44	
3	8.966	28 Days	1100	48.89	

Trial-13 for 0.6%Steel Fiber + Fly-Ash

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1	2	3	4	5	6
Date of Testing :-08/5/2017					
1	8.900	7 Days	820	36.44	36.14
2	8.795	7 Days	840	37.34	
3	8.866	7 Days	780	34.69	
Date of Testing :- 30/5/2017					
1	8.845	28 Days	1220	54.23	55.42
2	8.885	28 Days	1240	55.16	
3	8.870	28 Days	1280	56.89	

Trial-14 for 0.9%Steel Fiber + Fly-Ash

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	ompressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1	2	3	4	5	6
Date of Testing :-10/5/2017					
1	8.790	7 Days	810	36.00	36.74
2	8.870	7 Days	840	37.33	
3	8.825	7 Days	830	36.89	
Date of Testing :- 31/5/2017					
1	8.844	28 Days	1310	58.22	57.19
2	8.770	28 Days	1230	54.67	
3	8.900	28 Days	1320	58.67	

Trial-15 for 1.5%Steel Fiber + Fly-Ash

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1	2	3	4	5	6
Date of Testing :-09/5/2017					
1	8.832	7 Days	850	37.78	36.60
2	8.755	7 Days	790	35.11	
3	8.890	7 Days	830	36.89	
Date of Testing :- 31/5/2017					
1	8.844	28 Days	1350	60.10	57.80
2	8.770	28 Days	1260	56.20	
3	8.900	28 Days	1290	57.33	

Trial-16 for 1.8%Steel Fiber + Fly-Ash

Sr. No.	Wt. of Specimen (kg)	Age At Testing	Crushing Load observed on Machine (KN)	Compressive Strength (N/mm²)	Average Compressive Strength (N/mm²)
1	2	3	4	5	6
Date of Testing :-13/5/2017					
1	8.758	7 Days	810	36.05	37.35
2	8.962	7 Days	880	39.14	
3	8.825	7 Days	830	36.90	
Date of Testing :- 10/6/2017					
1	8.874	28 Days	1350	60.05	58.68
2	8.760	28 Days	1280	56.89	
3	8.900	28 Days	1330	59.11	

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Sr. No.	ID Mark	7 Days	28 Days
1	T-1(0.6%PP)	41.82	53.96
2	T-1(0.9%PP)	44.48	59.11
3	T-1(1.5%PP)	44.62	67.26
4	T-1(1.8%PP)	42.53	63.42
5	T-2(0.6%PP+FA)	39.74	53.20
6	T-2(0.9%PP+FA)	40.76	56.61
7	T-2(1.5%PP+FA)	39.72	53.20
8	T-2(1.8%PP+FA)	36.00	58.54
9	T-3(0.6%SF)	44.51	56.45
10	T-3(0.9%SF)	45.05	56.45
11	T-3(1.5%SF)	44.60	53.05
12	T-3(1.8%SF)	44.75	47.55
13	T-4(0.6%SF+FA)	36.14	55.42
14	T-4(0.9%SF+FA)	36.74	57.19
15	T-4(1.5%SF+FA)	36.60	57.80
16	T-4(1.8%SF+FA)	37.35	58.68

2.0 TEST REPORT

2.1.1 Flexural Strength for Normal Concrete:-

Table 2.0 Flexural Strength for Normal Concrete

Sr. No.	ID mark	Size of beam (cm)	7 Days	28 days
1	**Plain Concrete**	**15X15X 70**	**3.5**	**4.41**

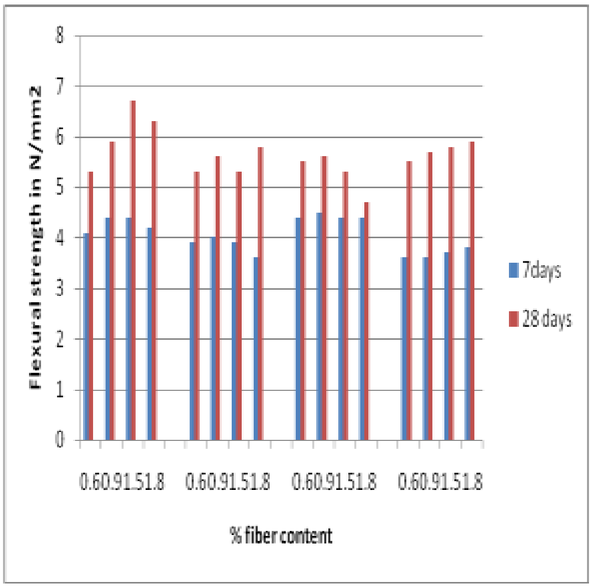
2.1.2 Flexural strength after addition of Fiber:-

1. **Grade of concrete: M-40**
2. **I.S. : 516:1959**

Table-2.1 Flexural strength

Sr no.	ID Mark		
		7 Days	28 Days
1	**T-1(PP)** (0.6%)	4.1	5.3
2	**T-2(PP)** (0.9%)	4.4	5.9
3	**T-3(PP)** (1.5%)	4.4	6.7
4	**T-4(PP)** (1.8%)	4.2	6.3
5	**T-5(PP+FA)** (0.6% +fly ash	3.9	5.3
6	**T-6(PP+FA)** (0.9%)	4.0	5.6
7	**T-7(PP+FA)** (1.5%)	3.9	5.3
8	**T-8(PP+FA)** (1.8%)	3.6	5.8
9	**T-9(SF)** (0.6%) Steel fiber	4.4	5.5
10	**T-10(SF)** (0.9%)	4.5	5.6
11	**T-11(SF) (1.5%)**	4.4	5.3
12	**T-12(SF) (1.8%)**	4.4	4.7
13	**T-13(SF+ FA) (0.6%)**	3.6	5.5
14	**T-14(SF+ FA) (0.9%)**	3.6	5.7
15	**T-15(SF+ FA) (1.5%)**	3.7	5.8
16	**T-16(SF+ FA) (1.8%)**	3.8	5.9

Graph-2 Flexural strength Vs % Fiber Content



2.2 Computation OF Rate Analysis for Mix Proportion M-40 Grade

Table-2.2 For Plain Concrete with admixture

Sr. No.	Particulars	Quantity	Rate	Cost
1	Cement	8.8 bags	300/bags	2640/-
2	F.A	$0.25m^3$	$750m^3$	187.5/-
3	C.A	$0.348m^3$	$790m^3$	274.92/-
4	Water	167	142/1000lit	23.71/-
5	Admixture	4.4	117.50/lit	517/-
TOTAL				$3642.194/m^3$

Result: Total Cost of $1m^3$ of Plain Concrete M-40 is 3643 Rupees Only

Table-2.3For After Addition Of Polypropylene Fiber

Sr. No.	Particulars	Quantity	Rate	Cost
1	PlainConcreteM40	$1m^3$	3643/-	3643/-
2	P.P. (0.6%)	2.6kg	270/kg	702/-
TOTAL				$4345/m^3$
3	PlainConcreteM40	$1m^3$	3643/-	3643/-
4	P.P. (0.9%)	3.6kg	270/kg	972/-
TOTAL				$4615/m^3$
5	PlainConcreteM40	$1m^3$	3643/-	3643/-
6	P.P. (1.5%)	6.6kg	270/kg	1782/-
TOTAL				$5425/m^3$
7	PlainConcreteM40	$1m^3$	3643/-	3643/-
8	P.P. (1.8%)	7.92kg	270/kg	2138/-
TOTAL				$5781/m^3$

Table-2.4 For After Addition Of Polypropylene Fiber + Fly Ash(15%)

Sr. No.	Particulars	Quantity	Rate	Cost
1	PlainConcreteM-40	$1m^3$	3643/-	3643/-
2	P.P.(0.6%)	2.6kg	270/kg	702/-
3	F.A(15%)	$0.021m^3$	$307.5/m^3$	64.58
TOTAL				$4410/m^3$
4	PlainConcrete M-40	$1m^3$	3643/-	3643/-
5	P.P.(0.9%)	3.6kg	270/kg	972/-
6	F.A(15%)	$0.021m^3$	$307.5/m^3$	64.58
TOTAL				$4680/m^3$
7	PlainConcrete M-40	$1m^3$	3643/-	3643/-
8	P.P.(1.5%)	6.6kg	270/kg	1782/-
9	F.A(15%)	$0.021m^3$	$307.5/m^3$	64.58
TOTAL				$5490/m^3$
10	PlainConcrete M-40	$1m^3$	3643/-	3643/-
10	PlainConcrete M-40	1m3	3643/-	3643/-
11	P.P.(1.8%)	7.92kg	270/kg	2138/-
12	F.A(15%)	0.021m3	307.5/m3	64.58
TOTAL				$5846/m^3$

Table-2.5 For After Addition Of Steel Fiber

Sr. No.	Particulars	Quantity	Rate	Cost
1	PlainConcreteM 40	$1m^3$	3643/-	3643/-
2	S.F. (0.6%)	2.6kg	66/kg	172/-
TOTAL				$3815/m^3$
3	PlainConcreteM40	$1m^3$	3643/-	3643/-
4	S.F. (0.9%)	3.6kg	66/kg	238/-
TOTAL				$3881/m^3$
5	PlainConcreteM40	$1m^3$	3643/-	3643/-
6	S.F. (1.5%)	6.6kg	66/kg	436/-
TOTAL				$4079/m^3$
7	PlainConcreteM40	$1m^3$	3643/-	3643/-
8	S.F. (1.8%)	7.92kg	66/kg	523/-
TOTAL				$4166/m^3$

Table-2.6For After Addition Of Steel Fiber + Fly Ash(15%)

Sr. No.	Particulars	Quantity	Rate	Cost
1	PlainConcrete M40	1m³	3643/-	3643/-
2	S.F.(0.6%)	2.6kg	66/kg	172/-
3	F.A(15%)	0.021m³	307.5/m³	64.58
TOTAL				3880/m³
4	PlainConcreteM-40	1m³	3643/-	3643/-
5	S.F. (0.9%)	3.6kg	66/kg	238/-
6	F.A(15%)	0.021m³	307.5/m³	64.58
TOTAL				3946/m³
7	PlainConcreteM-40	1m³	3643/-	3643/-
8	S.F. (1.5%)	6.6kg	66/kg	436/-
9	F.A(15%)	0.021m³	307.5/m³	64.58
TOTAL				4144/m³
10	PlainConcreteM-40	1m³	3643/-	3643/-
11	S.F. (1.8%)	7.92kg	66/kg	523/-
12	F.A(15%)	0.021m³	307.5/m³	64.58
TOTAL				4231/m³

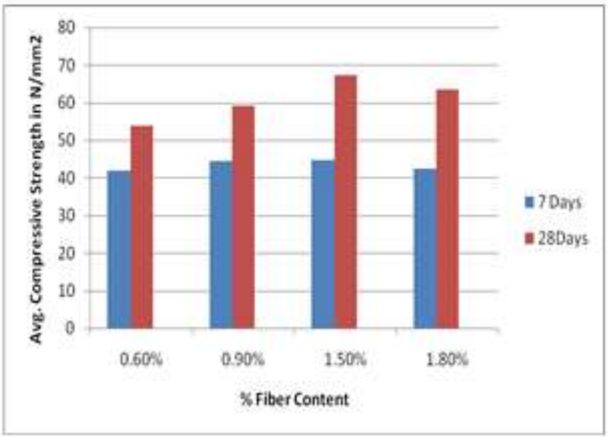
CHAPTER 4

RESULTS ANDDISSCUSSION

Average Experimental results for Polypropylene Fiber are as follows

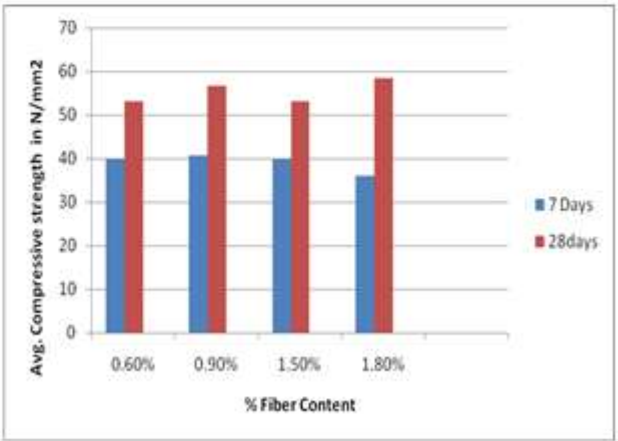
Age/% Fiber	0.6%	0.9%	1.5%	1.8%
7	41.82	44.48	44.62	42.53
28	53.96	59.11	67.26	63.42

Graph-3 Compressive strength Vs % Fiber Content



Age/% Fiber	0.6%	0.9%	1.5%	1.8%
7	39.74	40.76	39.72	36.00
28	53.20	56.61	53.20	58.54

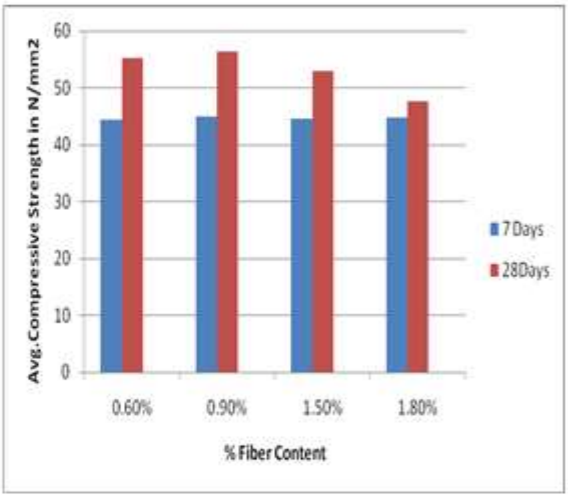
Graph-3Compressive strength Vs % Fiber Content



Age/% Fiber	0.6%	0.9%	1.5%	1.8%
7	44.51	45.05	44.60	44.75
28	55.25	56.45	53.05	47.55

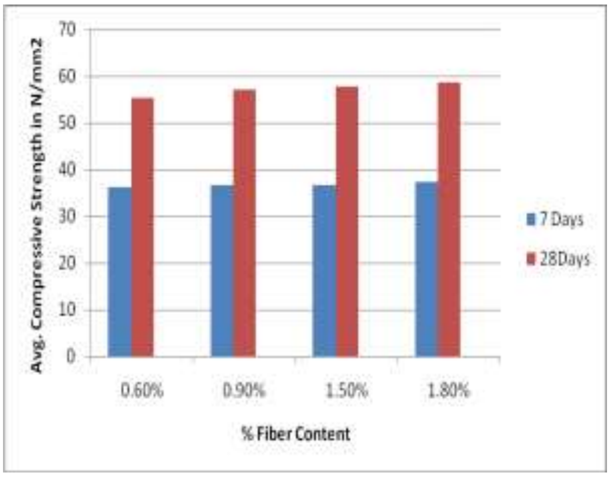
Graph-4 Compressive strength Vs % Fiber Content

Average Experimental results for **Steel Fiber + Fly-Ash** are as follows:



Age/% Fiber	0.6%	0.9%	1.5%	1.8%
7	36.14	36.74	36.60	37.35
28	55.42	57.19	57.80	58.68

Graph-5 Compressive strength Vs % Fiber Content



CONCLUSIONS

Following are the conclusion based on experimental results

1. Compressive Strength increase by about 34% when 1.5% PP fibres are used and its cost after addition of 1.5%PP increase by 48%compare to plain concrete.
2. Compressive strength increase by about 18when 1.8%PP+15% FA is used its cost after addition of 1.8%PP+ 15% FA increase by 58% compare to plain concrete.
3. Compressive strength increase by about 13% when 0.9% SF is used its cost after addition of 0.9%SF increase by 7% compare to plain concrete. Therefore it is more effective.
4. Compressive strength increase by about 17% when 1.8%SF+15% FA is used its cost after addition of 1.8%SF+ 15% FA increase by 15% compare to plain concrete. Therefore it is more effective.
5. Flexural strength increase by about 51.92%at 28 days when 1.5%PP fibres used, where as it increases by about 27% when 0.9% SF is used.
6. Split tensile strength increase by 43.47% at 28 days when 1.8% PP + 15%FA is used, where as it increases by 39% when 1.8% SF is used.
7. Modulus of Elasticity of concrete increases by about 29.66% when 1.5%PP fibers are used where as it increases by 18.78% when 0.9% SF is used.

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