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Study on Properties of Concrete Using Recron3s Fibre

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***Abstract** – The present-day world is witnessing the construction of very challenging and difficult civil engineering structures. Quite often, concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Efforts are being made in the field of concrete technology to develop such concretes with special characteristics. Researchers all over the world are attempting to develop high performance concretes by using fibres and other admixtures in concrete up to certain proportions. Fibres impart energy absorption, toughness and impact resistance properties to fibre reinforced concrete material and these characteristics in turn improve the fracture and fatigue properties of fibre reinforced concrete research in glass fibre reinforced concrete resulted in the development of an alkali resistance fibres high dispersion that improved long term durability. The study involves experimental determination of mechanical properties of recron fibre concrete. This work involves M40 &M60 grade of concrete with variation of water-cement ratio and also variation of recron fibre up to 1% and fly ash up to 30% with respective weight of concrete.*

Keywords - recron fibre, M40 &M60, durability, fly ash, very high strength, workability properties etc.

I- INTRODUCTION

Concrete is one of the most important materials used for building wide range of structures. Concrete is the second most consumed substance in the world after water. While the usage of concrete as a construction material is ever expanding, the researches and studies have been undertaken to enhance the properties like durability, strength, superiority and other factors. The concrete exhibit great compressive strength but fails in tension. The rigid pavement laid of concrete exhibit cracks that are arise due to the changing temperature. The pavement shrinks. Efforts have been undertaken in order to mitigate the splits and introduce changes in ductility of concrete. By using strengthened steel bars and by use of limiting procedures the service life can be extended. This kind of Concrete is known as Fibre reinforced concrete. In these papers, an effort is being made to understand the behavior of concrete blended with RECRON 3s Fibre in correlation with plain concrete. Concrete has excellent resistance against fire rating, extensive service life and shielding capability, under normal and accidental conditions. Concrete is very easy to use, cast and is cheaper than most of construction materials. However, concrete having such excellent properties, structures made from concrete usually exhibit micro-cracking that may result in fracture of a concrete structures when subjected to accidental load or service loads and/or exposure to normal environmental conditions. Therefore, a micro-crack in concrete causes crack propagation that leads to the probable catastrophic failure. So, in order to mitigate this type of catastrophic failures, it is Necessary to forecast the mechanism of

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failure of concrete. The present work is restricted considering the experimental testing to be done. This Study involves investigational testing of pre-notched beams under three point bending. Beams of the same size but with changing notch to depth ratio are used. Mathematical modelling of the present work is out of scope.

II- OBJECTIVES OF THE STUDY

The following are the principle goals of study:

1. To relate compressive strength of conventional concrete with recron fibre concrete.
2. To relate flexural strength of conventional concrete with recron fibre concrete.
3. To determine the durability of recron fibre concrete using acid test [dil.hcl][20%]
4. To determine the optimum percentage of recron fibre.
5. To economies the recron fibre concrete with the use of fly ash.
6. To determine optimum dosage of recron fibre used.

III- MATERIALS AND METHODS

Materials:

1. Cement

In this experiment we have used OPC grade 43 cement and the tests are conducted by following Bureau of Indian Standards (BIS) confining to IS-12269: 19870. The physical characteristics of the tested cement have been shown in table Physical characteristics of cement.

Table 1- Physical properties of Cement

Sr. No.	Properties	Test result
1.	Specific gravity	3.12
2.	Standard consistency	31.5%
3.	Initial setting time	80minutes
4.	Final setting time	350minutes

2. Coarse Aggregate

In the present investigation coarse aggregates available from local crushers were used. Here we have used 20mm size coarse aggregate. Different tests such as specific gravity, water absorption etc. were carried out in the laboratory for the coarse aggregate, the results are presented in Table 2. Coarse aggregates are used in fractions based on the sieve analysis conducted in the laboratory and the same is presented in Table 2.The coarse aggregate conforming to IS: 383-2016 was used.

Table 2- Physical properties of coarse aggregates

Sr. No.	Properties	Test results
1.	Shape of aggregates	Angular
2.	Specific gravity	2.83
3.	Free surface moisture	0.06
4.	Water absorption	1.94%

Table 3-Sieve analysis results of Coarse Aggregates

Sr. No.	IS Sieve	Weight retained (gm)	Cumulative Weight Retained	Cumulative % retained	Cumulative % passing
1.	80	-	-	-	
2.	60	-	-	-	
3.	40	-	-	-	
4.	25	27	27	1.35	98.65
5.	20	462	489	24.45	75.55
6.	16	1018	1507	75.35	24.65
7.	12.5	440	1947	97.35	2.65
8.	10	34	1981	99.05	0.95
9.	6.3	16	1997	99.85	0.15
10	4.75	1	1998	99.90	0.10
11	pan	2	2000	100	0
				Sum =597.3	

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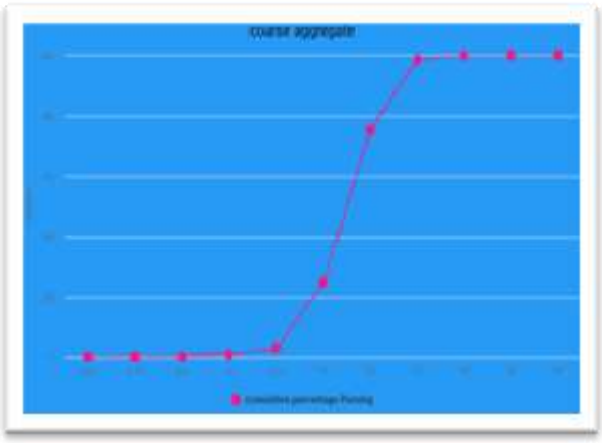


GRAPH 1- Cumulative percentage passing

3. Fine Aggregate

Sand is used as fine aggregate which is locally available River to be used in mortar mix. Fine aggregate testing is done by following Bureau Of Indian Standards (BIS) in accordance with IS: 650-1966 7 IS: 2386-1968 to which helps to find specific gravity and fineness modulus of sand. Good quality zone-I fine aggregate was used. The different tests for physical properties of fine aggregate are carried out in the laboratory and the same is presented in Table 4 and Table 5. The fine aggregate conforming to IS: 383-2016 was used

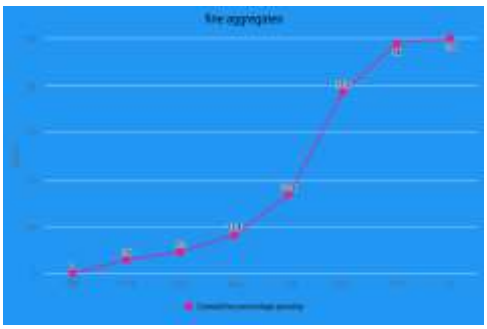
Table 4- Physical Properties of Fine Aggregates

Sr. No	Properties	Fine aggregate
1.	Specific gravity	2.69
2.	Water absorption	3.04%
3.	Silt contain	Nil
4.	Fineness modulus	3.398
5.	Free surface moisture	1.96

Table 5: Sieve analysis of Fine aggregates

Sr. No.	IS Sieve size (mm)	Weight of sand retained (gm)	Cumulative weight retained	Cumulative % retained	Cumulative % passing
1.	10	0	0	0	100
2.	4.75	10	10	2	98
3.	2.36	104	114	22.8	77.2
4.	1.18	219	333	66.6	33.4
5.	600µ	85	418	83.6	16.4
6.	300 µ	36	454	90.8	9.2
7.	150 µ	18	472	94.4	5.6
8.	PAN	28	500	100	0
		500			339.8

Fineness modulus of crushed sand = 339.8/100 = 3.398



GRAPH 2: Cumulative percentage passing of fine aggregate

4. RECRON 3s FIBRE

Recron 3s strands are propelled by the dependence business with the thought process of illuminating the nature of a mortar and the solid. The general properties and employments of RECRON 3s fibre strengthened cement utilized as a part of a development. The more slender and the more grounded components spread crosswise over whole segment, when utilized as a part of low measurements captures splitting. It is a triangular polyester fibre in cross segment with cut length of 6mm and 12mm which is in effect widely utilized as a part of the Indian development industry showcase. It is far shoddy than some other imported development filaments. At the predetermined measurement of 0.25% by wt of bond there are heaps of strands which frame a work in the solid. The dispersing is around under 1millimeter between any two fibres in any organize of the grid. This characterizes the general properties and

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utilization of RECRON 3s fibre fortified cement utilized as a part of development. The more slender and the more grounded components spread crosswise over whole area, when utilized as a part of low dose captures breaking.

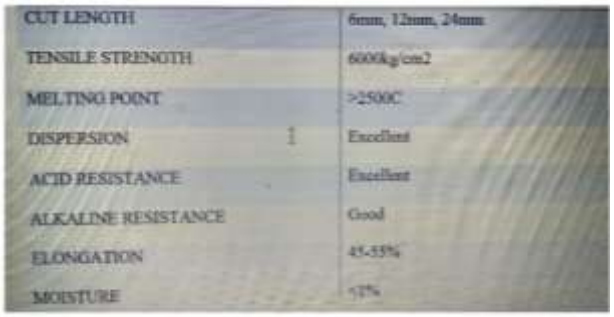

Fig 1. PROPERTIES OF RECRON FIBRE

5. Superplastisizer (Bs Futura Pcx 107)

BS Futura PCX 107 is an advanced next generation Superplastisizer based in Polycarboxylic Ether Polymers Integrating Nano –Technology concepts for creating high performance concrete at site and concrete production plants. It is a chloride free nontoxic and nonflammable material and compatible with all commonly available cements and various blends.

Table 6: Properties of superplastisizer

Specific Gravity	1.03 Kg/l
Solid Contents	40%
Shelf Life	12 mins from MFG Month
pH Value	8 as per DIN EN ISO 2114
Type	High Performance Plasticizer
Solubility	Soluble in Water

6.Fly Ash

Fly ash is a fine powder that is a by product of burning pulverized coal in electrical generation power plant. Fly ash is a pozzolan, a substance containing aluminous and siliceous material that forms cement in the presence of water. When mixed with lime and water, fly ash forms a compound similar to Portland cement. When used in concrete mixes, fly ash improves the strength and segregation of the concrete and makes it easier to pump.

Table 7: Properties of fly ash

Appearance	Grey powder
Specific Gravity	2.2
PH	7.3
Wet density	1.75
Moisture content	0.20

7. ACID (HYDROCLORIC ACID) [HCL]

Hydrochloric acid (**HCl**) and sulphuric acid (H2SO4) are the two main acids responsible for the deterioration of concrete structures. We are using hydrochloric acid for durability test of concrete. Concrete structures should possess an excellent resistance against environmental agencies for a better performance during their lifetime.

Batching

Weigh Batching method was used for batching. Use of weigh system in batching, facilitates accuracy and simplicity. Batching procedure was carried out for batching of cement, sand, coarse aggregate and water.

Fig 2: Batching process

Mixing

Thorough mixing of materials was done for the production of uniform mortar. The mixing should ensure that the mass becomes homogeneous, uniform in colour and consistency.

Mixing was done in two stages:

• Dry mixing

• Wet mixing (by adding water)

Fig 3: Mixing process

Casting

Cube specimen of size 15cm×15cm×15cm were cast using the obtained mix proportion for compressive strength test. The moulds were filled in three layers and

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each layer is compacted by giving 25 blows with standard rod. And also casting of beam for flexural strength with specimen of size 70cm×15cm×15cm.


Fig 4- Casting

Demoulding

The moulds were demoulded after 24 hours of moulding. Then the numbering of cubes was done and also details of date of casting and polymer content were written on them.

Fig 5- Demoulding

Curing

The mould were then kept in the tank filled with water for curing for the period of 14 days and 28 days protect against loss of moisture required for hydration. Curing will also increase the strength of concrete.


Fig 6- Curing

Testing

Compressive strength

The compressive strength test was carried out using IS: 516-1959 [10] code book. At the end of curing period, i.e. 7 days and 14 days, compressive strength test was conducted. Cube specimens were taken out of curing tank and kept exposed to laboratory environment, till the surface becomes dry. Cube specimens were tested for compressive strength under UTM as per IS 9013 (1978). Specimens were placed under in a direction perpendicular to the direction in which they were cast.


Fig7- Compression testing

Flexural Strength:

Flexure strength is also known as modulus of rupture or fracture strength, it is a material property which is defined as the at which material starts to yield in flexure. We have used the transverse 2 point bending test, in which a specimen having a circular cross-section is bent until it is fractured or yielded. Flexural strength MPa after 7 days and 14 days are noted.


Fig 8 -Flexural testing

Durability strength:

Durability of concrete may be defined as the ability of concrete to resist weathering action, chemical attack, and abrasion while maintaining its desired engineering properties. Different concretes require different degrees of durability depending on the exposure environment and properties desired. For acid attack test concrete cube of size 150x150x150 mm are prepared for various percentages of fly ash and recron 3s fibre addition. The specimen are cast and cured in mould for 24 hours, after 24 hours, all the specimen are demoulded and kept in curing acid tank for 14-days.and after 14 days we checked the compressive strength.

Fig 9- Durability testing

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Trial casting of Compression Test
For M40 grade of concrete with 0.5% of recron fibre and 15% of fly ash with weight of cement

Sr. No.	Grade of concrete	W/C ratio	Average compressive strength in N//mm2 (7 days curing)
1.	M40	0.364	28.09

For M40 grade of concrete with 0.5% of recron fibre and 25% of fly ash with weight of cement

Sr. No.	Grade of concrete	W/C ratio	Average compressive strength in N//mm2 (7 days curing)
1.	M40	0.364	23.67

For M40 grade of concrete with 0.75% of recron fibre and 30% of fly ash with weight of cement

Sr. No.	Grade of concrete	W/C ratio	Average compressive strength in N//mm2 (7 days curing)
1.	M40	0.364	18.97

For M40 grade of concrete with 1% of recron fibre and 20% of fly ash with weight of cement

Sr. No.	Grade of concrete	W/C ratio	Average compressive strength in N//mm2 (7 days curing)
1.	M40	0.364	26.88

Trial casting of flexural Test
For M40 grade of concrete with 0.5% of recron fibre and 15% of fly ash with weight of cement

Sr. No.	Grade of concrete	W/C ratio	Average Flexural strength in N//mm2 (7 days curing)
1.	M40	0.364	7.67

For M40 grade of concrete with 0.5% of recron fibre and 25% of fly ash with weight of cement

Sr. No.	Grade of concrete	W/C ratio	Average Flexural strength in N//mm2 (7 days curing)
1.	M40	0.364	7.05

For M40 grade of concrete with 0.75% of recron fibre and 30% of fly ash with weight of cement

Sr. No.	Grade of concrete	W/C ratio	Average Flexural strength in N//mm2 (7 days curing)
1.	M40	0.364	4.997

For M40 grade of concrete with 1% of recron fibre and 20% of fly ash with weight of cement

Sr. No.	Grade of concrete	W/C ratio	Average Flexural strength in N//mm2 (7 days curing)
1.	M40	0.364	8.29

After This Trail Test We Adopt Two Proportion Of Concrete For Final Casting For Grade M40 And M60
1) Fiber 0.75% And Fly Ash 30%
2) Fiber 1% And Fly Ash 20%

IV-PROPORTION OF MIX DESIGN

Sr. No.	Grade Of Concrete	Cement Kg/m^3	Fly ash Kg/m^3	Water Kg/m^3	Coarse Aggregate Kg/m^3
1.	M40	383	0	167	1286.25
2.	M40	294.7	126.3	166.39	1228.61
3.	M40	336.8	84.2	167.14	1237.56
4.	M60	446	0	166.48	1237.74
5.	M60	357.21	153.09	165.94	1168.05
6.	M60	408.24	102.06	165.84	1183.53

Table.8- Proportion of mix design

Fine Aggregate Kg/m^3	Fibre Kg/m^3	Super plastisizer Kg/m^3	% Of Fly ash	% of Fibre
674.90	0	3.83	0	0
644.66	3.157	4.21	0.75	30
683.16	4.21	4.21	1	20
649.46	0	4.46	0	0
612.67	3.82	5.103	0.75	30
620.83	5.103	5.103	1	20

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V- RESULTS AND CONCLUSION

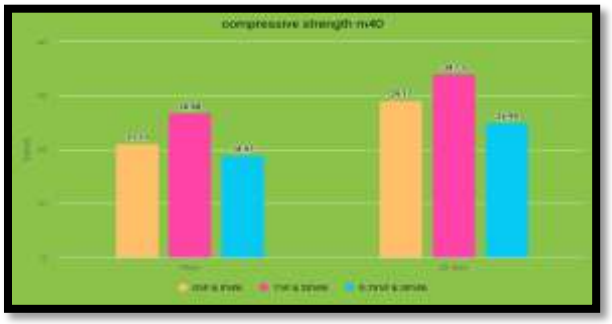
Compressive Strength
M40 Grade in Water Curing

Sr. No.	Grade of concrete	% of fibre	% of fly Ash	7 days compressive strength (N/mm^2)
1.	M40	0	0	21.4
	M40	0	0	20.3
	M40	0	0	21.65
2.	M40	1	20	25.83
	M40	1	20	27.31
	M40	1	20	27.52
3.	M40	0.75	30	19.47
	M40	0.75	30	18.62
	M40	0.75	30	18.84

Table 9- Compressive StrengthM40 Grade

Average 7 days compressive strength (N/mm^2)	14 days compressive strength (N/mm^2)	Average 14 days compressive strength (N/mm^2)
21.11	29.53	29.17
	29.12	
	28.86	
26.88	32.78	34.11
	34.62	
	34.94	
18.97	24.44	24.99
	26.22	
	24.31	

Average 7 days compressive strength (N/mm^2)	14 days compressive strength (N/mm^2)	Average 14 days compressive strength (N/mm^2)
34.57	50.53	50.51
	51.2	
	49.82	
38.11	55.64	55.49
	54.57	
	55.28	
28.84	46.44	46.76
	47.11	
	46.75	

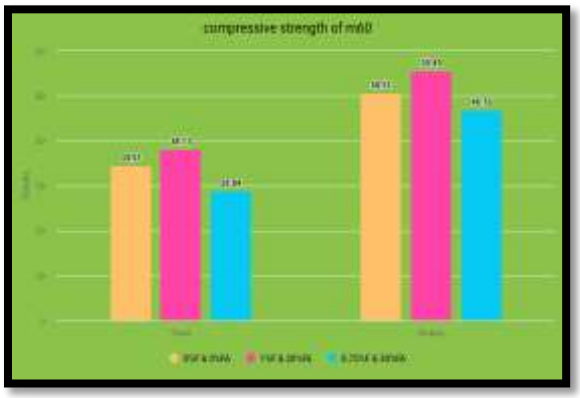


GRAPH 3- Compressive StrengthM40 Grade

M60 Grade in Water Curing

Table 10 -Compressive StrengthM60 Grade

Sr. No.	Grade of concrete	% of fibre	% of fly Ash	7 days compressive strength (N/mm^2)
1.	M60	0	0	35.51
	M60	0	0	32.66
	M60	0	0	35.55
2.	M60	1	20	38.04
	M60	1	20	37.86
	M60	1	20	38.44
3.	M60	0.75	30	28.04
	M60	0.75	30	28.66
	M60	0.75	30	29.82



GRAPH 4 -Compressive StrengthM60 Grade

Durability test

M40 Grade (DURABILITY TEST)

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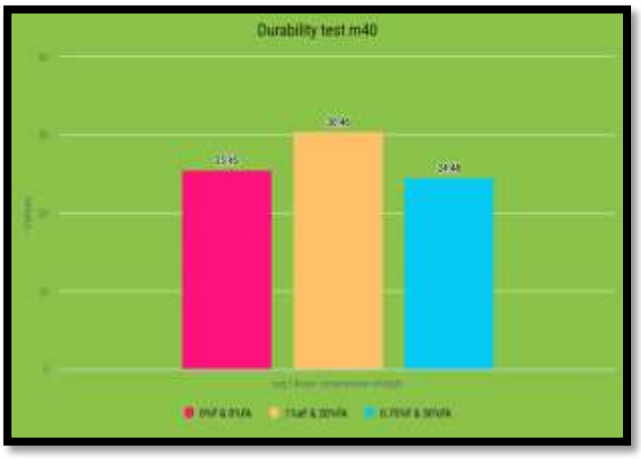
Table 11 M40 Grade (DURABILITY TEST)

Sr. No.	Grade of concrete	% of fibre	% of fly Ash	14 days compressive strength (N/mm^2)	Average 14 days compressive strength (N/mm^2)
1.	M40	0	0	24.85	
	M40	0	0	25.56	
	M40	0	0	25.95	25.45
2.	M40	1	20	30.88	
	M40	1	20	27.61	
	M40	1	20	32.90	30.46
3.	M40	0.75	30	21.2	
	M40	0.75	30	26.88	
	M40	0.75	30	25.37	24.48

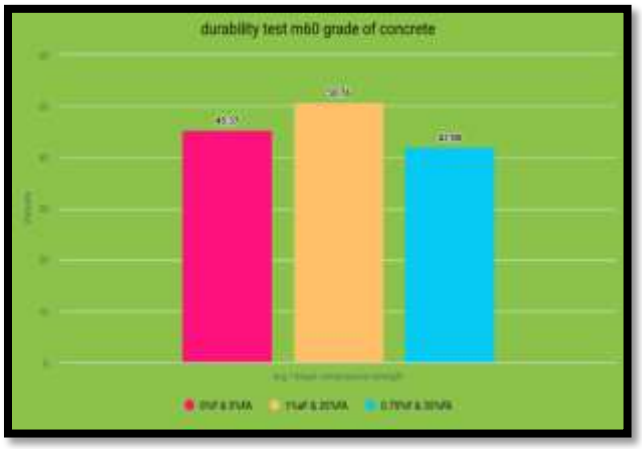


GRAPH 5 M40 Grade (DURABILITY TEST)

M60 Grade (DURABILITY TEST)

Table 12 M60 Grade (DURABILITY TEST)

Sr. No.	Grade of concrete	% of fibre	% of fly Ash	14 days compressive strength (N/mm^2)	Average 14 days compressive strength (N/mm^2)
1.	M60	0	0	46.75	
	M60	0	0	43.77	
	M60	0	0	45.6	45.37
	M60	1	20	51.37	
2.	M60	1	20	52.66	
	M60	1	20	48.26	50.76
4.	M60	0.75	30	40.97	
	M60	0.75	30	43.77	
	M60	0.75	30	41.51	42.08



GRAPH 6 M60 Grade (DURABILITY TEST)

Flexural Strength

M40 Grade in Water Curing

Table 13 Flexural StrengthM40 Grade

Sr. No.	Grade of concrete	% of fibre	% of fly Ash	7 days flexural strength (N/mm^2)	Average 7 days flexural strength (N/mm^2)
1.	M40	0	0	5.1	
	M40	0	0	4.93	5.03
	M40	0	0	5.25	
2.	M40	1	20	8.29	
	M40	1	20	8.13	8.13
	M40	1	20	7.98	
3.	M40	0.75	30	4.97	
	M40	0.75	30	4.6	4.78
	M40	0.75	30	4.78	

14 days flexural strength (N/mm^2)	Average 14 days flexural strength (N/mm^2)
7.29	
7.55	7.26
11.40	
10.37	10.43
9.54	

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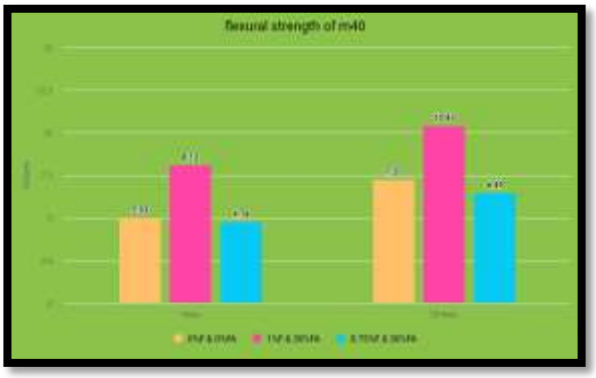
6.84	6.49
6.63	
6.01	



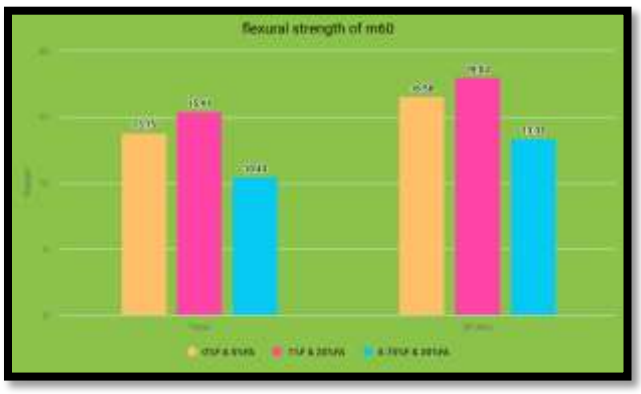
GRAPH 7 Flexural StrengthM40 Grade

Flexural StrengthM60 Grade

Table 14- Flexural StrengthM60 Grade

Sr. No.	Grade of concrete	% of fibre	% of fly Ash	7 days flexural strength (N/mm^2)
1.	M60	0	0	13.48
	M60	0	0	14.10
	M60	0	0	13.68
2.	M60	1	20	15.55
	M60	1	20	14.93
	M60	1	20	15.76
3.	M60	0.75	30	10.37
	M60	0.75	30	10.99
	M60	0.75	30	9.95

Average 7 days flexural strength (N/mm^2)	14 days flexural strength (N/mm^2)	Average 14 days flexural strength (N/mm^2)
13.75	16.17	16.58
	17	
	16.59	
15.41	18.45	18.03
	18.04	
	17.62	
10.43	12.85	13.33
	13.48	
	13.68	



GRAPH 8 Flexural StrengthM60 Grade

VI- CONCLUSION

1. On analysis of the test results of plain concrete beam, Polypropylene fibre reinforced concrete beam, we found that the value of flexural strength increases on introduction of fibres.
2. As we can see that at 1% ratio of recron fibre used to the weight of cement we are getting the maximum value of compressive, flexure strength and durability strength.
3. As per the results, the **Compressive strength** of M40 & M60 grade of recron 3s fibre concrete increase around **8 to 13%** compare with plain concrete and **Flexural strength** of **M40 & M60** grade of recron 3s fibre concrete increase around **7.25 to 20%** compare with plain concrete.
4. There was no much cracks and deterioration on concrete blocks after **Acid test**.

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