A STUDY AND INVESTIGATION ON STRENGTH PARAMETERS OF POLYPROPYLENE FIBER REINFORCED CONCRETE

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ABSTRACT

Fiber reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fiber that are uniformly distributed and randomly oriented. High performance fiber reinforced cementations composites have been engineered to satisfy various field performance requirements such as high durability or impact load resistance. Fibers are usually used in concrete to control cracking due to both plastic shrinkage and drying shrinkage.

They also reduce the permeability of concrete and thus reduce bleeding of water. Taking these advantages into account a study was done on FRC. The interest in the use of fibers for the reinforcement of composites has increased during the last several years. A combination of high strength, stiffness and thermal resistance favorably characterizes the fiber. In this study, the results of the Strength properties of Polypropylene fiber reinforced concrete have been presented.

The compressive strength, flexural strength of concrete samples made with different fibers amounts varies from 0%, 0.1 %, 0.2% 0.3% and 0.4% were studied. The samples with added Polypropylene fibers of 0.3% showed better results in comparison with the others.

I. INTRODUCTION

1.1 GENERAL

The term fiber reinforced concrete (FRC) is defined as a concrete made of hydraulic cements containing fine or fine and coarse aggregates and discontinuous discrete fibers. Inherently concrete is brittle under tensile loading. Mechanical properties of concrete can be improved by reinforcement with randomly oriented short discrete fibers, which prevent and control initiation, propagation, or coalescence of cracks.

FRC can continue to sustain considerable loads even at deflection exceeding fracture deflections of plain concrete. The character and performance of FRC changes depending on matrix properties as well as the fiber material, fiber concentration and fiber distributions.

FRC can be regarded as composite materials with two phases in which concrete represents the matrix phase and the fiber constitutes the inclusion phase. Volume fraction of fiber inclusion is the most commonly used parameter attributed to the properties of FRC.

Fiber count, fiber specific surface area, and fiber spacing are other parameters, which may also be used for this purpose. Another convenient numerical parameter describing a fiber is its aspect ratio, defined as the fiber length divided by its equivalent diameter.

It is possible to make several classifications among fiber types. Fibers can be divided into two groups; those with elastic moduli lower than the cement matrix, such as cellulose, nylon, and polypropylene and those with higher elastic moduli such as asbestos, glass, steel, and carbon.

There are various applications of FRC. Asbestos fibers have been used in pipes or thin sheet elements for a long time. Glass fibers are also used in thin sheet element production as well as shotcrete applications.

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Conventionally polypropylene fibers are used in concrete at relatively low contents, 0.1 to 0.3% by volume, as a secondary reinforcement to control and reduce the plastic shrinkage cracking of concrete.

Polypropylene is hydrophobic due to its chemical structure, which leads to reduced bonding with the cement, and negatively affecting its dispersion in the matrix. In addition polypropylene has a relatively higher Poisson ratio.

Under tensile loading, the cross section of polypropylene fibers reduce rapidly and fiber surface is deboned from the matrix. On the other hand, dynamic modulus of elasticity of polypropylene is much higher when compared with static values.As a result, under dynamic loading PPFRC can perform with success.

Polypropylene fibers are used to control cracks due to plastic shrinkage. New application areas become available as new fiber types and new FRC production techniques are developed.

1.2 TYPES OF FIBERS

Although every type of fiber has been tried out in cement and concrete, not all of them can be effectively and economically used. Each type of fiber has its characteristic properties and limitations.

The following fibers are could be used as in concrete,

- Steel fibers.
- Polypropylene fibers,
- Nylon fibers.
- Asbestos fibers.
- Coir fibers.
- Glass fibers.
- Carbon fibers.

Fiber is a small piece of reinforcing material possessing certain characteristic properties. They can be circular or flat. The fiber is often described by a convenient parameter called “aspect ratio”. The aspect ratio of the fiber is the ratio of its length to its diameter. Typical aspect ratio value ranges from 30 to 150.

Steel fibers are one of the most commonly used fiber. Generally, round fibers are used. The diameter may vary from 0.25 to 0.75 mm. The steel fibers is likely to get rusted and lose some of its strengths. But investigations have shown that the rusting of the fibers takes place only at the surface. Use of steel fiber makes significant improvement in flexural, impacts and fatigue strength of concrete, it has been extensively used in various types of structures, particularly for overlays of roads, airfield pavements and bridge decks. Thin shells and plates have also been constructed using steel fiber.

Different types of steel fibers are used in concrete. But the recently introduced steel fiber by name “Dramix glued steel Fiber”. As it glued in a bunch the ditachement and dispersion will be in a more regulated manner avoiding ballooning of fibers. On account of the typical shape of fiber it functions efficiently in the concrete.

The major use of dramix fiber has been in the production of tunnel segment for channel tunnel (UK). The tunnel segment were 350mm thick made up of M60 grade concrete. Only dramix fiber has been used fully replacing the conventional reinforcement. It is reported that the tunnel segments behaved well when channel tunnel was subjected to fire hazard.

Polypropylene and nylon fibers are found to be suitable to increase the impact strength. They possess very high tensile strength, but their low modulus of elasticity and higher elongation do not contribute to the flexural strength.

Glass fiber is a recent introduction in making fiber concrete. It has very high tensile strength 1020 to 4080N/mm2. Glass fiber which is originally used in conjunction with cement was found to be effected by alkaline condition of cement. Therefore alkali resistant glass fiber by trade name "CEM – FIL" has been developed and used.

The alkali resistant fiber reinforced concrete shows considerable improvement in durability when compared to conventional E – glass fiber.

Carbon fibers perhaps very high tensile strength 2110 to 2815 N/mm^2 and Young's modulus. It has been reported that cement composited made with carbon fiber as reinforcement will have very high modulus of elasticity and flexural strength. The limited studies have shown good durability. The use of carbon fibers of structures like cladding, panels and shells will have promising future.

1.3 MATERIALS USED:

1.3.1 CEMENT

The Bureau of Indian Standards (BIS) has classified PPC in three different grades The classification is mainly based on the compressive strength of cement-sand mortar cubes of face area 50 cm^2 composed of 1 part of cement to 3 parts of standard sand by weight with a water-cement ratio arrived at by a specified procedure.

1.3.2 COARSE AGGREGATE

The coarse aggregate for the works should be river gravel or crushed stone. Angular shape aggregate of size is 20mm and below. The aggregate which passes through 75mm sieve and retain on 4.75mm are known as coarse aggregate.

1.3.3 FINE AGGREGATE

Aggregate which is passed through 4.75 IS Sieve and retained on 75micron (0.075mm) IS Sieve is termed as fine aggregate. Fine aggregate is added to concrete to assist workability and to bring uniformity in mixture.

1.3.4 POLYPROPYLENE FIBER

The polypropylene-based thermoplastic fibers are uniform in cross-section, not having any degraded surface skin, and they are heat-weldable at a pressure at a temperature which is lower than the melting temperature, by virtue of internal heating due to the effect of said pressure.

They are made of a first constituent with high crystalline and at least one second constituent, compatible with the first constituent, and of crystallinity that is lower than that of the first constituent.

They have a quantity of primary oxidation inhibitor lying in the range 350 ppm to 1000 ppm. Such fibers are made by spinning under conditions that avoid molecular degradation by thermal oxidation at the periphery of the fibers, in particular with cooling that is rapid immediately on leaving the extrusion head.

The non-woven fabric obtained by heat-bonding such fibers is characterized by weld points that are in the form of a polymer laminate that is uniform and transparent.

1.4 OBJECTIVE OF THE STUDY

The objective of this study is to determine the structural behavior of concrete beam grade 20 N/mm^2 with adding of 0%, 0.1%, 0.2%, 0.3% and 0.4% of polypropylene fiber to weight of Portland pozzolana cement. Laboratory experiments conducted in the Structural Engineering Laboratory Loading Frame of 500 kN.

- To achieve the economy, polypropylene fiber added with Portland pozzolana cement.
- The experimental work consists of compressive strength and flexural behavior of RCC beams.
- In the flexural behavior test the following characteristic studies are of interest.

(i) Mid span deflection
(ii) Initial crack
(iii) Location of crack and type of crack failure
(iv) Load Vs Deflection

4.INGREDIENTS

4.1 CEMENT

The binding materials used in concrete are Portland pozzolana cement. This cement is of 53 grades conforming to IS 456-2000 and is having desired properties. The compressive strength of cement is checked by casting cube and testing under compressive testing machine and the tensile strength of cement is checked by casting beam and testing under tensile testing machine.

This cement should be cool and stored in dry cool place. The specific gravity of cement should be determined by adopting standard procedure.

4.2 COARSE AGGREGATES

The coarse aggregate for the works should be river gravel or crushed stone. Angular shape aggregate of size is 20mm and below. The aggregate which passes through 75mm sieve and retain on 4.75mm are known as coarse aggregate.

It should be hard, strong, dense, durable, clean, and free from clay or loamy admixtures or quarry refuse or vegetable matter. The pieces of aggregates should be cubical, or rounded shaped and should have granular or crystalline or smooth (but not glossy) non-powdery surfaces.

Aggregates should be properly screened and if necessary washed clean before use. Coarse aggregates containing flat, elongated or flaky pieces or mica should be rejected. The grading of coarse aggregates should be as per specifications of IS 383-1970.

After 24-hrs immersion in water, a previously dried sample of the coarse aggregate should not gain in weight more than 5%. Aggregates should be stored in such a way as to prevent segregation of sizes and avoid contamination with fines.

4.3 FINE AGGREGATES

Aggregate which is passed through 4.75 IS Sieve and retained on 75micron (0.075mm) IS Sieve is termed as fine aggregate. Fine aggregate is added to concrete to assist workability and to bring uniformity in mixture.

Usually, the natural river sand is used as fine aggregate. The moisture content of fine aggregate is determined to apply field corrections in design mixes. Ordinary river sand conforming IS 383-1970.

4.4 POLYPROPYLENE FIBERS

The polypropylene-based thermoplastic fibers are uniform in cross-section, not having any degraded surface skin, and they are heat-weldable at a pressure at a temperature which is lower than the melting temperature, by virtue of internal heating due to the effect of said pressure.

They are made of a first constituent with high crystalline and at least one second constituent, compatible with the first constituent, and of crystalline that is lower than that of the first constituent.

They have a quantity of primary oxidation inhibitor lying in the range 350 ppm to 1000 ppm. Such fibers are made by spinning under conditions that avoid molecular degradation by thermal oxidation at the periphery of the fibers, in particular with cooling that is rapid immediately on leaving the extrusion head.

4.5 WATER

(i) Mixing water:

The water should be fit for drinking. The water should not have high concentrations of sodium and potassium and there is a danger of alkali-aggregate reaction.

Natural waters that are slightly acidic are harmless, but water containing humic or other organic acids may adversely affect the hardening of concrete. Such water as well as highly alkaline water should be tested.

(ii) Curing water:

Generally, water satisfactory for mixing is also suitable for curing purposes. However, it is essential that curing water should be free from substances that attack hardened concrete like free CO_2 etc.

4.6 CONCRETE

Concrete is the hardened cement paste. Concrete is one of the most widely used construction material throughout the world. The major advantage is to take required compressive strength. The ingredients for making concrete are cement, fine aggregate, coarse aggregate and water.

Sometimes certain additives are added to it to improve or alter some properties. Making concrete is an art which one has to be through, otherwise that will end up with bad concrete.

The ingredients for good and bad concrete are same it is only the art of making it. Hence as a civil engineer one should be with the entire factor with which he can produce a good concrete.

5.TESTING ON INGREDIENTS

5.1 SPECIFIC GRAVITY OF CEMENT

The specific gravity of cement is to be found in the laboratory by using pyconometer and other accessories. Value of specific gravity of cement is obtained as 3.05.

5.2 SPECIFIC GRAVITY OF COARSE AGGREGATES

The specific gravity of coarse aggregate usually called coarse aggregate is the ratio of the weight in air of the given volume of dry coarse aggregate at a stated temperature to the weight in air is equal volume of distilled water at a stated temperature.

The specific gravity of coarse aggregate is to be found in the laboratory by using pyconometer and other accessories. Value of specific gravity of coarse aggregate is 2.81.

5.3 SPECIFIC GRAVITY OF FINE AGGREGATES

The specific gravity of soil grains (or solids) usually called soil is the ratio of the weight in air of the given volume of dry soil solids at a started temperature to the weight in air of an equal volume of distilled water at a started temperature.

The specific gravity of sand is to be found in the laboratory by using pyconometer and other accessories. Value of specific gravity of sand is 2.63.

5.4 WATER ABSORPTION OF COARSE AGGREGATES

The water absorption of aggregate is determined by measuring the increase in weight of a dry sample when immersed in water for 24 hours. The ratio of the increase in weight to the weight of dry sample expressed as percentage is known as absorption of aggregate. The water absorption of aggregate is to be found in the laboratory. Values of water absorbing capacity of coarse aggregate are 0.5%.

5.5 INITIAL AND FINAL SETTING TIME

(i) Initial Setting Time: The period elapsed between the times when is water added to the cement and the time that the paste starts losing its plasticity. The needle may penetrate only to a depth of 33-35mm from the top is taken as initial setting time.

(ii) Final Setting Time: The period elapsed between the instant of addition of water and the paste has completely lost its plasticity.

5.6 SETTING OF CEMENT

When water is mixed with cement, the paste so formed remains pliable and plastic for a short time. During this period it is possible to disturb the paste and remit it without any deleterious effects.

As the reaction between water and cement continues,the paste loses its plasticity. This early period in the hardening of cement is referred to as ‘setting’ of cement.

5.7 MOISTURE CONTENT

Free moisture is both fine and coarse aggregate affects the quality of concrete in more than one way. In case of weigh batching, determination of free moisture content of the aggregate is necessary and then correction of w/c ratio to be effected in this regard.

But when volume batching adopted, the determination of moisture content of fine aggregate doesn’t become necessary but the bulking sand and correction of volume sand to give allowance for bulking becomes necessary.

5.8 PROPERTIES OF CEMENT

The properties of cement tested were listed below in table 5.1

Sl. No.	Particulars	Values
1	Specific gravity	3.15
2	Initial setting time	30 min
3	Final setting time	5hrs 10 min

Table 5.1 Properties of Cement

5.9 PROPERTIES OF COARSE AGGREGATES

The properties of coarse aggregate tested were listed below in

Table5.2 Properties of Coarse Aggregates

Sl. No.	Particulars	Values
1	Specific gravity	2.70
2	Water absorption	0.96%

5.10 PROPERTIES OF FINE AGGREGATES

The properties of fine aggregate tested were listed below in table 5.3.

Properties of Fine Aggregates

Sl. No.	Particulars	Values
1	Specific gravity	2.60
2	Water absorption	1.73 %
3	Moisture content	1.4 %

5.11 PROPERTIES OF POLYPROPYLENE FIBERS

The properties of polypropylene fibers tested were listed below in table 5.4.

Table 5.4 Properties of Polypropylene Fibers

Sl. No	Particulars	Values
1	Specific gravity	0.91
2	Water absorption	0.01

The above properties shall be used during mix design.

6. EXPERIMENTAL INVESTIGATION

6.1 CONCRETE MIX DESIGN

Mix design for concrete was made using the properties of constituents of concrete. Grade of concrete was taken as M20 and the Mix design was done as per IS: 10262 – 2009 and IS: 456-2000. It should be the maximum for M20 grade under mild exposure condition as per IS:456-2000 table 5. In this research the concrete samples were prepared with fiber ratios of 0, 0.1, 0.2, 0.3 and 0.4% by volume. The mix ratio is shown in table 6.

Table 6.1 Concrete Mix ratio

Water	Cement	Fine aggregate	Coarse aggregate
197litres/m^3	394 kg/m^3	670 kg/m^3	1135 kg/m^3
W/C ratio = 0.55	**1.00**	**1.7**	**2.88**

6.2 REINFORCEMENT DETAILS

Beam carries transverse external load that cause bending moment, shear forces and in some cases torsion. Concrete is strong in compression and very week in tension and Steel reinforcement is used to take up tenstile stresses in reinforced concrete beams. Beam is designed as under reinforced section.3nos of 12mm dia rods as bottom reinforcement and 2nos of 10mm dia rods as top reinforcement and Stirrups –two legged 8mm dia rods.

Figure 6.1 Reinforcement Details

6.3 SPECIMENS PREPARED

(i) Cube size 150 x150 x150 mm

Concrete specimen 150 x 150 x 150 mm cubes were cast with different proportions 0, 0.1%, 0.2%, 0.3%, 0.4% of polypropylene fiber concrete. For each proportion three specimens were cast.

(ii) Beam size – 1800x125x200

Reinforced Concrete specimen 1800 x 125 x 200 mm beams were cast with different proportions 0%,0.1%,0.2%,0.3%,0.4% of polypropylene fiber concrete. The single beam was cast for each varying proportion**.**

(iii)Curing

The specimens are cured for 28days in ordinary water.

6.4 TESTING PROGRAMME

6.4.1 Compression test:

Compression test is common tests conducted on harden concrete, partly because it is an easy test to perform, and party because most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength.

The compression test is carried out on specimens cubical or cylindrical in shape. Prism is also sometimes used, but it is not common in our country. Sometimes, the compressive strength of concrete is determined using parts of a beam tested in flexure. The end part of the beam is left intact after failure in flexure and, because the beam usually of square crosses section, this part of the beam could be used to find out the compressive strength.

The specimens of size 150mmx150mmx150mm were cast and cured for 28 days. The cubes were cast by adding polypropylene fiber from 0 to 0.4%. For each proportion three specimens were cast. The specimens were tested in the compression testing machine of capacity 1000kN. The load was applied gradually on the specimen. The load at which the specimen fails is noted. The average compressive strength of three cube specimens gives the compressive strength of the specimens in 28days curing.

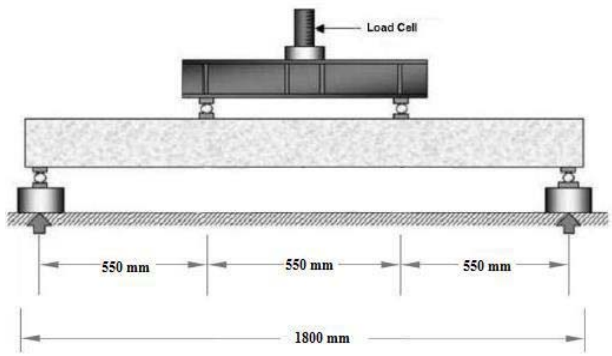
Figure 6.2 Compression Testing Machine

6.4.2 FLEXURAL TEST:

The beam moulds were cleaned thoroughly using a waste cloth and properly oiled along its face. The concrete material was mixed in a mixture machine and concrete as then filled in mould and then compacted in using a table vibrator. After curing, all the specimens were white washed in order to facilitate marking of cracks. The specimens were tested for flexural strength of 28 days.

The standard sizes of the specimens are 15x15x70 cm. If the largest nominal size of the aggregate does not exceed 20 mm, specimens 180x12.5x20cm may be used. This ensures that top and bottom surfaces of the beam are parallel so that loading is uniform across the width. Loading is applied through 2 rollers, each at a distance of L/3 from the supports on either side.
- Apply the loading without shock and increase at a constant stroke rate (0.02mm/min). For flexure test, the load should be increased gradually till the failure of the specimen will takes place and at each stage of loading; deflection at the mid-span and the deflection at a distance L/3 from both the ends have to be measured using a dial gauge. The strains at the compression face and the tension face are measured using mechanical strain gauge.

LOADING SETUP FOR FLEXURE TESTING



TEST SET UP FOR BEAM IN LOADING FRAME

TEST SET UP FOR BEAM IN LOADING FRAME

7.RESULTS AND DISCUSSION

7.1 GENERAL

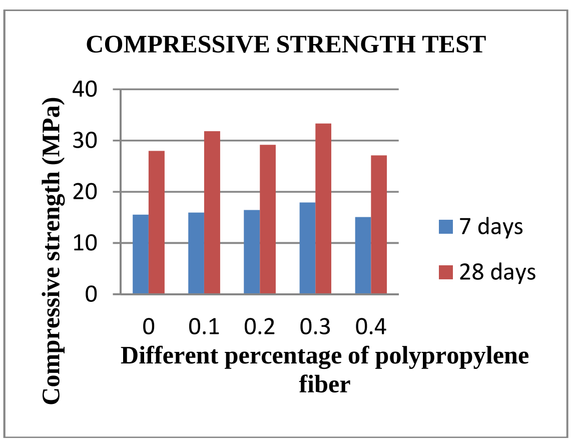
In this chapter compressive strength, flexural strength test were conducted for eight reinforced cement concrete beams and the readings were recorded. The appropriate reading is plotted as bar chart and graph according to the requirement.

7.2 COMPRESSIVE STRENGTH

Compressive Strength of concrete was found out at 7th and 28th day for conventional concrete and polypropylene fiber reinforced concrete. polypropylene fiber content were added to the concrete by 0%, 0.1%, 0.2%, 0.3% and 0.4% in weight of cement. The size of cubes to find out compressive strength of concrete is 150 X 150 X 150 mm. The compressive strength results were tabulated below.

Table 7.1 Cube Compressive Strength Results

Different percentage of polypropylene fiber	Compressive strength (MPa)	
	7 days	28 days
0	15.53	27.97
0.1	15.93	31.83
0.2	16.44	29.18
0.3	17.92	33.32
0.4	15.05	27.09



The cube compressive strength of 0.3% of polypropylene fiber was increased compare to conventional cube. The cube compressive strength of 0.3% is 17.92 for 7 days and 33.32 for 28 days. The cube compressive strength of 0.4% of polypropylene fiber was decreased compare to 0.3% of polypropylene fiber. The compressive strength of 0.4 % is 15.05 for 7 days and 27.09 for 28 days testing of cubes. The cube compressive strength of 0.4% of polypropylene fiber was decreased compare to conventional cube.

7.3 TEST RESULT OF RC BEAM UNDER FLEXURE

Flexural Strength of concrete will be found out at 28th day for conventional concrete and polypropylene fiber reinforced concrete. Polypropylene fiber content will be added to the concrete by 0%, 0.1%, 0.2%, 0.3% and 0.4% in weight of cement. The size of beam to find out the flexural strength of concretes is 1800 X 125 X 200 mm. The flexural strength of concrete was tabulated below.

Table 7.2 Flexural Strength RC beam

Different percentage of polypropylene fiber	Flexural load(kN)	Flexural Strength of 28days (N/mm^2)
0	63.52	22.68
0.1	100	36
0.2	141	50
0.3	143	51.48
0.4	73	26.28

The Beam Flexural strength of 0.3% of polypropylene fiber was increased compare to conventional beam. The Flexural strength of 0.3% is 143kN for 28 days is 51.58N/mm^2.The Beam Flexural strength of 0.4% of polypropylene fiber was decreased compare to 0.3% of polypropylene fiber beam. The flexural strength of 0.4 % is 73kN for 28 days is 26.28 N/mm^2.The Beam Flexural strength of 0.4 % of polypropylene fiber was decreased compare to conventional beam.

7.4 Load–deflection relationship

The following tables and figures shows that the relationship between the load and displacement for all cast test beam specimens.

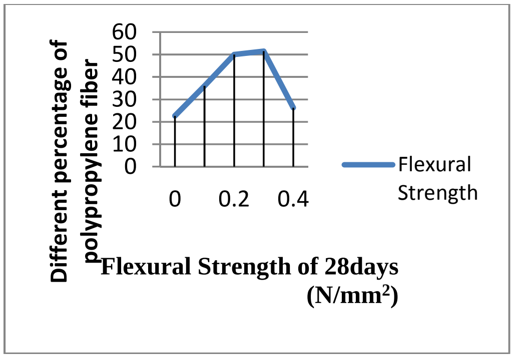


Figure 7.2 Flexural strength of 28 days

Sl. No	Load in KN	Mid span deflection(mm)	1/3 span deflection(mm)
1	0	0	0
2	9.9	0.97	0.85
3	21.9	2.57	2.41
4	28.13	3.52	3.12
5	33.3	4.86	4.63
6	38.33	5.53	5.25
7	42.98	6.60	6.29
8	50.55	7.80	7.44
9	57.23	9.80	8.64
10	60.68	10.9	9.57
11	62.55	11.77	11.07
12	63.53	13.41	12.44

Table 7.3 Load Vs Deflection relationship for PF 0%

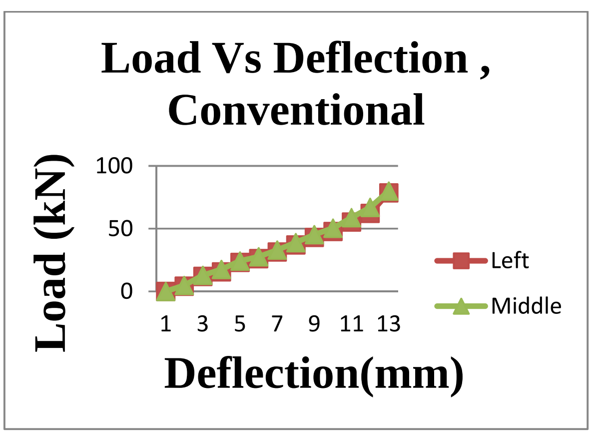


Figure 7.3 Load Vs Deflection for Polypropylene Fiber 0%

Table 7.4 Load Vs Deflection relationship for PF 0.1%

Sl. No	Load in KN	Mid span deflection (mm)	1/3 span deflection (mm)
1	0	0	0
2	4.42	0.24	0.24
3	7.125	0.37	0.38
4	10.125	0.52	0.54
5	14.625	0.73	0.77
6	18.975	0.99	1.05
7	24.75	1.32	1.4
8	29.25	1.65	1.75
9	35.475	2.03	2.19
10	43.575	2.66	2.88
11	50.85	3.11	3.39
12	55.8	3.52	3.84
13	67.57	4.31	4.68
14	74.85	4.51	6.02
15	85.95	5.78	6.25
16	94.5	6.58	7.18
17	99	7.21	7.66
18	104.85	8.11	8.56
19	112.5	9	9.41
20	117.82	9.88	10.34
21	123.15	10.92	11.29
22	127.72	11.94	12.96
23	100.35	12.69	14.1
24	43.57	14.21	17.54

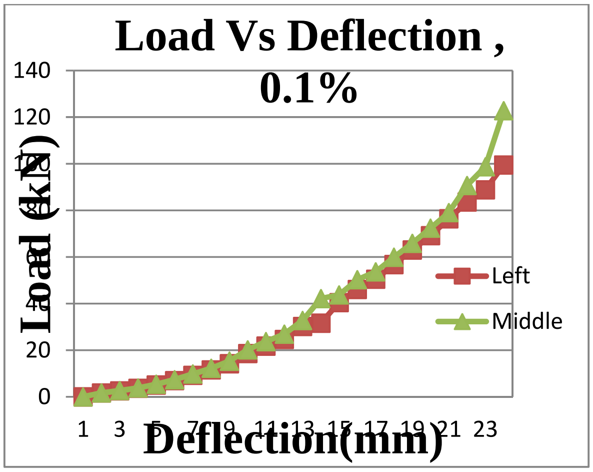


Figure 7.4 Load Vs Deflection for Polypropylene Fiber 0.1%

Table 7.5 Load Vs Deflection relationship for PF 0.2%

Sl. No	Load in KN	Mid span deflection (mm)	1/3 span deflection (mm)
1	0	0	0
2	7.5	0.27	0.29
3	15	0.62	0.59
4	22.5	0.98	0.89
5	30	1.39	1.24
6	38.85	1.91	1.69
7	48.15	2.5	2.19
8	57.15	2.98	2.62
9	63.9	3.46	3
10	73.43	4.07	3.5
11	82.2	4.73	4.11
12	93.08	5.25	4.51
13	102	5.78	4.45
14	108.45	6.22	5.32
15	115.43	6.64	5.69
16	123.38	7.17	6.13
17	123.9	7.34	6.28
18	132.98	7.88	6.73
19	141.75	8.62	7.35
20	86.25	7.89	7.2

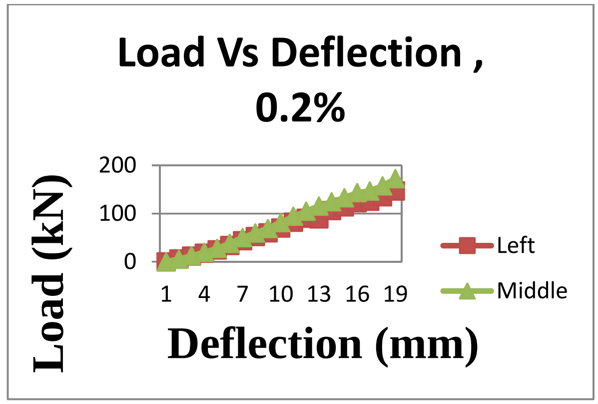


Figure 7.5 Load Vs Deflection for Polypropylene Fiber 0.2%

Table 7.6 Load Vs Deflection relationship for PF 0.3%

Sl. No	Load in KN	Mid span deflection (mm)	1/3 span deflection (mm)
1	0	0	0
2	7.5	0.43	0.4
3	15	1	0.92
4	22.875	1.71	1.55
5	31.875	2.59	2.37
6	38.1	3.21	2.95
7	45.75	4	3.68
8	50.55	4.43	4.09
9	57.525	5.15	4.74
10	63.375	5.77	5.29
11	71.625	6.47	5.94
12	78.825	7.25	6.66
13	85.95	8.06	7.4
14	90.75	8.65	7.93
15	96.075	9.38	8.62
16	98.7	10.01	9.21
17	105.67	11.11	10.21
18	112.5	11.49	10.59
19	113.92	12.55	11.59
20	120.75	13.94	12.76
21	126.45	14.05	13.12
22	129.75	14.67	13.65
23	132.75	15.09	14.44
24	136.12	15.98	14.97
25	140.17	16.56	15.67
26	143.85	18.04	16.2
27	93.75	16.95	16.96

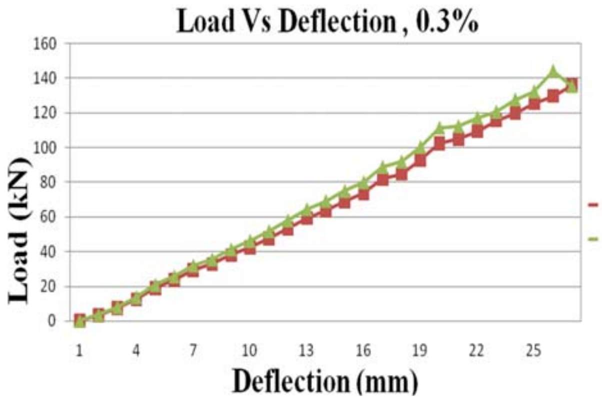


Figure 7.6 Load Vs Deflection for Polypropylene Fiber 0.3%

Table 7.7 Load Vs Deflection relationship for PF 0.4%

Sl. No.	Load in KN	Mid span deflection(mm)	1/3 span deflection(mm)
1	0	0	0
2	9.9	0.97	0.85
3	21.9	2.57	2.41
4	28.12	3.52	3.12
5	33.3	4.86	4.63
6	38.32	5.53	5.25
7	42.97	6.6	6.29
8	50.55	7.8	7.44
9	57.22	9.05	8.64
10	60.67	10.09	9.57
11	62.55	11.77	11.07
12	63.52	13.41	12.44
13	63	16	15.72
14	68.25	17.01	16.01
15	70.12	17.2	16.35
16	73.87	17.6	16.7

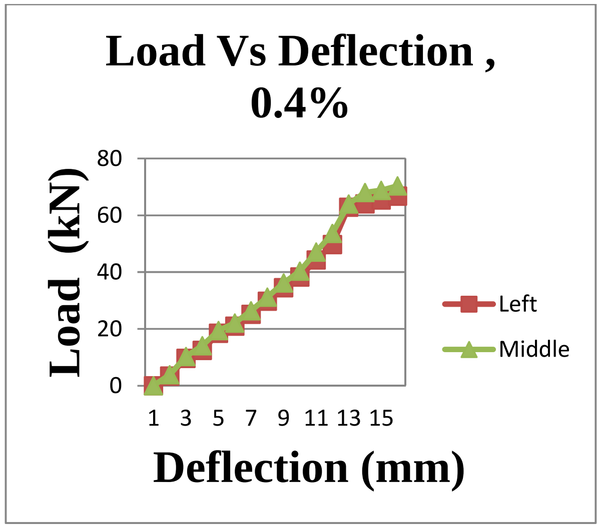


Figure 7.7 Load Vs Deflection for Polypropylene Fiber 0.4%

It is observed that all the fiber of 0.3% beam specimen showed greater load carrying capacity than the controlled beam.At first crack load for 0.3% of polypropylene fiber reinforced beam specimen is 31.89 kN. At first crack load for controlled beam specimen is 21.9 kN.

CONCLUSION

- The polypropylene fiber reinforced concrete achieves higher compressive and flexural strength.
- The Compressive strength and flexural strength tests reveals that, the strengths were increased proportionately with the increase in volume ratios of Polypropylene Fibers with reference to the conventional mix without fibers.
- In addition to this the compressive and flexural strength properties of polypropylene fiber reinforced concrete are found to increase by increasing the percentage of fibers in it.
- It is observed that the fiber with 0.3% of polypropylene fiber beam specimen shows that the greater load carrying capacity compared with all other different percentage of fiber .
- From the load Vs deflection relationship for different percentage of fiber, it is identify the optimum percentage was 0.3% of polypropylene fiber.

- The samples with fibers content of 0.3%showed optimum results in Comparison with other samples in this study.

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