



# STUDY ON STRENGTH OF CONCRETE USING POLYPROPYLENE FIBRES

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**Abstract:** Now-a-days, there has been a significant increase in the use of fibres in concrete for improving its properties such as tensile strength and ductility. Now-a-days polypropylene fibre, etc. use while preparing concrete. polypropylene fibre has the advantages of having higher tensile strength and compressive strength, thus reducing the loss of damage during fire accident of concrete structures. In this investigation polypropylene fibre are added to the concrete by volume fraction to determine its strength characteristics. Determination of compressive, split tensile and flexural strength of concrete. Polypropylene is a synthetic hydrocarbon polymer, the fiber of which is made using extrusion processes by hot drawing the material through a die. Its use enables reliable and effective utilization of intrinsic tensile and flexural strength of the material along with significant reduction of plastic shrinkage cracking and minimizing of thermal cracking. Comparison of the strength performance of conventional concrete was made. This is experimental study done by using polypropylene fibres without flyash in concrete and conclusion from their various strength parameters finding out the optimum quantity of polypropylene fibers required to achieve the maximum compressive strength for M40 grade concrete. From the exhaustive and extensive experimental work it was found that with increase in polypropylene fiber content in concrete there was a tremendous increase in compressive strength. The effect of the addition of polypropylene fibers on the mechanical properties of normal strength concrete is studied. The polypropylene fibers were added at concentration of 0.3, 0.4, 0.5 and 0.6 % by volume. Compression, pullout and bending tests were carried out to determine the mechanical properties such as maximum compressive strength, splitting strength. On the basis of the experimental results, it can be concluded that, ductility of concrete significantly increased and maximum compressive strength slightly increased with increasing the content of polypropylene fibers materials. Further increase of polypropylene fibers (higher values than 0.5 vol. %) did not increase the ultimate bond strength, but it provided much more ductile bond behaviour.

**Index Terms** – Concrete, Strength, Polypropylene Fibres.

## I. INTRODUCTION

### 1.1 Concrete

Concrete is composite mix of cement, sand, coarse aggregate, water and admixture if required. Concrete is one of the most important materials among the building materials in all types of civil engineering works. Since the adaptation of concrete as a building material, lot of researches and studies has been made to improve the quality, strength and durability of it. By the same time efforts are also being made to economize concrete construction compared to other materials. Plain concrete is good in compression but weak in tensile strength with very limited ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor tensile strength is due to propagation of such micro cracks, eventually leading to brittle fracture of concrete. Attempts have been made to reduce the cracks and impart improvements in tensile property of concrete members using conventionally reinforced steel bars and also by applying restraining techniques. Although both these methods provide tensile strength to concrete

members, they however do not increase the tensile strength of concrete itself. In plain concrete and similar brittle materials, structural micro cracks develop even before loading due to drying and shrinkage or other causes of volume changes. The concept of using fibres as reinforcement is not new but used since 19<sup>th</sup> century were asbestos fibre, steel fibres used in concrete to increase the strength of concrete. Historically, horsehair was used in mortar and straw in mud bricks. Fibres are usually used in concrete to control cracking due to shrinkage and to reduce bleeding of water as well as produce greater impact, and abrasion resistance in concrete. Generally fibres do increase the flexural strength of concrete, and so can replace moment– resisting or structural steel reinforcement. It has been recognized that the addition of small closely spaced and uniformly dispersed fibres to concrete would act as crack resistance and substantially improve its static and dynamic properties. This type of concrete is known as fibre reinforced concrete.

## 1.2 Polypropylene Fibre

Polypropylene is an economical material that offers a combination of outstanding physical, mechanical, thermal and electrical properties not found in any other synthetic fibres. There are two general types of fibres currently available in the market. These are referred to as fibrillated and monofilament. Polypropylene is widely used in ropes, distinctive because they are light enough to float in water. For equal mass and construction, polypropylene rope is similar in strength to polyester rope. Polypropylene costs less than most other synthetic fibres.

### 1.2.1 Properties of polypropylene fiber.

Sl. No	Characteristics	Description
1	Polypropylene forms	Straight Fibres and Special crimped Fibres
2	Dispersion in Water	Within Seconds
3	Dimension	High matrix [6 –7 times]
4	Construction advantage	Helps in thermal expansion & Contractions

1. Comes in two forms – straight and special crimped, unlike other manmade fibres. Crimped fibre allows improved interlocking.
2. Polypropylene disperses in water within seconds, their by allowing the uniformity in application and properties.
3. Polypropylene is produced in fine controlled dimension and gives very high matrix (6-7 times). Such fine fibre and dispersion ensures uniform three dimensional micro reinforcement .
4. In construction industry, these fine fibres help the structure take-up thermal expansion and contractions. In RCC and plastering, the fine fibres checks micro cracks. They are also used in cement mix.
5. It has excellent UV stability as compared to the Polyester polymer fibres.
6. The alkali stability of the fibre in the 2% cement slurry alkalinity shows excellent stability over a period of time

### 1.2.2 Advantages of Polypropylene Fibres in Concrete.

- Increases tensile strength.
- Greater impact resistance of fiber reinforced concrete.
- Reduces permeability.
- Arrest drying shrinkage.
- Easy to use and mix.
- Controls cracking.
- Reduces rebound loss-Brings direct savings and gains.
- Increases flexibility and abrasion resistance.
- Chemically very inert and highly integral product.
- Minimize steel reinforcement in industrial floors.
- Compactable to all type of fibers.
- Rust and alkaline proof material.
- Suitable for pumped concrete.

### 1.2.3 Disadvantage of Polypropylene Fibres in Concrete.

- The fibers form very small lumps while mixing.
- The fibers appearing on the surface of the concrete and are not recommended from the aesthetic views.

### 1.2.4 Application

- Plain concrete and wall plastering.
- Used in footings, foundations and tanks.
- Pipes, burial vaults, pre-stressed beams etc.
- Roads and pavements.

## II. OBJECTIVE

- To study the effect of polypropylene fiber in varying content and finding the optimum polypropylene fiber content.
- To study the various mechanical property of concrete using polypropylene fiber such as compressive strength, split tensile strength and flexural strength.
- To compare the various strength parameters of polypropylene strength with nominal concrete.

## III. LITERATURE VIEW

1) Salahaldeen Alsadey, Muhsen Salem in the paper "Influence of Polypropylene Fiber on Strength of Concrete" American Journal of Engineering Research [2016] studied the determination of optimum quantity of polypropylene fibers required to achieve the maximum compressive strength for M25 grade concrete. It has been successfully used in construction with its excellent flexural-tensile strength, resistance to spitting, impact resistance and excellent permeability and frost resistance. It is an effective way to increase toughness, shock resistance and resistance to plastic shrinkage cracking of the concrete. From the exhaustive and extensive experimental work it was found that with increase in polypropylene fibre content in concrete there was a tremendous increase in compressive strength. Even at 2 % polypropylene fibre content compressive strength of 28 N/mm<sup>2</sup> was observed against compressive strength 25 N/mm<sup>2</sup> at 0 % hence increase of 12 % compressive strength was obtained.

2) Divya S Dharan, Aswathy Lal in the paper "Study the effect of polypropylene fiber in concrete" International research journal of engineering and technology [2016] studied Fibre reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. The character of fibre reinforced concrete changes with varying concretes fibre materials, geometries, distribution, orientation, and densities. Polypropylene fibre is a light weight synthetic fibre. It prevents crack formation and provides reinforcement to the concrete structure. The polypropylene fibres (Blended type) of different percentage (0.5%, 1%, 1.5%, and 2%) added in concrete. Tests on workability, compressive strength, flexural resistance, split tensile strength and modulus of elasticity were conducted on specimens.

3) Mohamed R.A.S in the paper "Effect of polypropylene fibers on the mechanical properties of normal concrete" Journal of Engineering Science [2006] studied the effect of addition of pure polypropylene fibers to concrete in order to diminish some poor performances particularly in case of ductility and tensile strength. The effect of the addition of polypropylene fibers on the mechanical properties of normal strength concrete is studied. on the basis of the experimental results, it can be concluded that, ductility of concrete significantly increased and maximum compressive strength slightly increased with increasing the content of polypropylene fiber materials. further increase of polypropylene fibers (higher values than 0.5 vol. %) did not increase the ultimate bond strength, but it provided much more ductile bond behaviour. besides, the addition of polypropylene fibers caused a significant increase in the percentage of water absorption for the tested concrete specimens.

4) Mr. Mehul J. Patel in the paper "Experimental Study On Properties Of polypropylene Fibre Reinforced Concrete" International Journal of Engineering Trends and Technology[ 2015] studied the effect of Polypropylene Fibres with different cut length can still be a promising work as there is always a need to overcome the problem of brittleness of concrete. Compressive strength increases with the increase in the percentage of Polypropylene fibre up to addition of Cement in Concrete for different mix proportions.

5) C. Selin Ravi kumar in the "paper Polypropylene Fibre Concrete" IOSR Journal of Mechanical and Civil Engineering [2013] Studied on Strength And Fire Resistant Properties investigate that , With 0.5 per cent addition of fibre, the increase in the compressive strength is 13 per cent, the increase in flexural strength is 42% and the increase in split tensile strength is 20 percent over conventional concrete.

6) Vinay Kumar Singh in the paper "Effect Of Fibre On Properties Of Concrete" Computer & Mathematical Sciences [2014] studied the addition of fibres into the concrete mixture marginally improves the compressive strength at 28 days but there is 60% increase in flexural strength with the addition of 0.7% fibre in concrete. It is observed from the experimental results and its analysis, that the compressive strength of concrete and flexural strength of concrete increases with addition of fibres. The 0.5% addition of fibres into the concrete shows better result in compressive strength and the 0.5% addition of fibres into the concrete shows better result in flexural strength.

## IV. MATERIAL

### 4.1 Cement

Ordinary Portland cement of 53 grade, 53 Grade OPC is a higher strength cement to meet the needs of the consumer for higher strength concrete, as per BIS requirements the minimum 28 days compressive strength of 53 Grade OPC should not be less than 53 MPa. 53 grades OPC produce higher-grade concrete at very economical cement content.

### 4.2 Coarse aggregate

For this project work locally available aggregate comprising 20mm coarse aggregate are used, 60% aggregate passing through 20mm sieve and remaining 40% passing through 12.5mm sieve is used. The specific gravity is found to be 2.8

### 4.3 Fine aggregate

For this project work locally available fine aggregate in dry surface condition, River sand having less moisture content passing through IS 4.75 mm sieve and retaining in IS 0.15 sieve with specific gravity 2.8. This sand is used for the mixing of concrete comes under Zone 1.

### 4.4 Water

Water is required for hydration of cement and for flow of concrete in the forms or for pumping. But too much water will reduce the strength of concrete. Its role is crucial and essential in acquiring the right concrete mix. The water-cement ratio is the ratio of the weight of water to the weight of cement used in a concrete mix. ... Refer to concrete slump test. Concrete hardens as a result of the chemical reaction between cement and water (known as hydration, this produces heat and is called the heat of hydration).

### 4.5 Super plasticizer

Water-reducing admixtures are used to reduce the quantity of mixing water required to produce concrete of a certain slump, reduce water-cement ratio, reduce cement content, or increase slump. Typical water reducers reduce the water content by approximately 5% to 10%.

## V. METHODOLOGY

### 5.1 Test conducted on materials

#### 5.1.1 Cement

- **Specific gravity test**  
Specific gravity is normally used in mixture proportioning calculations. Measure the weight of empty flask (W1). The flask should be totally dry and free of liquid. Fill half of the flask with cement (about 50 gm) and Measure the weight with its stopper (W2). Then fill the flask with kerosene up to the top level of the flask. Mix cement and kerosene properly to remove air bubble from it. Weigh the flask with cement and kerosene (W3). Now empty the flask and again fill it with kerosene up to the top of the flask. Weigh the flask (W4). Calculating by following formula

$$\text{Specific Gravity } (S_g) = \frac{(W2 - W1)}{(W2 - W1) - (W3 - W4) \times G_k}$$

- **Standard consistency of cement**  
Standard consistency of a cement paste is defined as that consistency which will permit a vicat plunger having 10 mm dia and 50 mm length to penetrate to a depth of 33-35. Prepare a paste of weighed quantity of cement (300gms) with weighed quantity of potable or distilled water, taking care that the time of gauging is not less than 3 minutes nor more than 5 minutes and the gauging is completed before any sign of setting occurs. Fill the vicat mould with this paste resting upon a non-porous plate. Immediately place the test block with the non-porous resting plate, under the rod bearing the plunger. Lower the plunger gently to touch the surface of the test block and quickly release, allowing it sink into the paste. Record the depth of penetration. Prepare trial pastes with varying percentages of water and test as described above until the plunger is 5mm to 7mm from the bottom of the vicat mould. Calculate the standard consistency of Cement using below formula

$$\text{Standard consistency } (\%) = \frac{\text{Weight of water added}}{\text{Weight of cement}} \times 100$$

- **Initial setting time of cement**  
Initial setting time can be defined as the time when the cement paste starts losing its plasticity. Prepare a paste of 300 grams of cement with 0.85 times the water required to give a paste of standard consistency. The time of gauging in any case shall not be less than 3 minutes not more than 5 minutes. Fill the vicat mould with this paste making it level with the top of the mould. Immediately place the test block with the non-porous resting plate, under the rod bearing the initial setting needle. Lower the needle

and quickly release allowing it to penetrate in to the mould. In the beginning the needle will completely pierce the mould. Repeat this procedure until the needle fails to pierce the mould for  $5 + 0.5\text{mm}$ . Record the period elapsed between the time of adding water to the cement to the time when needle fails to pierce the mould by  $5 + 0.5\text{mm}$  as the initial setting time.

#### ➤ **Final setting time of cement**

The time at which cement completely loses its plasticity and became hard is a final setting time of cement. Replace the needle of the vicat apparatus by the needle with an annular ring. Lower the needle and quickly release. Repeat the process until the annular ring makes an impression on the mould. Record the period elapsed between the time of adding water to the cement to the time when the annular ring fails to make the impression on the mould as the final setting time.

#### **5.1.2. Coarse aggregate**

##### ➤ Specific gravity

About 2 kg of aggregate sample is washed thoroughly to remove fines, drained and placed in wire basket and immersed in distilled water at a temperature between  $22- 32^\circ \text{C}$  and a cover of at least 5cm of water above the top of basket. Immediately after immersion the entrapped air is removed from the sample by lifting the basket containing it 25 mm above the base of the tank and allowing it to drop at the rate of about one drop per second. The basket and aggregate should remain completely immersed in water for a period of 24 hour afterwards. The basket and the sample are weighed while suspended in water at a temperature of  $22^\circ - 32^\circ\text{C}$ . The weight while suspended in water is noted =W1g. The basket and aggregates are removed from water and allowed to drain for a few minutes, after which the aggregates are transferred to the dry absorbent clothes. The empty basket is then returned to the tank of water jolted 25 times and weighed in water=W2g. The aggregates placed on the absorbent clothes are surface dried till no further moisture could be removed by this cloth. Then the aggregates are transferred to the second dry cloth spread in single layer and allowed to dry for at least 10 minutes until the aggregates are completely surface dry. The surface dried aggregate is then weighed =W3 g. The aggregate is placed in a shallow tray and kept in an oven maintained at a temperature of  $110^\circ \text{C}$  for 24 hrs. It is then removed from the oven, cooled in an air tight container and weighted=W4 g.

$$\text{Specific gravity} = \frac{\text{Dry Weight of the aggregate}}{\text{Weight of equal volume of water}}$$

#### **5.1.3 Fine aggregate**

##### ➤ Specific gravity

Clean and dry the Pycnometer. Tightly screw its cap. Take its mass (M1) to the nearest of 0.1 g. Unscrew the cap and place about 200 g of oven dried fine aggregate in the Pycnometer. Screw the cap. Determine the mass (M2). Fill the Pycnometer with water completely up to the mark. Dry it from outside. Take its mass (M3). Empty the Pycnometer. Clean it and wipe it dry. Fill the Pycnometer with water only. Screw on the cap up to the mark. Wipe it dry. Take its mass (M4). using below formula calculate specific gravity

$$G = \frac{M2 - M1}{(M2 - M1) - (M3 - M4)}$$

##### ➤ . Sieve analysis

Sieve analysis helps to determine the particle size distribution of the coarse and fine aggregates. Take the sieves and arrange them in descending order with the largest size sieve on top. If mechanical shaker is using then put the ordered sieves in position and pour the sample in the top sieve and then close it with sieve plate. Then switch on the machine and shaking of sieves should be done at least 5 minutes. If shaking is done by the hands then pour the sample in the top sieve and close it then hold the top two sieves and shake it inwards and outwards, vertically and horizontally. After some time shake the 3rd and 4th sieves and finally last sieves. After sieving, record the sample weights retained on each sieve. Then find the cumulative weight retained. Finally determine the cumulative passing percentage retained on each sieves.

## **5.2 TESTS ON SPECIMEN**

### **5.2.1 Compressive strength**

Size of the specimen is  $150 \times 150 \times 150\text{mm}$  cubes determined by averaging perpendicular dimensions at least at two places. Place the specimen centrally on the compression testing machine and load is applied continuously and uniformly on the surface parallel to the direction of tamping. The load is increased until the specimen fails and record the maximum load carried by each specimen during the test. Compressive strength was calculated as follows  $\text{Compressive strength} = P/A \times 1000$

Where ,

P= Load in KN

A=Area of cube surface 150X150mm<sup>2</sup>

### 5.2.2 Split tensile test

I. Draw diametrical lines on two ends of the specimen so that they are in the same axial plane. Diameter of specimen is 150mm and length 300mm.

II. Determine the diameter of specimen to the nearest 0.2mm by averaging the diameters of the specimen lying in the plane of pre marked lines measured near the ends and the middle of the specimen. The length of specimen also shall be taken be nearest 0.2 mm by averaging the two lengths measured in the plane containing pre marked lines.

III. Centre one of the plywood strips along the centre of the lower pattern. Place the specimen on the plywood strip and align it so that the lines marked on the end of the specimen are vertical and cantered over the plywood strip. The second plywood strip is placed length wise on the cylinder cantered on the lines marked on the ends of the cylinder.

IV. Apply the load without shock and increase it continuously at the rate to produce a split tensile stress of approximately 1.4 to 2.1 N/mm<sup>2</sup>/min, until no greater load can be sustained. Record the maximum load applied to specimen.

V. Computation of the split tensile strength was as follows.

$$\text{Split tensile strength} = \frac{2P}{\pi dL} \times 1000$$

where,

P = Load in KN and  $\pi = 3.142$

d = Diameter of cylinder = 150 mm L = Length of cylinder = 300 mm

### 5.2.3. Flexural strength test

I. Brush the beam clean. Turn the beam on it side, with respect to its position as moulded and place it in the breaking machine.

II. Set the bearing plates with the beam and adjust for distance by means of the guide plates furnished with the machine.

III. Place a strip if leather or similar material under the upper bearing plate to assist in distributing the load.

IV. Bring the plunger of the jack into contact with the ballon the bearing bar by turning the screw in the end of the plunger.

V. After contact is made and when only firm finger pressure has been applied, adjust the needle on the dial gauge to "0".

VI. Here we are applying two point loading on the beam specimen, apply load till it breaks and note that as failure load.

Flexural Strength =  $\frac{PL}{BD^2} \times 1000$ .

## 5.3 MIX DESIGN.

### 1. TARGET STRENGTH FOR MIX PROPORTIONING

$$f'_{ck} = f_{ck} + 1.65 s$$

$$s = 5 \text{ N/mm}^2$$

$$\text{Target strength} = 40 + 1.65 \times 5 = 48.25 \text{ N/mm}^2$$

### 2. SELECTION OF WATER-CEMENT RATIO

$$\text{Maximum water-cement ratio} = 0.45$$

Based on experience, adopt water-cement ratio as 0.40.

$$0.40 < 0.45 \text{ hence O.K.}$$

## 3. SELECTION OF WATER CONTENT

Maximum water content =186 litre (for 25 to 50 mm slump range)  
for 20 mm aggregate

Estimated water content for 100 mm slump =186 + (0.6\*186) = 197 litre

As super plasticizer is used, the water content can be reduced up 20% and above.

Based on trials with super plasticizer water content reduction of 30 percent has been achieved. Hence, the

Arrived water content =197.16 x 0.70 =138 litre

## 4. CALCULATION OF CEMENT CONTENT

Water-cement ratio

Cement content

= 0.40

=140/0.4 = 350 kg/m<sup>3</sup>

From Table 5 of IS 456, minimum cement

Content for 'severe' exposure condition = 320 kg/m<sup>3</sup>

350 kg/m<sup>3</sup> > 320 kg/m<sup>3</sup>, hence, O.K.

## 5. PROPORTION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT

Volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate (Zone I)

for water-cement ratio of 0.50 =0.60.

In the present case water-cement ratio is 0.40. Therefore volume of coarse aggregate is required to be increased

To decrease the fine aggregate content. As the water-cement ratio is lower by 0.10. the proportion of volume of coarse aggregate is increased by 0.02 (at the rate of +/- 0.01 for every ± 0.05 change in water-cement ratio).

Therefore, corrected proportion of volume of coarse aggregate for the water-cement ratio of 0.40 = 0.62.

suitably, based on experience.

For pumpable concrete these values should be reduced by 10 percent.

Therefore, volume of coarse aggregate = 0.62 x 0.9 = 0.56.

Volume of fine aggregate content =1 - 0.56 =0.44.

## 6. MIX CALCULATIONS

The mix calculations per unit volume of concrete shall be as follows:

- a) Volume of concrete = 1m<sup>3</sup>
- b) Volume of cement = (Mass of cement / Sp. Gravity of Cement) \* 1 / 1000  
= (345 / 3.15) \* 1 / 1000  
= 0.109 m<sup>3</sup>
- c) Volume of water = 138 lit.  
= 0.138m<sup>3</sup>
- d) Volume of chemical admixture (super plasticizer) (@ 2.0 percent by mass of cementitious material) = (6.9 / 1.2) \* 1 / 1000  
= 0.00575 m<sup>3</sup>
- e) Volume of all in aggregate = 0.746 m<sup>3</sup>
- f) Mass of coarse aggregate = 0.418 \* 2.8 \* 1000  
= 1170.4 kg
- g) Mass of fine aggregate = 0.328 \* 2.8 \* 1000  
= 918.4 kg

## 7. MIX PROPORTIONS FOR TRIAL NUMBER

Cement	= 345 kg/m <sup>3</sup>
Water	= 138 lit/m <sup>3</sup>
Fine aggregate	= 918.4 kg/m <sup>3</sup>
Coarse aggregate	= 1170.4 kg/m <sup>3</sup>
Chemical admixture	= 6.9 kg/m <sup>3</sup>
Water-cement ratio	= 0.4

**VI. RESULTS AND DISCUSSION****CEMENT****6.1.1 SPECIFIC GRAVITY****Observation**

- 1) Empty weight of bottle (W1) = 40gm
- 2) Bottle + 1/3<sup>rd</sup> of Cement (W2) = 69.8gm
- 3) Bottle + 1/3<sup>rd</sup> of cement + Kerosine (W3) = 145gm
- 4) Bottle + Kerosine (W4) = 125gm
- 5) Bottle + Water (W5) = 146gm

**Formula**

a) Specific gravity of Kerosine (G<sub>k</sub>) =  $\frac{(W_4 - W_1)}{(W_5 - W_1)}$

Specific gravity of Kerosine =  $(125 - 40) / (146 - 40) = 0.8$

b) Specific Gravity (S<sub>g</sub>) =  $\frac{(W_2 - W_1)}{(W_2 - W_1) - (W_3 - W_4) \times G_k}$

Specific of gravity of Cement =  $\frac{(69.8 - 40)}{(69.8 - 40) - (145 - 125) \times 0.8}$   
= 3.15

**6.1.2 Normal consistency**

Percentage of Water (%)	Initial (mm)	Final (mm)	Depth of Penetration (mm)
30	43	38	5
32	43	30	13
34	43	26	17
36	43	20	23

Normal consistency = 30% of Water with 300gm of OPC

### 6.1.3 Initial and Final setting Time

Time ( Min)	Initial reading (mm)	Final reading (mm)	Depth of penetration
0	43	0	43
5	43	6	37
10	43	8	35
15	43	12	31
20	43	13	30
25	43	15	28
30	43	21	22
35	43	26	17
40	43	37	6
45	43	39	4
50	43	39	4
55	43	40	3
60	43	41	2

- Initial setting Time of Cement = 40 Min
- Final setting Time of Cement = 350 Min

## 6.2 Coarse Aggregate

### 6.2.1 Specific gravity

- 1) Weight of dry sample of coarse aggregate (W) = 3000gm
- 2) Weight of saturated aggregate suspended in water + basket(W1) = 2746gm
- 3) Weight of empty basket in water (W2) = 818gm
- 4) Weight of saturated aggregate in water (W3) = (W1-W2) = 1927.90gm
- 5) Weight of surface dry aggregate (W4) = 2980gm
- 6) Weight of oven dry aggregate (W5) = 2950gm

$$\begin{aligned} \text{Specific gravity of Coarse aggregate} &= \frac{(W5)}{W3-(W1-W2)} \\ &= \frac{(2950)}{2980-(2746-818)} = 2.8 \end{aligned}$$

## 6.2.2 Flakiness index

Size of passing (mm)	Aggregate retain(mm)	Weight of aggregate (gm)	Weight of aggregate retain(gm)	Weight of aggregate passing (gm)
25	20	2950	2350	600
20	16	1550	1100	450
16	12.5	1050	800	250
12.5	10	560	440	120

Weight of aggregate retained = 5550gm

Weight of aggregate passing = 1420gm

$$\text{Flakiness index} = \frac{\sum w}{\sum W} * 100 = \frac{1420}{5550} * 100 = 25.58$$

## 6.2 Fine Aggregate

### 6.2.1 Sieve analysis

Sieve size	Empty wt of sieve	Sieve + Sand retain	Wt Retain of sand	Cumulative mass retain	% of Cumulative	% of finer
4.75mm	460	530	70	70	6.9	93.5
2.36mm	350	500	150	220	21.9	78.5
1.18mm	300	370	70	290	28.88	71.52
600μ	330	750	420	710	70.71	29.63
300 μ	220	420	200	910	90.763	9.77
150 μ	330	380	50	960	95.61	4.79
75 μ	300	340	40	1000	100	0.4
Pan	350	354	4	1004	100.4	0

The % of passing of sand through IS sieve of 600 μ is 29.69 % there fore sand lies in Zone 1

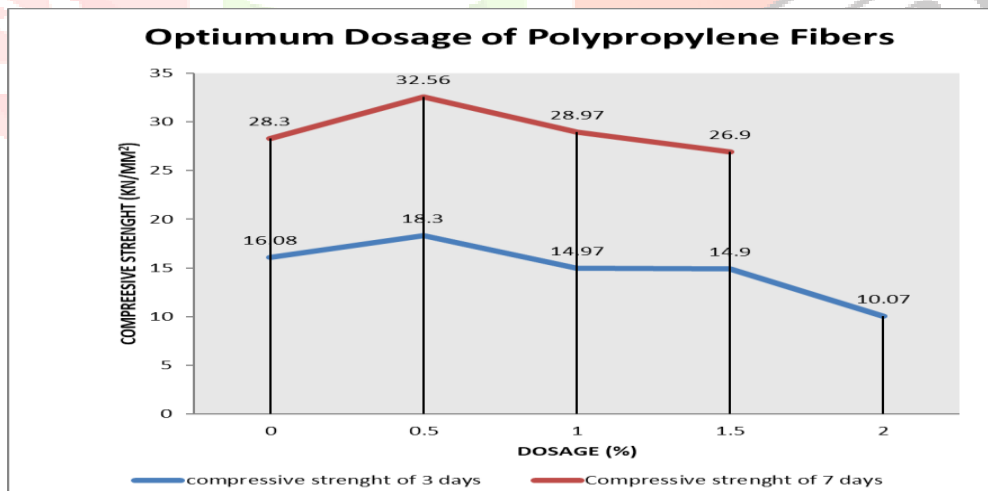
6.4 OPTIMUM DOSAGE OF POLYPROPYLENE

DAYS	DOSAGE [%]	LOAD [ KN]	COMPRESSIVE STRENGTH [N/mm <sup>2</sup> ]
3 days	0	361.8	16.08
	<b>0.5</b>	<b>411.7</b>	<b>18.30</b>
	1	336.82	14.97
	1.5	335.20	14.9
	2	226.57	10.07
7 days	0	636.75	28.30
	<b>0.5</b>	<b>732.60</b>	<b>32.56</b>
	1	651.82	28.97
	1.5	605.25	26.90
	2	474.07	21.07

Calculation.

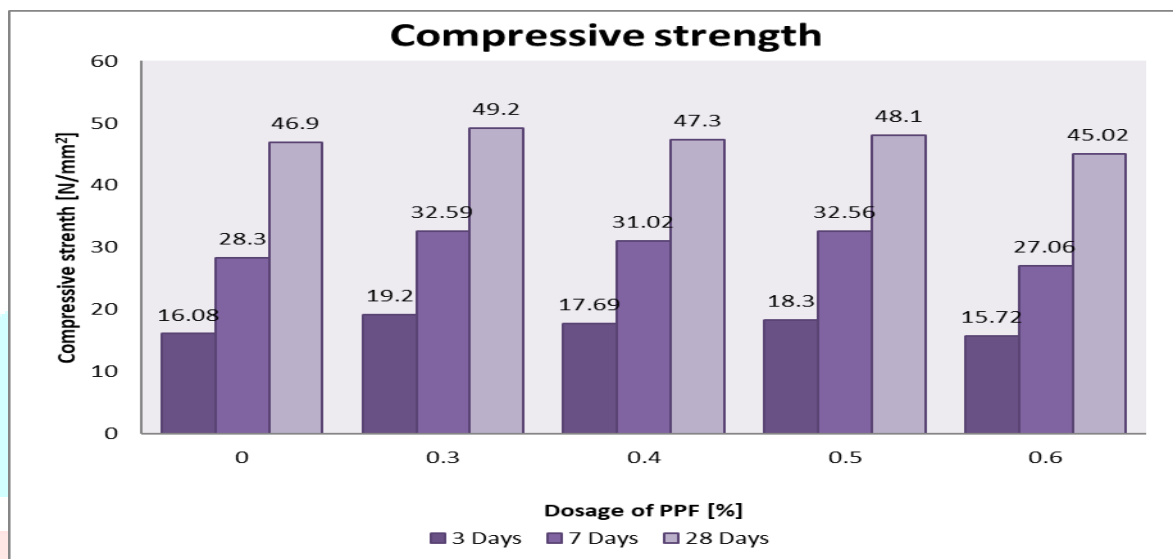
$$\Delta = \frac{P}{A}$$

- 1)  $0 = 249.5 \times 10^3 / 22500 = 11.08 \text{ N/mm}^2$
- 2)  $0.5 = 292.7 \times 10^3 / 22500 = 13.0 \text{ N/mm}^2$
- 3)  $1 = 111.9 \times 10^3 / 22500 = 4.97 \text{ N/mm}^2$
- 4)  $1.5 = 110.3 \times 10^3 / 22500 = 4.9 \text{ N/mm}^2$
- 5)  $2 = 24.1 \times 10^3 / 22500 = 1.07 \text{ N/mm}^2$



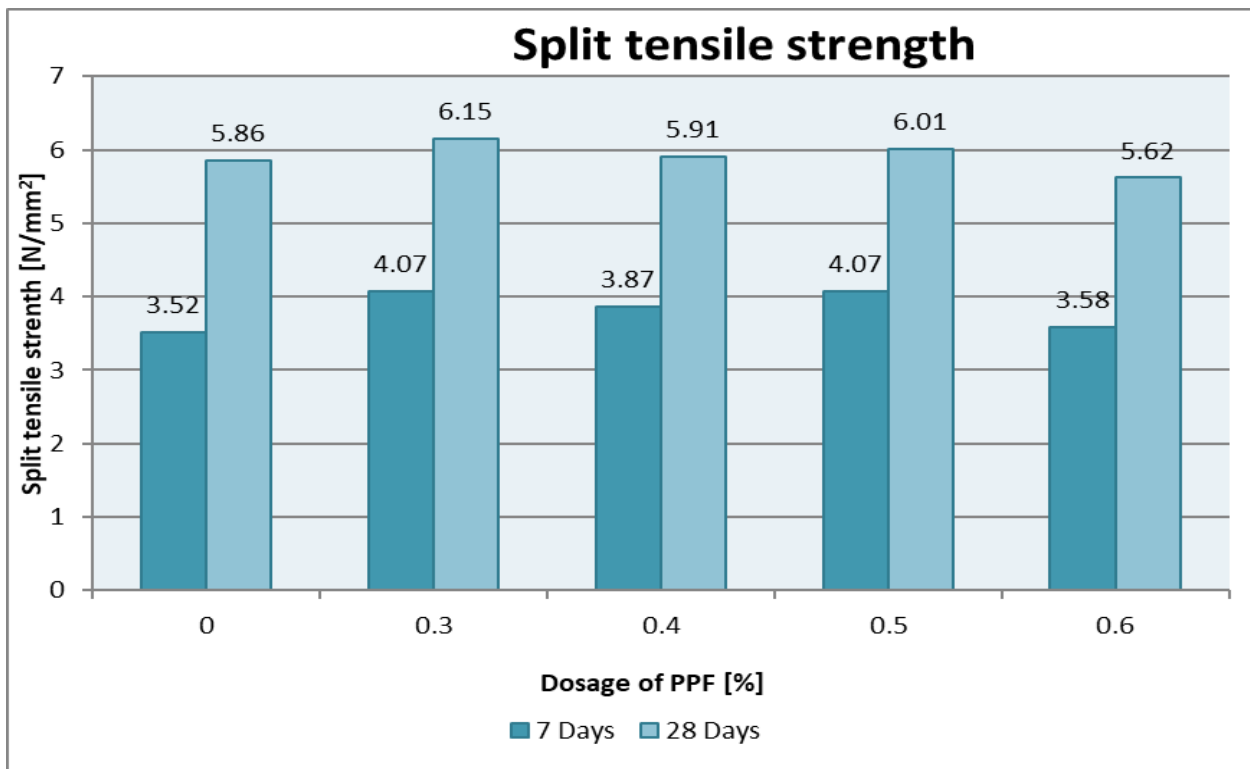
### 6.5 Compressive strength

Sl.No	Dosage[%]	Compressive strength of 3 Days [N/mm <sup>2</sup> ]	Compressive strength of 7 Days [N/mm <sup>2</sup> ]	Compressive strength of 28 Days [N/mm <sup>2</sup> ]
1	0	16.08	28.30	46.9
2	0.3	19.2	32.59	49.2
3	0.4	17.69	31.02	47.3
4	0.5	18.30	32.56	48.1
5	0.6	15.72	27.06	45.02



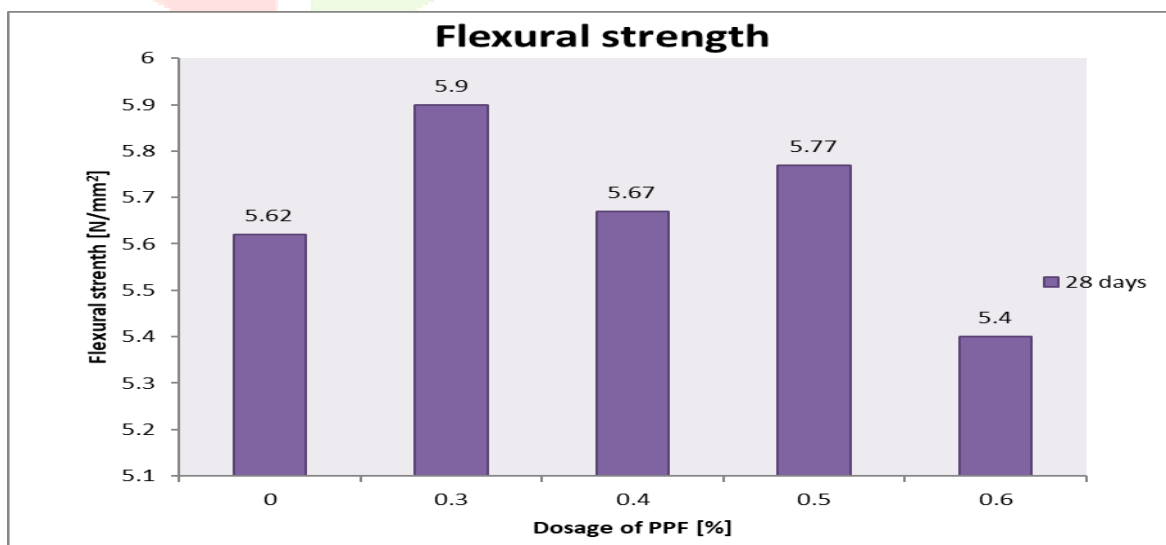
### 6.6 SPLIT TENSILE STRENGTH

Sl.No	Dosage[%]	Split tensile strength 7 Days [N/mm <sup>2</sup> ]	Spilt tensile strength of 28 Days [N/mm <sup>2</sup> ]
1	0	3.52	5.86
2	0.3	4.07	6.15
3	0.4	3.87	5.91
4	0.5	4.07	6.01
5	0.6	3.58	5.62



### 6.7 FLEXURAL STRENGTH

Sl.No	Dosage[%]	Flexural strength of 28 Days [N/mm <sup>2</sup> ]
1	0	5.62
2	0.3	5.90
3	0.4	5.67
4	0.5	5.77
5	0.6	5.40



## VII. CONCLUSION

- Adding of 0.4% & 0.5% of polypropylene fiber in concrete increases the compressive strength of M<sub>40</sub> concrete as compared to nominal concrete.
- Adding of 0.6% of polypropylene fiber in concrete decreasing compressive strength of M<sub>40</sub> concrete by 2.97% as compared to nominal concrete.
- Adding of 0.3% of Polypropylene fiber in concrete increases the compressive strength of M<sub>40</sub> concrete by 5.69% as compared to nominal concrete.
- Split Tensile strength increased by 2.49% for 0.5% Adding of Polypropylene fiber.
- Split tensile strength of concrete decreased by 5.9% for adding 0.4% of polypropylene fiber and it decreases by 4.09% for 0.6% of adding polypropylene fiber in concrete.
- Split tensile strength of concrete increased by 4.7% Adding of polypropylene fiber in concrete which is optimum dosage.
- Flexural strength decreased by 3.5% for adding of 0.6% polypropylene fiber in concrete.

Flexural strength increased by 0.88% and 2.59% for 0.4% and 0.5% adding of polypropylene fiber respectively and for 0.3% of polypropylene fiber adding in concrete increases flexural strength by 4.7% which is optimum

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