EFFECT OF FLY ASH AND POLYPROPYLENE FIBRE ON PROPERTIES OF CONCRETE

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IN

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Under the supervision of

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DECLARATION

I hereby declare that the work reported in the B.Tech thesis entitled "**EFFECT OF FLY ASH AND POLYPROPYLENE FIBRE ON THE PROPERTIES OF CONCRETE**" submitted at **Jaypee University of Information Technology, Waknaghat, Indian** is an authentic record of my work carried out under the supervision of **Assistant Prof. Dr. Saurav**. I have not submitted this work elsewhere for any other degree or diploma.

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CERTIFICATE

This is to certify that the work which is being presented in the project title **" EFFECT of FLY ASH AND POLYPROPYLENE FIBRE ON PROPERTIES OF CONCRETE"** in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology submitted in Civil Engineering Department, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **Abhishek Verma, Raghvendra Pratap Singh, Ankit Singh** during a period from JULY 2017 to MAY 2018 under the supervision of Dr. **Saurav,** Assistant Professor, Civil Engineering Department, Jaypee University of Information Technology, Waknaghat.

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ABBREVIATIONS

FA	Fly Ash
MAS	Maximum Aggregate Size
CTM	Compressive Testing Machine
CA	Coarse Aggregate
FA	Fine Aggregate
LOI	Loss on Ignition
FTM	Flexural Testing Machine
PPF	Polypropylene Fibre

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ABSTRACT

The purpose of concrete mix design is to ensure the most optimum proportions of the constituent materials to fulfill the requirement of the structure being built. The fly ash obtained by combustion of coal can be used as partial replacement for cement owing to its pozzolanic nature, which provides strength to cement. The huge quantity of fly ash being accumulated over the years is likely to pose a serious threat for its disposal and cause environmental problems. An effort has been made to determine the effect on compressive strength of concrete by partial replacement of cement with 0%, 10% and 20 % of fly ash for M20 and M30 grade of concrete**.** Test results indicate that workability and durability of concrete increases with increase in fly ash content.

Plain concrete has low tensile strength, less ductility, destructive and brittle failure. In order to improve these properties of plain concrete, an attempt has been made to study the effect of addition polypropylene fiber in ordinary portland cement concrete. In the this experimental investigation fibers in different percentage 0 to 2% has been studied for the effect on strength properties of concrete by carrying compressive strength test and flexural strength test at 7 days 14 days and 28 days for M40 grade of concrete. Test results show that the addition of polypropylene fiber to concrete exhibit better performance than the plain concrete. The results have shown improvement in compressive strength and flexural strength with the addition of polypropylene fiber in ordinary portland cement concrete The fiber content is vary from 0%, 1%, and 2% by weight of concrete.

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Industrial waste products like fly ash and silica fumes are byproducts of thermal power plant and glass industries. Huge amount of fly ash poses major disposal problem in present times. By utilizing fly ash in concrete we can eliminate disposal problems. These days construction industries require faster development and also need high strength of concrete to ease the fast construction and economical construction. Use of fly ash in concrete supply several environmental benefits and that is why it is ecofriendly. It also saves the cement want for the similar strength and saving of raw stuff like limestone, coal that is required for manufacturing of cement. Fly ash is pozzolanic material which improve the characteristics of concrete such as compressive strength, workability and durability.

This study deals with the probability of fly ash as cement substitution in concrete. The main aim is to decrease the number of ordinary portland cement require in building construction so to achieve economic construction and sustainable improvement through the protection of the environment.

1.2 FLY ASH

In electric power generation plants Fly Ash is a by-product of the combustion of pulverized coal. As the pulverized coal is provoked in the combustion chamber, the carbon and volatile materials are burned out. When few of the minerals that are contaminant of clay, shale, feldspars are combined in suspension and carried out of the combustion chamber in the exhaust gases. when the exhaust gases cool, the combined materials solidify into spherical glassy particles that is called Fly Ash. Because of the fusion-in-suspension, Fly Ash particles are mostly consist of few solid spheres and hollow ecospheres with few particles even being plerospheres, that are spheres including smaller spheres. The size of the Fly Ash particles differ but tends to be equivalent to the type I portland cement. The Fly Ash is composed from the exhaust gases by electrostatic precipitators.

1.2.1 FLY ASH IS A POZZOLAN

The pozzolanas are siliceous or alumino siliceous material which in finely divided from and in the existence of moisture chemically reacts with the calcium hydroxide liberated by the hydration of portland cement to form additional calcium silicate hydrate and other cementitious compounds. Fly Ash pozzolan are thick, more powerfull and generally more tough as compared to the portland cement concrete mixtures.

1.2.2 FLY ASH IS ECONOMICAL

The cost of Fly Ash is always less than portland cement. For to increase the long term strength and durability enough quantity may be replace for portland cement in concrete mixtures. So, the use of Fly Ash can impart significant benefits to the concrete mixture over a plain concrete for lesser cost.

1.2.3 CLASS F FLY ASH

Class F Fly Ash emanate from anthracite and bituminous coals. It mostly contains of alumina and silica that has a higher loss on ignition (LOI) than Class C fly ash. Class F Fly Ash as consist of lower calcium content than Class C fly ash. When replacing cement with class F fly ash, it is very necessary to various several safeguards as the time of set can be slightly slow down and the early compressive strengths (before 28 days) can be decrease. besides in totality fragment of the concrete may needa to be altered as the fly ash that has a lower bulk specific gravity than the portland cement and that is why it occupies a greater volume for an equal mass. While applying organic admixtures like air entrainment, the amount added should be modified since the carbon (LOI) in the fly ash absorbs organic compounds. lastly, if the fly ash has a high calcium content then it should not be used in hydraulic applications. Figure 1.1 shows class F Fly Ash.

FIGURE 1.1 CLASS F FLY ASH

1.2.4 CLASS C FLY ASH

Class C Fly Ash originates from sub bituminous and lignite coals. Its formation involve mainly calcium, alumina, and silica with a lower loss on ignition (LOI) than Class F fly ash. it is essntial to know various precautions when using class c fly ash as a substitute of Portland cement. The time of set may be slightly slow down. Besides, the fine aggregate fraction of the concrete needs to be altered as fly ash has a lower bulk specific gravity than portland cement and therefore engross more volume for the same mass. Class C fly ash ought to replace at least 25% of the portland cement to reduce the effects of alkali silica reaction. While utilizing organic admixtures like air entrainment, the amount added can be modified since the carbon (LOI) in the fly ash absorbs organic compounds. lastly, if the fly ash is having high calcium content, that should not be used in sulfate exposure applications.

1.3 POLYPROPYLENE FIBER

Polypropylene fibres are hydrophobic, that is they do not absorb water. Therefore, when placed in a concrete matrix they need only be mixed long enough to insure dispersion in the concrete mixture. The length of fibre recommended is normally tied to the nominal maximum size of aggregate in the mixture. Manufacturers recommend that the length of the fibre be greater than twice the diameter of the aggregate. According to fibre manufacturers, it only provide control of cracking caused by shrinkage and thermal stresses occurring at early ages. The function of the polypropylene fibres mixed into concrete is not to replace the steel but to avoid the creation of micro cracks in the concrete. Polypropylene fibres are used in concrete to obtain a much better, more stable surface and more resistant cube and beam of concrete. It reduces the danger of micro cracks dramatically. This increases the lifetime of this cube and beam of concrete – especially true where this is exposed to changing weather conditions. It was found that using polypropylene fibers can improve spalling behavior of concrete. Polypropylene fibers also possess better durability as plastic does not rust. Polypropylene fiber is a synthetic fiber with low density, fine diameter and low modulus of elasticity. It has some special characteristics such as high strength, ductility and durability, abundant resources and easily physical and chemical reformations according to certain demands. In this project study the polypropylene fibers with 12mm cut length is used. Figure1.2 shows polypropylene fibre.

FIGURE 1.2 POLYPROPYLENE FIBRE

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

Sarath Chandra Kumar et al [1] noticed that the consumption of fly ash in concrete as substutute of partial cement is earning huge importance today mainly on the account of the enhancement of the long term toughness of concrete combined with ecological benefits. Technological enhancement in thermal power plants performance and fly ash gathering systems have evolving in improving the uniformity of fly ash.

Izhar Ahmed and S.S Jamkar [2] presented the results of the study conducting with Concrete cubes of 100 mm size, to replace 0%, 5%, 10% and 15% cement with fly ash. To cover a wide range of concrete mixes water cementitious material ratio (W/C) of 0.35, 0.40 and 0.50 were used for water content of 187 kg/m^3, 195.58 kg/m^3 and 199.16 kg/m^3 each. The result of different frameworks like substitute of cement by fly ash, water to cementitious material ratio and water content is considered on fresh and hardened properties of concrete.

Amit Mittal et al [3] studied the outcomes of fly ash on workability, setting time, density, air content, compressive strength, modulus of elasticity, shrinkage and permeability by Rapid Chloride Test (RCPT). In this study substitute of fly ash by 20%, 30%, 40% and 50% with the weight of cement were made for concrete mixes with 300 to 500 kg/m^3 cementitious material. And compressive strength, water cement ratio curves have been plotted for concrete mixes of grade M15 to M45 with fresh amount of fly ash that can be directly designed.

A. K. Mathur [4] tries to makes an effort to present information concerning fly ash as a resource material for strong and tough concrete. With the better understanding in this area fly ash can be used as an important component of the concrete, and this will help in increasing fly ash usage in such value added and environment friendly tasks.

Aman Jatale et al [5] observed the effects on compressive strength that fly ash substitute the cement partially and studied that the use of fly ash slightly delays the setting time of concrete. It was also establish that the rate of toughness developed at various ages is related to the w/c ratio and percentages of fly ash in the concrete mix. besides, this modulus of elasticity of fly ash concrete also decreased with the increase in fly ash proportion for a given w/c ratio.

S.A.K. Reddy and K.C. Reddy [6] found out that the effect of fly ash on strength and stability frameworks of concrete and found that uniformity increases greatly with increase in proportion of fly ash. The optimum 7, 14 and 28 days compressive strength was evolve in the range of 20% fly ash at substitute level. It also led to the increase in split tensile strength of concrete.

Vinay Kumar Singh and Dilip Kumar [7] observe the effect of polypropylene fiber on strength and toughness of concrete. The optimum 7 and 28 days compressive strength was obtained in the range of 1% PPF replacement level.

Milind V. and Mohod [8] states that the review done by numerous researchers discussed the mechanism of fibre-matrix interaction where different models of used to compute the bonding of fibres and cement matrix, this bonding of fibre plays a important role in the composite behavior.

Syed Zaheer Ahmed et al [9] Studies deals with the effect on accumulation of various proportion of the polypropylene fiber on the strength properties of the concrete. An investigation study has been advice, on effect of partial replacement of polypropylene fibre to the concrete. The outcome from test are increases the flexural, tensile and shear strength was found.

CHAPTER 3

EXPERIMENTAL INVESTIGATION

3.1 GENERAL

Concrete is composed mainly of aggregates, portland cement and water and many comprise other cementitious materials and chemical admixtures. It will include some amount of entrapped air and may also involve purposely entrained air obtained by use of admixture or air-entraining cement. Chemical admixtures are usually used to speed up, delay, improve workability, reduce mixing water requirements, increase strength, or modify other properties of the concrete. The choice of concrete proportions involves a balance between savings and need of placeability, strength, durability, compactness and development.

3.2 MATERIALS USED

The physical properties of cement, fine aggregates, coarse aggregates, fly ash and water used for mix design of M20, M30 and M40 grade of concrete were tested in laboratory and are mentioned below.

3.2.1 CEMENT

Ordinary Portland Cement of 53 grade confirming to IS 4031 [10] was used in the present study. The properties of cement are shown in Table 3.1.

TABLE 3.1 PROPERTIES OF CEMENT

S.No.	Property	Result
1.	Normal consistency	32%
2.	Initial setting time	45 min
3.	Specific gravity	3.15
4.	Fineness of cement	05%

3.2.2 FINE AGGREGATE

Natural sand as per IS 383 [11] was used. Locally available River sand having bulk density 1860 kg/m^3 was used. The properties of fine aggregate are shown in Table 3.2 and Table 3.3.

TABLE 3.2 SEIVE ANALYSIS OF FINE AGGREGATE

Initial sample = 2000g

Sieve size	Weight retained(g)	Cumulative Wt. retained(g)	Cumulative % retained (g)
4.75 mm	55	55	2.75
2.36 mm	118	173	8.65
1.18 mm	248	421	21.05
600 micron	1158	1579	78.95
300 micron	383	1962	98.1
150 micron	30	1992	99.6
pan	2	1994	99.7
Sum			**408.8**
Fineness modulus of fine aggregates (F.M)			**408.8/100 =4.088**

TABLE 3.3 PROPERTIES OF FINE AGGREGATE

S.NO	Property	Result
1.	Specific gravity	2.5
2.	Fineness modulus	4.08
3.	Grading zone	ZONE I

3.2.3 COARSE AGGREGATE

Crushed aggregate confirming to IS 383 [11] was used. Aggregates of size 20mm and 12.5 mm of specific gravity 2.75 and fineness modulus 3.78 were used. The properties of coarse aggregate are shown Table 3.4.

TABLE 3.4 SEIVE ANALYSIS OF COARSE AGGREGATE

Initial sample = 2000gm

Sieve size	Weight retained(gm)	Cumulative weight retained(gm)	Cumulative % retained (gm)
40 mm	0	0	0
20 mm	0	0	0
12.5 mm	1620	1620	81.0
10 mm	333	1953	97.65
6.3 mm	32	1985	99.25
4.75 mm	10	1995	99.75
	Sum =		**377.65**

3.2.4 FLY ASH

Fly ash used was confirming to grade1 of IS: 3812-1987 and was supplied by Fly ash is collected from RTPP. The fly ash is used as a partial replacement of cement. The properties of fly ash are shown in Table 3.5.

TABLE 3.5 PROPERTIES OF FLY ASH

Specific gravity	2.5
Physical form	Powder
Size (Micron)	1.0
Colour	Dark grey
SiO_2	(60-65)%
Al_2O_3	(20-25)%

3.2.5 POLYPROPYLENE FIBRE

In this project study the polypropylene fibers with 12mm cut length is used. These polypropylene fibers are brought from Chandigarh. The properties of polypropylene fibers with their stipulation are mentioned in the Table 3.6 below.

TABLE 3.6 PROPERTIES OF POLYPROPYLENE FIBER

S.No.	Specifications	Values
1.	Aspect ratio	1800
2.	Tensile strength (MPA)	2.56×10^3
3.	Elastic modulus	8×10^3

3.2.6 WATER

According to ACI water used for preparing concrete should be of potable quality. In this investigation ordinary tap water which is fit for drinking has been used in preparing all concrete mixes and curing.

3.3 M20 MIX DESIGN

Specified minimum strength	M20
Maximum Aggregate Size	12.5mm
Minimum cement content	250 kg/m^3
Maximum W/C ratio	0.50
Exposure	Severe
Workability	Medium(75mm)
Type of Aggregate	Crushed angular
Maximum water content	186 kg/m^3
Sand 600 micron passing	20.65%
Zone of sand	Zone I
Target Mean Strength	$f_t = f_{ck} + t \times б$
Standard Deviation (б)	4
Value 't ' selected	1.65
Target Mean strength	26.6 N/mm^2

Let us assume w/c ratio	0.45
Maximum water cement content for 20 mm MAS	186 Kg/m^3
Calculation of Cement Content	
Cement Content	186/0.45=413 kg/m^3
Minimum cement content	250 kg/m^3
	413>250
	Hence Ok
Mass of Cement	413 kg
Mass of Water	186 kg
Volume of aggregate= Mass of Aggregate/ (Specific Gravity of Aggregate*1000)	1 – (413/(3.15×1000) – (186 / 1×1000) =0.68m^3
volume of aggregate	0.68 m^3
volume of coarse aggregate	61% of volume of aggregate= 0.414 m^3
Mass of coarse aggregate	Specific gravity coarse aggregate× volume×1000= 1138.5 kg
volume of fine aggregate	39% of volume of aggregate= 0.265 m^3

Mass of fine aggregate	Specific gravity fine aggregate× volume ×1000 =662.5kg/m^3

Weight Batching

Cement	413 Kg
Water	186 Kg
Coarse Aggregate	1138.5 Kg
Fine Aggregate	662.5 Kg
w/c ratio	0.45

3.4 M30 MIX DESIGN

Specified minimum strength	M30
Cement Type	OPC 53 Grade
Maximum Aggregate Size	12.5mm
Minimum cement content	250 kg/m^3
Maximum W/C ratio	0.50
Exposure	Severe
Workability	Medium(75mm)

Degree of Supervision :-

Type of Aggregate	Crushed angular
Sand 60 micron passing	21.35%
zone of sand	Zone I
Target Mean Strength	
Standard Deviation	5
Value 't ' selected	1.65
Target Mean strength	38.25 N/mm^2
Let us assume w/c ratio	0.40
Maximum water cement content for 20 mm MAS	202.2 kg/m^3
Calculation of Cement Content	
Cement Content	202.5/0.40=506.25 kg/m^3
Minimum cement content	250 kg/m^3 506.25>250 Hence Ok

Coarse Aggregate Proportion :-

For zone I of fine aggregate and MAS=12.5mm the % coarse aggregate in total aggregate (for 0.5 w/c ratio) = 0.60 (60%)

Our w/c =0.40

w/c decreases by 0.1 to coarse aggregate increase by .02[+/-0.01 for every 0.05 w/c)=0.6+.02 =0.62

So

corrected coarse aggregate = 62%

corrected fine aggregate = 100-62=38%

Specific Gravity of Coarse Aggregate	2.75
Specific Gravity of fine Aggregate	2.5

Volumetric Calculation:-

Volume of Concrete	1 m^3
Volume of Concrete	(Mass of Cement/Specific Gravity of Cement×1000) +(Mass of Water/Specific Gravity of Water×1000) + volume of aggregate
Mass of Cement	506 kg
Mass of Water	202 kg
volume of aggregate= Mass of Aggregate/Specific Gravity of Aggregate*1000)	1 – (506/(3.15×1000) – (202 / 1×1000) =0.64m^3
volume of aggregate	0.64 m^3
volume of coarse aggregate	61% of volume of aggregate= 0.39m^3
Mass of coarse aggregate	Specific gravity coarse aggregate× volume× 1000= 1072.5 kg
Mass of fine aggregate	Specific gravity fine aggregate× volume× 1000=625kg/m^3

Weight Batching :-

Cement	506 kg
Water	202 kg

Coarse Aggregate	1072.5 kg
Fine Aggregate	625 kg
w/c ratio	0.40

3.5 M40 MIX DESIGN

Specified minimum strength	M 40
Maximum Aggregate Size	16mm
Minimum cement content	320 kg/m^3
Maximum W/C ratio	0.50
Exposure	Severe
Workability	Medium(75mm)
Type of Aggregate	Crushed angular
Maximum water content	186 kg/m^3
Sand 600 micron passing	20.65%
Zone of sand	Zone II

Target Mean Strength

Standard Deviation	5
Value ‘t ‘ selected	1.65
Target Mean strength	48.25 N/mm^2
Let us assume w/c ratio	0.40
Maximum water cement content for 12.5 mm MAS	195 Kg/m^3

Calculation of Cement Content

Cement Content	195/0.40=413 kg/m^3
Minimum cement content	320 kg/m^3 413>320Hence Ok

Coarse Aggregate Proportion

For zone1 of fine aggregate and MAS=16mm the % coarse aggregate in total aggregate (for 0.5 w/c ratio) = 0.56 (60%)
Our w/c =0.40
w/c decreases by 0.05 to coarse aggregate increase by .01 [+/-0.01 for every 0.05 w/c)=0.56+.02 =0.58 or 58%
So
corrected coarse aggregate = 58%
corrected fine aggregate = 100-58=42%

Specific Gravity of Coarse Aggregate	2.75
Specific Gravity of fine Aggregate	2.5

Volumetric Calculation:-

Volume of Concrete	1 m^3
Volume of Concrete	(Mass of Cement/Specific Gravity of Cement×1000) +(Mass of Water/Specific Gravity of Water×1000) + (volume of aggregate)
Mass of Cement	488 kg
Mass of Water	195 kg
Volume of aggregate=Mass of Aggregate/(Specific Gravity of Aggregate*1000)	1 – (488/(3.15×1000) – (195 / 1× 1000) = 0.65m^3

volume of aggregate	0.65 m^3
volume of coarse aggregate	58% of volume of aggregate = 0.377 m^3
Mass of coarse aggregate	Specific gravity coarse aggregate× volume × 1000 = 1036.75 kg
volume of fine aggregate	42% of volume of aggregate = 0.273 m^3
Mass of fine aggregate	Specific gravity fine aggregate × volume × 1000 =682.5kg/m^3

Weight Batching :-

Cement	488 Kg
Water	195Kg
Coarse Aggregate	1036.75 Kg
Fine Aggregate	682.5 Kg
w/c ratio	0.40

3.6 SLUMP CONE TEST

The concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows. We also measured slump loss for different proportion of fly ash as shown in Table 3.7 and 3.8

We can see the variation in slump loss with different proportion of fly ash and variation in ultimate compressive strength (MPa) with different age of concrete. In this study we used different proportion of fly ash in 0%, 10% and 20%.

TABLE 3.7

SLUMP WITH DIFFERENT PROPORTION OF FLY ASH M20

% of Fly Ash With Wt. of Cement	0%	10%	20%
Slump in mm	50	57	62

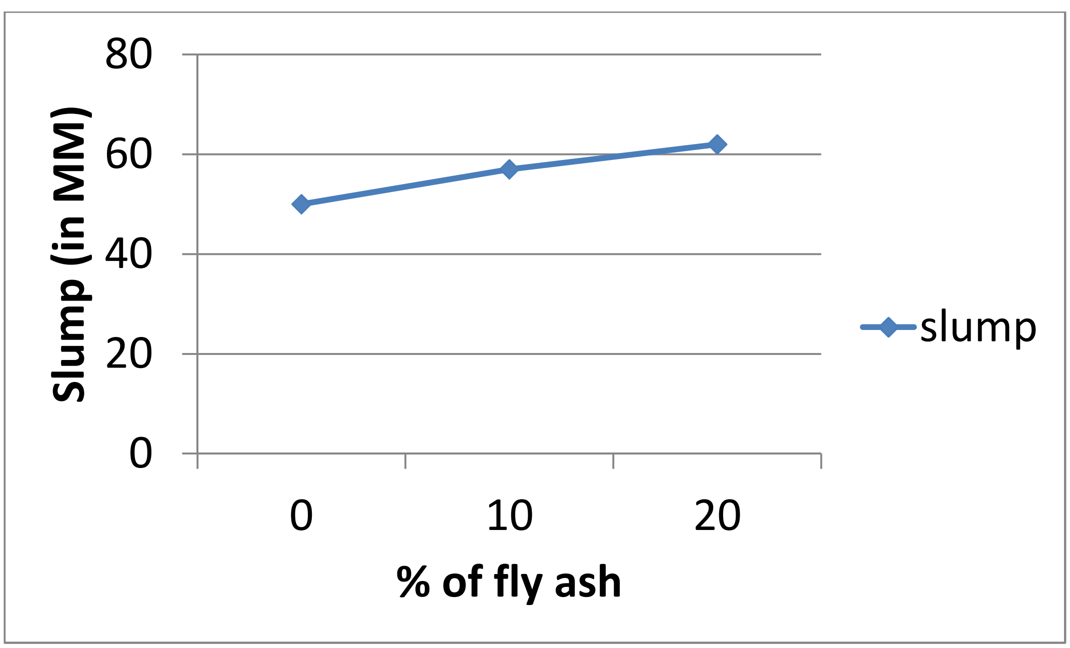

FIGURE 3.1 SLUMP WITH DIFFERENT PROPORTION OF FLY ASH M20

TABLE 3.8

SLUMP WITH DIFFERENT PROPORTION OF FLY ASH M30

% of fly ash with weight of cement	0%	10%	20%
Slump in mm	27	29	37

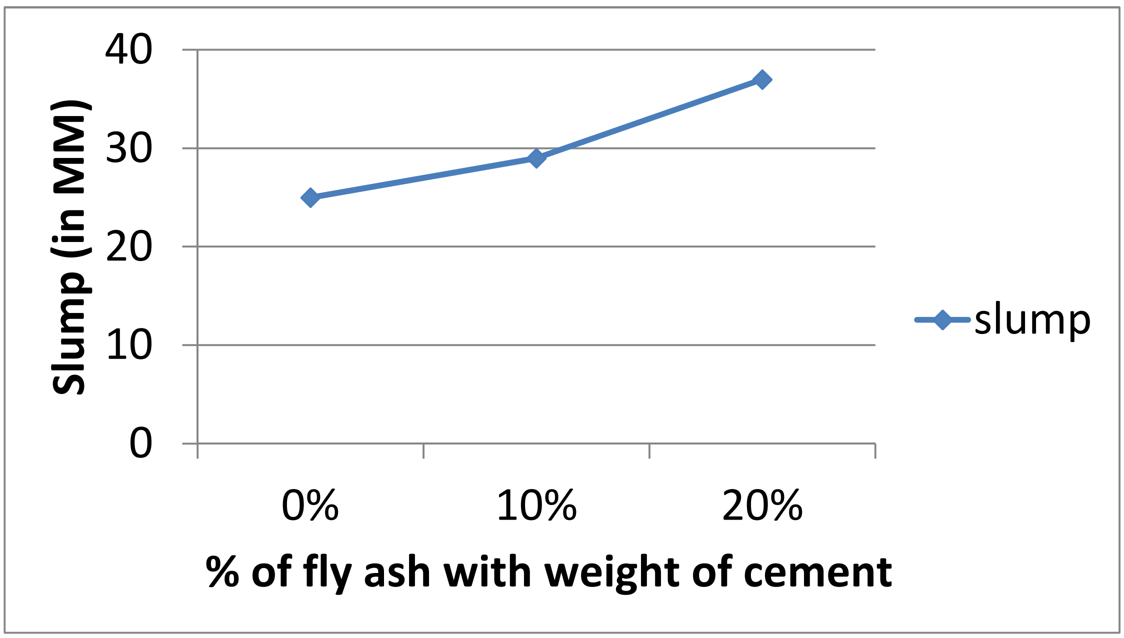

FIGURE 3.2 SLUMP WITH DIFFERENT PROPORTION OF FLY ASH M30

Figure 3.1 and 3.2 shows that on increasing proportion of fly ash there is an increase in slump value and hence workability increases.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 GENERAL

The work is conducted for nominal mix M20 grade concrete for 0.45 w/c ratio and M30 grade concrete for 0.40 w/c ratio. In this present work it was studied that effects of different w/c ratio, percentage of mineral admixture over the properties of concrete like workability and strength, additionaly it was studied that the effect with age of concrete and slump loss. Quality is the result of good work.

To assemble good quality concrete these are the following steps.

1. Batching of materials.
2. Mixing
3. Compaction.
4. Finishing.
5. Curing and Demoulding.
6. Cube testing.

To assemble good quality of concrete the choice of materials and choice of required grade of concrete is required.

4.2 TESTING

Once curing the specimen for 7 days, 14 days and 28 days the specimen were removed and dried for 24hrs then specimen are tested.

 

(a) (c)

 

(b) (d)

FIGURE 4.1 CASTED SPECIMENS

Figure 4.2(a) shows the cube without Polypropylene Fibre (PPF),Figure 4.2(b) shows the cube with 1% PPF, Figure 4.2(c) shows cube with 2% PPF and Figure 4.2(d) shows Beam with PPF.

4.3 RESULTS

In this report it is shown that how the effect of fly ash and polypropylene fibres on the properties of concrete and results obtained. So it is presented graphically and discussed. The study has been carried out by preparing concrete cubes for M20, M30 and M40 grade of nominal mix and tested at 7, 14 and 28 days of curing. Cubes are casted for 0%, 10% and 20% replacement of fly ash with cement and 0%, 1% and 2% replacement of polypropylene fibres with the volume of concrete.

To study slump loss and workability of concrete slump cone test has been performed. The result has been explained in terms of various combination forms as follows.

1. Variation in slump for different w/c ratio.
2. Variation in slump for different proportion of fly ash.
3. Variation of compressive strength with replacement of fly ash in different quantity and for different curing period.
4. Variation in slump for different proportion of PPF.
5. Variation of flexural strength with replacement of fly ash in different quantity and for different curing period.

Tests for Compressive Strength: In the present work Compressive strength test can be carried out by using cube size of 150mm×150mm×150mm cubes are casted for M20 and M30 grade concrete with fly ash present in concrete.

The cubes are then demoded after 24 hours of casting. After completion of curing period of 7, 14 and 28 days cubes shell be remove from water and keep it for drying.

After that cubes are tested in compression testing machine with machine having capability of 2000KN the load has apply at the rate of 315 KN/min. the load applied in such a way that two opposite sides are compressed. The load at which specimen fail is noted. For accurate values 3 cubes shall be casted and tested compressive strength can be calculated by following:

fc= the ratio of cube failure in N to its cross section of cube

where fc = compressive strength of cube

(a)

(b)

(c)

(d)

FIGURE 4.2 TESTING OF CUBES IN CTM

Figure 4.3(a) shows compression testing machine, Figure 4.3(b) shows the cube with 0% PPF, Figure 4.3(c) shows cube with 1% PPF and Figure 4.4(d) shows cube with 2% PPF.

The following tables depict the compressive strength results of M20 and M30 grade concrete cubes with fly ash for 7 days and 28 days curing period

Number of cube tested for different proportion with conventional concrete and fly ash in concrete is shown below Table 4.1, 4.2 and 4.3.

TABLE 4.1

COMPRESSIVE STRENGTH OF M20 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF FLY ASH AT 7 DAYS CURING

SN	% of Fly Ash	Load KN	Comp. Strength MPa	Avg. Comp. Strength MPa	% Change
1	0%	296.10	13.16	13.86	0%
2		316.80	14.08		
3		322.65	14.34		
4	10%	275.40	12.24	12.76	7.96%
5		279.68	12.43		
6		306.22	13.61		
7	20%	246.15	10.94	11.52	16.88%
8		262.58	11.67		
9		268.88	11.95		

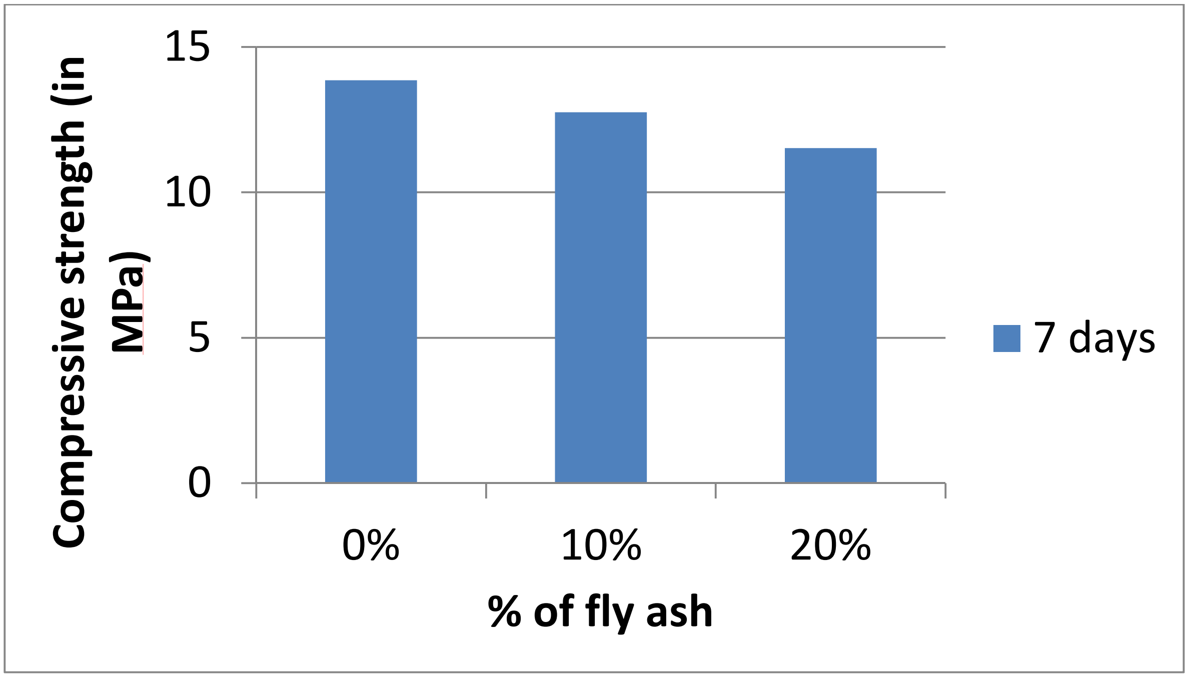

FIGURE 4.3 COMPRESSIVE STRENGTH FOR DIFFERENT PROPORTIONOF FLY ASH AT 7 DAYS CURING

Figure 4.3 shows that on increasing proprtion of fly ash compressive strength of concrete decreasing because pozzolanic reaction takes a long time to complete and hence compressive strength is decreasing at 7 days curing.

TABLE 4.2

COMPRESSIVE STRENGTH OF M20 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF FLY ASH AT 14 DAYS CURING

SN	% of Fly Ash	Load KN	Comp. Strength MPa	Avg. Comp. Strength MPa	% Change
1	0%	355.30	15.80	16.26	0%
2		369.68	16.40		
3		373.18	16.88		
4	10%	383.54	17.04	17.07	4.07%
5		370.06	16.45		
6		398.76	17.72		
7	20%	434.12	19.30	18.57	14.20%
8		406.54	18.07		
9		412.86	18.35		

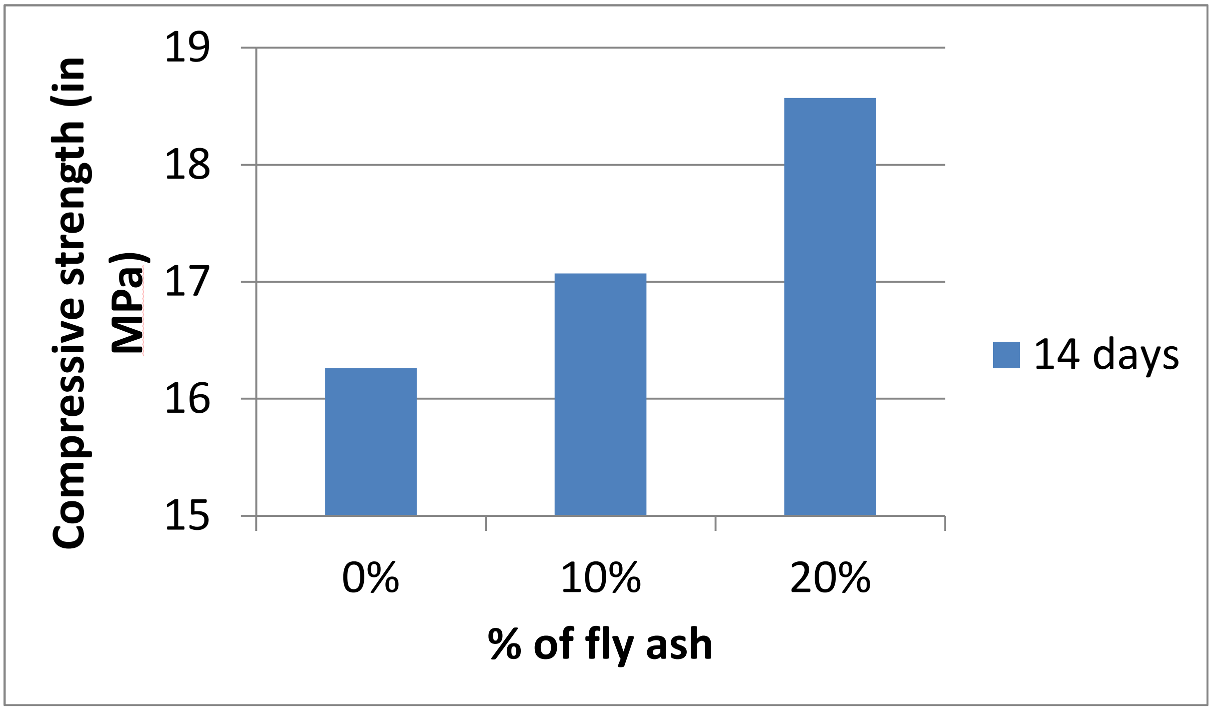

FIGURE4.4 COMPRESSIVE STRENGTH FOR DIFFERENT PROPORTION OF FLY ASH AT 14 DAYS CURING

Figure 4.4 shows that on increasing proportion of fly ash there is an increase in compressive strength of concrete at 14 days curing because pozzolanic reaction completes about 75 percent.

TABLE 4.3

COMPRESSIVE STRENGTH OF M20 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF FLY ASH AT 28 DAYS CURING

SN	% of Fly Ash	Load KN	Comp. Strength MPa	Avg. Comp. Strength MPa	% Change
1	0%	456.30	20.28	20.58	0%
2		459.68	20.43		
3		473.18	21.03		
4	10%	473.63	19.45	21.22	3.1%
5		482.62	21.45		
6		551.87	22.75		
7	20%	464.62	20.65	22.45	9.1%
8		514.13	22.85		
9		536.62	23.85		

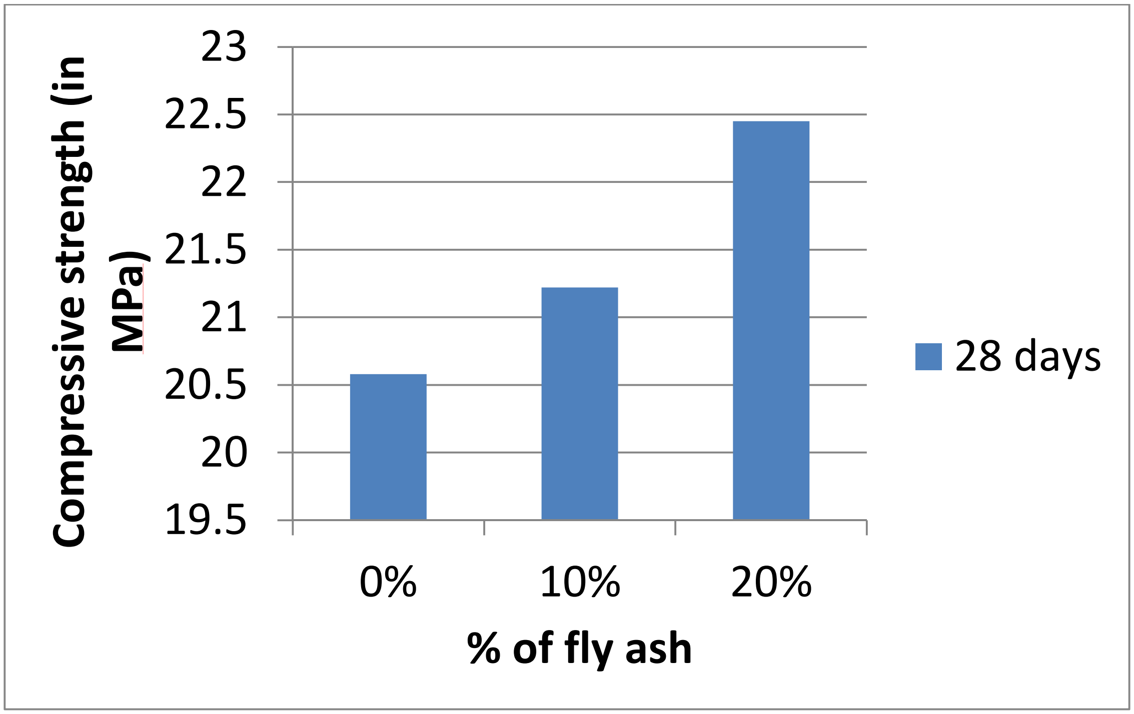

FIGURE 4.5 COMPRESSIVE STRENGTH FOR DIFFERENT PROPORTION OF FLY ASH AT 28 DAYS CURING

Figure 4.5 shows that on increasing proportion of fly ash there is an increase in compressive strength of concrete at 28 days curing because pozzolanic reaction completes about 90 percent.

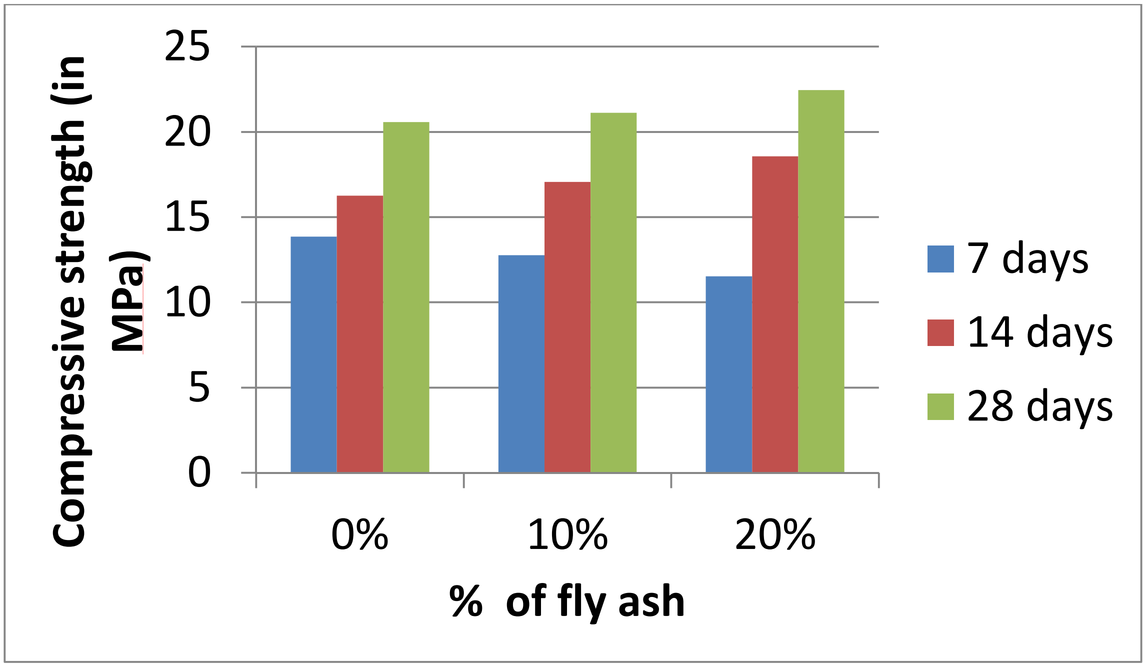

FIGURE 4.6 COMPARISION OF COMPRESSIVE STRENGTH OF CONCRETE FOR DIFFERENT PROPORTION OF FLY ASH AND AT DIFFERENT AGE OF CONCRETE

Figure 4.6 shows the variation of compressive strength of concrete at 7 days, 14 days and 28 days curing period. In figure 4.6 at 7 days curing comprssive strength is decreasing on increasing proportion of fly ash because pozzolanic reaction doesn't take place while at 14 days and 28 days curing period compressive strength is increasing on increasing proportion of fly ash because of pozzolanic reaction taking place.

TABLE 4.4

COMPRESSIVE STRENGTH OF M30 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF FLY ASH AT 7 DAYS CURING

SN	% of Fly Ash	Load KN	Comp. Strength MPa	Avg. Comp. Strength MPa	% change
1	0%	409.00	18.17	19.98	0%
2		484.00	21.51		
3		444.00	19.73		
4	10%	330.00	14.67	17.16	14.11%
5		434.00	19.3		
6		393.00	17.5		
7	20%	356.00	15.84	16.45	17.70%
8		374.00	16.63		
9		380.00	16.89		

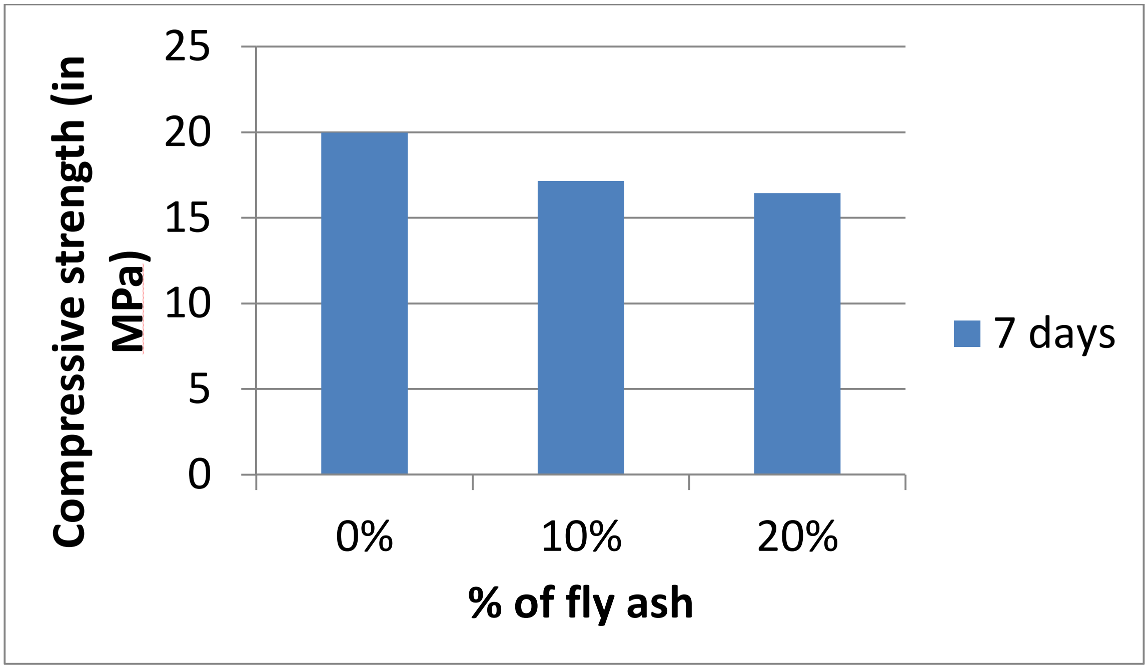

FIGURE 4.7 COMPRESSIVE STRENGTH FOR DIFFERENT PROPORTION OF FLY ASH AT 7 DAYS CURING

Figure 4.7 shows that on increasing proprtion of fly ash compressive strength of concrete decreasing because pozzolanic reaction takes a long time to complete and hence compressive strength is decreasing at 7 days curing.

TABLE 4.5

COMPRESSIVE STRENGTH OF M30 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF FLY ASH AT 14 DAYS CURING

SN	% of Fly Ash	Load KN	Comp. Strength MPa	Avg. Comp. Strength MPa	% change
1	0%	450.00	20.00	21.02	0%
2		494.00	21.95		
3		474.00	21.10		
4	10%	484.00	21.50	22.46	6.85%
5		510.00	22.60		
6		524.00	23.30		
7	20%	518.00	23.02	24.34	15.79%
8		558.00	24.80		
9		567.00	25.20		

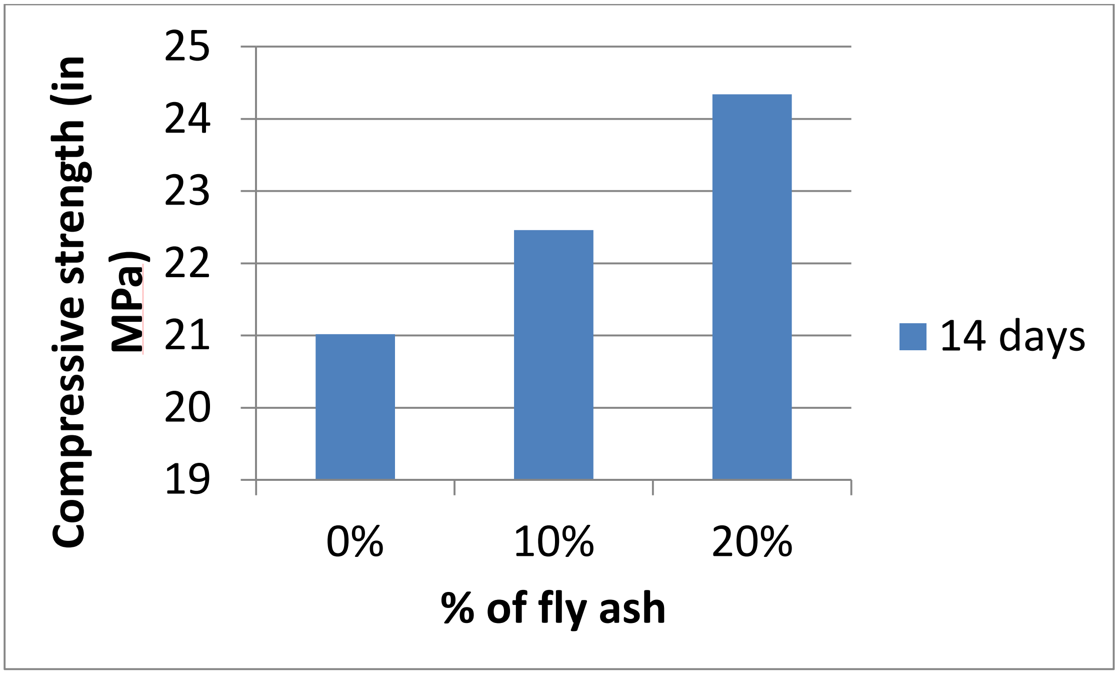

FIGURE4.8 COMPRESSIVE STRENGTH FOR DIFFERENT PROPORTION OF FLY ASH AT 14 DAYS CURING

Above figure shows that on increasing proportion of fly ash there is an increase in compressive strength of concrete at 14 days curing because pozzolanic reaction completes about 75 percent.

TABLE 4.6

COMPRESSIVE STRENGTH OF M30 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF FLY ASH AT 28 DAYS CURING

SN	% of Fly Ash	Load KN	Comp. Strength MPa	Avg. Comp. Strength MPa	% change
1	0%	741.00	32.93	30.27	0%
2		633.00	28.10		
3		719.00	29.80		
4	10%	670.00	29.78	31.18	2.92%
5		645.00	28.67		
6		789.00	35.10		
7	20%	740.00	32.88	33.52	7.50%
8		706.00	31.38		
9		817.00	36.30		

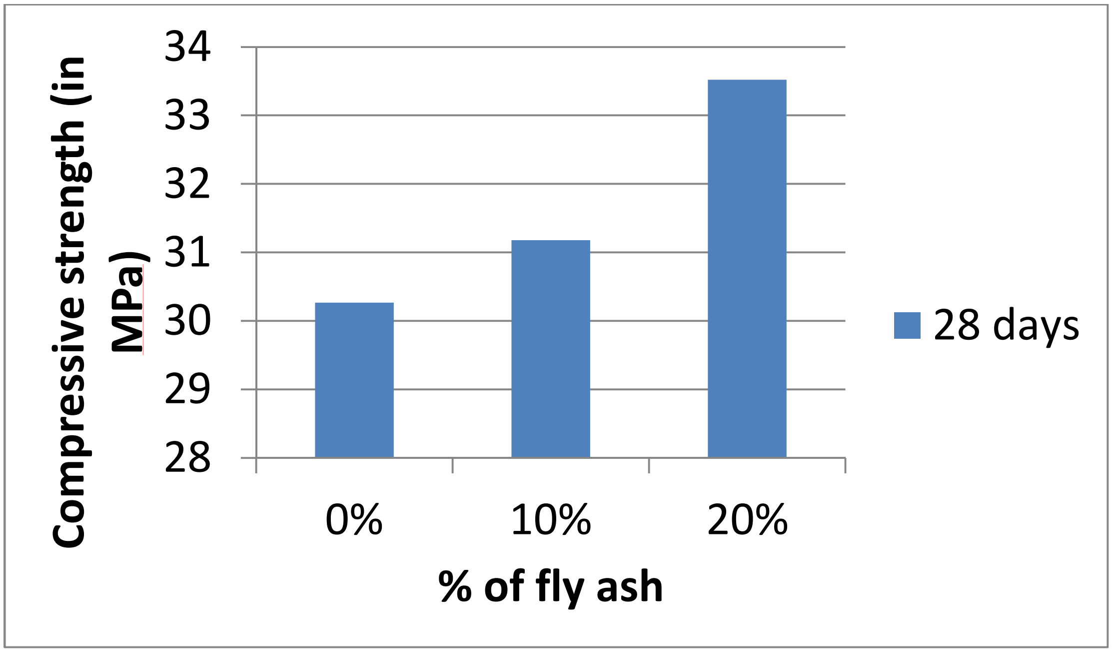

FIGURE 4.9 COMPRESSIVE STRENGTH FOR DIFFERENT PROPORTION OF FLY ASH AT 28 DAYS CURING

Figure 4.9 shows that on increasing proportion of fly ash there is an increase in compressive strength of concrete at 28 days curing because pozzolanic reaction completes about 90 percent.

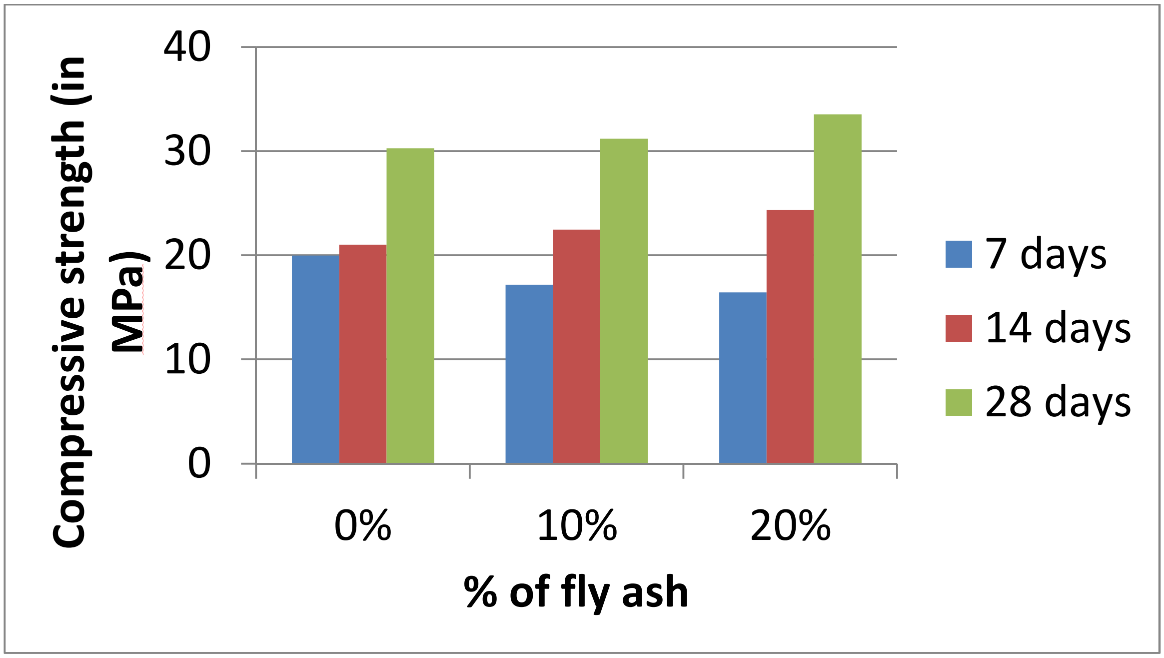

FIGURE 4.10 COMPARISION OF COMPRESSIVE STRENGTH OF CONCRETE FOR DIFFERENT PROPORTION OF FLY ASH AND AT DIFFERENT AGE OF CONCRETE

Figure 4.10 shows the variation of compressive strength of concrete at 7 days, 14 days and 28 days curing period. In this figure at 7 days curing comprssive strength is decreasing on increasing proportion of fly ash because pozzolanic reaction doesn't take place while at 14 days and 28 days curing period compressive strength is increasing on increasing proportion of fly ash because of pozzolanic reaction taking place.

The following tables depict the compressive strength results of M40 grade concrete cubes with PPF for 7 days, 14 days and 28 days curing period.

TABLE 4.7

COMPRESSIVE STRENGTH OF M40 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF POLYPROPYLENE FIBRE (PPF) AT 7 DAYS CURING

SN	% of PPF	Load KN	Comp. Strength MPa	Avg. Comp. Strength MPa	% change
1	0%	523.00	23.20	23.06	0%
2		529.00	23.51		
3		506.00	22.48		
4	1%	628.00	27.91	27.75	16.9%
5		612.00	27.20		
6		633.00	28.13		
7	2%	513.00	22.80	25.38	9.14%
8		587.00	26.00		
9		615.00	27.33		

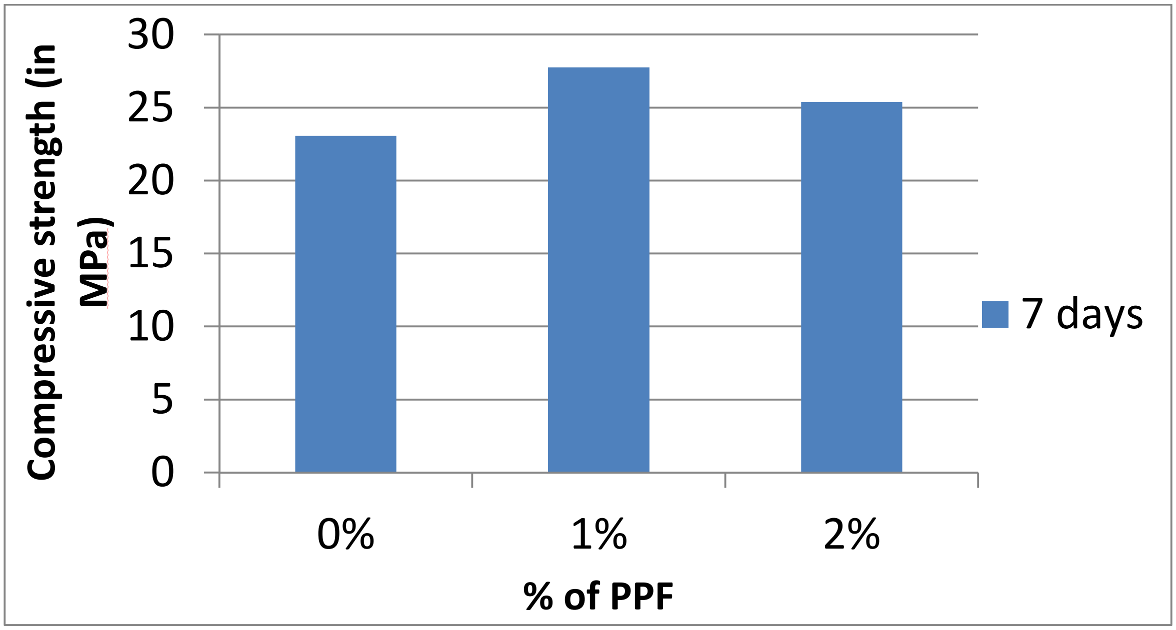

FIGURE 4.11 COMPRESSIVE STRENGTH FOR DIFFERENT PROPORTION OF PPF AT 7 DAYS CURING

Above figure shows that on increasing the proportion of polypropylene fibre compressive strength of concrete is increasing and is maximum at 1% PPF but on further increasing proportion of polypropylene fibre there is a decreasing in compressive strength of concrete.

TABLE 4.8

COMPRESSIVE STRENGTH OF M40 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF POLYPROPYLENE FIBRE (PPF) AT 14 DAYS CURING

SN	% of PPF	Load KN	Comp. Strength MPa	Avg. Comp. Strength MPa	% change
1	0%	623.00	27.68	28.66	0%
2		687.00	30.53		
3		625.00	27.78		
4	1%	745.00	33.11	32.96	15.00%
5		725.00	32.22		
6		755.00	33.55		
7	2%	648.00	28.8	30.53	6.52%
8		698.00	31.02		
9		715.00	31.78		

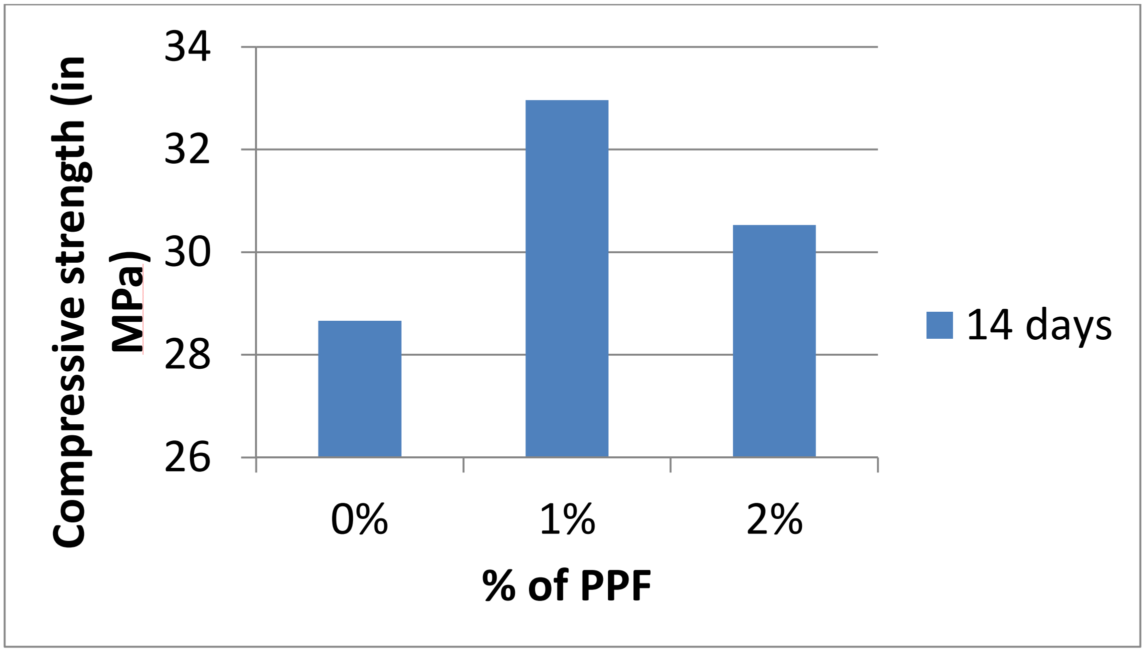

FIGURE 4.12 COMPRESSIVE STRENGTH FOR DIFFERENT PROPORTION OF PPF AT 14 DAYS CURING

Figure 4.12 shows that on increasing the proportion of polypropylene fibre compressive strength of concrete is increasing and is maximum at 1% polypropylene fibre but on further increasing proportion of polypropylene fibre there is a decreasing in compressive strength of concrete.

At maximum compressive strength cracks and shrinkage are reduced but on further increasing proportion of polypropylene fibre there is an increase in cracks and shrinkage were found.

On increasing proportion of polypropylene fibre workability increases maximum at 1% polypropylene fibre and then on further increasing proportion of polypropylene fibre workability decreases.

TABLE 4.9

COMPRESSIVE STRENGTH OF M40 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF POLYPROPYLENE FIBRE (PPF) AT 28 DAYS CURING

SN	% of PPF	Load KN	Comp. Strength MPa	Avg. Comp. Strength MPa	% change
1	0%	760.00	33.78	33.45	0%
2		737.00	32.75		
3		761.00	33.82		
4	1%	874.00	38.84	38.92	16.35%
5		898.00	39.91		
6		855.00	38.00		
7	2%	780.00	34.67	36.80	10.01%
8		847.00	37.64		
9		857.00	38.08		

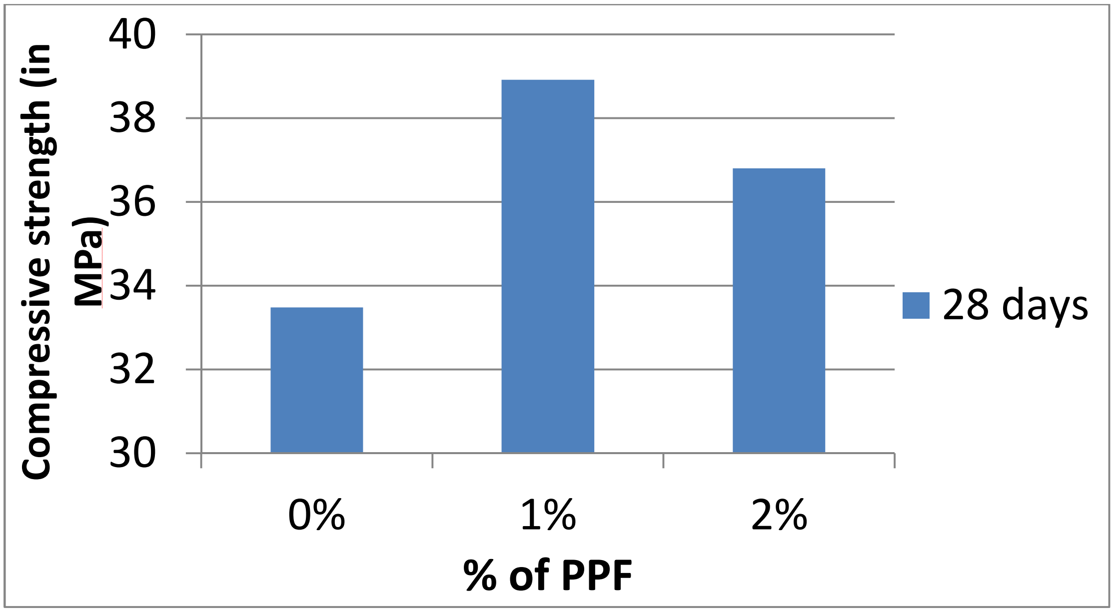

FIGURE 4.13 COMPRESSIVE STRENGTH FOR DIFFERENT PROPORTION OF PPF AT 28 DAYS CURING

Figure 4.13 shows that compressive strength increases upto 1% and after that decreases.

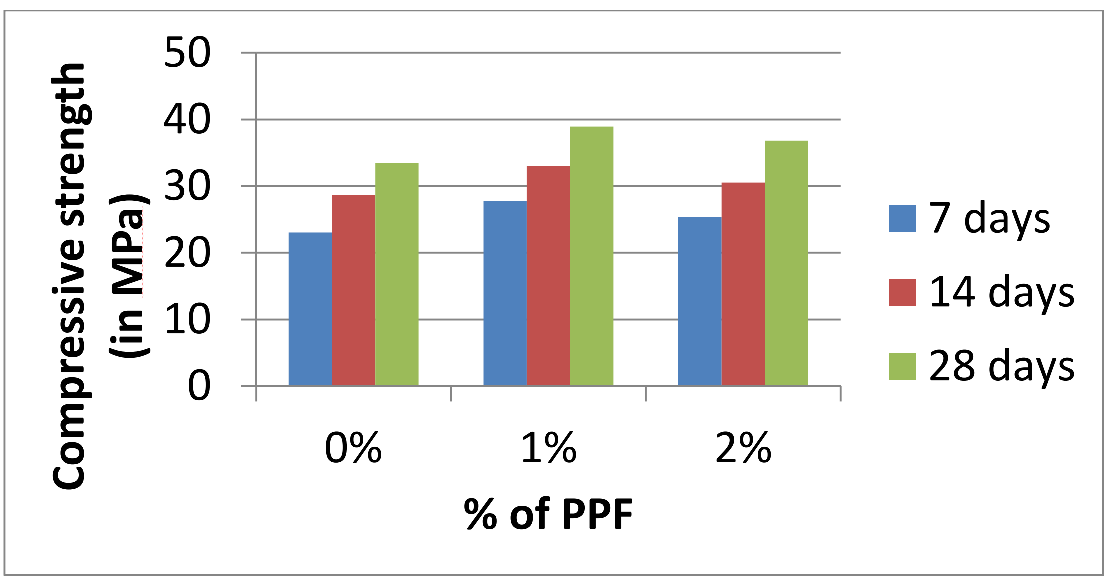

FIGURE 4.14 COMPARISON OF COMPRESSIVE STRENGTH OF CONCRETE FOR DIFFERENT PROPORTION OF PPF AND AT DIFFERENT AGE OF CONCRETE

Figure 4.14 Shows the variation of compressive strength at different age of concrete.

4.4 TEST FOR FLEXURAL STRENGTH

For flexure strength test prisms should be casted with having an dimension of 100mm×100mm×500mm prisms are casted for M40 grade concrete with different type of hybrid fibers present in concrete. The moulds are removed after 24 hours of casting and then prisms are kept in immersion water tank for 7 and 28 days. After curing is completed prisms shell be remove from water and keep it for drying. After that prisms should be tested in universal testing machine (UTM) having capacity of 1000KN failure load can be note down and flexural strength can be calculated by: Flexural strength= PL/bd^2

Where, p= failure load l= length of specimen d= depth of specimens b= breadth of specimens

FIGURE 4.15 TESTING OF BEAM IN FTM

TABLE 4.10

FLEXURAL STRENGTH OF M40 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF POLYPROPYLENE FIBRE (PPF) AT 7 DAYS CURING

SN	% of PPF	Load KN	Flexural Strength MPa	Avg. Flexural Strength MPa	% change
1	0%	6.00	3.00	3.58	0%
2		8.00	4.00		
3		7.50	3.75		
4	1%	9.50	4.75	5.50	34.90%
5		11.00	5.50		
6		12.50	6.25		
7	2%	9.00	4.50	4.17	16.48%
8		7.50	3.75		
9		8.50	4.25		

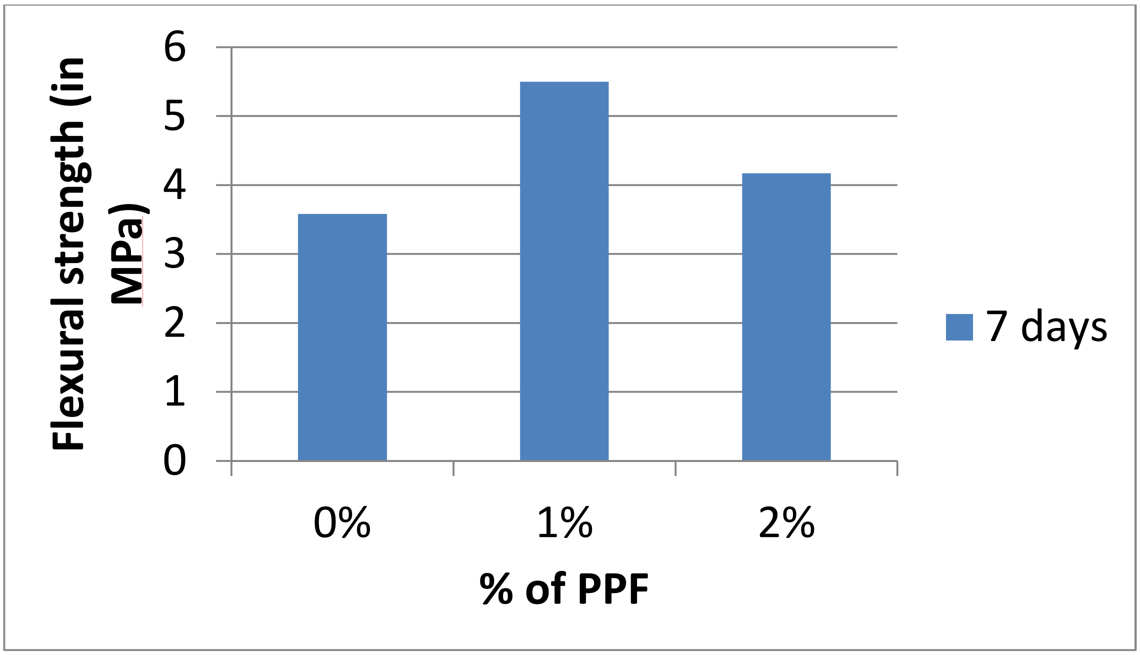

FIGURE 4.16 FLEXURAL STRENGTH FOR DIFFERENT PROPORTION OF PPF AT 7 DAYS CURING

Figure 4.17 shows that on increasing the proportion of polypropylene fibre flexural strength of concrete is increasing and is maximum at 1% polypropylene fibre but on further increasing proportion of polypropylene fibre there is a decreasing in flexural strength of concrete.

At maximum flexural strength cracks and shrinkage are reduced but on further increasing proportion of polypropylene fibre there is an increase in cracks and shrinkage were found.

TABLE 4.11

FLEXURAL STRENGTH OF M40 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF POLYPROPYLENE FIBRE (PPF) AT 14 DAYS CURING

SN	% of PPF	Load KN	Flexural Strength MPa	Avg. Flexural Strength MPa	% change
1	0%	6.50	3.25	4.20	0%
2		9.75	4.87		
3		9.00	4.50		
4	1%	11.50	5.75	5.70	35.71%
5		12.00	6.00		
6		10.75	5.37		
7	2%	11.00	5.50	5.25	25.00%
8		9.00	4.50		
9		11.50	5.75		

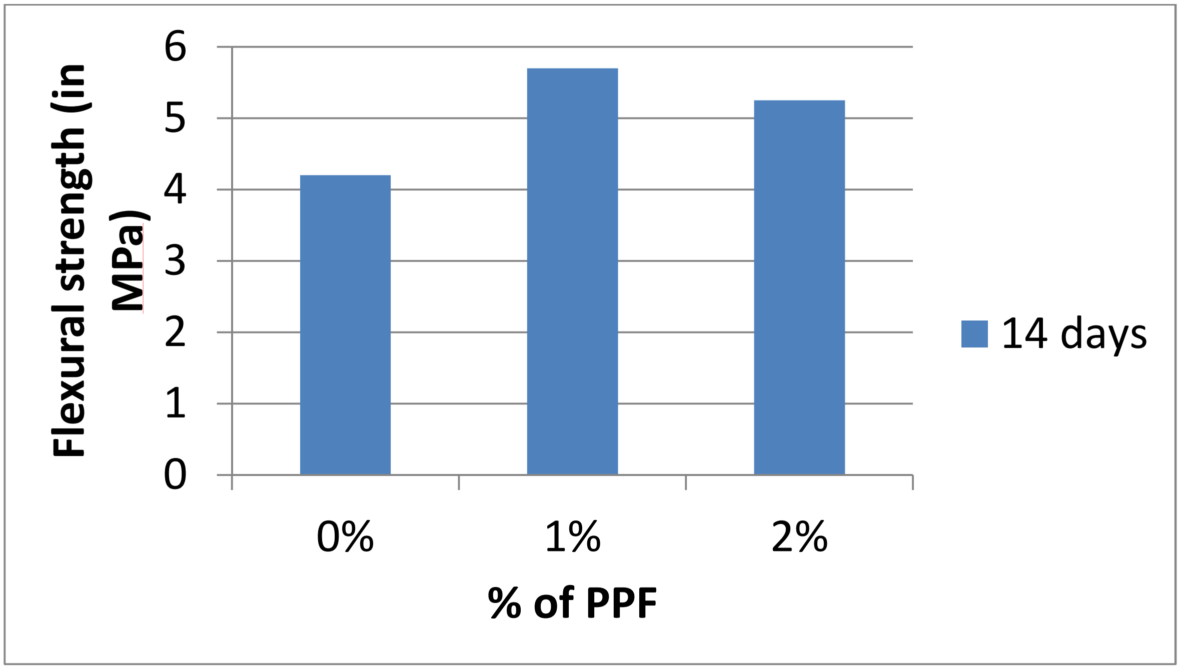

FIGURE 4.17 FLEXURAL STRENGTH FOR DIFFERENT PROPORTION OF PPF AT 14 DAYS CURING

Figure 4.17 shows that on increasing the proportion of polypropylene fibre flexural strength of concrete is increasing and is maximum at 1% PPF but on further increasing proportion of polypropylene fibre there is a decreasing in flexural strength of concrete.

At maximum flexural strength cracks and shrinkage are reduced but on further increasing proportion of polypropylene fibre there is an increase in cracks and shrinkage were found.

TABLE 4.12

FLEXURAL STRENGTH OF M40 GRADE OF CONCRETE FOR DIFFERENT PROPORTION OF POLYPROPYLENE FIBRE (PPF) AT 28 DAYS CURING

SN	% of PPF	Load KN	Flexural Strength MPa	Avg. Flexural Strength MPa	% Change
1	0%	12.75	6.375	6.54	0%
2		13.00	6.50		
3		13.5	6.75		
4	1%	14.00	7.00	7.08	8.25%
5		14.75	7.375		
6		13.75	6.875		
7	2%	13.25	6.625	6.71	2.59%
8		14.50	7.25		
9		12.50	6.25		

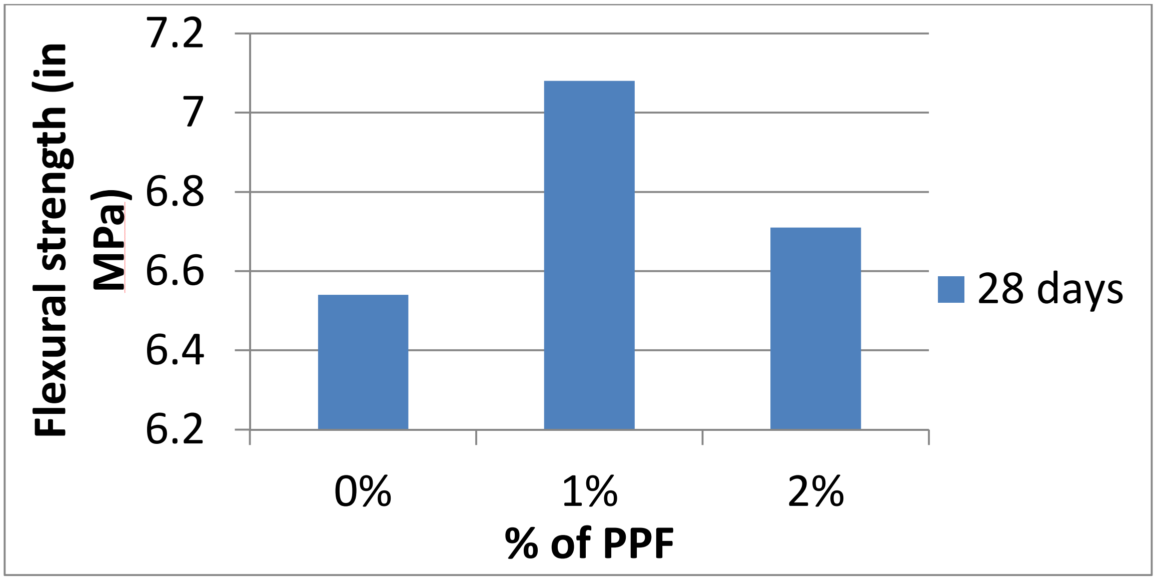

FIGURE 4.18 FLEXURAL STRENGTH FOR DIFFERENT PROPORTION OF PPF AFTER 28 DAYS CURING

Figure 4.18 shows that compressive strength increases upto 1% and after that decreases

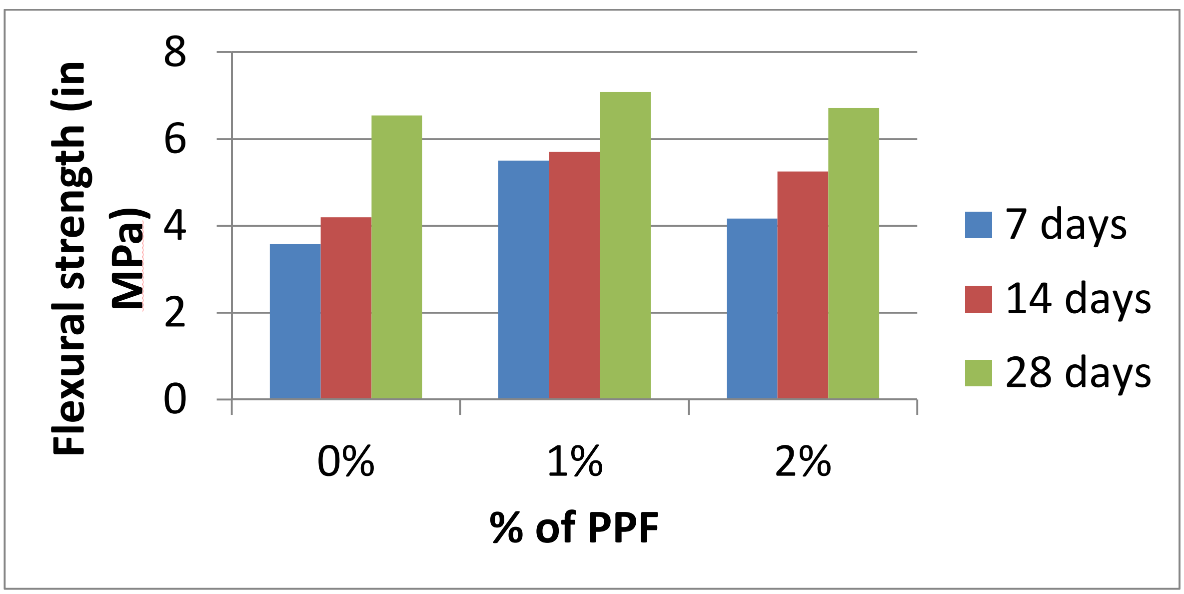

FIGURE 4.19 FLEXURAL STRENGTH OF CONCRETE FOR DIFFERENT PROPORTION OF PPF AND FOR DIFFERENT AGE OF CONCRETE

Figure 4.14 Shows the variation of compressive strength at different age of concrete.

CHAPTER 5

CONCLUSION

The report concludes the study on the effect of fly ash on properties of concrete for nominal mix of M20 and M30 grade of concrete and effect of PPF on properties of concrete for nominal mix of M40 grade of concrete are as follows.

1. Slump loss of concrete increase with increase in w/c ratio of concrete.
2. Concrete with 10% and 20% replacement of cement with fly ash shows ultimate compressive strength of concrete decreases for M20 grade of concrete for 7 days curing. Concrete with 10% and 20% replacement of cement with fly ash shows good compressive strength of concrete for 14 and 28 days of M20 grade of concrete.
3. Concrete with 10% and 20% replacement of cement with fly ash shows ultimate compressive strength of concrete decreases for M30 grade of concrete for 7 days curing. Concrete with 10% and 20% replacement of cement with fly ash shows good compressive strength of concrete for 14 and 28 days of M30 grade of concrete.
4. A Significant effect in addition of polypropylene fibre increases percent of water absorption.
5. Mechanical properties of concrete improved by use of fibers. When PPF is used which increased the shear capacity of concrete. Use of polypropylene reduces shrinkage and cracking.
6. The use of polypropylene fibre decreased the workability to some extent. Compressive strength increased with use of PPF content from 0% to 1%.

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