"COMPARATIVE ANALYSIS OF COMPRESSIVE AND SPLIT TENSILE STREGTH OF CONCRETE REINFORCED WITH STEEL FIBER , POLYPROPYLENE FIBER AND RECRON FIBER"

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision of

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to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

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CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"Comparative Analysis of Compressive and Split Tensile Strength of Concrete Reinforced with Steel Fiber, Polypropylene Fiber and Recron Fiber"** in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering and submitted to the Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **Rageshwar Kapoor (141611)** and **Nikhil Sharma (141624)** under the supervision of **Dr. Ashish Kumar (Associate Professor)** and **Mr. Kaushal Kumar** (Assistant Professor), Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

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It has been a wonderful experience working on **"Comparative Analysis of Compressive and Split Tensile Strength of Concrete Reinforced with Steel Fiber, Polypropylene Fiber and Recron Fiber"** which is in itself an advancement idea of concrete technology.We gratefully acknowledge the Management and Administration of Jaypee University ofInformation technology, Waknaghat for providing us the opportunity and hence the environment to initiate and complete our project now. For providing with the finest suggestion for the project , we are greatly thankful to our projectguide **Dr. Ashish Rohila** and **Mr. Kaushal Kumar**. He provided us the way to the job done by providing the concept behind the complexities so that we can make better use of existingknowledge and build up higher skills to meet industry needs. Last but not the least, we would also like to thank our Lab Assistants for the help and support.

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ABSTRACT

This study is to investigate the response of conventional reinforced concrete and fiber reinforced designed cementitious composites members on their compressive strength and split tensile strength behavior of concrete.Currently Fiber reinforced concrete (FRC) is a new structural material which is gaining increasing importance.The behavior of split tensile strength and compressive strength of conventional reinforced concrete member are reviewed and compared with fiber reinforced engineered cementitious composites. Combined effect of reinforcement and matrix leads to high interfacial bonding and thus prevent disintegration and lowers the effect of spalling. In our study , Steel fiber, Polypropylene and Recron fiber are commonly used as they are waste materials and can be reused for the reinforcement purpose.So we made a comparision of mechanical properties like Compressive Strength and Split Tensile Strength between these fibers.Concrete mixes with fiber dosage of 0.25%, 0.50% , 0.75% , 1.00% and 1.25 % by volume Fraction with control concrete mix were manufactured results in improvement of Compressive Strength and Split Tensile Strength.

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Chapter 1

Introduction

Lack in strain in both plastic and hardened concrete made with portland cement can be overcome by the utilization of traditional rod reinforcement and the consideration of an adequate volume of specific filaments. Also concrete forms many macro and micro cracks during the process of setting and hardening. Synthetic fibers are very effective in reducing plastic and shrinkage cracking. Fiber-reinforced concrete is concrete containing fibrous material which increases its structural integrity. Polypropelene (PP) and Steel fibers are widely used for this purpose in the construction industry. The impact of fiber on the properties of cement relies upon their type, length, aspect ratio, concrete mix and so forth.

The cutting edge improvement of fiber reinforced concrete began in the mid sixties .Adding fibrous material to concrete make the concrete homogeneous in nature.When concrete cracks the dispersed fibers gets oriented arrests crack formation and propagation and thus imoproving the strength and ductility of concrete.

Polypropylene fibers are available in three forms which are Monofilaments, Multifilament and Fibrillated fibers. Monofilament is a synthetic thread composed of single strand rather than twisted fibers.They have uniform cross section area and produced in an extrusion process.Multifilament is a thread comprising of several filaments.Most textile filament yarn are multifilament.The diameter of the multifilaments fibers depends on the number of monofilament fibers used and how they are combined to form a yarn. Fibrillated fibers are manufactured as films or tapes that are slit such that they can be expanded into an open network to allow penetration of cementitious materials.

Reliance Industry Limited (RIL) has propelled Recron 3s fibers with the target of enhancing the nature of plaster and concrete . Recron 3S is a modified polyester fiber. It is for the most part utilized as auxiliary reinforcing material in concrete and soil to expand their execution.

Steel fibers are produced fibers made of stainless steel .Composition may include carbon (C), silicon (Si), mangnese (Mn), phosphorous (P), sulfur (S), and different components.

NOTE: We are using M20 grade concrete to conduct various experiments,as it is usually used in the main structure of the building like beam, column and foundations.

The main objective of our study is to compare the compressive strength and split tensile strength of Fiber Reinforced concrete at various point of dosages with M20 grade of concrete.

Our study is also on basis to show that for normal loading conditions these fibers which generally obtained from waste products can be replaced with heavy reinforcement as there fibers are eco friendly also.

This study is subdivided in various Chapters , as in Chapter 1 we are explaining the need of our project and what are the various problems occur in concrete.History of Fiber Reinforced Concrete also explained in this section. It also includes various types of fibers exists. In Chapter 2 , Literature review has been explained conducted previously on Various Mechanical Properties of Fibers and their Conclusions. In Chapter 3 ,we deal with the Specifications and Description of Material Used to perform various experiments on the contituents of matrix. Chapter 4 deals with the Experimental Setup and Procedure in which the casting and curing of specimens and also the testing procedure and detailing are there.Chapter 5 includes our final result data and its analysis.

1.1 History of fiber reinforced concrete

Fibers have been utilized concrete reinforcement since ancient circumstances however innovation has enhanced altogether, as it is used in different fields. In early centuries, straw and mortar were utilized for mud bricks, and horsehair were utilized for their reinforcement. Natural fibers such as pine needles and wheat straws are shown in Fig.1.1. As the fibers innovation developed cement was fortified by asbestos fibers. Then, advanced materials such as synthetic fibers and supplanted asbestos because of its location of wellbeing dangers. Fiber Fortified Cement is thought to be the one of the best accomplishments in the development history amid the twentieth century.

a. Pine Needles

b. Wheat straws

Fig 1.1 : Natural Fibers

1.1 Types of Fibers

Various types of fibers are discussed below:

a) Glass Fiber Reinforced Concrete(GFRC)

Notwithstanding steel , this fibers reinforced has been effectively utilized since most recent 25 years for concrete reinforcement. GFRC is being manufactured into huge panels with a straightforward design or into intricate shapes by utilizing extraordinary methods. A pictorial view of glass fiber is shown in fig. 1.2 below.

Fig.1.2 : Glass Fiber

b) Steel Fiber Reinforced Concrete

It is a composite material that can be sprinkled. It contains steel fibers poured in hydraulic cement that can be scattered arbitrarily and have a rectangular cross section. It can withstand tensile cracking and its flexural strength is greater than unreinforced concrete. Steel fibers can withstand light and heavy loads. Pictorial view of steel fibers as shown in fig 1.3

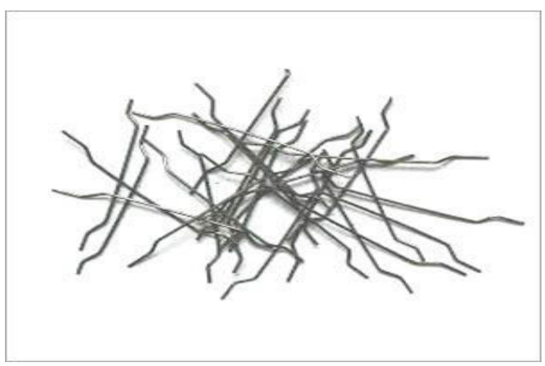

Fig. 1.3 : Steel Fiber

c) Natural Fiber Reinforced Concrete

In this, cellulose fibers extract from straws and pine trees are processed. Also , recycles carpet waste is used as reinforcement in concrete.

d) Asbestos fibers

These fibers are comparatively cheap that provides mechanical, chemical and thermal resistence, although these appear to have low impact strength. Pictorial view as shown below in fig 1.4

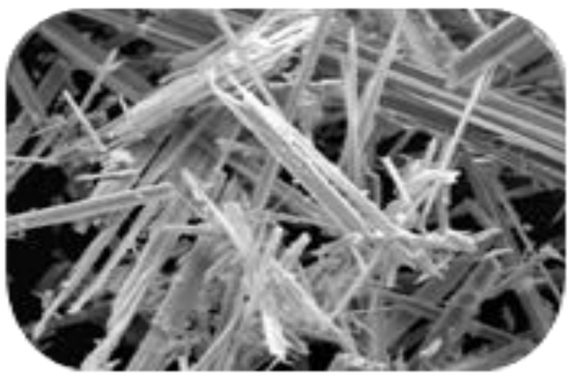

Fig 1.4 : Asbestos fibers

e) Carbon fibers

Strength and Stiffness characteristics are superior than steel fibers in spite of the fact that they are more susceptible to harm as shown in fig. 1.5

Fig .1.5 : Carbon Fiber

f) Synthetic fibers

Now days, Synthetic fibers are widely used. Few are discussed below namely , Polypropylene fiber , nylon fiber and polyester fiber.

g) Polypropylene Fiber Reinforced Concrete :

These fibers are extensively used in ready mix concrete. These are hydrophobic and have no effect on concrete mixing water requirements. They come as either fibrillated bundles or monofilaments. For fibrillated fibers, manufacturers extrude the polypropylene in sheets that are stretched along its dimensions. The result is a mesh of interconnected fiber strands rectangular in shape. Manufactures cut the strands to specified lengths and separate them bundled as length ranges from ¼ to 21/2 inches. When added to concrete during mixing , the fibrillated fibers open into network of linked fiber filament and anchor itself to cement mixing. Monofilament is fine, cylinder shaped strands that separate during mixing. Due to small surface area, they don’t tend to anchor in matrix. With fibrillated fibers, cement paste goes into the networks and lock themselves for better mechanical anchoring. Research shows that lower volume of fibrillated fibers than of monofilament fibers are needed to improvise the post cracking load carrying capacity and ductility.

h) Polyester Fiber :

These fibers are made only in monofilament form length ranges ¾ to 2 inches. Like Polypropylene, these fibers are also hydrophobic. A pictorial view as shown below in fig 1.6

Fig 1.6 : Polyester fiber

i) Nylon Fiber :

Like Polyester fibers, these are only made in monofilament form and are hydrophilic. Having strong affinity to water, these fibers bond chemically to the matrix. Manufacturers also reported that these fibers have higher aspect ratios than those of polypropylene and thus can be added to smaller dosages(usually 1 pounds per cubic yard) to produce same reinforcing effects as fig. shown in Fig 1.7

Fig .1.7 : Nylon Fiber

Chapter 2

Literature Review

Use of synthetic fibers in concrete has been advocated by many researchers for improving some specific properties of mix. Thoroughly mixed and dispersed microfibers are effective in reducing plastic shrinkage cracking as they delay the process by which micro cracks coalesce to form macro cracks. In this way, addition of synthetic fibers modes the properties of concrete mix. The fibers are commonly included for slab grade construction to decrease early plastic shrinkage breaking and prompts increment in impact and abrasion resistance with toughness. The impact of fibers on the properties of concrete varies depend on length, ratio, concrete mix etc. Fix studies are discussed as:

2.1 FRC using steel fibers

Amit Rai and Dr. Y.P Joshi examined that Fiber Reinforced is successfully played very vital role to reduce shock protection, increase toughness and reduce plastic shrinkage cracking. Requirement of bulky reinforcement is also replaced by steel fiber for structural strength. Freezes thaws protection of the concrete has further been increased. Many departments have been in the FRC's and the expansion of fibers improves concrete's ductility and post cracking load carrying capacity.

2.2 FRC using Waste materials

G. Murali et. al. examined the impacts of expansion of waste materials. They use tin cans , plastic bottle caps ,steel powder waste from workshop with a dosage of 1% to total weight of concrete. Rectangular segments of 3mm width and 10mm length of the disposal waste , purge tin cans , plastic bottle caps were shaped. Examination was led using M20 grade concrete and tests were done according to suggested strategies given in important codes. The analysis comes about were contrasted and conventional concrete and it was watched that concrete squares blended with steel powder builds its compressive strength by 41.22% and tensile strength by 40.82%. Plastic bottle caps fortified squares demonstrated an expansion in flexural strength of concrete by 25.89%. The example with steel powder as waste material was observed to be good in pressure which had the compressive strength of 41.23% which is more than the traditional concrete.

2.3 Using polythene fibers (domestic waste plastic)

R. Kandasamyand R. Murugesan considered the impacts of expansion of polythene fibers with a measurement of 0.5% by mass of cement. They examine the properties which incorporate compressive strength and flexural strength. This examination was directed on a M20 grade concrete and tests have been carried out as per recommended procedures given in relevant codes The conclusion was made that expansion of these fibers increases the cube compressive strength of concrete in 7 days to a degree of 0.68%, increases the cube compressive strength of concrete in 28 days to a degree of 5.12%, increases the cylinder compressive strength of concrete in 28 days to a degree of 3.84% increases the split tensile strength to a degree of 1.63%.

2.4 Using Polypropylene Fiber

Rakesh Kumar, et al., 2013, in their paper briefly discussed the effect of addition of polypropylene discrete and fibrillated fiber on the properties of paving grade concrete mix of 48 Mpa compressive strength at 28 day. Six concrete mixes with fiber dosage of 0.05% , 0.1% and 0.15% by volume fraction besides the control concrete mix were manufactured. Discrete and fibrillated polypropylene fiber was used in this study. The properties such as settlement , compressive strength, drying shrinkage and abrasion resistance of the concrete was evaluated.

2.5 B Venkat Narsimha Rao et. Al , in their paper clarifies the progression in pavement design by including polyester fiber in concrete in the field of reinforced concrete pavement design. Fibers, for example, polyester or polypropylene (Recron fibers) are being utilized because of their financially savvy and also corrosion protection. RFRC requires particular design contemplations and development methodology to obtain optimum performance. The higher initial cost by 15-20% is counterbalanced by the decrease in upkeep and rehabilitation tasks, making RFRC less expensive than flexible pavement by 30-35%.

Chapter 3

SPECIFICATIONS AND DESCRIPTION OF MATERIAL USED

In order to achieve the objectives of the study , the systematic series of Laboratory experiments were conducted. The chapter deals with the detailed specification and description of material used in experiments.

3.1 Cement Used

Portland Pozzolana Cement is a sort of Blended Cement which is delivered by either intergrinding of OPC clinker alongside gypsum and pozzolanic materials in specific extents or granulating the OPC clinker , gypsum and Pozzolanic materials independently and completely mixing it in specific extents.

Pozzolona contains silica either as artificial of natural in reactive form.

3.1.1 Tests on Cement

a) Soundness Test

In this test , a specimen belong to hardened cement paste is boiled as any expansion is speeded up and can be detected at specific time period.

Following are the results and calculations of Laboratory Le chatliers test conducted by us :

$$Expansion\ of\ cement\ = L_1 - L_2$$

L_1 = Reading taken after immersion in water for 27 hours at 27 ± 2 degree centigrade.

L_2 = Reading taken after 3 hours of immersion in water at boiling temperature.

L_1= 2.3 cm

L_2= 1.8 cm

$$Soundness\ of\ Concrete\ =\ 2.3 -\ 1.8\ =\ 0.5\ cm\ or\ 5\ mm$$

According to IS:1489:1991(part 1) the maximum value of soundness of PPC by Le-Chatliers test method is 10 mm and our result is 5mm which indicates that cement used is quite good.

b) Normal Consistency

Standard consistency of cement paste is also defined by the consistency that will allow vicat plunger having dimensions 10 mm dia and 50 mm length to penetrate 30 to 35 mms deep form top of the mould

In the lab test conducted by us , the normal consistency comes out to be 35% for PPC.

c) Initial and Final Setting time

IST is the time period between time when water is added to cement and the time at which 1mm sq. needle can't penetrate to cement paste which is placed at Vicat's mould 5 to 7 mm from bottom of mould.

FST is that time period between the time water is added to cement and the time at which 1mm needle makes an impression on the paste in the mould but 5mm attachment does not make any impression.

Following are the results and calculation of lab test conducted by us:

$$Initial\ Setting\ time\ =\ t_2 - t_1$$

$$Final\ Setting\ time\ =\ t_3 - t_2$$

Where,

t_1 = Time at water is added to cement

t_2 = Time when needle fails to penetrate 5mm to 7mm from the bottom of the mould .

t_3 = Time when the needle makes an impression but the attachment fails to do so.

t_1= 0 min, t_2=48 min , t_3 = 8 hrs 20 min

So, IST = 48 min and FST = 8 hr 20 min

3.2 **Aggregates Used**

It gives strength , resistance to wear, stability , volume to the completed item. Mainly fine aggregates composed of sand, crushed stones and coarse aggregates as composites of gravel , disintegrates of broken stone are used. Fine aggregates are used where smooth surfaces is wanted and coarse aggregates are used for large members.

3.2.1 Tests on Aggregates

a) Specific Gravity of Coarse Aggregates

Calculations and Results of lab tests:

$$\textbf{Specific Gravity} = \frac{\textbf{Dry weight of Aggregate}}{\textbf{weight of equal volume of water}}$$

$$\frac{\mathbf{1.889}}{(\mathbf{1.935 - 1.224})} = \mathbf{2.90}$$

b) **Specific Gravity of Fine Aggregates**

$$\boldsymbol{Specific\ Gravity\ =\ 2.61}$$

According to IS : 2386 – Part -3 , The range of Specific Gravity of aggregates is from 2.5 to 3 and our results are within the standard range which indicates that the aggregates used are appropriate.

NOTE : So, as per the results of our material used i.e. cement , coarse and fine aggregates , the material is suitable for specimen casting and further concrete tests.

3.3 Fibers Used

Fiber mesh 300 e-3 : Micro-synthetic fiber as per its technical name and is commonly known as Polypropylene fibrillated fiber. Fiber mesh 300 e-3 formerly known as Inforce TM e3 , micro-reinforcement fibers for concrete are 100 % virgin homopolymer polypropylene graded fibrillated fibers containing no reprocessed plefin materials.

ADVANTAGES:

.These type of fibers are Non magnetic in nature.

. These are Rustproof.

. These Micro-synthetic fibers are Alkali Proof.

. It doesn’t require any amount of concrete cover.

. These are Safe and easy to use

. Thus saves time and hassle.

PRIMARY APPLICATIONS

Polypropylene Fibrillated Fiber is widely used in ground supported slabs , External roads and pavements , driveways , pools atc.

CHEMICAL AND PHYSICAL PROPERTIES

Fiber length	Various
Type / Shape	Grade / Fibrillated
Absorption	Nil
Specific Gravity	0.91
Electrical Conductivity	Low
Acid and Salt Resistance	High
Melting Point	162 degree centigrade

Reliance industry limited (RIL) has propelled Recron 3s fibers with the goal of enhancing the nature of plaster and concrete. The general properties and utilizations of Recron 3s fiber reinforced concrete utilized as a part of development. The more slender and more grounded components spread crosswise over whole area, when utilized as a part of low measurements captures cracking. Recron 3s is a triangular polyester fiber in cross area with cut length of 6mm and 12mm which is in effect broadly utilized as a part of the Indian development industry showcase. It is significantly less expensive than some other imported development fibers. At the predetermined dose of 0.25% by wt of bond there are a large number of fibers which shape a mesh in the concrete. The spacing is approx under 1mm between any two fiber filaments in any facilitate of the matrix. This depicts the general properties and use of RECRON 3s fiber reinforced concrete utilized as a part of development. The more slender and more grounded components spread crosswise over whole segment, when utilized as a part of low measurements captures cracking.

CHEMICAL AND PHYSICAL PROPERTIES

DIAMETER	33-35 micron
CUT LENGTH	6mm , 12mm , 24mm
TENSILE STRENGTH	6000 kilograms per square centimeters
MELTING POINT	> 250 Degree centigrade
DISPERSION	Excellent
ACID RESISTANCE	Excellent
ELONGATION	45 – 55 %
MOISTURE	< 1 %

Steel Fibers are relatively of short length with an aspect ratio of 30 to 150 with number of cross – sections.The most commonly used fibers are of hooked ends of dia 0.25 to 0.75 as increases compressive , flexural and tensile strengths They are widely used in pavements , decks etc.

CHAPTER 4

EXPERIMENTAL SETUP & PROCEDURE

Introduction

Detailed description about the materials used are discussed and explained in previous chapter. A we know , specimen details are essential for investigations of results. So , as discussed below.

4.1 Experimental Investigation

Details of specimen

For all the tests in this study we have use M20 concrete of standard mix proportion of 1:1.5:3 and w/c ratio is taken as 0.5.

Table 4.1 shows the details of different test specimens. It is proposed to discover, tentatively the impact of addition of polypropylene fiber on the properties of concrete to be utilized for construction purpose hence the examination are taken up to assess workability compressive strength and split tensile strength of plain and fiber reinforced concrete specimen according to measures.

Casting and curing of specimen

The constituents of concrete such as cement , water and sand are required for casting as per Indian standard codes.M20 grades is taken into consideration. Concrete was mixed in mixer as per the recommendation of IS:516-1959. Steel moulds of size 150 mm x 150 mm x 150 mm and cylinder of 150 mm diameter and 300 mm height. Then the concrete is poured in three layers with the help of tamping rod and thus filled completely and finished by smoothening the top surface. Then , the remolding is done after 24 hours and then sink it to water tank for 7 days and 28 days for both cubes and cylindrical.

Table 4.1 Details of Experimental Specimen

1.	Compressive Strength Test (7 days & 28 days)	Cube 150mm X 150mm X150 mm	0% 0.25% 0.5% 0.75% 1.00% 1.25%	3 3 3 3 3 3
3.	Split Tensile Test (7days & 28 days)	Cylinder 150mm dia & 300mm height	0% 0.25% 0.50% 0.75% 1.00% 1.25%	3 3 3 3 3 3

4.2 Testing Method Details

The slump test for the workability of fresh concrete and 7 days and 28 days compressive strength and split tensile strength tests are conducted in this study and testing method details are given in detail in this chapter.

4.2.1 **Compressive Strength Test**

PROCEDURE

Preparation of Concrete Cube Specimen

The proportion and material for making these test specimens are from the same concrete used in the field.

Specimen

3 cubes of 15cm X 15cm X 15cm size Mix. M20

Mixing of Concrete for Cube Test

Mix the concrete either by hand or in a laboratory batch mixer

Sampling of Cubes for Test

(i) Wash the moulds and apply lubricant

(ii) Concrete is poured in the moulds in layers approximately 5cm thick

(iii) Each layer of concrete is compacted with atleast 34 strokes per layer by using a rod.

(iv) Smoothen and level the top surface

Curing of Cubes

The test specimens are put away in damp air for 24 hours and after this period the specimens are stamped and expelled from the moulds and kept submerged in clear fresh water until the point when taken out preceding test.

Procedure for Cube Test

(I) Specimens are expelled from the water after a specific curing time and surface gets wipe out from excess water.

(II) Dimension of specimen is taken as close to 0.2m.

(III) The bearng surface gets cleaned.

(IV)Specimen is placed in such a way that load is to be applied on opposite surfaces of cube.

(V) Specimen is aligned on centre part of base plate.

(VI) The movable surface is rotated gently as it touches the specimen's top surface.

(VII) The load is then applied without shock at the   rate of 140 kg/sq.cm/minute continuously till specimen fails.

(VIII) Record and note the maximum load with other unusual features in failure.

4.2.3 Split Tensile Test

PROCEDURE

1. Take mix proportion 1:1:2 with w/c ratio 0.6. Take cylinder with dimension of 150 x 300mm .
2. Concrete is poured in oiled mould. Fill the cylinder mould and place them on table vibrator till smooth surface is obtained.
3. Extra concrete layer is removed from the top with the help of trowel.
4. Engrave identification mark over it after 2 to 3 hours.
5. Mould is removed after 24 hrs. and immersed in water.
6. Test atleast three specimen for each age of test as follows.

Testing on CTM

1. Draw geometry lines on tow end surface of the space such that it lies on correct axial plane.
2. Centre part of the specimen is placed over the plywood strip lies below and a strip of plywood lies above aligned correctly with the centre axis.
3. Apply the maximum split tensile load over the specimen til the cracks developed.
4. Take note at appeance of failure.
5. Compute the split tensile strength of the specimen to the nearest 0.25 N/mm2.

CALCULATIONS

The splitting tensile strength is calculated using the formula

$$T_{sp} = 2P/\pi DL$$

Where P = applied load,kN

D = diameter of the specimen, m

L = length of the specimen, m

T_{sp}= splitting tensile strength, kpa

CHAPTER 5

ANALYSIS OF DATA AND DISCUSSION

OF RESULTS

INTRODUCTION

Particularly, cube Compressive strength and cylinder split tensile strength test are conducted by us in the Concrete Laboratory Of CIVIL ENGINEERING DEPARTMENT of JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT. The results are analyzed and discussed as under :

5.1 Properties of Plain Concrete

Results of various experiments on M20 concrete:

Table 5.1: 7 days cube testing result for plain concrete

Sample No.	Load (KN)	Compressive Strength(N/mm^2)
1.	340	15.33
2.	345	15.44
3.	345	15.44

Table 5.2: 28 days cube testing result for plain concrete

Sample No.	Load (KN)	Compressive Strength(N/mm^2)	Avg. Load	Avg. Compressive Strength(N/mm^2)
1.	510	22.66	516	22.75
2.	515	22.88		
3.	525	23.33		

Average Compressive Strength for 28 days is 22.75 N/mm^2

Table 5.3: Split Tensile strength for PCC 7 days

Sample No.	Load (KN)	Tensile Strength(N/mm^2)
1.	150	2.12
2.	150	2.12
3.	145	2.05

Table 5.4: Split Tensile strength for PCC 28 days

Sample No.	Load (KN)	Tensile Strength(N/mm^2)	Avg. Load (KN)	Avg. Tensile Strength(N/mm^2)
1.	200	2.83	196	2.78
2.	180	2.54		
3.	210	2.97		

Average Split Tensile Strength for 28 days is 2.78 N/mm^2

5.2 Properties of concrete on adding fibers

Table 5.5 : Compressive Strength of Steel fiber

S.No.	% Steel fiber	Average load(KN)		Compressive strength (N/mm^2)	
		7 Days	**28 Days**	**7 Days**	**28 Days**
1.	0.25	470	677	21.02	30.04
2.	0.50	472	741	21.08	33.22
3.	0.75	522	800	22.55	35.48
4.	1.00	567	853	25.15	38.11
5.	1.25	608	902	27.07	40.21

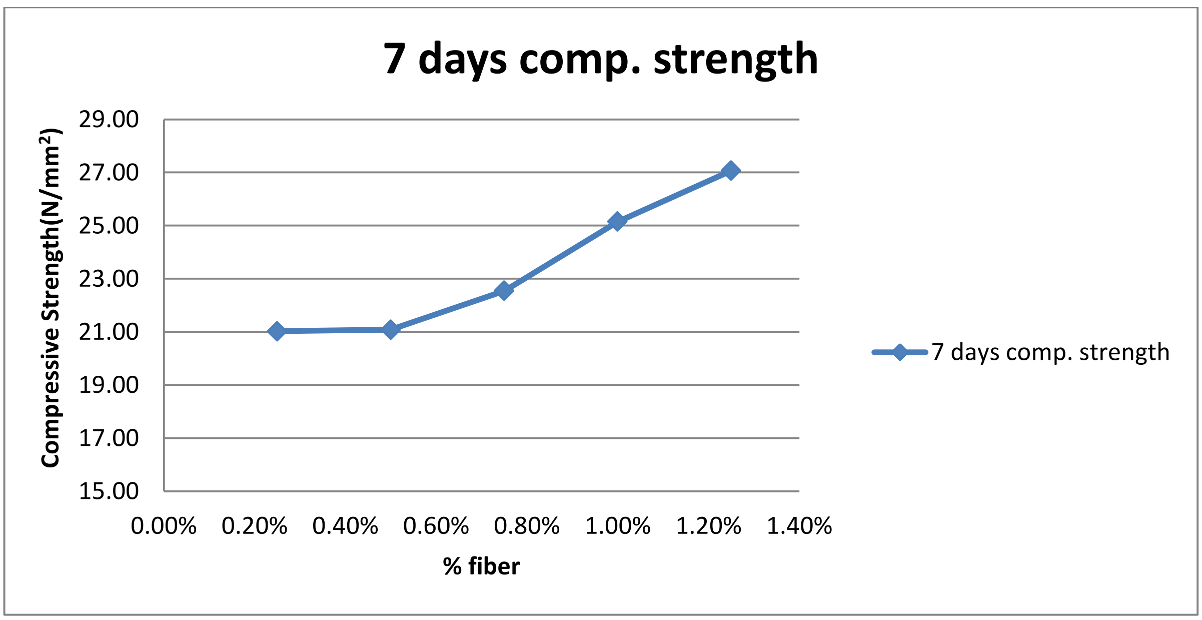

Fig 5.1: Graphical representation of 7 days compressive strength of Steel fibers

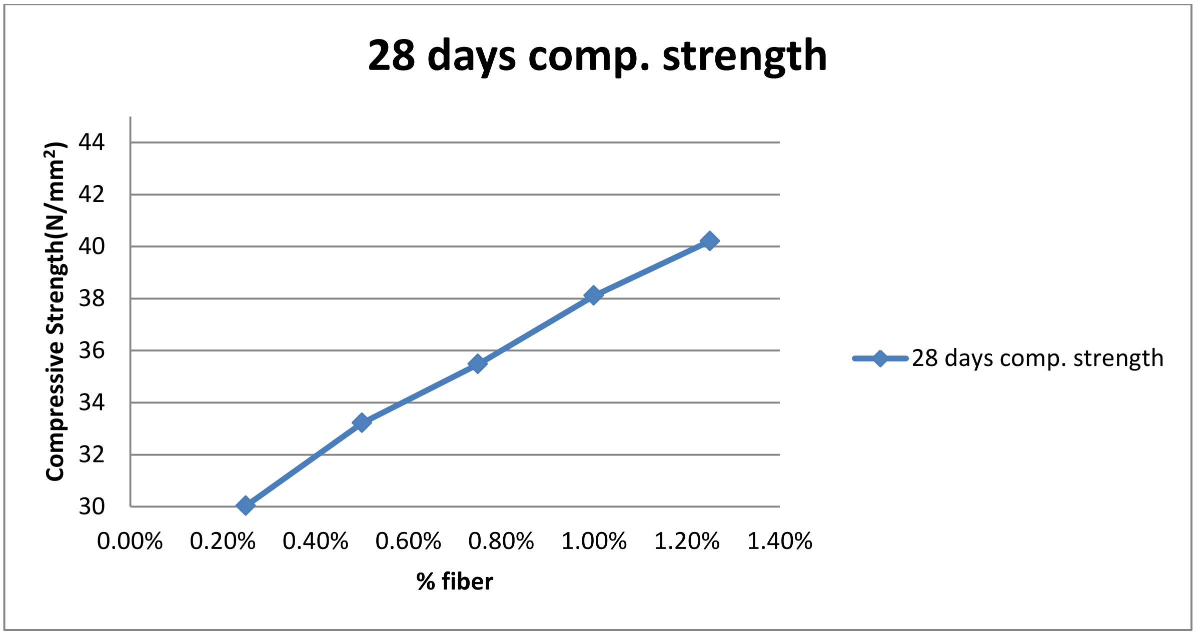

Fig. 5.2 : Graphical representation 28 days compressive strength of Steel fibers

Table 5.6: Compressive Strength for Recron Fiber

S.NO	% Recron fiber	Average Load (KN)		Compressive Strength (N/mm^2)	
		7 Days	**28 Days**	**7 Days**	**28 Days**
1.	0.25	385	567	17.03	25.18
2.	0.50	350	518	15.62	23
3.	0.75	325	505	14.9	22.8
4.	1.00	325	495	14.44	21.98
5.	1.25	312	473	13.84	21.03

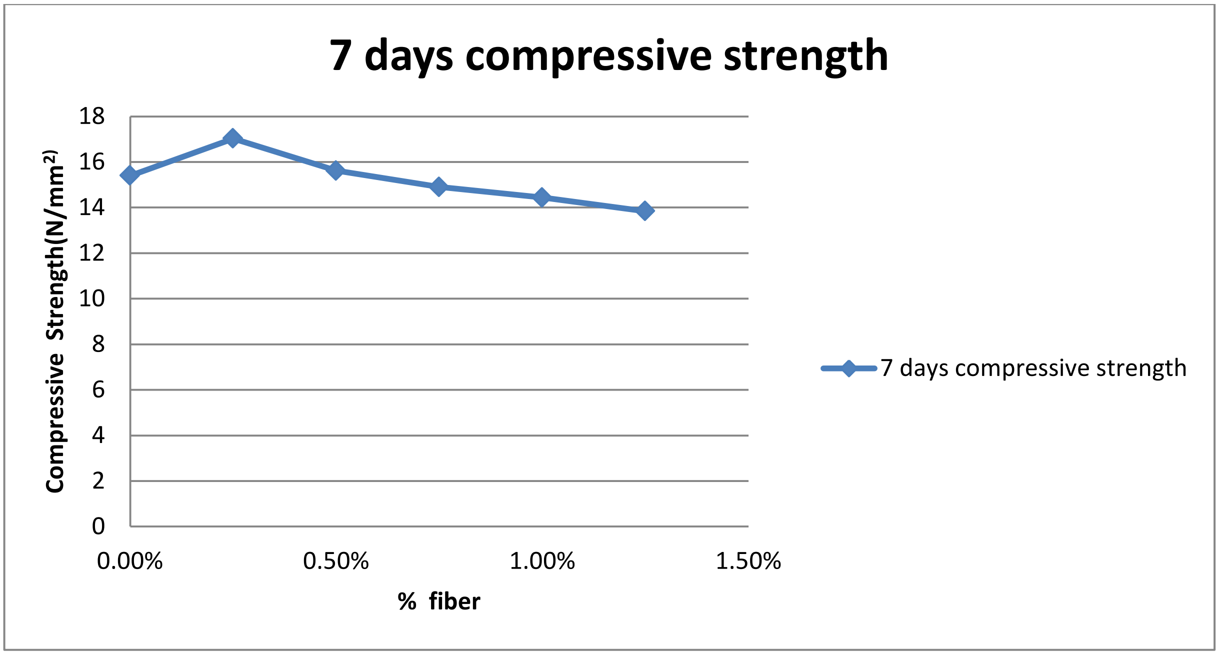

Fig 5.3 :Graphical representation of 7 days compressive of Recron Fiber

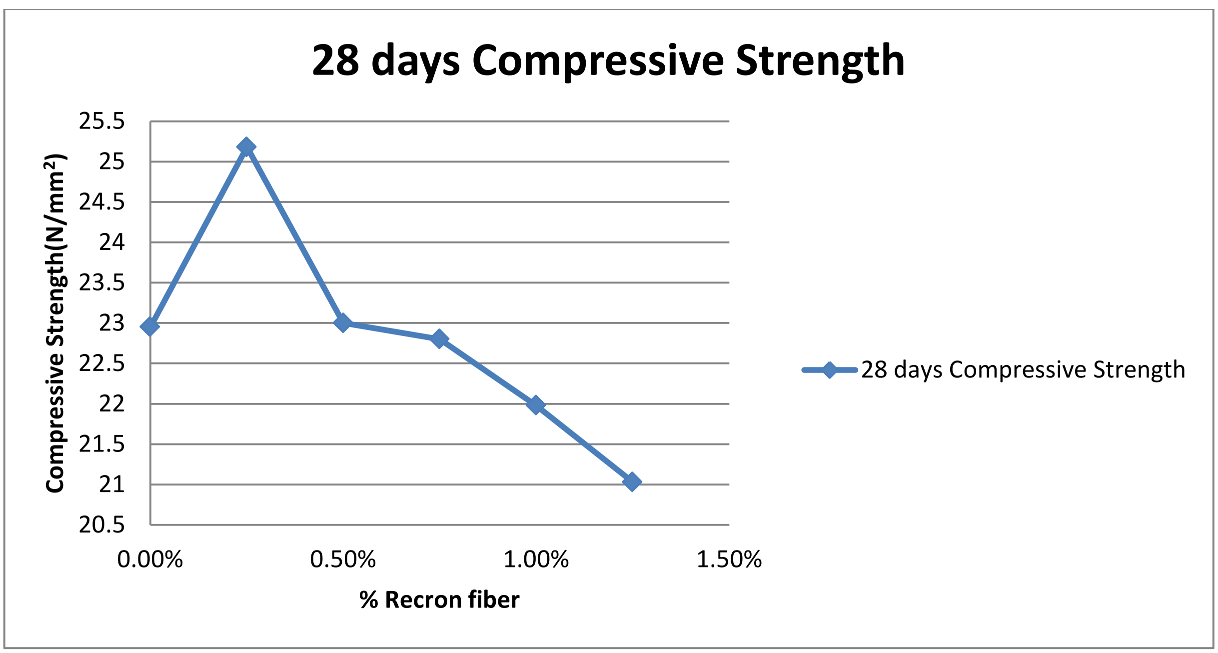

Fig 5.4: Graphical representation 28 days compressive strength of Recron fiber

Table 5.7: Compressive Strength for Polypropylene Fiber

S.NO	% Polypropylene Fiber	Average Load (KN)		Compressive Strength (N/mm^2)	
		7 Days	**28 Days**	**7 Days**	**28 Days**
1.	0.25	460	740	20.44	32.88
2.	0.50	470	790	20.88	35.1
3.	0.75	500	870	22.21	38.44
4.	1.00	420	810	18.83	36.12
5.	1.25	411	750	18.27	33.77

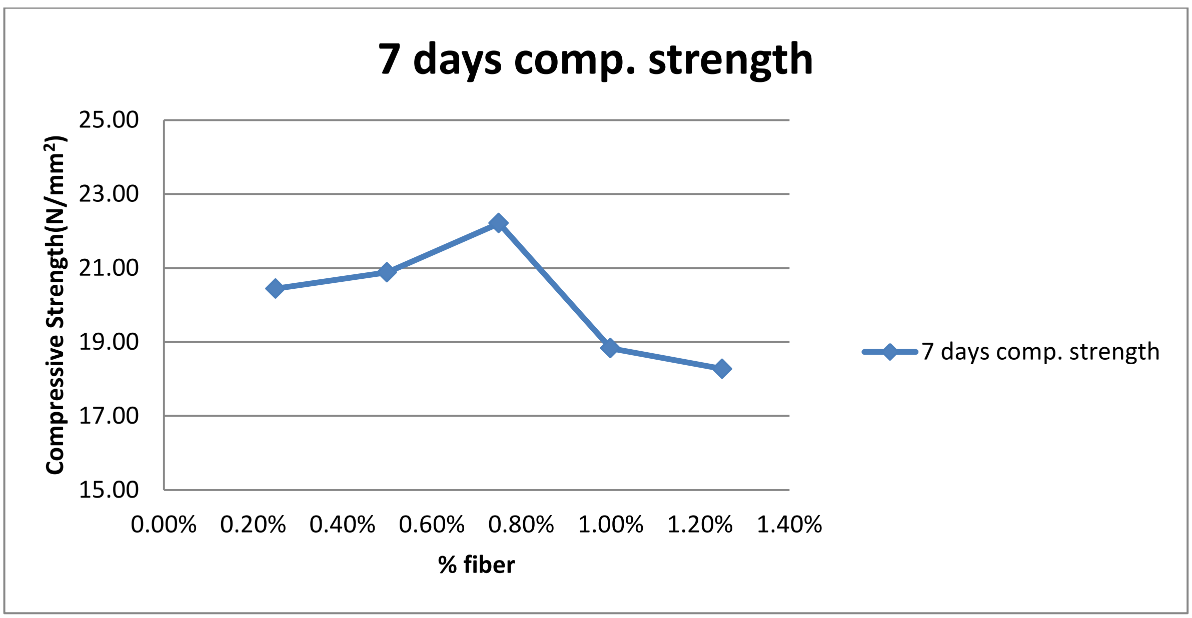

Fig 5.5 : Graphical representation of 7 days compressive strength of Polypropylene fiber

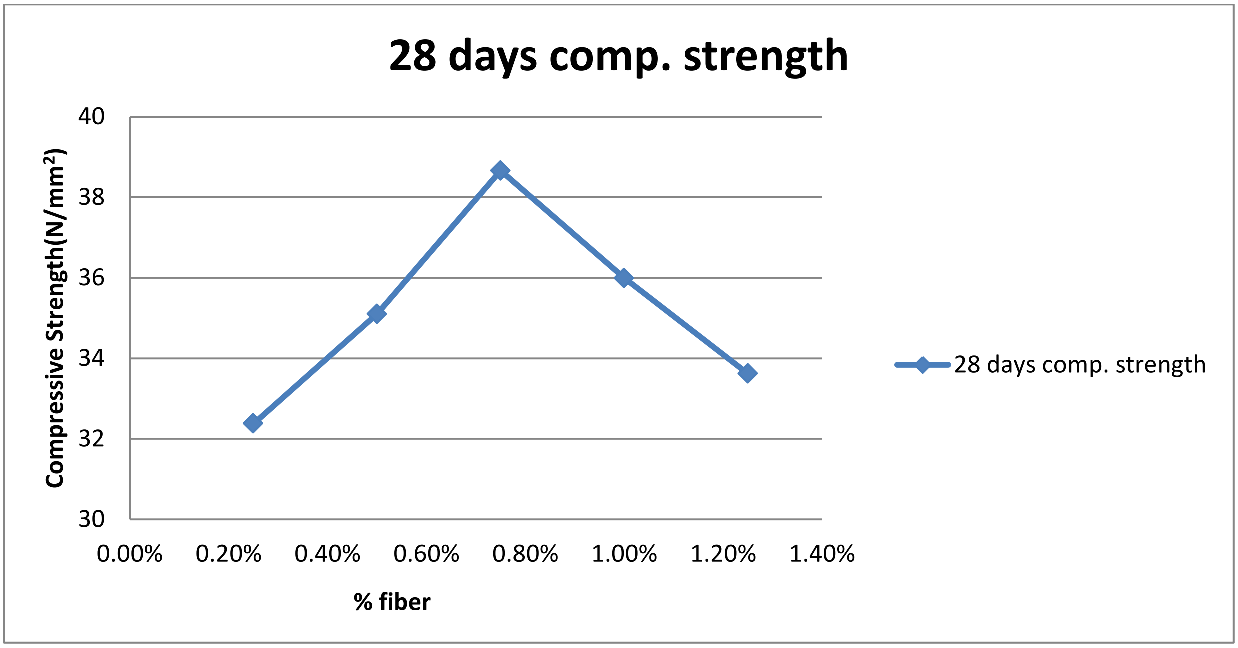

Fig 5.6 :Graphical representation of 28 days compressive strength of polypropylene fiber

Table 5.8 Split Tensile strength for steel fibers

S.No	% Steel fiber	Average load (KN)		Avg. Tensile Stength (N/mm^2)	
		7 Days	**28 Days**	**7 Days**	**28 Days**
1.	0.25	158	213	2.22	3
2.	0.50	178	237	2.51	3.44
3.	0.75	200	258	2.82	3.65
4.	1.00	220	280	3.10	3.93
5.	1.25	247	290	3.50	4.11

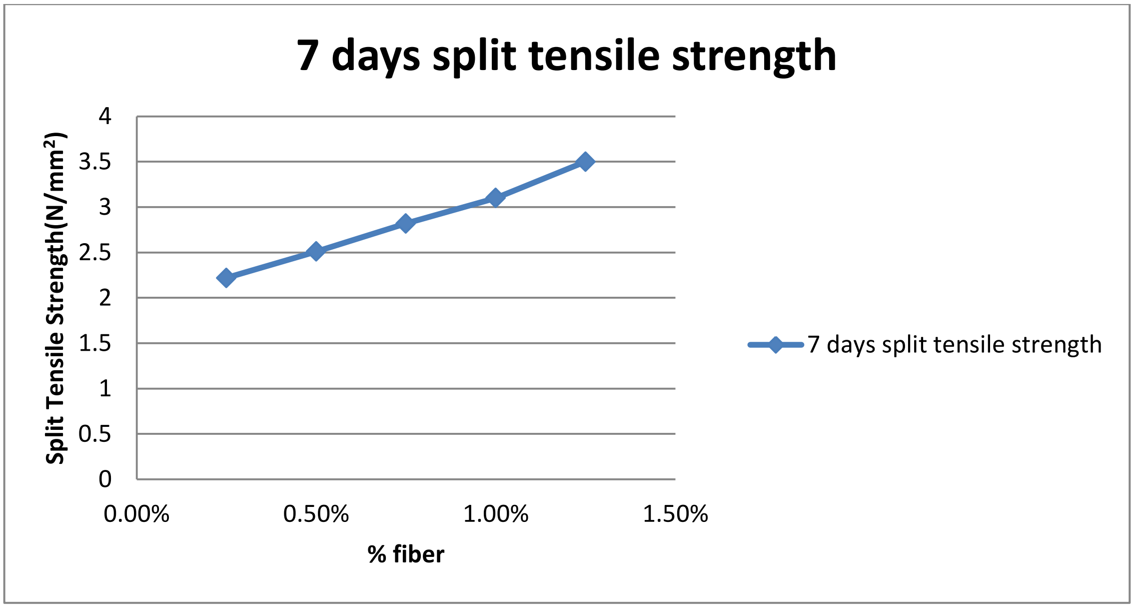

Fig 5.7 : Graphical representation of 7 days split tensile strength of steel fiber

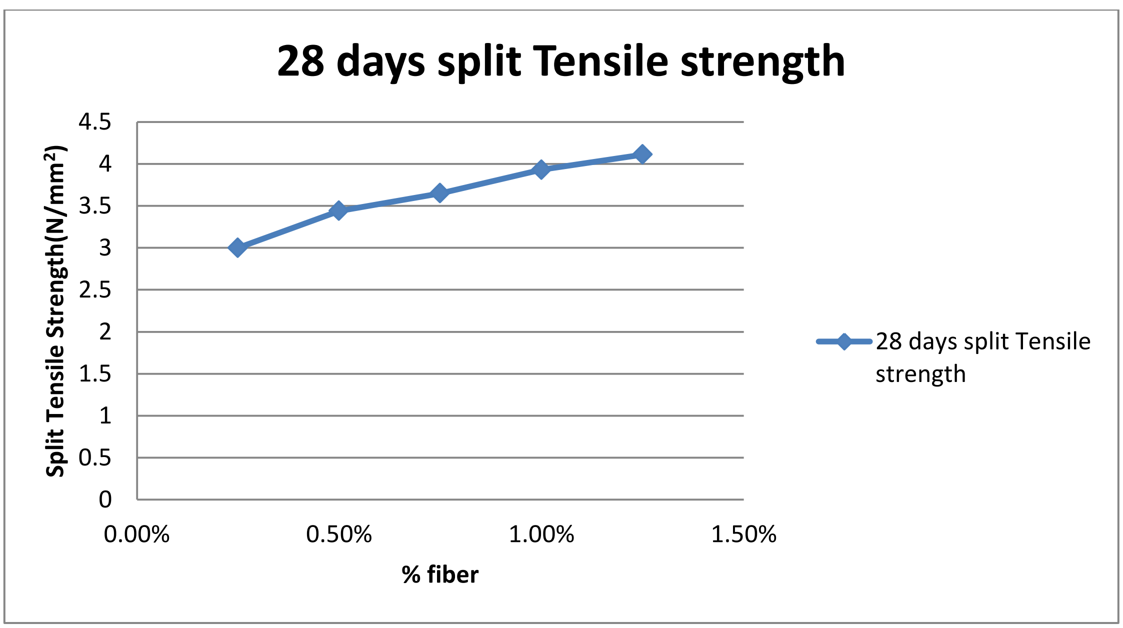

Fig 5.8 : Graphical representation of 28 days split tensile strength of steel fiber

Table 5.9: Split Tensile Strength for Recron Fiber

S.NO	% Recron fiber	Average Load (KN)		Avg. Tensile Strength(N/mm^2)	
		7 Days	**28 Days**	**7 Days**	**28 Days**
1.	0.25	156	210	2.21	2.94
2.	0.50	165	215	2.30	3.018
3.	0.75	170	220	2.34	3.1
4.	1.00	175	230	2.51	3.256
5.	1.25	170	225	2.45	3.15

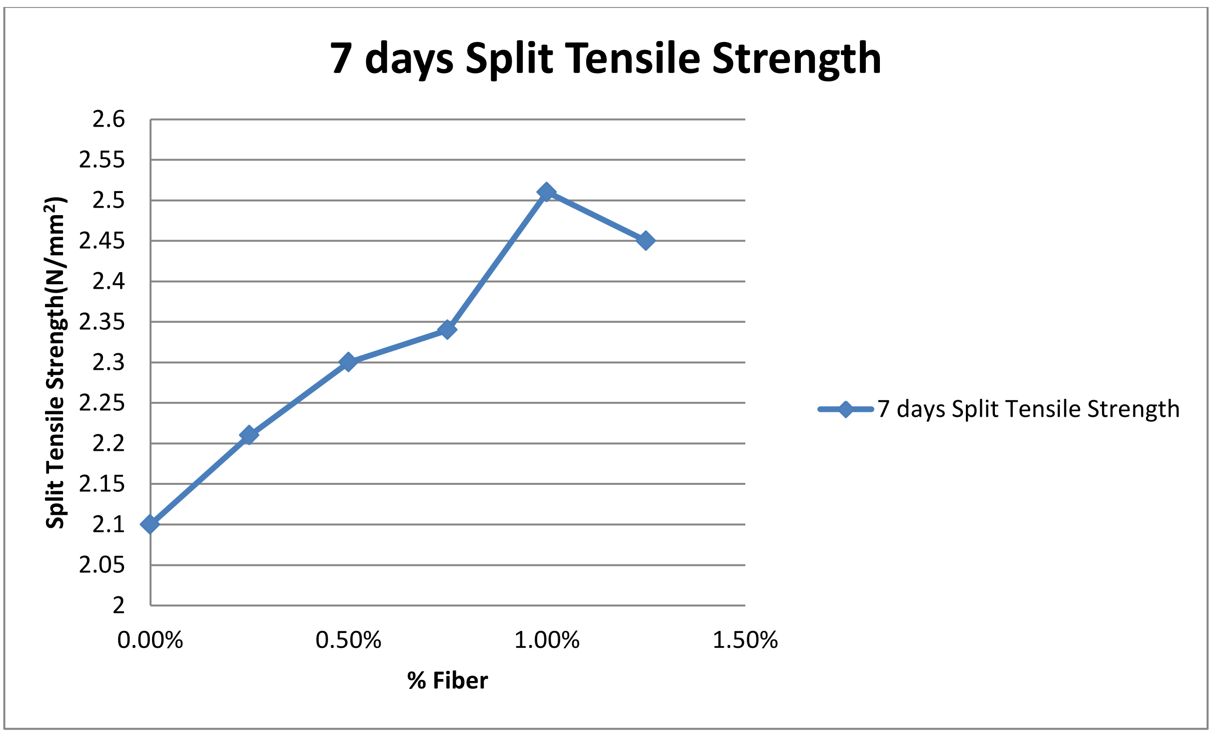

Fig 5.9 : Graphical representation 7 days spilit tensile strength of Recron fiber

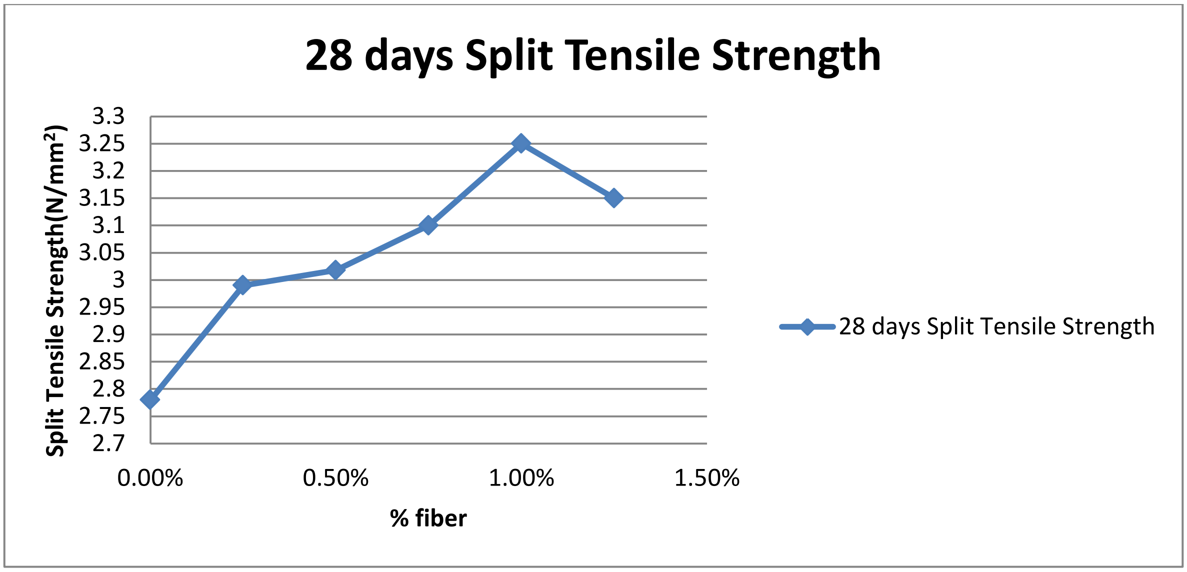

Fig 5.10:Graphical representation of 28 days split tensile strength of Recron fiber

Table 5.10: Split Tensile Strength for Polypropylene Fiber

S.NO:	% Polypropylene Fiber	Average Load (KN)		Avg. Tensile Strength(N/mm^2)	
		7 Days	**28 Days**	**7 Days**	**28 Days**
1.	0.25	151	210	2.146	2.97
2.	0.50	168	230	2.418	3.252
3.	0.75	200	260	2.87	3.677
4.	1.00	190	250	2.747	3.536
5.	1.25	170	230	2.419	3.252

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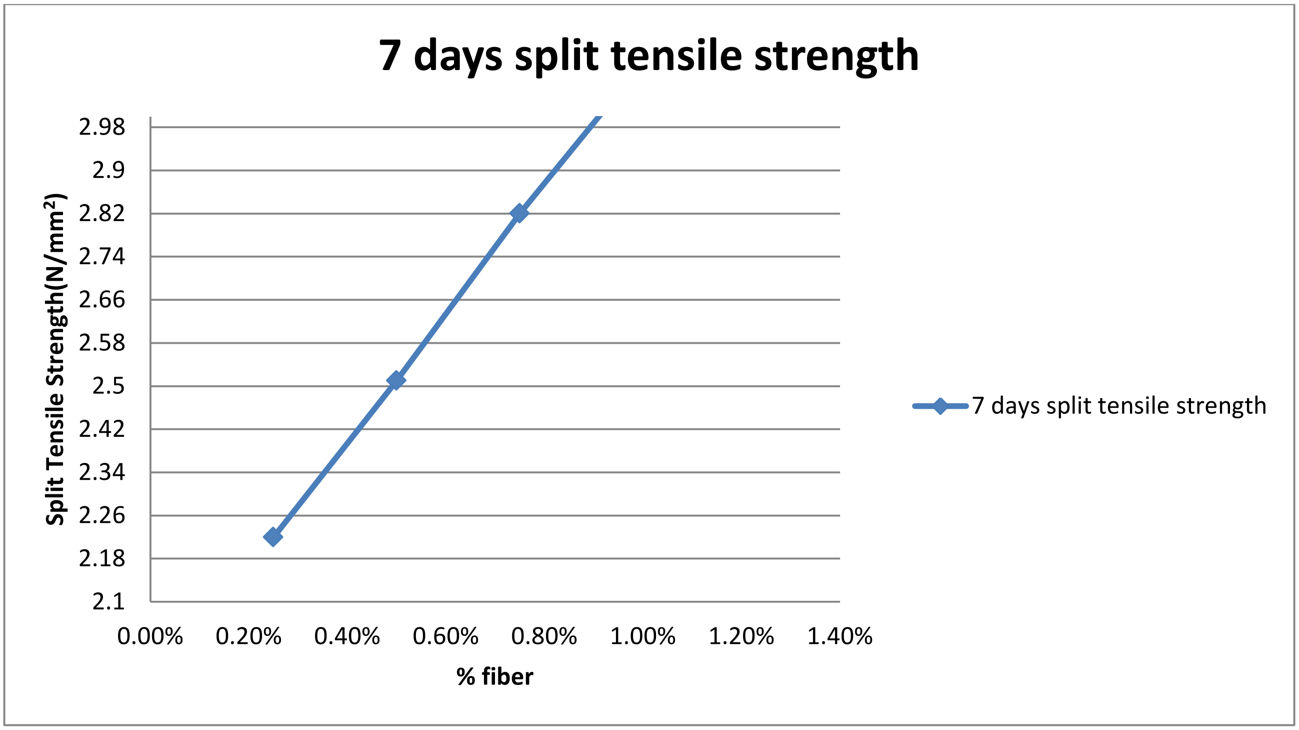

Fig 5.11:Graphical representation of 7 days split tensile strength of polypropylene fiber

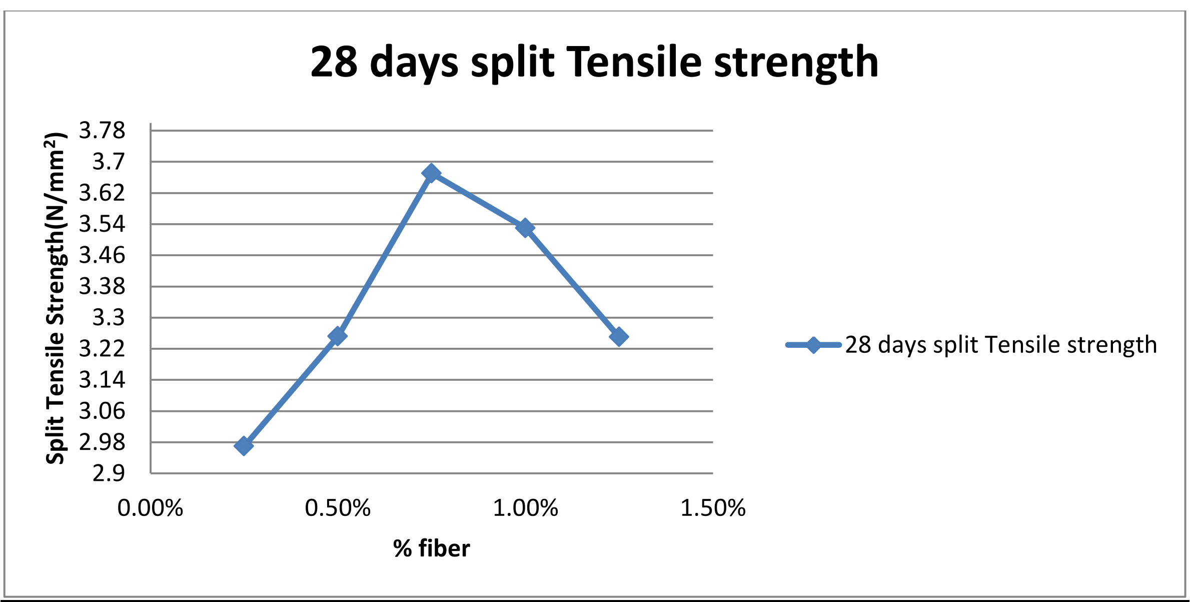

Fig 5.12 :Graphical representation of 28 days split tensile strength of polypropylene fiber

5.3 Comparison of results

5.3.1 Compressive strength

The experimental result shows that the 7 days compressive strength of steel fiber is greater than recron fiber and polypropylene fiber for all dosages of fiber.But, the 28 days compressive strength of polypropylene fiber is greater than steel fiber upto 0.75% dosage of fiber after that the compressive strength of steel fiber becomes more than polypropylene fiber on increasing the dosage of fiber.But, the compressive strength of steel fiber and polypropylene fiber was greater than recron fiber at all percentage of mix. And, in case of recron fiber the compressive strength increases till 0.25 % dosage then the compressive strength decreases till 0.5% of fiber added then the compressive strength FRC becomes lower than the compressive strength of PCC; also explains from the graph-9.

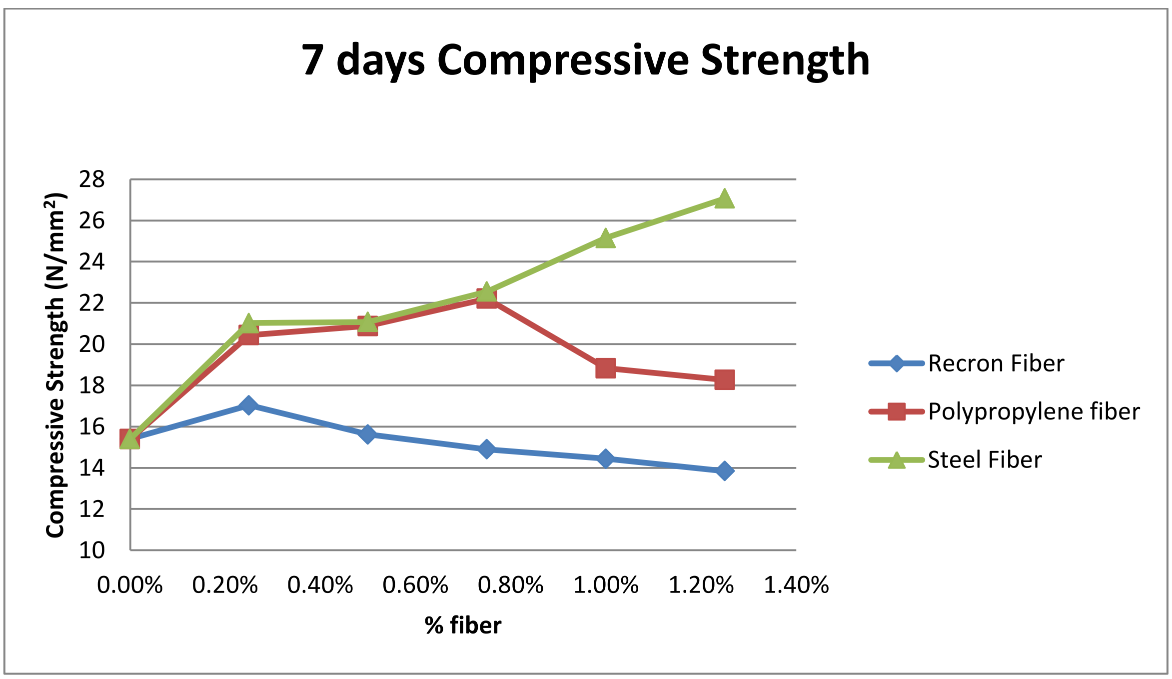

Fig 5.13 : Comparsion of 7 days compressive strength of different types of fibers

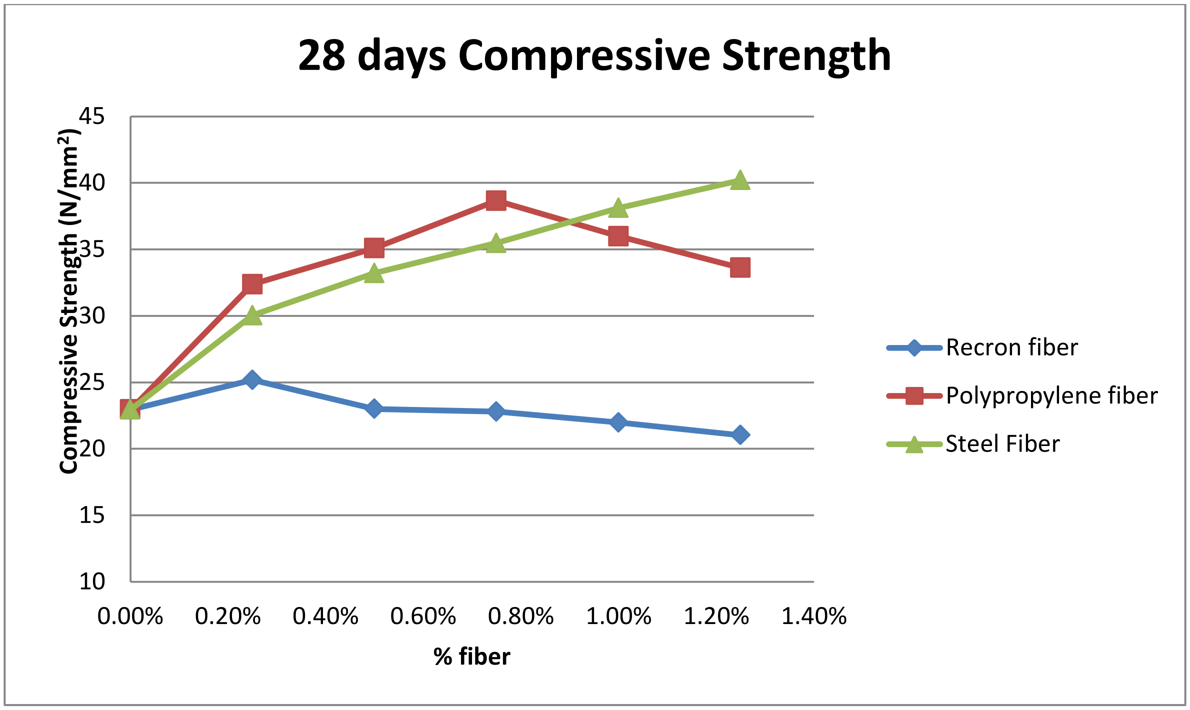

Fig 5.14: Comparison of 28 days compressive strength of different types of fibers

5.3.2 Split Tensile Strength

The experimental result shows that the 7 days and 28 days split tensile strength of polypropylene fiber, steel fiber and recron fiber.The 7 days and 28 days split tensile strength of steel fiber is greater than or nearly equal to split tensile strength of recron fiber and polypropylene fiber at all dosages of fiber. Upto 0.25 % dosage of fiber the split tensile strength of all the 3 fibers are neary equal.on furthur addition of fiber the split tensile strength of steel fiber is more than polypropylene fiber and recron fiber.At 0.75 % of fiber the split tensile strength of polypropylene fiber and steel fiber becomes equal after increasing dosage of fiber the tensile strength of steel fiber increases whereas the tensile strength of polypropylene fiber decreases and at 1.25% fiber dosage the tensile strength of polypropylene fiber becomes equal to recron fiber. As shown in graph-10.

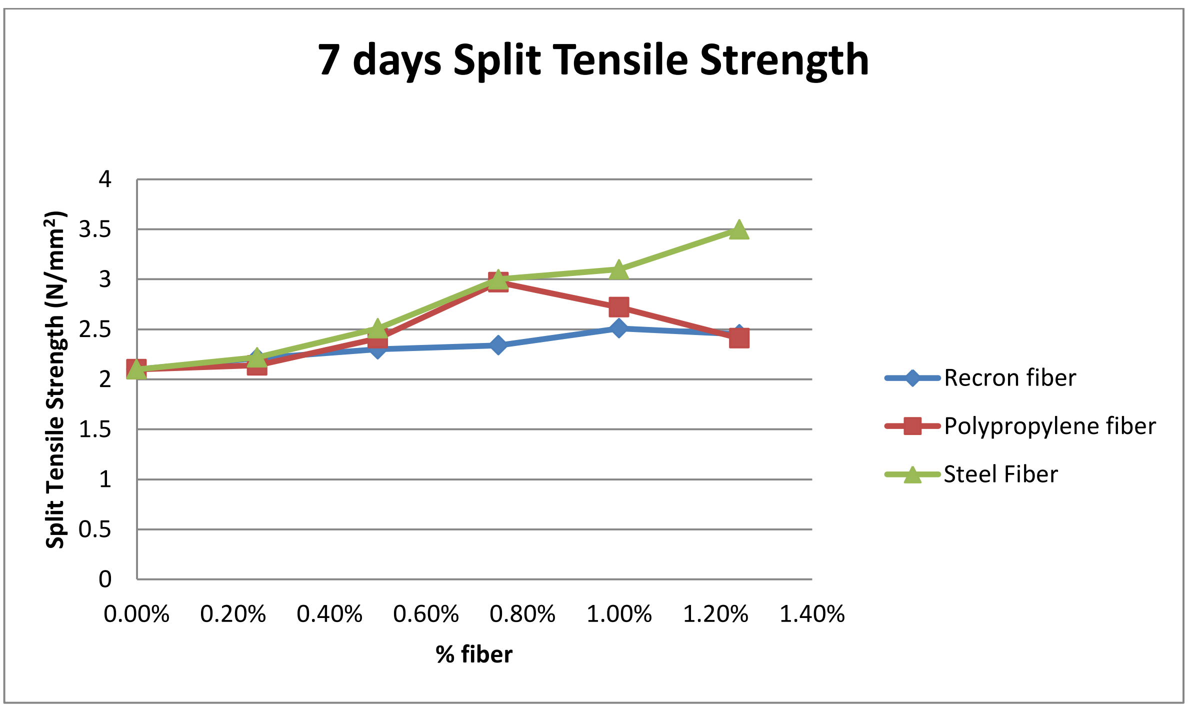

Fig 5.15 : Comparsion of 7 days split tensile strength of different types of fibers

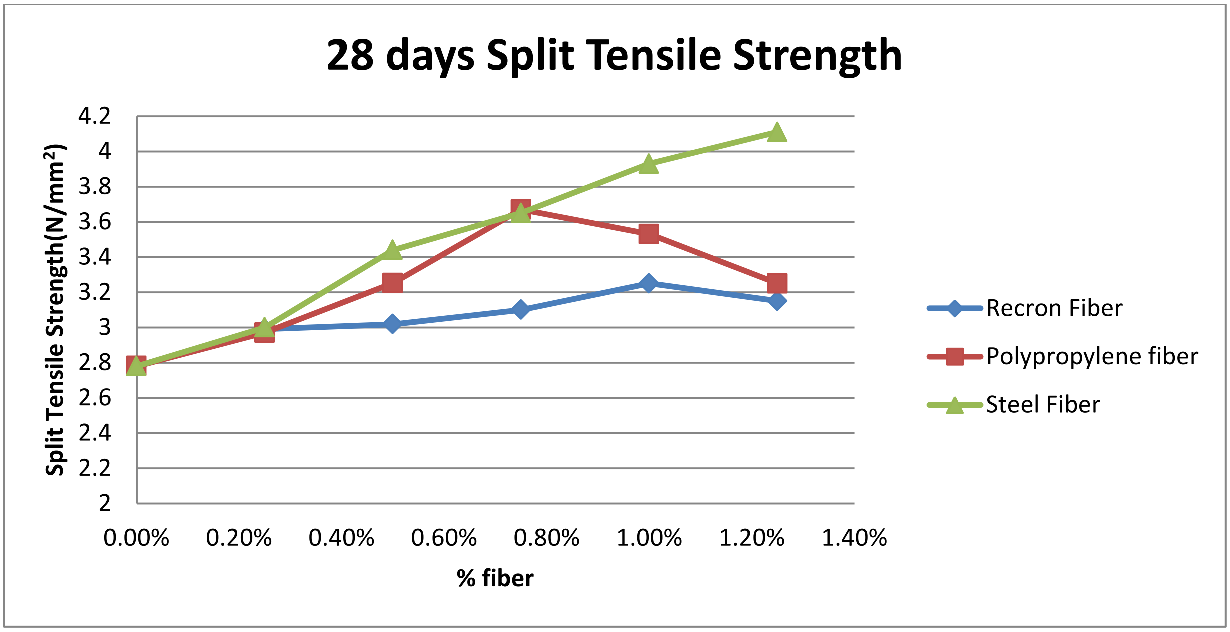

Fig 5.16 : Comparison of 28 days split tensile strength of different types of fibers

5.4 Conclusions

An experimental study was conducted on cubes and cylinders for compressive and split tensile strength by mixing various percentages of recron , polypropylene & steel fiber. Based on the investigation the following conclusions were drawn. They are;

- For low dosage of fiber i.e. less than 0.75 % the compressive strength of polypropylene fiber is 7.7% more than steel fiber and 40.4 % greater than compressive strength of recron fiber.
- At high dosage of fiber i.e. greater than 0.75 % the compressive strength of steel fiber becomes higher than compressive strength of recron as well as polypropylene fiber.
- Also, in case of recron fiber the compressive strength increases till 0.25 % dosage then the compressive strength decreases till 0.5% of fiber added then the compressive strength FRC becomes lower than the compressive strength of PCC but in case of polypropylene fiber compressive strength is always greater than PCC.
- The Split tensile strength of steel fiber was greater than or equal to polypropylene and recron fiber at all percentage of mix.

REFERENCES

1. Balaguru, P. , and Shah, S. P. (1992). " Fiber – reinforced cement composites , ACI 544.1 R – 96.

2. Banthia, N ., and Gupta, R. (2006). " Influence of polypropylene geometry on plastic shrinkage cracking in concrete. Cement and Research , 36 (7), 1263-1267.

3. Bentur, A., and Mindess, S. (2007). "Fiber reinforced cementitious composites" , Modern Concrete Technology Series, Second Edition.

4. Concrete Technology Theory and Practice by M.S. Shetty.

5. IS: 456. 2000. Indian Standard " Plain and Reinforced Concrete" –Code of Practice.Beureau of Indian Standards, New Delhi.

6. Vairagade, V.S. , & Kene, K.S., 2012, "Introduction to Steel Fiber Reinforced Concrete on Engineering Performance of Concrete", International Journal of Scientific & Technology Research, Vol. 1, (ISSN 2277-8616).

7. Akim choudappa yallappa, Marabathina maheswara rao and vinod nagpure. "Experimental Investigation of Recron 3s Fiber reinforced Concrete." International Journal of Emerging Trends in Engineering and Development. Vol. 6, Issue 5(Oct.-Nov. 2015).

8. IS : 516 . 1959 . Indian Standard " Methods of Tests for Strength of Concrete" – Code of Practice. Bureau of Indian Standards , New Delhi.

9. Kandasamy, R., And Murugesan, R., (2011)." Fiber Reinforced Concrete using Domestic Waste Plastics as Fibers", ARPN Journal of Engineering And Applied Sciences, Vol. 6, No. 3.

10. Kumar, R., Goel, P. and Mathur, R., (2011). " Suitability of Concrete Reinforced with Synthetic Fiber for the Construction of Pavements." Third International Conference on Sustainable Construction Material and Technologies, http://www.claisse.info/proceedings.htm.

11. Kumar, R ., Goel, P., and Mathur , R. (2012). "Conventional vis –a –vis fiber reinforced concrete for the construction of rigid pavements." Proceeding of the conference on Fiber reinforced concrete- global developments.FIBCON 2012, India. 112-124.

12. Laning, A., (1992), Synthetic Fibers " Primarily Used To Reduse Shrinkage Cracking , Polypropylene , Nylon, and Polyester Fibers Offer Other Benefits", Publication .

13. Lawler, J. S., Zampini, D., and Shah, S. p. (2002). " Permeability of cracked hybrid fiber reinforced concrete using image analysis and a modified weibull function." Mater and Struc 35(6),386-395.

14. Vairagade, V.S., & Kene, K.S., 2012, " Introduction of Steel Fiber Reinforced Concrete on Engineering Performance of Concrete", International Journal of Scientific & Technology Research, Vol. 1,(ISSN 2277-8616).

15. Joshi , Reddy, Kumar & Hatker,2016, "Experimental Work On Steel Fiber Reinforced Concrete" , International Journal of Scientific & Engineering Research, Vol. 7,(ISSN 2229-5518)

16. A.K. Jain, Verma & Kumar, 2016, "Effects of Steel Fiber and Glass Fiber on Mechanical Properties of Concrete" , IJSTE , Vol. 3 ,(ISSN: 2349-784X).

17. Utkarsh R.Nishane., 2017 , " Experimental Studies on Fiber Reinforced Concrete" , *Int. Journal of Engineering Research and Application ISSN : 2248-9262 , Vol.7 , Issue 5 ,(Part 2), pp. 40-44.*

18. Pathan & Swarup, 2017, " A Review on Steel Fiber Reinforced Concrete" , International Journal of Advance Research in Science and Engineering, Volume No. 06 , Special Issue No.(01).

19. Varis Ali , Dipak , Sohil, Hardik, Nagesh & P. Shailesh, (2010), "Properties of M20 Fiber Reinforced Concrete" , Vol-3 Issue-2 , IJARIIE- ISSN(O)-2395 – 4396.

20. Shende.A.M & A.M, " Experimental study and prediction of tensile strength for steel fiber reinforced concrete" , INTERNATRIONAL JOURNAL OF CIVIL AND STRUCTURAL ENGINEERING Volume 1 , ISSN 0976-4399.

Appendix-A

Results of 7 days cube compressive strength using recron fiber

Grade of concrete	% age fiber	Sample No.	Load (KN)	Compressive strength(N/mm^2)
M20	0%	1	340	15.33
		2	345	15.44
		3	345	15.44
	0.25%	1	375	16.67
		2	385	17.11
		3	390	17.33
	0.50%	1	350	15.55
		2	340	15.33
		3	360	16
	0.75%	1	320	14.77
		2	330	15.26
		3	320	14.77
	1.00%	1	320	14.77
		2	320	14.22
		3	335	14.88
	1.25%	1	305	13.77
		2	310	13.55
		3	320	14.22

Result of 28 days cube compressive strength using recron fibers

Grade of concrete	% age fiber	Sample No.	Load (KN)	Compressive strength(N/mm^2)
M20	0%	1	510	22.66
		2	515	22.88
		3	525	23.33
	0.25%	1	560	24.88
		2	565	25.11
		3	575	25.55
	0.5%	1	520	23.11
		2	515	22.88
		3	520	23.11
	0.75%	1	515	22.88
		2	495	22.00
		3	500	22.22
	1.00%	1	495	22.00
		2	500	22.22
		3	490	21.77
	1.25%	1	460	20.44
		2	475	21.11
		3	485	21.55

Appendix-B

Result of 7 days cube compressive strength using Polypropylene fiber

Grade of concrete	% age fiber	Sample No.	Load (KN)	Compressive strength(N/mm^2)
M20	0.25	1	460	20.44
		2	465	20.667
		3	455	20.22
	0.5	1	460	20.44
		2	475	21.11
		3	475	21.11
	0.75	1	485	21.55
		2	505	22.44
		3	510	22.66
	1.00	1	410	18.22
		2	435	19.33
		3	415	18.44
	1.25	1	405	18.00
		2	405	18.00
		3	425	18.89

Result of 28 days cube compressive strength using Polypropylene fiber

Grade of concrete	% age fiber	Sample No.	Load (KN)	Compressive strength(N/mm^2)
M20	0.25%	1	740	32.88
		2	745	33.11
		3	735	32.66
	0.50%	1	790	35.11
		2	775	34.44
		3	805	35.77
	0.75%	1	885	39.33
		2	865	38.44
		3	860	38.22
	1.00%	1	805	35.77
		2	800	35.55
		3	825	36.667
	1.25%	1	755	34.44
		2	750	33.33
		3	745	33.11

Appendix-C

Result of 7 days cube compressive strength using Steel fiber

Grade of concrete	% age fiber	Sample No.	Load (KN)	Compressive strength(N/mm^2)
M20	0.25%	1	455	20.20
		2	460	20.87
		3	495	22.00
	0.50%	1	495	20.77
		2	460	22.29
		3	500	20.20
	0.75%	1	510	22.77
		2	515	20.89
		3	540	24.00
	1.00%	1	585	25.98
		2	545	24.24
		3	570	25.23
	1.25%	1	615	27.33
		2	600	26.68
		3	610	27.20

Result of 28 days cube compressive strength using Steel fiber

Grade of concrete	% age fiber	Sample No.	Load (KN)	Compressive strength(N/mm^2)
M20	0.25%	1	655	29.00
		2	700	31.13
		3	675	30.00
	0.50%	1	730	33.00
		2	760	33.98
		3	730	32.69
	0.75%	1	790	35.11
		2	810	36.12
		3	800	35.20
	1.00%	1	880	37.98
		2	855	36.64
		3	825	39.33
	1.25%	1	885	39.33
		2	925	41.16
		3	895	40.14

Appendix-D

Results of 7 Days Cylinder Split tensile strength using recron fiber

Grade of concrete	% age fiber	Sample No.	Load (KN)	Split Tensile Strength(N/mm^2)
M20	0%	1	150	2.12
		2	150	2.12
		3	145	2.05
	0.25%	1	160	2.26
		2	155	2.19
		3	155	2.19
	0.50%	1	175	2.47
		2	155	2.19
		3	160	2.26
	0.75%	1	150	2.12
		2	175	2.74
		3	175	2.47
	1.00%	1	185	2.61
		2	175	2.47
		3	175	2.47
	1.25%	1	170	2.406
		2	170	2.406
		3	180	2.54

Results of 28 Days Cylinder Split tensile strength using recron fiber

Grade of concrete	% age fiber	Sample No.	Load (KN)	Split Tensile Strength(N/mm^2)
M20	0%	1	200	2.83
		2	180	2.54
		3	210	2.94
	0.25%	1	195	2.76
		2	225	3.18
		3	215	3.04
	0.50%	1	225	3.18
		2	215	3.04
		3	220	2.83
	0.75%	1	230	3.25
		2	215	3.04
		3	200	2.83
	1.00%	1	230	3.25
		2	230	3.25
		3	230	3.25
	1.25%	1	215	3.04
		2	225	3.04
		3	240	3.39

Appendix-E

Results of 7 Days Cylinder Split tensile strength using polypropylene fiber

Grade of concrete	% age fiber	Sample No.	Load (KN)	Split Tensile Strength(N/mm^2)
M20	0.25%	1	150	2.12
		2	150	2.12
		3	155	2.20
	0.50%	1	160	2.30
		2	160	2.30
		3	185	2.30
	0.75%	1	195	2.78
		2	195	2.78
		3	210	3.04
	1.00%	1	190	2.72
		2	185	2.65
		3	195	2.78
	1.25%	1	160	2.30
		2	160	2.30
		3	185	2.65

Results of 28 Days Cylinder Split tensile strength using polypropylene fiber

Grade of concrete	% age fiber	Sample No.	Load (KN)	Split Tensile Strength(N/mm^2)
M20	0.25%	1	210	2.97
		2	215	3.04
		3	205	2.90
	0.50%	1	220	3.11
		2	220	3.11
		3	250	3.53
	0.75%	1	255	3.60
		2	250	3.53
		3	275	3.89
	1.00%	1	255	3.60
		2	245	3.46
		3	250	3.53
	1.25%	1	220	3.11
		2	250	3.53
		3	220	3.11

Appendix-F

Results of 7 days Cylinder Split Tensile Strength using Steel fiber

Grade of Concrete	%age fiber	Sample No.	Load(KN)	Split Tensile Strength(N/mm^2)
M20	0.25%	1	160	2.25
		2	165	2.3
		3	150	2.11
	0.5%	1	180	2.55
		2	175	2.45
		3	180	2.54
	0.75%	1	195	2.76
		2	200	2.84
		3	205	2.88
	1.00%	1	230	3.24
		2	215	3.04
		3	215	3.04
	1.25%	1	235	3.34
		2	230	3.27
		3	275	3.89

Results of 28 days Cylinder Split Tensile Strength using Steel fiber

Grade of Concrete	%age fiber	Sample No.	Load (KN)	Split Tensile Strength(N/mm^2)
M20	0.25%	1	200	2.82
		2	215	3.04
		3	225	3.18
	0.5%	1	240	3.39
		2	235	3.32
		3	245	3.46
	0.75%	1	260	3.67
		2	270	3.81
		3	250	3.53
	1.00%	1	295	4.17
		2	280	3.96
		3	265	3.74
	1.25%	1	280	3.96
		2	280	3.96
		3	310	4.38