Study of the Properties of concrete reinforced with Basalt fiber

A

PROJECT REPORT

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

Of

BACHELOR OF TECHNOLOGY

IN

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Under the supervision

Of

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to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT, SOLAN – 173234

HIMACHAL PRADESH, INDIA

December 2018

STUDENT'S DECLARATION

I hereby declare that the work presented in the Project report entitled **"(Study of the properties of cement reinforced with basalt fiber)"**submitted for fulfillment of the requirements for the degree of Bachelor of Technology in Civil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of my work carried out under the supervision of **Mr. Abhilash Shukla**. This work has not been submitted elsewhere for the reward of any other degree. We are fully responsible for the contents of my project report.

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CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"Study of the properties of Cement Reinforced with Basalt Fiber"** in fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering submitted to the Department of Civil Engineering, **Jaypee University of Information Technology, Waknaghat** is an authentic recordof work carried out by **Ankaj Mohan Sandhu (141685) and Shubham Chaudhary (141657)** during a period from August, 2018 to Dec, 2018 under the supervision of **Mr. Abhilash Shukla** dept. of Civil Engineering JUIT (Jaypee University Of Information And Technology).The above statement made is correct to the best of our knowledge.

Date: …………………

Signature of Supervisor	Signature of HOD	Signature of External
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Department of civil	Department of civil engineering	
Engineering JUIT, Waknaghat	JUIT, Waknaghat	

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ABSTRACT

Basalt fiber has increased the popularity in reinforcing application of concrete due to its excellent mechanical properties and environmental friendly manufacturing process. Research work presented in this report was undertaken to understand better potential applications of three different sizes of basalt fiber construction. The mechanical performance was calculated by measuring the effect of fibers on the post and pre cracking behavior of concrete, and by investigating that how fiber concrete interfacial properties effects that behavior. The durability was estimated by calculating the effect of fibers on plastic shrinkage and their ability to stop cracking by shrinkage. Results suggest that by using the different sizes of basalt fibers, how it effects the compressive, split tensile and flexural strength of the concrete.

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CHAPTER 1

GENERAL INTRODUCTION

Concrete is the most widely construction material in the world. So it comes no surprise that there is many researches has been performed to improve its performance. Making it more stable, safer and more economical. In the last few decades one area of research is growing to the use of discrete fibers to produce a material called FRC (fiber reinforced concrete).However this idea of reinforcing materials with fibers was way back from ancient times when straw was used for reinforcing mud bricks. Addition of fibers makes concrete an isotropic and homogenous material.

1.1 INTRODUCTION OF FIBER REINFORCED CONCRETE

In general, the areas of improvement in fiber reinforced concrete over OPC include compressive strength, tensile strength, flexure strength, elastic modulus, crack control, durability, crack resistance, fatigue life, shrinkage, expansion, fire resistance etc. some commonly used types of fibers are shown below in table 1.1

	Basalt	**E-Glass**	**S2- Glass**	**Aramid**	**Carbon Fiber**
Tensile strength MPa	3000-4000	3100-3800	4020-4650	2900-3450	3500-4400
Elastic modulus GPa	93-110	72.5-75.5	83-86	70-179	230-800
Elongation at break %	3.1-6	4.7	5.3	2.4-3.6	0.5-1.5
Specific gravity	2.65	2.5	2.46	1.44	1.75
Max temp of application °C	-650	-380	-500	-250	-400
Melting temp °C	1450	1120	1550	NM	NM

Tab 1.1 commonly types of fiber and their properties

The mechanical and physical properties of fibers are not only the areas that should be considered when determining their potential use of fiber reinforced concrete. Effects such as chemical stability and increased difficulty of fresh concrete is also require careful consideration. Factors like workability of concrete also changes when we use different types of fibers.

1.1.1 BASIC MECHANISM OF FIBER REINFORCED CONCRETE

The addition of adding fiber has mainly two effects:-

- Transferring stress across cracks, will increase strength of composite. This behavior is shown by ascending stress strain curve monitoring by strain hardening or first-crack.
- By providing energy absorption mechanism it increases the toughness of the composite. It results of the gradual pull out of the fiber which is then reflected the descending part of the stress strain curve and strain softening.

The first crack depends upon the load bearing capacity of the fibers. After the cracking the outcomes are possible after the material used. For e.g. using fibers with better elastic modulus and high tensile strength than the concrete matrix will increase in the pre cracking strength. And the fiber matrix bond strength causes the post cracking.

A fiber that has a very poor bond with the matrix will pull out after the cracking. And thus gives no increase in toughness. This type of variation is illustrated in fig 1.2

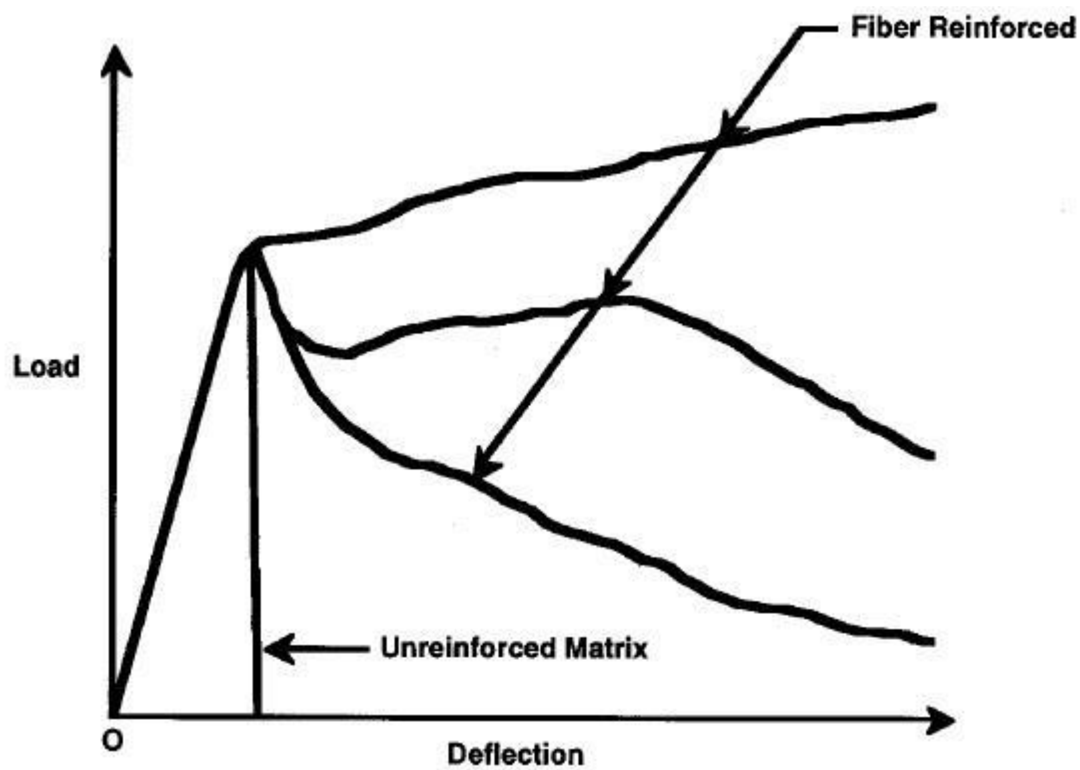


Fig 1.1 typical post cracking behavior of fiber reinforced concrete

The load bearing capacity of the fiber can be improved by increasing fiber's quantity. The use of different cement, material proportions, aggregates and production methods we can altered the behavior.

1.1.2 STEEL FIBER REINFORCED CONCRETE

The most important benefit of using steel fiber is to increase the toughness and reduce the cracking severity. The typical application of steel fiber reinforced concrete is to replace traditional steel rebar when it is not so essential for the integrity and safety of the structure. Steel fibers are also useful in secondary reinforcement as a flexural members.

Also steel fiber can decrease the cost of construction by reducing the required thickness of structure and reducing the labor required. Cost of steel fiber at a dosage of 1% of the volume can double the material cost of the concrete.

1.1.3 GLASS FIBER REINFORCED CONCRETE

Glass fibers are stronger and lighter than the steel fibers. Hence GFRC are used mainly to produce thin, light weight structures. Glass fibers can also be mixed with concrete at a higher dosage than steel fibers. So as a result first crack strength of glass fibers reinforced concrete is higher than of unreinforced matrix.

GFRC has a limited architectural applications due to its poor chemical stability of the fibers in concrete. The regular glass fiber will lose their tensile strength due to alkalinity. To overcome this, AR glass (alkalinity resistance) were develop by adding zirconia to the fibers.

1.1.4 NATURAL FIBER REINFORCED CONCRETE

In general, research shows that the use of natural fibers is very economical and environment friendly alternative to traditional rebar. A lot of research is inspired to take the advantage of low cost, abundant, available materials to improve construction in the developing world. Commonly used fibers are shown in fig 1.3

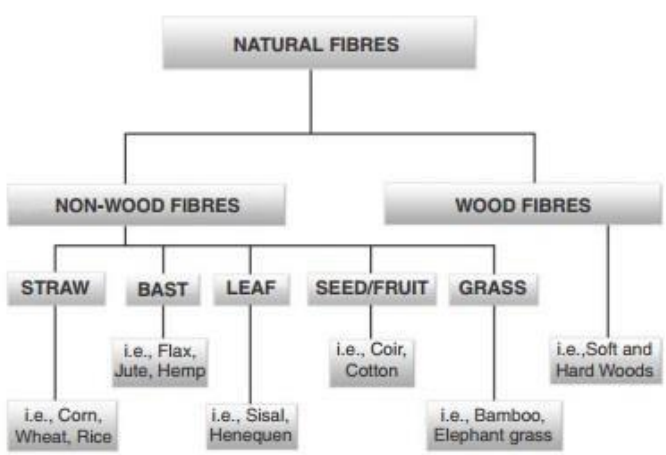
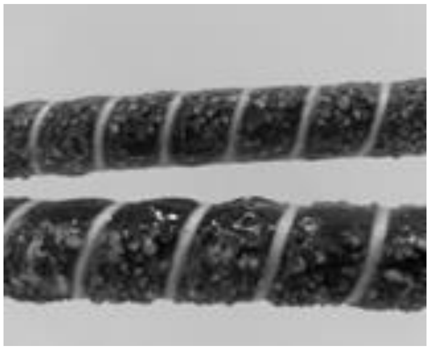


Fig 1.2 Classification of natural fibers

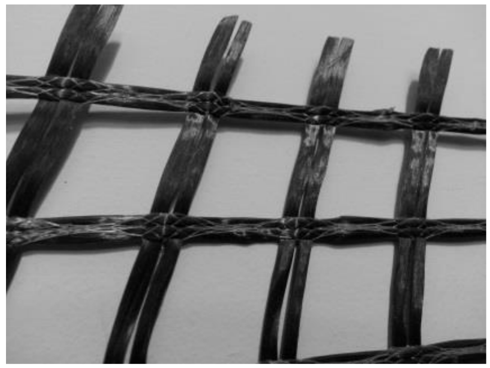
1.2 INTRODUCTION TO BASALT FIBERS

1.2.1 MANUFACURING PROCESS OF BASALT FIBER

Basalt is found by an igneous rock throughout the world. Basalt rock is then crushed, loaded into furnace and liquefied. Then the basalt filament is drawn by platinum rhodium bushing, as the filament cools they are coated with the sizing agent. It is composed by the minerals like plagioclase, pyroxene and olivine. Fig 1.4 shows the common basalt fiber products reinforced with concrete.



a) Rebar



b) Mesh

C) Chopped fibers

Fig 1.3 Basalt fiber products for concrete reinforcing

In general, the chemical composition and manufacturing process of basalt fiber is same as glass fiber. The comparison is shown below tab 1.2

Composition content	Basalt fiber (weight %)	Glass fiber (weight %)
Sic_2	56	54
Al_2O_3	17.4	15
Fe_2O_3	11.8	-
MgO	3.2	5
CaO	9.9	17
Na_2O+K_2O	1.7	0.6
Others	-	8

Tab 1.2 comparison of basalt and glass fibers

Currently glass fiber is used as a much greater extent in concrete reinforced concrete. so the further comparison will use glass finer as a base of comparison for basalt fiber.

1.2.2 BENEFICIAL ASPECTS OF BASALT FIBERS

Basalt fiber can be manufactured by the simple raw material basalt rock, making it more simpler process than glass fiber. As the result fibers can be manufactured by conventional process and equipment and less energy which is an economical advantage. As well as fibers are considered 100% natural and have no toxic reaction with water or air and fiberization process is more environmental friendly than glass fibers. In terms of physical and mechanical properties of basalt fiber, it gathers attention due to its high strength, high elastic modulus, high temperature resistance, corrosion resistance, and light weight. Some mechanical and physical properties of basalt and glass fiber is below table 1.1

TABLE 1.3 comparisons of basalt and glass fibers

Fiber	**Density (g/ cm3)**	**Elastic modulus (GPa)**	**Tensile strength (GPa)**	**Elongation at break (%)**
Basalt	2.8	89	2.8	3.15
Glass	2.56	76	1.4-2.5	1.8-3.2

1.2.3 PROBELEMS TO OVERCOME

The key concern of basalt fiber is its chemical stability. Its alkaline resistance is good but it may be better than of glass fibers. Basalt manufacturer states that fiber is very durable on the basis of weight loss of 0.35% after immersion in a solution of cement in comparison to glass fiber that lost 0.45% of weight. After 90 days the tensile strength of basalt fibers reduces with time.

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE REVIEW

1. The performance of basalt fiber in high strength concrete by Mr. Gore Ketan, Suhasini M. Kulkarni (2011)

Initially adding fiber in high strength concrete, the strength is decreasing on 7 days to 14 days but strength of basalt fiber will gain more after 28 days. Basalt fiber can replace the steel bars. 1 kg of basalt fiber is equal to 9.6 kg of steel. These fibers have non toxic reaction with the air and water, explosion proof and are non combustible. Due to its low melting temperature, the energy consumption is also low.

2. Thermal and mechanical properties of basalt fiber reinforced concrete by Tumadhir M, Borhan (2012)

A slight increase in the splitting tensile strength with increase fraction volume of fiber till 0.3% and then decrease with 0.5% basalt fiber.Adding basalt fiber to concrete decreases the amount of heat conducted through the thickness. The basalt fibers are compatible with the phenolic resins. Basalt fibers are highly stable in the strong alkalis. These fibers also have a good resistance to UV rays and fungal contamination.

3. Basalt fiber reinforced concrete by NayanRathore, MukundGonbare, Malikarjun Pujari (2013)

The benefits of using fibers is that it is non corrosive. The strength is good. The heat resistance power is also very good which is extremely important for buildings. The rupture stress to density ratio of basalt fiber is more than that of the steel. Basalt fibers have a high stability in strong alkali environment. Basalt fibers gives good moisture resistance due to non-capillary and non-hygroscopic properties.

4. Strength aspects of basalt fibers reinforced concrete by FathimaIrine I (2014)

Workability property of concrete decreases with the addition of basalt fibers. The flexural strength of basalt fiber reinforced concrete is found having a maximum increase of 53% at 4kg/cubic meter of fiber cement. It is also found that there are more cracks in concrete without fibers and less cracking take place in case of concrete having basalt fibers. The fibers present in the concrete acts as crack arrestors.

5. Use of basalt fibers for concrete structures by Cory High, Hatem M. Seliem, Sami H. Rizkalla (2015)

Using basalt fiber slightly increased the 28 day compressive strength. Also it increases the modulus of rupture of concrete. Basalt fibers also enhances the flexural strength and split tensile strength of concrete when used in different proportions and also using the fibers of different length which increases the toughness and impact resistance of the concrete.

6. Durability studies on basalt fiber reinforced concrete by S. K. Khritika, S. K. Sinha and M surya (2015)

The studies on basalt fiber in concrete have showed that it has higher thermal and chemical stability. Permeability and depth of carbonation of chloride ion of Basalt fiber RC were found to be 70 and 51% as compare to control concrete. When basalt fiber is immersed in sodium hydro-oxide (NaOH), a brittle layer is formed around the fibers. The experimental investigation on the basalt fiber showed that, it is a potential building material having higher chemical stability and thermal stability.

7. Effect of basalt fiber on length and proportions on mechanical properties of concrete by Sami Elshafie, Gareth Whittleston (2016)

As the proportion of basalt fiber increases workability decreases. To achieve the higher tensile strength the long range basalt fiber used in mixture. To achieve higher level of permeability and less porosity fibers of different length should be used. When the basalt fiber content is 0.25%, maximum compressive strength is achieved. By using the fiber length between 10mm and 20mm, maximum compressive strength is achieved.

8. Effect of basalt fiber on strength of cement concrete by Suchite Hirde and Sagar Shelar (2018)

The maximum Percentage increases in strength of compression is 7.31 % and 3% basalt fiber content. For 4% basalt fiber content split tensile strength is increased by 33.7%.Flexural strength is increased by addition of basalt fiber. The increase in compressive strength, flexural and split tensile strength increases the stability of the structure and provides good mechanical properties.

CHAPTER 3

OBJECTIVES

OBJECTIVES

1. To study the compressive strength, split tensile strength and flexural strength of fiber reinforced concrete.
2. To study the effect on strength parameters of different length of fibers.

CHAPTER 4

METHODOLOGY

4.1 TESTS ON COARSE AGGREGATES

1. IMPACT VALUE TEST

2. CRUSHING VALUE TEST

3. LOS ANGLES ABRASION TEST

4. WATER ABSORPTION TEST

5. SPECIFIC GRAVITY TEST

1. Impact value Test:-

The property of a material to resist the impact is known as toughness. The aggregate impact value is a measure of resistance to sudden impact, which may be differ from its resistance to gradually applied compressiveload. Fig 4.1 is below showing impact machine

2. Aggregate crushing value test:-

The aggregate crushing value gives a relative measure of resistance to crush under a gradually applied compressive load.

Fig 4.2 universal testing machine (UTM)

3. Los Angeles Abrasion Test:-

It is measure of aggregate toughness and abrasion resistance like crushing, degradation and disintegration.

4. Specific Gravity Test:-

It is the ratio of density of a substance to the density of a reference substances.

5. Water Absorption Test:-

The increase in wt of dry specimen when immersed in a depth of water is generally referred as a water absorption test.

4.2 TESTS ON FINE AGGREGATES

1. Bulking of sand

2. Water Absorption

3. Specific Gravity

1. Bulking ofSand: - Volume of dry sand increases due to having absorption of moisture. This increased volume of sand is known as bulking of sand.

When dry sand comes in contact with liquid, a thin layer is formed around the particles, which causes them to get apart from each other.

2. Water Absorption: -The increase in wt of dry specimen when immersed in a depth of water is generally referred as a water absorption test.

3. Specific Gravity: -It is the ratio of density of a substance to the density of a reference substances.

4.3 TESTS ON CEMENTS

1. CONSISTENCY TEST

2. IST TEST AND FST TEST

3. SOUNDNESS TEST

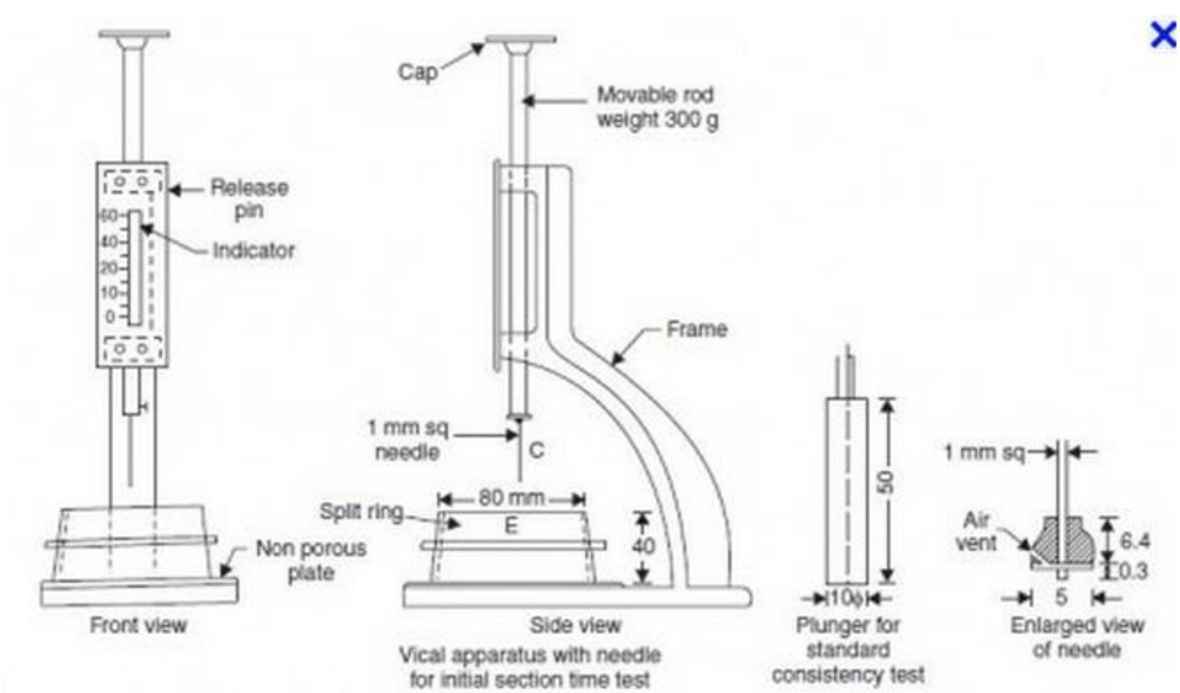
4. SPECIFIC GRAVITY TEST

5. FINENESS TEST

6. COMPRESSIVE STRENGTH

7. TENSILE STRENGTH

1. CONSISTENCY TEST:-It is defined as the consistency which will allow a vicat plunger having diameter of 10 mm and 50 mm length to penetrate at depth of 33 to 35 mm from the top of the mold.



Vicat apparatus

Fig 4.3 vica**t's**apparatus

2. IST AND FST TEST: - The time at which cement paste lose its plasticity is known as initial setting time. And the time at which the cement paste becomes hard is known as final

setting time.

3. SOUNDNESS TEST: - Th**e** ability of cement to retain its volume after it gets hardened is commonly known as soundness of cement. The test is conducted to find the extra amount of lime in cement is called soundness test of cement. This test is done by Le-chatelier apparatus.

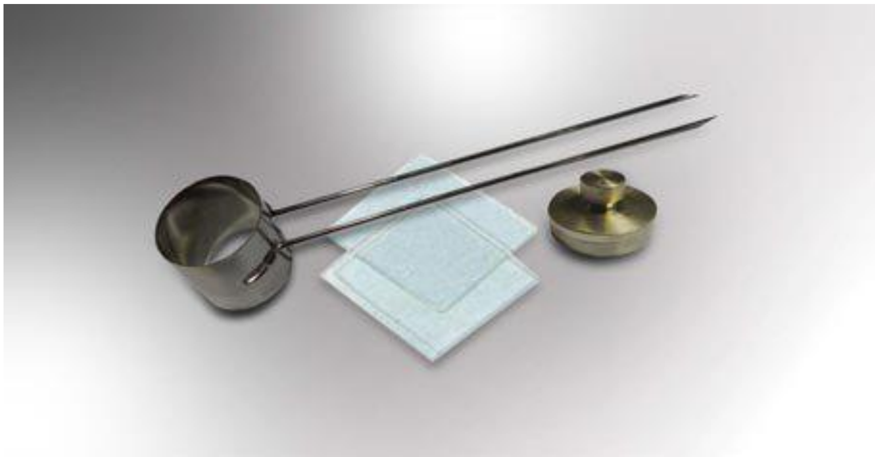


Fig 4.4 Le Chatelier's apparatus

4. SPECIFIC GRAVITY TEST OF CEMENT:-

The specific gravity is defined as ratio b/w the weight of given volume of material and weight of equal volume of water.

5. FINENESS TEST OF CEMENT:-

The fineness is measured by the standard sieve by sieving the cement. The proportion of cement at which the grain size are larger than the 90 micron sieve are determined. The higher the specific surface, the finer the cement is.

6. COMPRESSIVE STRENGTH OF CEMENT:-

It is determined by compressive strength test on cubes of mortar compacted by standard vibration machine. The cubes are in the form of 15cm×15cm×15cm.

7. TENSILE STRENGTH OF CEMENT:-

Tensile strength of cement is the indirect indication of the compressive strength of cement. Generally it is assumed in between 1/8 to 1/10 of compressive strength of cement.

4.4 MIX DESIGN OF CONCRETE (M40)

The mix proportioning of one cubic per meter for concrete of M40 is given in IS Code 10262 is below table 4.1

MATERIAL	QUANTITY (Kg/cubic meter)
Cement	350
Coarse aggregate	1140
Fine aggregate	896
Water	140
Water/cement ratio	0.45
Basalt fiber	0

Tab 4.1 mix proportioning of concrete for one cubic per meter

Coarse aggregates are used that are passed from 20 mm sieve and retained from 10 mm sieve.

CHAPTER 5

EXPERIMENTAL INVESTIGATION

5.1 Experimental Program

- **Cement**
- **Coarse aggregates**
- **Fine aggregates**
- **Water**
- **Basalt fiber (6mm, 9mm, 12mm)**

In order to study the interaction of basalt fibers with concrete under compression, split tensile and flexural strength, 20 cubes, 20 cylinder, and 20 beams was casted respectively.

The program was divided into 4 sections and apart from first section each section consists of 3 groups.

- **The first section is casting plain concrete (PCC) with 0% fiber.(F_0)**
- **The second section is casting of concrete with 6mm basalt fiber**

1. It consists of basalt fiber having volume fraction 0.1% of total volume. (F_1)

2. It consists of basalt fiber having volume fraction of 0.2% of total volume. (F_2)

3. It consists of basalt fiber having volume fraction of 0.3% of total volume. (F_3)

- **The third section is casting of concrete with 9mm basalt fiber**

1. It consists of basalt fiber having volume fraction 0.1% of total volume. (F_4)

2. It consists of basalt fiber having volume fraction of 0.2% of total volume. (F_5)

3. It consists of basalt fiber having volume fraction of 0.3% of total volume. (F_6)

- **The fourth section is casting of concrete with 12mm basalt fiber**
  1. It consists of basalt fiber having volume fraction 0.1% of total volume. (F_7)
  2. It consists of basalt fiber having volume fraction of 0.2% of total volume. (F_8)
  3. It consists of basalt fiber having volume fraction of 0.3% of total volume. (F_9)

5.2 EXPERIMENTAL SETUP

5.2.1 Cube compression test

The tests was done as per IS 516-1959. The cubes of standard size of 150×150×150mm were used to find compressive strength. Cubes were placed on the surface of UTM, and apply a uniform rate of loading till the failure of cube. The maximum load was noted and compre

5.2.2 Split tensile strength test

This test was done as per IS 5816-1970. The cylinder of standard size of 150mm dia and 300 mm height was placed on the UTM with the horizontal diameter. At the bottom and at the top two strips of wood were placed to avoid concrete crushing at the points where bearing surface of CTM and cylinder specimen meets. The maximum load was noted down.

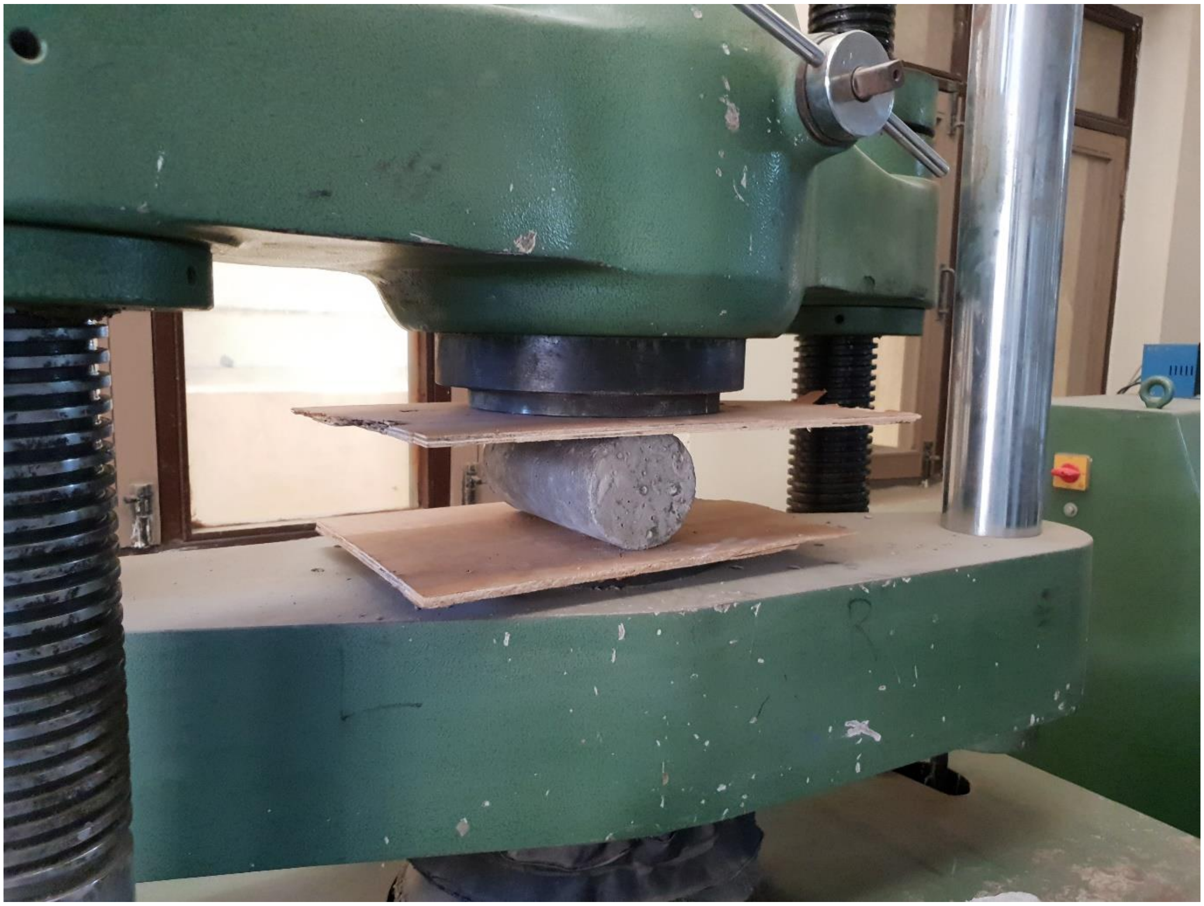


Fig 5.2 testing of concrete cylinder in UTM

5.2.3 Flexural test

This test was performed by the procedure given in ASTM C-78, beam of size 100×100×500mm were casted. Center loading was performed on this test in UTM.

Fig 5.3 testing of beam under UTM (flexure)

5.3 MATERIAL USED IN EXPERIMENT

5.3.1 CEMENT

Ordinary Portland cement (OPC) was used and its specific gravity is 3.14

The brand was used “ULTRATECH” with P43 grade.

5.3.2 FINE AGGREGATES

River sand was used. Specific gravity of fine aggregate was 2.59

Water absorption was 1.5%

5.3.3 COARSE AGGREGATES

Crushed stone aggregates of maximum size 20mm were used.

Specific gravity of coarse aggregate was 2.73

Water absorption was 0.25%

5.3.4 WATER

As per IS 456-2000 recommendation, potable water was used for concrete mix.

5.3.5 BASALT FIBER

Basalt fiber of different lengths are used (6mm, 9mm, 12mm)

pH of basalt fiber is not applicable.

Density of basalt fiber is 2.6g/cc

CHAPTER 6 (RESULTS)

6.1 COMPRESSIVE STRENGTH OF CONCRETE REINFORCED WITH BASALT FIBER (6MM)

% by total volume	Load (KN)	7 days (MPa)	Load (KN)	15 days (MPa)
0.1%	**244**	**10.48**	**407.4**	**18.106**
0.2%	**259.1**	**11.51**	**393.9**	**17.50**
0.3%	**308.9**	**13.72**	**455.9**	**20.26**

SPLIT TENSILE STRENGTH OF CONCRETE REINFORCED WITH BASALT FIBER (6MM)

% by total volume	Load (KN)	7 days strength (MPa)	Load (KN)	15 days strength (KN)
0.1%	**88.1**	**4.48**	**85.1**	**4.26**
0.2%	**92.3**	**4.52**	**117.5**	**5.89**
0.3%	**80.7**	**4.01**	**122.9**	**6.02**

FLEXURAL STRENGTH OF CONCRETE REINFORCED WITH BASALT FIBER (6MM)

% by total volume	**Load (KN)**	**7 days (MPa)**	**Load (KN)**	**15 days(MPa)**
0.1%	**1.9**	**0.247**	**12.8**	**1.65**
0.2%	**16.7**	**2.14**	**16**	**2.08**
0.3%	**17.7**	**2.301**	**16.8**	**2.184**

6.2 DIFFERENT STRENGTHS OF CONCRETE REINFORCED WITH BASALT FIBER (9MM)

COMPRESSIVE STRENGTH

% by total volume	**Load (KN)**	**7 days strength (MPa)**	**Load (KN)**	**15 days (MPa)**
0.1%	**280.9**	**12.48**	**437.3**	**19.43**

0.2%	**357.3**	**15.88**	**485.7**	**21.58**
0.3%	**360.4**	**16.01**	**470.4**	**20.9**

SPLIT TENSILE STRENGTH

% by total volume	**Load (KN)**	**7 days strength (MPa)**	**Load (KN)**	**15 days strength (MPa)**
0.1%	**68.5**	**3.35**	**122.9**	**6.02**
0.2%	**87.6**	**4.39**	**74.3**	**3.64**
0.3%	**89.4**	**4.38**	**92.4**	**4.52**

FLEXURAL STRENGTH

% by total volume	**Load (KN)**	**7 days (MPa)**	**Load (KN)**	**15 days (MPa)**
0.1%	**14.4**	**1.87**	**17**	**2.21**
0.2%	**16.2**	**2.106**	**19.5**	**2.535**

0.3%	**17.7**	**2.301**	**22.6**	**2.938**

5.3 DIFFERENT STRENGTHS OF CONCRETE REINFORCED WITH BASALT FIBER (12MM)

COMPRESSIVE STRENGTH

% by total volume	**Load (KN)**	**7 days strength (MPa)**	**Load (KN)**	**15 days strength (MPa)**
0.1%	**438.1**	**19.47**	**490.6**	**21.8**
0.2%	**374.1**	**16.62**	**440.8**	**19.59**
0.3%	**407.4**	**18.10**	**464.5**	**20.6**

SPLIT TENSILE STRENGTH

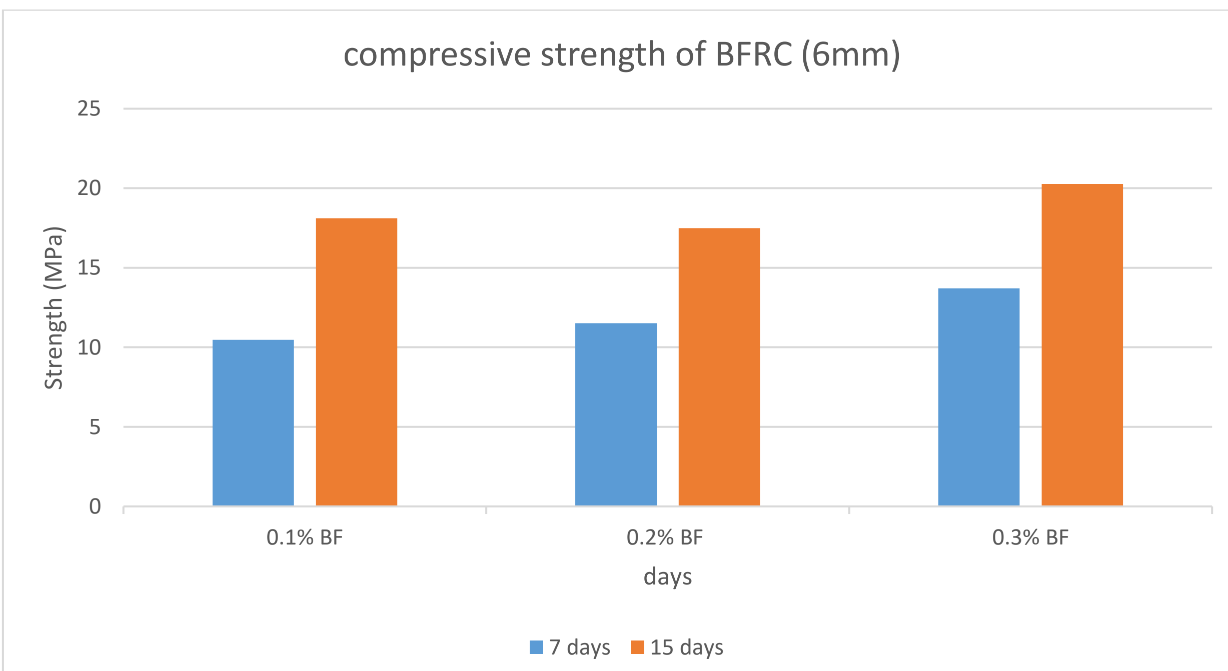
% by total volume	Load (KN)	7 days (MPa)	Load (KN)	15 days(MPa)
0.1%	**107.5**	**5.34**	**123.4**	**6.09**
0.2%	**99.3**	**4.86**	**117.6**	**5.85**
0.3%	**102.4**	**5.01**	**119**	**5.87**

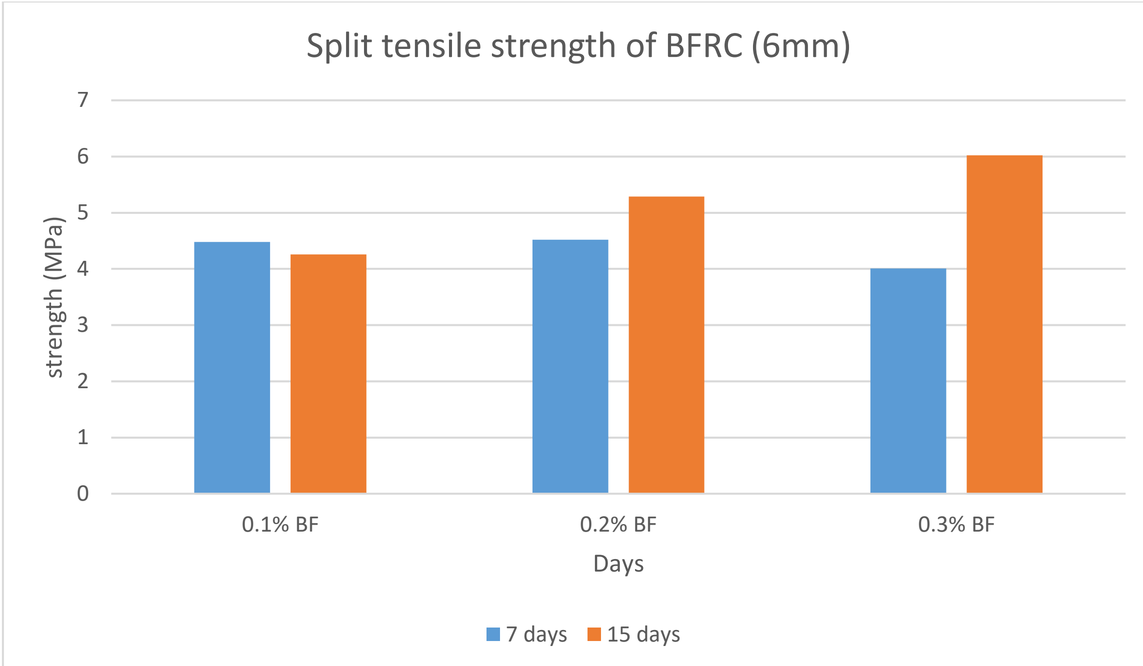
FLEXURAL STRENGTH

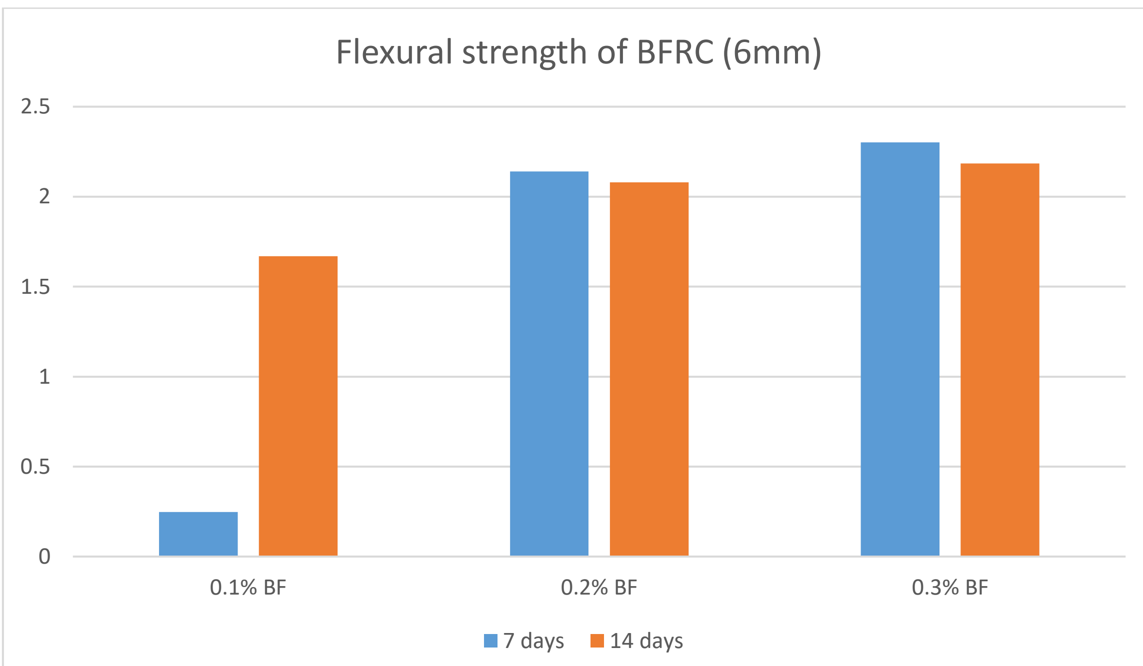
% by total volume	Load (KN)	7 days (MPa)	Load (KN)	15 days (MPa)
0.1%	**11**	**1.143**	**17.4**	**2.262**
0.2%	**12**	**1.56**	**16.2**	**2.16**
0.3%	**14.3**	**1.859**	**16.5**	**2.2**

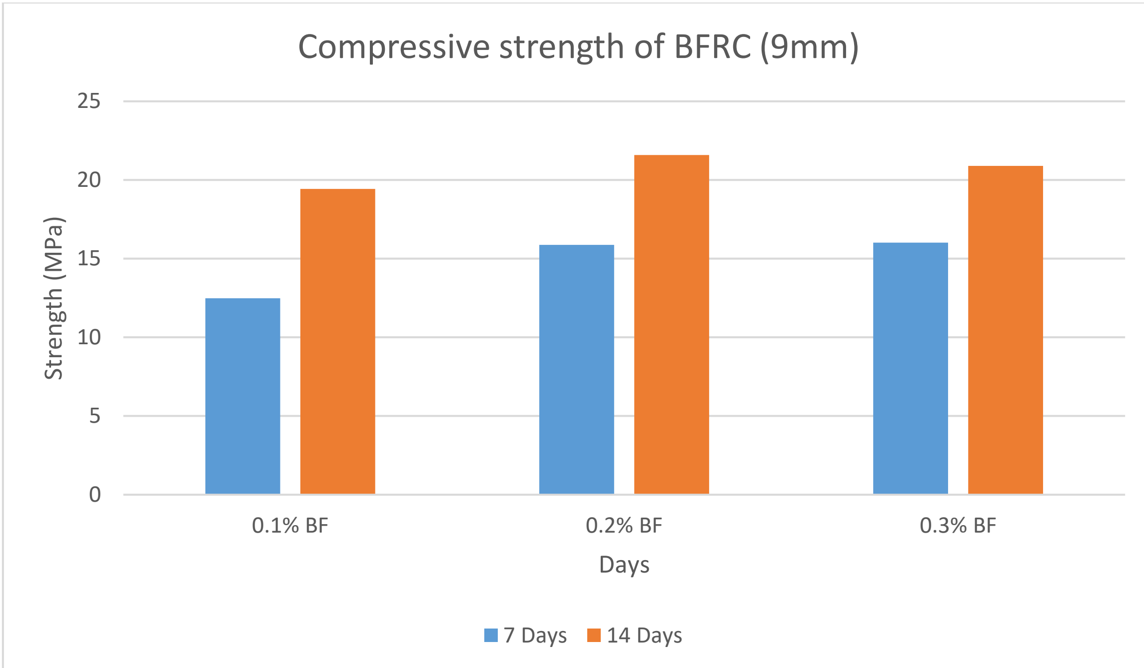
5.4 DIFFERENT STRENGTH OF PLAIN CONCRETE

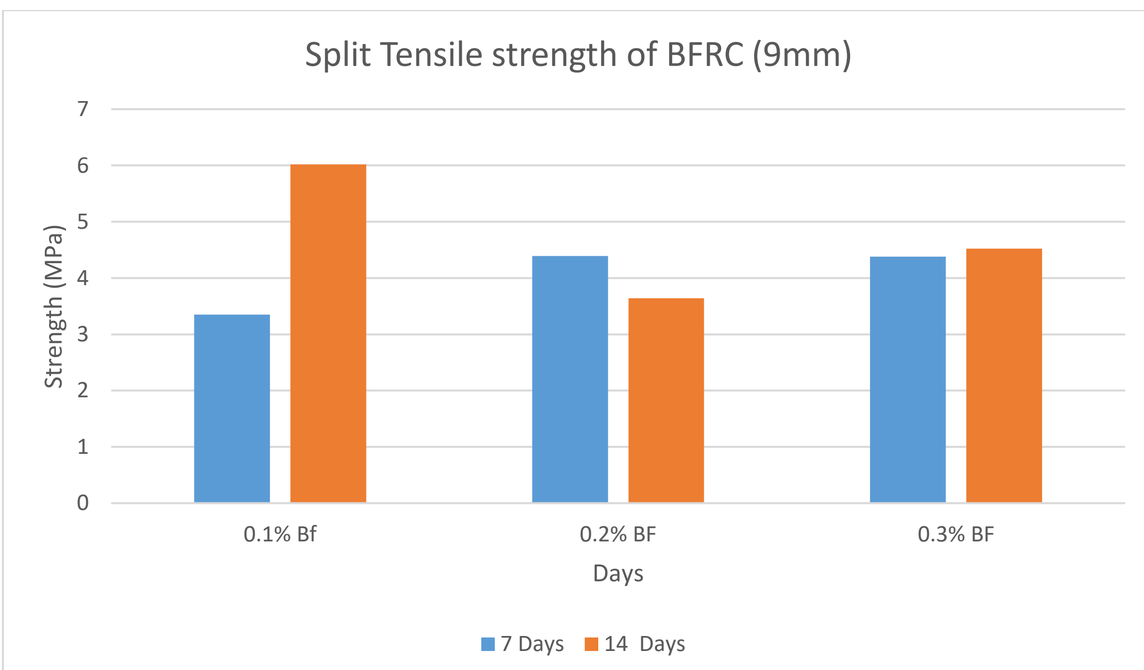
STRENGTHS	Load (KN)	7 DAYS strength (MPa)	Load (KN)	15 DAYS strength (MPa)
Compressive strength	**236**	**10.51**	**387.4**	**17.2**
Split tensile strength	**68.4**	**3.48**	**105.2**	**5.58**
Flexural strength	**16.4**	**2.12**	**17.6**	**2.28**

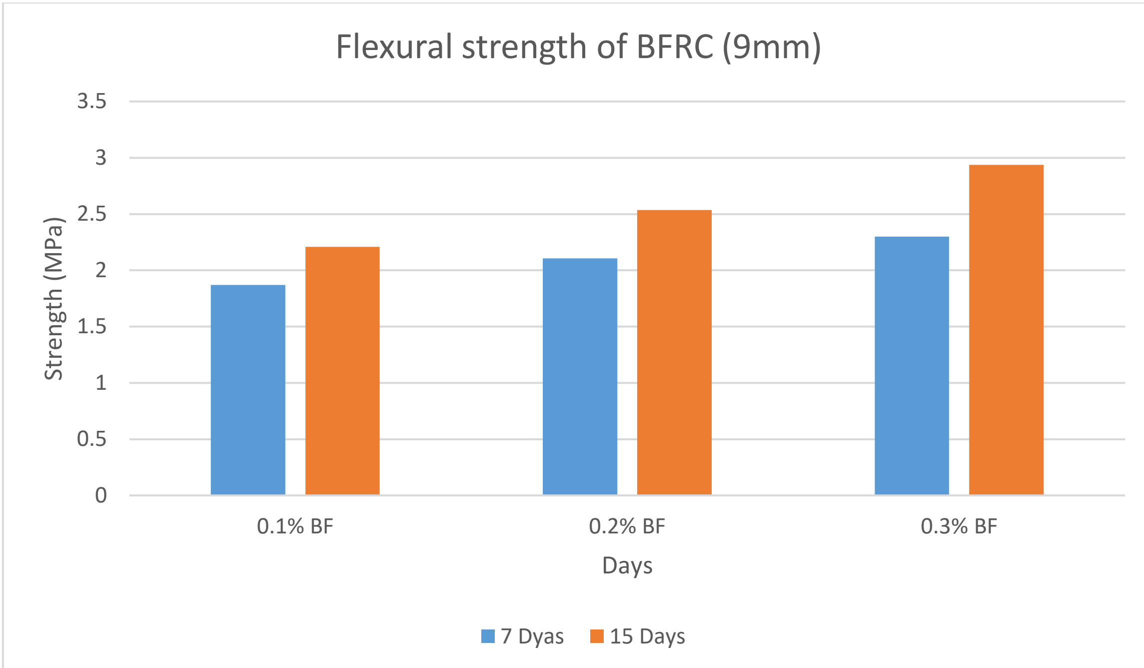


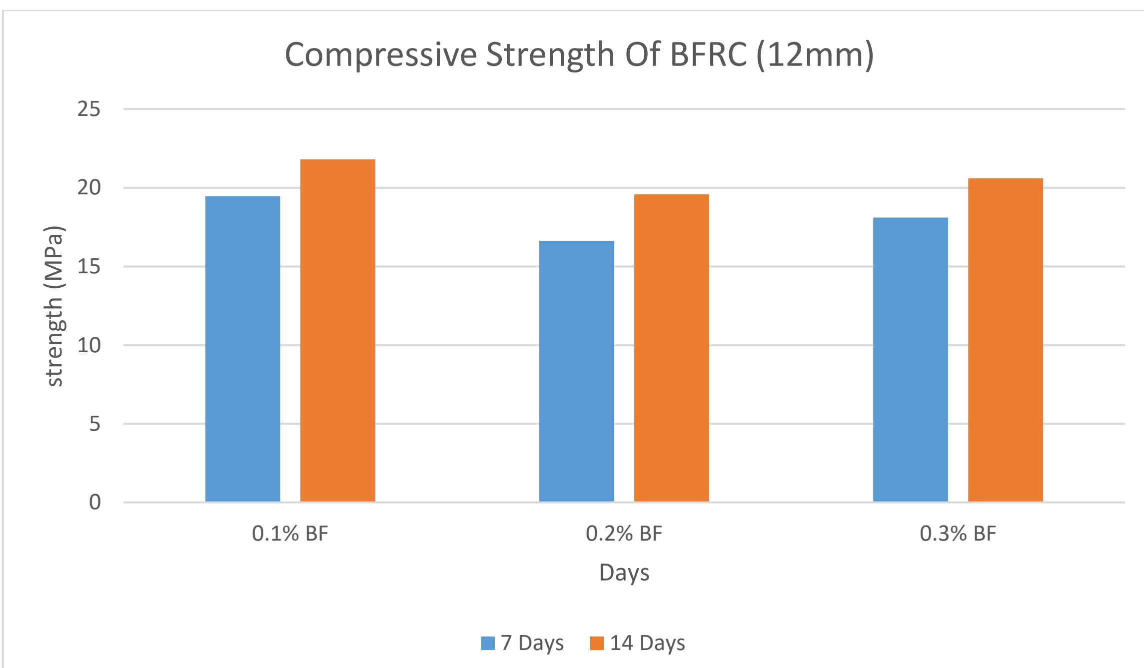

Split tensile strength of BFRC (6mm)
strength (MPa)
0
1
2
3
4
5
6
7
0.1% BF
0.2% BF
0.3% BF
Days
7 days
15 days

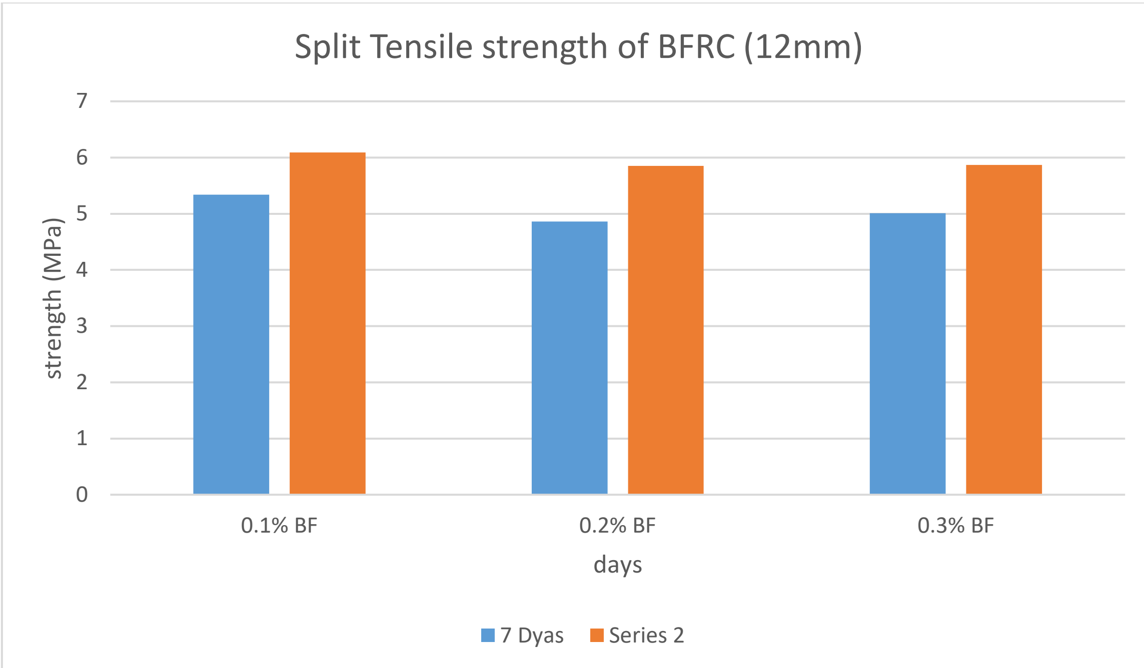

Flexural strength of BFRC (6mm)
0
0.5
1
1.5
2
2.5
0.1% BF
0.2% BF
0.3% BF
7 days
14 days

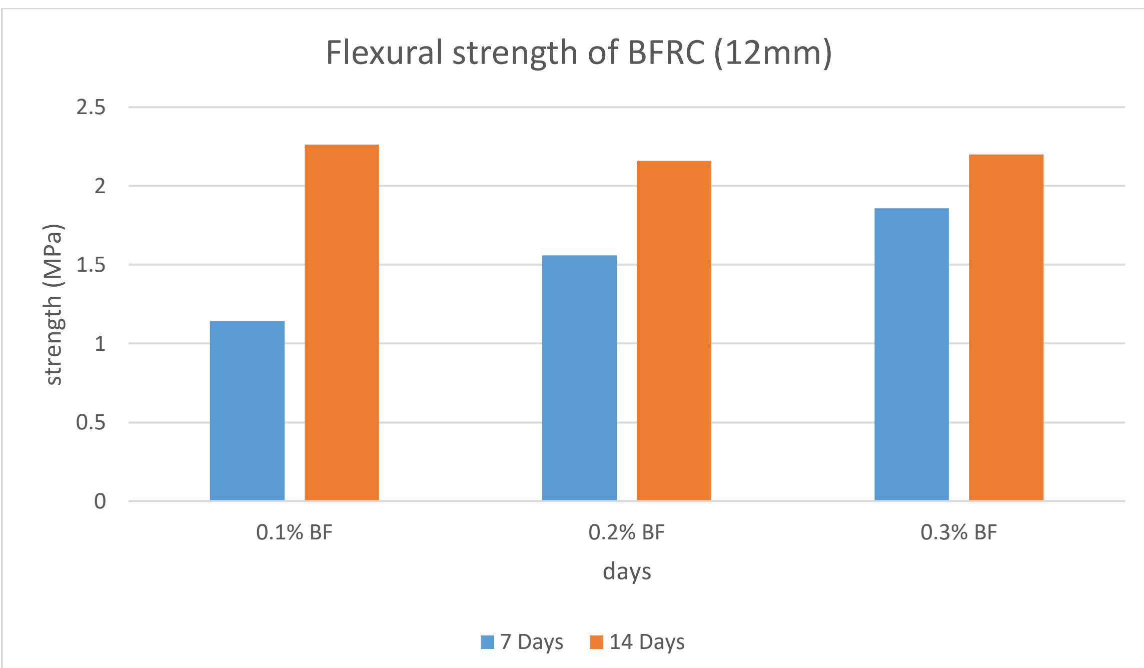

Compressive strength of BFRC (9mm)
Strength (MPa)
25
20
15
10
5
0
0.1% BF
0.2% BF
0.3% BF
Days
7 Days
14 Days

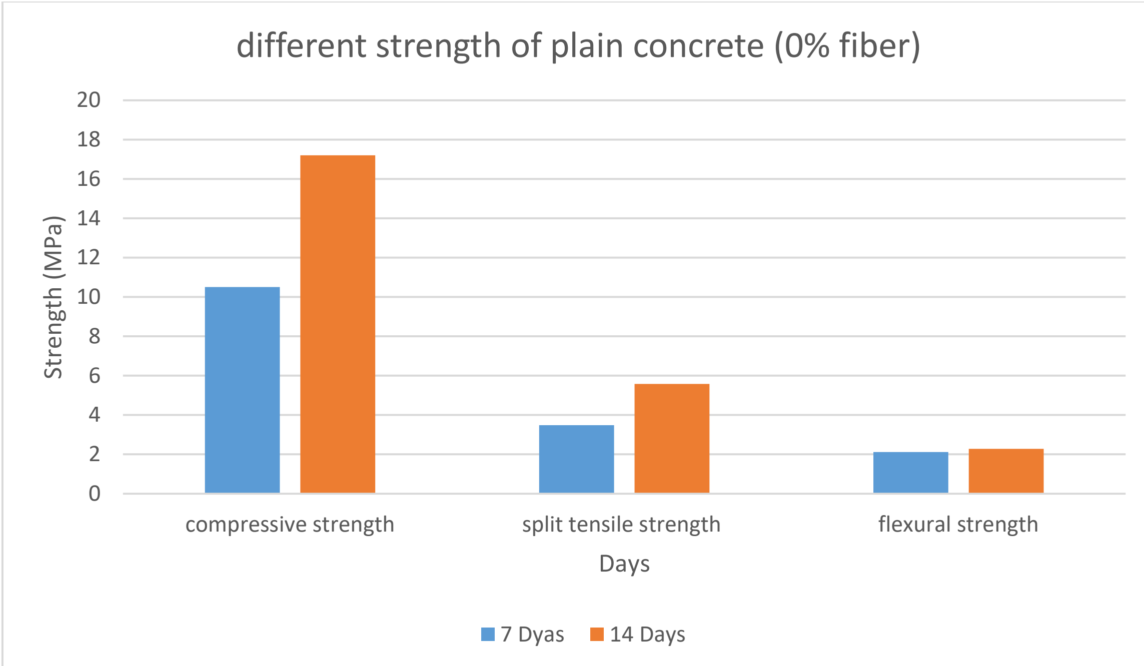

Split Tensile strength of BFRC (9mm)
Strength (MPa)
7
6
5
4
3
2
1
0
0.1% Bf
0.2% BF
0.3% BF
Days
7 Days
14 Days


Flexural strength of BFRC (9mm)
Strength (MPa)
3.5
3
2.5
2
1.5
1
0.5
0
0.1% BF
0.2% BF
0.3% BF
Days
7 Dyas
15 Days


Compressive Strength Of BFRC (12mm)
strength (MPa)
25
20
15
10
5
0
0.1% BF
0.2% BF
0.3% BF
Days
7 Days
14 Days


Split Tensile strength of BFRC (12mm)
strength (MPa)
7
6
5
4
3
2
1
0
0.1% BF
0.2% BF
0.3% BF
days
7 Dyas
Series 2


Flexural strength of BFRC (12mm)
strength (MPa)
2.5
2
1.5
1
0.5
0
0.1% BF
0.2% BF
0.3% BF
days
7 Days
14 Days


different strength of plain concrete (0% fiber)
Strength (MPa)
20
18
16
14
12
10
8
6
4
2
0
compressive strength
split tensile strength
flexural strength
Days
7 Dyas
14 Days

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

The benefits of using basalt fiber is that it is non corrosive, having high stability in strong alkali environments and inherits good chemical resistance. The basalt fiber enhances the compressive strength of concrete by 10-15% as compare to plain/control concrete.

The flexural strength increases by 5-10% but often in some cases it decreases by 5%.

By using 0.1% basalt fiber (6mm) of total volume the strength was increasing from 7^{th} day to 15^{th} day but 0.2 and 0.3 % gives reduction in flexural strength. Split tensile strength also increased by 15%.

The experimental investigation shows that 12mm basalt fibers gives the best results on enhancing mechanical properties of concrete as compared to the fibers of length 6mm and 9mm.

7.2 FUTURE SCOPE

In today's world for the purpose of construction, concrete is the most commonly material. . The fibers are used in the concrete to enhance its physical, mechanical and chemical properties. The compressive, split tensile and flexural strength are gradually increased by using the basalt fiber. Basalt fibers are non-corrosive and highly stable in the strong alkali environment. These fibers enhances the structural integrity of the structure. Also the basalt fibers led to decrease the crack propagation in the concrete phenomena called crack arresting. Fiber reinforced concrete can also replace the steel reinforcement and these fibers lead to reduction in corrosion as compare to steel reinforcement. The fiber reinforced concrete are also used in the application of building structures like bridges etc. These fibers provide excellent resistance to accidental impact due to its high impact resistance and toughness. The fiber reinforced concrete are also used in payment slabs and repair. These material has a very high strain capacity, toughness and controlled crack propagation.

The main characteristics of fiber reinforced concrete are high strength, toughness, high resistance to corrosion and chemical attack, high resistance to abrasion and fatigue.

CHAPTER 8

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