

## International Journal of Innovative Research in Science, Engineering and Technology

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# Study of Strength Properties of Concrete by Using Polypropylene and Basalt Fiber

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**ABSTRACT:** Concrete made with Portland cement has certain characteristics: it is relatively strong in compression but weak in tension and tends to be brittle. These two weaknesses have limited its use. Another fundamental weakness of concrete is that cracks start to form as soon as concrete is placed and before it has properly hardened. These cracks are major cause of leading to subsequent fracture and failure and general lack of durability. The weakness in tension can be overcome by the use of conventional rod reinforcement and to some extent by the inclusion of a sufficient volume of certain fibers.

This paper provides result data of the Compressive strength, Split tensile strength and Flexural strength of Basalt fiber concrete and Polypropylene fiber concrete containing fibers dosage of 0%, 0.2%, 0.4%, 0.6% and 0.8% by weight of cement with admixture.

A result data obtained has been analyzed and compared with a control specimen (0% fiber). Result data clearly shows increases in compressive strength for M40 Grade of concrete due to addition of Basalt and Polypropylene fibers concrete. Also results show that, the optimum dosage for the Splitting tensile strength of Basalt fiber is in the vicinity of 0.6% and that of polypropylene fiber concrete is in the vicinity of 0.3%. Flexural strength of basalt fiber concrete increases up to 0.6% dosage then decreases and in case of polypropylene fiber concrete flexural strength increases.

**KEYWORDS:** Polypropylene Fiber, Basalt Fiber, Compression strength, Split Tensile Strength, Flexural strength.

### I. INTRODUCTION

Concrete is a composite construction material made primarily with aggregate, cement, and water, admixture. There are many formulations of concrete, which provide varied properties, and concrete is the most used man-made product in the world. Concrete formulated with high compressive strength, but always has lower tensile strength. For this reason it is usually reinforced with material with strong in tension.

By using concrete the compressive strength, good fire resistance, high water resistance, low maintenance and service life increases. But it leads to concrete poor tensile strength low strain of fracture and formwork requirement. The major disadvantage is that concrete develops micro crack during curing. It is the rapid propagation these micro crack under applied stress that is responsible for low tensile strength of material. Hence fibers are added to concrete to overcome these disadvantages. The addition of fiber in the matrix has much important effect. Most notable among the improved mechanical characteristics of fiber reinforced concrete are its superior fracture strength, toughness, impact resistance, flexural strength, improving fatigue performance is one of the primary reasons for use of polypropylene fiber reinforced

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concrete. Fibers are used in concrete, to control cracking due to plastic shrinkage and drying shrinkage and also reduce permeability of concrete and thus reduces bleeding of water.

## II. RELATED WORK

In work done by Mr. Mustapha Abdulhadi the compressive strength of concrete mixes was observed to be increasing as the inclusion of fibers increases. For M40 grade concrete by adding 0.3%, 0.6%, 0.9% and 1.2% resulted in decrease in compressive strength relative to plain concrete. Splitting tensile strength increases by adding basalt fiber and polypropylene fiber. This shows that as we go for higher grade of concrete, increases in percentage of fibers increases the strength rapidly.

## III. OBJECTIVE OF PROPOSED WORK

1. To assess the percentage increase or decrease in strength of concrete using basalt and polypropylene fiber for their dosages (0.2%, 0.4%, 0.6% and 0.8%)
2. To identify the optimum dosage of basalt and polypropylene fiber for 0.2%, 0.4%, 0.6%, 0.8%.
3. To compare properties of basalt and polypropylene fiber with conventional concrete.

## IV. EXPERIMENTAL MATERIALS USED

### A. Fine Aggregate

Coarse sand locally available to us was used as fine aggregate. The test procedures as mentioned in IS-383(1970) were followed to determine the physical properties of fine Aggregate.

### B. Coarse Aggregate

Two single sized crushed stone aggregates ranging from 10mm and 20mm sizes were used in respective proportions in concrete mixes. The aggregates were tested in accordance to IS-383: (1970).

### C. Polypropylene Fibre and Basalt Fibre

Both fiber of 12mm long and 32micron in diameter used in the proposed work.

### D. Water

As per recommendation of IS: 456 (2000), the water to be used for mixing and curing of concrete should be free from deleterious materials. Therefore potable water was used in the present study in all operations demanding control over water quality.

### E. Fly Ash

Fly ash of Techpozso Company was used in this research. Which was mix 25% weight of cement content.

### F. Superplasticizer

The Master Glenium SKY 8233 used for reducing was used as superplasticizer for reducing water content.

## V. MIX DESIGN

The mix was designed for M40 grade as per IS: 10262:2009 at ratio of 1:21.875:2.95 for water cement ratio of 0.36. Table:1 shows various percentage replacement of fibre.

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Batch no.	% replacement of fibers
1	Control mix= 0%
2	Polypropylene fibre= 0.2%
3	Polypropylene fibre= 0.4%
4	Polypropylene fibre= 0.6%
5	Polypropylene fibre= 0.8%
6	Basalt fibre= 0.2%
7	Basalt fibre= 0.4%
8	Basalt fibre=0.6%
9	Basalt fibre=0.8%

## VI. METHODOLOGY

1. Selection of Materials.
2. Basic Tests performed on cement and aggregate.
3. Prepare mix design for M40 grade of concrete.
4. Prepare conventional concrete sample for cylinder and cube.
5. Curing of specimen.
6. Testing of conventional concrete specimen.
7. Result of conventional concrete.
8. Addition of polypropylene fibre and basalt fibre in proportion of 0.2%, 0.4%, 0.6%, 1.5%.
9. Curing and testing process of fibre reinforced concrete.
10. Result for fibre reinforced concrete.
11. Comparison between Conventional concrete and fibre reinforced concrete.

## VII. EXPERIMENTAL INVESTIGATION

### A. Compressive strength test:

Compression Testing Machine is used for Compressive strength test. Cube size of 150 x150x 150 mm was used. Three cubes of each batch were tested.



Figure 1 compressive strength test

### B. Split tensile strength:

Split tensile test was carried out on Compression Testing Machine. Cylinder specimen of 150 mm diameter and height 300mm are used. Three cylinder of each batch were tested.

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Figure 2 split tensile strength

### C. Flexural strength:

Flexural test was carried out on Universal Testing Machine. Beam specimen of 150 mm height, 150mm breadth and length 700mm are used. Three beam of each batch were tested.



Figure 3 Flexural strength

## VIII. TEST RESULTS

Test were conducted at 7 & 28 days. A comparative study was made on concrete with addition of coir fibre and glass fibre results are reported in Tables below for the conventional concrete and fibre reinforced concrete.

Table 1 :-Results for conventional concrete

Specimen	7 days (N/mm <sup>2</sup> )	28 days (N/mm <sup>2</sup> )
Cube	31.97	46.77
Cylinder	-	2.79
Beam	-	4.02

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**Table 2:- 7 days Results for Polypropylene fibre**

Specimen	0.2%	0.4%	0.6%	0.8%
Cubes	36.5	35.87	39.42	34.78

**Table 3:- 28 days Results for Polypropylene fibre**

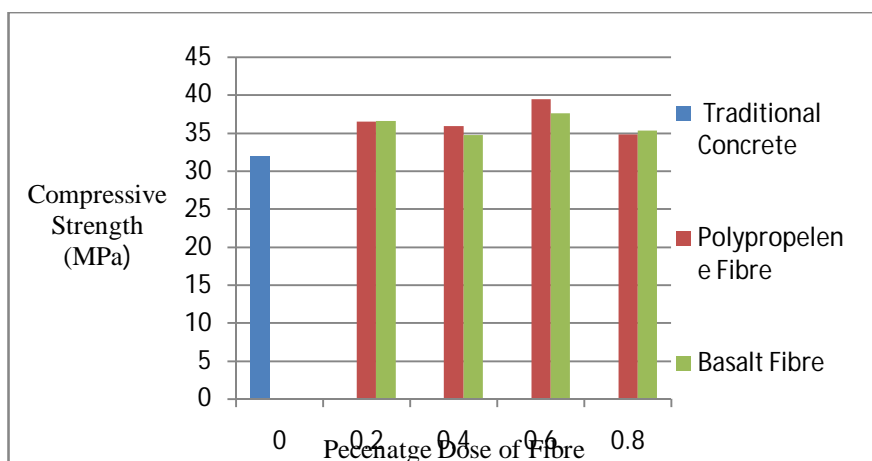
Specimen	0.2%	0.4%	0.6%	0.8%
Cubes	48.91	47.12	52.34	47.08
Cylinder	4.04	4.25	3.79	3.33
Beam	4.40	5.15	3.90	3.60

**Table 4:- 7 days Results for Basalt fibre**

Specimen	0.2%	0.4%	0.6%	0.8%
Cubes	36.60	34.75	37.55	35.29

**Table 5 :-28 days Results for Basalt fibre**

Specimen	0.2%	0.4%	0.6%	0.8%
Cubes	48.52	46.85	51.36	50.56
Cylinder	4.26	4.42	4.72	4.26
Beam	4.26	4.92	5.36	4.63



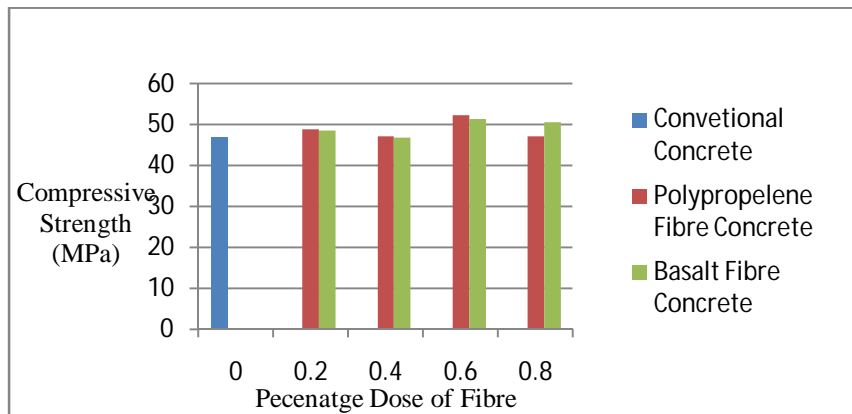
Graph 1. Comparison of compressive strength results PFFC and BFC with conventional concrete for 7 days.

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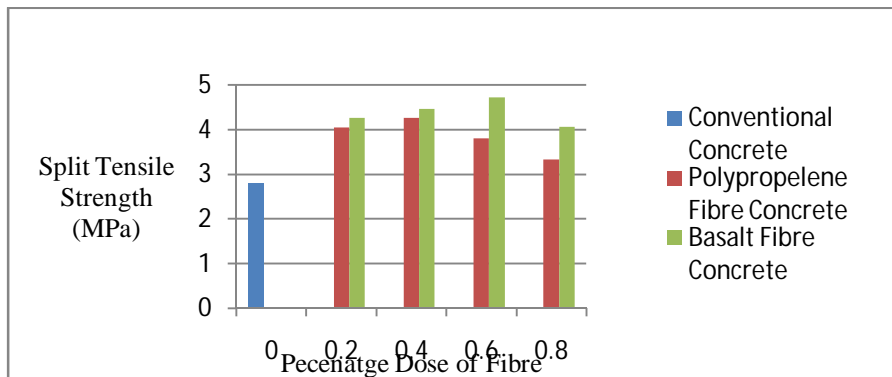
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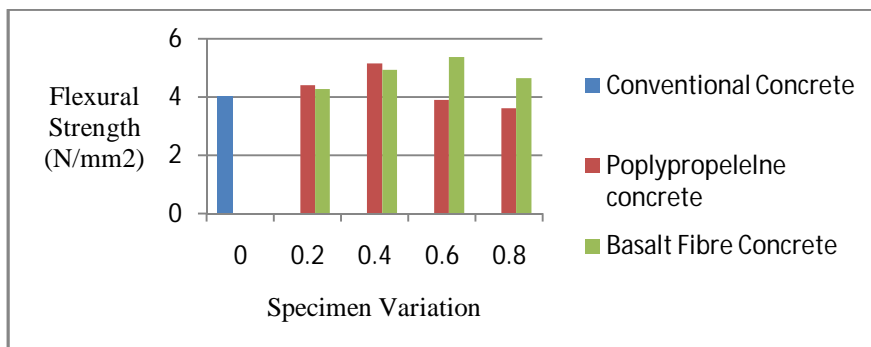
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Graph 3. Comparison strength of results of PPFC and BFC with conventional concrete for 28 days.



Graph 3. Comparison of Split tensile strength results of PPFC and BFC with conventional concrete for 28 days.



Graph 4. Comparison of Flexural strength results of PPFC and BFC with conventional concrete for 28 days.

## IX. CONCLUSION

1. It is observed that the compressive strength for M40 grade of concrete using basalt and polypropylene fiber for different dosage shows different increase in strength.

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2. Addition of PPF percentage of 0.2%, 0.4, 0.6% and 0.8% resulted in increase in compressive strength relative to conventional concrete by 8%, 12%, 17% and 24% for 7 days curing and addition of basalt fiber 14%, 8%, 17% and 10% for 7 day curing.
3. Addition of PPF percentage of 0.2%, 0.4, 0.6% and 0.8% resulted in increase in compressive strength relative to conventional concrete by 4%, 0.74%, 10% and 0.66% for 28 days curing and addition of basalt fiber 3%, 0.17%, 9.58% and 8% for 28 day curing.
4. By adding flay ash and admixture in concrete mix compressive strength increases continuously.
5. It was observed that the incorporation of fiber in the concrete mix greatly increases splitting tensile strength. Addition of 0.4% of polypropylene fiber and 0.6% of basalt fiber by weight of cementitious material it is observed that respectively; 52.3% and 69.1%. Therefore the optimum dosage for the splitting tensile strength of polypropylene fiber is in vicinity of 0.4% and that of basalt fiber is in the vicinity of 0.6%.
6. It was observed that the incorporation of fiber in the concrete mix greatly increases flexural strength. Addition of 0.4% of polypropylene fiber and 0.6% of basalt fiber by weight of cementitious material it is observed that respectively; 29.35 and 29.60%. Therefore the optimum dosage for the flexural strength of polypropylene fiber is in vicinity of 0.4% and that of basalt fiber is in the vicinity of 0.6%.

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### IS Codes:

1. IS 10262: 2009 Concrete Mix Proportioning- Guidelines (1<sup>st</sup> revision)
2. IS 516: 1959 Method of Test for Strength of Concrete.
3. IS 3286 : Part 3 method of test for aggregates for concrete.
4. IS 456 : 2000 Plain and Reinforced Concrete
5. IS 383 : 1970 Course and Fine aggregates from natural source for concrete.