# AN EXPERIMENTAL STUDY ON VARIOUS PROPERTIES OF FIBER REINFORCED SELF-COMPACTING CONCRETE

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**Abstract -** *The development of Self Compacting Concrete (SCC) is progressive milestone throughout the entire existence of construction industry bringing about prevalent utilization of SCC overall these days. It has numerous benefits over ordinary cement regarding upgrade in efficiency, decrease in labor and generally cost, amazing completed item with magnificent mechanical reaction and solidness. Joining of filaments further improves its properties extraordinarily identified with post break conduct of SCC. Henceforth, the point of the current work is to make a similar investigation of mechanical properties of self-merging concrete, supported with various kinds of filaments. The factors include in the examination are type and diverse level of strands. The fundamental properties of new SCC and other properties were studied. The fibers used in the study are 15 mm long chopped glass fiber, carbon fiber and basalt fiber. First stage comprised of improvement of SCC blend plan of M20 grade and in the subsequent stage, various filaments like Glass, basalt and carbon Fibers are added to the SCC blends and their new and solidified properties were resolved and thought about. The investigation showed noteworthy enhancements overall properties of self-compacting concrete by adding strands of various sorts and volume parts. Carbon FRSCC displayed best execution followed by basalt FRSCC and glass FRSCC in solidified state while most unfortunate in new state attributable to its high water ingestion. Glass FRSCC showed best execution in fresh state. The current examination infers that as far as generally exhibitions, ideal dose and cost Basalt Fiber is the most ideal alternative in improving by and large nature of self-compacting concrete.*

***Key Words***: *self-compacting concrete, Glass Fiber, carbon fiber, glass FRSCC*

## 1.INTRODUCTION

Self-compacting concrete (SSC) is a concrete that is able to flow and fill every part of the corner of the formwork, even in the presence of dense reinforcement, purely by means of own weight and without the need of for any vibration or other type of compaction. When comparing with traditional cement the advantages of SCC involving more strength like non-SCC, might be higher because of better compaction, comparable rigidity like non-SCC, modulus of versatility might be marginally lower in light of higher glue, somewhat higher jerk because of glue, shrinkage as ordinary concrete, better bond strength, imperviousness to fire comparable as non SCC, solidness better for better surface cement. Expansion of more fines substance and high water decreasing admixtures make SCC more touchy with diminished sturdiness and it planned and assigned by solid society that is the reason the utilization of SCC in an extensive manner in making of pre-projected items, spans, divider boards and so forth likewise in certain nations. Be that as it may, different examinations are completed to investigate different attributes and primary utilizations of SCC. SCC has set up to be powerful material, so there is a need to manage on the standardization of self-merging attributes and its conduct to apply on various underlying development, and its utilization taking all things together risky and difficult to reach project zones for unrivaled quality control.

### 1.2 Fiber Reinforced Self-Compacting Concrete (FRSCC)

There is an innovative change in the Concrete technology in the recent past with the accessibility of various grades of cements and mineral admixtures. However, there is a remarkable development, some complications quiet remained. These problems can be considered as drawbacks for this cementatious material, when it is compared to materials like steel. Concrete, which is a „quasi-fragile material‟, having negligible tensile strength. Several studies have shown that fiber reinforced composites are more efficient than other types of composites. The main purpose of the fiber is to control cracking and to increase the fracture toughness of the brittle matrix through bridging action during both micro and macro cracking of the matrix. Debonding, sliding and pulling-out of the fibers are the local mechanisms that control the bridging action. In the beginning of macro cracking, bridging action of fibers prevents and controls the opening and growth of cracks. This mechanism increases the demand of energy for the crack to propagate. The linear elastic behavior of the matrix is not affected significantly for low volumetric fiber fractions. At initial stage and the hardened state, Inclusion of fibers improves the properties of this special concrete. Considering it, researchers have focused on studied the strength and durability aspects of fiber reinforced SCC which are: Glass fibers ,Carbon fibers ,Basalt fibers, Polypropylene fibers etc. Fibers used in this investigation are of glass, basalt & carbon, a brief report of these fibers is given below. The objective of present research is to mix design of SCC of grade M20 and to investigate the effect of inclusion of chopped basalt fiber, glass fiber & carbon fiber on fresh properties and hardened properties of SCC with different types of fibers added to it. In the present work the mechanical properties of a self- compacting concrete with chopped Basalt, glass & Carbon fiber of length 15mm, added in various proportions will be studied in fresh and hardened state.

## 2. EXPERIMENTAL INVESTIGATION ON SELF-COMPACTING CONCRETE

In this study, the mechanical behavior of fiber reinforced self-compacting concrete of M20 grade prepared with basalt fiber; glass fiber and carbon fiber were studied. For each mix six numbers of cubes (150×150×150) mm, three numbers of cylinders (150×300) mm and six numbers prisms (100×100×500) mm were cast and investigations were conducted to study the mechanical behavior, fracture energy behavior, microstructure of plain SCC, basalt fiber reinforced SCC (BFC), glass fiber reinforced SCC (GFC), carbon fiber reinforced SCC (CFC).

### 2.1 Glass Fiber

Alkali resistant glass fiber having a modulus of elasticity of 72 GPA and 15mm length was used.

### 2.2 Basalt Fiber

Basalt fiber of 15mm length was used in the investigations.

### 2.3 Carbon Fiber

Carbon fiber of length 15 mm was used in the investigations.

Table 1 Mechanical Property of Fibers

| Fiber variety | Density (g/cm3) | Elastic Modulus (GPa) | Tensile strength(MPa) | Elong. at break(%) | Water absorption |
|---|---|---|---|---|---|
| BASALT | 2.65 | 93-11 | 4100-4800 | 3.1-3.2 | <0.5 |
| GLASS | 2.53 | 43-50 | 1950-2050 | 7-9 | <0.1 |
| CARBON | 1.80 | 243 | 4600 | 1.7 | |

## 3. RESULTS AND DISCUSSION

The graph (Fig 1) shows the optimum fiber content for maximum strength in mixes with different fibers. The maximum strength of 43.11MPa was observed with 0.15% carbon fiber content, 45.48MPa was observed with 0.25% basalt fiber content and 33.77 MPa was observed with 0.15% glass fiber content. The highest 7-day compressive strength was observed for mix with 0.25 % basalt fiber and lowest for mix with 0.3% basalt fiber.

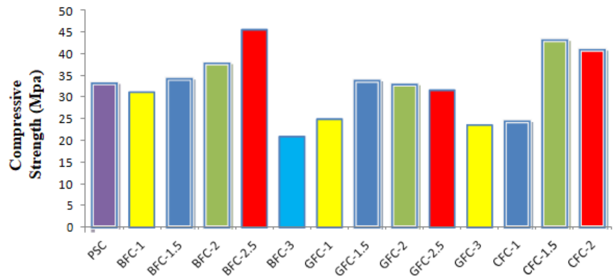


Fig. 1 Variation of 7-Days Compressive Strength for Different SCC Mixes

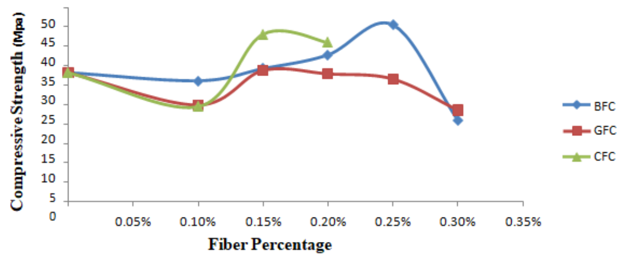


Fig. 2 Comparison of Different Percentages of Fiber Mixes with 7 days Compressive Strength

The fig.3 shows the optimum fiber content in mixes with different fibers. The maximum strength of 61.4 MPa was observed with 0.25% basalt fiber content, 60.35 MPa was observed with 0.15% carbon fiber content and 47.11 MPa was observed with 0.2% glass fiber content. The highest 28-days compressive strength was observed for mix with 0.25%basalt fiber and lowest for mix with 0.3%basalt fiber.

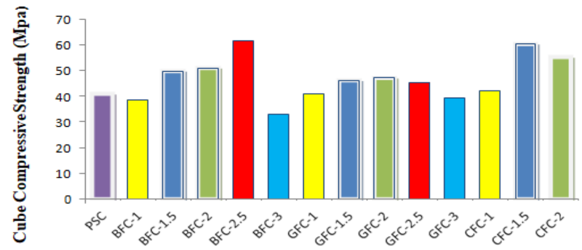


Fig. 3 Variation of 28 days Compressive Strength for Different SCC Mixes

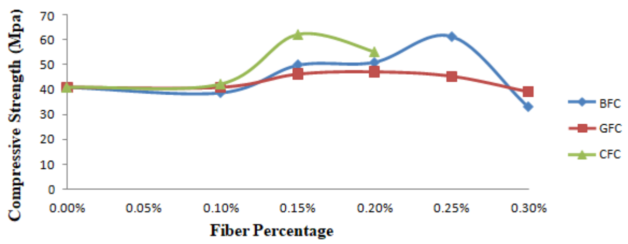


Fig. 4 Comparison of Different Percentages of Fiber Mixes with 28 days Compressive Strength

The Fig.5 shows the optimum fiber content in mixes with different fibers. The maximum strength of 5.6 MPa was observed with 0.2% basalt fiber content, 5.23MPa was observed with 0.15% carbon fiber content and 4.96 MPa was observed with 0.2% glass fiber content. The highest 28-days split tensile strength was observed for mix with 0.2% basalt fiber and lowest for mix with 0.1% glass fiber.

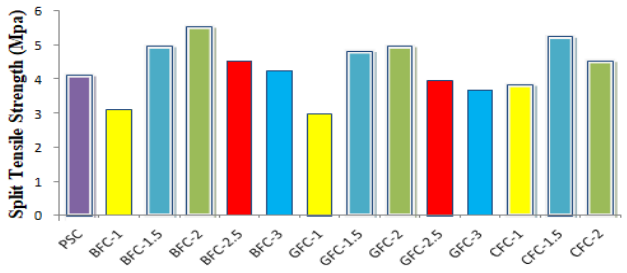


Fig. 5 Variation of Split Tensile Strength for Different SCC Mixes at 28 days

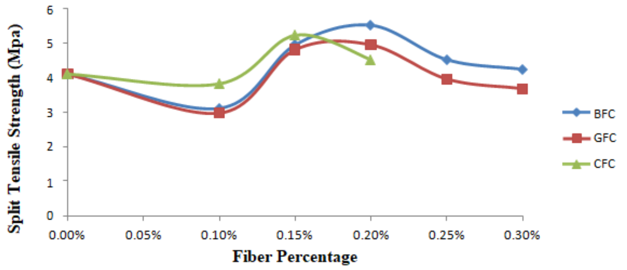


Fig. 6 Comparison of Different Percentages of Fiber Mixes with 28 days Split Tensile Strength

The Fig.7 the optimum fiber content in mixes with different fibers. The maximum strength of 12.32 MPa was observed with 0.15% carbon fiber content, 11.92 MPa was observed with 0.25% basalt fiber content and 10.08MPa was observed with 0.2% glass fiber content. The highest 28-days flexural strength was observed for mix with 0.15%carbon fiber and lowest for mix with 0.1% glass fiber.

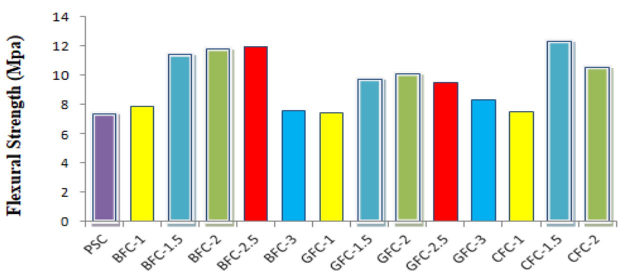


Fig. 7 Variation of Flexural Strength for Different SCC Mixes at 28 days

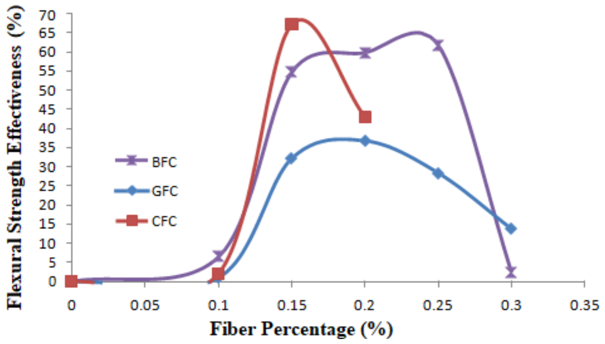


Fig. 8 Flexural Strength-Effectiveness of FRSCC at 28-Days

### 3.1 Compressive Strength

*7-Days Compressive Strength*

Compared to the plain SCC the compressive strength reinforced with basalt fiber of volume fraction 0.15%, 0.2% and 0.25% increase by 3.12%, 13.82% and 37.05% respectively. Compared with the plain SCC the compressive strength reinforced with glass fiber of volume fraction 0.15% increase by 1.76%. In this study the 7 days compressive strength of glass fiber shows no obvious improvement. Compared with the plain SCC the compressive strength reinforced with carbon fiber of 0.15% and 0.2% increase by 29.9% and 23.22% respectively.

*28-Days Compressive Strength*

While compared with plain SCC, 0.15% of BFC, GFC and CFC increment 21.72%, 10.52% and 47.6% individually. For 0.2% of BFC, GFC and CFC increment 24.7%, 15.21% and 35% individually. For 0.25% of BFC and GFC increments 50.16% and 11% separately. In this examination, The ideal measurements for BFC are 0.25%, for GFC is 0.2% and for CFC is 0.15%.

### 3.2 Split Tensile Strength

The rate improvement of split rigidity for basalt fiber more than plain SCC is 20.44%, 34.56%, 10.24% and 3.41% while adding 0.15%, 0.2%, 0.25% and 0.3% separately. The rate improvement of split elasticity for glass fiber more than plain SCC is 17.31%, 20.73% while adding 0.15% and 0.2% separately. The rate upgrade of split elasticity for carbon fiber more than plain SCC is 27.56% and 10.24% individually. The expansion is because of the fiber as clarified previously.

### 3.3 Flexural Strength

The flexural qualities of FRSCC blends following 28 days the ideal fiber division bestowing greatest flexural strength with various filaments. True to form, all FRSCC examples show an expansion in flexural strength with increment in fiber content. Contrasted and the plain SCC the improved level of the flexural strength of carbon FRSCC were seen in the scope of 2.03% to 67.16% while 0.15% invigorated most extreme. Expansion in flexural strength were seen in goes from 0.95% to 36.77% for GFC with the fiber level of 0.1% to 03% , the and improved rate flexural strength goes from 2.37% to 61.736% were noticed for basalt fiber with rate fiber goes from 0.1% to 0.3%. Most extreme flexural strength 12.32MPa was noticed for carbon FRCCC for 1.5% of fiber rate.

## 5. CONCLUSIONS

The exhibition of carbon fiber supported SCC blends was superior to basalt FRSCC and glass FRSCC blends. At that point carbon fiber FRSCC showed best mechanical properties with similarly lower volume portion however its impact on SCC new properties was simply opposite. Its consideration diminished stream capacity, deformability since it ingests more water. Other downside is that it is costliest than other two sorts of strands. Glass FRSCC displayed improvement altogether mechanical properties particularly in early ages, with higher volume division. It showed better exhibitions in new state. Aside from being least expensive, its exhibition in fresh state yet showed least strength, most elevated sorptivities. Basalt FRSCC displayed better properties in fresh state. Hence, basalt fiber outperformed compared to glass and carbon fiber.

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