# Assessment Of Improvement In Properties of Self Compecting Concrete By Using Basalt Fibre

**Dr. S.V. Admane[1], Mrs. T.D. Sayyad[2], Mr.Yelbhar M.D [3], Mr.Dahe A.N.[4]**
[2] hod, Dept of Civil Engineering
[3, 4]Lecturer, Dept of Civil Engineering
[1]Principal
[1, 2, 3, 4] Bhivrabai Sawant Polytechnic, Wagholi, Pune, India.

***Abstract****- Concrete is widely used material in the construction industry for building structures that are ordinary to those that involve highly specialized jobs. Fiber reinforced concrete, normally aims at producing material having desirable properties. Various types of fiber shave been tried by a number of researchers in the past. In this dissertation work, composite fiber i.e. combination of equal proportion chopped basalt fibers and carbon fiber of 6 mm and 12mm length have been used by varying its percentage by weight of cement as 0.5%, 1% and 1.5% for various grades of concrete from M40and M45 to cover the largest contribution to the construction industry using Self compacting concrete as also a substantially large component of the same using standard concrete. The effect of fiber percentage of various properties of concrete like compressive strength, flexural strength, etc. has been studied. Optimum fiber percentages for M40 and M45 grades of self-compacted concrete from the view point of maximizing compressive strength has been calculated by using the curve fitting approach.*

***Keywords***- SCC, Self-Compacting Concrete, Basalt fibers, Strength, Flexural, M40 and M45

## I. INTRODUCTION

The concept of using fibers as reinforcement is not new. Fibers have been used as reinforcement since ancient times. Historically, horsehair was used in mortar and straw in mud bricks. In the 1900s, asbestos fibers were used in concrete. In the 1950s, the concept of composite materials came into being and fiber-reinforced concrete was one of the topics of interest. Once the health risks associated with asbestos were discovered, there was a need to find a replacement for the substance in concrete and other building materials. By the 1960s, steel, glass (GFRC), and synthetic fibers such as polypropylene fibers were used in concrete. Research into new fiber-reinforced concretes continues today.

Fiber Reinforced Concrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete and discontinuous, discrete, uniformly dispersed suitable fibers. Fiber reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short, discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, Glass fibers, synthetic fibers and natural fibers. Within these different fibers that character of fiber reinforced concrete changes with varying Concretes, fiber materials, geometries, distribution, orientation and densities.

Basically, this method of reinforcing the concrete, substantially alters the properties of the non-reinforced cement-based matrix which is brittle in nature, possesses little tensile strength compared to the inherent compressive strength. Fibers are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. Some types of fiber produce greater impact–, abrasion–, and shatter–resistance in concrete.

The amount of fibers added to a concrete mix is expressed as a percentage of the total volume of the composite (concrete and fibers), termed "volume fraction" ($V_f$). $V_f$ typically ranges from 0.1 to 3%. The aspect ratio (l/d) is calculated by dividing the fiber length (l) by its diameter (d). Fibers with a non-circular cross section use an equivalent diameter for the calculation of aspect ratio. If the fiber modulus of elasticity is higher than the matrix (concrete or mortar binder), they help to carry the load by increasing the tensile strength of the material. Increasing the aspect ratio of the fiber, usually segments the flexural strength and toughness of the matrix. However, fibers that too long tend to "ball" in the mix and create workability problems.

Some recent research indicated that using fibers in concrete have limited effect on the impact resistance of the materials. This finding is very important since traditionally, people think that ductility increases when concrete is reinforced with fibers. The results also indicated that the use of micro fibers offers better impact resistance to that of longer fibers.

Recent studies performed on a high-performance fiber-reinforced concrete in a bridge deck found that adding fibers provided residual strength and controlled cracking. There were fewer and narrower cracks in the FRC even though the FRC had more shrinkage than the control. Residual strength is directly proportional to the fiber content.

A new kind of natural fiber-reinforced concrete (NFRC) made of cellulose fibers processed from genetically modified slash pine trees is giving good results. The cellulose fibers are longer and greater in diameter than other timber sources. Some studies were performed using waste carpet fibers in concrete as an environmentally friendly use of recycled carpet waste. A carpet typically consists of two layers of backing (usually fabric from polypropylene tape yarns), joined by $CaCO_3$ filled styrene-butadiene latex rubber (SBR), and face fibers (majority being nylon 6 and nylon 66 textured yarns). Such nylon and polypropylene fibers can be used for concrete reinforcement. Other ideas are emerging to use recycled materials as fibers: recycled Polyethylene terephthalate (PET) fiber, for example. Steel fiber-reinforced shotcrete (SFRS) is a kind of spray concrete (shotcrete) with steel fibers added.

### A. Benefits

- Improve structural strength
- Reduce steel reinforcement requirements
- Improve ductility
- Reduce crack widths and control the crack widths tightly, thus improving durability
- Improve impact– and abrasion–resistance
- Improve freeze-thaw resistance

In certain specific circumstances, steel fiber can entirely replace traditional steel reinforcement bar ("rebar") in reinforced concrete. This is most common in industrial flooring, but also in some other broadcasting applications. Typically, these are corroborated with laboratory testing to confirm that performance requirements are met. Care should be taken to ensure that local design, code requirements are also met, which may impose minimum quantities of steel reinforcement within the concrete. There are increasing numbers of tunneling projects using precast lining segments reinforced only with steel fibers.

Only a few of the possible hundreds of fiber types have been found suitable for commercial applications. In order for fiber reinforced concrete (FRC) to be a viable construction material, it must be able to compete economically with existing reinforcing systems. This project deals specifically with the concrete reinforced with the 'Basalt fibers'. The objective of this project is to explore the properties of Basalt fibers in Self-Compacting concrete.

## II. BACKGROUND

Self - Compacting Concrete (SCC) has been considered as a 'quiet revolution' in the concrete construction process, with major benefits in increased productivity, enhanced construction quality, and much improved working environment on site. Already, it is rapidly gaining acceptance throughout the industry and being viewed by many as having the potential of replacing most of the ordinary concrete currently produced. There are various aspects like the use of admixtures, low, coarse aggregate content, etc., whichmakes SCC different from the traditional concrete mix. Due to such significant differences in the mix proportions and also in placing and compaction processes between the SCC and traditional vibrated mix, it is uncertain that SCC would have the same durability characteristics as traditional concrete if their strength grade were similar. Due to this uncertainty and its great significance to the serviceability of concrete structure, knowledge of the durability performance of SCC mixes is urgently needed. Much research has been carried out regarding the fresh properties, mix design, placing methods and strength of various SCC mixes. However, only very limited work has been done to systematically assess the durability performance of SCC, particularly in comparison with traditional vibrated normal concrete.

The main objective of this study was to systematically assess the durability by investigating the oxygen permeability, capillary absorption and chloride diffusivity of different types of SCC mixes in comparison with vibrated reference normal concretes of a same-strength grade. Two grades of concrete mixes were examined: C40, having characteristic cube strength of 40 MPa, and C60, having characteristic cube strength of 60 MPa. For each grade, three different SCC mixes namely, one using limestone powder, one using PFA (Pulverized Fuel Ash) and one using no additional powder, but a viscosity agent and two traditionally vibrated references (REF) mixes one using Portland cement only, the other using Portland cement and PFA as the binder material was produced. Standard cube (150 mm) and cylinder (ϕ150 (300) specimens were prepared. The SCC mixes with characteristic cube strength of 40 and 60 MPa were designed containing either additional powder as filler or containing no filler but using a viscosity agent. Oxygen permeability, capillary water absorption and chloride diffusivity tests were made on preconditioned specimens to provide comparisons of permeation properties between the different SCC and reference mixes. Basic fresh properties and compressive strength of hardened concrete are tabulated below.

The results indicated that the SCC mixes had significantly lower oxygen permeability and sorptivity (i.e. The rate of water absorption through the concrete surface) than the vibrated normal reference concretes of the same strength grades. Theoretically, the main factors that control the permeation properties of concrete materials are the relative volume of paste matrix, the pore structure of the bulk matrix and the interfacial zone around the aggregate particles. The significantly lower oxygen permeability and capillary water absorption for the SCC mixes observed in this study may be attributed to their less porous interface zone, and also the refined pore structure of the paste matrix.

The chloride diffusivity was very much dependent on the type of additional powder used in concrete. Both the SCC and the reference mix using PFA showed a much lower value of chloride migration coefficient than the other mixes. The SCC mixes containing no additional powder, but using a viscosity agent were found to have considerably higher diffusivity than the reference mixes and the other SCCs. The results also seemed to suggest that equal strength grade or equal w/c ratio alone could not ensure different SCC mixes have equal or lower chloride diffusivity than the traditional vibrated concretes.

## III. EXPERIMENTAL SETUP & METHOD

There are many test methods developed in attempts to characterize the properties of SCC. So far, no single method or combination of methods has achieved universal approval and most of them have their adherents. Similarly, no single method has been found which characterizes all the relevant workability aspects of Self Compacting Concrete, so each mix design should be tested by more than one test method for the different workability parameters. Alternative test methods for the different parameters are listed in the table

**Table 1: List of methods for workability properties of SCC**

| | Method | Property |
|---|---|---|
| 1 | Slump-flow by Abrams cone | Filling ability |
| 2 | $T_{50cm}$ slump flow | Filling ability |
| 3 | J-ring | Passing ability |
| 4 | V-funnel | Filling ability |
| 5 | V-funnel at $T_{5minutes}$ | Segregation resistance |
| 6 | L-box | Passing ability |
| 7 | U-box | Passing ability |
| 8 | Fill-box | Passing ability |
| 9 | GTM screen stability test | Segregation resistance |
| 10 | Orimet | Filling ability |

For the initial mix design of SCC, all three workability parameters need to be assessed to ensure that all aspects are fulfilled. A full-scale test should be use to verify the self-compacting characteristics of the chosen design for a particular application. For site quality control, two test methods are generally sufficient to monitor production quality. Typical combinations are Slump-flow and V-funnel or Slump-flow and J-ring. With consistent raw material quality, a single test method operated by a trained and experienced technician may be sufficient. The table gives a classification of the methods use in laboratory and field (Quality Control) for assessment of Self Compacting Concrete and modification of these tests for maximum size of aggregate.

**Table 2: Workability properties of SCC and alternative test methods**

| Property | Test Method | | Modification of Test According to Maximum Aggregate Size |
|---|---|---|---|
| | Lab (Mix Design) | Field (QC) | |
| Filling Ability | 1. Slump Flow | 1. Slump Flow | None |
| | 2. T50cm Slump Flow | 2. T50cm Slump Flow | Maximum 20 mm |
| | 4. V-Funnel | 4. V-Funnel | |
| | 10. Orimet | 10. Orimet | |
| Passing Ability | 6. L-Box | J-Ring | Different opening in L-Box, U-Box and J-Ring |
| | 7. U-Box | | |
| | 8. Fill-Box | | |
| Segregation Resistance | 9. GTM Test | 9. GTM Test | None |
| | 5. V-Funnel at $T_{5minutes}$ | 5. V-Funnel at $T_{5minutes}$ | |

### A. Workability Criteria for the Fresh SCC

These requirements are to be fulfilled at the time of placing. Typical acceptance criteria for Self-Compacting Concrete with a maximum aggregate size up to 20 mm is presented in Table

**Table 3: Acceptance criteria for SCC**

| | Method | Unit | Typical range of values | |
|---|---|---|---|---|
| | | | Min | Max |
| 1 | Slump-flow by Abrams cone | mm | 650 | 800 |
| 2 | $T_{50cm}$ slump flow | sec | 2 | 5 |
| 3 | J-ring | mm | 0 | 10 |
| 4 | V-funnel | sec | 6 | 12 |
| 5 | V-funnel at $T_{5minutes}$ | sec | 0 | +3 |
| 6 | L-box | $(H_2/H_1)$ | 0.8 | 1.0 |
| 7 | U-box | $(H_2 - H_1)$ mm | 0 | 30 |
| 8 | Fill-box | % | 90 | 100 |
| 9 | GTM screen stability test | % | 0 | 15 |
| 10 | Orimet | sec | 0 | 5 |

These typical requirements shown against each test method are based on current knowledge and practice. However, future developments may lead to different requirements being adopted. Values outside these ranges may be acceptable if the producer can demonstrate satisfactory performanc1e in the specific conditions, e.g., large spaces between reinforcement, layer thickness less than 500 mm, short distance of flow from point of discharge, very few obstructions to pass in the formwork, very simple design of formwork, etc. Special care should always be taken to ensure no segregation of the mix is likely as, at present, there is not a simple and reliable test that gives information about segregation resistance of SCC in all practical situations.

In construction of structures having thin section, pour heights of more than the acceptable free fall for conventional concrete, combined with dense reinforcement and inserts, it is essential that the concrete used has high durability with moderate viscosity to ensure uniform dispersion of concrete constituents during transportation, the casting and thereafter until setting. It should have the ability to pass through the congestion and occupy complete space in formwork. The concrete should be capable of retaining fresh concrete properties for a longer duration to cater to the time requirements of other concreting operations from transportation to final finishing. In fact, the most important property is the ability of the concrete to resist segregation i.e. the stability of fresh concrete. It depends on the cohesiveness and viscosity of the mix. The mix should be capable of withstanding the expected possible variation in the amount of mixing water, moisture content of ingredients or in the proportion of coarse and fine aggregate to remain cohesive and free flowing.

### B. Mix Design

Self-compact ability can be largely affected by the characteristics of materials and the mix proportion. The coarse and fine aggregate contents are fixed so that self-compactability can be achieved easily by adjusting the water cement ratio and the super plasticizer dosage only. The project we aim to achieve M40 strength concrete mix. For this, various trials were taken according to the specifications laid by FNARC and a suitable mix-design was selected. Concrete mixes were prepared with 0%, 1% and 2% fibre content and were tested for properties of SCC like flowing ability, passing ability and segregation resistance before casting was done. [7]

After the mix design was prepared, the materials namely Cement, Sand, Fly Ash, and Aggregates & Super plasticizer were weighted on an electronic weighing balance. Each material was weighed accurately according to the required proportion. Super plasticizer and fibres were weighed on weighing balance accurate to 0.1 g. All the materials were mixed in a pan mixer. Firstly, dry mixing was carried out which included Aggregates, both 10mm and 20mm and sand. Cement and fly Ash were added and mixed thoroughly. After dry mixing, water was added in the required proportion. Thorough mixing was done till homogeneous mix was obtained adding super plasticizer slowly to it. Mixing was done 4-5min for obtaining highly workable concrete mix.After the Fibre Reinforced Self-Compacting Concrete was prepared and the mix tested for properties of SCC, cubes and beams were casted as shown below:

**Table 4: Mix tested Properties of SCC**

| SR. NO. | FIBRE CONTENT | NO. OF CUBES | NO. OF BEAMS |
|---|---|---|---|
| 1. | 0% | 6 | 6 |
| 2. | 1% (12mm) | 6 | 6 |
| 3. | 1% (6mm) | 6 | 6 |
| 4. | 2% (12mm) | 6 | 6 |
| 5. | 2% (6mm) | 6 | 6 |
| | TOTAL | 30 | 30 |

The highly workable mix of SCC were poured in the cubes of size 150x150x150mm and in Beams of size 500x100x100mm for casting. Due to its self-compacting properties, mechanical compaction was not required. The cubes and beams were removed from the moulds and placed in curing tank within 24 hours of casting. Curing was done for a period of 28 Days and 56 Days.

### C. Interpretation of Results for Flexure Strength & Compressive Strength

Calculation for Flexure

Flexural Formula = $\frac{M}{I} = \frac{6}{y}$

Therefore: $6 = \frac{M\,y}{I}$

Where,

6 = Flexural Strength ($N/mm^{2)}$)
M = Maximum Moment (Nmm)
I = Moment Of Inertia (mm4)
Y = Depth of Neutral Axis from Top

Compressive strength: $6c = \frac{load}{area}$

Area = 150x150 =22500 $mm^2$

The mathematical formulae allow the theoretical calculations from the measurements of the material and the components used in the experiment.

## IV. RESULTS AND DISCUSSION

The section of the paper discusses the results achieved from the experiment. The table 5 below shows the details of the features of the proportions for the experiments.

**Table 5: Features of Proportion at 26 and 32 degrees**

| Sr.No. | Description | Result |
|---|---|---|
| 1. | Date of Mixing | |
| 2. | Temperature | 32& 26 °C |
| 3. | W/c Ratio | 0.38 |
| 4. | SP Content (%) | 1.00& 1.05 |
| 5. | Fiber Content (%) | 0 |
| 6. | Cement Fly Ash Content | 80-20 |

The experiment is conducted at the set room temperature. The experiment being conducted in India the normal room temperature is recorded as 32 and 26degrees Celsius. In the initial material components there are no fibers used.

**Table 6: Result OfWorkability Test**

| Sr No | | Description | Result |
|---|---|---|---|
| 1. | | V – funnel at $T_0$ Minute (Seconds) | 5.48 |
| 2. | | V – funnel at $T_5$ Minute (Seconds) | 8.48 |
| 3. | | L – BOX TEST | |
| | a. | Time for 20cm (Seconds) | -------- |
| | b. | Time for 40cm (Seconds) | -------- |
| | c. | $H_2$ / $H_1$ Ratio | --------- |
| 4. | | SLUMP Flow TEST | |
| | a. | Diameter 1 (mm) | 700mm |
| | b. | Diameter 2 (mm) | |
| | c. | Diameter 3 (mm) | |
| | d. | Diameter 4 (mm) | |

Table 6 displays the results from the workability tests are displaced.

**Table 7: Results of Flexural & Compression Tests**

| Sr No | Duration | Flexural Strength ($N/mm^{2)}$) | | Compressive Strength ($N/mm^2$) | |
|---|---|---|---|---|---|
| 1. | 28 Days | 3.915 | 3.97 | 25.78 | 26.81 |
| 2. | | 3.98 | | 27.11 | |
| 3. | | 4.00 | | 27.55 | |
| 4. | 56 Days | 4.32 | 4.30 | 31.55 | 32.30 |
| 5. | | 4.25 | | 32.88 | |
| 6. | | 4.32 | | 32.44 | |

The table 7 shows the results from the compression tests and Flexural tests for the duration of 28 and 56 days of curing.

**Table 8: Result of Workability test**

| Sr No | | Description | Result |
|---|---|---|---|
| 1. | | V – funnel at $T_0$ Minute (Seconds) | 5.98 |
| 2. | | V – funnel at $T_5$ Minute (Seconds) | 9.02 |
| 3. | | L – BOX TEST | |
| | a. | Time for 20cm (Seconds) | 0.89 |
| | b. | Time for 40cm (Seconds) | 1.72 |
| | c. | $H_2$ / $H_1$ Ratio | 0.92 |
| 4. | | SLUMP Flow TEST | |
| | a. | Diameter 1 (mm) | 675mm |
| | b. | Diameter 2 (mm) | |
| | c. | Diameter 3 (mm) | |
| | d. | Diameter 4 (mm) | |

Table 6 and 8 both display the workability test with a difference in time and at a different temperature. Table 6 is the result at the 32 degrees and table 8 at 26 degrees. In V funnel test T1 is taken as 5.48 and 5.98 while T2 is 8.48 and 9.02 respectively in seconds. In table 6 Time for 20 cm and 40 cm are not tested where as in table 8 they tested with time of 0.89 and 1.72 seconds. The slump test in table 6 is at 700 mm and in table 8 is at 675 mm diameters.

**Table 9: Results of Flexural & Compression Tests**

| Sr No | Duration | Flexural Strength ($N/mm^2$) | | Compressive Strength ($N/mm^2$) | |
|---|---|---|---|---|---|
| 1. | 28 Days | 4.69 | 4.96 | 26.67 | 27.26 |
| 2. | | 5.13 | | 27.11 | |
| 3. | | 5.06 | | 28.00 | |
| 4. | 56 Days | 5.265 | 5.42 | 37.77 | 38.00 |
| 5. | | 5.467 | | 38.67 | |
| 6. | | 5.535 | | 37.55 | |

In table 9 the flexural and compression test conducted at 26 degrees room temperature.Conducted at an interval of 28 days and 56 days respectively.

**Table 10: Features of Proportion at 28 degrees**

| Sr.No. | Description | Result |
|---|---|---|
| 1. | Date of Mixing | |
| 2. | Temperature | 28° C |
| 3. | W/c Ratio | 0.38 |
| 4. | SP Content (%) | 1.35 |
| 5. | Fiber Content (%) | 2% (12mm) |
| 6. | Cement Fly Ash Content | 80-20 |

In table 10 explains the proportion features at 28 degrees room temperature and this time there are 2% fiber contents in the materials.

**Table 11: Result of Workability test at 28 degrees**

| Sr No | | Description | Result |
|---|---|---|---|
| 1. | | **V – funnel at $T_0$ Minute** | 5.32 |
| 2. | | **V – funnel at $T_5$ Minute** | 8.12 |
| 3. | | **L – BOX TEST** | |
| | a. | Time for 20cm (Seconds) | 0.89 |
| | b. | Time for 40cm (Seconds) | 2.09 |
| | c. | $H_2$ / $H_1$ Ratio | 0.84 |
| 4. | | **SLUMP Flow TEST** | |
| | a. | Diameter 1 (mm) | 760mm |
| | b. | Diameter 2 (mm) | |
| | c. | Diameter 3 (mm) | |
| | d. | Diameter 4 (mm) | |

Table 11 has the test results with a time of 5.32 and 8.12 seconds with time for 20 cm box test performed for 0.89 and 40 cm for 2.09 seconds. The H ration is 0.84 whereas the slump test was performed with 760 mm diameter.

**Table 12: Results of Flexural & Compression Tests**

| Sr No | Duration | Flexural Strength (N/mm²) | | Compressive Strength (N/mm²) | |
|---|---|---|---|---|---|
| 1. | 28 Days | 5.87 | 5.895 | 28.88 | 27.99 |
| 2. | | 6.075 | | 28.44 | |
| 3. | | 5.74 | | 26.67 | |
| 4. | 56 Days | 6.21 | 6.34 | 40.00 | 40.00 |
| 5. | | 6.35 | | 39.11 | |
| 6. | | 6.45 | | 40.88 | |

**Table 13: Features of Proportion at 28 degrees**

| Sr.No. | Description | Result |
|---|---|---|
| 1. | Date of Mixing | |
| 2. | Temperature | 28° C |
| 3. | W/c Ratio | 0.38 |
| 4. | SP Content (%) | 1.05 |
| 5. | Fiber Content (%) | 1% (6mm) |
| 6. | Cement Fly Ash Content | 80-20 |

**Table 14: Result of Workability test**

| Sr No | | Description | Result |
|---|---|---|---|
| 1. | | **V – funnel at $T_0$ Minute** (Seconds) | 5.29 |
| 2. | | **V – funnel at $T_5$ Minute** (Seconds) | 8.34 |
| 3. | | **L – BOX TEST** | |
| | a. | Time for 20cm (Seconds) | 0.89 |
| | b. | Time for 40cm (Seconds) | 2.02 |
| | c. | $H_2$ / $H_1$ Ratio | 0.835 |
| 4. | | **SLUMP Flow TEST** | |
| | a. | Diameter 1 (mm) | 715mm |
| | b. | Diameter 2 (mm) | |
| | c. | Diameter 3 (mm) | |
| | d. | Diameter 4 (mm) | |

**Table 15: Results of Flexural & Compression Tests**

| Sr No | Duration | Flexural Strength (N/mm²) | | Compressive Strength (N/mm²) | |
|---|---|---|---|---|---|
| 1. | 28 Days | 4.05 | 4.49 | 28.89 | 28.147 |
| 2. | | 4.83 | | 27.55 | |
| 3. | | 4.59 | | 28.00 | |
| 4. | 56 Days | 4.86 | 4.96 | 36.44 | 36.66 |
| 5. | | 4.96 | | 36.00 | |
| 6. | | 5.06 | | 36.33 | |

**Table 16: Features of Proportion at 29 degrees**

| Sr.No. | Description | Result |
|---|---|---|
| 1. | Date of Mixing | |
| 2. | Temperature | 29° C |
| 3. | W/c Ratio | 0.38 |
| 4. | SP Content (%) | 1.35 |
| 5. | Fiber Content (%) | 2% (6mm) |
| 6. | Cement Fly Ash Content | 80-20 |

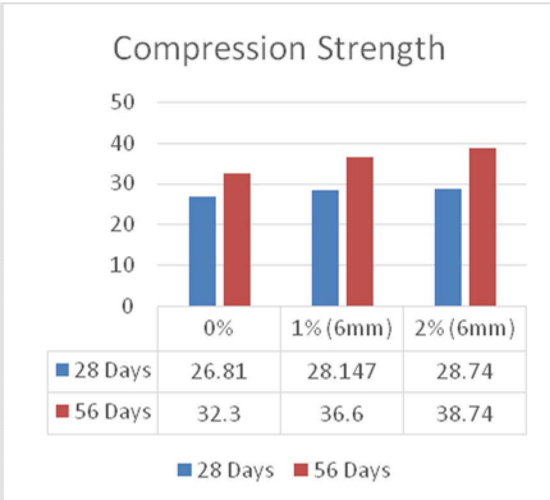
**Table 17: Result of Workability test**

| Sr No | | Description | Result |
|---|---|---|---|
| 1. | | **V – funnel at $T_0$ Minute** (Seconds) | 6.02 |
| 2. | | **V – funnel at $T_5$ Minute** (Seconds) | 9.12 |
| 3. | | **L – BOX TEST** | |
| | a. | Time for 20cm (Seconds) | 0.92 |
| | b. | Time for 40cm (Seconds) | 2.34 |
| | c. | $H_2$ / $H_1$ Ratio | 0.85 |
| 4. | | **SLUMP Flow TEST** | |
| | a. | Diameter 1 (mm) | 705mm |
| | b. | Diameter 2 (mm) | |
| | c. | Diameter 3 (mm) | |
| | d. | Diameter 4 (mm) | |

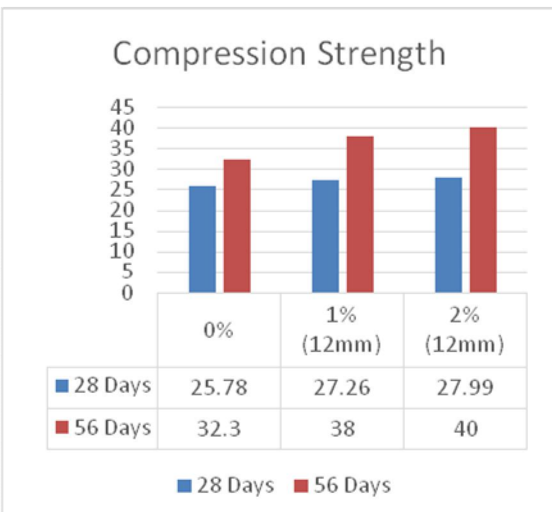
**Table 18: Results Of Flexural & Compression Tests**

| Sr No | Duration | Flexural Strength (N/mm²) | | Compressive Strength (N/mm²) | |
|---|---|---|---|---|---|
| 1. | 28 Days | 4.56 | 4.57 | 30.22 | 28.74 |
| 2. | | 4.32 | | 27.11 | |
| 3. | | 4.826 | | 28.88 | |
| 4. | 56 Days | 5.6 | 5.73 | 38.22 | 38.74 |
| 5. | | 5.77 | | 38.88 | |
| 6. | | 5.81 | | 39.11 | |

The tables explain multiple tests conducted at different temperatures and with and without presence of fibers in the concrete contents. The cumulative discussions for the tabular results are given below:




**Graph 1: Compression Strength at 6mm**

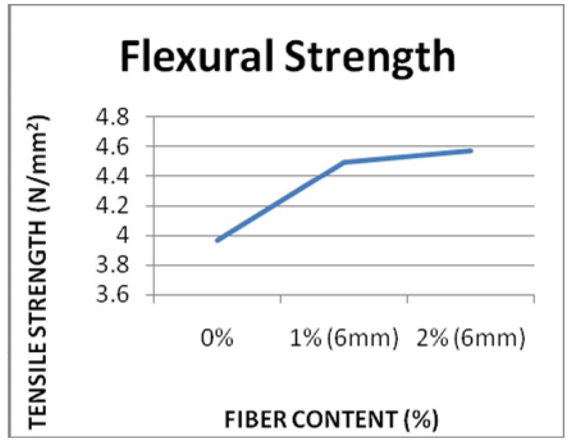



**Graph 2:Compression Strength at 12 mm**

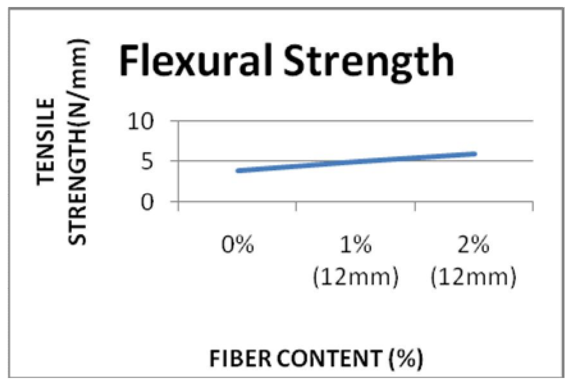
On the basis of the compression tests carried out at the end of 28 Days and 56 Days age of concrete, we have seen that the compressive strength of concrete is more at the age of 56 days compared to that of 28 Days.

This is due to the presence of Fly ash content increases the compressive strength of concrete with its age. Concrete achieves 90-95% of its strength at the age of 28 days itself, but the reaction of Fly ash at this time is nearly 0%. The increase in the compressive strength due to the action of the fly ash is evident only after 56 days' time period. This is the reason why we have obtained an increasing percentage of compressive strength at 56 Days age.

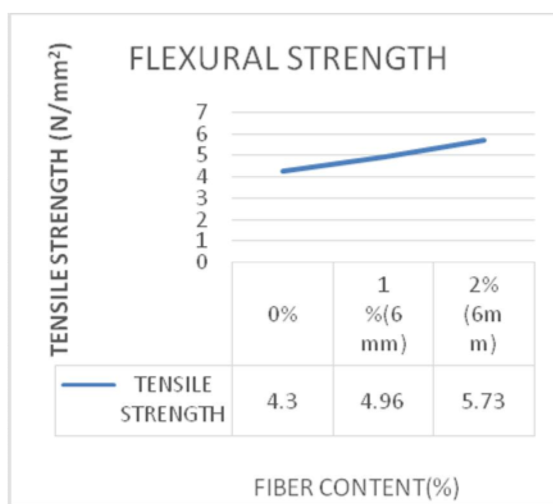
This increase in the compressive strength does not depend upon the variations in the fiber content. Thus, we can say that Fly ash plays a major role in increasing the compressive strength of the concrete mix.



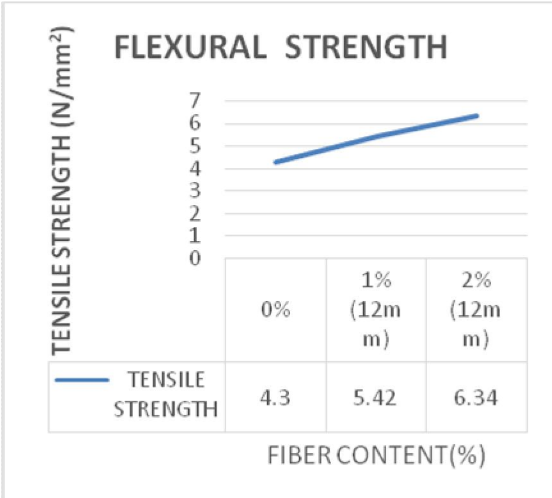

**Graph 3: Comparison for Flexural Strength at age 28 Days (6mm)**




**Graph 4: Comparison for Flexural Strength at age 28 Days (12mm)**




**Graph 5: Comparison for Flexural Strength at age 56 Days (6mm)**




**Graph 6: Comparison for Flexural Strength at age 56 Days (12mm)**

On the basis of the flexural strength tests carried out, we can see that the percentage increase in the flexural strength from 0% fiber content to 1% fiber content of 6mm size is 13.09%. The Increase in flexural strength from 0% to 2% fiber content of 6mm size is 15.11%. This shows that the presence of basalt fiber in the SCC increases its flexural strength progressively. Thus, it can be said that the flexural strength is proportional to fiber content.

## V. CONCLUSION & FUTURE SCOPE

- On the basis of the compression tests carried out at the end of 28 Days and 56 Days age of concrete, we have seen that the compressive strength of concrete is more at the age of 56 days compared to that of 28 Days.
- This increase in the compressive strength does not depend upon the variations in the fiber content. Thus, we can say that Fly ash plays a major role in increasing the compressive strength of the concrete mix.
- We can also see that the increase in the flexural strength from 1% to 2% content was not substantial. The hike in the flexural strength was low, i.e. 1.78% compared to 0% to 1% fiber content.
- To evaluate the reason for the same we can say that as concrete is not a homogeneous material, its properties cannot be ascertained on the basis of the limited number of the tests.
- We need to carry out more trials in this respect which the future is beyond scope of this project.

## REFERENCE

[1] EFNARC "Specifications and Guidelines for Self-Compacting Concrete" February2002.
[2] Wenzhong Zhu, "Permeation properties of self-compacting concrete", Cement and Concrete Research 33 (2003) 921–926
[3] Corinaldesi, "Durable fiber reinforced self-compacting concrete", Cement and Concrete Research 34 (2004) 249–254
[4] OthmaneBoukendakdji, "Effects of granulated blast furnace slag and super plasticizer type on the fresh properties and compressive strength of self-compacting concrete", Cement & Concrete Composites 34 (2012) 583–590
[5] Felekoglu, B. (2007). Utilisation of high volumes of limestone quarry wastes in concrete industry (self-compacting concrete case). Resources, Conservation and Recycling, 51(4), 770-791.
[6] Mansoor, J., Shah, S. A. R., Khan, M. M., Sadiq, A. N., Anwar, M. K., Siddiq, M. U., & Ahmad, H. (2018). Analysis of Mechanical Properties of Self Compacted Concrete by Partial Replacement of Cement with Industrial Wastes under Elevated Temperature. Applied Sciences, 8(3), 364.
[7] Hesami, S., Hikouei, I. S., &Emadi, S. A. A. (2016). Mechanical behavior of self-compacting concrete pavements incorporating recycled tire rubber crumb and reinforced with polypropylene fiber. Journal of cleaner production, 133, 228-234.