IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X.
PP 05-11
www.iosrjournals.org

Deformation Characteristics of Basalt Reinforced Concrete with Superplasticizer

G.K.Geethanjali[1],Mohinder.R[2],Chandraraj.R[2],Venkateshwaran.M[2], Vijayaprabu.M [2]

[1](Assistant professors, Department of civil engineering Easwari engineering college, Chennai)
[2](UG Students, Department of civil engineering Easwari engineering college, Chennai)

Abstract- *Concrete quality is controlled by the flow behavior of cement paste, which is related to the dispersion of cement particle. Superplasticizers(SPs) provide the possibility of better dispersion of cement particle and also provide better workability. In this work two kinds of new generation SPs were used. The strength of concrete in tension is much lower than in compression. A growing tensile crack in plain concrete can very soon lead to failure. The load carrying capacity of concrete in tension can be increased by the addition of fibers. The incorporation of fibers in the concrete leads to an increase in the tensile strength and improvement in cracking resistant.*

The objective of this paper is to investigate and compare the compressive, flexural strength of basalt fiber reinforced concrete in addition to SPs with plain M30 grade concrete and to study the workability properties and workability retention of SPs and fibers. In this, the effect of inclusion of basalt fibers and SPs on the compressive, flexural strength of fiber reinforced concrete was studied. The experimental test results demonstrated at considerable increases in compression, flexural of specimen at 3, 7 and 28 days with addition of basalt fibers and SPs. NDT test like Rebound Hammer test and Ultrasonic Pulse Velocity(UPV) test on concrete mixtures under different stress conditions are seen.

Keywords - *concrete, basalt fiber, super plasticizers*

I. INTRODUCTION

Concrete is a building material composed of cement, fine aggregate, coarse aggregate and water. Every civil engineering construction has its on premeditated purposes. In order to meet this purposes many modification has been brought in ancient cement concrete construction. It has been found that fibers added in specific percentage to concrete improves the mechanical properties, durability of the structure. It is now established that one of the important properties of Fiber Reinforced Concrete (FRC) is its superior resistance to cracking and crack propagation. It contains short discrete fibers that are uniformly distributed and randomly oriented. There are many types fibers available ,they include steel fibers, glass fibers, synthetic fibers and natural fibers – each of which lend varying properties to the concrete.

The fibers are used in the concrete in addition to steel reinforcement..As concrete is weak in tension addition of fibers in concrete leads to increase in structural integrity.

Apart from preserving the integrity of concrete, improves the load-carrying capacity of structural member beyond cracking .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.

Superplasticizer is a type of water reducers; The use of high range water reducer has become a quite common practice. Generally, there are four main categories of superplasticizer: sulfonated melamine-formaldehyde, sulfonated naphthalene-formaldehyde, modified lignosulfonates and others such as sulfonic-acid esters and carbohydrate esters. Effects of superplasticizer are to produce concrete with a very high workability. The ability of superplasticizers to increase the slump of concrete depends on such factors as the type, dosage, and time of addition of superplasticizer; w/c; and the nature or amount of cement. Superplasticized concretes show enormous increases in slump without any significant segregation

II. BASALT FIBERS

Basalt fiber is a material made from extremely fine fibers of basalt, which is composed of the minerals plagioclase, pyroxene, olivine The manufacture of basalt fiber requires the melting of the quarried basalt rock at

about 1,400 °C . It is a commonly known as a basalt roving or continuous filament fiber. It is cost effective, and anti aging .Its color can vary between brown, gold or gravy formed from the molten lava after solidification.

The production of basalt fiber consists of melt preparation, extrusion, fiber formation, application of lubricates and finally winding. The functions of the fibers are to carry the load and provide stiffness, strength, thermal stability. Basalt fiber has a higher compressive strength and higher shear strength. It is used as a load bearing profiles, high pressure vessels, bridges and highways bullet proof vests and retrofitting and rehabilitation of structures.

Fig: 1 Basalt fiber

EXPERIMENTAL PROGRAM

Materials Used

In this the various materials used for the study, their properties, test conducted and results are discussed. This section also explains the mix proportions used for the study.

Cement

The Portland Pozzolona Cement (PPC) is used in this investigation. The following table I is the various tests conducted as per Indian Standard to determine the properties of this cement.

TABLE 1.
PROPERTIES OF CEMENT

S NO.	PROPERTIES	VALUE
1	Specific gravity	31
2	Standard consistency	32%
3	Initial Setting time in minutes	34min
4	Final Setting time in minutes	7hr 35min

Aggregates

The aggregate consists of both fine and coarse aggregates. The fine aggregate, which often referred to sand, is usually taken directly from nature. Coarse aggregate is a material commonly produced by crushing larger rock.

Fine Aggregates

Various tests were conducted to determine the properties of sand which are shown in table II. Grading is the particle-size distribution of an aggregate as determined by a sieve analysis. The test was done according to IS: 2386 (Part 1) – 1963.

TABLE II
PROPERTIES OF FINE AGGREGATE

S.NO	PROPERTIES	VALUE
1	Specific gravity	2.54
2	Fineness modulus	2.4
3	Water absorption	1.5%
4	Zone	II

Coarse Aggregate

Aggregates of 20 mm size were chosen for the experiment which is clean and free from deleterious materials. The following table III shows the tests conducted in order to determine the properties of this aggregate.

TABLE III
PROPERTIES OF COARSE AGGREGATE

S.NO	PROPERTIES	VALUE
1	Specific gravity	2.70
2	Fineness modulus	6.99
3	Water absorption	1.2%

Superplasticizers
The superplasticizer used in the study was conplast Sp430 DIS and ceraplast.

Concrete mix proportions
The mix proportion was done according to the Indian standard Method IS 10262-2009.The target mean strength of control mixture was 30MPa, the total cement content was 462 kg/m3, fine aggregate is taken was 671 kg/m3 and coarse aggregate is taken 1049kg/m3, the water to cement ratio was kept as 0.45, the Super plasticizer content was taken as 0.2% and 0.75 % .The samples were then casted and demoulded after 24 hours. It is then kept for curing until the day of testing. The samples are casted for 100 x 100 x100 mm^3 cubes and 500 x 100 x 100mm^3 Beam. The concrete specimens are tested for 3,7 and 28 days

TEST RESULTS AND DISCUSSIONS
Compressive Strength Test:
Control concrete:
The control concrete cubes casted are tested for 3 ,7,and 28 days respectively, for which NDT test are carried out and test results have been plotted. The graph represents the micro crack initiation stress curve.

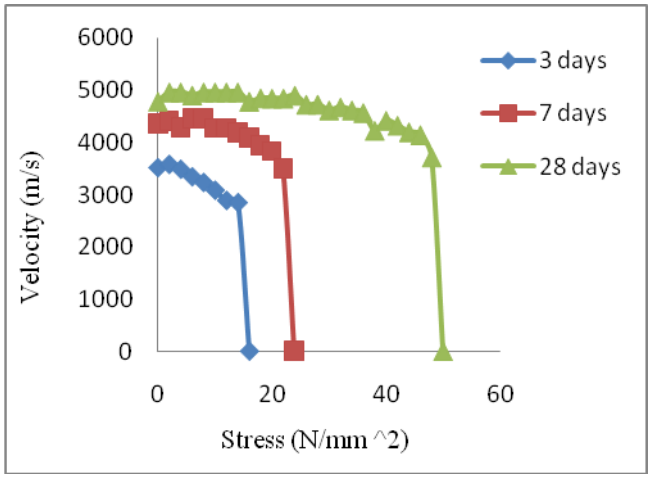

Fig 2 Stress Vs Velocity graph of control concrete

Fig 3 Test for compressive strength along with UPV test

Compressive strength results of basalt and SPs after 28 days

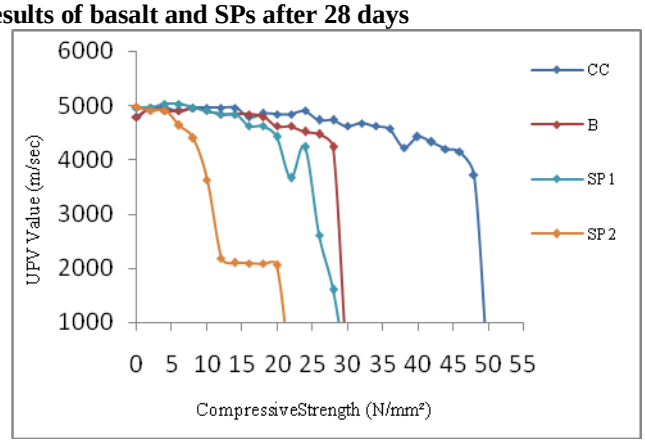

Fig 4 Compressive strength

Compressive Strength Test

The compressive strength is the capacity of a material or structure to withstand loads tending to reduce size. It can be measured by plotting applied force against deformation in a testing machine. Compressive strength were measured at 3, 7, 28 day of testing. The test results are shown in the following table V

TABLE IV
Compressive strength results of specimen

Specification	Compressive Strength (N/mm²)		
	After 3 days	After 7 days	After 28 days
CC	14.583	20.42	41.02
Basalt	21.02	30.93	55
B + SP 1	23.8	26.4	39.73
B + SP	15.33	38.43	42.13
SP 1	23.23	33.23	59.03
SP 2	23.26	33.36	42.83
W. C↓ + SP 1	33.3	49	59.46
W. C↓ + SP 1	23.5	38.5	40.5

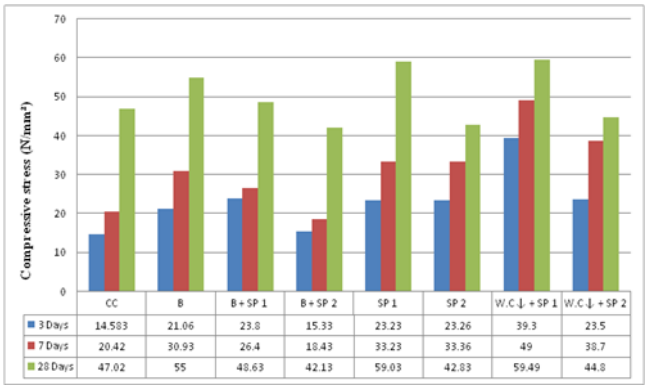

Fig 5 Compressive strength of cubes

Flexural Strength Test

Fig 6 Flexural strength testing of beams

The flexural Strength were tested at 28 day of testing for control mix and basalt fiber concrete mixes with superplasticizer. The test results are presented in the below.

TABLE V
Flexural strength results of specimen

Sl. No	Specification ID	Ultimate Load (KN)	Flexural Strength (N/mm²)
1	Control Concrete	9.66	4.83
2	Basalt	13.8	6.9
3	Basalt + SP 1	9.9	4.95
4	Basalt + SP 2	11.6	5.8
5	SP 1	11.42	5.71
6	SP 2	10.73	5.38
7	20 %red. + SP 1	12.2	6.1
8	20 %red. + SP 2	12.4	6.2

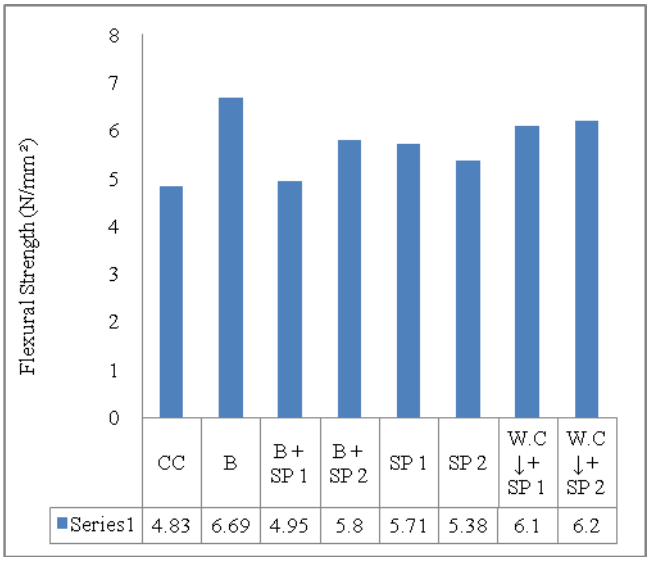

Fig 7 Flexural strength of cubes

III. CONCLUSION

Based on the experiments conducted on basalt reinforced concrete with super plasticizer the following conclusions can be made:

- It has been observed that the workability of concrete decreases with the addition of Basalt Fibers. But this difficulty can be overcome by using super-plasticizers. From results SP1 gives better flow and strength properties.
- The percentage increase of flexural strengths of basaltfiber,B+SP1,B+SP2,SP1,SP2,WC+SP1,WC+SP2 concrete mixes compared with 28 days compressive strength of Plain Concrete is observedas42.85%,2.48%,20.08%,18.21%,11.38%,26.29%,28.36% respectively. According to the results basalt fiber mix provides maximum increased in compressive strength and SP2 added Mixes did not provide significant improvement even though they produced better results when compared to plain cement concrete mix.
- The percentage increase of compressive strength of basalt fiber,B+SP1,SP1,WC+SP1,concrete mixes compared with 28 days flexural strength of Plain Concrete is observed as 16.97%,3.42%,25.54%,26.52% respectively. It is observed that the samples of Basalt,SP1,WC+SP1 give significant improvement in compressive strength. Among those 20% water reduced SP1 mix gives maximum improvement in compressive strength .
- It was observed that, the percentage increase in the strength of basalt reinforced concrete, superplasticizer added concrete increase with the age of concrete.
- All mixes after 28 days provide excellent(above 4500m/s) results in UPV value according to quality of concrete given by is code (BS, 1881, 1983) as a function of UPV.
- Also it was found from the failure pattern of the specimens, that the formation of cracks is more in the case of concrete without fibers than the basalt fiber reinforced concrete.
- It shows that the presence of fibers in the concrete acts as the crack arrestors. The ductility characteristics have improved with the addition of basalt fibers. The failure of fiber concrete is gradual as compared to that of brittle failure of plain concrete.
- From the results of cyclic load graphs it is observed that After unloading, there is a certain amount of elastic recovery and some residual
- Strain, that is, a permanent elongation of the specimen. Upon reloading, the unloading curve is followed.Basalt,B+SP1,SP1 provide excellent results in residual strength.

FINDINGS OF EXPERIMENT

- As far from the study of experimental that the strength of basalt fiber will gain more, than the design mix after 28days.Use of basalt reduces the workability that can be rectified with the use of SP1which provides extra strength in addition to improved workability properties.
- When Basalt in contact with other chemicals they produce no chemical reactions that may damage health or the environment. Basalt base composites can replace steel and known reinforced plastics (1 kg of basalt reinforces equals 9.6 kg of steel).
- Basalt can replace almost all applications of asbestos and has three times its heat insulating properties. Basalt is well known as a rock found in virtually every country round the world. Basalt rock is more in India (specially in Maharashtra). The cost of basalt is 10 times lower than that of raw materials for fiberglass.
- Basalt is more available than any other raw material. Also the melting temperature is lower, thus energy consumption lower. Thus, the cost of basalt fiber is considerable lower than that of similar materials.
- This experimental study mainly predicts the medium strength concrete can be safely extended to high strength concrete by adding chemical admixtures like SP1. From the present investigation it is observed that the experimental characteristic compressive strength of the cubes is nearly 20 to 26.52% more, than the medium, plain concrete cube compressive strength.

ACKNOWLEDGEMENT

We wish to express our deep sense of gratitude to **Dr.M.Neelamegam**, Professor, Department of Civil Engineering, for his valuable guidance, constant encouragement and motivation throughout the project work. I am deeply indebted to him for the inspiration he has nurtured and developed during the period of this work.

References

[1]. Concrete Technology, M.S. Shetty – 2007
[2]. IS 10262:2009 Concrete mix proportioning –guidelines (first revision).
[3]. IS 456:2000 Plain and reinforced concrete–code of practice (fourth revision)
[3] High Performance Concrete: Properties and Applications-by SP SHAH & SH AHMAD.
[4] The Indian Concrete Journal, Vol.80, June 2006
[6]. Y.F. Houst (1999) "Superplasticizer – Reinforcing Filler for Composites." Powder Metallurgy and Metal Ceramics, Vol.33 (9-10), 555-557.
[7]. Salvatore (2011). "Compressive behavior of Basalt Fiber Reinforced Composite." International Journal of Structural Analysis & Design, Volume 1: Issue 1, pp. 50-53.
[9]. Bin (2011) "An investigation on strength characteristics of basalt fiber reinforced concrete." International journal of Engineering Research, Vol. 2(5), pp.64-67.