A STUDY ON EFFECT OF DIFFERTENT TYPES OF FIBERS ON PROPERTIES OF SELF COMPACTING CONCRETE

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Abstract: To enhance the physical properties of concrete various types of fibers like glass fibers, basalt fibers, polypropylene fibers, steel fibers are used from time to time. Moreover there are various situations where the concrete is required to be self-compacting without external vibration and have good workability. A special type of concrete called self-compacting concrete (S.C.C.) which settles under its own weight is prepared by using chemical admixtures like superplasticizers. In this project we will analyze the mechanical properties of self-compacting concrete prepared by using super plasticizer Polycarboxylic ether along with addition of a small percentage of Basalt fiber and Polypropylene fibers. We will first make a mix design of M25 grade self-compacting concrete find out its workability and Compressive strength on 7 days and 28 days. After that we will make 6 more batches of S.C.C. with addition of 1%, 0.5%, 0.25% basalt fiber and polypropylene fibers respectively and find out its workability and compressive strength, and we will compare the workability and compressive strength to the nominal mix produced earlier.

Keywords: Basalt fiber, Polypropylene fiber, Self-Compacting Concrete, Compressive Strength, Workability

INTRODUCTION

Self-compacting concrete: Self-compacting concrete or SCC is a special type of concrete developed in japan in 1980s its specialty is that it is able to flow under its own weight completely filling whole formwork and achieving full compaction, it does not require any external compaction or vibration.

Basalt fiber: Basalt is an igneous rock formed from the rapid cooling of magnesium-rich and iron-rich lava exposed at or very near the surface of a terrestrial planet or a moon. More than 90% of all volcanic rock on Earth is basalt. Basalt lava has a low viscosity, due to its low silica content, resulting in rapid lava flows that can spread over great areas before cooling and solidification. The manufacture of basalt fiber requires the melting of the crushed and washed basalt rock at about 1,500 °C (2,730 °F). The molten rock is then extruded through small nozzles to produce continuous filaments of basalt fiber.

Polypropylene fiber: Polypropylene fiber is a synthetic fiber formed by polypropylene melt. Polypropylene (PP), also known as polypropene, is a thermoplastic polymer used in a wide variety of applications. It is produced via chain-growth polymerization from the monomer propylene.

MATERIAL

1.CEMENT OPC-43 has been used for this study.

Table 1 Physical Properties of OPC-43

Characteristics	Test Result	Recommended Value (As per IS 8112:1989)**Error! Reference source not found.**
Fineness	94%	≥90%
Consistency	30.5%	27-32 %
Initial Setting Time	110 minute	30 minute (Minimum)
Final Setting Time	217 minute	600 minute (Maximum)

2. FINE AGGREGATE
Locally available aggregates passing through 4.75mm sieve and retained on .7mm sieve are used as fine aggregate.
Grading Zone of fine aggregate - Zone II
Specific Gravity = 2.76
Silt content = 1.26 %

3. COARSE AGGREGATE

Size of coarse aggregates used 10mm
Specific gravity of coarse aggregates = 2.71

4. BASALT FIBER Finely chopped basalt fiber of 12 mm is used.

Table 2. Physical properties of basalt fiber

Property	Value
Length	12mm
Diameter	9µ
Specific Gravity	2.7
Tensile Strength	400-695 MPa

5. POLYPROPYLENE FIBER

Table 3. Physical properties of polypropylene fiber

Property	Value
Length	12mm
Diameter	9µ
Specific Gravity	0.91
Tensile Strength	550-700 MPa

6. ADMIXTURE

Polycarboxlate Ether Superplasticizer is chemical admixture used to increase the workability of concrete. And it reduces the water cement ratio without negatively affecting the workability. IS 9103:2007**Error! Reference source not found.** is referred.

Table No. 4 Properties of Superplasticizer

Property	Value
Specific Gravity	1.15
Chlorides	Nil
Nitrates	Nil
Sulphates	0.5%
Appearance	Straw Coloured liquid
Freezing point	+5 ºC Material can be reconstituted by agitating at 30 ºC.
Role in Concrete	Improves workability and flow properties of concrete.

EXPERIMENTAL PROCEDURE

To find out the compressive strength of the concrete we will cast 6 cubes of dimensions 150m*150m*150mm for each batch 3 cubes will be tested on 7 days and 3 cubes will be tested on 28 days of casting. We will make one batch of nominal mix N1 with 0% addition of any fiber, Three batches P1, P2, P3 with of polypropylene fiber (by weight of cement) respectively and three batches B1,B2,B3 with 0.25%, 0.5%, 1% of basalt fiber respectively.

Table No.5 Mix Design

Cement	w/c	Fine Aggregate	Coarse Aggregate	Superplasticizer
1	0.45	2.02	1.686	0.01

Table No. 6 Mix Proportion

Batch name	wt. of cement Kg.	Wt. of water Kg.	Wt. of superplasticizer Kg.	Wt. of fine Aggregate Kg.	Wt. of coarse Aggregates Kg.	Wt. of fibers Kg.
N	9.85	4.43	0.098	19.94	16.61	0
B1	9.85	4.43	0.098	19.94	16.61	0.098
B2	9.85	4.43	0.098	19.94	16.61	0.049
B3	9.85	4.43	0.098	19.94	16.61	0.025

P 1	9.85	4.43	0.098	19.94	16.61	0.098
P2	9.85	4.43	0.098	19.94	16.61	0.049
P3	9.85	4.43	0.098	19.94	16.61	0.025

For making concrete all the materials are weighted according to the mix design , while mixing, first coarse aggregate, fine aggregate and cement was poured in mixer and machine was started to rotate and material was allowed to mix dry. A small amount of cement is taken separately in which the fibers are added thoroughly and this mixture is poured in the mixer. After few minutes water was added in mix in two installments, in first installment half of water was poured in to the mixer, in second installment rest of the water mixed with Superplasticizer was applied. And the machine was allowed to rotate for few minutes. After the fresh mix was prepared, the properties of fresh concrete were checked, workability of self compacting concrete was checked through L-Box and V Funnel tests. And after that, to check the compressive strength of concrete cubes were casted by pouring the concrete mix into the lubricated moulds the moulds are unscrewed after 24 hours and the cubes are immersed into the curing tank for curing process.

RESULT AND DISCUSSION

WORKABILITY

With increase in percentage of fibers the workability of concrete decreases which also result in decrease in the ability of concrete of passing and filling which is essential for self compacting concrete. To check these properties V Funnel, L-Box tests are done. It was found that the workability of concrete is decreasing with the increase of addition of fiber content due to the fact that fiber particle generate friction and create hindrance in the flow of concrete.

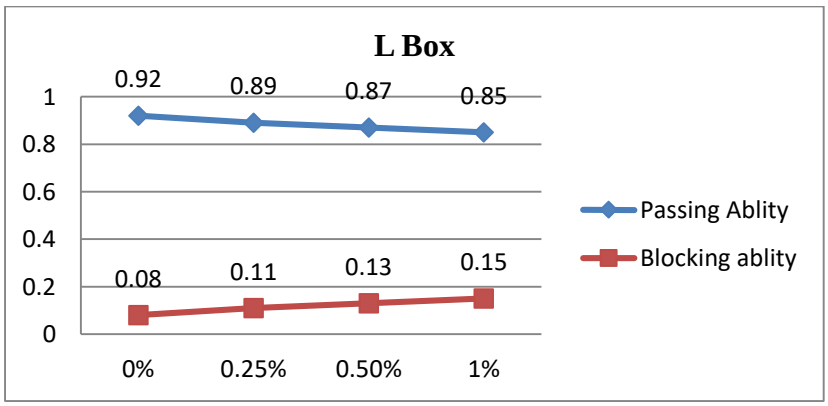
L Box shows the passing ability of concrete. L Box result shows that passing ability of concrete is decreasing with increase of percentage of both the fibers.The decrease in workability is more in the case of polypropylene fiber

Table 7. L Box results on addition of basalt fibers

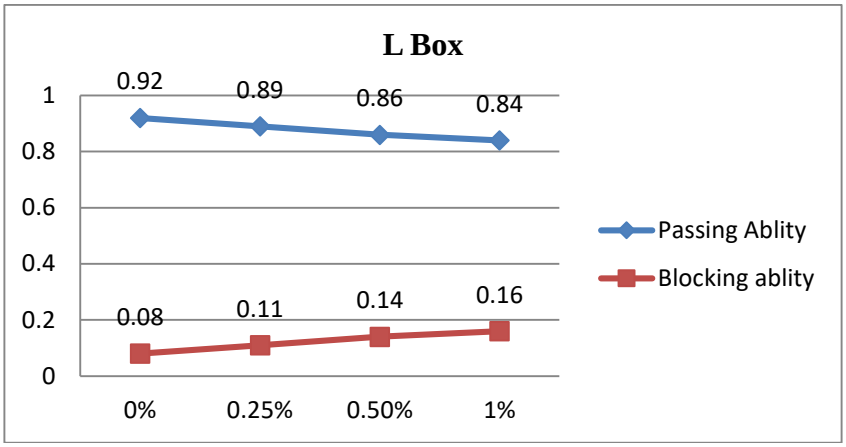
Batch	P_L	B_L
Batch N nominal mix	0.92	0.08
Batch B1 0.25% basalt	0.89	0.11
Batch B2 0.5% basalt	0.87	0.13
Batch B3 1% basalt	0.85	0.15

Table 8. L Box results on addition of polypropylene fibers

Batch	P_L	B_L
Batch N nominal mix	0.92	0.08
Batch P1 0.25% polypropylene	0.89	0.11
Batch P2 0.5% polypropylene	0.86	0.14
Batch P3 1%polypropylene	0.84	0.16



Graphical representation of L box test on addition of basalt fibers



Graphical representation of L box test on addition of polypropylene fibers

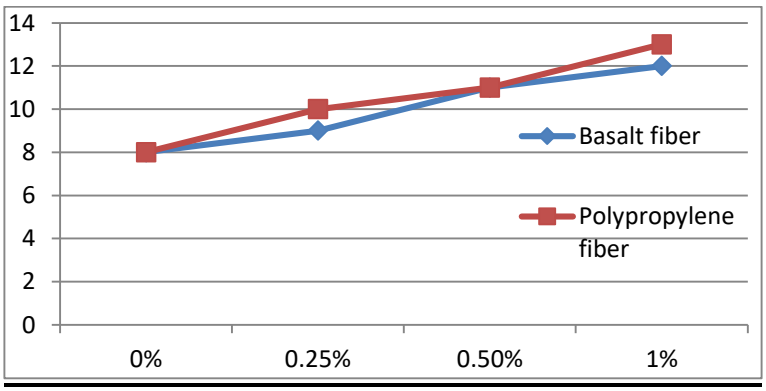
V Funnel shows the flowability of concrete. Result shows increase in time with increase in increase of percentage of fibers. That means flowability is decreasing. It can be seen in table no. 8 and 9 that with increase in the percentage of fibers the flow time of concrete is increased which is more for polypropylene fibers.

Table No.9 V Funnel result for basalt fiber

Batch	Time (second)
Batch N nominal mix	8
Batch B1 0.25% basalt	9
Batch B2 0.5% basalt	11
Batch B3 1% basalt	12

Table No.10 V Funnel result for polypropylene fiber

Batch	Time (second)
Batch N nominal mix	8
Batch P1 0.25% polypropylene	10
Batch P2 0.5% polypropylene	11
Batch P3 1% polypropylene	13



Graphical representation of V funnel test result

COMPRESSIVE STRENGTH

Table 11. 7 day compressive strength test result on addition of basalt fiber

Batch	Compressive strength MPa
Batch N nominal mix	20.06
Batch B1 0.25% basalt	23.26
Batch B2 0.5% basalt	14.1
Batch B3 1% basalt	12.66

Table 12. 7 day compressive strength test result on addition of polypropylene fiber

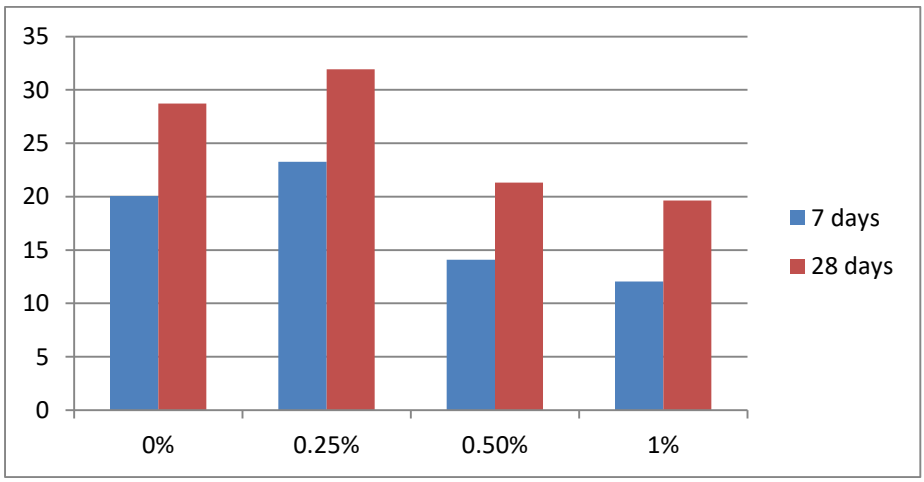
Batch	Compressive strength MPa
Batch N nominal mix	20.06
Batch P1 0.25% polypropylene	25.7
Batch P2 0.5% polypropylene	21.6
Batch P3 1% polypropylene	15.3

Table 13. 28 day compressive strength test result on addition of basalt fiber

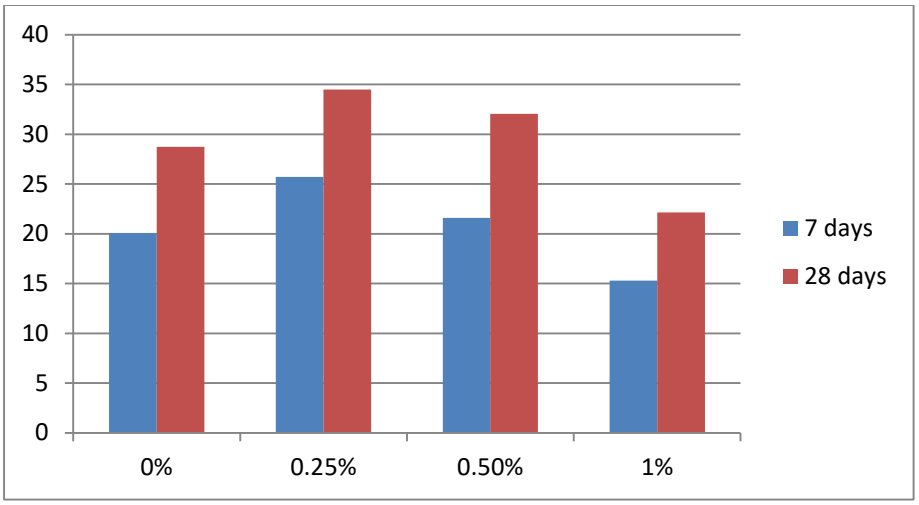
Batch	Compressive strength MPa
Batch N nominal mix	28.73
Batch B1 0.25% basalt	31.93
Batch B2 0.5% basalt	21.23
Batch B3 1% basalt	19.63

Table 14. 28 day compressive strength test result on addition of polypropylene fiber

Batch	Compressive strength MPa
Batch N nominal mix	28.73
Batch B1 0.25% polypropylene	34.3
Batch B2 0.5% polypropylene	32.03
Batch B3 1% polypropylene	22.13



Graphical representation of Compressive strength on addition of basalt fiber MPa



Graphical representation of Compressive strength on addition of polypropylene fiber MPa

CONCLUSIONS

1) On addition of fibers the workability of self compacting decreases. Increasing the percentage of fibers further decreases the workability.
2) The decrease in workability is more on addition of polypropylene fibers than on addition of basalt fibers for same percentage.
3) In case of basalt fiber both 7 days and 28 days compressive strength are more than nominal strength for 0.25 percent addition of fiber. But on further increasing the fiber content the compressive strength is lesser than nominal strength.
4) In case of polypropylene fiber both 7 days and 28 days compressive strength are more than nominal strength. On increasing the fiber percentage to 0.5 percent compressive strength is reduced but is still more than nominal strength, but on increasing fiber content to 1 percent the compressive strength is lesser than nominal strength.

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