Experimental Investigation of Chopped Glass Fibres on Strength of Concrete Tile

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Abstract- Effect of glass fibre on split-tensile strength, flexural strength & compressive strength was studied for different fibre content for M-20 grade concrete. The fibre content was varied from 0% to 0.3% of the total weight of concrete. After that a practical application of GFRC in the form of cement concrete tiles was taken into consideration and no special technique was used to produce this tiles. The thickness of the tiles was 20mm and maximum size of aggregates used was 8mm.The water cement ratio was kept consistent. The mix proportion used was 1:1.5:3. The size of short fibres used was 30mm and the glass fibres were alkali resistant and fibre content was varied from 0% to 0.7% of the total weight of concrete. The effect of these short fibres on wet transverse strength, compressive strength and water absorption was carried out. Six full sized tiles 400mm*400mm*20mm were tested and the results recorded. Pulse velocity tests were also conducted.

I. INTRODUCTION

Concrete is brittle by nature and possess very low tensile strength and therefore fibers are used in one form or another to increase its tensile strength and decrease the brittle behavior. Fibres which are applied for structural concretes are classified according to their material As Steel fibers, Alkali resistant Glass fibres (AR), Synthetic fibres, Carbon, pitch and polyacrylonitrile (PAN) fibres.

Glass fibre reinforced concrete (GFRC) is a cementitious composite product reinforced with discrete glass fibres of varying length and size. The glass fibre used is alkaline resistant as glass fibre are susceptible to alkali which decreases the durability of GFRC. Glass strands are utilized for the most part for outside claddings, veneer plates and different components where their reinforcing impacts are required during construction. GFRC is stiff in fresh state has lower slump and hence less workable, therefore water reducing admixtures are used. Further the properties of GFRC depend on various parameters like method of producing the product. It can be done by various methods like spraying, casting, extrusion techniques etc. Cement type is also found to have considerable effect on the GFRC. The length of the fibre, sand/filler type, cement ratio methods and duration of curing also affect the properties of GFRC.

II. FORMULATION OF WORK

Stage-I

In this stage the effect of glass fibre on flexural strength, split-tensile strength and compressive strength was studied for different fibre content on M-20 grade concrete.

Batch Mix	Cement (%)	Sand (%)	Aggregate (%)	Glass Fibre (%)
1	100	100	100	0
2	100	100	100	0.1
3	100	100	100	0.2
4	100	100	100	0.3

Stage-II

In this Stage cement concrete tiles was taken into consideration and wet transverse strength, compressive strength and water absorption test was carried out.

Batch Mix	Cement (%)	Sand (%)	Aggregate (%)	Glass Fibre (%)
1	100	100	100	0
2	100	100	100	0.1
3	100	100	100	0.2
4	100	100	100	0.3

5	100	100	100	0.4
6	100	100	100	0.5
7	100	100	100	0.6
8	100	100	100	0.7

RESULTS & DISCUSSION

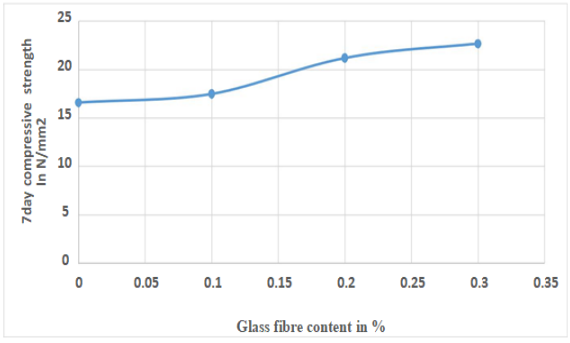
The stage I results obtained are shown below in tabular & graphical form.

Compressive Strength of Concrete (in N/mm2)

The 7 day compressive strength was studied and the values of 3 samples studied are shown in the tabular form. Table shows the data of 7 days compressive strength obtained. Table gives the 7 day compressive strength of concrete with maximum nominal size of aggregates 20mm.The 7 days compressive strength was also plotted Fig by taking the average of this three values overall an increase in the compressive strength was observed with addition of fibers.

7 day compressive strength of concrete

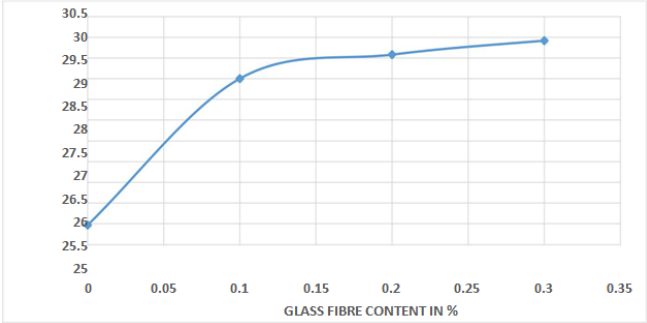
Serial number	Without fibre	0.1% fibre	0.2% fibre	0.3% fibre
1	16.89	17.77	21.33	22.22
2	16.44	17.33	20.88	22.67
3	16.44	17.33	21.33	23.11



28 day compressive strength of concrete

The 28 days compressive strength was studied and the values of 3 samples studied are shown in the tabular form. Table 2 shows the data of 28 days compressive strength obtained. Table 2 gives the 28 days compressive strength of concrete with maximum nominal size of aggregates 20mm.The 28 days compressive strength was also plotted Fig3 by taking the average of this three values overall an increase in the compressive strength was observed with addition of fibers.

Serial number	Without fibre	0.1% fibre	0.2% fibre	0.3% fibre
1	25.33	28	28.88	30.22
2	25.77	31	28.88	28.88
3	25.33	28	31	30.66

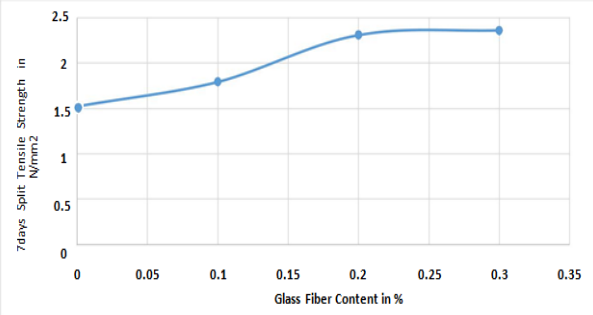


Split Tensile Strength of Concrete (in N/mm2)

The 7 days Split Tensile strength was studied and the values of 3 samples studied are shown in the tabular form Table shows the data of 7 days Split Tensile strength obtained. Table gives the 7 days Split Tensile strength of concrete with maximum nominal size of aggregates 20mm.The 7 days Split Tensile strength was also plotted Fig by taking the average of this three values overall an increase in the Split Tensile strength was observed with addition of fibers.

7 day split tensile strength of concrete

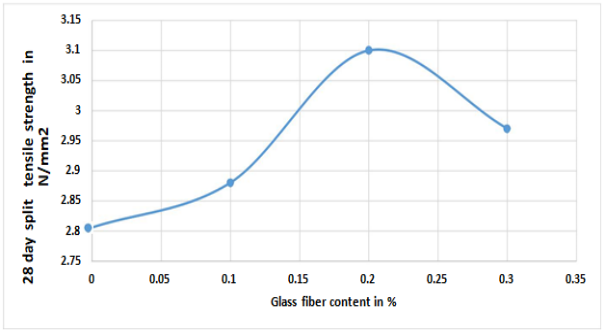
Serial number	Without fibre	0.1% fibre	0.2% fibre	0.3% fibre
1	1.485	1.84	2.405	2.405
2	1.626	1.70	2.26	2.405
3	1.45	1.84	2.26	2.263



28 day split tensile strength of concrete

The 28 days Split Tensile strength was studied and the values of 3 samples studied are shown in the tabular form. Table shows the data of 28 days Split Tensile strength obtained. Table gives the 28 days Split Tensile strength of concrete with maximum nominal size of aggregates 20mm.The 28 days Split Tensile strength was also plotted Fig by taking the average of this three values overall an increase in the Split Tensile strength was observed with addition of fibers.

Serial number	Without fibre	0.1% fibre	0.2% fibre	0.3% fibre
1	2.829	2.83	2.97	2.97
2	2.76	2.83	2.97	2.97
3	2.829	2.97	3.35	2.97

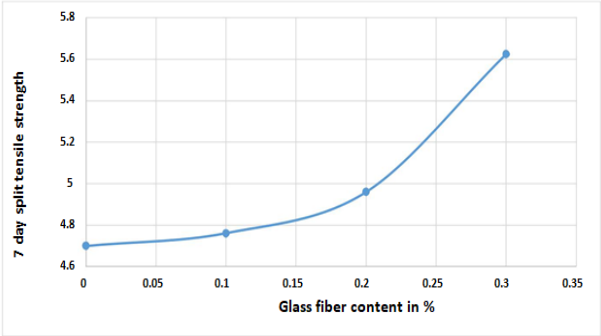


Flexural Tensile Strength of Concrete (in N/mm2)

The 7 days Flexural Tensile strength was studied and the values of 3 samples studied are shown in the tabular form Table shows the data of 7 days Flexural Tensile strength obtained. Table gives the 7 day Flexural Tensile strength of concrete with maximum nominal size of aggregates 20mm.The 7 days Flexural Tensile strength was also plotted Fig by taking the average of this three values overall an increase in the Flexural Tensile strength was observed with addition of fibers.

7 day flexural tensile strength of concrete

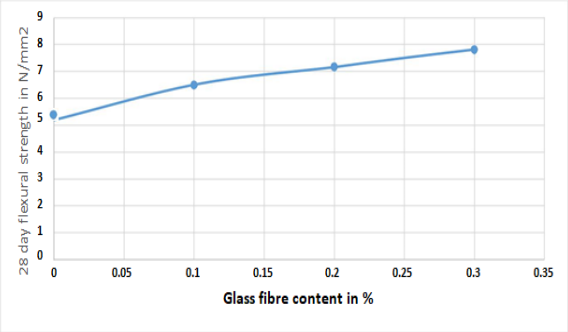
Serial number	Without fibre	0.1% fibre	0.2% fibre	0.3% fibre
1	4.6	4.744	4.988	5.744
2	4.7	4.776	4.988	5.424
3	4.8	4.756	4.9	5.704



28 day flexural tensile strength of concrete

The 28 days flexural tensile strength was studied and the values of 3 samples studied are shown in the tabular form. Table shows the data of 28 days Flexural Tensile strength obtained. Table gives the 28 days Flexural Tensile strength of concrete with maximum nominal size of aggregates 20mm.The 28 days flexural tensile strength was also plotted Fig by taking the average of this three values overall an increase in the Flexural Tensile strength was observed with addition of fibers.

Serial number	Without fibre	0.1% fibre	0.2% fibre	0.3% fibre
1	5.104	6.368	7.544	7.156
2	5.204	6.456	7.104	7.96
3	5.242	6.652	6.844	8.32



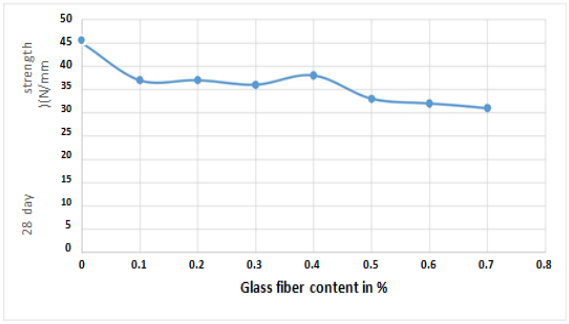
The stage II results obtained are shown below in tabular & graphical form.

Cement and concrete tiles were tested as per IS 1237:2012.The test performed were wet transverse strength, water absorption test .Compressive strength test is not mentioned in the code but it was performed as fibers can reduce the strength of the concrete. Pulse velocity test and natural frequency test were also conducted. The results obtained are given below in tabular form.

28days Compressive Strength of Concrete Tile

The 28 days Compressive strength was studied and the average values of 3 samples studied are shown in the tabular form. Table shows the data of 28 days compressive strength obtained. Table gives the 28 days compressive strength of concrete with maximum nominal size of aggregates 8mm.The 28 days compressive strength was also plotted as shown Fig overall a decrease in the compressive strength was observed with addition of fibers.

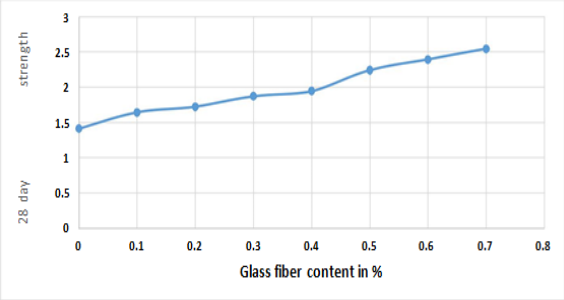
Fibre content(% of the total weight of concrete)	WEIGHT(KG)	Average 28 days compressive strength (N/mm^2)
0	2.495	45
0.1	2.478	37
0.2	2.478	37
0.3	2.500	36
0.4	2.487	38
0.5	2.500	33
0.6	2.400	32
0.7	2.390	31



Wet transverse strength

The 28 days flexural tensile strength was studied and the average values of 3 samples studied are shown in the tabular form. Table shows the data of 28 days wet transverse strength obtained. Table gives the 28 days wet transverse strength of concrete with maximum nominal size of aggregates 8mm.The 28 days wet transverse strength was also plotted as shown in Fig overall an increase in the wet transverse strength was observed with addition of fibers.

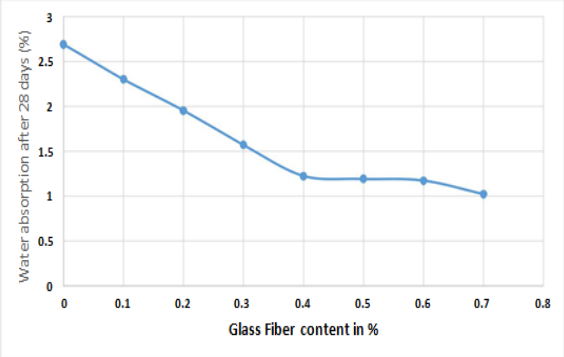
Fibre content(% of the total weight of concrete)	Average 28 day transverse strength (N/mm^2)
0	1.41
0.1	1.64
0.2	1.72
0.3	1.87
0.4	1.944
0.5	2.24
0.6	2.39
0.7	2.542



Water absorption

The water absorption of concrete after 28 days was studied and the average water absorption values of 6 samples obtained are shown in the tabular form. Table shows the data of 28 days water absorption obtained. Table gives the 28 days water absorption of concrete with maximum nominal size of aggregates 8mm.The 28 days water absorption was also plotted as shown in Fig overall decrease in the water absorption was observed with addition of fibers.

Fibre content(% of the total weight of concrete)	Average water absorption after 28 days (%)
0	2.69
0.1	2.30
0.2	1.95
0.3	1.57
0.4	1.22
0.5	1.19
0.6	1.17
0.7	1.02



Pulse Velocity test

Pulse velocity test was carried out on the tiles and the average values of the velocities which were not varying more than 15% are reported and the implications are shown in Table.

Fibre content(% of the total weight of concrete)	Average velocity(m/s)	Grade of concrete
0	4497	Good
0.1	4800	Excellent
0.2	4365	Good
0.3	4612	Excellent
0.4	4395	Good
0.5	4458	Good
0.6	4386	Good
0.7	4436	Good

III. CONCLUSIONS

In this experimental program the effect of short discrete glass fibers on the compressive, split tensile strength and flexural strength of concrete was studied. The effect of glass fibres on cement and concrete tiles which are produced by vibration method are also studied. The properties studied are compressive strength, wet transverse strength and water absorption .The concrete mix gets harsher and less workable with increase of fiber content also the workability could not be obtained and some segregation was observed. Therefore it was not possible to go beyond 0.7% fiber content.

The various observations based on the experimental result are as follows:

1. The compressive strength of concrete without admixture is not affected by the presence of short discrete glass fibers with fibre content in the range 0.1 to 0.3 % of fiber content by weight of concrete.
2. The split tensile strength of concrete increases with the addition of glass fibers.
3. The flexural strength of concrete increases with increase in fiber content and as such the tension carrying capacity of concrete may increase in flexure.
4. The wet transverse strength of tiles increases and the increase has been found with addition of fibers.
5. The water absorption of the concrete decreases with increase in fiber content.

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