



INVESTIGATION ON STRENGTH AND BEHAVIOUR OF TILES PREPARED WITH GLASS FIBRE CONCRETE

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ABSTRACT

Concrete being brittle is weak in tension. The inclusion of fibres in concrete have significantly improves its compressive as well as tensile strength. The use of different types of fibres & their orientation in the matrix have shown positive responses among the researchers. In the present study alkali resistant glass fibres were used in the concrete mixes. A total of 8 mixes were prepared by varying the percentages of glass fibres and grade of concrete mixes. Based on the laboratory results the compressive and tensile strength was reported to increase up to 26.19% and 25.4%. However the workability of concrete mixes is not much affected by the addition of fibres. The tensile strength of concrete is improved which shows the use of glass fibres in concrete mixes may reduce its shortcoming of low tensile strength without affecting its workability and compressive strength.

Keywords: *Compressive Strength, Split Tensile Strength, Glass Fibers, Grade of concrete.*

1. INTRODUCTION: Reinforcement is provided in the concrete not only to improve its tensile property but also to improve the durability properties of concrete. Concrete structures are subjected to very aggressive environment. To overcome the deterioration of concrete and to enhance the durability of concrete, reinforcement is provided. Without reinforcement concrete is imperiled to catastrophic failure when it is subjected to pure compressive force. Reinforcement provided in concrete will prohibit such catastrophic failure and also reduce the progression of cracks, thereby enhancing the mechanical property of concrete. Addition of fiber in concrete will decrease the development of holes at certain

degrees and also the failure of concrete at interface zone gets reduced [1]. Chopped glass fibers which are alkaline resistant shows marginal increase in strength properties of concrete. Workability of concrete is not much affected by the addition of fibers [2]. With consistent increase in addition of fibers up to 1% shows marginal improvement in strength of concrete. Such 1% addition of glass fiber in concrete shows the saturation limit, which means addition of fiber beyond 1% shows marginal reduction in strength of the concrete [3] [4]. Glass fibers which are alkaline resistant can be used in retrofitting of concrete structures. Innovations were made in glass fiber reinforced concrete with gypsum plaster can be used for construction of hollow panels. Such hollow wall panels can be used as load bearing structures [5]. The ratio of surface area to weight is high compared to other fibers. Thermal conductivity of glass fiber reinforced concrete is in the order of 0.05 w/mk. Use of Glass fiber in tension zone of reinforced concrete beam reduces the cracking and improves the durability. This is mainly due to the redistribution of moments within the reinforcement. Altering the composition of cement matrix with E glass fiber and alkaline resistant glass fiber will improve the strength and durability of concrete. Aspect ratio has greater influence on strength and durability properties of concrete. Glass fiber reinforced shows

good fire resistant property up to 1% replacement [6]. Addition of glass fiber in concrete reduces bleeding, improves the homogeneity and thereby reducing the probability of cracks [7]. Major problem that arises while providing reinforcement is corrosion. Glass fibers are not susceptible to corrosion, but its gets deteriorated due to chloride ingress. Glass fiber reinforced concrete shows less ingress of chloride ions into concrete [11]. Ultrasonic pulse velocity behavior of glass fiber reinforced shows better results. Workability of glass fiber reinforced concrete reduced with increase in the replacement percentage. This can be overcome by adding some plasticizers/water reducing admixtures [13]. Water penetration and gas permeability of fibers increases with increase in addition of fibers. Steel fibers has highest gas permeability and less scaling resistance compared to all fibers. Only few researches have been carried out in durability point of view. So in this work an attempt has been taken to study both strength and durability of concrete reinforced with glass fibers.

2. OBJECTIVES

- To study the strength property of chopped glass fiber reinforced concrete.
- To study the durability property of chopped glass fiber reinforced concrete.
- To analyze the optimum fiber concrete to improve its strength and durability properties.

3. EXPERIMENTAL PROGRAMME

The experimental Programme involves various processes of material testing, mix proportioning, mixing, casting and curing

of test specimens which is elaborated in the following sections.

A. Materials Used The materials used in the preparation of concrete mix includes cement, fine aggregates, coarse aggregates and glass fibres. Each material was tested & its physical properties are described below.

Cement Ordinary Portland cement of 43 grade were used, conforming to recommendations stated in IS 4031(1999). The normal consistency and initial setting time of cement was 30% and 30 minutes respectively.

Fine Aggregate Coarse sand locally available to us was used as fine aggregate. The test procedures as mentioned in IS-383(1970) were followed to determine the physical properties of fine aggregate as shown in Table 1.

Coarse Aggregate Two single sized crushed stone aggregates ranging from 12.5 mm to 2.36 mm and 20 mm to 4.75 mm (10mm and 20mm sizes) were used in respective proportions in concrete mixes. The aggregates were tested in accordance to IS-383: (1970). The results obtained are tabulated in Table 2.

Glass Fibre Cem-Fil Anti-Crack, HD-12mm, Alkali Resistant glass fibres were used throughout the experimental work. From the micro to the macro fibre range, these fibers control the cracking processes that can take place during the life-span of concrete. The specifications of these fibres are presented in Table 3.

Water As per recommendation of IS: 456 (2000), the water to be used for mixing and curing of concrete should be free from deleterious materials. Therefore potable

water was used in the present study in all operations demanding control over water quality.

Table 1: Physical Properties of Fine aggregate

Physical Properties	Observed values	Recommended values
Grading Zone	1	-
Fineness modulus	3.173	2.9-3.2
Specific Gravity	2.632	2.6-2.67

Table 2: Physical Properties of coarse aggregate

Physical Properties	Observed values		Recommended values
	10mm aggregate	20mm aggregate	
Fineness Modulus	6.28	7.11	6.5-8.0
Aggregate crushing value (%)	18.15	25.13	Not more than 45%
Aggregate impact value (%)	28.63	22.10	Not more than 45%

Table 3: Physical Properties of Glass Fibre [10]

Physical Properties	Recommended values by the supplier
Specific gravity	2.68
Elastic Modulus (Gpa)	72
Tensile Strength (Mpa)	1700
Length (mm)	12

4. RESULTS AND DISCUSSION

The results obtained are presented in Table 5. Result shows that as the percentage of glass fibers increases in the mix there is corresponding increase in the strength. Apart from this workability of the mixes is also affected by the addition of fibers.

Table 4: Mix details of Glass Fiber Concrete Mixes

MIX NO.	Grade of concrete	WC	% of Glass fibers	Cement (Kg/m ³)	Fine Aggregate (Kg/m ³)	Water content(Lite)	Coarse Aggregate (Kg/m ³)
M-1	M 20	0.50	0	320	704	160	1141
M-2			0.02				
M-3			0.04				
M-4			0.06				
M-5	M 30	0.42	0	380	646	194.6	1150
M-6			0.02				
M-7			0.04				
M-8			0.06				

Table 5: Compressive & Tensile strength of Glass Fiber Reinforced concrete

MIX NO.	Grade of concrete	% of Glass fibres	Mean Compressive strength (Mpa)	Mean Tensile strength (Mpa)
M-1	M 20	0	26.16	3.20
M-2		0.02	35.66	4.25
M-3		0.04	38.73	5.05
M-4		0.06	41.28	5.76
M-5	M 30	0	37.80	4.19
M-6		0.02	50.93	5.67
M-7		0.04	55.73	5.91
M-8		0.06	61.29	7.17

A. Effect of percentage of fibers on workability of concrete

The result shows that workability of the concrete is solely affected by addition of fibers in the mixes. The slump value for M 20 grade of concrete was observed to be 100 mm. With the addition of fibers the value of slump reduces and is reported between 90 to 100 mm. The slump value for M 30 grade of concrete mixes was observed to be 75 mm. On inclusion of fibers in the mixes the slump value again decreases and is reported between 65 mm to 75 mm. Thus a bit harsh mixes are obtained as the percentages of fibers are increased. Fig. 4 illustrates the variation in slump value on addition of glass fibers.

B. Effect of percentage of fibers on compressive strength of concrete

The compressive strength of concrete mixes was observed to be increasing as the inclusion of fibers increases. The addition of 0.02% glass fibers by weight of concrete mix, increases the strength to 26.6% for M 20 grade of concrete and 25.78% for M 30 grade of concrete. On further addition of 0.02% of fibers the average increase in strength is reported as 7% for M 20 grade & 8.8% for M 30 grade of concrete mix. This shows that as we go for higher grade of concrete, increases in percentage of fibers increases the strength rapidly. Fig. 5 clearly shows the increase in strength for two different grade of concrete.

c. Effect of percentage of fibers on tensile strength of concrete

The result shows that there is a significant improvement in the tensile strength of concrete with the addition of glass fibers. Addition of 0.02% glass fiber increases the tensile strength to 24.7% for M 20 grade of concrete and 26.10% for M 30 grade of concrete. Further addition of 0.02% of fibers the average increase in strength is reported as 14% for M 20 grade & 15.8% for M 30 grade of concrete mix. Fig. 6 shows the effect of percentage of fibers on tensile strength of concrete.

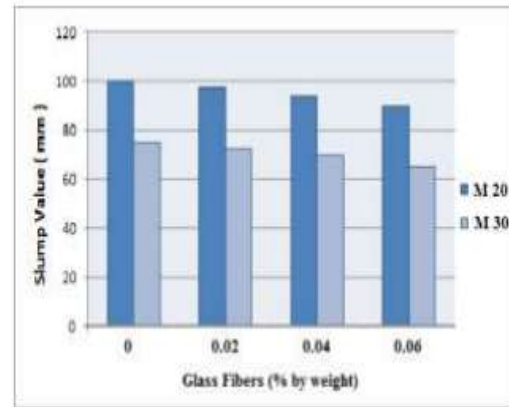


Fig.4: Effect of % age of fibers on slump value of concrete mixes

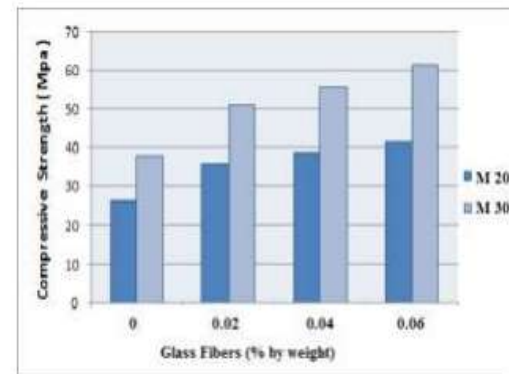


Fig.5: Effect of % age of fibers on compressive strength of concrete

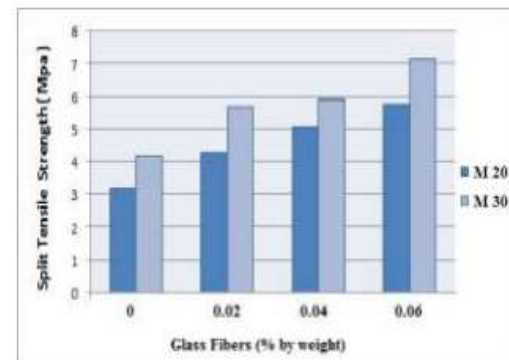


Fig.6: Effect of %age of fibers on tensile strength of concrete

5. CONCLUSIONS

Based on the experimental study on concrete mixes, the following conclusions could be made:

1. The use of alkali resistant glass fibers significantly improves the compressive as well as tensile strength irrespective of affecting the workability of concrete mixes.



2. The slump value is not much affected by the addition of fibers irrespective of grade of concrete mixes. For M 20 grade the slump value varies between 90 to 100 mm and that for M 30 grade it varies between 65 to 75 mm.

3. The compressive strength of concrete show a marginal increase on addition of fibres to concrete mixes. Increased strength was reported as 26.6% and 25.78% for M 20 and M 30 grade of concrete. However further addition of fibres improves average strength up to 7% for M 20 grade and 8.8% for M 30 grade of concrete.

4. The tensile strength of concrete also shows an increasing trend. For M 20 & M 30 grade of concrete increased tensile strength were observed to be 24.7% and 26.10%. Again further inclusion of fibres significantly improves the average tensile strength. 5. The percentage increase in strength for higher grade of concrete is marginally high.

REFERENCES

[1] R.Gowri, M.AngelineMary (2013). "Effect of glass wool fibres on mechanical properties of concrete." *International Journal of Engineering Trends and Technology*, Volume-4 Issue-7 July 2013.

[2] N. Banthia (2003), "Crack Growth Resistance of Hybrid Fiber Composites", *Cem. Con. Comp.*, Volume 25, Issue 1, Pp. 3-9, 2003

[3] S.Harle, Prof.R.Meghe (2013). "Glass Fiber Reinforced Concrete & Its Properties" *International Journal of Engineering and computer science*, Volume-2, Issue-12, PP-3544-3547, December 2013.

[4] Chandramouli.K, Srinivasa.R.P, Pannirselvam.N, Sekhar.T (2010) "Strength Properties of Glass Fibre Concrete" *ARPN Journal of Engineering and Applied Sciences*, vol-5, No-4, April 2010.

[5] Murthy.I.Y, Sharda.A, Jain.G (2012) "Performance of Glass Fiber Reinforced Concrete" *International Journal of Engineering and Innovative Technology*, Volume-1, Issue-6, June 2012.

[6] D.D.Paradava, Prof. J.Pitroda (2013) "Utilization of Artificial Fibres in Construction Industry: A Critical Literature Review" *International Journal of Engineering Trends and Technology*, Volume-4 Issue10October 2013.

[7] Praveen Kumar Goud.E, Praveen.K.S (2015) "Experimental Comparative Study on the Mechanical Properties of hooked end steel, crimped steel and Glass Fibre Reinforced Concrete" *International Journal of Engineering Trends and Technology*, Volume-21Number5March 2015.

[8] Duggal.s.k,(2012)"Building Materials" Fourth edition, New Age International Publishers.

[9] V.L.Shah, Karve.S.R (2010) "Limit State Theory and Design of Reinforced Concrete" Fifth edition, Structures Publications.

[10] http://www.ocvreinforcements.com/uploadedFiles/Reinforcement/CemFil/Doc/anti_crak_brochure_screen.pdf