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USE OF FIBER REINFORCED CONCRETE BY USING GLASS FIBER

Swati Dhiman[1], Shubham Gairola[2], Saurabh Arya[3]

[1]M E Civil (Structure Engineering) Assistant Professor, Roorkee Institute of technology, India
[2]B.Tech(civil Engineering) Assistant Professor, Maya Group of college, India
[3]B.Tech(Mechanical Engineering) Assistant Professor, Roorkee Institute of technology, India

ABSTRACT

Concrete is relatively brittle, and its tensile strength is typically only about one tenths of its compressive strength that"s why regular concrete is therefore normally reinforced with steel reinforcing bars. For many applications, it is becoming increasingly popular to reinforce the concrete with small, randomly distributed fibers their main purpose is to increase the energy absorption capacity and toughness of the material, but also increase tensile and flexural strength of concrete. AlsoPlain concrete fails suddenly once the deflection corresponding to the ultimate flexural strength is exceeded; on the other hand, fiber-reinforced concrete continue to sustain considerable loads even at deflections considerably in excess of the fracture deflection of the plain concrete. The greatest advantage of fiber reinforcement of concrete is the improvement in flexural toughness (total energy absorbed in breaking a specimen in flexure).

Fiber reinforced concrete can offer a convenient, practical and economical method for overcoming micro-cracks and similar type of deficiencies.It may also contain pozzolans and other admixtures commonly used in conventional concrete. Since concrete is weak in tension hence some measures must be adopted to overcome this deficiency. Glass fiber is strong in tension; hence it can be used as a fiber reinforcement material. Glass Fiber (GF) an alternate non-degradable matter is available in abundance and at a very cheap cost. Many of its applications are found in sewer pipe, retaining wall, corrugated sheets,Ventilation ducts,Pavement overlays,Fire-resistant coverings etc. It also creates environmental problem for its decompositions so it"s better to use it in concrete as it will improve the strength of the concrete and the problem of its decomposition will also be solved. Present studies has been undertaken to study the effect of Glass fiber on plain cement concrete on the basis of its compressive & flexural strength. Experiments were conducted on concrete beams and cubes with various percentages of glass fiber i.e. 0%, 1%, 1.5% and 2% by volume of concrete mix. For each combination of proportions of concrete one beam and three cubes are tested for their mechanical properties. By testing of cubes and beams we found that there is an increment in the various properties and strength of concrete by the addition of Glass

Introduction

Almost everybody has heard about the concrete and knows that it is something which is used in construction of structures. And also very few of us have heard about the fiber reinforced concrete. But what exactly is it?

Fiber Reinforced Concrete (FRC) was invented by French gardener Joseph Moniker in 1849 and patented in 1867. The concept of using fibers as reinforcement is not new. This can be proved by the following: Fibers have been used as reinforcement since ancient times. Historically, horsehair was used in mortar and straw in mud bricks. In the early 1900s, asbestos fibers were used in concrete, and in the 1950s the concept of composite materials came into being and fiber reinforced concrete was one of the topics of interest. There was a need to find a replacement for the asbestos used in concrete and other building materials once the health risks associated with the substance were discovered. By the 1960s, steel, glass (GFRC), and synthetic fibers such as polypropylene fibers were used in concrete, and 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. Continuous meshes, woven fabrics and long wires or rods are not considered to be discrete fibers. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers.

Fiber is a small piece of reinforcing material possessing certain characteristics properties. The fiber is often described by a convenient parameter called aspect ratio. The aspect ratio of the fiber is the ratio of its length to its diameter. Typical aspect ratio ranges from 30 to 150.

Glass are used as a fiber reinforcing material in concrete to study its effects on the compressive , flexural strength and cracking control to economize concrete and to reduce environmental problems created by the decomposition of glass.Today, FRC is very widely used, with annual production now approaching about 100 m3. The principal applications are slabs on grade, shotcrete, and precast members, as well as a number of specialty applications. Until now, most of the production of FRC has been for “non-structural” applications, with the fibers added primarily for control of cracking due to plastic or drying shrinkage. However, there is now increasing use of fibers as the primary reinforcement in truly structural application.FRC can now be considered to be a mature technology; there are still some areas in which further research is required.

PROPOSED WORK

The methodology adopted to test the mechanical properties and strength of glass fiber reinforced concrete is governed by:

1- Compressive Strength,
2- Flexural Strength

EXPERIMENTAL WORK

MIX DESGIN

Form all the data related to cement, coarse aggregate and fine aggregate mix design for target mean strength 31.6 N/mm2 was computed and after calculations mix proportions are found to be as fallows.

Table No. 1 (Mix Design)

Water cement ratio.	cement	Fine aggregate	Coarse aggregate

0.486	1	1.3405	2.742

RESULT AND DISCUSSION

The results are briefly tabulated and are shown in tables below. First table shows the results of the test performed on cubes for compressive strength with the various varying percentages of glass fiber by the volume of concrete mix.

Result of compressive strength test

Table No. 2 (Result of Testing after 3 Days)

S.NO.	Mix	% of fiber	Maximum load recorded after 3 days			Compressive strength after 3 days		
			Cube 1	Cube 2	Cube 3	Cube 1	Cube 2	Cube 3
1	M25	0	440	425	442	19.5	18.8	19.6
2	M25	1	460	445	447	20.5	19.7	19.9
3	M25	1.5	483	425.5	460	21.5	18.9	20.5
4	M25	2	481	440.5	465	21.4	19.6	20.7

Table No. 3 (Result of Testing after 7 Days)

S.NO.	Mix	% of fiber	Maximum load recorded after 7 days(KN)			Compressive strength after 7 days(N/mm2)		
			Cube 1	Cube 2	Cube 3	Cube 1	Cube 2	Cube 3
1	M25	0	727.4	766.8	769.50	32.33	34.08	34.2
2	M25	1	760.5	763.8	783.00	33.80	33.95	34.8
3	M25	1.5	801	805.5	834.7	35.6	35.8	37.1
4	M25	2	852.7	866.5	843.7	37.9	38.5	37.5

Table No. 4(Result of Testing after 28 Days)

S.NO.	Mix	% of fiber	Load recorded after 28 days(KN)	Compressive strength after 28 days(N/mm2)

			Cube 1	Cube 2	Cube 3	Cube 1	Cube 2	Cube 3
1	M25	0	935	955	885	37.5	38.2	38.5
2	M25	1	940	938	935	41.8	41.7	41.7
3	M25	1.5	955	965	940	42.5	42.9	43.1
4	M25	2	965	980	970	42.8	43.5	43.1

. Result of flexural strength test

Table No.5 (Result of Testing after 3 Days)

S.No.	% of fiber	Flexural strength(N/mm2)
1	0	1.5
2	1	1.55
3	1.5	1.6
4	2	1.62

Table No. 6 (Result of Testing after 7 Days)

S.No.	% of fiber	Flexural strength(N/mm2)
1	0	1.9
2	1	2.0
3	1.5	2.05
4	2	2.15

Table No. 7 (Result of Testing after 28 Days)

S.No.	% of fiber	Flexural strength(N/mm2)

1	0	3.8
2	1	4
3	1.5	4.2
4	2	4.3

Plots

After Testing results are represented in graphical form, showing the variation on compressive and flexural strength with respect to plain cement concrete.

Plots for Compression Tests

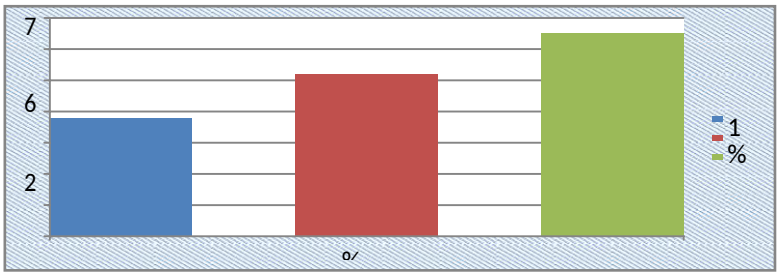


Figure 1: Showing the % increment in the compressive strength as fiber content increases (After Three Days)

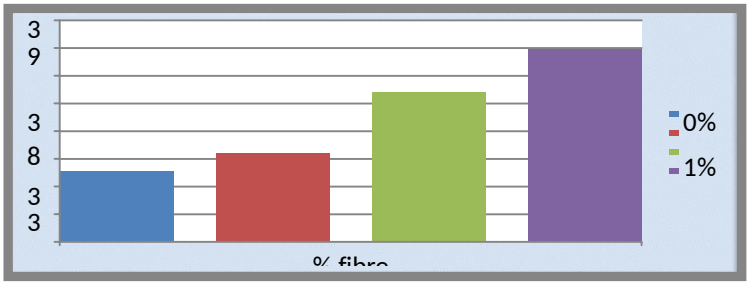


Figure 2: Result of compression Test after 7 Days

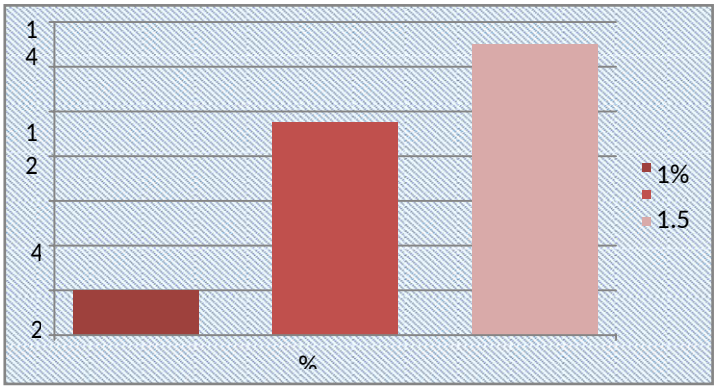


Figure 3: Showing the % increment in the compressive strength as fiber content increases (After Seven

Days)

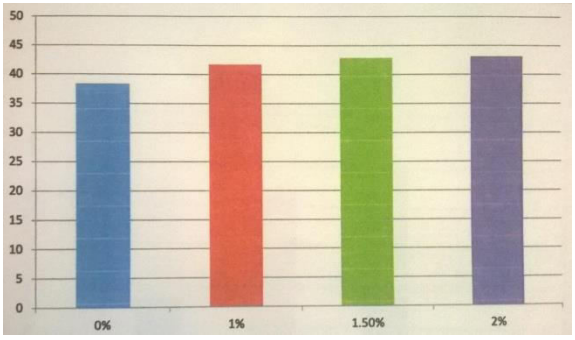


Figure 4: Result of compression Test after 28 Days

X axis -- % of fiber
Y axis – compressive strength of concrete after 28 Days

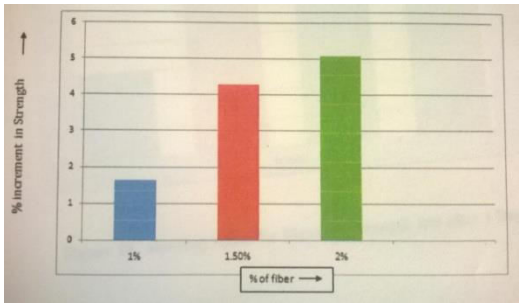
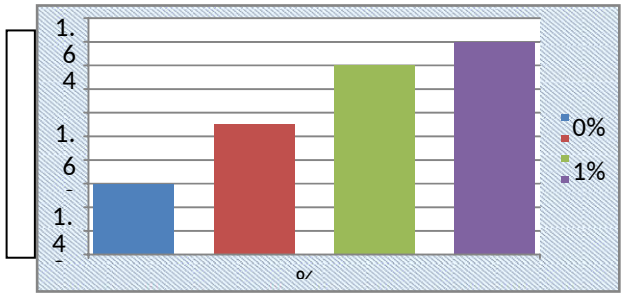


Figure 5: Showing the % increment in the compressive strength as fiber content increases (After 28



Days) Figure 6: Result of Flexural Strength Test after 3 Days

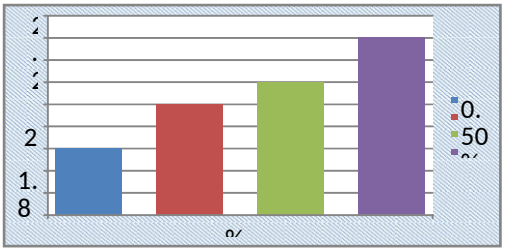


Figure 7: Result of Flexural Strength Test after 7 Days

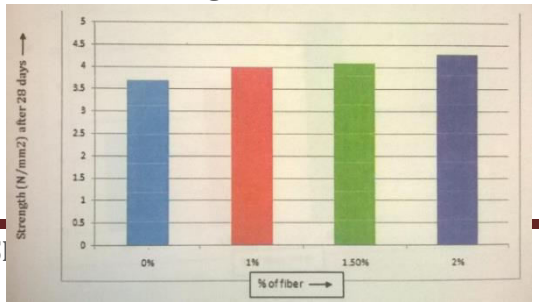


Figure 8: Result of flexural strength Test after 28 Days

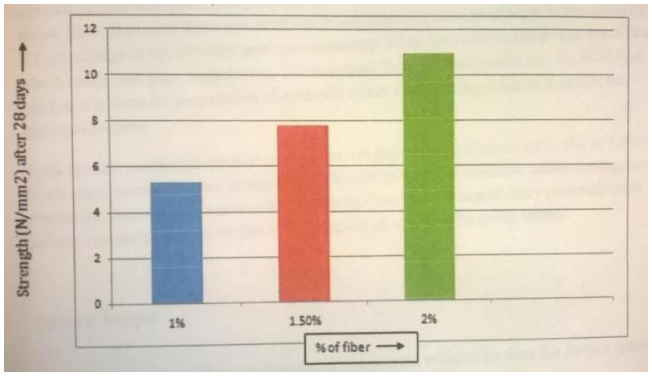


Figure 9: Showing % increment in Flexural Strength as fiber content increases (After 28 Days)

Conclusion

There is considerable improvement in flexural strength of the concrete mixed with glass fiber (mixed by volume of mix). This has been shown in the above plots. However there was problem in uniform distribution of fiber in the concrete as it‟s percentage in the concrete increases. Fiber also absorbs some amount of water that‟s why suitable admixture must be used. To over come from all these sort of problems we followed hand mix pattern of preparing of concrete rather than mixing it inside the mixture machine

From the test conducted we find out that by mixing the fiber content up to 1% to 1.5 % best result with respect to compressive strength and flexural strength of concrete mix. Since this is a new area of investigation more research work is being carried out in various research institutes so that we can utilize all its benefits to the fullest

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