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Effect of Partially Replacement of Glass Fibre on the Engineering Properties of Cement Concrete

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ABSTRACT—

Glass fiber concrete repair systems provide an economically viable alternative to traditional repair systems and materials. Experimental investigations on the flexural and shear behavior of RC beams strengthened using continuous glass fiber concrete are carried out. Total five models are prepared with 0.5%, 1%, 1.5% and 2% cement replacement and without replacement. Experimental data on load, deflection and failure modes of each of the beams were obtained. The detail procedure and application of glass fiber concrete for strengthening of RC beams is also included. The effect of number glass fiber concrete of and its orientation on ultimate load carrying capacity and failure mode of the beams are investigated.

Keywords: Glass Fibre, RC Beam, compressive strength, flexural strength, tensile strength

1. INTRODUCTION

Concrete is one of the most useful materials in the world. It is the basic building block of almost every construction in the world. It is interesting to note that concrete is made up from basic materials which are cheap as well as abundant. Cement, which is integral part of concrete, can be mixed with any granular material to give a solid structure. The demand of concrete is expected to keep growing in near future thus increasing the depletion of natural resources used in manufacturing of cement. Construction industry is known to be one of the significant wellsprings of contamination. Different exercises of construction industry CO_2 discharges. Commitment of the building industry to an earth-wide temperature boost can never again be disregarded. Present day buildings expend vitality in various ways. Vitality utilization in buildings materials and segments causes the increase utilisation of natural resources and production of CO_2 in environment. Thus, causes the various types of pollution and health hazards. In recent years, there has been marked awareness on lowering the carbon footprint in construction industry. The main contributor to carbon dioxide in particular and environmental pollution in general is cement production. Therefore various techniques are implemented all over the world to reduce the use of cement so that production is decreased and thereby environmental pollution is reduced.Waste utilization is a major concern in today's world and safe disposal of these wastes is essential for the sustainable development and overall growth of the society.

2. MATERIAL USED

2.1 Cement:

Ordinary Portland cement (OPC) is the most common type of binder used for concrete production and hence, OPC 43 Grade conforming to Indian Standard IS 12269:1987 was used as a binder.

2.2 Sand:

For this experiment fine aggregate river sand is used. Sand passed through from 2.36 mm sieve. Sand is free from organic properties. After mixing the water in the mix, sand become bulk and occupies more space than it was in wet state. This bulking is increase as water proportion is increases after the optimum water content sand cannot bulk more but moister is increases gradually which is no use except workability.

2.3 Natural aggregate:

20 mm natural coarse aggregate is used having a specific gravity of 2.74.

2.4 Glass Fibre:

Discrete glass fibres were used and as glass fibre is susceptible to alkali we used alkali resistant glass fibres. A fiber is a material made into a long filament with a diameter generally in the order of 10 tm.

3. EXPERIMENTAL WORK AND TEST

3.1Slump Cone Test:

The form for the slump test is a frustum of a cone, 300 mm (12 in) of tallness. The base is 200 mm (8in) in distance across and it has a littler opening at the highest point of 100 mm (4 in). The construct is put in light of a smooth surface and the compartment is loaded with concrete in three layers, whose workability is to be tried . Each layer is temped 25 times with a standard 16 mm (5/8 in) distance across steel bar, adjusted toward the end. At the point when the form is totally loaded with concrete, the finish surface is struck off (leveled with shape beat opening) by methods for screening and moving movement of the temping bar.

3.2 Compressive Strength Test:

Out of numerous tests conducted to the solid, this is the most extreme essential which gives a thought regarding every one of the attributes of cement. By this single test one can judge that whether Concreting has been done appropriately or not. For solid shape test one sort of examples either 3D squares of 15 cm X 15 cm X 15 cm relying on the measure of total are utilized. For the majority of the works cubical moulds of size 15 cm x 15cm x 15 cm are normally utilized. The glass fibres are included at the rate of 0.5%, 1%, 1.5% and 2% of cement. This solid is poured in the mould and altered legitimately so as not to have any voids. Following 24 hours these moulds are evacuated and test examples are placed in water for curing. These examples are tried by pressure testing machine following 7 days curing or 28 days curing.

3.3 Flexural Strength:

The test can be performed in accordance with as per BS 1881. A simple plain concrete beam is loaded at one third span points. Typical standard size of example 500 x 100x 100 mm is utilized. The load should be partitioned similarly between the two stacking rollers, and all rollers might be mounted in such a way, to the point that the load is connected pivotally and without subjecting the example to any torsional burdens or limitations. Set up the test example by including the glass fibre at the rate of 0.5%, 1%, 1.5% and 2% by filling the solid into the mould in 3 layers of roughly equivalent thickness. Pack every layer 35 times utilizing the packing bar as determined previously. Packing ought to be circulated consistently over the whole cross segment of the bar mould and all through the profundity of every layer. The example put away in water might be tried instantly on expulsion from water for 7 and 28 days. The test example should be put in the machine accurately focused with the longitudinal pivot of the example at right edges to the rollers.

3.4 Split Tensile Test:

Sampling of Concrete Cylinders:

The cylindrical mould shall is of metal, 3mm thick. The mean internal diameter of the mould is 15 cm and the height is 30 cm. Each mould is provided with a metal base plate mould and base plate should be coated with a thin film of mould oil before use, in classify to check bond of concrete.

Compacting of Concrete

The test specimen should be complete as early as practicable after the concrete is to the top into the mould in layers approximately 5 cm deep. Each one layer is compacted by hand or by vibration.

4. TEST RESULTS

4.1 Slump Cone Test Results:

Slump tests results are shown in below table and the pattern is projected in graph shown below table. Three samples of cubes are taken from each type of mix specimen and they are tested and there results are shown below.

Table 4.1 Slump test results

Sr. No.	**%weight of glass fiber**	**Slump value**			**Avg. Value of slump**
		Sample 1	**Sample 2**	**Sample 3**	
01	0%	120.42	123.32	125.23	123.00
02	0.5%	100.53	99.54	93.53	97.87

03	1%	80.54	75.44	83.53	79.84
04	1.5%	64.64	68.67	69.32	67.54
05	2.0%	50.45	55.65	54.33	53.47

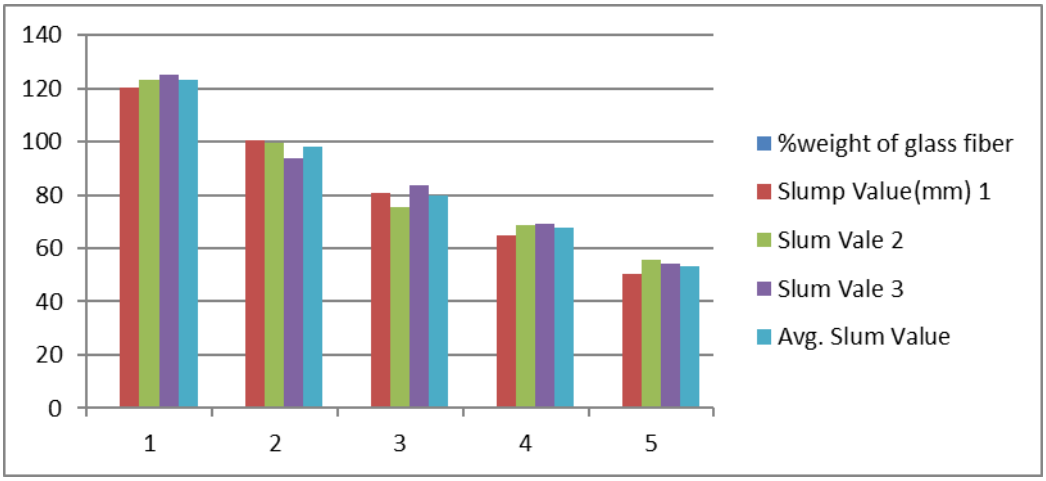

Figure 1 Graph showing variation in slump of concrete

4.2 Compressive Strength:

The Steel mould of size 150 x 150 x 150 mm is well tighten and oiled thoroughly. They were allowed for curing in a curing tank for 7 and 28 days and they were tested in 200-tonnes electro hydraulic closed loop machine. The test procedures were used as per IS: 516-1979. The results are shown in table and graphs below of different mixed design specimen. In this comparison Compressive strength increase with increase in glass fiber content, but this shows that glass fiber affect the strength of concrete positively. In this results Model No.03 (1% Glass fiber) show the highest Compressive Strength.

Table 4.2: Compressive Strength Result

Sr. No.	%weight of glass fiber	Avg. 7 Days Value of compressive strength	Avg. 28 Days Value of compressive strength
01	0	18.32	28.49
02	0.5%	21.36	32.10
03	1.0%	24.15	36.27
04	1.5%	22.20	34.59
05	2.0%	21.61	31.49

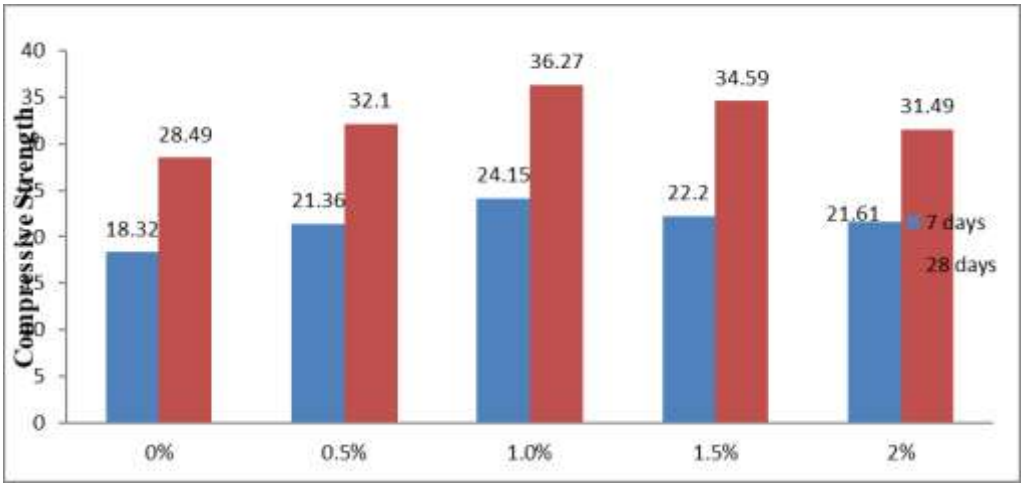

Figure 2 showing variation of 7 & 28 days compressive strength of concrete

The 28 days compressive strength is shown below. In case of 28 days compressive strength, there is marked improvement in strength. In different mixes there is about 30-50% increase in strength for same mix concrete. The glass fiber contributed to better binding of material and pozzolanic action of coconut shells are main reasons for this increase. In this results also Model No. 03 (1% Glass fiber) show the highest Compressive Strength

4.2 Flexural Strength:

In this study, glass fibers are used to compensate some of this and improve flexural strength. The results show that there is slight increase in flexural strength about 20-30%. In this results Model No. 03 Show Highest Value of Flexural strength at 28 days

Table 4.3: Flexural Strength Result

S. No	% weight of glass fiber	Avg 7 Days Flexural Strength	Avg 28 Days Flexural Strength
1	**0%**	1.43MPa	2.45 MPa
2	**0.5%**	1.71 MPa	2.85MPa
3	**1.0%**	2.1MPa	3.35MPa
4	**1.5%**	1.83MPa	3.15MPa
5	**2.0%**	1.8MPa	2.90MPa

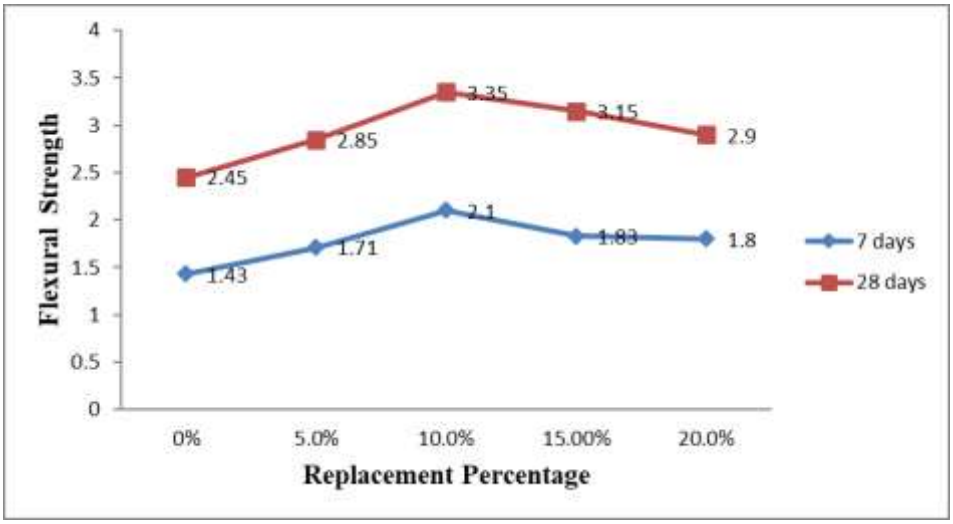

Figure3: Showing variation of 7 & 28 days flexural strength of concrete

4..3 Split Tensile Strength

Cylinders of size 15 cm diameter and 30 cm height are casted for determining Split TensileStrength. Test on cylinders are performed at the age of 7days, 14 days & 28 days of the specimen. Placement of specimen in machine is done as per IS: 516-1959. Load is applied until specimen fails and load at which specimen fails is recorded. As specified in the IS code Split Tensile Strength is calculated and tabulated below:-

Table 4.4: Variation of Split Tensile strength with age

S. No	% weight of glass fiber	Avg 7 Days Flexural Strength	Avg 28 Days Flexural Strength
1	**0%**	1.72 MPa	3.38 MPa
2	**0.5%**	1.92MPa	3.71 MPa
3	**1.0%**	2.56 MPa	4.25 MPa
4	**1.5%**	2.35MPa	4.01 MPa
5	**2.0%**	2.25 MPa	3.75 MPa

Figure 4: Showing variation of 7 & 28 days tensile strength of concrete

5. CONCLUSIONS

From the above research work the conclusion are as follows:

- It has been observed that the workability of concrete decreases with the addition of Glass Fibres. But this difficulty can be overcome by using plasticizers or super-plasticizers.
- There is increase in Compression strength for M-20 concrete when compared with strength of Plain Concrete. Best results get form glass fiber with 1% of cement replacement.

- There is increase in flexure strength for M-20 concrete when compared with strength of Plain Concrete. Best results get form glass fiber with 1% of cement replacement.
- There is increase in tensile strength for M-20 concrete when compared with strength of Plain Concrete. Best results get form glass fiber with 1% of cement replacement
- It has been also observed that there is gradual increase in early strength for Compression, Flexural & Tensile strength of Glass Fibre Reinforced Concrete as compared to Plain Concrete.

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