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Compressive Strength of Hybrid Fiber Reinforced Concrete

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ABSTRACT:
Fiber reinforced concrete (FRC) became in the recent decades a very popular and attractive material in structural engineering because of its good mechanical performance. The most important advantages are hindrance of macro-cracks' development, delay in micro-cracks' propagation to macroscopic level. In this study the compression test was carried out for concrete prepared using different hybrid fiber combinations of glass fibers and polypropylene fibers. The volume fraction of the glass fibers and polypropylene fibers used in this study are 0.4% and 0.5% of total volume of concrete. The objective of this study is to evaluate compressive strength at 28 days and 56 days of curing of fiber reinforced concrete with respect to different combination of glass fibers and polypropylene fibers. It is observed that lower content of fibers give the maximum compressive strength.

Keywords: Glass Fiber, Polypropylene Fiber, Compressive Strength, HFRC, Tensile Strength

I. INTRODUCTION

Concrete is weak in tension and has a brittle character. Use of continuous reinforcement in concrete (reinforced concrete) increases strength and ductility, but requires careful placement and labour skill. Addition of fibers to concrete makes it a homogeneous and isotropic material. When concrete cracks, the randomly oriented fibers start functioning, arrest crack formation and propagation, and thus improve strength and ductility.[1] Various studies have covered different mix designs, fibre volumes and aspect ratios but still there is a considerable gap in knowledge about the behaviour of concrete reinforced with both glass and polypropylene fibers. This study is therefore based on the comparative mechanical behaviour of the glass and the polypropylene fibre concrete types in the same mix design and fibre weight after 28 days and 56 days with respect to their performance in compression. Concrete is the second most consumed construction material after water with twice as much concrete used across the world than all other construction materials put together [2]. Concrete meanwhile, in its unreinforced state, has certain common characteristics: strong in compression and weak in tension. As a result, steel rods are used to resist any tensile forces or to apply compressive forces to the concrete to be able to withstand the tensile forces [3]. There is therefore the need to do further studies with the aim of improving on the brittle nature of concrete in view of its huge benefit to society.

II. MATERIALS AND PROPERTIES

Following are the materials which are used in present study.

A. Cement:

The cement used in this experimental work is Binani 53 grade Ordinary Portland Cement. The specific gravity of the cement is 3.15. All properties of cement are tested by referring IS 12269 – 1987.

B. Fine aggregate:

Locally available sand of Bodeli is used in this study. Sand passing from 4.75 mm sieve, specific gravity of 2.63 and fineness modulus of 2.84 are used.

C. Course aggregate:

Course aggregate of size 20 mm available from the source sevalia is used. Specific gravity of course aggregate is 2.64 and fineness modulus is 3.79.

D. Fibre:

Details of glass fibres and polypropylene fibers used in this study are as follows.

Table 1 : Properties of Fibers

Property	Glass Fiber	Polypropylene Fiber
Diameter	0.005 to 0.015 mm	33-36 Micron
Density (gm/cm3)	2.58	0.855
Tensile strength (MPa)	3445	670

Figure 1 Glass Fiber

Figure 2 Polypropylene Fiber

F. Superplasticizer:

Perma Plast PC 401 is based on polyearboxylic Ether hyper plasticising sulphonated synthetic polymers. It may be dispensed at dosages varying between 0.5 to 2 percent by weight of cement depending upon type of concrete required. Specific gravity of superplasticizer is 1.15

III. EXPERIMENTAL WORK

All the specimens in this study are cast from M_{25} grade of concrete. A total of 30 Cubes of size 150x150x150mm were caste with different volume fraction of glass and polypropylene fibers. Compression test is carried out after 28 & 56 days of curing period. Mix proportion of M_{25} concrete and design of mixes are shown in table 2 and table 3 respectively.

Table 2 Mix Proportion

Materials	Unit	Quantity
Cement	kg	362
Fine Aggregates	kg	820
Coarse Aggregates	kg	1101.71
Water	lit.	152
Chemical Admixture	kg	4.34

Table 3 Design of Mixes

Mix Name	Glass Fibre	Polypropylene Fibre
M1	0%	0%
M2	0.4%	0.4%
M3	0.4%	0.5%
M4	0.5%	0.4%
M5	0.5%	0.5%

IV. RESULTS AND DISCUSSION

Compression test is carried out at 28 days and 56 days of curing. The results of the same are shown in table 4,

Table 4 Compressive Strength Results

Mix Name	Compressive strength (N/mm2)	
	28 days	56 days
M1	36.97	51.41
M2	36.53	44.66
M3	31.60	43.21
M4	33.82	43.30
M5	30.43	47.24

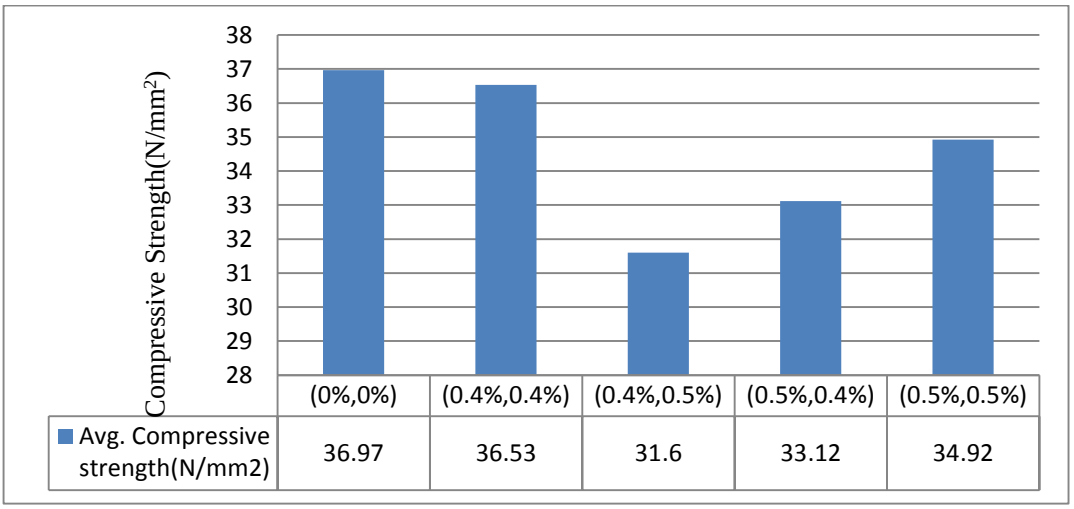

Figure 3: compressive strength (28 days)

Figure 3 shows that after adding the fibres (Glass & Polypropylene), the compressive strength is nearly same as normal mix in case of M-2 which contains minimum dosage of both the fibers. As the fiber content increases compressive strength of the concrete is decreses.

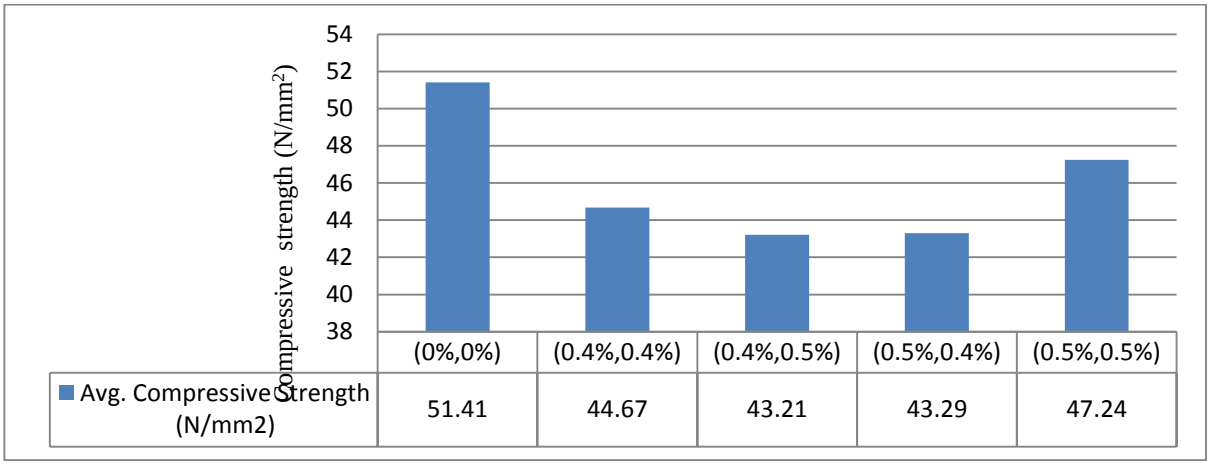

Figure 4 compressive strength (56 days)

Figure 4 shows that after the curing period of 56 days targeted compressive strength is achieved for all the mixes. But at the same time compressive strength of the concrete with glass and polypropylene fibers is lower than normal mix.

V. CONCLUSION

This paper sets out to compare the compressive strength of concrete reinforced with glass fibre and polypropylene fibre. The literature review identified a gap in knowledge on the compressive strength when these fibre type is added.

From the results it can be seen that targeted mean strength of concrete of all mixes is achieved. After the curing period of 28 days maximum compressive strength is shown in M-2 which contains minimum fibres along with normal concrete without fibres. After the curing period of 56 days all mixes shows increased value of compressive strength and M-5 shows the higher value of compressive strength which contains maximum fibres.

From the results we can conclude that compressive strength of concrete is decreased with the addition of fibres. Role of fibre is not more predominant in case of compressive strength.

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