Mechanical Property 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. In this project the mechanical properties, namely compressive strength, flexural strength were studied for concrete prepared using different hybrid fiber combinations of glass fibers and polypropylene fibers. The objective of this study is to evaluate compressive strength and flexural strength of fiber reinforced concrete with respect to different combination of glass fibers and polypropylene fibers. It is observed that quantity of fibers both glass fibers and polypropylene fibers play significant role in increment flexural properties of concrete.

Key words: Hybrid Fiber Reinforced Concrete, GFRC, Glass Fiber

I. INTRODUCTION

A. *Fiber Reinforced Concrete*

A concrete consisting of, cement, water, fine and coarse aggregate, along with different types of Fibers. Fiber reinforced concrete is an alternative way to reinforce concrete other than traditional steel bar. The main purpose of Fiber reinforced concrete it to improve flexural behavior. Advantages of Fiber Reinforced Concrete are Improves toughness of concrete. Flexural strength is improved by up to 30% by decreasing the propagation of cracks, Improves tensile strength.

II. METHODOLOGY

A. *Aim*

To study the hybrid effect of Glass and Polypropylene Fibers in the concrete.

B. *Objectives*

1) To study the effects of Fibers on Compressive strength of the concrete with different percentage of Glass as well as Polypropylene Fibers.
2) To study the effects of Fibers on Flexural strength of the concrete with different percentage of Glass as well as Polypropylene Fibers.
3) To find out Optimum mix among all mixes with respect to Compressive strength and Flexural strength

III. DATA FINDINGS & PRESENTATION

A. *Strength*

High tensile strength (2-4GPa) and elastic modulus (70-80GPa).glass products exposed Glass-Fiber products exposed to outdoor environment have shown a loss of strength and ductility, alkali attack or Fiber embrittlement is possible causes for this. Because of the lack of data on long-term durability, GRC has been confined to non-structural uses where it has wide applications.

B. *Advantages of Glass Fiber Reinforced (GFRC)*

- Highly durable and safe
- Design freedom since GFRC is able to be moulded into almost any shape and colour
- Requires very low maintenance
- Installation is quick and cost effective
- Weather and fire resistant
- Economical
- Energy efficient

C. *Properties of Glass Fiber*

Divided into two categories E-glass and S-2 glass.

Fiber type	Tensile Strength in MPA	Comp. Strength in MPA	Den-sity (g/cm^3	Thermal expansion(um/m^{0}C	Soften Temp. ^{0}C	Price$/KG
E glass	3445	1080	2.58	5.4	846	2
S2-glass	4890	1600	2.46	2.9	1056	20

Table 1: Properties of Glass Fiber

IV. POLYPROPYLENE FIBER

In our project polypropylene Fiber is used. In this project we were using 12mm length polypropylene Fiber having 33 micron diameters. Polypropylene is found to be suitable to increase impact strength. They possess very high tensile strength, but there low modulus of electricity and higher elongation do not contribute to the flexural strength.

Polypropylene is one of the cheapest and abundantly available polymers polypropylene Fibers are resistant to most chemical and it would be cementious matrix which would deteriorate first under aggressive chemical attack. Its melting point is high (about 165 degrees centigrade). So that a working temp. As (100 degree centigrade) may be sustained for short periods without detriment to Fiber properties.

Polypropylene short Fibers in small volume fractions between 0.5 to 15 commercially used in concrete.

A. *Advantages of Polypropylene Fiber*

- Avoid micro cracks in concrete
- Improved closed surface of concrete
- Excellent crack reduction in early-age concrete.
- Better concrete durability & reduced surface dusting.
- Improves impact and abrasion resistance.
- Improves mix cohesiveness.
- Reduces segregation of the mix.
- Significant improvement in freeze-thaw cycle resistance.
- Saves time.

fiber	Eq Dia mm	Sp. gravity	Tensile strength MPA	Young's modulus	elongation
polypropylene	0.02-0.4	0.9	5.62-7.23	35.16	25

Table 2: Properties of Polypropylene Fiber

V. TESTING OF THE SPECIMENS

After 28 days and 56 days of curing period the specimens were allowed to dry the surface for about 1 to 2 hours. Then they were tested in appropriate testing machine.

Cube no.	M1 mix (0,0) %	M2 mix (0.4,0.4)%	M3 mix (0.4,0.5)%	M4 mix(0.5,0.4)%	M5 mix(0.5,0.5)%
Cube1	37.52	36.54	31.61	35.06	35.54
Cube2	36.93	37.11	31.2	31.13	37.2
Cube3	36.46	35.96	32.01	33.19	32.04

Table 3: Compressive Strength after 28 Days

Cube no.	M1 mix (0,0) %	M2 mix (0.4,0.4)%	M3 mix (0.4,0.5)%	M4 mix(0.5,0.4)%	M5 mix(0.5,0.5)%
Cube1	56.26	45.77	31.61	35.06	35.54
Cube2	48.08	44.22		31.13	37.2
Cube3	49.91	44	32.01	33.19	32.04

Table 4: Compressive Strength after 56 Days

VI. RESULTS

RATIO IN %	Avg. compressive strength(n/m^2)
0, 0	51.41
0.4, 0.4	44.67
0.4, 0.5	43.21
0.5, 0.4	43.29
0.5,0.5	47.24

Table 5: Average Compressive Strength after 56 Days

RATIO IN %	Avg. compressive strength(n/m^2)
0, 0	36.97
0.4, 0.4	36.53
0.4, 0.5	31.6
0.5, 0.4	33.12
0.5,0.5	34.92

Table 6: Average Compressive Strength after 28 Days

VII. CONCLUSIONS

From the results we can conclude that compressive strength of concrete is decreased with the addition of fibers. Role of fiber is not more predominant in case of compressive strength. By adding glass fibers and polypropylene fibers in concrete, values of flexural strength of concrete shows large increment compared to normal concrete. The mix which contains maximum glass fibers as well as polypropylene fibers (M-5) have maximum flexural strength at 28 days curing period. Apart from M-5, M-4 mix which contains higher dosage of glass fibers and lower dosage of polypropylene fibers have higher flexural strength. Mix which contains maximum dosage of glass fibers as well as polypropylene fibers have higher value of compressive strength at 56 days and higher value of flexural strength at 28 days curing period.

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