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A Comparative Study on Various Mix Designs of Concrete by Using Steel and Glass Fiber

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Abstract:

There is always a search for concrete with higher strength and durability. Plain concrete has good compressive strength but has low tensile strength, low ductility and low fire resistance. This research paper aim to study characteristics and comparison of the mechanical properties of steel and glass fiber reinforce concrete with conventional concrete. In order to achieve and verify that 1%,2%,3% fiber percentage by the volume of cement are used in this study with three different concrete mixes M20, M25, and M30. 7 and 28days compressive strength and 28 days spilt tensile strength and flexural strength; tests have been performed in the hardened state. In this project the behaviour of cube, cylinder & beam structures strengthen by using FRC is experimentally tested. The fiber used are steel and glass fibers in sundry volume fraction the main reason for integrating steel fiber to concrete matrix is to ameliorate the post cracking replication of the concrete i.e. to ameliorate its energy absorption capacity and ostensible ductility and to provide a crack resistance and crack control and addition of glass fiber form bridging the micro-cracks are suggested as the reason for the enhancement in flexural strength.

Keywords — **Steel fiber, Glass fiber, Compressive strength, Split tensile strength, flexural strength.**

I. INTRODUCTION

Concrete is considered a brittle material, primarily because of its low tensile strain capacity and poor fracture toughness. Reinforcement of concrete with short randomly distributed fibers can address some of the concerns related to concrete brittleness and poor resistance to crack growth. Fibers, used as reinforcement, can be effective in arresting cracks at both micro and macro-levels. At the micro-level, fibers inhibit the initiation and growth of cracks, and after the micro-cracks converts into macro-cracks, fibers provide mechanisms that abate their unstable propagation, provide effective bridging, and impart sources of strength gain, toughness and ductility. Concrete can be modified to perform in a more ductile form by the addition of randomly distributed discrete fibers in the concrete matrix.

Certain disadvantages like brittleness and poor resistance to crack opening and spread. Concrete is brittle by nature and possess very low tensile strength and therefore fibers are used in one form or another to increase its tensile strength and decrease the brittle behaviour. With time a lot of experiments have been done to enhance the properties of concrete both in fresh state as well as hardened state. The basic materials remain the same but super plasticizers, admixtures, micro fillers are also being used to get the desired properties like workability, Increase or decrease in setting time and higher compressive strength.

FRC can be regarded as a composite material with two phases in which concrete represents the matrix phase and the fiber constitutes the inclusion phase. Volume fraction of fiber inclusion is the most commonly used parameter attributed to the properties of FRC. Fiber count, fiber specific surface area, and fiber spacing are other parameters,

which may also be used for this purpose. Another convenient numerical parameter describing a fiber is its aspect ratio, defined as the fiber length divided by its equivalent diameter.

Glass Fiber Reinforced Concrete: Glass fiber reinforced concrete (GFRC) is a cementitious composite product reinforced with discrete glass fibers of varying length and size. The glass fiber used is alkaline resistant as glass fiber are susceptible to alkali which decreases the durability of GFRC.

Steel Fiber Reinforced Concrete: During recent years, steel fiber reinforced concrete has gradually advanced from a new, rather unproven material to one which has now attained acknowledgment in numerous engineering applications.

II. MATERIALS TEST RESULTS

S.NO.	PROPERTY.	TEST RESULTS.
1	Normal consistency	30 %
2	Specific gravity	3.15
3	Initial setting time	80 minutes.
	Final setting time.	260 minutes.
4	Fineness of cement (Dry sieving method)	2.7 %

Physical Properties of ordinary Portland cement

S.NO.	PROPERTY.	TEST RESULTS.
1	Specific gravity	2.68

Physical Properties of Fine aggregate (Sand)

S.NO.	PROPERTY.	TEST RESULTS.
1	Specific gravity	2.72

Physical Properties of Coarse aggregate

III.MIX DESIGN

Material	Water	Cement	Fine Aggregate	Coarse Aggregate
Ratio	0.45	1	1.63	2.58

Mix propose for M20 grade concrete per m^3 quantity of concrete

Material	Water	Cement	Fine Aggregate	Coarse Aggregate
Ratio	0.35	1	1.21	1.93

Mix propose for M25 grade concrete per m^3 quantity of concrete

Material	Water	Cement	Fine Aggregate	Coarse Aggregate
Ratio	0.35	1	1.21	1.93

Mix propose for M30 grade concrete per m^3 quantity of concrete

IV.TEST RESULTS

S.No:	Mix	% of FIBER		Compressive strength (N/mm2)	
		STEEL	GLASS	7 days	28 days
1	20	0	0	19.04	28.86
2		1	1	17.46	32.11
3		2	2	18.70	33.87
4		3	3	18.41	30.71
5	25	0	0	21.75	32.78
6		1	1	22.84	34.96
7		2	2	29.94	42.23
8		3	3	30.65	41.41
9	30	0	0	25.26	38.27
10		1	1	25.73	38.81
11		2	2	28.46	43.13
12		3	3	27.02	40.94

Table1: The Compressive strength values obtained from the different trail mixes values

S.No:	Mix	% of FIBER		Split tensile strength (N/mm2)
		STEEL	GLASS	28 days
1	20	0	0	2.33
2		1	1	3.98
3		2	2	4.68
4		3	3	4.18
5	25	0	0	3.48
6		1	1	4.58
7		2	2	6.13
8		3	3	5.28
9	30	0	0	4.86
10		1	1	5.34
11		2	2	5.88
12		3	3	5.73

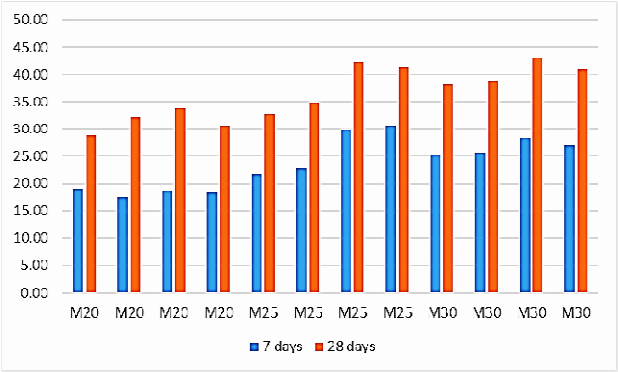
Table2: The Split tensile strength values obtained from the different trail mixes for 28 days

S.No:	Mix	% of FIBER		Flexural strength (N/mm2)
		STEEL	GLASS	28 days
1	20	0	0	6.85
2		1	1	8.33
3		2	2	10.00
4		3	3	8.84
5	25	0	0	7.35
6		1	1	8.63
7		2	2	10.02
8		3	3	9.29
9	30	0	0	7.63
10		1	1	8.85
11		2	2	10.09
12		3	3	9.88

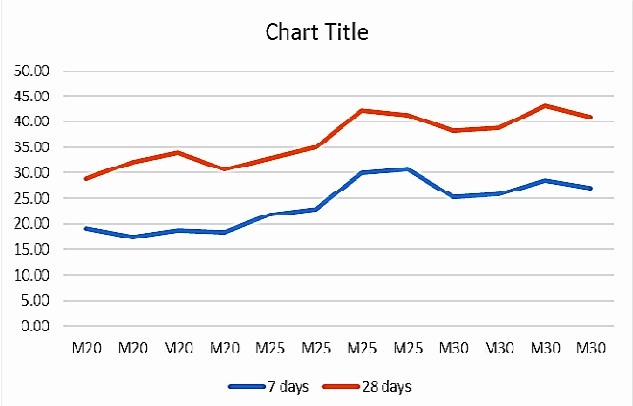
Table3: The Flexural strength values obtained from the different trail mixes for 28 days

Note: in the all of the below graphs, each concrete mix is added with steel and glass fibre with 0%, 1%, 2% and 3% respectively.

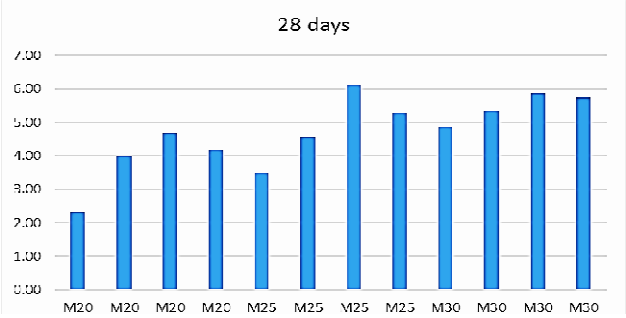
V.GRAPHS



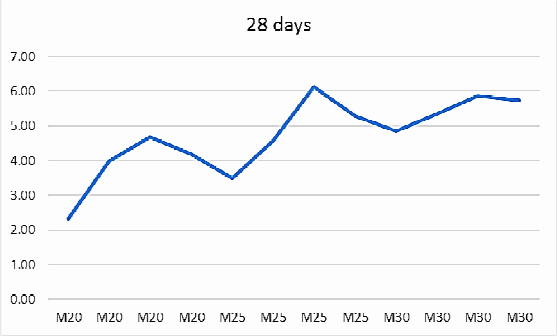
Graph1: Bar chart for Compressive Strength of Concrete for 7 and 28 days



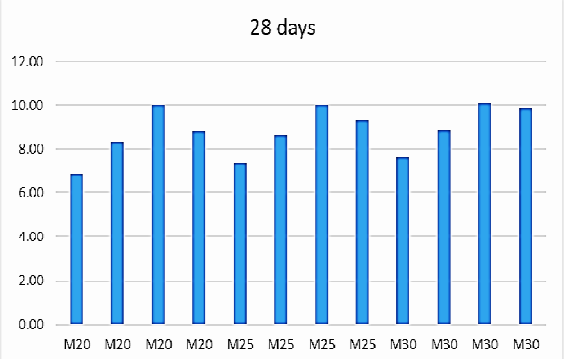
Graph2: Line chart for Compressive Strength of Concrete for 7 and 28 days



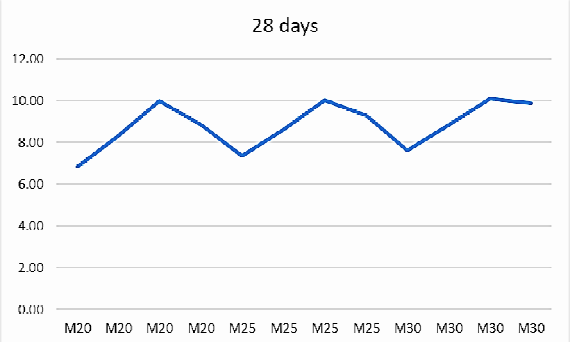
Graph3: Bar chart for Split Tensile Strength of Concrete for 28 days



Graph4: Line chart for Split Tensile Strength of Concrete for 28 days



Graph5: Bar chart for Flexural Tensile Strength of Concrete for 28 days



Graph6: Line chart for Flexural Tensile Strength of Concrete for28 days

VI.CONCLUSION

From above discussion it's far finish that, all mechanical properties viz. compressive strength, flexure strength, splitting strength are advanced via addition of fibers no matter what kind fiber is used and w/c ratio.

All strength likes compressive strength, flexure strength and splitting strength are advanced with increasing w/c ratio. There may be marginal improvement in flexure of concrete with trade in w/c ratio.

The resistance of RC and plain concrete dose suggests suggested impact on flexure strength. However the addition of fibers in both kinds i.e. with or without reinforcement indicates improvement inside the flexure strength.

The share growth of compressive strength of various grades of concrete mixes with glass and steel fibers compared with 28 days compressive power is discovered from 20 to 25%.

The share increase of flexural and split tensile strength of numerous grades of concrete mixes compared with 28 days is discovered from 15 to 20%.

In general, the giant development in various strengths is located with the inclusion of glass and steel fibers in the apparent concrete. But, maximum benefit in strength of concrete is found to rely upon the quantity of fiber content. The superior fiber content material to impart maximum gain in numerous strengths varies with sort of the strengths. Satisfactory workability turned into maintained with increasing extent fraction of fibers by means of using different w/c ratio. The width of cracks is found to be much less in SFRC & GFRC than that in undeniable cement concrete beam.

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