Strength Characteristics of Glass Fiber Reinforced Concrete

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***Abstract*: Glass fibre has been used over 30 years in several construction members. Glass wool, which is commonly known as "fibre glass" today, however, was invented in 1938 by Russell Games Slayter of Owens-Corning as a material to be used as insulation. It is marketed under the trade name Fibre glass. It is material made from extremely fine fibers of glass. Fibre glass is a lightweight, extremely strong, and robust material. Although its bulk strength and weight properties are also very favorable when compared to other fibres. Glass is the oldest, and most familiar, performance fibre. Use of glass fibres as an admixture in concrete and can add to the concrete's final strength and increase its chemical resistance and durability. This study was done to find out the effect of glass fibres in different grades of concrete.**

Keywords: Compressive Strength, GFRC, Glass Fibre, Flexural Strength, Split Tensile Strength, Super Plasticizer.

1. INTRODUCTION

Glass Fibres are the load-carrying members, while the matrix keeps them intact in the desired locations and orientation, acting as a load transfer channel between the fibres and protecting them from environmental clamities and chemical exposure. The effect of the fibers in the matrix leads to an increase in the tension because concrete is weak in tension and also increase impact strength of the matrix. Glass fibres have large tensile strength and modulus of elasticity.

In the present study CEM-FIL Anti crack HD glass fibres were used throughout the experiments. The study comprises of a comparative study of mechanicalproperties of concrete for M20, M30 and M40 grades of concrete by varying the percentages offibres by 0.5%, 1%, 2% and 3% of weight of cement as an admixture.

2. MATERIALS

A. Cement :

OPC 53 grade was used in this work. It conforms to IS 12269:2013.

B. Glass fibre :

CEM- FIL Anti-Crack HD glass fibres was used in this work.

C. Fine Aggregate and Coarse Aggregate :

Zone-II sand was considered for work and machine crushed stone used as coarse aggregate. The size of aggregate varies from 20mm to 4.75mm.

Fineness modulus of fine aggregate: 3.10
Fineness modulus for Coarse aggregate: 7.15
Specific gravity for fine aggregate: 2.62
Specific gravity for Coarse aggregate:2.8

D. Water :

Drinking water supplied by the college was used for the preparation and curing of the concrete.

E. Admixture :

Conplast was used as a super plasticizer in this project for M30 and M40 Grade of concrete.

3. MIX DESIGN

M20, M30 & M40 Grades of Concrete were considered. Mix were designed by using IS 10262.The mix proportions corresponding to M20 are 1:1.43:3.20:0.50, M30 are 1:1.58:2.75:0.45 and M40 are 1:1.37:2.39:0.40

4. EXPERIMENTAL PROGRAM AND METHODOLOGY

Following tests were conducted on the cubes.

A. Compressive Strength Test:

The compression test carried out on the cube specimen. The cube specimen is of the size 150×150×150 mm. The specimens were tested for compressive strength as per IS 516-1959 on a compression testing machine of 2000 kN capacity. After placing the specimen the compression load is applied due to load the specimen fails and failure is noted.

B. Split Tensile Strength:

Cylindrical moulds are used to determine split tensile strength, having the dimension 150mm diameter and 300mm length.The test was carried out in compression testing machine by placing the specimen horizontally between the loading surfaces of the compression testing machine for split

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tensile strength and the axis of the specimen was aligned at the centre of loading frame. The load was increased continuously at the constant rate.

C. Flexural Strength Test:

Flexural strength of the specimen was determined with the help of universal testing machine. The flexural strength of the prism specimen is expressed as the modulus of rupture. The two point loading method is used for the testing.All the tests were performed under vertical displacement control.

Table 1 Showing Mix proportions and quantity of materials used for M20 Mix 'A'

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	340.25	6.89
2	Fine Aggregate	731.53	14.81
3	Coarse Aggregate	1122.82	22.73
4	Glass Fibre	1.70	0.034
5	Water	170.125	3.45
	Density	**2367**	

Table 2 Showing Mix proportions and quantity of materials used for M30 Mix 'A'

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	405.67	8.21
2	Fine Aggregate	628.79	12.73
3	Coarse Aggregate	1127.76	22.83
4	Glass Fibre	2.02	0.041
5	Water	182.55	3.89
6	Superplasticizer	4.06	0.082
	Density	**2350**	

Table 3 Showing Mix proportions and quantity of materials used for M40 Mix 'A'

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	455	9.21
2	Fine Aggregate	623.35	12.62
3	Coarse Aggregate	1087.45	22.02
4	Glass Fibre	2.27	0.046
5	Water	182	3.69
6	Superplasticizer	4.55	0.092
	Density	**2354**	

Table 4 showing Mix proportions and quantity of materials used for M20 Mix 'B'

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	340.25	6.89
2	Fine Aggregate	731.53	14.81
3	Coarse Aggregate	1122.82	22.73
4	Glass Fibre	3.40	0.069
5	Water	170.125	3.45
	Density	**2367**	

Table 5 Showing Mix proportions and quantity of materials used for M30 Mix 'B'

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	405.67	8.21
2	Fine Aggregate	628.79	12.73
3	Coarse Aggregate	1127.76	22.83
4	Glass Fibre	4.05	0.082
5	Water	182.55	3.89
6	Superplasticizer	4.06	0.082
	Density	**2352**	

Table 6 Showing Mix proportions and quantity of materials used for M40 Mix

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	455	9.21
2	Fine Aggregate	623.35	12.62
3	Coarse Aggregate	1087.45	22.02
4	Glass Fibre	4.55	0.092
5	Water	182	3.69
6	Superplasticizer	4.55	0.092
	Density	**2357**	

Table 7 showing Mix proportions and quantity of materials used for M20 Mix 'C'

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	340.25	6.89
2	Fine Aggregate	731.53	14.81
3	Coarse Aggregate	1122.82	22.73
4	Glass Fibre	6.80	0.138
5	Water	170.125	3.45
	Density	**2371**	

Table 8 Showing Mix proportions and quantity of materials used for M30 Mix 'C'

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	405.67	8.21
2	Fine Aggregate	628.79	12.73
3	Coarse Aggregate	1127.76	22.83
4	Glass Fibre	8.11	0.164
5	Water	182.55	3.89
6	Superplasticizer	4.06	0.082
	Density	**2356**	

Table 9 Showing Mix proportions and quantity of materials used for M40 Mix 'C

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	455	9.21
2	Fine Aggregate	623.35	12.62
3	Coarse Aggregate	1087.45	22.02
4	Glass Fibre	9.1	0.184
5	Water	182	3.69
6	Superplasticizer	4.55	0.092
	Density	**2362**	

Table 10 showing Mix proportions and quantity of materials used for M20 Mix 'D'

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	340.25	6.89
2	Fine Aggregate	731.53	14.81
3	Coarse Aggregate	1122.82	22.73
4	Glass Fibre	10.20	0.206
5	Water	170.125	3.45
	Density	**2375**	

Table 11 Showing Mix proportions and quantity of materials used for M30 Mix 'D'

S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	405.67	8.21
2	Fine Aggregate	628.79	12.73
3	Coarse Aggregate	1127.76	22.83
4	Glass Fibre	12.11	0.245
5	Water	182.55	3.89
6	Superplasticizer	4.06	0.082
	Density	**2360**	

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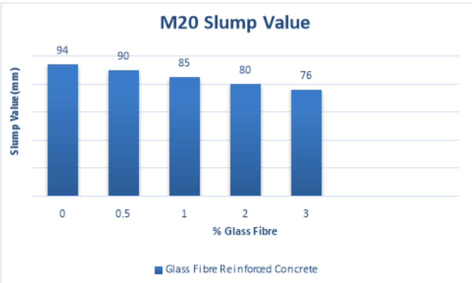
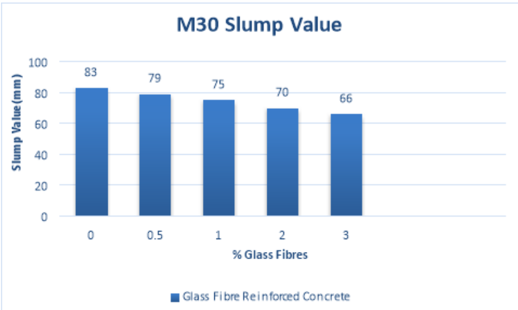
Table 12 Showing Mix proportions and quantity of materials used for M40 Mix 'D'

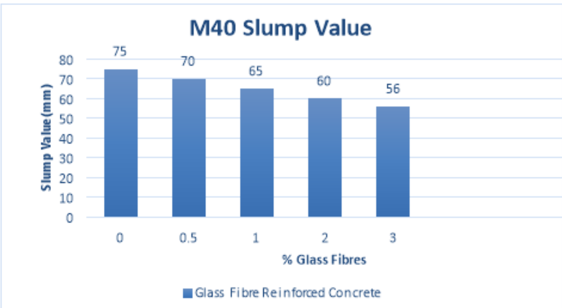
S.No.	Material	Quantity kg/m^3	Quantity for 6 cubes in Kg
1	Cement	455	9.21
2	Fine Aggregate	623.35	12.62
3	Coarse Aggregate	1087.45	22.02
4	Glass Fibre	13.65	0.276
5	Water	182	3.69
6	Superplasticizer	4.55	0.092
	Density	**2367**	

5. RESULTS

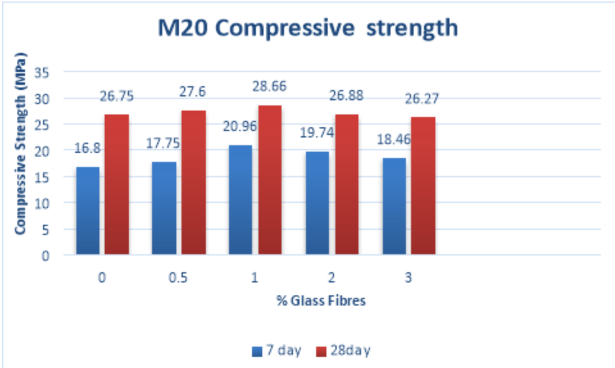
A. *WORKABILITY OF CONCRETE*

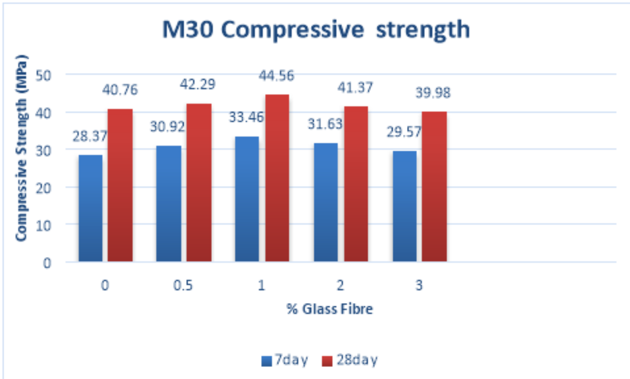


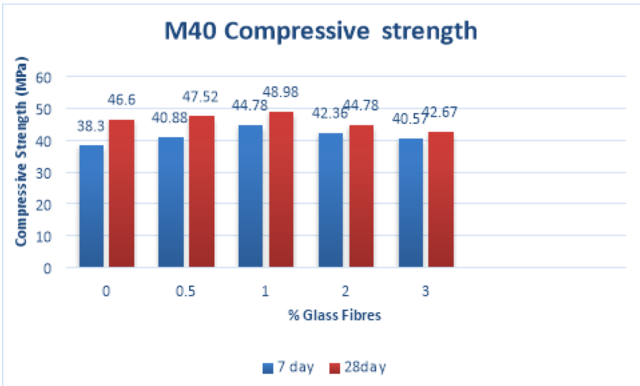




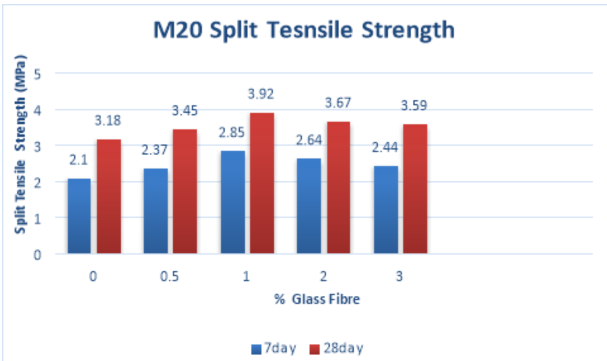
B. *COMPRESSIVE STRENGTH OF CUBES*

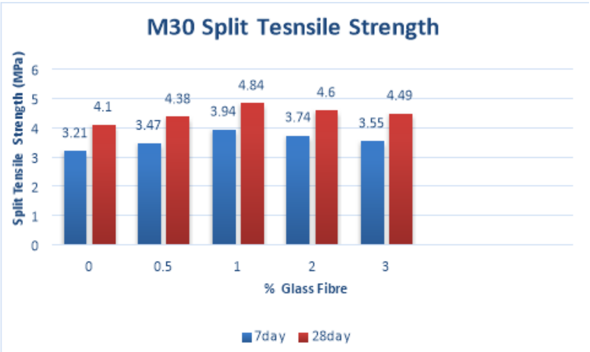


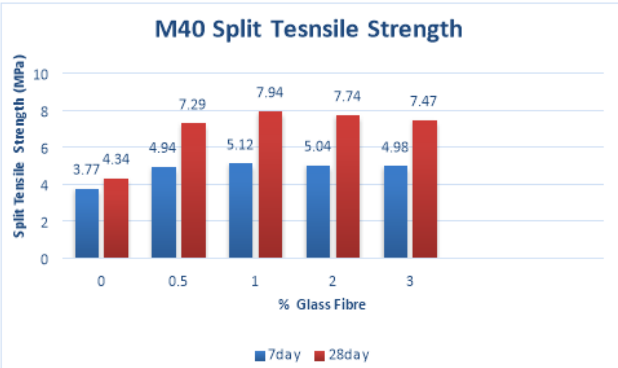




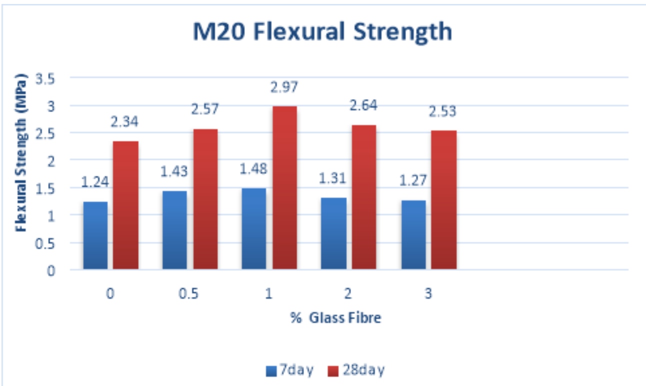
C. SPLIT TENSILE STRENGTH OF CYLINDERS

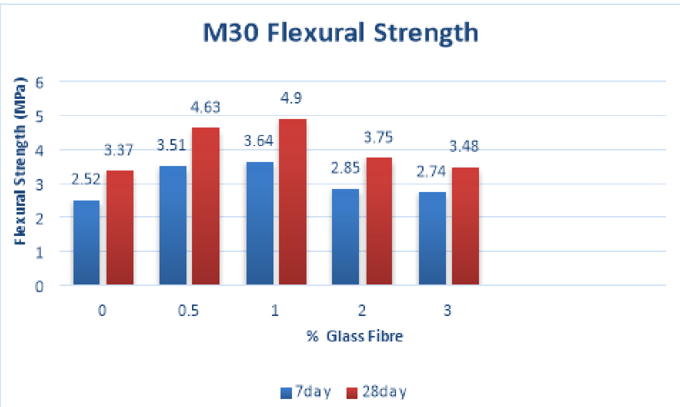


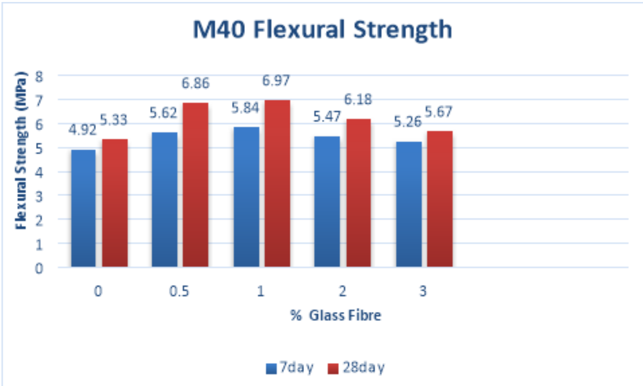




D. FLEXURAL STRENGTH







6. DISCUSSION AND CONCLUSION

From the experiments conducted on the glass fibre reinforced concrete, developed in the concrete laboratory of RSR RCET, the following conclusions have been made.

1. The slump value of the matrix decreases with the increase in percentage of glass fibres.
2. If there should arise an occurrence of GFRC the 1% addition of glass fiber, by weight of cement can be taken as the ideal percent for compressive strength, which can be utilized for giving greatest compressive quality at any age for Glass Fiber Reinforced Concrete.
3. The compressive strength, split tensile strength and flexural strength increased till the 1% addition of glass fibres after that it gradually decreases.
4. Addition of glass fibre improves the toughness, flexural strength, ductility as well as compressive strength ofconcrete.
5. The suitable addition of glass fibre in matrix is 0.5 to 1%.
6. The addition of glass fibres at 0.5%, 1%, 2% and 3% of cement reduces the cracks under different loading conditions.
7. It will help to counteract the problem of disposal of waste glass for the glass industry and in addition to that it will also help in preparing greener concrete.
8. It can be concluded that an application of 1% of glass fibre, to concrete mix may be conveniently allowed.

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