AN EXPERIMENTAL STUDY ON MECHANICAL PROPERTIES OF M20 & M25 GRADE CONCRETE WITH ADDITION OF GLASS FIBER

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Abstract: In this paper an attempt has been made to improve the mechanical properties of M20 and M25 grade with addition of glass fiber. This Paper presents the optimization use of glass fiber with concrete mixture. In this paper glass fiber of diameter 0.0120 m with aspect ratio 857.1 at various percentages 0%, 0.3%, 0.5%, 0.7% has been used. The volume of concrete on M20 grade is of mix proportions (1: 1.4: 2.96) with water cement ratio 0.5 and volume of concrete on M25 grade is of mix proportions (1: 1.9: 2) with water cement ratio 0.5 has been used. GFRC based samples has been used to test the compressive strength, flexure strength and split tensile strength.
Keywords: Glass fibers, Compressive Strength, Flexure Strength and Split Tensile Strength

I. INTRODUCTION

The most versatile material is concrete. The conventional concrete mixes are usually prone to plastic shrinkage during the curing phase and often lead to crazing and cracking. Economic dispatch is a method of determining the most efficient, low cost and reliable operation of power system by dispatching the generation resources to supply the load on the system. The addition of relatively small amounts of fibers can effectively eliminate this problem by controlling this early – age plastic shrinkage cracking. It also avoids the need for light crack –control steel –mesh with its attendant disadvantage of handling and positioning. Not only the fiber concrete is easy and cost effective to use, but also enables to produce a hardened concrete, which has improved surface quality, greater impact resistance and enhanced damaged resistance. Most importantly fiber restricts the growth of crack under load thereby arresting ultimate cracking. Non metallic fibers like alkali resistant glass fiber and synthetic fibers provide resistance against chemicals. Reinforcing capacity and proper functioning of fiber is based on length of fiber, diameter of fiber, the percentage of fiber and condition of mixing, orientation of fibers and aspect ratio. A major advantage of using fiber reinforced concrete besides reducing permeability and increasing fatigue strength is that fibers addition improves the toughness or residual load carrying ability after the first crack. This concrete is known as glass fiber reinforced concrete (GFRC)

II. LITERATURE REVIEW

We know that the properties of concrete improved with the addition of glass fiber. A large number of papers have been published which tells about the compressive strength, flexure strength and split tensile strength. Md.Abid Alam [1] in his work uses alkali resistant glass fibers in the concrete mixes. A total of 8 mixes were prepared by varying the percentages of glass fibers and grade of concrete mixes. Based on the laboratory results the compressive and tensile strength was reported to increase up to 26.19% and 25.4%. However the workability of concrete mixes is not much affected by the addition of fibers. The tensile strength of concrete is improved which shows the use of glass fibers in concrete mixes may reduce its shortcoming of low tensile strength without affecting its workability and compressive strength.. Alida Abdullah et al [2] in the project concentrated on making the cement panel with coconut fibers to replace fine aggregate. Various tests were conducted with the samples such as compression test, density, moisture and water absorption test for treated and untreated coconut fiber. The study, pointed out that the organic and inorganic impurities have significant role in controlling the density, moisture content, water absorption and compressive strength of the cement panels. S.R. Rabadiya et al [3] studied concrete made from glass fiber and recycled and coarse aggregate as partial replacement of coarse aggregate will be studied for workability, compressive strength, tensile strength, and modulus of elasticity. I will use recycled coarse aggregate as partial replacement of coarse aggregate by different percentage for making concrete of different grade from lower to higher like M-20. The percentage replacement will be 0%, 10%, 20%, 30%, 40%, 50% and 60% with natural coarse aggregate. Chandramouli [4] The compressive, split tensile and flexural strength on M20, M30, M40 and M50 grades of concrete made of alkali resistant glass fiber. Ankit singla [5] studies the effect of addition of glass fiber into M30 grade cement and studies its compressive strength and its workability.

III. MATERIAL USED

Materials required for making GFRC essentially consist of cement, fine sand, coarse aggregates and glass fiber. These materials are described below.

3.1 CEMENT

Ordinary Portland cement of 43 grade has been used in this experimental work. OPC 43 grade of JAYPEE cement has been used after investigate the strength of cement at 28 days as per IS 4031-1988.

3.2 FINE AGGREGATES

Locally available river sand passed through 4.75mm IS sieve has been used in the preparation of GFRC. It confirms to IS 383-1970 which comes under Zone I. The physical Properties of sand like Fineness Modulus, Specific Gravity and water absorption are 3.25, 2.67 and 2.31% respectively.

3.3 COARSE AGGREGATES

The Coarse aggregate are obtained from a local quarry has been used. The coarse aggregate with a maximum size 20mm having a specific gravity 2.89. In this experimental work coarse aggregates of 20mm are taken. The physical Properties of coarse aggregates like Fineness Modulus, Specific Gravity are 7.31, 2.89 respectively.

3.4 GLASS FIBRE

The glass fibers are of Cem-FIL Anti-Crack HD with Modulus of Elasticity 72 GPA, Filament diameter 14 microns, Specific Gravity 2.68, length 12mm and having the aspect ratio of 857. For 1 kilo gram, the number of fibers is 212 million.

Fig.1 Glass Fiber Used

3.5 WATER

Water used for mixing and curing was clean and free from injurious amounts of oils, acids, alkalis, salts and sugar, organic substances that may be deleterious to concrete. As per IS 456- 2000 Potable water is generally considered satisfactory for mixing and curing of concrete. Accordingly, potable tap water was used for the preparation of all concrete specimens.

IV. EXPERIMENTAL STUDY

Under this section, GFRC based sample has been tested for compressive strength, flexure strength and split tensile strength.

4.1 Compressive Strength Test for M20 & M25 Grade

Standard cubical moulds of size 150mm × 150mm×150mm made of cast iron were used to cast concrete specimens to test compressive strength of concrete. To determine the compressive strength of GFRC, total 48 no's of cubes been casted. The quantities of cement, fine aggregates, coarse aggregates, glass fiber and water for each batch were weighted to an accuracy of 1kg separately. Sand and glass fiber is added to this mixture in dry form. Finally, coarse aggregates were added and thoroughly mixed to get a uniform mixture throughout the batch. Required dosage of water was added in the course of mixing. Through mixing was done until concrete appeared to be homogeneous and of desired consistency. Concrete mix so prepared was tested for slump flow and reading of slump carefully recorded. The inner surfaces of moulds were oiled so as to avoid the sticking of concrete. Concrete was then filled in previously prepared moulds with controlled vibration to the concrete. Surface of concrete was finished level using a trowel and date along with batch number was marked properly on it. Finished specimens were left to harden and removed from moulds approximate after 24 hours of casting. They were then placed in water tank containing portable water and were left for curing. Specimens were taken out from curing tank at the age of 7 and 28 days of moist curing and were then tested. After that the specimen are tested at 7 days and 28 days at compression testing machine (CTM). The test was conducted on cubes according to IS code 516

Fig.2 Casting of cubes, beams and cylinders

Fig.3 Test set up for Compressive Strength

4.2 Flexure Strength Test for M20 & M25 Grade

For flexural strength, test beam specimens of dimension 150x150x700 mm were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. . To determine the compressive strength of GFRC, total 48 no's of beams been casted. These flexural strength specimens were tested under two point loading as per I.S. 516-1959, over an effective span of 640 mm on Flexural testing machine. Load and corresponding deflections were noted up to failure. The bearing surfaces of the supporting and loading rollers was wiped clean, and any loose sand or other material removed from the surfaces of the specimen where they were to make contact with the rollers. The specimen was then placed in the machine in such a manner that the load was applied to the uppermost surface as cast in the mould, along two lines spaced 13.3 cm apart. The axis of the specimen was carefully aligned with the axis of the loading device. No packing was used between the bearing surfaces of the specimen and the rollers. The load was applied without shock and increasing continuously at a rate such that the extreme fiber stress increased at approximately 7 kg/sq cm/min, that is, at a rate 180 kg/min.

Fig.4 Test set up for Flexure Strength

4.3 Split Tensile Strength Test for M20 & M25 Grade

For Split tensile strength test, cylinder specimens of dimension 150 mm diameter and 300 mm length were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. . To determine the compressive strength of GFRC, total 48 no's of cylinder been casted. These specimens were tested under compression testing machine. The test was conducted on cylinders according to IS code 516-1999. The position of the cylinder while testing was at horizontal.

Fig.5 Test set up for Split Tensile Strength

V. RESULT ANALYSIS

5.1 Compressive Strength Test

Compressive Strength of the test material has been tested at the ages of 7 days and 28 days. The results are shown in table below.

Table 1: Compressive Strength test for M20 for 7 days and 28 days

Sr. No.	Mix designations	% of glass fiber	Compressive Strength after 7 days Mpa	Compressive Strength after 28 days Mpa
1	MX0	0	15.55	20.44
2	MX1	0.3	16.44	22.22
3	MX2	0.5	18.66	23.99
4	MX3	0.7	19.11	24.59

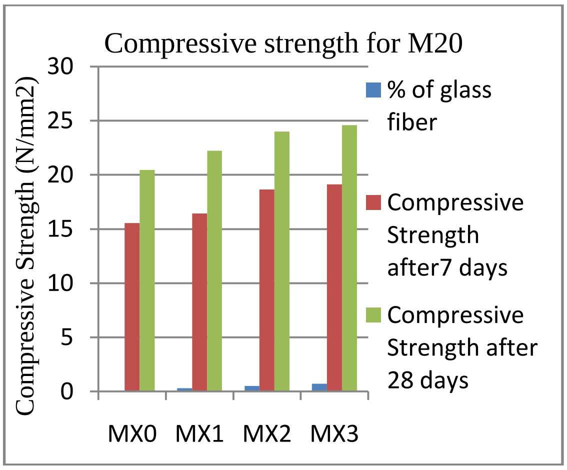

Fig.6 Compressive strength for M20 after 7 days and 28 days

Table 2: Compressive Strength test for M25 for 7 days and 28 days

Sr. No.	Mix designations	% of glass fiber	7 days Mpa	28 days Mpa
1	MX0	0	16.88	26.81
2	MX1	0.3	18.96	26.88
3	MX2	0.5	20.29	30.22
4	MX3	0.7	20.44	30.58

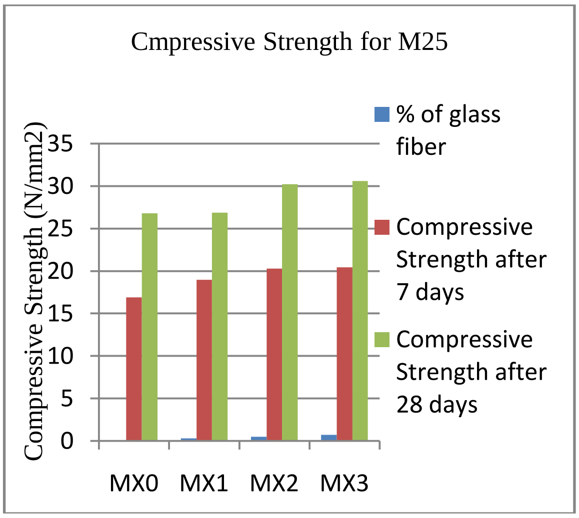

Fig.7 Compressive strength for M25 after 7 days and 28 days

5.2 Flexure Strength Test

Flexure Strength of the test material has been tested at the ages of 7 days and 28 days. The results are shown in table below.

Table 3: Flexure Strength test for M20 for 7 days and 28 days

Sr. No.	Mix designations	% of glass fiber	Average Strength after 7 days Mpa	Average Strength after 28 days Mpa
1	MX0	0	1.91	3.30
2	MX1	0.3	2.04	3.67
3	MX2	0.5	2.56	3.85
4	MX3	0.7	2.93	3.97

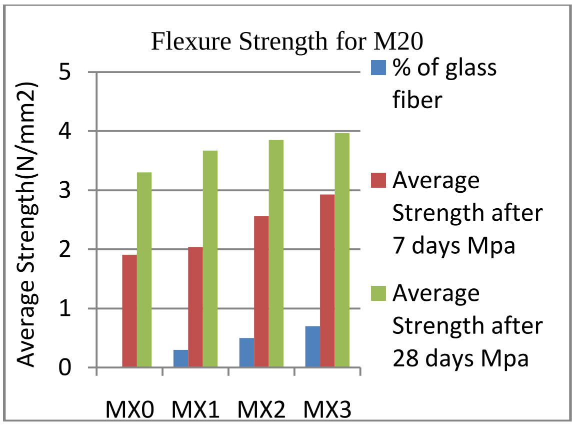

Fig.8 Flexure strength for M20 after 7 days and 28 days

Table 4: Flexure Strength test for M25 for 7 days and 28 days

Sr. No.	Mix designations	% of glass fiber	Average Strength after 7 days Mpa	Average Strength after 28 days Mpa
1	MX0	0	2.38	3.76
2	MX1	0.3	2.94	4.03
3	MX2	0.5	3.21	4.52
4	MX3	0.7	3.51	4.95

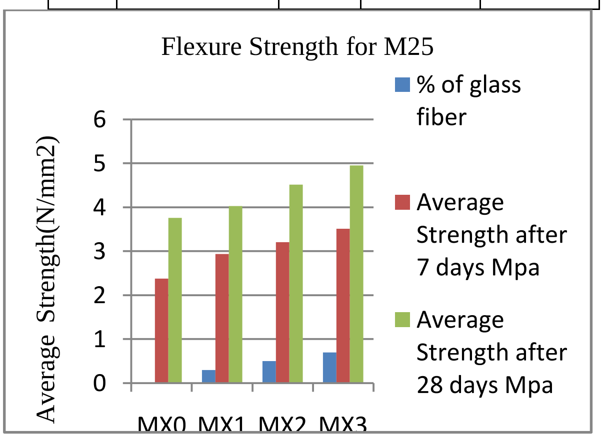

Fig.9 Flexure strength for M25 after 7 days and 28 days

5.3 Split Tensile Strength Test

Split Tensile Strength of the test material has been tested at the ages of 7 days and 28 days. The results are shown in table below.

Table 5: Split Tensile Strength test for M20 for 7 days and 28 days

Sr. No.	Mix designations	% of glass fiber	Average Strength after 7 days Mpa	Average Strength after 28 days Mpa
1	MX0	0	1.13	1.69
2	MX1	0.3	1.41	1.97
3	MX2	0.5	1.74	2.4
4	MX3	0.7	1.85	2.54

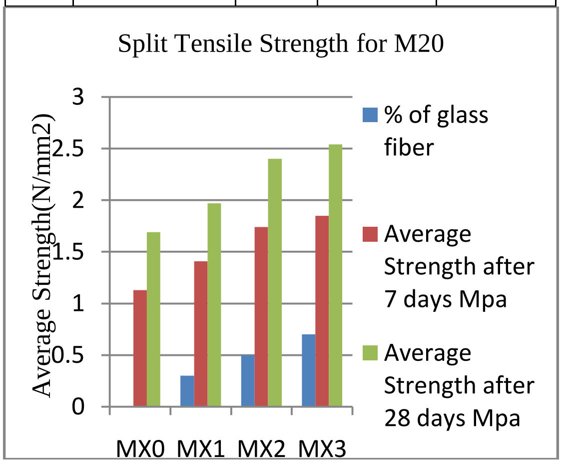

Fig. 10 Split tensile strength for M20 after 7 days and 28 days

Table 6: Split Tensile Strength test for M25 for 7 days and 28 days

Sr. No.	Mix designations	% of glass fiber	Average Strength after 7 days Mpa	Average Strength after 28 days Mpa
1	MX0	0	1.41	2.30
2	MX1	0.3	1.74	2.82
3	MX2	0.5	2.02	3.4
4	MX3	0.7	2.26	3.72

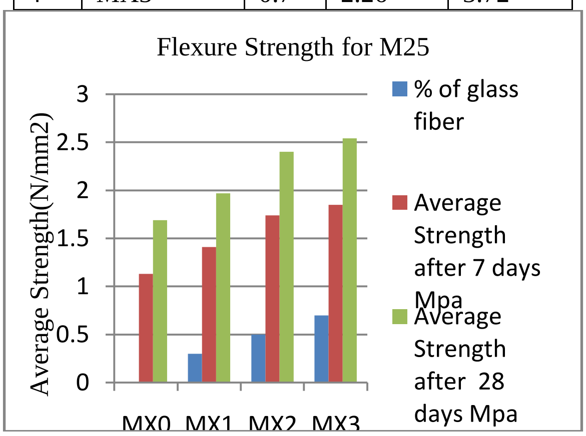

Fig.11 Split tensile strength for M25 after 7 days and 28 days

VI. CONCLUSION

The following conclusion has been drawn from the experimental work.

The experimental work shows that the properties of M20 and M25 have been increased due to addition of glass fiber.

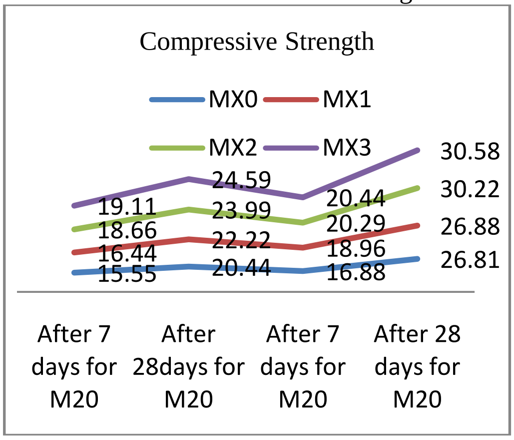

Fig.12 Comparison of Compressive Strength for M20 and M25

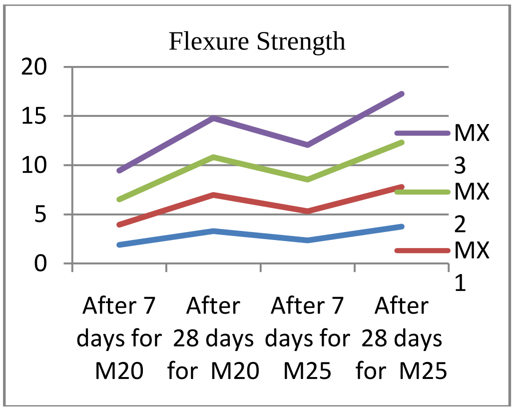

Fig. 13Comparison of Flexure Strength for M20 and M25

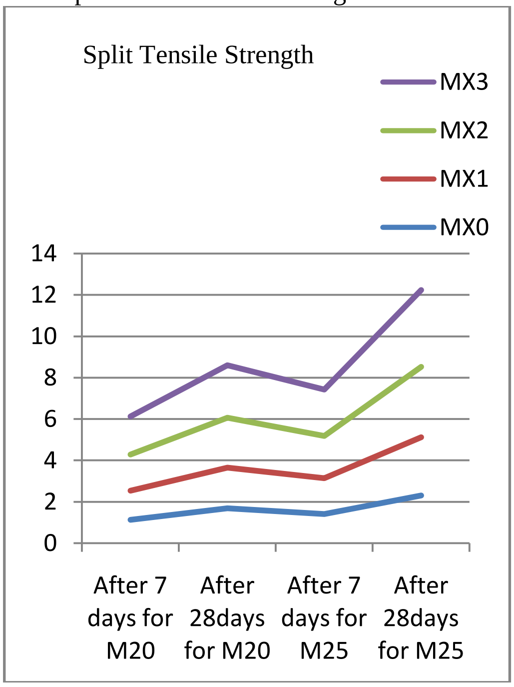

Fig. 14 Comparison of Split Tensile Strength for M20 and M25

- It can be observed that from above calculations that the compressive strength has been increased to 16 % in M20 and 12% in M25 with the addition of 0.7% of glass fiber. The increase in strength is more after 28 days. Further increasing the percentage of glass fiber in cement increase the compressive strength to more value.
- It can also conclude from above calculations that the flexure strength has been increased to 17% in M20 and 24% in M25 with the addition of 0.7% of glass fiber. The increase in strength is more at the age of 28 days. Further increasing the percentage of glass fiber in cement increase the flexure strength to more value.
- It can also conclude from above calculations that the split tensile strength has been increased to 33% in M20 and 38% in M25 with the addition of 0.7% of glass fiber. The increase in strength is more at the age of 28 days. Further increasing the percentage of glass fiber in cement increase the split tensile strength to more value.

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