An Experimental Investigation of Properties of Cement Concrete on Addition of Different Percentage of Glass Fibre and SBR-latex

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Abstract– Glass Fibre Reinforced Concrete is recent introduction in the field of concrete technology Glass fibre–reinforced concrete (GFRC) is a type of concrete which basically consists of a cementious matrix composed of cement, sand, coarse aggregate, water, polymer and admixtures, in which short length glass fibres are dispersed. This journal documents the effects of using glass fibres in Styrene Butadiene Rubber (SBR) latex modified concrete. The study was carried out to record the different properties of glass fibre reinforced latex modified concrete such as compressive strength, flexural strength and split tensile strength. Latex modified concrete is defined as Portland cement and aggregate combined at the time of mixing with polymers that are dispersed in water. This dispersion is called as latex. Polymer when used as an admixture can improve properties like higher strength and lower water permeability than the conventional concrete. The polymer concrete specimens with and without fibres and latex were cast and tested to watch the improvement of certain mechanical and physical properties like compressive strengths, flexural strengths, tensile strengths and workability. Styrene Butadiene Rubber Latex polymer and Cem-Fill Anti-Crack, HD-12mm, AR Glass fibres have been used for our study. The percentage of Glass fibre used were 0%,0.03%,0.06%,0.10%,0.13%. The fraction of glass fibre which gave the best result was taken and latex was varied in percentage 5%, 10%, 15% to obtain maximum strength. In all total 24 specimen cubes (150mm X 150 mm X 150 mm), 24 beam (500mm X 100mm X 100mm) and 24 cylinder specimens (150 mm X 300 mm) were made. The hardened properties of concrete were tested at 28th days.

Index Terms — M20 Grade Concrete, Styrene Butadiene Rubber Latex Polymer, Glass Fibre, Flexural Strength, Compressive Strength, Split Tensile Strength.

1. INTRODUCTION

Generally, concrete is strong in compression and weak in tension. Concrete is brittle and will crack with the application of increasing tensile force. Once concrete cracks it can no longer carry tensile loads. In order to make concrete capable of carrying tension at strains greater than those at which cracking initiates, it is necessary to increase the tensile strength. To increase the tensile and flexural strength, fibres are added in concrete. The addition of fibres to concrete will result in a composite material that has properties different from those of un-reinforced concrete. The extent of this variation depends not only on the type of fibres, but also on the fibre dosage. Glass fibre reinforced concrete is one of the most versatile building materials available to architects and engineers. Composed principally of cement, sand and special alkali resistant (AR) glass fibres, GRC is a thin, high strength concrete with many applications in construction. Glass fibers serve the similar purpose with an additional advantage of being used in ornamental concrete This material is alkali resistant and less dense than steel, so the final product known as ‘glass fiber reinforced concrete (GFRC)’, is lightweight but strong. GFRC is composed of fine sand, cement, water, admixtures (if required) and alkali-resistant (AR) glass fibers in different ratios. It has been recognized that the addition of small, closely spaced and uniformly dispersed fibres to concrete would act as crack arrester and would substantially improve its static and dynamic properties. GFRC derives its strength from a high dosage of AR glass fibers; while compressive strength of GFRC can be increased, it is the much higher flexural and tensile strengths that make it superior to ordinary concrete. LMGFRC latex modified glass fibre reinforced concrete used in this study due to both its admixture increase the strength of concrete and make the concrete light weight and water tight.

2. REVIEW OF LITERATURE:

- deshmukh s.h. et. al
- liaqat a. qureshi and adeel ahmed.
- ms. karthika kishore koka

2.1. Deshmukh S.H. et. al, "Effect of Glass Fibres on Ordinary Portland Cement Concrete". this research programme was conducted for determining the mechanical properties (compressive strength, flexural strength and tensile strength) of M20 cement concrete on addition of different fraction of glass fibre as 0.00%, 0.03%, 0.06% and 0.10% by volume fraction of concrete and tested at 28 days. Maximum strength increase on addition of 0.10% glass fibre. Compressive strength increase 8.81%, 11.15% and 23.44% , flexural strength 7.27%, 9.27%, 19.31% and split tensile strength 2.8%, 12.73% and 42.23% on addition of glass fibre 0.03%, 0.06% and 0.10% respectively when compared to nominal mix M 20 at 28 days.

2.2. Liaqat A. Qureshi and Adeel ahmed, "An investigation on Strength properties of Glass fibre reinforced concrete". Present program has been carried out to study the mechanical properties of glass fiber reinforced concrete with the glass fiber percentage by weight of cement 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5% at 3, 7, 28, 56 days. The addition of 1.5% glass fiber maximum strength increases at all days. Compressive strength 18%, 15%, 13%, 2% at 3, 7, 28, 56 days respectively, flexural strength 50% and split tensile strength 18%, 26%, 13%, 11% increases.

2.3. Ms. Karthika Kishore koka, "Steel Fiber Reinforced Latex Modified Concrete". In this paper the study was carried out to record the different physical and mechanical properties of Steel fiber reinforced latex Modified concrete. 5% of SBR latex and 0.5% of steel fibers have been used. Due to addition of latex highest value of mechanical properties find at 7days. Increasing the early age strength. Enhance the durability. Specimen did not fail suddenly. Reduce the cracks.

3. EXPERIMENTAL PROGRAMME

3.1. Materials

3.1.1. Cement

The ordinary portland cement, 43 grade conforming to is standards was used. the cement was procured from local markets and in one lot to maintain uniformity throughout the investigation and the properties of the cement are investigated in the laboratory. the specific gravity of cement is 3.15, consistency 32%.

3.1.2. Fine Aggregate

coarse sand locally available to us was used as fine aggregate. sand conforming to grading zone-II of is 383-1970 has been used as fine aggregate. the various properties of fine aggregate used in present study are fineness modulus 3.017, specific gravity 2.63.

3.1.3. Coarse Aggregate

The locally available crushed granite material has been used as coarse aggregate. the coarse aggregate also confirms to is 383-1970. size of aggregate 20 mm, fineness modulus 6.865, specific gravity 2.64.

3.1.4. Glass Fibre

The glass fibres used cem-fil anti-crack with modulus of elasticity 72gpa, filament diameter – 14 microns, specific gravity 2.68, length 12 mm and having the aspect ratio of 857.1.the number of fibres per 1 kg is 212 million fibres.

3.1.5. Styrene butadiene rubber latex

Form- white liquid, density-1kg/l at 25^0c, solid content- 50%, chloride content – 50%. styrene-butadiene rubber (sbr), a general-purpose synthetic rubber, produced from a copolymer of styrene and butadiene. sbr is a mixture of approximately 75 percent butadiene (CH_2=CH-CH=CH_2) and 25 percent styrene (CH_2=CHC_6H_5). in the present study, berger home shield sbr latex has been used.

3.1.6. Water

Ordinary tap water was used for mixing and curing operations.

3.2. Fabrication and Casting

Mixing of Concrete by Mechanical Mixer.
Preparation of specimens.

The moulds used for cubes, beams and cylinders were of steel having an internal dimension of 150 mm x 150 mm for cube, 100 mm x 100 mm x 500 mm for beam and 300 mm x 150 mm for cylinder. The cement, coarse and fine aggregate were mixed thoroughly with the help of mechanical mixer. Then glass fibre is dispersed to the above mixture while mixer is working. SBR- latex is mixed in water and is put into the mixture. For all test specimens, moulds were kept on table vibrator and the concrete was poured into the moulds in three layers by tamping with a tamping rod and the vibration was effected by table vibrator after filling up the moulds. The moulds are kept in vibration for one minute and it was maintained constant for all the specimens. The glass fibre is varied in a fraction of 0%,0.03%,0.06%,0.1% and 0.13%. The percentage at which maximum strength is obtained was taken to vary sbr latex in a percentage of 5%, 10% 15%. 3 cubes, 3 beams and 3 cylinder specimen are made for each set.

3.3. Curing

The moulds were removed after 24 hours and the specimens were kept immersed in a clear water tank. After curing the specimens in water for a period of 28 days the specimens were removed out and allowed to dry under shade.

4. RESULTS AND DISCUSSIONS

Mix Name	Grade Of Concrete	% Of Glass Fibre	% Of Sbr Latex	No of Specimen			
				Compressive Strength	Flexural Strength	Tensile Strength	Total
M	M20	0.00	0.00	3	3	3	9
N	M20	0.03	0.00	3	3	3	9
O	M20	0.06	0.00	3	3	3	9
P	M20	0.10	0.00	3	3	3	9
Q	M20	0.13	0.00	3	3	3	9
R	M20	0.10	5.00	3	3	3	9
S	M20	0.10	10.00	3	3	3	9
T	M20	0.10	15.00	3	3	3	9
Total				24	24	24	72

Table 1 Specimens Detailing.

4.1. Compressive strength

S. NO.	Mix Name	Average Compressive Strength at 28 Days (Mpa)
1.	M	24.02
2.	N	26.17
3.	O	26.77
4.	P	29.55
5.	Q	28.10

Table: 2 Variation of Compressive Strength for different fraction of Glass Fibre.

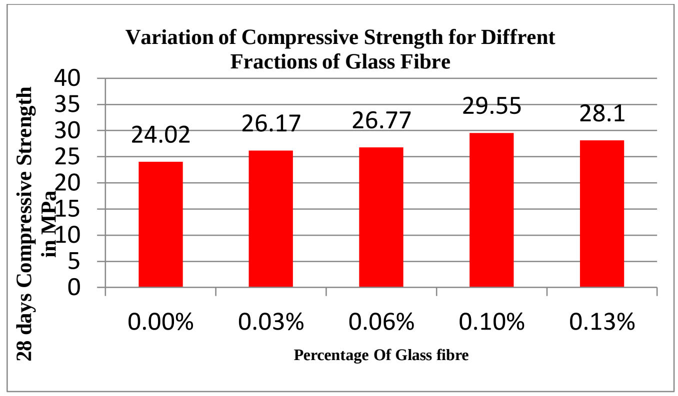

Figure 1. Variation of Compressive Strength for different fraction of Glass Fibre.

S. No.	Mix Name	Average Compressive Strength at 28 Days (Mpa)
1.	R	26.87
2.	S	31.17
3.	T	26.41

Table 3 Variation of Compressive Strength for different fraction of Glass Fibre & SBR-Latex.

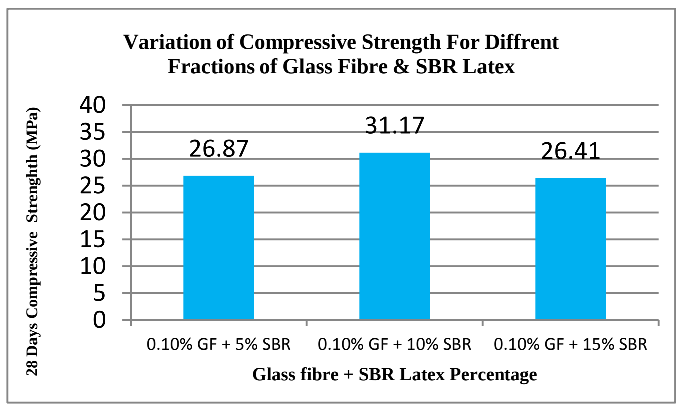

Figure 2. Variation of Compressive Strength for different fraction of Glass Fibre & SBR-Latex..

4.2. flexural strength

S. NO.	Mix Name	Average Flexural Strength at 28 Days (Mpa)
1.	M	3.37
2.	N	3.62
3.	O	3.75
4.	P	4.05
5.	Q	3.90

Table 4 Variation of flexural Strength for different fraction of Glass Fibre.

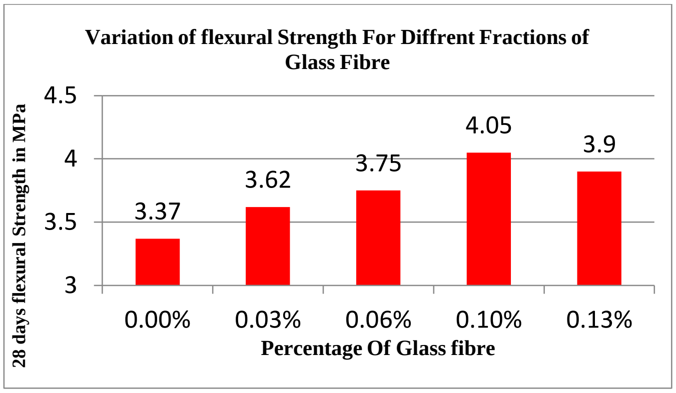

Figure 3. Variation of flexural Strength for different fraction of Glass Fibre.

S. No.	Mix Name	Average flaxural Strength at 28 Days (Mpa)
1.	R	4.24
2.	S	4.45
3.	T	4.17

Table 5 Variation of flexural Strength for different fraction of Glass Fibre & SBR-Latex.

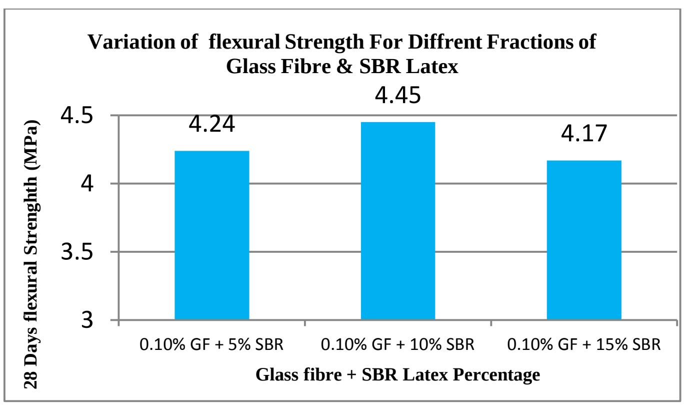

Figure. 4. Variation of flexural Strength for different fraction of Glass Fibre & SBR-Latex.

4.3. split tensile strength

S. NO.	Mix Name	Average Tensile Strength at 28 Days (Mpa)
1.	M	3.28
2.	N	3.35
3.	O	3.65
4.	P	4.60
5.	Q	4.20

Table 6 Variation of Tensile Strength for different fraction of Glass Fibre.

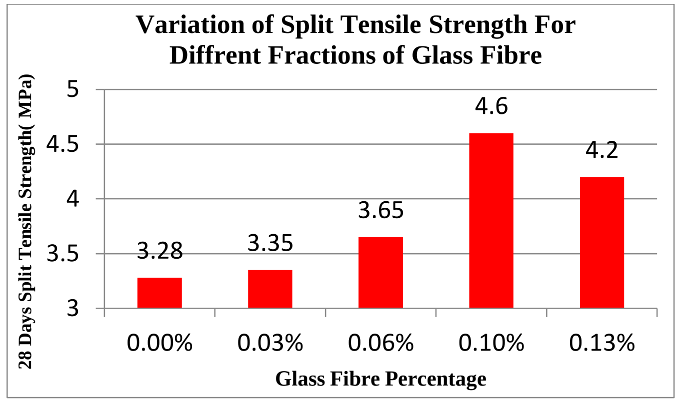

Figure 5. Variation of Tensile Strength for different fraction of Glass Fibre.

S. No.	Mix Name	Average Tensile Strength at 28 Days (Mpa)
1.	R	3.87
2.	S	4.90
3.	T	3.70

Table 7 Variation of Tensile Strength for different fraction of Glass Fibre & SBR-Latex.

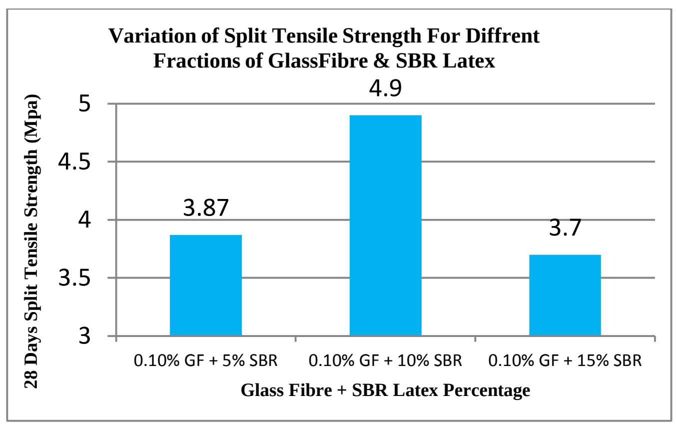

Figure 6. Variation of Tensile Strength for different fraction of Glass Fibre & SBR-Latex.

5. CONCLUSIONS

In the present study, the mechanical properties of three types of concrete namely plain concrete, glass fibre reinforced concrete and LMGFRC latex modified glass fibre reinforced concrete has been determined on the basis of various test results carried out in laboratory.

Based on these results and observations made in this experimental research study, the following conclusions are drawn:-

1. It has been found that compressive, flexural and split tensile strength have their maximum values for 0.10% glass fibre dosage among all fibre variations. The compressive strength is increased by 23.04%, flexural strength by 20.40% and split tensile strength by 40.10% when compared to their nominal strength.

2. When SBR latex is added along with 0.10% glass fibre dosage, maximum strengths are obtained at 10% of latex. The compressive strength is increased by 29.77%, flexural strength by 32.18% and split tensile strength by 49.24% when compared to their nominal strength.

3. The test results show that by using 10% latex along with 0.10% glass fibre, the compressive strength increased by 5.47%, flexural strength by 9.79% and split tensile strength by 6.52% when compared to strength values for 0.10% glass fibre alone.

4. The compressive, tensile strength decrease for any further increase in the quantity of latex above 10% dosage.
own above.

REFERENCES

[1] IS 10262: 2009 Indian Standard Guidelines for Concrete mix design.

[2] IS 383: 1970 Indian Standard specifications for coarse and fine aggregate from natural sources for concrete.

[3] Textbook on Concrete Technology by ML Gambhir.

[4] Deshmukh S. H., Bhusari J. P. , Zende A.M. , "Effect of Glass fiber on ordinary Portland Cement Concrete ", IOSR Journal of Engineering, Vol. 2, No.6, June , 2012, pp: 1308-1312, Singhgad College of Engineering, Pune.

[5] Dr. S. Suriya, S. Sowmiya Sadhana, Suman Naaz Shaikh, "Study on polymer modified Steel Fiber Reinforced". (ICARBEST'15) Journal of Advanced Research in Biology, Ecology, Science and Technology, 19th November 2015, B.S. Abdur Rahman University, Chennai, India.

[6] Sudheer Jirobe, Brijbhushan.S, Maneeth P. D., "experimental investigation on strength and durability properties of hybrid fiber reinforced concrete", International Research Journal of Engineering and Technology (IRJET), ISSN: 2395-0072,Vol. 2,Issue 4, Aug- 2015,

[7] Liaqat A. Qureshi and Adeel Ahmed, "An investigation on Strength properties of Glass fiber reinforced concrete", International Journal of Engineering Research and Applications (IJERT), ISSN:2278-0181,Vol. 2,Issue 4, April- 2013, University of Engineering, & Technology, Taxila , Pakistan.

[8] Chandramouli K., Srinivasa Rao P. , Pannirselvam N. , Seshadri Sekhar T. and Sravana P. , "Strength properties of Glass fiber concrete", ARPN Journal of Engineering and Applied Sciences, Vol. 5, No.4, April , 2010, ISSN 1819-6608 ,JNTU College of Engineering, Hyderabad , Andhra Pradesh, India.

[9] Ramkumar V.R, "strength and permeability characteristics of fibre reinforced concrete", IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 1, Issue 1, ISSN: 2320 – 8791, March, 2013

[10] A. Upendra Verma , A.D. Kumar "Glass fiber reinforced concrete ," International Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 3, Issue 5, Sep-Oct 2013, pp. 1914-1918, V. R. Siddhartha Engineering College, Vijayawada.

[11] Kapil Soni, YP Joshi, "Performance analysis of SBR Latex on cement concrete mixes," International Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 4, Issue 3(Version 1), pp. 838-844, March 2014, Sati Govt. Engineering College, Vidisha

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