An Experimental Study of Comparison between the Study of Glass Fibre Reinforced Concrete and Conventional Concrete (M30 Grade)

Adarsh Sharma[1] Iliyas Khaleel[2]
[1,2]Department of Civil Engineering
[1,2]Bharat Institute of Technology, Sonepat, Haryana, India

Abstract— Glass-fibre reinforced (GFRC) is a fabric manufactured from a cementitious matrix composed of cement, sand, water and admixtures, wherein brief duration fibres are dispersed. It has been extensively used within side the creation enterprise for non-structural factors like- façade panels, piping and channels. It is advancement in the construction technology, since it is light in weight, therefore bringing economy in the construction. Steel is replaced by the glass fibres helps in avoiding structural deterioration and corrosion in reinforced concrete structures. Keeping in mind about the global environment conditions, many alternatives are searched to increase the strength, durability, shrinkage characteristics and serviceability of concrete. Hence, here glass fibre is added and tests have performed with varying percentage of 1%, 2% and 3% of cement by adding as an admixture.

Keywords: Glass Fibre, Light Weight, Economic, Eco Friendly, Compressive Strength

I. INTRODUCTION

The creation enterprise is revolutionizing in predominant ways. One manner is the improvement of creation techniques, consisting of the use of automatic equipment in creation. The different is the development in excessive-overall performance creation substances, consisting of advent of excessive energy concrete. Among those excessive-overall performance substances, fibre strengthened concrete (FRC) is progressively gaining reputation from civil engineers. In current years, studies and improvement of fibres and matrix substances and fabrication method associated with creation enterprise have grown rapidly.

Their benefits over the alternative production substances are their excessive tensile electricity to weight ratio, capacity to be moulded into numerous shapes and ability resistance to surroundings conditions, ensuing doubtlessly low renovation cost. These houses make FRC composite a great opportunity for progressive production.

Concrete are broadly used production substances having numerous suitable residences like excessive compressive strength, stiffness and sturdiness below standard environmental condition. Plain concrete possesses a totally low tensile strength, restricted ductility and little resistance to cracking. This shortcoming is offset through imparting metallic bars at suitable places on the time of casting the participants to soak up the tensile stresses and every so often the compressive stresses if required. The gain of reinforcing and pre-stressing era using metallic reinforcement as excessive tensile metallic wires have helped on overcoming of concrete in anxiety however the sturdiness and resistance to cracking isn't stepped forward. These residences may be stepped forward through using fibres within side the concrete.

Glass fibre-reinforced concrete (GFRC) is a type of concrete which basically consists of a cementitious matrix compound composed of cement, sand, coarse aggregate, water, polymer and admixtures, in which short length glass fibres are diffused. The fibres provide reinforcement for the matrix and other useful functions in fibre-reinforced composite materials. Glass fibres can be incorporated into a matrix either in continuous or discontinuous chopped lengths. Glass fibres have high tensile strength and elastic modulus. Glass fibres are usually round and straight with diameter from 0.005 mm to 0.015 mm.

The goal of this study is to identify the improvements in the strength of concrete with the addition of glass fibre. In this study, glass fibre is added to concrete and plain cement concrete (PCC) is used as reference to study its reaction on flexural, compressive and tensile strength properties and also drying shrinkage. Fibre is coated with oil so as to decrease the water absorption. Some of the advantages being observed are low cost, low density, reasonable specific strength, good thermal insulation, reduced wear and ability to be recycled with minimum impact on environment.

II. LITERATURE REVIEW

Bhatia, 2001 studies the usefulness of fibre reinforced concrete in various civil engineering applications. Fibres include steel fibres, natural and synthetic fibres each of which lends varying property to concrete. The study revealed that the fibrous material increase the structural integrity.

J.D. Chaitanya Kumar 2016, his study concludes that the addition of glass fibres at 0.5%, 1%, 2% and 3% of cement cut down the cracks under different weather conditions. It has been found that the workability of cement will increase at 1% with the addition of glass fibre. The compressive strength is very high at 1% having for 7 days is 20.76 N/mm^2 and for 28 days is 28.46 N/mm^2. The tensile strength is very high at 1% having for 7 days is 1.47 N/mm^2 and for 28 days is 2.94 N/mm^2. The split tensile strength is very high at 1% having for 7 days 2.83 N/mm^2 and for 28 days is 3.92 N/mm^2.

III. MATERIAL USED

The materials used in this study are-

- We have used 43 grade Ordinary Portland Cement (OPC) confirming to IS 8112-1989.
- We have used fine aggregate of grading zone-II (sand).
- We have used coarse aggregate most of which is retained on 4.75 mm IS sieve.
- We have used water which ph value shall not be less than 6.
- We have used the glass fibres of various shapes and sizes, typically aspect ratio range from about 30 to 150 for length dimension of 6.4 mm to 76 mm (0.25 in. to 3.0 in.).

All rights reserved by www.ijsrd.com

IV. MATERIAL TESTING

The various tests done on cement are-

A. Standard Consistency

As per IS 4031- Part IV, the value of consistency should be 30%.
Test was conducted on OPC 43 grade and result was found to be 33%.

B. Initial Setting Time

Experiment was done as per IS- 1489 part 1, and the obtained value of initial setting time is 34 min. According to IS code initial setting time of cement shall not be less than 30 minutes.

C. Final Setting Time

Experiment was done as per IS 4031part 1 and the obtained valve of final setting time is 8 hours 43 minutes. According to IS code final setting time should not exceed 10 hours.

D. Fineness of Cement

Experiment was done as per IS part 1 1996 and the obtained value of fineness of cement is 6%. According to IS code the weight of residue should not exceed 10% for OPC.

E. Density of Cement

Experiment was done by Le Chatelier's flask and the obtained value of density of cement is 3.09 g/ml. According to IS 4031 Part II-1988 density of cement is around 3.15 g/ml.

F. Soundness of Cement

Experiment was done by Le Chatelier's method and the obtained value of soundness of cement is 8 mm. According to IS 4031: 1998 part III the expansion of cement should not exceed 10 mm for OPC.

The various tests done on aggregates are-

A. Bulk Density of Coarse Aggregate

Experiment was done and the obtained value was 1.29 kg/lit. As per IS code 2386 part III, the value of bulk density is varies from 1.2 to 1.8 kg/lit.

B. Specific Gravity of Coarse Aggregate

Experiment was done and the obtained value of specific gravity was 2.6. As per IS code 2386 part III 1963, average value of specific gravity should lies between 2.6 to 2.8.

C. Aggregate Crushing Test

Experiment was done and the obtained value of aggregate crushing test was 20.62 which are good.

D. Impact Test on Coarse Aggregate

Experiment was done and the obtained value of impact test was 11.44 which are good.

V. METHODOLOGY

A flow chart showing the methodology-

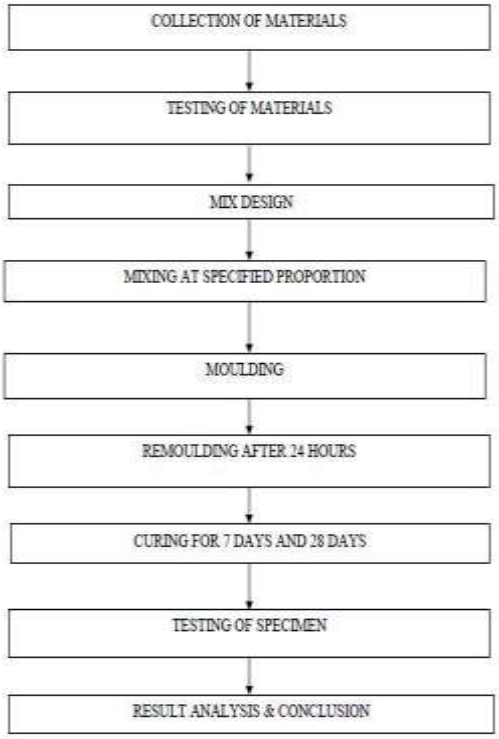

Fig. 1: Flow Chart Showing Methodology

VI. TEST AND RESULTS

Test Results for Conventional Cube Test

S.NO	LOAD		COMPRESSIVE STRENGTH	
	7 DAYS	28 DAYS	7 DAYS	28 DAYS
1	350	570	15.55	25.33
2	345	585	15.33	26
3	360	565	16	25.11
Average			15.62	25.48

Table 1: Compressive Strength of conventional cube at 7 days and 28 days

Test Results of Glass Fibre Reinforced Concrete Cube

Sr.no.	% of glass fibre	Load (KN)		Compressive Strength (N/mm2)		Average	
		7days	28days	7 days	28 days	7 days	28 days
1	1%	505	685	22.44	30.44	22.14	30.14
		490	670	21.77	29.77		
		500	680	22.22	30.22		
2	1.5%	535	725	23.77	32.22	23.25	32.22
		515	720	22.88	32		
		520	730	23.11	32.44		
3	2%	485	670	21.55	29.77	21.18	29.55
		470	660	20.88	29.33		
		475	665	21.11	29.55		

Table.2 Compressive Strength of GFRC Cubes at Various Percentages of Fibr

All rights reserved by www.ijsrd.com

VII. CONCLUSION

These are conclusions made by the experimental results-

- There is an increase in compressive strength of conventional concrete cube by mixing alkali glass fibres in it.
- Maximum compressive strength (26%) was obtained by mixing glass as 1.5% by weight by whole concrete mix.
- Use of glass fibre is economic & amp; appropriate method to obtain high strength concrete panels obtained require less material and are high strength.

VIII. FUTURE SCOPE

GFRC is a composite material comprising a mixture of hydraulic cement, silica sand, alkali resistant glass fibre and water. GFRC is a particularly attractive and durable cladding material. It can be moulded into a wide variety of complex shapes and profiles and is ideally suited to the popular fast-track approach of modern building. The main advantage of GFRC panels over the corresponding precast concrete alternatives is the considerable saving in weight.

GFRC is used extensively in the architectural and civil engineering fields with the main products being-

- Cladding
- Permanent formwork
- Cornices
- Coping units
- Canopies
- Porticos
- Sunscreens
- Walkway roofs/walls
- Artificial rocks
- Planters
- Street furniture

REFERENCES

[1] Komalachawla, STUDIES OF GLASS FIBRE REINFORCED CONCRETE COMPOSITES (IJSCER), 2013.
[2] Eng, Pshtiwan N. Shakoe, Glass Fibre Reinforced Concrete Concrete Use in Concrete (IJTES), 2011.
[3] C. Selin Ravikumar, Glass Fibre Conrete: Investigation on Strength and Fire Resistant Properties, (IOSR-JMCE), 2013.
[4] "GRC for Architects and Engineers, GRC in Action UK", GRCA International, 2003.
[5] J.D. Chaitanya Kumar, Experimental Studies on Glass Fibre Concrete (AJER), 2016.
[6] Practical Design Guide, International GRCA Technical Committee, Version 1.0.
[7] Masuelli, M.A., "Fibre Reinforced Polymers
[8] Girard, J., "Introduction to GFRC (Glass Fibre Reinforced Concrete)", The Concrete Countertop Institute, 2008.
[9] Alam, Md. A., Ahmad, I., Rahman, F., "Experimental Studies on Properties of Glass Fiber Reinforced Concrete", IJETT, June 2015, 24(06): 297-301.
[10] Retnakar. A., S., Hussain, S. S. K, Shilpa, T. S., Varun, V., Kumar, M.D.S. "Performance Evaluation of Glass Fiber Reinforced Concrete", IJERT, March 2017, 04 (03): 950-954.
[11] Stahli, P., Custer, R, Van Mier, J. G. M. "On Flow Properties, Fiber Distribution, Fiber Orientation and Flexural Behaviour of FRC", Materials and Structures, 2008,41: 189-196.
[12] "Design Manufacture and Installation of Glass Reinforced Concrete (GRC)", GRC Industry Group of National Precast Concrete Association, Australia, October 2006, pp. 29-32.
[13] Zollo, R. F., "Fiber–Reinforced Concrete: An Overview after 30 Years of Development", Cement and Concrete Composites, 1997, 19(2): 107–122.
[14] Bentur, A., Mindess. S., "Fiber Reinforced Cementitious Composites", Second
[15] Afroughsabet, V., Biolzi L., Özbakkaloğlu, T., "High–Performance Fiber–Reinforced Concrete: A Review", J. Mater. Sci., 2016, 51: 6517–6551.
[16] Masood, U., "Studies on Characteristics of Mixed Fiber Reinforced Concrete for Structural Applications", Jawaharlal Nehru Technological University, Hyderabad, PhD Thesis, 2014.
[17] Ferreira, J. P. J. G., Branco, F. A. B., "The Use of Glass Fiber–Reinforced Concrete as a Structural Material", Experimental Techniques, May–June,2007, pp. 64–73
[18] Bartos, P. J. M., "Review on the Performance of Glass Fiber Reinforced Concrete", IOP Conf. Series: Materials Science and Engineering, Scotland, 2017, 246.

All rights reserved by *www.ijsrd.com*