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Experimental Studies on Mortar Using Glass Fibers

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Abstract

An experimental program was carried out to evaluate the properties of cement Mortar. Compressive strength test, splitting tensile strength test and Water absorption test were performed and the results were analysed statistically. Glass fibres can greatly increase the properties of cement Mortar. Specimens containing fibre of 0.00%, 0.10%, 0.20% and 0.30% are prepared and tested in this work. It is demonstrated that a certain amount of fibres enhances the compressive, splitting tensile strength and Water absorption capacity of the fibre reinforced cement mortar. The Compressive strength of mortar was increased to 111.78 % at 7 days & 28.46 % at 28days and splitting tensile strength was increased by 115.15 % at 7 days & 40.00 % at 28 days.

Keywords: Glass Fiber, Cement Mortar (1:6), Compressive Strength Test, Splitting Tensile Strength Test, Water Absorption.

Introduction

Contemporary Civil engineering is permanently setting new conditions concerning the quality of engineering materials. These conditions have to be completely fulfilled in order to increase the durability, serviceability and cost-effectiveness of modern buildings. The composite materials, which will be the main subject of this paper, are offering great possibilities in the field of research and combination of more advanced solutions in order to keep up with contemporary trends.

In any construction brick masonry is very much of used to make a walling units and in that cement mortar is one of the important ingredients it makes up as little as 7% of total volume of brick masonry and it also prevent moisture and air penetration so in short cement mortar is very much of use in brick masonry so if we change certain amount of cement mwith Glass Fiber materials which is less in cost than cement and it also reduces the danger to the environment so it is essential to check that how much amount of cement is replaced by various materials.

The aim of this research is to Glass fiber materials as an addition in cement mortar accordingly in the range of 0.00%, 0.10%, 0.20% and 0.30% by weight of 1:6 proportion of mortar.

To check mechanical properties of cement mortar by Compression Test (at 7 and 28 days),

Splitting test (at 7 and 28 days) and Water absorption test (at 28 days).

Design Mix Materials

A. Cement:

The cement used OPC 53 grade. The Ordinary Portland Cement of 53 grades conforming to IS: 8112-1989 was used. Tests were conducted on the cement like Fineness Specific Surface , Soundness, Setting time, Consistency, Compressive Strength N/mm² 3, 7, and 28 days. The Physical Properties of O.P.C are given in table 1.

TABLE-1 Physical Properties of O.P.C

Sr. No.	Description	Test Result (O.P.C)	Requirements As Per IS: 12269-1987
1	Fineness Specific Surface m ² /kg	299 m ² /Kg	Min. 225 m²/Kg
2	Soundness in mm	1.25 mm	Max. 10mm
3	Setting time in min		
	(a) Initial	33 min	Min.

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	(b) Final	174 min	30 min Max. 600 min
4	Consistency in %	27%	30-35
5	Compressive strength in N/mm ²		
	(a) After 3 days	29.33 Mpa	Min. 27Mpa
	(b) After 7 Days	44.49 Mpa	Min. 43 Mpa
	(c) After 28 Days	55.94 Mpa	Min. 53 Mpa

B. Fine aggregate

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand is used as fine aggregate conforming to the requirements of IS: 383. The river sand is washed and screens, to eliminate deleterious materials and oversize particles. The Properties of Fine Aggregate are given in Table 2. The aggregate Shown in fig.2.



Fig 2 Fine Aggregate (Sand)

TABLE- 2 Properties of Fine Aggregate

Sr. No	Name of Test	IS Code	Result	Permissible Limit of IS Code
1	Sieve analysis	IS: 2368-1963 Part-I, IS: 383-	Zone-I	-

		1970		
2	Fineness Modulus	-	3.01	-
3	Specific Gravity	IS: 2386-1963 Part-III	2.73	2.6-2.8
4	Water absorption	IS: 2386-1963 Part-III	0.96%	Max. 2 %

C. Water

Water is an important ingredient of Mortar as it actually participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water are required to be looked into very carefully.

D. Glass Fiber

Glass fibre also called fibreglass. It is a material made from extremely fine fibres of glass; fibreglass is a lightweight, extremely strong, and robust material. Although strength properties are somewhat lower than carbon fibre and it is less stiff, the material is typically far less brittle, and the raw materials are much less expensive. Its bulk strength and weight properties are also very favourable when compared to metals, and it can be easily formed using moulding processes. Glass is the oldest, and most familiar, performance fibre. Fibres have been manufactured from glass since the 1930s. The Properties of Glass Fiber are given in Table 3. The Glass Fiber shown in fig.3.



Fig 3 Glass Fiber

TABLE- 3 Properties of Glass Fiber

Properties	AR-glass
Tensile Strength	1700mpa
Modulus	73 Gpa
Dispersion	High Dispersion
Softening Point	775 C
Elongation (%)	2.4 %
Combustibility	Non Combustible

Source: SHIVAM ENTERPRISE GIDC, Ankleshwar, GUJARAT

Mortar compositions

A cement mortar mix 1:6 was designed as per IS: 2250 methods and the same were used to prepare the test samples. The design mix proportion is done in Table 4 and 5.

TABLE- 4 Mix Design Proportions

	Water	Cement	Fine aggregate
By Weight, [gms]	45	100	600

TABLE - 5 Design Mix Proportions for Mortar (1:6)

Mortar Mix	Design Mix Proportions For Mortar (1:6)		
	Cement	Fine aggregate	Addition of Glass Fiber by Cement Weight
A0	1	6	-
B1	1	6	0.1
B2	1	6	0.2
B3	1	6	0.3

Experimental Methodology

A. Compressive strength

Compressive strength tests were performed on compression testing machine using cube samples. Three samples per batch were tested with the average strength values reported in this paper. The loading rate on the cube is 35 N/mm² per min. The

comparative studies were made on their characteristics for cement mortar ratio of 1:6.

Three cube samples were cast in the mould of size 70.6 x 70.6 x 70.6 mm for test. The Compressive strength testing Machine Shown in fig.4



Fig 4 Setup of Compressive strength test

B. Splitting Tensile Strength

The splitting tensile strength test will be carried out on the specimens at the end of 7 days and 28 days of curing. The procedure to be followed is as given below.

Tensile strength is an important property of a mortar because mortar structures are highly vulnerable to tensile cracking due to various kinds of effects and applied loading itself. However, tensile strength of mortar is very low in comparison to its compressive strength.

In splitting tensile strength test same machine is used which are used in compressive strength test, the concrete block will be placed at an angle of 45°. The axes of the specimen are to be carefully aligned with the centre of the lower pressure plate of the testing machine. Then an upper pressure plate is to be lowered till the distance between the pressure plate and the top surface of the specimen achieved. No packing used between the face of the pressure plates and block.

The load will be applied without shock and increased gradually at the rate of 35 kg/cm²/min until the specimen was crushed. The splitting tensile strength testing machine Shown in fig.5



Fig 5 Setup of Splitting tensile strength



Fig 6 Water absorption test

C. Water absorption test

The 70.6 mm x 70.6 mm x 70.6mm size cube after casting were immersed in water for 28 days curing. These specimens were then oven dried for 24 hours at the temperature 85°C until the mass became constant and again weighed. This weight was noted as the dry weight (W1) of the cylinder. After that the specimen was kept in water at 85°C for 24 hours. Then this weight was noted as the wet weight (W2) of the cylinder.

- % water absorption = $[(W2 - W1) / W1] \times 100$
- Where, W1 = Oven dry weight of cubes in grams
 W2 = After 24 hours wet weight of cubes in grams.

The water absorption test setup in Fig.6

Experimental Results

From Table 6 and Fig.7 Shows the result of the Compressive Strength test for Mortar Mix (1:6) at 7 and 28 days

Table 6 Comparative Experimental Results for Compressive Strength Test for all Mortar Mix at 7 & 28 Days

Mortar Mix	Average Compressive Strength (N/mm ²)	
	7 days	28 days
A0	3.14	10.33
B1	6.12	10.53
B2	6.59	11.37
B3	6.65	13.27

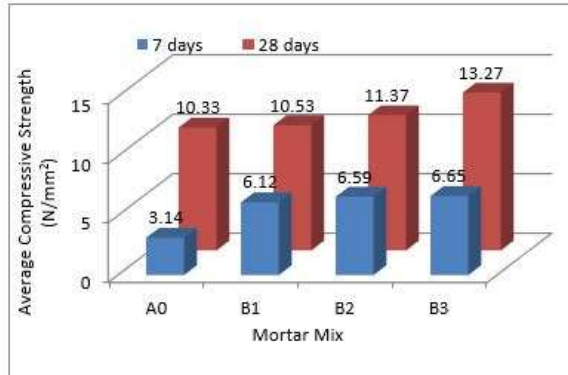


Fig 7 Mortar Mix V/S Average Compressive Strength (N/mm²) at 7 and 28 days

From Table 7 and Fig.8 shows the result of the Splitting tensile Strength test for Mortar Mix (1:6) at 7 and 28 days.

Table 7 Comparative Experimental Results for splitting tensile Strength Test for all Mortar Mix at 7 & 28 Days

Mortar Mix	Average Splitting tensile Strength (N/mm ²)	
	7 days	28 days
A0	0.33	1.30
B1	0.36	1.34
B2	0.57	1.42
B3	0.71	1.82

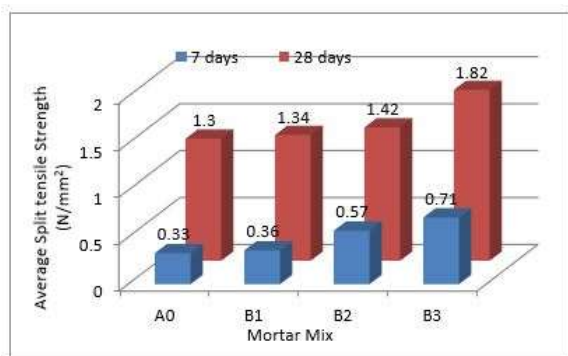


Fig 8 Mortar Mix V/S Average Splitting tensile Strength (N/mm²) at 7 and 28 days

From Table 8 and Fig.9 shows the result of % Water absorption for Mortar Mix (1:6) at 28 days.

Table 8 Average % Water Absorption at 28 Days

Mortar Mix	Average % Water Absorption At 28 Days
A0	14.18
C1	10.03
C2	7.60
C3	6.10

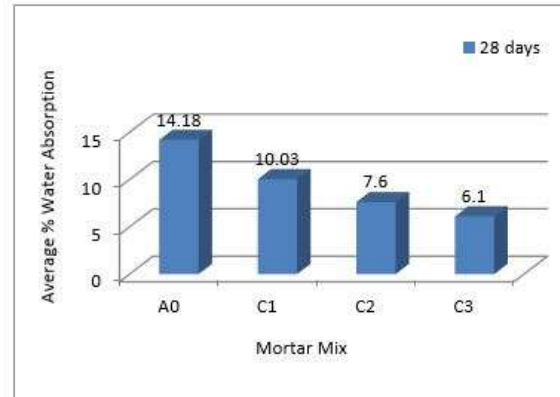


Fig 9 Mortar Mix V/S Average % Water Absorption at 28 Days

Conclusion

- ✚ In Glass fiber mortar, the maximum compressive strength increased 111.78 % at 7 days and 28.46 % at 28days without any chemical agents or any other additives.
- ✚ For Glass fiber mortar, the maximum splitting tensile strength increased 115.15 % at 7 days and 40.00 % at 28 days respectively.
- ✚ From the above results it is observed that addition of 0.30% by cement weight Glass fibers in mortar giving good compressive strength compare to plain mortar at early stages. And in splitting tensile test, tensile strength of Glass fiber in some certain quantity in mortar mix gives high tensile strength compare to plain mortar. From the above results, it is clear that fiber addition in mortar gives high tensile strength which prevents the cracks. As mortar is weak in tension fiber in certain quantity gives high tensile strength as well as good compressive strength to the mortar.

- ✦ It is observed that addition of 0.30% by cement weight Glass fibers in mortar giving lower Water Absorption at 28 Days.

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References

- [1] A. Sadromtazi and a. Fasihi (2010), "influence of polypropylene fibres on the performance of nano-sio₂-incorporated mortar" *iranian journal of science & technology, transaction b: engineering*, vol. 34, no. B4, pp 385-395 printed in the islamic republic of iran, 2010 © shiraz university
- [2] Ahsan Habib, Razia Begum, Mohammad Mydul Alam (2013), "Mechanical Properties of Synthetic Fibres Reinforced Mortars" *International Journal of Scientific & Engineering Research*, Volume 4, Issue 4, April 2013 ISSN 2229-5518
- [3] C.D. Johnston, "Definition and measurement of flexural toughness parameters for fiber reinforced concrete" *Cem. Concr. Agg.* 1982.
- [4] C.H. Henager , "Steel fibrous shotcrete". *A summary of the State - of - the art concrete Int.: Design and construction* 1981.
- [5] Colin D. Johnston, "Fiber reinforced cements and concretes" *Advances in concrete technology volume 3 - Gordon and Breach Science publishes - 2001.*
- [6] Damyanti G. Badagha, Dr. C. D. Modhera (2013), " Studies on harden properties of mortar using carbon Fibers" *International Journal of Advancements in Research & Technology*, Volume 2, Issue 5, May -2013 249 ISSN 2278-7763
- [7] Damyanti G. Badagha, Dr. C. D. Modhera (2013), " Studies On Harden Properties Of Mortar Using Steel Fiber" *International Journal of Engineering Research & Technology (IJERT)* ISSN: 2278-0181 Vol. 2 Issue 6, June - 2013
- [8] Dragica Jevtić, Dimitrije Zakić, Aleksandar Savić, (2008), "Modeling Of Properties Of Fibre Reinforced Cement Composites" *University of Belgrade, Faculty of Civil Engineering, Serbia*
- [9] *facta universities Series: Architecture and Civil Engineering Vol. 6, No 2, 2008, pp. 165 - 172*
- [9] IS 8112:1989 Specification for 53 grade ordinary Portland
- [10] IS 12269:1987 Specification for 53 grade ordinary Portland
- [11] IS 383:1970 - Specification for coarse and fine aggregates from natural sources for concrete
- [12] IS 2386(Part 1):1963 Methods of test for aggregates for concrete: Part 1 Particle size and shape
- [13] IS 2386(Part 3):1963 Methods of test for aggregates for concrete: Part 3 Specific gravity, density, voids, absorption and bulking
- [14] IS 2250-1981 Preparation and Use of Masonry Mortar
- [15] J. Endginton, D.J. Hannant & R.I.T. Williams, "Steel fiber reinforced concrete" *Current paper CP 69/74 Building research establishment Garston Watford 1974.* 9. C.D. Johnston, "Steel fiber reinforced mortar and concrete", *A review of mechanical properties. In fiber reinforced concrete ACI - SP 44 - Detroit 1974.*
- [16] M. Zhu and D.D.L. Chung, (1997) "Improving Brick-To-Mortar Bond Strength By The Addition Of Carbon Fibres To The Mortar" *Cement and Concrete Research*. Vol. 27, No. 12, pp. 1829-1839. 1997
- [17] Mohammed Ezziane, Laurent Molez Raoul Jauberthie Damien Rangeard, (2011), "Heat Exposure Tests On Various Types of Fibre Mortar" *EJECE*. Volume 15 - No. 5/2011, pages 715 to 726
- [18] P. Rathish Kumar and K. Srikanth a Department of Civil Engineering, NIT Warangal, India, (2008), "Mechanical Characteristics Of Fibre Reinforced Self Compacting Mortars" *Asian journal of civil engineering (building and housing)* vol. 9, no. 6 (2008) pages 647-657
- [19] R.J. Craig, "Structural applications of reinforced steel fibrous concrete". *Concrete Int. Design and Construction* 1984. Colin D. Johnston, "Fiber reinforced cements and concretes" *Advances in concrete technology volume 3 - Gordon and Breach Science publishes - 2001.*
- [20] Rushabh A. Shah, Jayeshkumar Pitroda (2013), " Effect of Water Absorption and Sorptivity on Durability of Pozzocrete Mortar" *International Journal of Emerging Science and Engineering (IJESE)* ISSN: 2319-6378, Volume-1, Issue-5, March 2013
- [21] Rushabh A. Shah, Jayeshkumar Pitroda (2013), " Fly Ash Class F: Opportunities for Development

of Low Cost Mortar" International Journal of Innovative Technolog and Explorin Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-4, March 2013

- [22]Saidi M., Safi B., Benmounah A. and Aribi C. (1992), "Effect of size and stacking of glass fibres on the mechanical properties of the fibre-reinforced-mortars (FRMs)" *International Journal of the Physical Sciences Vol. 6(7), pp. 1569-1582, 4 April, 2011 Available online at IJPS DOI: 10.5897/IJPS11.168 ISSN 1992 - 1950 ©2011 Academic Journals*