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Experimental Study on Concrete By Using Glass Fiber

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Abstract: ***Plain concrete possesses very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor tensile strength is due to propagation of such micro cracks. Fibers when added in certain percentage in the concrete improve the strain properties well as crack resistance, ductility, as flexure strength and toughness. Mainly the studies and research in fiber reinforced concrete has been devoted to steel fibers. In recent times, glass fibers have also become available, which are free from corrosion problem associated with steel fibers. In this project we experimental study on the use of glass fibers with structural concrete. Cement fill anti crack, high dispersion, alkali resistance glass fiber of diameter 14 micron, having an aspect ratio 857 was employed in percentages , varying from 0.33 to1 percentage by weight in concrete and the properties of this Fiber Reinforced Concrete (FRC) like compressive strength, flexure strength, toughness, modulus of elasticity we study. In this project we study on glass fibers us in a concrete as an admixture with a different water cement ratio. Also find the strength of concrete with different water cement ratio and different percentage of glass fibers.***

Keywords: Plain cement concrete, Glass fiber, Fiber reinforced concrete, admixture, steel fiber, high dispersion.

1. INTRODUCTION

GFRC is a specialized form of concrete with many applications. It can be effectively used to create façade wall panels, fireplace surrounds, vanity tops and concrete countertops due to its unique properties and tensile strength. One of the best ways to truly understand the benefits of GFRC is to take a deeper look into this unique compound.

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. The concrete without any fibres will develop the cracks due to plastic shrinkage, drying shrinkage and other reasons of changes in volume of concrete. The development of these micro cracks causes elastic deformation of concrete. Plain concrete is a brittle material and having the values of modulus of rupture and strain capacity is low. In order to meet the required values of flexural strength and enhances the strain capacity of the plain concrete, the fibres are being used in normal concrete. The addition of fibres in the plain concrete will control the cracking due shrinkage and also reduce the bleeding of water. The addition of glass fibres in plain concrete shows higher flexural strength than plain concrete. Environmental and economic considerations played a great role in the increase in use of mineral admixtures. Cement with pozzolana like fly ash reduces the permeability of concrete and dense calcium silicate hydrate (C–S–H). A preliminary test program has been carried out to study the mechanical characteristics of glass fibre reinforced concrete with the percentage of glass fiber 0 to 0.1.

The hollow cores inside the walls can be filled with in-situ plain or reinforced concrete. This paper presents guidelines for the use of GFRG wall panel as a lateral load resisting component in buildings based on a numerical analysis procedure to arrive at its capacity estimation under axial compression, compression with inplane bending and shear. Variation of buckling load of unfilled GFRG wall panels for various widths is reported. The axial load carrying capacity of 1.02 m wide and 2.85 m high wall panel, obtained from the numerical analysis and the test results are comparable for this load case. While assessing the axial load capacity for design under compression, a minimum possible eccentricity (causing out-of plane bending) is accounted for. An engineering model is proposed to assess the strength of unfilled and concrete filled GFRG wall panels in multi-storied building system subjected to lateral load such as earthquake.

1.1.1 What is GFRC?
GFRC is similar to chopped fiberglass (the kind used to form boat hulls and other complex three-dimensional shapes), although much weaker. It's made by combining a mixture of fine sand, cement, polymer (usually an acrylic polymer), water, other admixtures and alkali-resistant (AR) glass fibers. Many mix designs are available online, but you'll find that all share similarities in the ingredients and proportions used.
1.1.2. Benefits of GFRC:
Ability to Construct Lightweight Panels– Although the relative density is similar to concrete, GFRC panels can be much thinner than traditional concrete panels, making them lighter.
High Compressive, Flexural and Tensile Strength– The high dose of glass fibers leads to high tensile strength while the high polymer content makes the concrete flexible and resistant to cracking. Proper reinforcing using scrim will further increase the strength of objects and is critical in projects where visible cracks are not tolerable.

2. LITURATURE REVIEW

1. Selin Ravikumar and T.S. Thandavamoorthy, The study there has been a significant increase in the use of fibers in concrete for improving its properties such as tensile strength and ductility. The fiber concrete is also used in retrofitting existing concrete structures. Among many different types of fibers available today, glass fiber is a recent introduction in the field of concrete technology.

2. Kavita S Kene has died the Concrete is most widely used construction material in the world. Fiber reinforced concrete (FRC) is a concrete in which small and discontinuous fibers are dispersed uniformly. The fibers used in FRC may be of different materials like steel, G.I., carbon, glass, aramid, asbestos, polypropylene, jute etc.
3. S. S. Pimplikar conducted an experiment as the Glass-fiber reinforced concrete (GRC) is a material made of a cementatious matrix composed of cement, sand, water and admixtures, in which short length glass fibers are dispersed.
4. T.Subramani, A.Mumtaj Hence, an attempt has been made in the present investigation to study the behaviour of Glass fibers in Concrete. To attain the set out objectives of the present investigation, sand has been replaced with Glass fibers by 5, 10, and 15 % to produce Concrete.
5. Eethar Thanon Derwood Investigations were conducted on the development of gypsum plaster used naturally by adding 1% of admixture (Super plasticizer) and reinforcing it with bar chip fibers. Different percentages of bar chip as 0, 0.5, 0.75, 1, 1.25 and 1.5% were used. The compressive and flexural strength of such gypsum plaster are discussed.
6. A. Meher Prasad and Devdas Menon mentioned Glass fiber reinforced gypsum (GFRG) wall panel is made essentially of gypsum plaster reinforced with glass fibers. The panels are hollow and can be used as load bearing walls.

3. METHODOLOGY AND RESULT DISCUSSION

3.1. Review:
Firstly we collecting data on glass fibers by different methods. In this data collecting process we collect information about glass fibers, their types their uses, manufacturing process etc.
Also we collecting data & study on other researchers their papers & works on glass fibers and research. Study on their research objectives & results.

3.2. Finding Suitable glass fiber.
Find a suitable glass fiber for our project by using collecting data. For this selection we study on different types of glass fibers. Study on their different properties & characteristics.
The glass fibers used in concrete suppressed the localization of micro cracks in to macro cracks hence tensile strength increase. It improves durability of concrete by increasing the strength of concrete. The Glass Fibers are of Cem-FIL Anti - Crack HD with modulus of elasticity 72 GPa, Filament diameter 14 microns. Specific Gravity is 2.68, length 12 mm and having the aspect ratio of 857.1. The number of fibers per 1 kg is 212 million.

3.3. Carry out mix proportion.
Fix a ratio & proportion of sand, aggregate, cement, water & glass fiber for casting specimen.
In this study, control mix A was designed as per IS 10262:1982 to achieve a target compressive strength of 20 MPa. The glass fibres of 0 %, 0.03%, 0.06% and 0.1 % by volume fraction of concrete were used.

3.4. design new concrete specimen.
Preparation and Details of Test Specimens In the present experimental investigation cubes of 150mm x 150mm x 150mm of M-20 grade concrete were casted with varying percentage of addition of 0.03%, 0.06% and 0.1% of glass fibre. After casting, test specimens were demoulded after 24 hours and were kept in the curing tanks until the time of test.
Design new specimen for testing made by using glass fibers with reinforce concrete. Also we design a reinforcement for this specimen. After that we cast this specimen.

3.5. Carry out lab test.

Different test carry on specimen in lab by using testing machines. For this we use ultimate testing machine & compressive testing machine foe checking tensile & compressive strength respectively.

Casting and testing of cubical specimens of size 150mm×150mm×150mm for compressive strength, flexural strength test and splitting tensile strength test test was done as per IS:516-1959 specification compressive strength test was performed on 150mm cubes, tested at 28 days, with their specimen in each case and cured in the water tank completely immersed at constant temperature 28˚-30˚C until the test age. All the test specimens were demodulate 24 hours after casting.

Type of concrete	Cube	Crushing load KN	Compressive strength N/mm2	Average compressive Strength N/mm2
M-20 with 0.0% glass fiber	N1	600	26.67	23.93
	N2	515	22.88	
	N3	500	22.22	
M-20 with 0.03% glass fiber	3a	540	24	26.07
	3b	538	23.91	
	3c	682	30.31	
M-20 with 0.06% glass fiber	6a	545	24.22	26.6
	6b	540	24	
	6c	711	31.6	
M-20 with 0.1% glass fiber	1a	430	19.11	29.54
	2b	680	30.22	
	3c	884	39.29	

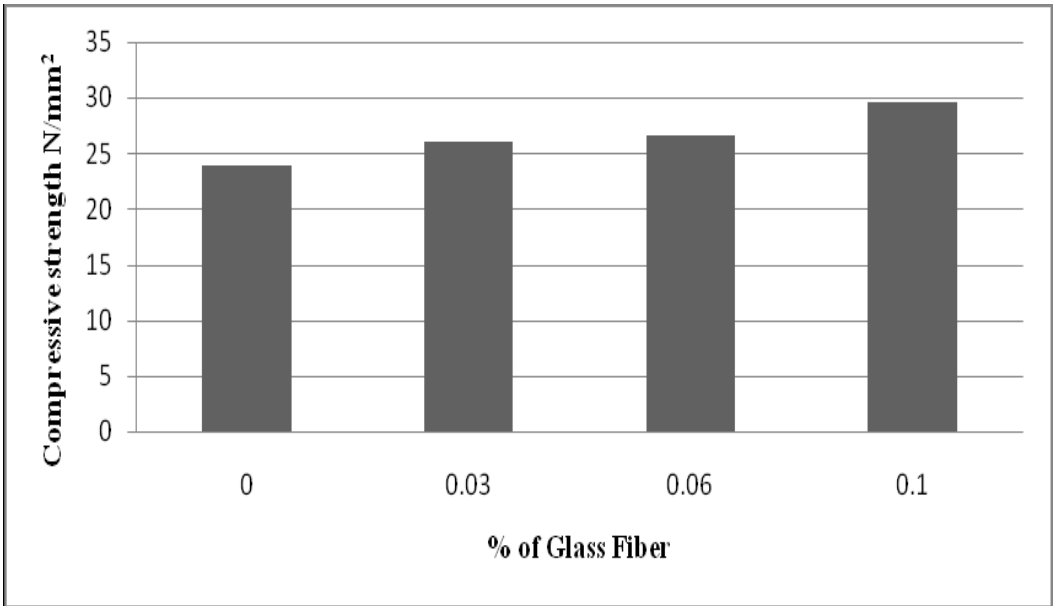

Fig. 1 Compressive strength of % of Glass Fiber

Type of concrete	Beam	Crushing load KN	Flexural strength N/mm2	Average Flexural Strength N/mm2
M-20 with 0.0% glass fiber	N1	16.2	3.312	3.344
	N2	14.31	2.86	
	N3	19.32	3.86	
M-20 with 0.03% glass fiber	3a	15.3	3.06	3.587
	3b	18.48	3.696	
	3c	20.03	4.006	
M-20 with 0.06% glass fiber	6a	16.48	3.296	3.654
	6b	18.50	3.7	
	6c	19.84	3.968	
M-20 with 0.1% glass fiber	1a	17.74	3.548	3.99
	1b	20.08	4.018	
	1c	22.15	4.43	

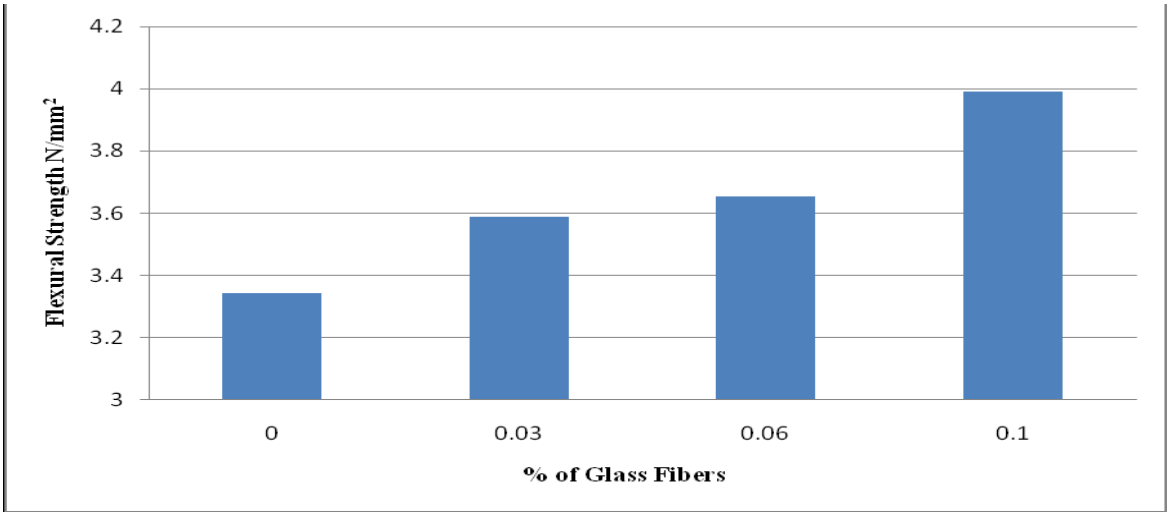

Fig. 2 Flexural Tensile strength of % of Glass Fiber

Type of concrete	Cylinder	Crushing load KN	Crushing load KN	Average Splitting Tensile Strength N/mm2
M-20 with 0.0% glass fiber	C 1	74.85	3.17	3.22
	C 2	71.60	3.04	
	C 3	81.43	3.45	
M-20 with 0.03% glass fiber	C 1	73	3.09	3.31
	C 2	81.4	3.45	
	C 3	79.9	3.31	
M-20 with 0.06% glass fiber	C 1	94.90	4.02	3.63
	C 2	77.9	3.3	
	C 3	84.43	3.58	
M-20 with 0.1% glass fiber	C 1	132.25	5.61	4.58
	C 2	112.20	4.76	
	C 3	80.03	3.39	

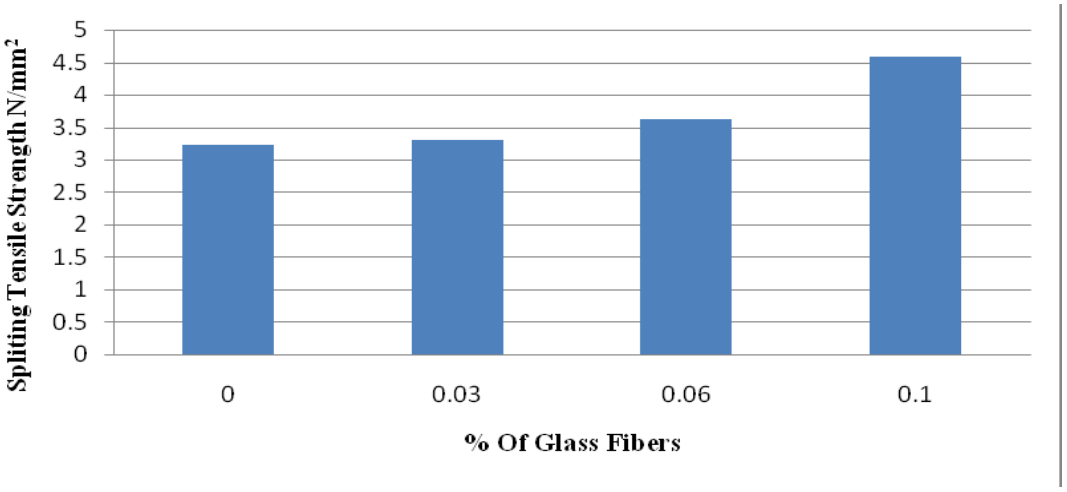

Fig. 3 Splitting Tensile strength of % of Glass Fiber

CONCLUSION

The addition of glass fibres into the concrete mixture marginally improves the compressive strength at 28 days. It is observed from the experimental results and its analysis, that the compressive strength of concrete, flexural strength of concrete, splitting tensile strength of concrete increases with addition of Percentage of glass fibers. The 0.1% addition of glass fibers into the concrete shows better result in mechanical properties and durability.

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