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A Literature Review On High Performance Concrete Using Supplementary Cementing Material And Glass Fiber

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ABSTRACT

Concrete is a tension weak building material, which is often crack ridden connected to plastic and hardened states, drying shrinkage. Glass-Fibre Reinforced Concrete (GFRC) is a material made of a cementatious matrix composed of cement, sand, water and admixtures, in which short length glass fibres are dispersed. GFRC has advantage of being light weight and thereby reducing the overall cost of construction there by bringing economy in construction, fire resistance and good appearance. The inclusion of fly ash in glass fibre reinforced concrete reduces the environmental pollution and improves the workability and durability properties of concrete. The present paper outlines the experimental investigation conducted on the use of glass fibre with structural concrete and class F fly ash and also on strength aspect of concrete.

KEYWORDS: Fly Ash (class-F) ,Glass-Fibre Reinforced Concrete (GFRC), High Performance Concrete (HPC)

1. Introduction

Concrete is the most widely used man-made construction material in the world. In the last fifty years, there has been significant progress in concrete technology, mainly owing to the revival of the interest in supplementary cementing materials, as well as because of the advent of new generation chemical additives for concrete. 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 are low. The addition of fibres in the plain concrete will control the cracking due shrinkage and also reduce the bleeding of water. Fibres help to improve the post peak ductility performance, pre- crack tensile strength, fatigue strength, impact strength and eliminate temperature. FRC are used in civil structures where corrosion can be avoided at the maximum. Fibre reinforced concrete is better suited to minimize cavitation /erosion damage in structures such as sluice - ways, navigational locks and bridge piers where high velocity flows are encountered. Higher flexural strength gained by the adding of glass fibre. Glass fibre is available in continuous or chopped lengths. Fibre lengths of up to 35-mm are used in spray applications and 25-mm lengths are used in premix applications. Glass fibre–reinforced concrete (GFRC) consists basically of a cementitious matrix composed of cement, sand, water, and admixtures, in which short length alkali-resistant glass fibres are dispersed. Fly ash played lead role for environment and economy aspects. Fly ash is a by-product of the thermal power plants and reduces permeability of concrete. Fly Ash is known to improve durability, workability, early strength, shrinkage, and creeping.

2. Experimental Research

- Surendra P. Shah et al. (1987)[10] have discussed about strength and durability properties of M 20 and M 30 grade of glass fibre reinforced concrete. They concluded that improved behaviour of glass fibre reinforced concretes over ordinary concrete and discussed about the effect of glass fibres on durability properties of glass fibre reinforced concrete.
- J.A.O.Barros et al. (2002) [5] have studied fracture energy of cement based materials is significantly increased by adding glass fibre to the mix composition. The tensile strength is largely determined by the fibre orientation which depends on the mixing method. A tensile strength of about 11 MPa is found when a spray up technique is used for the PGFRC. A tensile strength between 4.5 and 5.5 MPa is found for GFRC mixes made with the premix method.
- J.P.J.G Ferreria et al. (2007) [6] have performed the test to shown that GFRC presents a better behaviour than premix GRC, namely, for tension loads, this last technique is better adapted to the production of structural elements, especially for important volumes of material. This study also analyzed the effectiveness of the reinforcing elements introduced in GFRC for structural elements.
- N. A. Libre et al. (2008) [7] have concluded that in order to retain high level workability with fibre reinforcement, the amount of paste in the mix should be increased to provide better dispersion of fibres. According to test results, the optimum fibre content to achieve workability, stability and appropriate mechanical properties, with suitable workability is about 1% for 12mm fibre lengths and 4% for 6mm fibre length.

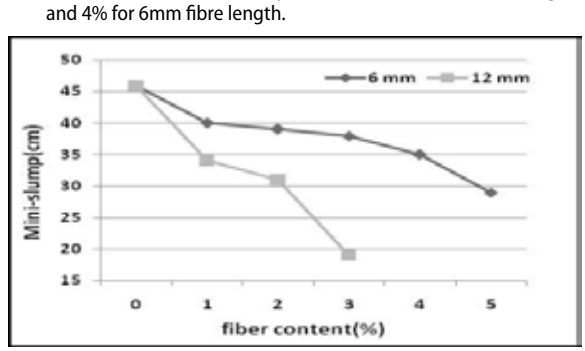


Fig.1 Result of Mini Slump Test [7]

- Chandramouli K. et al (2010) [1] have observed that the percentage increase of compressive strength of various grades of glass fibre concrete mixes compared with 28 days compressive strength is observed from 20 to 25%.The percentage increase of flexural and split tensile strength of various grades of glass fibre concrete mixes compared with 28 days is observed from 15 to 20%.
- Vaishali G Ghorpade (2010)[11] has studied that the percentage increase in compressive strength at 28days of 1% fibre volume with 10% silica fume concrete over plain high performance concrete without fibre and silica fume is 14% .The compressive strength of glass fibre reinforced high performance concrete 20 and 30% silica fume are as the lower side when compared with that of plain glass fibre reinforced high performance concrete mixes.

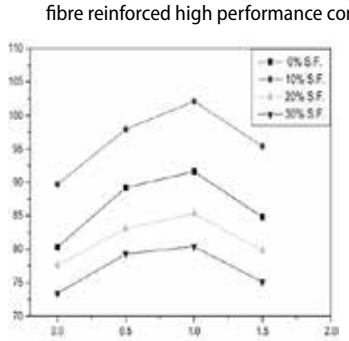
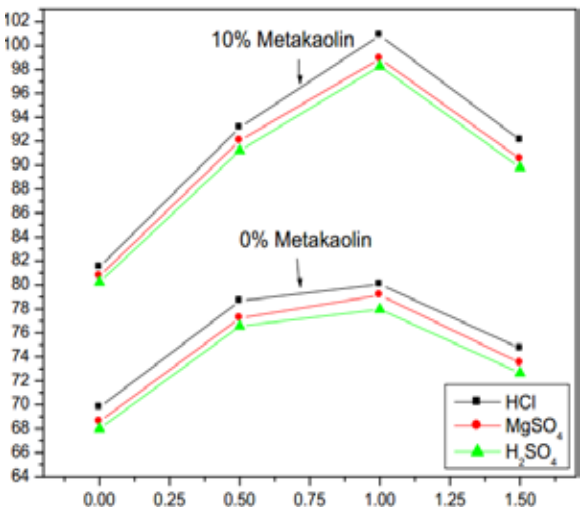


Fig-2 Compressive Strength vs % of Fibres [11]

- P. Sangeetha (2011)[8] has investigated that Increase in the percentage of Glass Fibre by weight of concrete (0.1%,0.2%& 0.3%) increase the Compressive and Impact strength and Glass Fibre reinforced concrete with Super plasticiser + Air entraining agent + Retarder S+AEA+R combination showed good result both in Compression test and Impact test.
- Dr.P.Srinivasa Rao et al.(2012) [4] have observed that the durability of concrete from the aspect of resistance to acid attack on concrete increases by adding AR-glass fibres in concrete. It was observed that there was no effect of sulphates on concrete. Chloride permeability of glass fibre reinforced concrete shows less permeability of chlorides into concrete when compared with ordinary concrete.
- Dr. H. Sudarsana Rao et al. (2012) [3] have investigated that the residual compressive strength of GFRC decreases with increase in age of acid immersion. Maximum loss of compressive strength has occurred at 90 days of acid immersion. This is true for all the acids tried in the present investigation.



Acid immersion for 60 Days

Fig-3 Variation of Residual Compressive Strength with % of Glass Fibre[3]

- Deshmukh S.H et al. (2012) [2] have concluded that 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 fibres. The 0.1% addition of glass fibres into the concrete shows better result in mechanical properties and durability.
- Yogesh Iyer et al. (2012) [12] have investigated that In order to compare the results obtained by adding varying amounts of glass fibre, plain cement concrete with 0% of the fibre is also prepared with the same material.

Table -1 % of Glass Fibre with 7 and 28 days Compressive Strength [12]

Sr.No.	% Glass Fibre	7 days (MPa)	28 days (MPa)
1.	0.0	24.44	38.00
2.	0.5	24.88	38.22
3.	0.7	24.88	38.44
4.	0.9	25.33	39.11
5.	1.2	25.55	39.55
6.	1.5	25.77	40.44

- S. Govindarajan et al. (2012)[9] have concluded that the percentage increase of compressive strength of glass fibre concrete with 28 days compressive strength is 63.19%. The percentage increase of flexural and split tensile strength of glass fibre concrete with 28 days strength is 7.54%.and 48%.

CONCLUSION

- From the above reviews conclusion can be drawn that inclusion of glass fibre in specific dose achieve better workability, concrete volume stability and appropriate mechanical properties.
- Significant Increases in compressive, split tensile and flexural strength with the use of glass fibre in various grade of concrete after 28 days of specimens have been observed.
- GFRC can be proved as effective supplementary structural material with reduced density and has good durability properties.
- From literature review observed for scope of using supplementary cementing material to make environment friendly concrete.
- An Experimental work on fly ash with glass fibre is not properly reported.
- Based on literature review durability and mechanical properties of GFRC with fly ash as supplementary cementing material can be studied as scope of this project.

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