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Experimental Investigation on the Properties of Glass Fibre Concrete

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ABSTRACT

The present day world is witnessing the construction of very challenging and difficult civil engineering structures. Quite often, concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Efforts are being made in the field of concrete technology to develop such concretes with special characteristics. Researchers all over the world are attempting to develop high performance concretes by using fibres and other admixtures in concrete up to certain proportions. Over the decades, there has been a significant increase in the use of fibres in concrete for improving its properties such as tensile strength and ductility. The fibre concrete is also used in retrofitting existing concrete structures. Among many different types of fibres available today, glass fibre is a recent introduction in the field of concrete technology. Glass fibre has the advantages of having higher tensile strength and fire resistant properties, thus reducing the loss of damage during fire accident of concrete structures. In this investigation glass fibres of 450 mm length are added to the concrete by volume fraction of up to 1% to determine its strength and fire resistant characteristics. Comparison of the strength and fire-resistance performance of conventional concrete and glass fibre concrete was made. The paper presents the details of the experimental investigations and the conclusions drawn there from.

INTRODUCTION

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 incorporation of fibres into a brittle concrete can have the effect of controlling the growth and propagation of micro cracks as the tensile strain in the concrete increases. Care is needed in using fibre as additive in concrete.

The use of fibres in concrete has increased with the development of fast-track construction. In fact, nearly 60 per cent of the fibres produced worldwide is currently used in concrete. It offers increasing toughness and ductility, tighter crack control and improved load-carrying capacity. Different types of fibres are available in the market for reinforcing concrete and they are: steel, glass, nylon, polyester, polyethylene, polypropylene, etc. Besides, natural fibres like sisal, wood cellulose, banana, jute, etc., have also been used. From the above mentioned fibres, glass fibre is more advantageous on the basis of strength and fire resistant characteristics. It has been recognized that adding small, closely spaced and uniformly dispersed fibres to concrete serves to arrest cracks and improve its properties under static and dynamic loading. Steel fibre have been used in various types of structures such as earthquake resistant structures, road overlays, airfield pavements and bridge decks.

Alkali resistant glass fibre reinforcement is a relatively new addition to the family of fibres that impart high tensile strength, high stiffness, high chemical resistance and considerable durability to FRC (Fibre Reinforced Concrete). Glass fibres are useful because of their high ratio of surface area to weight. However, the increased surface area makes them much more susceptible to chemical attack. Humidity is an important factor in the tensile strength. Moisture is easily absorbed, and can worsen microscopic cracks and surface defects, and lessen tenacity. Glass fibres improve the strength of the material by increasing the force required for deformation and improve the toughness by increasing the energy required for crack propagation. FRC is a relatively new material.

This is a composite material consisting of a matrix containing a random distribution or dispersion of small fibres, either natural or artificial, having a high tensile strength. Due to the presence of these uniformly dispersed fibres, the cracking strength of concrete is increased and the fibres act as crack arresters. Fibres suitable of reinforcing concrete have been produced from steel, glass and organic polymers. Many of the current applications of FRC involve the use of fibres ranging around 1-5%, by volume of concrete. Chawla and Tekwari (2012) outlines the experimental investigation conducted on the use of glass fibres with structural concrete. CEM-FILL anti crack high dispersion, alkali resistance glass fibre of diameter 14 micron, having an aspect ratio 857 was employed in percentages varying from 0.33 to 1 percent by weight in concrete and properties of this FRC, like compressive strength, flexural strength toughness, modulus of elasticity, were studied.
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OBJECTIVE

The objective of the investigation presented in this paper was to assess comparison of the strength and fire-resistance performance of conventional concrete and glass fibre concrete.

Experimental Programme

Conventional concrete of M25 grade was used in this investigation using glass fiber as reinforcement with varying percentages of 0 to 1. The basic materials were tested to evaluate their properties. Control specimen cubes 28 days to determine the mechanical properties. The results of strength testing at 28 days are presented in Table 1.

Table-1Compressive strength M25 grade of concrete mix with different % of glass fibre without heating

Percentage addition of fibre	Compressive Strength (N/mm^2)
	28 Days
0.0	31.50
0.5	35.60
1.0	42.80

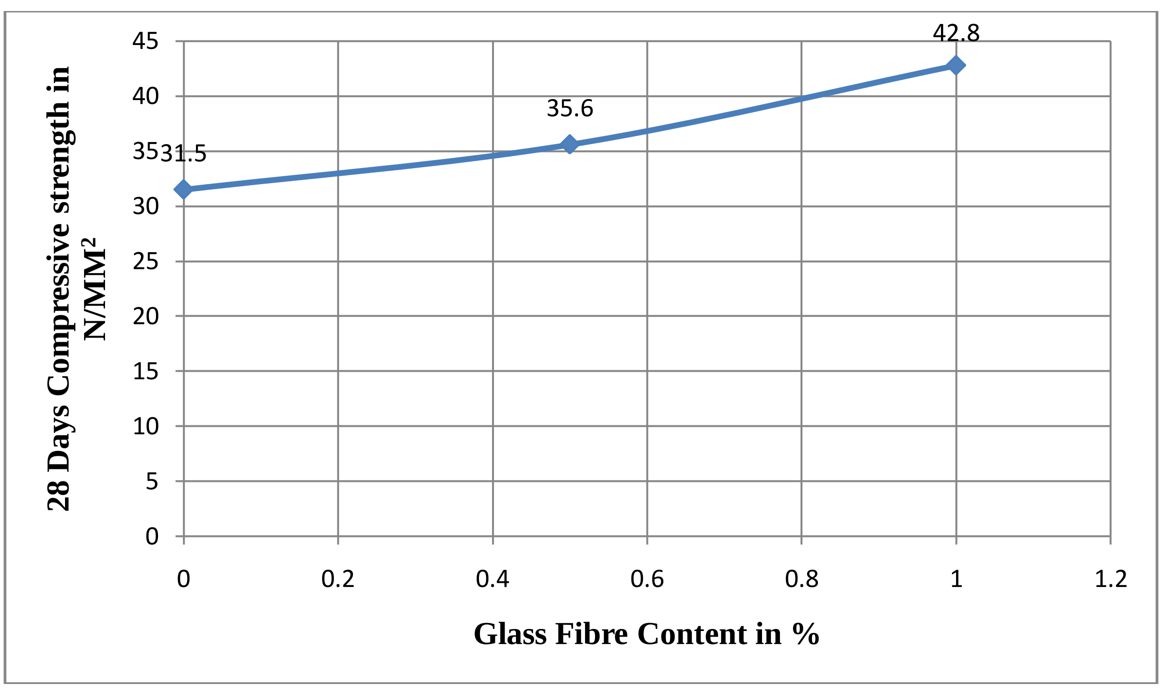

Figure-1 Effect of glass fibers on 28 day compressive strength without heating

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Fire Resistant Test

The concrete cubes were subjected to elevated temperature of 300°C for two hour durations. Afterwards they were tested under Compression Testing Machine to determine their residual strength as generally the compressive strength of the concrete will be reduced after it is heated. The objective of this study here is to determine whether the glass fibre concrete is highly resistant to fire as compared to conventional concrete.

Table-2 Reduction in the compressive strength M25 grade of concrete mix with different % of glass fibre with heating

Percentage addition of fibre	Compressive Strength (N/mm^2)
	28 Days
0.0	21.30
0.5	28.60
0.1	38.45

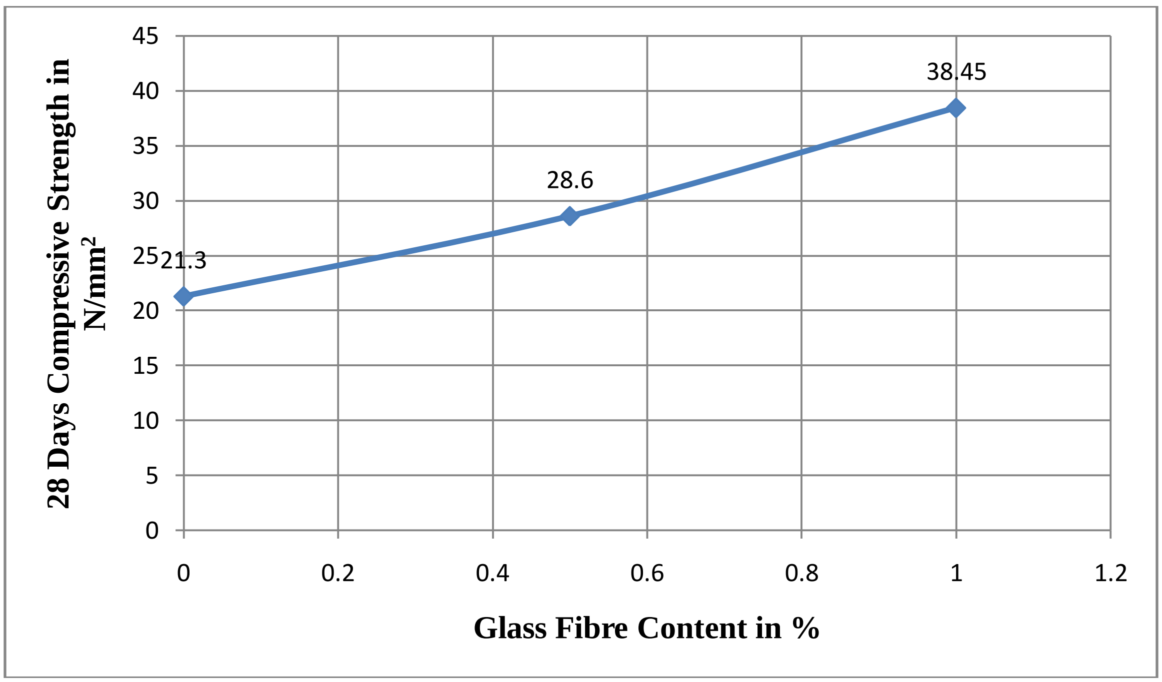

Figure-2 Effect of glass fibers on 28 day compressive strength with heating

RESULTS AND CONCLUSION

The normal as well as fibre reinforced concrete cubes were exposed to elevated temperature of 300°Ctwo hours . Afterwards, they were tested to determine their residual strength. The results are shown in Table 2. There is a reduction of about 32.38 per cent in strength of normal concrete after fire. There is a reduction of 19.66 per cent in strength of 0.5 per cent fibre reinforced concrete over that of its original strength. Corresponding value in the case of 1.0 per cent fibre addition the reduction in strength was 10.16 percent. It is quite clear that with higher percentage of fibre addition, there is a lesser degradation in strength. The fire rating of concrete with higher fibre content is better.

REFERENCES

[1]. Bonakdar .A, Babbitt F., Mobasher B. “Physical and mechanical characterization of Fiber-Reinforced Aerated Concrete (FRAC)” .Cement & Concrete Composites 38 (2013) 82-91

[2]. [1]. Bentur, A, and Kovler, K, (1997) “Durability of some glass fibre reinforced cementations composites”, Fifth International Concrete on Structural Failure, Durability Retrofitting, Singapore, November 27-28,pp. 190- 199.

[3]. Chanaka M. Abeysinghe, David P. Thambiratnam , Nimal J. Perera “Flexural performance of an innovative Hybrid Composite Floor Plate System comprising Glass- fibre Reinforced Cement, Polyurethane and steel laminate” Composite Structures 95 (2013)179-190

[4]. Tassew S.T., Lubel A.S. /'Mechanical properties of glass fiber reinforced ceramic concrete". Construction and Building Materials 51 (2014) 215-224.

[5]. Dey V., Bonakdar A., Mobasher B. "Low-velocity flexural impact response of fiber- reinforced aerated Concrete". Cement & Concrete Composites 49 (2014) 100-110

[6]. Pantelides C.P., Garfield T.T., Richins W.D., Larson T.K., Blakeley J.E. "Reinforced concrete and fiber reinforced concrete panels subjected to blast detonations and post-blast static tests". Engineering Structures 76 (2014) 24-33.

[7]. [3]. Chandramouli, K, Srinivasa Rao, P, Pannirselvam, N, Seshadri Sekhar,T, and Sravana, Priyadrashini, T .P, (2010), " Strength and durability characteristic of glass fibre concrete", International Journal of Mechanics of Solids,Vol. 5, No.1, pp. 15-26.

[8]. Agarwal Atul ,Nanda Bharadwaj ,Maity Damodar. "Experimental investigation on chemically treated bamboo reinforced concrete beams and columns". Construction and Building Materials 71 (2014) 610-617

[9]. Raphael Contamine, Angel Junes , Amir Si Larbi "Tensile and in-plane shear behaviour of textile reinforced concrete: Analysis of a new multiscale reinforcement". Construction and Building Materials 51 (2014) 405-413.

[10]. Wai Hoe Kwan , Mahyuddin Ramli, Chee Ban Cheah "Flexural strength and impact resistance study of fibre reinforced concrete in simulated aggressive environment" .Construction and Building Materials 63 (2014) 62-71.

[11]. Mobasher Barzin, Dey Vikram, Zvi Cohen,Alva Peled "Correlation of constitutive response of hybrid textile reinforced concrete from tensile and flexural tests" Cement & Concrete Composites 53 (2014) 148-161.

[12]. Ali Shams , Michael Horstmann , Josef Hegger "Experimental investigations on Textile- Reinforced Concrete (TRC) sandwich sections" Composite Structures 118 (2014) 64365