Strength properties of glass fibre reinforced concrete: a review

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***Abstract*: The present day world is witnessing the construction of very challenging and the difficult civil engineering structures. Quite often, concrete being the most important and widely accepted material is called upon to provide very high strength and sufficient workability properties. Researchers in world are attempting to develop high performance concretes by using fibres and other admixtures in concrete up to certain proportions and limits. In the view of sustainable developments, it is imperative that fibres like glass, carbon and Polypropylene provide improvements in tensile strength, fatigue characteristics, durability, shrinkage characteristics, impact, cavitations, erosion resistance and serviceability of concrete. Fibres impart energy absorption; toughness and also impact resistance properties to fibre reinforced concrete material and these characteristics in turn improve fracture and fatigue properties of fibre reinforced concrete. Research in glass fibre reinforced concrete resulted in the development of an alkali resistance fibres high dispersion that improve the long term durability. This system was named alkali resistance glass fibre reinforce concrete.**

***Keywords*: glass fibre, compressive strength and concrete.**

I. INTRODUCTION

Basically, concrete is always strong in compression and weak in tension. Concrete is brittle and will crack with the application of increasing tensile force [1][2]. Once concrete shows cracks, it can no longer carry loads. In order to make concrete capable of carrying tensile loads also, it is necessary to increase the tensile strength. To increase the strength, fibres are added in concrete.The addition 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. The use of fibres in concrete has increased with the development of fast-track construction. In fact, nearly 65% of the fibres produced worldwide are now used in concrete. It offers increasing toughness and ductility, tighter crack control and improved load-carrying capacity. Different types of the fibres are available for reinforcing concrete and they are: steel, glass, acrylic, aramid, carbon, nylon, polyester, polyethylene, polypropylene, etc. Besides it natural fibres like sisal, wood cellulose, banana, jute, etc., have also been used in concrete.

Glass fibre

Alkali resistant glass fibre reinforcement is a recently a 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).These fibres improve the flexural strength and energy absorption of concrete.

Glass fibres are very useful because of their high ratio of surface area to weight. The more surface is scratched, the less the resulting tenacity. Because glass has an amorphous structure, its properties are the same along the fiber and across fiber [3]. Humidity is an important factor in tensile strength. Moisture is easily absorbed, and can worsen microscopic cracks and surface defects. FRC is the 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 the crack binders. Fibres suitable of reinforcing concrete have been produced from steel, glass and organic polymers. Many of current applications of FRC involve the use of fibres ranging around 1-5%, by volume of concrete.

II. RELATED WORK

Griffiths conducted study to investigate mechanical properties of glass fibre reinforced polyester Polymer concrete. The author observed that modulus of rupture of polymer concrete containing 20% polyester resin and about 79% fine silica aggregate is about 20 MPa. The addition of 1.5% chopped glass fibres (by weight) to the material increases the modulus of rupture by about 20% and fracture toughness by about 55%. Glass fibres improve strength of the material by increasing the force required for deformation and improve the toughness by increasing the energy required for the crack propagation.

Sorousshian reported the results of an experimental study on relative effectiveness of different types of steel fibre in concrete. The author observed that inclusion of fibres decreases the workability of fresh concrete and this effect is more pronounced for fibres with higher aspect ratios. The effects of fibre type on fresh mix workability, as represented both subjectively and by the

inverted slump and one time, seem to be insignificant. Crimped fibres result in slightly higher slump values when compared with the straight and hooked fibres.

Rao studied the effect of glass fibres on the mechanical properties of M20 and M30 grades of concrete. Babu investigated the addition of glass fibres and concluded that there is increase in the compressive strength up to 1% by volume at the higher fibre percentages and the strength decrease if the fibre content is increased significantly.

Chandramouli et al (2010) had conducted experimental investigation to study the effect of using the alkali resistance glass fibres on compressive, split tensile and flexural strength on M20, M30, M40 and M50 grades of concrete. The mechanical properties of glass fibre reinforced polyester polymer concrete were evaluated. The author observed that the modulus of rupture of polymer concrete containing 20 per cent polyester resin and about 79 per cent fine silica aggregate is about 20 MPa. The addition of about 1.5 per cent chopped glass fibres (by weight) to the material increases the modulus of rupture by about 20 per cent and the fracture toughness by about 55 per cent.

Muthuswamy and Thirugnanam (2013) described the experimental work on Hybrid Fibre Reinforced High Performance concrete using three types of fibres namely, steel, glass and polyester fibres of a reputed brand. Silica fume was added as a mineral admixture to partially replace the cement in concrete and a super plasticizer was used to get the desired workability. A comparison with steel fibre reinforced concrete and plain concrete showed significant improvement in the strengths of the hybrid fibre reinforced concrete due to the inclusion of both fibres and silica fume .

Chawla and Tekwari (2012) outline the experimental investigation conducted on the use of glass fibres with structural concrete. CEM-FILL anticrack 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.

III. PROPOSED WORK

In proposed work following materials are used to compare the compressive strength of concrete with and without addition of glass fibres. Comparison is done between M20, M25 and M30 grades of concrete.

Materials used

Cement

Pozzolana Portland cement is used in the project work, as it is readily available in local market. The cement used in the project work has been tested for various proportions as per IS: 4031-1988 and found to be conforming to various specifications of IS: 1489-1991[6]. The specific gravity was 3.02 and the fineness was 3200 cm2/gm.

Coarse Aggregate

Crushed angular granite metal from a local source was used as coarse aggregate. The specific gravity was 2.71, Flakiness index of 4.58 % and elongation index of 3.96 %. The coarse aggregate used in the project work are 20 mm down grade.

Fine Aggregate

River sand was used as fine aggregate. The specific gravity was 2.55 and fineness modulus was 2.93. The fine aggregate used in the project work is 4.75 mm down grade.

Glass Fibre

The glass fibres used are of Cem-Fill Anti-Crack HD with modulus of elasticity 72 G pa, filament diameter 14 microns, specific gravity 2.68, length 12 mm and having the aspect ratio of 857.1. The numbers of fibres per Kg is 212 million fibres [4] [5].

IV. METHODOLOGY

Compressive Strength

The Steel mould of size 150 x 150 x 150 mm is well tighten and oiled thoroughly. They were allowed for curing in a curing tank for 28 days and they were tested in 200-tonnes electro hydraulic closed loop machine. The test procedures were used as per IS: 516—1979[7].

Table 1.Quantity of materials required per 1 cum of ordinary concrete

Grades of concrete	cement (kg)	Fine aggregates	Coarse aggregates	Water (l)	w/c ratio
M 20	338.18	722.41	1132.42	186	.55
M 30	413.33	661.90	1131.33	186	.45
M 40	465.00	628.54	1121.86	186	.44

V. CONCLUSION

The proposed work is based on the different tests performed on the materials used in making different mixes of concrete. In this project, comparison study is made between the concrete with the addition of different ratios of glass fibre in the traditional concrete, so as to get a high and good quality mix because the strength, durability and other characteristics of concrete depend upon the properties of its ingredients, on the proportions of mix, the method of compaction and other controls during placing, compaction and curing.

REFERENCES

[1] GAMBHIR, M.L (Fourth Edition) - Concrete Technology.

[2] SHETTY, M.S (2012 edition). -Concrete Technology.

[3] Frederick T. Wallenberger; Paul A. Bingham (October 2009). Fiber glass and Glass Technology: Energy- Friendly Compositions and Applications. Springer. pp. 211.

[4] Lubin, George (Ed.) (1975). Handbook of Fiberglass and Advanced Plastic Composites. Huntingdon NY: Robert E. Krieger.

[5] Hillermeier KH, Melliand Textilberichte (1/1969), Dortmund-Mengede, "Glass fiber—its properties related to the filament fiber diameter". pp. 26–28.

[6] IS: 1489-1991. Indian Standards - Specification for Pozzolana Portland cement.

[7] IS: 516-1979. Indian Standards - Method of tests for Concrete.