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Experimental Studies on Glass Fiber Concrete

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ABSTRACT : *Concrete is one of the most widely recognized development material for the most part delivered by utilizing locally accessible ingredients. The development of concrete has brought about the essential need for additives both chemical and mineral to improve the performance of concrete. Hence varieties of admixtures such as fly ash, coconut fibre have been used so far. Hence an attempt has been made in the present investigation to study the behaviour of glass fibre in concrete. The present trend in concrete technology is towards increasing the strength and durability of concrete to meet the demands of the modern construction. The main aim of the study is to study the effect of glass fibre in the concrete. Glass fibre has the high tensile strength and fire resistant properties thus reducing the loss of damage during fire accidents. The addition of these fibres into concrete can dramatically increase the compressive strength, tensile strength and split tensile strength of the concrete. In this study, tests have done for the concrete with glass fibre of 0.5%, 1%, 2% and 3% of cement by adding as an admixture.*

Keywords:- *Glass fibre, Eco- friendly, compressive strength, tensile strength, split tensile strength, admixture.*

I. INTRODUCTION

Glass fibre has used over 30 years in several construction elements, mainly non constructional ones, like façade panels, piping for sanitation, decorative non recoverable form work and other products. Concrete is one of the most durable building materials. It provides superior fire resistance compared with wooden construction and gains strength over time. Structures made of concrete can have a long service life. Concrete is used more than any other manmade material in the world Concrete, has relatively high compressive strength, but much lower tensile strength. Concrete has a very low coefficient of thermal expansion and shrinks as it matures. All concrete structures crack to some extent, due to shrinkage and tension. Glass fiber concrete (GFC) consists basically of a matrix composed of cement, sand, water, and admixtures, in which short length glass fibers are dispersed. The effect of the fibers in this composite leads to an increase in the tension and impact strength of the material. Glass wool, which is commonly known as "fibreglass" today, however, was invented in 1938 by Russell Games Slayter of Owens-Corning as a material to be used as insulation. It is marketed under the trade name Fibreglass, which has become a generalized trademark. It is material made from extremely fine fibers of glass. Fibreglass is a lightweight, extremely strong, and robust material. Although Its bulk strength and weight properties are also very favorable when compared to metals, and it can be easily formed using moulding processes. Glass is the oldest, and most familiar, performance fibre.

LITERATURE REVIEW

R.Gowri and M.AngelineMary, this study, the present trend in concrete technology is towards increasing the strength and durability of concrete to meet the demands of the modern construction world at lower cost. These factors can be achieved in concrete by adding natural or synthetic fiber. The strength parameters of concrete such as compressive strength and tensile strength were studied by varying the percentage of fiber from 0.025% to 0.075% of the weight of concrete.

T.Subramani and C.Sumathi the study, Concrete has been used in various structures all over the world since last two decades. Recently a few infrastructure projects have also seen specific application of concrete. The development of concrete has brought about the essential need for additives both chemical and mineral to

improve the performance of concrete. Most of the developments across the work have been supported by continuous improvement of these admixtures.

C. 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.

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.

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.

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.

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.

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.

Deshmukh S.H., Bhusari J. P, Zende A. M Concrete is a tension weak building material, which is often crack ridden connected to plastic and hardened states, drying shrinkage, and the like. Moreover, concrete suffers from low tensile strength, limited ductility and little resistance to cracking.

MATERIALS USED

Materials

Cement

Pozzolana Portland cement is used in the project work, as it is readily available in the local market. The cement used in the project work has been tested for various preparations as per IS: 4031-1988 and found to be conforming to various specifications of IS: 1489-1991. The specific gravity was 2.6.

Fine aggregate

Locally available river sand conforming to grading zone 2 of IS: 383-1970. Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm sieve will be used for casting all the specimens.

Coarse aggregate

Crushed annular granite metal from a local source was used as a coarse aggregate. The specific gravity was 2.7, the coarse aggregate used in the project work of 60% of 20mm aggregate and 40% of 10mm aggregate.

Glass fibre

It is the material made from extremely fine fibres of glass. It is a light weight, extremely strong and robust material. There are distinctive sorts of fibre however in these we have taken E-glass fibre to show better resistance and a very good insulation to electricity.

METHODOLOGY

COMPRESSIVE STRENGTH

Out of numerous tests conducted to the solid, this is the most extreme essential which gives a thought regarding every one of the attributes of cement. By this single test one can judge that whether Concreting has been done appropriately or not. For solid shape test two sorts of examples either 3D squares of 15 cm X 15 cm X 15 cm or 10cm X 10 cm x 10 cm relying on the measure of total are utilized. For the majority of the works cubical moulds of size 15 cm x 15cm x 15 cm are normally utilized. The glass fibres are included at the rate of 0.5%, 1%, 2% and 3%of cement. This solid is poured in the mould and altered legitimately so as not to have any voids. Following 24 hours these moulds are evacuated and test examples are placed in water for curing. These examples are tried by pressure testing machine following 7 days curing or 28 days curing. Burden ought to be connected steadily at the rate of 140 kg/cm2 every moment till the Specimens fizzles. Load at the disappointment isolated by zone of example gives the compressive quality of cement.

Compressive Strength (Mpa) = Failure load/Cross sectional area

FLEXURAL STRENGTH

The test can be performed in accordance with as per BS 1881. A simple plain concrete beam is loaded at one-third span points. Typical standard size of example 500 x 100x 100 mm is utilized. The load should be partitioned similarly between the two stacking rollers, and all rollers might be mounted in such a way, to the point that the load is connected pivotally and without subjecting the example to any torsional burdens or limitations. Set up the test example by including the glass fibre at the rate of 0.5%, 1%, 2% and 3% by filling the solid into the mould in 3 layers of roughly equivalent thickness. Pack every layer 35 times utilizing the packing bar as determined previously. Packing ought to be circulated consistently over the whole cross segment of the bar mould and all through the profundity of every layer. The example put away in water might be tried instantly on expulsion from water for 7 and 28 days. The test example should be put in the machine accurately focused with the longitudinal pivot of the example at right edges to the rollers. The heap should be connected at a rate of stacking of 400 kg/min for the 15.0 cm examples and at a rate of 180 kg/min for the 10.0 cm examples.

Flexural Strength (Mpa) = $\frac{pl}{bd^2}$

P=Failure Load
L=c/c distance=500mm
b=width of the specimen=100mm
d=Depth of the specimen=100mm

SPLIT TENSILE STRENGTH:

To locate the split elasticity the barrels were placed in the moulds of measurements 300mm length and 150mm diameter across with M20 grade concrete. Set up the test example by including the glass fibre at the rate of 0.5%, 1%, 2%, 3% were additionally included. While placing the barrels the compaction is done utilizing the table vibrator. Finally the top layer of the example is completely levelled and very much wrapped up. From time of casting 24 hours the barrels were demoulded and were kept for curing in curing tank for 28days. After 28days curing is done these examples have been tried in pressure testing machine. The split rigidity is figured as takes after

Split tensile strength (Mpa) = $2p/\pi Dl$

P=Failure load
D=Diameter of Cylinder
L=Length of cylinder

RESULTS AND DISSCUSION

Table: 1 (Compressive strength)

S.NO	M20 + Glass fibre	Compressive strength (N/mm^2)	
		7 days	28 days
1.	0.5%	17.7	27.06
2.	1%	20.76	28.46
3.	2%	19.64	26.98
4.	3%	18.4	26.108

Table: 2 (Flexural strength)

S.NO	M20 + Glass fibre	Flexural strength (N/mm^2)	
		7 days	28 days
1.	0.5%	1.42	2.45
2.	1%	1.47	2.94
3.	2%	1.3	2.6
4.	3%	1.28	2.45

Table: 3 (Split tensile strength)

S.NO	M20 + Glass fibre	Split tensile strength (N/mm^2)	
		7 days	28 days
1.	0.5%	1.41	3.4
2.	1%	2.83	3.92
3.	2%	2.62	3.57
4.	3%	2.43	3.42

Effect of Compressive strength on Glass Fiber Concrete:

This figure represents the graph between the Compressive strength vs % of glass fibre. The glass fibre is added at the rate of 0.5%, 1%, 2%, and 3%. Out of these, the compressive strength is very high at 1% having for 7 days is 20.76N/mm^2 and for 28 days is 28.46N/mm^2.

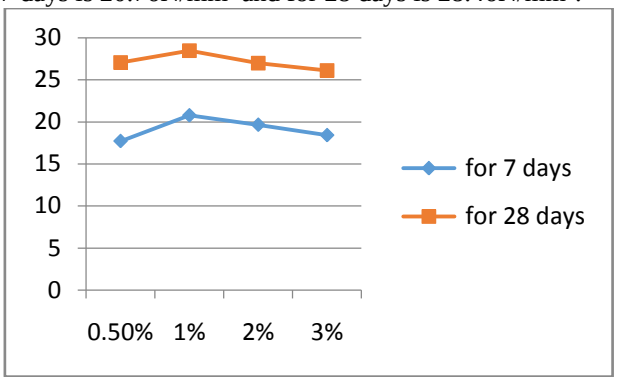

Fig2: Compressive strength vs % of glass fibre

Effect of Flexural strength on Glass Fiber Concrete:

This figure represents the graph between the Compressive strength vs % of glass fibre. The glass fibre is added at the rate of 0.5%, 1%, 2%, and 3%. Out of these, the tensile strength is very high at 1% having for 7 days is1.47N /mm^2 and for 28 days is 2.94N /mm^2.

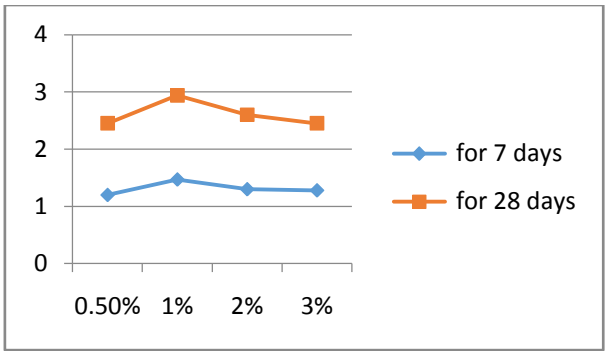

Fig3: Flexural strength vs. % of glass fibre

Effect of Split Tensile strength on Glass Fiber Concrete:

This figure represents the graph between the Split Tensile strength vs % of glass fibre. The glass fibre is added at the rate of 0.5%, 1%, 2%, and 3%. Out of these, the split tensile strength is very high at 1% having for 7 days is 2.83 N /mm^2 and for 28 days is 3.92N /mm^2.

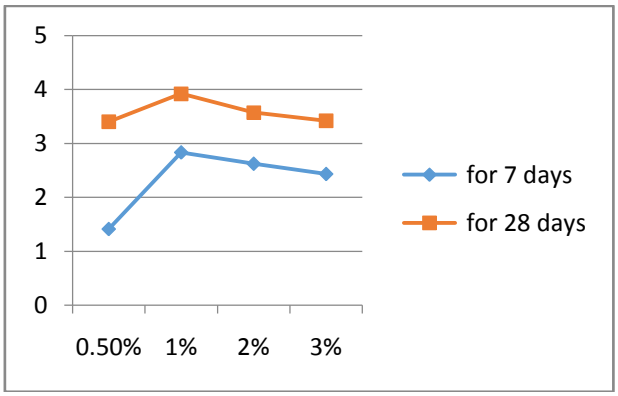

Fig4: Split Tensile strength vs. % of glass fibre

II. CONCLUSIONS

The present study concluded that the addition of glass fibres at 0.5%, 1%, 2% and 3% of cement reduces the cracks under different loading conditions.

- It has been observed that the workability of concrete increases at 1% with the addition of glass fibre.
- The increase in compressive strength, flexural strength, split tensile strength for M-20 grade of concrete at 7 and 28 days are observed to be more at 1%. We can likewise utilize the waste product of glass as fibre.
- It has been observed that there is a gradual increase in compressive strength compare to the normal concrete. The workability of concrete decreases from 1% due to the addition of fibre.
- The compressive strength is very high at 1% having for 7 days is 20.76N/mm^2 and for 28 days is 28.46N/mm^2.
- The tensile strength is very high at 1% having for 7 days is1.47N /mm^2 and for 28 days is 2.94N /mm^2.
- The split tensile strength is very high at 1% having for 7 days is 2.83 N /mm^2 and for 28 days is 3.92N /mm^2.

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