

EXPERIMENTAL INVESTIGATION FOR STRENGTH OF CONCRETE BY USING FIBRE FLASS

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Abstract – In this experiment the effect of glass fibre on compressive strength, split tensile strength, flexural strength and workability of concrete is studied for different fiber content on M-20 grade of concrete designed as per IS 10262. In this study the maximum size of aggregate is 20mm. In this study I observed that the compressive strength, split tensile strength and flexural strength of concrete is increased with the increasing of glass fibre content up to 0.3% by weight of cement concrete & the workability of concrete is decreased with the presence of higher (above 0.1%) of glass fibre content by of cement concrete.

Key Words: Compressive strength, split tensile strength, flexural strength and workability of concrete...

1. INTRODUCTION

Concrete is one of the most important building material and its use has been ever increasing in the entire world. The reasons being that it is relatively cheap and its constituents are easily available, and has usability in wide range of civil infrastructure works. However concrete has certain disadvantages like brittleness and poor resistance to crack opening and spread. Concrete is brittle by nature and possess very low tensile strength and therefore fibres are used in one form or another to increase its tensile strength and decrease the brittle behaviour. With time a lot of experiments have been done to enhance the properties of concrete both in fresh state as well as hardened state. The basic materials remain the same but super plasticizers, admixtures, micro fillers are also being used to get the desired properties like workability, Increase or decrease in setting time and higher compressive strength.

1.1 GLASS FIBRE REINFORCED CONCRETE

Glass fibre reinforced concrete (GFRC) is a cementitious composite product reinforced with discrete glass fibres of varying length and size. The glass fibre used is alkaline resistant as glass fibre are susceptible to alkali which decreases the durability of GFRC. Glass strands are utilized for the most part for outside claddings, veneer plates and different components where their reinforcing impacts are required during construction. GFRC is stiff in fresh state has lower slump and hence less workable, therefore water reducing admixtures are used. Further the properties of GFRC depends on various parameters like method of

producing the product. It can be done by various methods like spraying, casting, extrusion techniques etc. Cement type is also found to have considerable effect on the GFRC. The length of the fibre, sand/filler type, cement ratio methods and duration of curing also effect the properties of GFRC.

1.2 APPLICATION

The main area of Fibre Reinforced Concrete applications are as following :

- Runway, aircraft parking and pavements.
- Tunnel lining and slop stabilization.
- Blast resistant structures.
- Thin walls, shell, pipes and manholes.
- Dams and hydraulic structures.
- Different applications include machine tool and instrument frames, lighting poles, water and oil tanks and concrete repairs.

1.3 ADVANTAGE AND DISADVANTAGE OF USING GLASS FIBERS IN CONCRETE

1.3.1 ADVANTAGE

- **Lighter Weight:** With glass fibre reinforced concrete can be cast in thinner section and is therefore as much as 75% lighter weight than similar pieces cast with traditional concrete.
- High flexural strength and high strength to weight ratio.
- **Toughness:** Glass fibre reinforced concrete does not crack easily it can be cut without chipping.

1.3.2 DISADVANTAGE

- **Durability:** According to ACI 544.1R-96, state of the Art report on Fibre Reinforced Concrete, "The strength of fully-aged GFRC composites will

decrease to about 40% of the initial strength prior to aging.” The durability of concrete can be increased through the use of low alkaline cements and pozzolanas.

- GFRC as a material, however is much more expensive than conventional concrete on a pound-for-pound basis.

2. LITERATURE REVIEW

In the Experimental study on properties of Glass Fibre Reinforced Concrete was studied in 2015 (Md. Abid Alam at al.) the glass fibre in concrete have significantly improves its compressive strength as well as tensile strength of concrete. In this study glass fibers are used in 0%, 0.02%, 0.04% & 0.06% in cement concrete and observed that –

- The workability of concrete is solely affected and the slump value is reduce from 100mm to 90mm and 75mm for M20 & M30 Grade of concrete respectively.
- The Compressive strength of Concrete is increased 26.6% & 25.78% for M20 & M30 grade of concrete respectively by using of 0.02% glass fibre by weight of concrete mix.
- The Tensile Strength of Concrete is increased 24.7% & 26.1% for M20 & M30 grade of concrete respectively by using of 0.02% glass fibre by weight of concrete mix.

In the Experimental studies on Glass Fibre Concrete was studied in 2016 (J.D. Chaitanya Kumar at al.) the glass fiber in concrete has increase the tensile strength and fire resistant properties so reducing the loss of damage during fire accidents and increased compressive strength and flexural strength of the concrete. In this study the glass fibre was used in 0.5%, 1.0%, 2.0% and 3.0% of weight of cement used in the mix and observed that the compressive strength, tensile strength and flexural strength of concrete is increased by using of glass fibre up to 1.0% and decreased by adding above 1.0% of glass fibre by the weight of cement in the concrete mix.

In the study of Glass Fibre Reinforced Concrete was studied in 2017 (Samprati Mishra at al.) the glass fiber was 12mm length and the diameter of each fibre was 14 micron used in concrete. In this study the fibre glass was used in 0%, 0.05%, 0.10%, 0.15%, 0.20% of weight of concrete mix for M25 & M40 grade of concrete it was observed that compressive strength of concrete was increased in M25 & M40 grade of concrete by using glass fibre up to 0.15%.

3. MATERIALS AND METHODS

3.1 MATERIALS

CEMENT

Pozzolana Portland Cement is used in this experiment. It is easily available in the local market. The cement has been tested for various proportions as per IS: 4031-1988 and found to be conforming to be various specifications of IS: 1489-1991 such as brand of cement, type of cement, fineness, consistency, initial setting time, final setting time, specific gravity, 3 days compressive strength, 7 days compressive strength, 28 days compressive strength and bulk density of cement is Birla Uttam Cement, Pozzolana Portland Cement (PPC), 0.17%, 31.7%, 67 minute, 556 minute, 3.12, 21.37 N/mm², 29.20 N/mm², 40.80 N/mm² and 1500 Kg/m³ respectively.

FINE AGGREGATE

Coarse sand is used as a fine aggregate in this experiment. The fine aggregate has been tested as per IS: 383-1970 and found the various specifications such as specific gravity, silt content, water absorption, bulk density, moisture content and fineness modulus is 2.72, 5.45%, 1.16%, 1718 Kg/Cum, 7.05% and 3.03 respectively. The sand belonged to zone II as per IS standards 383-1970.

COARSE AGGREGATE

Crushed stone aggregate 10mm and 20mm is used as a coarse aggregate in this experiment. The coarse aggregate has been tested as per IS:383-1970 and found the various specifications such as specific gravity for 10mm & 20mm is 2.78 & 2.79 respectively and bulk density of 10mm & 20mm aggregate is 1598 Kg/Cum & 1566 Kg/Cum. The size of coarse aggregate is taken in this experiment is 20mm.

WATER

Water is the one most essential element of cement concrete. Water assumes the vital part of hydration of cement concrete which frames the coupling lattice in which the dormant totals are held in suspension medium until the grid has solidified, furthermore it serves as the lubricant between the fine and coarse aggregates and makes concrete workable. So that potable water available at site is used for experiment.

GLASS FIBRE

In this experiment AR-glass fibers is used. The filament diameter of glass fibre is 14 micron and length 12 mm having the aspect ratio of 857.1. The glass fibers used had a density of 2.7 gm/cm³, tensile strength 1700 MPa and Young's Modulus 72 GPa.

3.2 METHODS

WORKABILITY

The workability of cement concrete is tested as per using standard sizes of Slump Moulds as per IS: 1199 - 1999.

COMPRESSIVE STRENGTH

For find out compressive strength of cement concrete we casted steel cube mould of size of 150mm*150mm*150mm. After 24 hour casting of cube removing the mould and allowed for curing in a curing tank for a period of 28 days. After 7days & 28 days of curing of cube we tested the cube on Universal Testing Machine. The test procedure is used as per IS: 516-1979.

SPLIT TENSILE STRENGTH

For find out split tensile strength of cement concrete we casted steel mould of cylinder with 150mm diameter and 300mm long. After 24 hour removing the mould and allowed for curing in a curing tank for a period of 28 days. After 7days and 28 days of curing of specimen we tested on Universal Testing Machine. The test procedure is used as per IS: 5816 - 1999.

FLEXURAL STRENGTH

For find out the flexural strength of cement concrete we casted steel mould of size 500mm*100mm*100mm. After 24 hour removing the mould and allowed for curing in a curing tank for a period of 28 days. After 7days 28 days of curing of specimen we tested in 200 tonnes electro-hydraulic closed loop machine. The test procedure is used as per IS: 516-1979.

4. CONCLUSIONS

In this experimental program the effect of glass fibers on the compressive, split tensile strength and flexural strength and workability of concrete is studied.

The concrete mix gets harsher and less workable with increase of fiber content therefore use of admixture become necessary. However even after giving dosage of admixture as high as 1.5% proper workability could not be obtained and some segregation was observed.

The various observation based on the experimental result are as follows:

1. The compressive strength of concrete with / without admixture is increased by the presence of glass fibres with fibre content in

the range 0.1 to 0.3 % of fiber content by weight of concrete and decreased with the presence of higher amount of fibers (above 0.3%).

2. The split tensile strength of concrete increases with the addition of glass fibers.
3. The flexural strength of concrete increases with increase in fiber content and as such the tension carrying capacity of concrete may increase in flexure.
4. The water absorption of the concrete also decreases with increase in fiber content.
5. The workability of concrete is decreased with the presence of higher (above 0.1% glass fibre content by weight of concrete) amount of fibers.

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