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Glass Fibre Reinforced Concrete

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Abstract - *The present day world is witnessing the construction of very challenging and difficult civil engineering structures. 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. One such effort is the addition of different fibres to concrete for increasing the strength aspects of concrete. Some of the commonly known fibres are steel, glass, carbon and organic fibres. In the present study we are using alkali resistance glass fibre. Glass fibre falls under the economical class i.e. without any extra expenditure (out of the total cost of concrete) it can be used. The glass fibre used here are 12mm in length and the diameter of each fibre is 14micron. A total of 10 mixes were prepared by varying the percentage of glass fibre and grade of concrete mixes. Firstly a trial test was done by adding different percentages of glass fibre to M25 grade concrete. As now a days higher grades of concrete is preferred for various construction purposes so here we are also using M40 grade concrete to find a detailed comparative value. The compressive strength test was done at 7days and 28days. The results were finally compared.*

Key Words: Alkali Resistance Glass Fibre, Aspect Ratio, OPC-43 grade, Mix Design, Compressive Strength

1. INTRODUCTION

The word concrete comes from the Latin word "*concretus*" (meaning compact or condensed). Concrete is a composite material composed of coarse aggregate bonded together with a fluid cement that hardens over time. Many types of concrete are available, distinguished by the proportions of the main ingredients below. In this way or by substitution for the cementitious and aggregate phases, the finished product can be tailored to its application. Strength, density, as well chemical and thermal resistance are variables. Concrete is strong in compression, as the aggregate efficiently carries the compression load. However, it is weak in tension as the cement holding the aggregate in place can crack, allowing the structure to fail. Reinforced concrete adds either steel reinforcing bars, steel fibres, glass fibres, or plastic fibres to carry tensile loads. Glass fibre reinforced concrete or GFRC is a type of fibre-reinforced concrete. Glass fibre concretes are mainly used in exterior building façade panels and as architectural precast concrete. Somewhat similar materials are fibre cement siding and cement boards. Glass fibre-reinforced concrete consists of high-strength, alkali-resistant glass fibre embedded in a concrete matrix. In this form, both fibres and matrix retain their physical and chemical identities, while offering a synergistic combination of properties that cannot be achieved with either of the components acting alone. In general, fibres are the principal load-carrying members, while the surrounding matrix keeps them in the desired locations and orientation, acting as a load transfer medium between the fibres and protecting them from environmental damage. The fibres provide reinforcement for the matrix and other useful functions in fibre-reinforced composite materials. Glass fibres can be incorporated into a matrix either in continuous or discontinuous (chopped) lengths.

2. MATERIALS USED

2.1 Cement

Ordinary Portland cement of 43 grade (RAMCO) available in local market is used in the investigation. The cement used has been tested for various proportions as per IS: 4031-1988 and found to be conforming to various specifications of IS: 12269-1987. The physical properties are given as under

- Specific Gravity 3.15
- Normal Consistency 29%
- Compressive Strength(28days) 52.10

2.2 Coarse Aggregate

Crushed angular granite metal from a local source was used as coarse aggregate. The coarse aggregate used in the project work are 20 mm and 10 mm grades. The physical properties are given as under

- Aggregate Impact Value 15.08
- Abrasion Value 22.92%
- Specific Gravity 2.861

2.3 Fine Aggregate

River white sand was used as fine aggregate. The fine aggregate used in the project work is 4.75 mm down grade. The zone of sand is ZONE-III. The physical properties are given as under

- Specific Gravity 2.674
- Water Absorption 1.36%

2.4 Glass Fibre

The glass fibres used are of Cem-Fil Anti-Crack HD with modulus of elasticity 72 Gpa, filament diameter 14 microns and length 12 mm. The numbers of fibres per Kg is 212 million fibres. The physical properties are given as under

- Aspect Ratio 857.1
- Specific Gravity 2.68

2.5 Admixture

Conplast SP430 is a chloride free, super plasticising admixture based on selected sulphonated napthalene polymers. It is supplied as a brown solution which instantly disperses in water.

- Specifc Gravity 1.18

2.6 Water

Fresh portable drinking water should be used for curing and casting of specimen. Water is important ingredient for strength and durability characteristics of concrete.

Fig – 1: Glass Fibre

3. EXPERIMENTAL METHODOLOGY AND ANALYSIS OF RESULTS

3.1 Compressive Strength Test

The compression test carried out on specimens like cube. The cube specimen is of the size 15×15×15cm. If the largest nominal size of the aggregate does not exceed 20mm, 10cm cubes may also be used as an alternative. The specimens were tested for compressive strength as per IS 516-1959 using a calibrated compression testing machine of 2000KN capacity. After placing the specimen the compression load is applied due to compression the specimen fails this failure is noted.

Expected maximum load =fck x A x f.s

Where,
fck = compressive strength in N/mm^2
fs = factor of safety
A = area over which the load is applied in mm^2

Table 1: 7 Days Compressive Strength Test Results

Types of concrete / Grades of concrete	M25	M40
0%	22.62	32.44
0.05%	25.30	34.11
0.10%	25.23	34.45
0.15%	23.50	35.61
0.20%	24.60	34.47

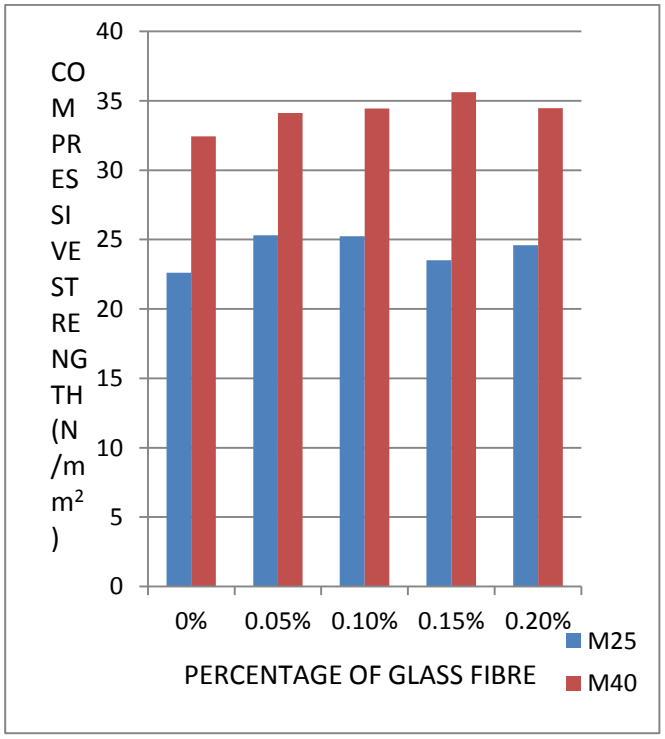

Chart-1: 7 Days Compressive Strength

Table 2: 28 Days Compressive Strength Test

Types of concrete / Grades of concrete	M25	M40
0%	32.70	49.20
0.05%	34.19	49.09
0.10%	34.62	51.07
0.15%	33.98	51.83
0.20%	35.07	52.11

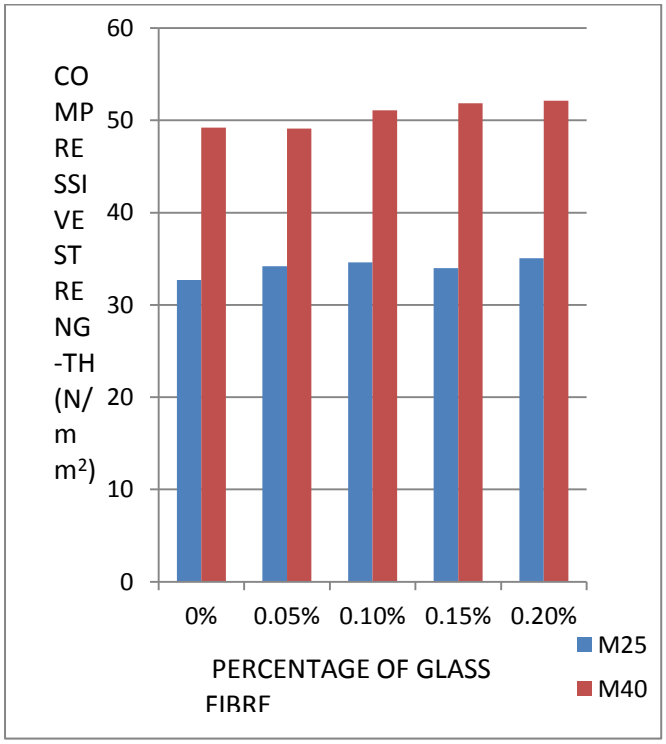

Chart-2: 28 Days Compressive Strength

4. CONCLUSIONS

From the above experiment, it has been observed that with addition of Glass Fibre with plain concrete increases the strength properties.

Maximum compressive strength is attained in addition of 0.20% of Glass Fibre with M40 grade of concrete.

The use of OPC cement gives accurate results as there is no addition of pozzolanic materials in OPC unlike PPC.

For better results the mixture should be carried in mixture machine.

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