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"An Experimental Analysis on Use of Glass Fiber and Steel Fiber in Concrete"

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Abstract
In this developing world, many countries are undergoing urbanization due to population growth. Since India is one of developing countries, the construction will grow in the future. Glass and Plastic is one of the waste materials which is generated from the various industry, which contributes to the environmental and disposal problem. Therefore, reusing eggshell as an additive in concrete is a better solution to reduce the environmental problem as it consists the constituents similar to that present in cement. These Glass and Plastic are used to make Glass fiber and Steel fiber for usage. The objective of this study is to determine the Strength Performance of the Concrete partially replaced with GFRC and SFRC and carry out comparative analysis with Conventional Concrete
Keywords: *Fiber, Steel, Glass, Concrete, Temperature.*

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I. INTRODUCTION

Concrete is the most important and historic discovery of man when it comes to construction. Concrete has allowed humans to build structures which are providing us with the resources to sustain our populated planet. Since the discovery of cement and the first concrete mix, most construction projects used concrete as the best material alternative due its properties, workability and relatively low cost. Concrete is considered a brittle material, primarily because of its low tensile strain capacity and poor fracture toughness. Reinforcement of concrete with short randomly distributed fibers can address some of the concerns related to concrete brittleness and poor resistance to crack growth. Fibers, used as reinforcement, can be effective in arresting cracks at both micro and macro-levels. Steel Fiber reinforced concrete (SFRC) is defined as concrete made with hydraulic cement containing Fine and coarse aggregate and discontinuous discrete fiber. In SFRC, thousands of small fibers are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties. SFRC is being increasingly used to improve static and dynamic tensile strength, energy absorbing capacity and better fatigue strength. Glass Fiber is chemical inorganic fiber, obtained from molten glass of a specific composition. This glass is compound of quartz sand, limestone, kaolin, calcium fluoride (fluorspar), boric acid, natrium sulphate, and clay. Glass fiber is made of natural materials, so that its products are ecologically pure and not harmful to human health. Glass fiber is highly light permeable and can be a semiconductor having excellent electronic, heat, and sound insulation capacities. Although not as strong or as rigid as carbon fiber, it is much cheaper and significantly less brittle.

1.1.1 Problem Statement

To study feasibility of using glass fiber and steel fiber in concrete, a set of composite cubes (150mmx150mmx150mm) will be cast

1.1.2 Objectives

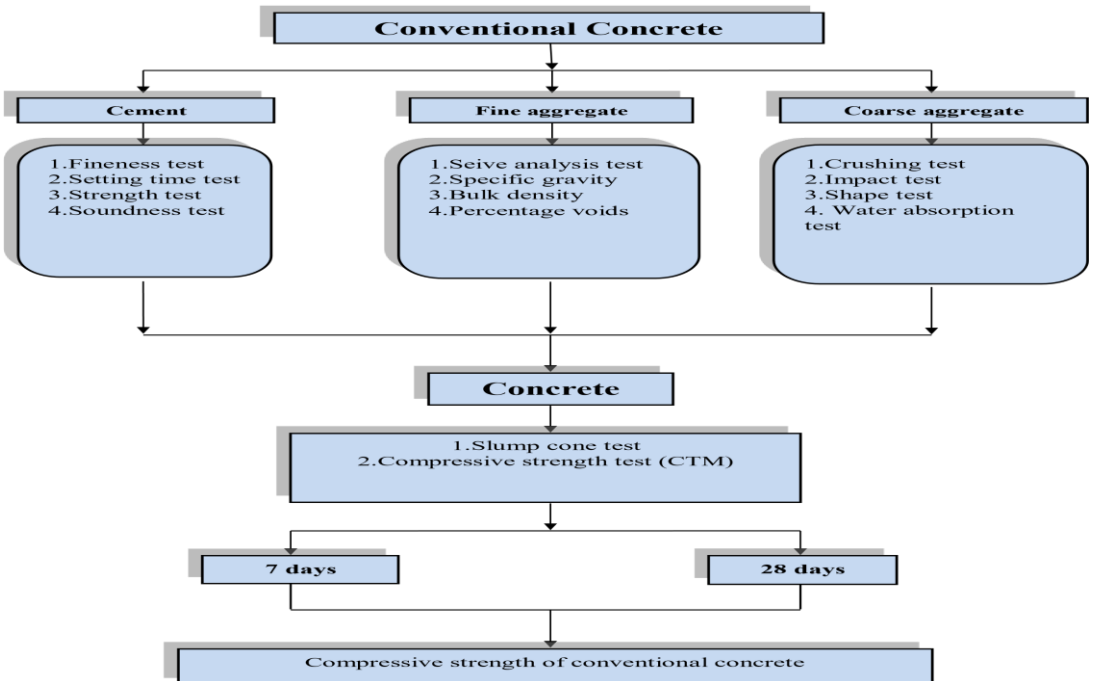
II. 1.To study the properties of Glass Fiber & Steel Fiber.
III. 2. To check the feasibility of using as partially replacement for cement in Concrete.
IV. 3. To prepare Concrete Mix Design for M20 Grade.
V. 4. To carry out Experimental Proportions for Concrete Manufacturing using Concrete Mix Design.

1.1.3 Expected Outcome

The load carried by the fiber reinforced concrete shall be equivalent to that of Conventional concrete. Use of glass fiber & steel fiber should provide similar results as that of research done with slight variations in load carrying capacities and deflections. Load carrying may Depend on the type of materials used to cast the pavement.

1.2 Methodology

Table 1. Conventional concrete



1.3 Material Used & its properties

1.3.1 Cement

43-grade OPC is used throughout the experimental work and the cement used has been tested for various proportions as per IS: 4031-1988.

1.3.2. Fine Aggregate

Locally available sand, from Pravara River, is used as fine aggregate, it confirms to zone II of IS 383-1983.

1.3.3. Coarse Aggregate

Locally available crushed stone aggregates with size 5mm to 12.5 mm and of maximum size 12.5 mm are used.

1.3.4. Water

Water confirming to the requirements of IS-456: 2000 is suitable for making concrete. In the present work, available tap water is used for concreting.

1.3.5 Steel Fiber

Steel fibers reinforced shotcrete (SFRS) is defined as a mortar or concrete, containing discontinuous discrete Steel fibers, which are pneumatically projected at high velocity onto a surface. Mechanical and Chemical Properties of SF are shown in fig.1&2.

Mechanical Properties of Steel Fibers	
Diameter	0.75MM
Length	60MM
Tensile Strength	1023MPa
Tolerance for Diameter and Length	(+)10%(As Per ASTM)

Table 1

Chemical Composition of Mild Steel wire	Percentages (%)
C	0.074
M_n	0.36
Si	0.065
P	0.01
S	0.009

Table 2

1.3.6 Glass Fiber

Glass fiber is formed when thin strands of silica-based or other formulation glass are extruded into many fiber with small diameters suitable for textile processing. Mechanical and Chemical Properties of GF are shown in fig.3&4.

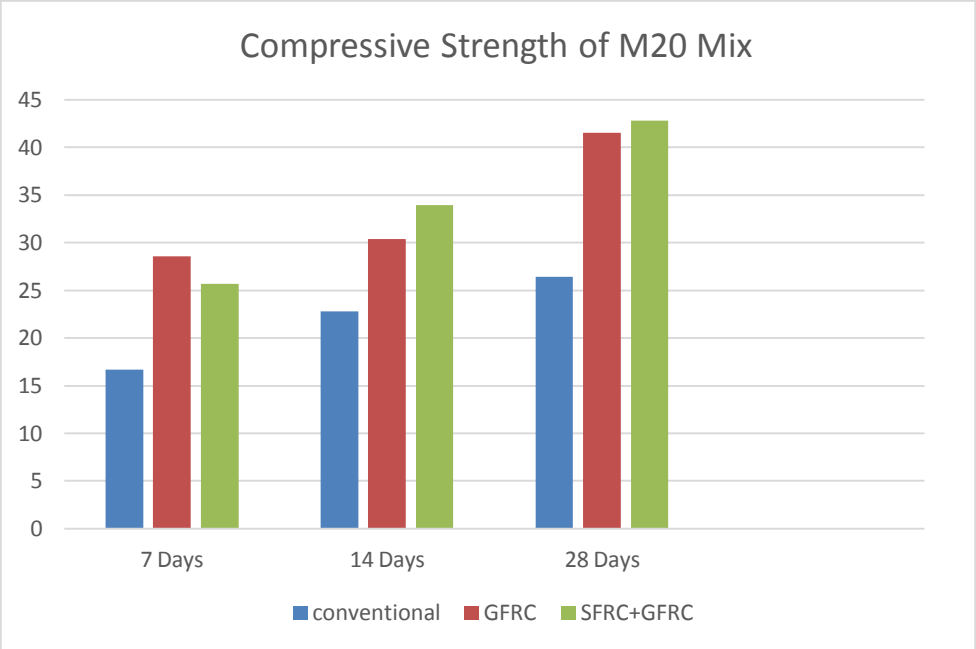
Property	Glass Fibre
Specific gravity	2.4-2.8
Bulk density	2.53
Moisture content (%)	Nil
Fine particles less than 0.075mm %	12-15

Table 3

Constituent	Glass Fibre
Silica (SiO_2)	72.5
Alumina (Al_2O_3)	01.06
Iron Oxide (Fe_2O_3)	0.36
Lime (CaO)	08
Magnesia (MgO)	4.18
Sodium Oxide (Na_2O)	13.1
Potassium oxide (K_2O)	0.26
Sulphur Trioxide (SO_3)	0.18

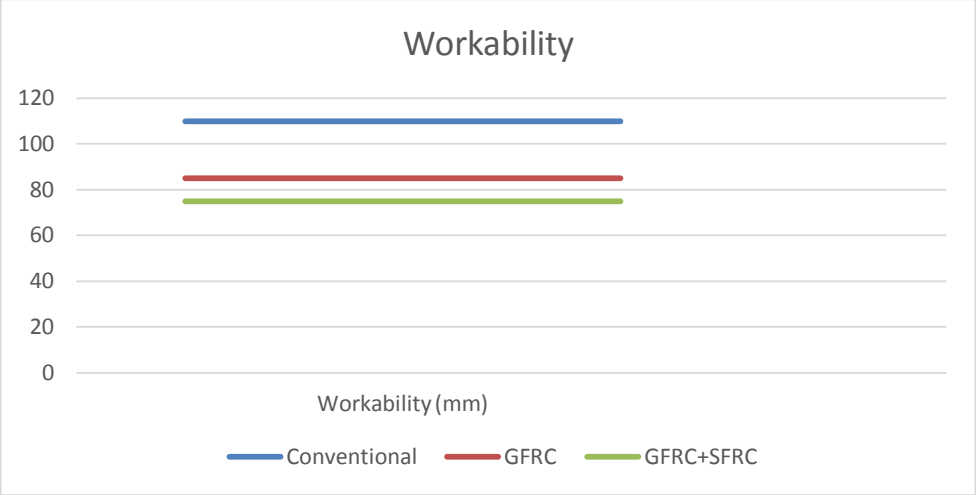
Table 4

2.1 Results & Conclusions



Serial No.	Type of concrete	Grade	7-Days	14-Days	28-Days
1.	Conventional	M20	16.7	22.81	26.42
2.	GFRC	M20	28.6	35.37	41.53
3.	SFRC+GFRC	M20	25.7	33.95	42.83

Table 5 Comparative Study of Compressive Strength



Serial no.	1	2	3
Type of Concrete	Conventional Concrete	GFRC	SFRC+GFRC
Workability (mm)	110	85	75

2.1.1Conclusion

A) Compressive Strength.

1. From above discussion it is conclude that, compressive strength is improved by addition of fibers irrespective of fiber type and w/c ratio.
2. From the results we have concluded that compressive strength of GFRC is more than Conventional Concrete about 25 % at 7 days of age.
3. From the results we have concluded that compressive strength of SFRC+GFRC is more than Conventional Concrete about 25 % but it is less than GFRC about 4% at 7 days of age.
4. At the age of 14 days compressive strength of GFRC is more than Conventional Concrete about 26%
5. At the age of 14 days compressive strength of SFRC+GFRC is more than Conventional Concrete about 25% but it is less than GFRC about 4%
6. The percentage increase of compressive strength of GFRC at the maturity age of 28 days is 30 % than the compressive strength of Conventional Concrete.
7. The percentage increase of compressive strength of SFRC+GFRC at the maturity age of 28 days is 32% than the compressive strength of Conventional Concrete and 2% more than GFRC.
8. The percentage increase of compressive strength of M20 grade of concrete mix with glass and steel fibers compared with 28 days compressive strength is observed from 25 to 30%.

B) Workability

1. We have Concluded from slump cone test that conventional concrete has slump more than GFRC & GFRC + SFRC it is about 110mm.
2. GFRC Slump is more than the SFRC + GFRC mix it is about 85mm.
3. GFRC + SFRC has the less slump as compare to Conventional as well as GFRC concrete, it is about 75 mm.

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