DESTRUCTIVE AND NON - DESTRUCTIVE PROPERTIES OF GLASS FIBER REINFORCED HIGH PERFORMENCE CONCRETE WITH MICRO SLICA B.

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ABSTRACT

As we well known that, the world is developing rapidly and the construction of buildings takes vital role in this development. If we go through in detail the usage of concrete gets raised up so it leads to the shortage of the natural resources. In order to save our natural resources, we thought that replace some of the proportions in the concrete with the following measures. The study focuses on the compressive strength, split tensile strength and flexural strength performance of concrete containing glass fiber and different percentage of micro silica as a partial replacement of cement. The cement in concrete is replaced accordingly with the percentage of 7.5%, 10%, 12.5%, 15% and 17.5% by weight of micro silica and 0.5%,1%,1.5%,2% and 2.5% of glass fiber is added by weight of cement. Concrete cubes, cylinders and beams are tested at the age of 7, 14 and 28 days of curing. Finally, the strength performance of slag blended fiber reinforced concrete is compared with the performance of conventional concrete.

Keywords: glass fiber, micro silica, compressive strength, split tensile strength, flexural strength.

INTRODUCTION

Concrete is most normally utilized and exceptionally solid constructional material. Concrete is a blend of concrete, coarse total and fine total and water. Concrete is the coupling material which holds the coarse and fine total together. The concrete and water frame a glue or gel which covers the sand and rock. Coarse total is utilized as quality material. Fine total is utilized as filler. Concrete is excellent in pressure and powerless in strain. To evade these issues now-a-days we are utilizing various sorts of admixtures in the solid. In this examination the expansion of glass strands in the solid and fractional supplanting of cement with micro silica and total volume of concrete with glass fibers. The interest for concrete is next just to water. With the progression of innovation and expanded field of utilization of cement and mortars, different properties of the standard cement required adjustment to make it progressively appropriate for different circumstances, conservative and eco well disposed. This has prompted the utilization of cementitious materials, for example, fly debris, micro silica, silica smolder, metakaolin and so forth which have contributed towards better, vitality protection and economy. The utilization of micro silica in part supplanting the fine total concrete in solid outcomes in decrease of concrete utilized, decrease in the emanation of carbon dioxide (Co2), protection of existing assets alongside the improvement in the quality and strength properties of cement.

LITERATURE REVIEW

Sasikumar & Tamilvanan (2016) Performed an Experimental Investigation on Properties of Micro silicas as a Partial Replacement of Cement. main parameter investigated in this study is M30 grade concrete with partial replacement of cement by micro silica0%, 25%, 30%, 40% and 50%. The normal consistency increases about 40% when micro silica percentage increases from 0% to 25%. The optimum 7 and 28-day compressive strength has been obtained in the 25 % micro silica replacement level. Also, the split tensile strength is high when using 25% micro silica replacement for cement.

Amarkhail (2015) observed Effects of Micro silica on Properties of High-Strength Concrete. He found that up to 10% cement may be replaced by micro silica without harming the concrete workability. Concrete containing 10% micro silica replacement achieved the highest compressive strength followed by 15% micro silica replacement with a small difference. Concrete with 15% micro silica content achieved the highest flexural strength.10% and 15% micro silica content as replacement of cement were found to be the optimum amount for significantly enhancement of compressive strength and flexural strength respectively.

Roy &Sil (2012) Studied the Effect of Partial Replacement of Cement by Micro silica on Hardened Concrete. From the study it has been observed that maximum compressive strength (both cube and cylinder) is noted for 10% replacement of cement with micro silica and the values are higher (by 19.6% and 16.82% respectively) than those of the normal concrete (for cube and cylinder) whereas split tensile strength and flexural strength of the SF concrete (3.61N/mm2 and 4.93N/mm2 respectively) are increased by about 38.58% and 21.13% respectively over those (2.6 N/mm2 and 4.07 N/mm2 respectively) of the normal concrete when 10% of cement is replaced by SF. **C.Selin Ravikumar et al (2013).,** have investigates the strength and fire resistance parameter of the glass fiber concrete. In this work M25 grade of concrete is used. Glass fibre is added with increment of 0.5% (0%, 0.5%, 1%). The concrete is subject for testing at two different ages they are 7 days and 28 days, after the curing the concrete for 28 days in compression test the concrete attains 42.87 Mpa strength when fibre is added for 1% of weight of the cement, in flexural test concrete attains 12.67Mpa and in split tensile test concrete attains 12.67Mpa when compared with the controlled concrete the contemporary concrete attains 72% percentage of more strength the controlled concrete in compression test

MATERIALS PROPERTIES AND EXPERIMENTAL INVESTIGATION

MATERIALS

Raw materials required for the concreting operations of the present work are micro silica, glass fibers, cement, fine aggregate, coarse aggregate, Polycarboxylate and water.

CEMENT

Ordinary Portland cement is the most common type of cement in general use around the world as a basic ingredient of concrete, mortar, stucco, and most non-specialty grout. Cement is the main ingredient in manufacturing of concrete. The characteristics of concrete will be greatly affected by changing the Cement content. The Cement used in this project is Ordinary Portland Cement of 53 grade confirming to IS 12269 – 2013.

S No	Properties	Values observed
1	Specific Gravity	3.15
2	Initial setting time	38 min
3	Final setting time	550 min

Physical properties of Ordinary Portland cement -53 Grade

FINE AGGREGATE

Gradation refers to the particle size distribution of aggregates. Grading is a very important property of aggregate used for making concrete, in view of its packing of particles, resulting in the reduction of voids. This in turn influences the water demand and cement content of concrete.

Grading is described in terms of the cumulative percentages of weights passing a particular IS sieve. IS 383-1970 specifies four ranges or zones for fine aggregate grading. Table gives the range of percentage passing for each zone.

Zone I sand is the coarsest and Zone IV is the finest whereas sand in Zone II and Zone III are moderate. It is recommended that fine aggregates conforming to grading zone II or Zone III can be used in reinforced concrete.

S.No	Property	Result
1	Fineness Modulus	2.7
2	Specific Gravity	2.65

Physical properties of fine aggregates

COARSE AGGREGATE

The aggregate which is retained over IS Sieve 4.75 mm is termed as coarse aggregate. The normal maximum size is gradually 10-20 mm; however, particle sizes up to 40 mm or more have been used in Self Compacting Concrete. Gap graded aggregates are frequently better than those continuously graded, which might expensive grader internal friction and give reduced flow. Regarding the characteristics of different types of aggregate, crushed aggregates tend to improve the strength because of interlocking of angular particles, while rounded aggregates improved the flow because of lower internal friction.

Locally available coarse aggregate having the maximum size of 20 mm and minimum size of 12.5 mm was used in this work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per IS: 383-1970.

S.No	Property	Result
1	Fineness Modulus	8.01
2	Specific Gravity	2.72

Physical properties of coarse aggregates

MICRO SILICA

Micro silica, also referred as micro silica or condensed silica flume, is another material that is used as artificial mineral admixtures

Micro silica as an admixture has opened a new advancement in concrete technology. The usage of super plasticizer with silica fume has been the backbone of modern high-performance concrete. It should be noted that micro silica by itself, doesn't contribute to strength. However, it produces the property of strength being fine pozzolanic material. Micro silica helps in reduction of water becomes possible in presence of high dosage of super plasticizer and dense packing of cement paste.

PHYSICAL COMPOSITION	
Physical state Solid	Non-Hazardous
Appearance	Very fine powder
Particle size	25 microns – mean
Colors	Grey
Odor	Odorless
Specific Gravity	2.2
CHEMICAL COMPOSITION	
Silica – Sio2	>90.0%
Carbon	<2.0%
Moisture	<2.0%
Water Soluble	<6.0%

Physical properties and chemical composition of micro silica

GLASS FIBER

Copper slag can be used in concrete production as a Glass fiber-reinforced concrete consists of high-strength, alkali-resistant glass fiber embedded in a concrete matrix. In this form, both fibers 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, fibers 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 fibers and protecting them from environmental damage.

type	Properties
Density (gm/cc)	7.85
Youngs modulus (m N/m^2)	0.5
Specific gravity	30

physical properties of glass fibers

POLYCARBOXYLATE (PC-F)

PC-F is a ready-to-use liquid superplasticizer that extremely improves the superb water-reducing performance when comparing with superplasticizers based on existing polycarboxylic systems. PC-F Polycarboxylate Superplasticizer for high water reducing has been primarily developed for applications in the ready mixed and precast concrete industries where the highest durability and performance is required.

Items	Specification
Visual Appearance	Light Yellow Liquid
Solid Content (%)	50.0±2.0
Density (23°C) (kg/m3)	1.13±0.02
Chloride Content (%)	≤0.20
Na2SO4 Content (%)	≤4.0
Na2O+0.658K2O (%)	≤5.0
Solubility	Completely soluble

typical properties of polycarboxylate

MIX DESIGN

Cement	Fine aggregate	Coarse aggregate	Water
650.6	673.03	938.46	195.18
1	1.03	1.44	0.3

mix proportion for M40 grade

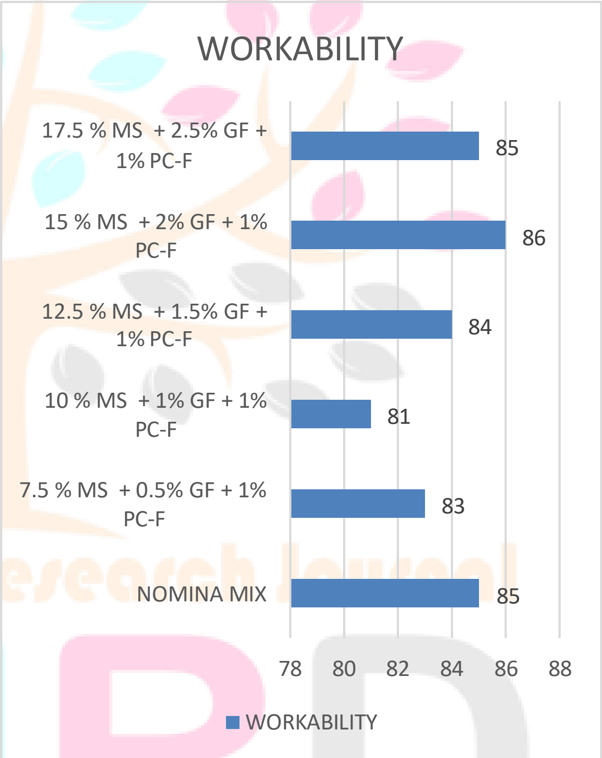
MATERIAL IDENTIFICATION	MATERIAL
MS	MICRO SILICA
GF	GLASS FIBER
PC-F	polycarboxylate

Material identification

RESULTS

SLUMP CONE TEST

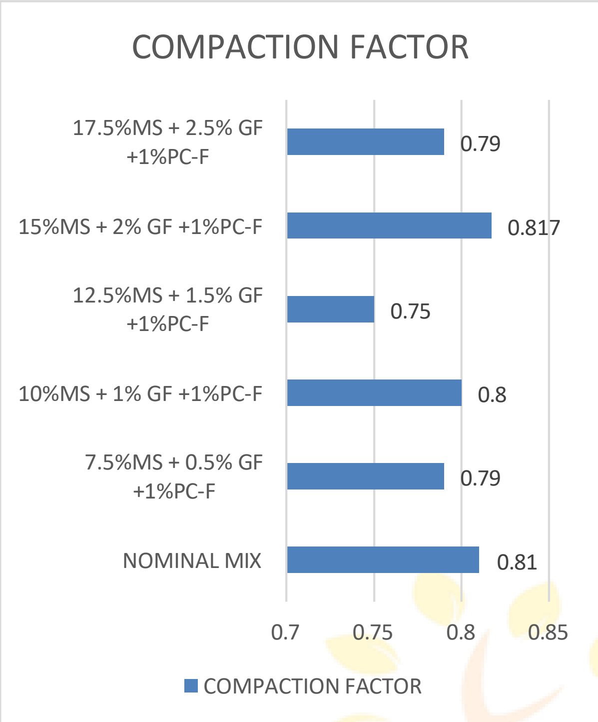
The strength of concrete of a given mix proportion is seriously affected by the degree of its compaction. It is therefore important that the consistency of the mix is such that the concrete can be transported, placed and finished sufficiently easily and without segregation. A concrete satisfying these conditions is said to be workable. Workability



workability results

COMPACTION FACTOR TEST

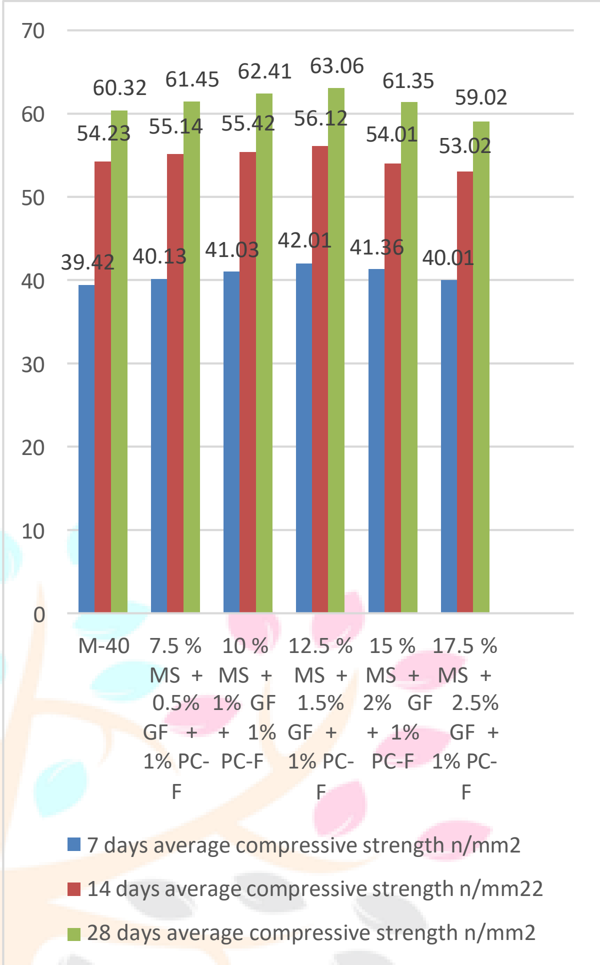
Scope and Significance Compaction factor test is adopted to determine the workability of concrete, where nominal size of aggregate does not exceed 40mm, and is primarily used in laboratory. It is based upon the definition, that workability is that property of the concrete which determines the amount of work required to produce full compaction. The test consists essentially of applying a standard amount of work to standard quantity of concrete and measuring the resulting compaction.



compaction factor results

COMPRESSION TEST ON CONCRETE CUBES

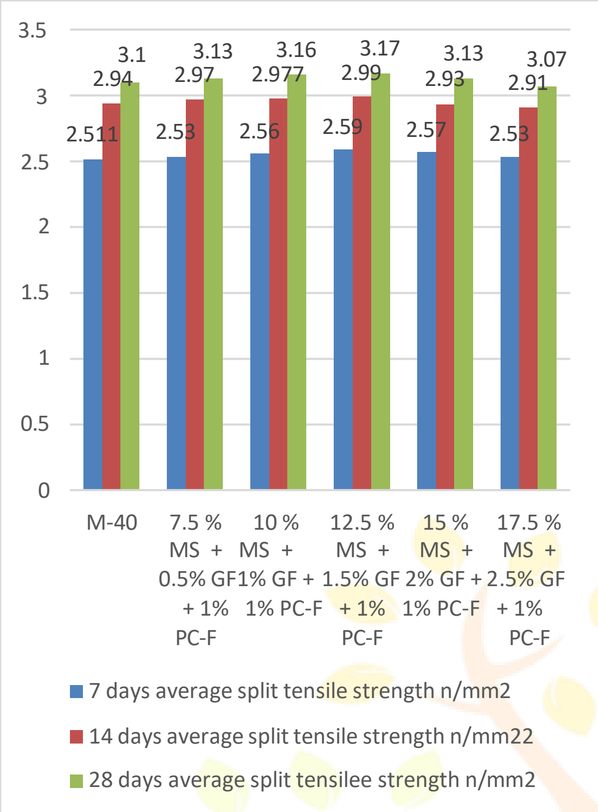
The determination of the compressive strength of concrete is very important because the compressive strength is the criterion of its quality. Other strength is generally prescribed in terms of compressive strength. The strength is expressed in N/mm2. This method is applicable to the making of preliminary compression tests to ascertain the suitability of the available materials or to determine suitable mix proportions. The concrete to be tested should not have the nominal maximum size of aggregate more than 20mm test specimens are either 15cm cubes or 15cm diameter used. At least three specimens should be made available for testing. Where every cylinder is used for compressive strength results the cube strength can be calculated as under. Minimum cylinder compressive strength = 0.8 x compressive strength cube (10 cm x 10 cm) The concrete specimens are generally tested at ages 3 days 7 days and 28 days. The cubes are generally tested at 3 days 7 days and 28 days. The cubes are removed from the curing tank, dried and grit removed. The cubes are tested using a calibrated compression machine. This can be carried out internally by competent personnel or by a certified test house. The cubes are tested on the face perpendicular to the casting face. The compression machine exerts a constant progressing force on the cubes till they fail, the rate of loading is 0.6 ± 0.2 M/Pas (N/mm²/s). The reading at failure is the maximum compressive strength of the concrete. BS EN 12390-2: 2009 / BS EN 12390-3:2009. The concrete minimum compressive strength will be specified by the client/designer in a specific format compressive strength results for 7, 14 and 28 days



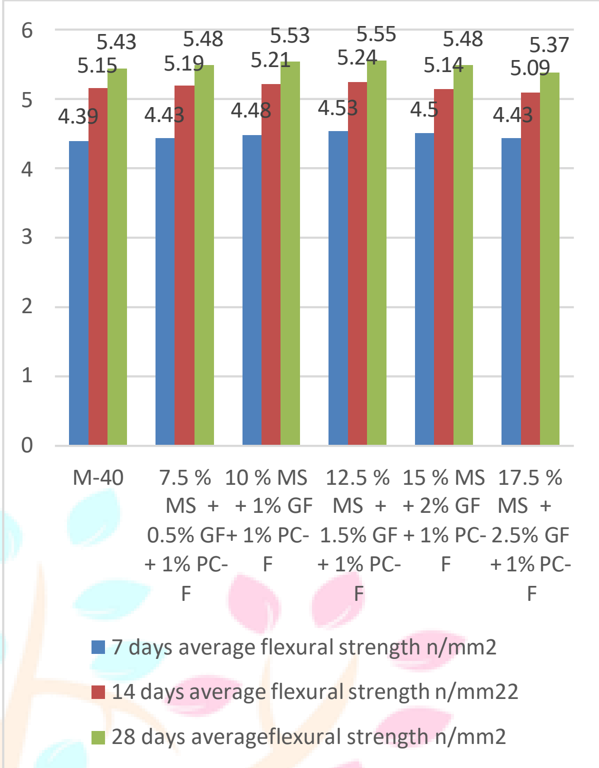
compressive strength results for 7, 14 and 28 days

SPLIT-CYLINDER TEST

It is the standard test, to determine the tensile strength of concrete in an indirect way. This test could be performed in accordance with IS : 5816-1970.A standard test cylinder of concrete specimen (300 mm X 150mm diameter) is placed horizontally between the loading surfaces of Compression Testing Machine. The compression load is applied diametrically and uniformly along the length of cylinder until the failure of the cylinder along the vertical diameter. To allow the uniform distribution of this applied load and to reduce the magnitude of the high compressive stresses near the points of application of this load, strips of plywood are placed between the specimen and loading platens of the testing machine. Concrete cylinders split into two halves along this vertical plane due to indirect tensile stress generated by poison's effect.



split tensile strength results for 7, 14 and 28 days



flexural strength results for 7, 14 and 28 days

FLEXURAL STRENGTH OF CONCRETE

The flexural strength would be the same as the tensile strength if the material were homogeneous. In fact, most materials have small or large defects in them which act to concentrate the stresses locally, effectively causing a localized weakness. When a material is bent only the extreme fibers are at the largest stress so, if those fibers are free from defects, the flexural strength will be controlled by the strength of those intact 'fibers'. However, if the same material was subjected to only tensile forces then all the fibers in the material are at the same stress and failure will initiate when the weakest fiber reaches its limiting tensile stress. Therefore, it is common for flexural strengths to be higher than tensile strengths for the same material. Conversely, a homogeneous material with defects only on its surfaces (e.g., due to scratches) might have a higher tensile strength than flexural strength.

FLEXURAL SET-UP

Sl.No.	Mix Identity	Pulse wave velocity (m/sec)	Quality of concrete
1	NOMINAL MIX	4450	Excellent
2	7.5 % MS + 0.5% GF + 1% PC-F	4583	Excellent
3	10 % % MS + 1% GF + 1% PC-F	4761	Excellent
4	12.5 % % MS + 1.5% GF + 1% PC-F	4850	Excellent
5	15 % % MS + 2% GF + 1% PC-F	4628	Excellent
6	17.5 % % MS + 2.5% GF + 1% PC-F	4539	Excellent

upv test results at 28 days(m/sec)

Mix Identity	Mean rebound value
NOMINAL MIX	31.5
7.5 % MS + 0.5% GF + 1% PC-F	43.52
10 % % MS + 1% GF + 1% PC-F	44.02
12.5 % % MS + 1.5% GF + 1% PC-F	45.31
15 % % MS + 2% GF + 1% PC-F	30.35
17.5 % % MS + 2.5% GF + 1% PC-F	29.12

rebound test results at 28 days

CONCLUSION

- We gain the highest compressive strength at the percentage of different admixtures added in M-60 grade concrete (12.5 % % MS + 1.5% GF + 1% PC-F)

– 63.06 N/mm2

- We gain the highest split tensile strength at the percentage of different admixtures added in M-60 grade concrete (12.5 % % MS + 1.5% GF + 1% PC-F)

– 3.17 N/mm2

- We gain the highest flexural strength at the percentage of different admixtures added in M-60 grade concrete (12.5 % % MS + 1.5% GF + 1% PC-F)

– 5.55 N/mm2

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