International Journal of Scientific & Engineering Research Volume 11, Issue 3, March-2020
ISSN 2229-5518

FATIGUE ANALYSIS ON GLASS FIBER REINFORCED SELF COMPACTING CONCRETE

Supriya R
Sri Ranganathar Institute of Engineering and Technology
Coimbatore-641110
riyaishu53@gmail.com

Mariselvi N
Sri Ranganathar Institute of Engineering and Technology
Coimbatore-641110
selviammu3578@gmail.com

Ranjithkumar P
Sri Ranganathar Institute of Engineering and Technology
Coimbatore-641110
ranjith300496@gmail.com

Moganapriya J
Sri Ranganathar Institute of Engineering and Technology
Coimbatore-641110
moganapriya777@gmail.com

ABSTRACT - Self Compacting Concrete (SCC) is able to flow under its own weight and completely fill the formwork, even in the presence of congested reinforcement, without any compaction, while maintaining homogeneity of the concrete. Compaction is difficult to be done in conditions where there are dense reinforcement and large casting area. Usage of SCC will overcome the difficult casting conditions and reduce manpower required. Addition of fibers will enhance the tensile and ductile behavior of concrete with brittle nature. SCC was added with relatively short, discrete, and discontinuous glass fibers to produce Glass Fiber Reinforced Self Compacting Concrete (GFRSCC). The purpose of this study is to investigate the workability and mechanical properties of plain SCC and GFRSCC. The laboratory testing included slump flow test, L-Box test, V box test compressive strength test.The dosage of super plasticizer required increased as fiber content increased. There has been a lack of studies for productivity improvement in the construction industry. A review of literature was done where an inventory of productivity related factors were found and interpolated. A survey of construction practitioners was conducted to rank and determine the degree of influence of various factors on construction productivity. We have selected the major factors such as Material, Labor and accessed it both quantitatively and qualitatively for a real time construction project. The results enhanced profit and productivity.

Keywords— slumpcone test, L box test, V box test,compression test.

I. INTRODUCTION

SCC can be considered as a concrete with high flow ability that can be placed and compacted under its own weight without any external vibration, assuring complete filling of formworks and also the complete covering of the reinforcing bars even when the space between the reinforcements is very narrow. SCC is characterized by high flow ability in its fresh state and increased strength in its hardened state because of a compact matrix structure. SCC has many advantages that include faster construction, better surface finishes, easier placing, reduction in noise levels and improved durability.

The term Glass Fiber Reinforced Concrete (GFSCC) can be defined as a concrete structure having randomly oriented and dispersed fibers. Fibers can be defined as small wire-like reinforcements which are made of either steel or polymers having high ductility. The fibers are produced in a wide range of sizes and shapes, stiff or flexible etc. Addition of fibers into concrete improves the overall ductility of the concrete imparting toughness, greater tensile strength, and resistance to fatigue, impact, blast loading and abrasion. Fibers are added not only to improve the ductility of concrete but also, more importantly to control the cracking, by the bridging of the fibers across the cracks, which delay the propagation and widening of localized cracks. The use of glass fibers in SCC might bring together the advantages of both fibers and SCC. Glass Fiber Reinforced Self-Compacting Concrete (GFRSCC) combines the advantages of SCC in its fresh state and that of fibers in its hardened state.

Because of the superior performance of SCC in its fresh state, addition of fibers will lead to a more uniform dispersion of fibers which is very critical for the performance of any fiber reinforced composite. Also the compactness of SCC matrix due to higher amount of finer particles may improve the interface zone properties and consequently the fiber-matrix bond leading to enhanced post-cracking toughness and energy absorption capacity.

II. OBJECTIVES

The primary objectives of this study are to:

- Examine the effects of adding the Glass Fiber in self compacting concrete with percentage weight of concrete.
- Provide recommendations for the use of plasticizer in Glass Fiber Reinforced self compacting concrete .

III. MATERIALS AND METHODS

A. Cement

Cement is one of the major ingredients in concrete. It is a binder material, which is capable of bonding material fragments in to solid mass. Ordinary Portland cement of 43 grade was used for this experimental work.

B. Aggregate

Aggregates are the primary constituents of concrete. In early times aggregates were considered to be an inert material but recent researches proved that they are reactive to some extent.

Well graded coarse aggregate of size 20mm and 12mm were used in this study. Fine aggregates are obtained from local resources confirming to zone II of IS: 383 – 1970. The sand was sieved through 4.75mm sieve to remove any particle greater than 4.75mm.

C. Water

Another important ingredient of concrete is water. Water initiates the hydration reaction of cement in concrete which provides the binding capacity for cement.

In this study fresh portable water is used for mixing and curing conforming to IS 456 – 2000.

D. Chemical Admixtures

The product shall comply with ASTM C494 Type G and shall be free of lignosulphonates, naphthalene salts and melamine formaldehyde when subjected to IR Spectra. **MasterGlenium SKY** 8630 is compatible with most of the products under the MasterPozzolith & MasterSet series.

IV. MIX PROPORTION DESIGNATIONS

Mix Design can be defined as the process of selecting ingredients of concrete and determine their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible.

V. METHODOLOGY

- Materials properties
- Mix design
- Test for fresh concrete
- Casting on concrete
- Test for compressive strength
- Comparison of results

VI. MATERIALS AND METHODS

Cement

Cement is one of the major ingredient in concrete. It is a binder material, which is capable of bonding material fragments in to solid mass. The Ordinary Portland cement was classified into three grades namely 33 grade, 43 grade and 53 grade. Ordinary Portland cement of 43 grade was used for this experimental work. The properties of cement listed in Table 4.1 was adopted from IS 4031.

Properties of cement

Sl.No	Components	Weight
1	Lime (CaO)	63%
2	Silica (SiO2)	21.9%
3	Alumina (Al2O3)	6.9%
4	Iron oxide (Fe2O3)	3%
5	Magnesium oxide (MgO)	2.5%
6	Sulphur trioxide & loss of ignition (SO3)	1.7%

Coarse aggregate

Aggregates are the primary constituents of concrete. In early times aggregates were considered to be an inert material but recent researches proved that they are reactive to some extent. As aggregates occupies major volume of concrete, changes in their property impose a major influence in the entire property of concrete. Good gradation of aggregates are necessary for producing workable concrete.

Fine aggregate

Well graded coarse aggregate of size 20mm were used in this study. Fine aggregates are obtained from local resources confirming to zone II of IS: 383 – 1970. The sand was sieved through 4.75mm sieve to remove any particle greater than 4.75mm.

Properties of coarse aggregate

Sl. No	Test	Obtained Values	Limited Values	As per Codes	Remarks
1	Specific gravity	2.71	2.5-3	IS 2386-1963 (Part 3)	Satisfied
3	Aggregate abrasion value	0.6%	30% (Not exceeds)	IS 2386 -1963 (Part 4)	Satisfied
4	Consistency test 1.initial setting time 2. final setting time	33 min 576 min	30min 10 hrs	IS 2386-1963 (Part 3)	Satisfied

Properties of fine aggregate

Sl. No	Test	Obtained Values	Limited Values	As per Codes	Remarks
1	Specific gravity	2.51	2.6-2.9	IS 383-1970	Satisfied
2	Fineness modulus	2.47	2.2-3.3	IS 383-1970	Satisfied
3	Water absorption	3.0	2.0-3.0	BS 6349	Satisfied

Water

Another important ingredient of concrete is water. Water initiates the hydration reaction of cement in concrete which provides the binding capacity for cement. Thus proper precautions must be taken regarding the quantity of water used. Water also provides workability in concrete. Quality of water should be maintained to attain desired strength.

In this study fresh portable water is used for mixing and curing conforming to IS 456 – 2000.

MIX PROPORTION DESIGNATIONS

Mix Design can be defined as the process of selecting ingredients of concrete and determine their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The proportions are either by volume or by mass. The water-cement ratio is usually expressed in mass. Depending upon the level of quality control available at the site, the concrete mix has to be designed for the target mean strength, which is higher than the characteristic strength. The Mix proportion used for the study was M30 (1:1.6:0.45) grade concrete

Mix proportion for M30 grade concrete

Cement Kg/m3	Fine Aggregate Kg/m3	Coarse Aggregate Kg/m3	Water Kg/m3	Glass fiber Kg/ m3
596.56	925.16	267.23	199.72	10
1	1.6	0.45	0.4	1%

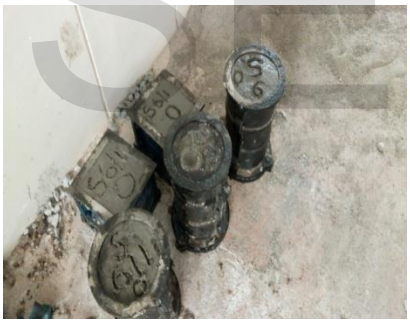
PREPARATION OF SPECIMENS

Batching of Concrete

Batching of concrete is the process of measuring concrete mix ingredients either by volume or by mass and introducing them into the mixture. Here, in this project weigh-batching system was adopted. Percentage of accuracy, flexibility and simplicity in usage is more in weigh batching system when compared to volume batching system.

Preparation of moulds

Before mixing of concrete the moulds in which the specimen are to be casted was prepared. The sides of the moulds are properly clamped with nuts and bolts so that the inner faces make 90º with each other as well as with the base plate and to avoid leakage of water from the freshly mixed concrete.



Mould

VII. Sizes of moulds

Specimen	Size Of Mould Adopted
Cube	150 mm x 150mm x 150mm
Cylinder	150mm x 300mm

Mixing of concrete

The mixing should ensure that the mass become homogeneous, uniform in color and consistency. Here, in this project Hand mixing was adopted.

Mixing of concrete

IX. CASTING AND COMPACTING OF CONCRETE

The operation of casting and compacting of concrete are interdependent and are carried out simultaneously. They are most important for the purpose of ensuring the requirements of strength, impermeability and durability of hardened concrete in the actual structure. As for as placing is concerned, the main objective is to deposit the concrete as close as possible to its final position so that segregation is avoided and the concrete can be fully compacted.

VIII. DEMOULDING OF SPECIMENS

Once the concrete specimen has been casted it is allowed to dry for 24 hours so that, the concrete specimen attains required strength such that it can be demoulded from the mould without causing damage to the sides of the specimen. Care should be taken to ensure the proper removal of mould as any damage can cause decrease in strength of specimen.

Demoulded sample

IX. CURING

Curing is the process in which the concrete is protected from loss of moisture and kept within a reasonable temperature range. This process results in concrete with increased strength and decreased permeability. Curing is also a key player in mitigating cracks, which can severely affect durability.

Concrete that has been specified, batched, mixed, placed and finished can still be a failure if improperly or inadequately cured. Here in this project once the concrete specimen has demoulded it was kept in ordinary curing tank and cured for 7 and 28 days.

EXPERIMENTAL PROGRAM

Test on fresh concrete

Slump test: Slump test is used to determine the workability or to measure the consistency of fresh concrete.

The internal surface of the mould is thoroughly cleaned and applied with a light coat of oil. The mould is placed on a smooth, horizontal, rigid and nonabsorbent surface.

X. TESTS ON HARDENED CONCRETE

Compressive strength tests

A compression test determines behavior of materials under crushing loads. Once the curing period of particular specimen was gets over they were taken out and allowed to dry for sometimes. Then the cube of size 150mmx150mmx150mm was subjected to test as per IS: 516-1959. A standard compressive testing machine of 1000kN capacity was used in this project. The specimen was placed between the steel plates of compression testing machine.

The compressive strength of the cube specimen was calculated using the following formula:

Compressive Strength, fc = P/A N/mm^2.

Where, P = Load at failure in N

A = Area subjected to compression in mm^2.

Compression test

Mix design for M30Concrete

Design stipulation:

Characteristic compressive strength	=	30 MPa
Maximum size of coarse aggregate	=	20 mm
Specific gravity of coarse aggregate	=	2.71
Specific gravity of fine aggregate	=	2.51
Water absorption of coarse aggregate	=	3%
Standard deviation	=	2
Workability	=	0.90 (compacting factor)

Result:

Cement	=	596.56 kg/cu.m.
Water	=	199.72 litres
Fine Aggregate	=	925.16kg/cu.m.
Coarse Aggregate	=	267.16kg/m^3
W/C	=	0.4
Glass fiber	=	10 Kg/cu.m.
Mix ratio	=	1:1.6:0.45

Specimen Preparations:

Sample Pictures,

1. Moulded Sample:

2. Demoulded Sample:

3. Curing Process

Testing Specimen:

After curing specimen ready to test

.

Test Reports:
For Cube,

Comparison result for cubes

Sl. No.	Percentage of glass fibre	Curing days	Compressive strength (N/mm^2)
1	0.4%	7 Days	22
2	0.5%		24
3	0.6%		35
4	0.4%	28 Days	36
5	0.5%		38
6	0.6%		42

CONCLUSION

- A convenient mix of M30 is adorable for both conventional and glass fiber reinforced self compacting concrete.
- There was a significant increase in compressive strength, L Box,V Box ,slumpcone test, with the increase in percentage of Glass fiber from 0.6% to 1% in all curing periods.
- In glass fiber added to the concrete it gives optimum increase in its mechanical properties.
- In large scale production of glass fiber reinforced self compacting concrete results 10% – 20% cheaper than conventional concrete.
- Glass fiber reinforced self compacting concrete gives more strength with minimum of 10% over than conventional concrete.
- Glass fibre self compacting concrete can improve the strength of concrete without any additives.
- Percentage of mechanical strength in glass fiber reinforced self compacting concrete over than conventional concrete may be increase.
- The maximum compressive strength of conventional concrete for 3 days, 7days, 14 days and 28 days curing period is 12.50 MPa, 23.33 MPa, 26.75 MPa and 34.25 MPa respectively by adding glass fiber reinforced self compacting concrete for 3 days, 7days, 14 days and 28 days curing period is30.50 MPa, 35.2 MPa, 39.41MPa and 42 .15MPa respectively by addition of glass fiber

REFERENCE

1. Evalution of self consolidating steel fiber concrete (scsfrc) & its fresh properties- dr. G. Elangovan and Mr. V K Ashokkumar
2. Self Compacting Fibre Reinforced Concrete - A Review Jayanta Chakraborty1, Sulagno Banerjee
3. Experimental Methods on Glass Fiber Reinforced Sellf Compactive Concrete- A. Deepak Raj, M. Mergin Benize, J. Esther Daisy, M. Sri Nikhil
4. Mohammed karem Abd Technical institute – Babylon has published Evaluation of consolidating fiber on properties of self – compacting concrete in kerbala university , vol.11 no,1 Scientific,2013
5. Manjunatha j.k , Ashwin B.T , etal Aduc/hunchanagiri Institute of Technology has published "Performance of glass fibre reinforcement self compacting concrete" in ISSN 2321-9939
6. N.Dhivyabharathi , Dr.E.k Mohanraj has published "study on effects of glass fiber on strengthening of self compacting concrete" in International level