An Experimental Study on Properties of Fibre Reinforced Self-Consolidating Concrete

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INTRODUCTION

GENERAL

Concrete technology has made massive development in the past decade. Now a day's concrete is not material that consists only cement, fine aggregate, coarse aggregate and water butitisan engineered material that consists of many new materials which performs satisfactorily under all conditions. The modern concrete consists of various filler materials and binder materials such as fly ash, micro silica, GGBS etc., the development of Self-Consolidating Concrete (SCC) has recently been one of the most important developments in the building industry.Thepurposeofthisconcreteconceptistodecreasetheriskduetothe human factor, to enable the economic efficiency, more freedom to designers and constructors and more human work. There is nostandard method for SCC mix design and many academic institutions, admixture, ready-mixed, precast and contracting companies have developed their own mixed proportioning methods. Mix designs often use volume as a key parameter because of the importance of the need to over fill the voids between the aggregate particles.

Incorporation of fiber in concrete has found to improve several properties like tensile strength, cracking resistance, impact and wear resistance, ductility and fatigue resistance. Many fibers like asbestos, steel, nylon, coir, etc have been used in the past. The initial studies showed deterioration of glass fibers due to corrosive alkali environment of the cement paste. The alkali resistant glass fiber, which is developed, recently has overcome this defect and can be effectively used in concrete. The production of fiber reinforced concrete should always be considered in two well defined phases i.e., the fresh phase and the hardened phase. Each phase must be considered carefully at mix design stage and each presents its own particular characteristics and related constructional or structural problems. It is necessary to understand the interaction between the fibers and the surrounding matrix in both phases to know how the fiber properties affect the properties of concrete.

GLASS FIBRE

Glass fiber is a material consisting of numerous extremely fine fibers of glass. Glass fiber is commonly used in Insulating material. It is also used as a reinforcing agent for many polymer products; to form a very strong and light fiber reinforced polymer (FRP) composite material called glass-reinforced plastic (GRP)n, properly known as "fiberglass". Glass fiber has roughly comparable properties to other fibers such as polymer and carbon fiber. Although not as strong as rigid as carbon fiber, it is much cheaper and significantly less brittle.

BENEFITS OF GLASS FIBER REINFORCED CONCRETE

There are lots of good reasons to use GFRC for thin sections of concrete:

I. Lighter Weight

With GFRC, concrete cab be cast in any section and therefore as much as 75% lighter than similar pieces cast with traditional concrete.

II. Environmental Impact

The Concrete Network claims that GFRC is more environmentally friendly then conventional concrete. These glass fibers often come from recycled sources. This material is also very long-lasting. According to the Concrete Network, correctly manufactured GFRC can outlast conventional concrete and cast stone.

III. High strength

GFRC can have flexural strength as higher then as compare with normal concrete and it has a very high strength-to-weight ratio.

OBJECTIVE

In the present experimental investigation the following are the objectives:

i. To study the strength characteristics of glass fiber reinforced concrete.

ii. The main objective of the present investigation is to study the flexural behaviour of Fiber reinforced self consolidating concrete.

iii. To compare the fiber reinforced self consolidating concrete with conventional concrete.

iv. To compare the fresh and hardened properties of fiber reinforced self consolidating concrete with conventional concrete.

v. To find the optimum mix for required grade and optimum value of addition of glass fiber and admixture for self consolidating concrete.

MATERIALS USED

The materials used for the work are given below

- OPC 53 grade

-Fine aggregate confirms to grading

Zone II as per IS: 383(1970)

- Course aggregate of nominal diameter

10 mm

- Glass fiber

- Admixture- Fly ash

- Super plasticizer – Naphthalene

MIX DESIGN FOR M30

The calculation of mix design M30 is Average compressive strength values of cubes (MPa)

Cement = 465 kg

Fine aggregate = 730 kg

Course aggregate = 694 kg

Water = 218 kg

Fly ash (15% 0f cement) = 70 kg

Super plasticizers (1.25% of cementation)

= 6.68 kg

VMA = 1.12 kg

OPTIMUM VALUE STUDY

Compressive Strength of Concrete

As per recommendations of IS: 0516 (1959). Standard dimensions of cubes 150 mm X 150 mm X 150 mm (3 nos) in each of the concrete cubes casted with different glass fibre percentages. The samples are taken at the end of 7 days, 14 days and 28 days kept outside and wiped of surface moisture. Three numbers of samples in each of the concrete were subjected to compression test using the Compression testing machine. The result of the average strength of the cubes is

Average compressive strength values of cubes (MPa)

S.No	MIXID	7 Days	14 Days	28 Days
1	GFC 0	19.85	30.81	31.75
2	GFC 0.5	20.49	31.24	32.41
3	GFC 0.75	20.79	31.69	33.13
4	GFC 1	20.98	32.87	33.53
5	GFC 1.25	20.99	32.92	33.48
6	GFC 1.5	21.07	32.95	33.51

In compressive strength of cubes 1% of glass fibre was giving the better strength result for M30 grade. Three different curing periods are selected. In 7 days curing specimen has achieve only 60% strength and for 14 days 90% strength has achieved and for 28 days full design strength

The compressive strength variation of M30 mix by adding different percentage of glass fibre. In this 1% of fibre content have a good result and 0.5% to 1% the compressive strength is keep on increasing only. But after that 1% to 1.5% the compressive strength does not have much change so we have chosen as a optimum dosage of fiber.

Split Tensile Strength of Cylinders

As per recommendations of IS: 0516 (1959). Standard dimensions of cylinder 75 mm X 150 mm height (3 nos) in each of the concrete cubes casted with different glass fibre percentages in M30 mix. .The samples are taken at the end of 7 days, 14 days and 28 days kept outside and wiped of surface moisture. Three numbers of samples in each of the concrete were subjected to split tensile test using the compression testing machine. The result of the average strength of the cubes is

Average Split tensile strength values of cylinders (MPa)

S.No	MIXID	7 Days	14 Days	28 Days
1	GFC 0	2.15	3.51	3.98
2	GFC 0.5	2.57	4.28	4.51
3	GFC 0.75	2.79	4.23	4.60
4	GFC 1	3.06	4.58	4.87
5	GFC 1.25	3.07	4.60	4.90
6	GFC 1.5	3.09	4.49	4.92

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CONCLUSION

From experimental results it has been observed that the Compression strength, Split tensile strength and flexural strength is improved.

i. The optimum dosage of glass fibre is 1% for this study.

ii. The optimum dosage of super plasticizer is 1.25% of cement.

iii. Addition of glass fibre in SCC, the compression strength has increased by 5.3% .

iv. Addition of glass fibre in SCC increases the Split Tensile strength by 12%.

viii. Addition of glass fibres reduces bleeding and it improves the surface integrity of concrete. Also it increases the homogeneity andreduces the probability of cracks.

ix. This experimental investigation helps to know the properties and behaviour of self compacting concrete with fibers.

SCOPE FOR FURTHER STUDY

The scope for further work is to study the Flexural behaviour of slab elements of glass fibre self consolidating concrete. Durability studies of glass fiber concrete can also best Studied.

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