Self Compacting Concrete Using Fly Ash and Glass Fibre

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ABSTRACT

Self compacting concrete is a relatively invention in concrete and the addition of fibres to it shows improved strength properties. Several studies has been done on self compacting concrete with fibre addition. In this work, an attempt has been made to make a comparative study on the fresh and hardened state properties of M20 and M30 grades of concrete mixes of self compacting concrete(SCC) and glass fibre reinforced self compacting concrete(GFRSCC). The SCC and GFRSCC mixtures had a cement replacement of 25% fly ash and addition of glass fibre at 0.05%, 0.10%, 0.15% and 0.2% on total volume of mix. For testing its properties in the fresh state, slum−flow test, L−box and V−funnel were used. Compression (strength of 7 and 28 days), flexural and split tensile strength tests were carried out.

Key words: Fly Ash, Glass fibre, Self compacting concrete, super plasticiser

INTRODUCTION

Self compacting concrete is the concrete which can flow under its own weight and fill congested reinforcements and gets compacted without any vibration. Concrete possesses high compressive strength and stiffness but it is brittle and weak in tension. Addition of fibres in concrete helps in arresting the crack growth and helps in increasing the flexural and tensile strength. Self Compacting Concrete (SCC) has been used since last few decades, Glass Fibre Reinforced Self Compacting Concrete (GFRSCC) is relatively new invention.

Considering the advantages of SCC and GFRC an attempt has been made to combine these two to produce Glass Fibre Reinforced Self Compacting Concrete (GFRSCC) and to study the mechanical properties of both SCC and GFRSCC incorporating fly ash as the mineral admixture by addition of glass fibres in various percentages to the mix. A study has been done on the compressive, flexural and split tensile strength with these various mixes.

EXPERIMENTAL PROGRAMME

Materials Used

Cement

Ordinary Portland cement of 53 grade was used and tested for physical and chemical properties as per IS: 4031 – 1988 and found to be conforming to various specifications as per IS: 12269-1987. Specific gravity was 3.10.

Coarse Aggregate

The crushed coarse aggregate of 20 mm maximum size rounded obtained from the local crushing plant; (Bidadi, Karnataka) is used in the present study. Specific gravity is 2.60 and fineness modulus 5.4.

Fine Aggregate

Locally available river sand which is free from organic impurities is used sand passing through 4.75mm sieve and retained on 150 micron IS sieve is used in this investigation. The specific gravity of 2.72 and fineness modulus 2.7 was used in the investigation.

Admixture

Glenium B233 an admixture based on modified polycarboxylic ether which is free of chloride & low alkali was used.

Glass Fibres

The Cem-FIL Anti – Crack glass fibres were used.

Fly Ash

Fly ash is obtained from Raichur Thermal Power Station; Karnataka was used as cement replacement material.

Mix Proportions of Self compacting Mixes

Fly ash conforming to IS: 3812-2003 is used as 25% replacement for cement in every mix with various percentage of glass. Mixes SCC 1 (0% glass fibre), SCC 2 (0.5% glass fibre), SCC 3 (1.0% glass fibre), SCC 4 (1.5% glass fibre) and SCC 5 (2.0% glass fibre) of M20 grade and mixes SCC 6 (0% glass fibre), SCC 7 (0.5% glass fibre), SCC 8 (1.0% glass fibre), SCC 9 (1.5% glass fibre) and SCC 10 (2.0% glass fibre) of M30 grade as shown in table 1 below were used. The amount of Glenium used is 1.1 % for M30 grade and 1.2 % for M20 Grade. Once the mix proportion is decided, self compactability was tested by slump flow test, L Box test, V Funnel.

Table 1: Mix Proportions

Mix Designation	Cement kg/m^3	Fly Ash (25 percent Replacement) kg/m^3	Fine Aggregate kg/m^3	Coarse Aggregate kg/m^3	Water kg/m^3	Glass Fibre To Total Volume Mix (in %)
SCC 1	295.74	98.58	970.71	794.21	197.16	0
SCC 2	295.74	98.58	970.71	794.21	197.16	0.05
SCC 3	295.74	98.58	970.71	794.21	197.16	0.10
SCC 4	295.74	98.58	970.71	794.21	197.16	0.15
SCC 5	295.74	98.58	970.71	794.21	197.16	0.20
SCC 6	328.60	109.53	938.27	767.67	197.16	0
SCC 7	328.60	109.53	938.27	767.67	197.16	0.05
SCC 8	328.60	109.53	938.27	767.67	197.16	0.10
SCC 6	328.60	109.53	938.27	767.67	197.16	0.15
SCC 10	328.60	109.53	938.27	767.67	197.16	0.20

Test Specimens

Test specimens consists of cube of 150mm×150mm, cylinder diameter 150mm and height 3000mm, prism of 100mm×100mm×500mm were casted using different concrete mixes as given in Table 1.The specimens were tested and the table 2 below shows the hardened state properties for the various mixes of concrete.

Table 2: Test Results

SI. No	Mix Designation	Compressive Strength (N/mm^2)		Split Tensile Strength (N/mm^2)	Flexural Strength (N/mm^2)
		7 Days	28 Days		
1	SCC 1	14.2	30.03	3.7	2.30
2	SCC 2	16.83	32.50	4.43	2.43
3	SCC 3	17.77	33.02	4.57	3.17
4	SCC 4	16.14	32.14	3.8	3.08
5	SCC 5	15.07	31.10	3.7	2.93
6	SCC 6	20.20	37.33	4.53	3.89
7	SCC 7	22.37	39.26	4.62	4.05
8	SCC 8	23.53	40.00	4.70	4.54
9	SCC 9	21.3	39.26	4.68	3.94
10	SCC 10	20.89	38.20	4.6	4.02

CONCLUSION

1. The specimen with 0.05%, 0.1%, 0.15% and 0.2% of glass fibre shows an increase of compressive strength by 8.2%, 9.2%, 7.02% and 3.5% respectively than the SCC without fibre for the M20 grade mixes.
2. The specimen with 0.05%, 0.1%, 0.15% and 0.2% of glass fibre has in increase compressive strength of 5.1%, 7.1%, 5% and 2.3% respectively than the SCC without fibre for M30 grade mixes.
3. The SCC developed split tensile strengths ranging from 3.7MPa to 4.75 MPa for M20 grade and from 4.53 MPa to 4.8 MPa for M30 grade.
4. GFRSCC with 0.1% glass fibre showed substantial increase in the flexural strength than the other specimens.

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